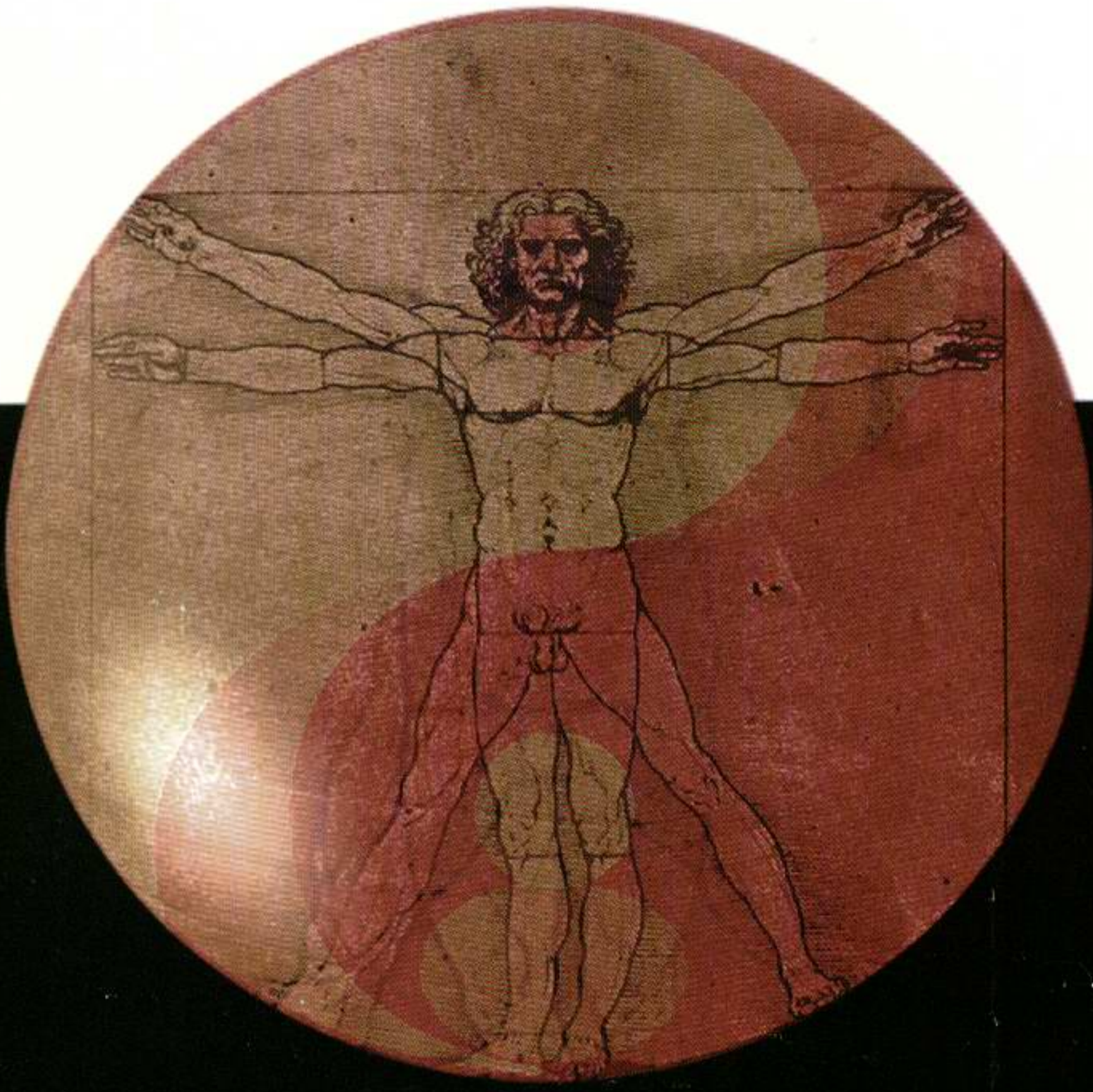
The Science of Martial Arts Training

Charles I. Staley, MSS



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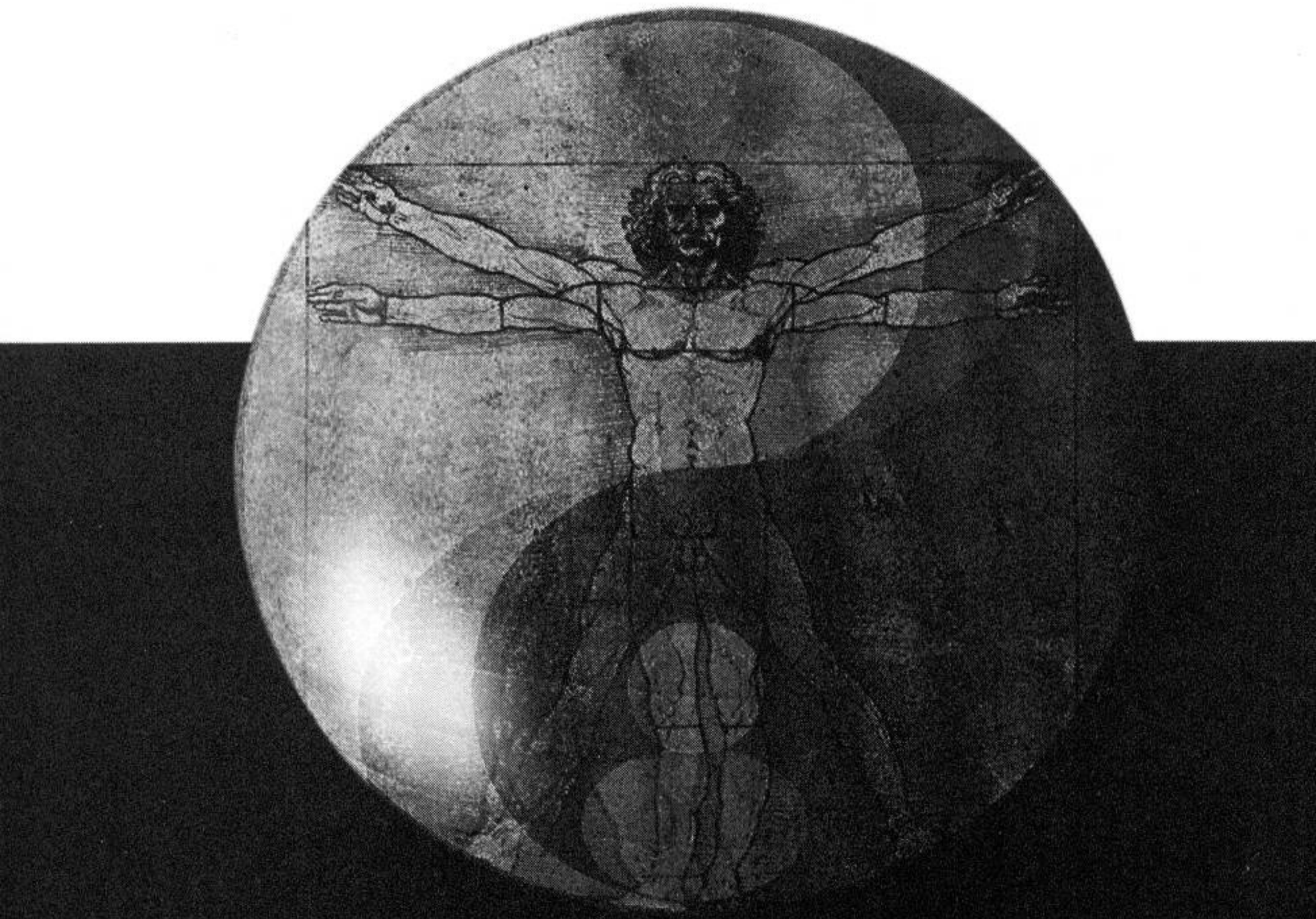

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Please note that the author and publisher of this book are NOT RESPONSIBLE in any manner whatsoever for any injury that may result from practicing the techniques and/or following the instructions given within. Since the physical activities described herein may be too strenuous in nature for some readers to engage in safely, it is essential that a physician be consulted prior to training.

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INTRODUCTION

Traditionally, martial arts emphasize the *process* of training over the end result. If the martial arts are meant to be solely a vehicle for self-knowledge (as the Zen masters purport), *what* is performed in training matters little compared to the quality to devotion to that training. This book is not at odds with such a philosophy. However, even for those whom the martial arts represent a non-sporting activity, *proper training methodologies should be adhered to in the interest of safety and to optimize the satisfaction and enjoyment available from athletic training.*

Remember that although people may have varied reasons for studying martial arts, ultimately, they are learning a *physical* skill. Athletes who have mastered their art as well as the principles and methods of scientific sport training will get the best results for their efforts.

What is the Integrated Model of Training (IMT)?

The process of training is a delicate balancing act that involves the integration of numerous components: skill training, strength development, flexibility, speed and quickness training, tournament strategy, motivation, nutrition, restoration, and many others. Each component exists within a relationship to all the others. The end result of the training process is a reflection of the (hopefully successful) synergistic effect of all the components in the training plan. To state an old maxim, "all the spokes of the wheel must be aligned to support the hub." These various components should be constantly monitored and adjusted, as each individual is unique and always changing.

A training plan that has worked in the past will not necessarily lead to the same results the second time around. Also, a plan that has worked wonders for one athlete might lead to overtraining or injury in another.

For these and other reasons, there is no one miracle training plan, device, or dietary supplement that will lead all people to success all of the time. In other words, there is no "magic bullet." It is the combined, synergistic effect of the training process as a whole that will define results. Such a notion defines the instructor's job as an art-form, since one cannot, for example, raise the volume (amount) of work being done on one component, without considering the possible effects (both long- and short-term) of all the others and hence, the end result.

The integrated model of training states that every aspect of training influences all other aspects. In the familiar spider web analogy, touching the web on one side means the entire web will be disrupted, not just the part that is touched. Therefore, the novice might think ". . . Hmm, I need more explosive strength, I think I'll do some plyometric drills. . . ." The expert however, considers the effect plyometric drills have on skill training, energy levels,

cardiovascular endurance, nutritional needs, and so forth. Admittedly, the IMT isn't simple, but neither is training.

It's also worth noting is that successful training is often not simply a matter of doing everything possible (covering all the bases) to win, but instead making sure that all components are necessary and justifiable. To be successful as a martial artist (or in any other athletic endeavor, for that matter) athletes must undergo high training loads, which makes overtraining and injury a constant threat. So by way of example, an athlete who can do a full split, but is unable to complete three rounds on the heavy bag due to fatigue, should minimize or even eliminate the flexibility component of the training plan and instead emphasize aerobic and anaerobic endurance drills. As the late Bruce Lee was fond of saying, "Training is not a process of adding on, but rather, one of chipping away at the inessentials until the essence has been revealed."

A Scientific Approach to Training

The Science of Martial Arts Training emphasizes the most contemporary research in the field of sports training. Some of these concepts originated in former Soviet and Eastern-bloc countries while others are derived from the author's own work with athletes as well as other contemporary authorities.

The Eastern-bloc nations have historically exceeded the Western world in the science of sport training. Although many in the West write off the successes of those countries' athletes in World-level competition as merely the result of performance-enhancing drugs, the fact is that in the former Soviet Union, for example, vast amounts of money were committed to sports training research. Furthermore, children were tested for their athletic potential and then nurtured in the sport in which they demonstrated the most potential. Obviously, these type of programs, coupled with very sophisticated sports schools and a very high value on athletic achievement indicate the chance for success is overwhelmingly good.

In this book's approach, the *details* of training are not nearly as important as the underlying *principles* that define proper and systematic training. By way of example, one could observe several training sessions of ten martial artists preparing for an upcoming Olympic competition. On the surface, it might appear to the novice that they are all following very different means of training! Some are training with weights, others are running or swimming, still others spend the majority of time practicing drills with a partner. Only if one had the opportunity to observe these workouts within the context of their overall training plans could someone render a determination as to the correctness of their training. If the training corresponds with valid and accepted training principles, it is correct.

Almost anything an athlete does, no matter how incorrect it appears, can possibly be justifiable for that particular athlete at that particular time. A fighter practicing difficult skills right after a hard session of running is normally considered incorrect. However, if that fighter has poor skill-endurance (needs work on practicing techniques while tired), it makes sense, at least sometimes, to train in this manner.

In another example, barbell squats are normally performed so that at the bottommost position, the tops of the athlete's thighs are parallel to the floor. Many coaches will not allow their athletes to squat any "shallower" than this position, and for the most part, this is good advice. Nevertheless, the occasional performance of reduced range of motion squats (which naturally allows for the use of heavier weight) can be beneficial in helping the ath-

lete get accustomed to heavier weight-loads than could otherwise be used. This is why it takes an experienced and discerning eye to be an effective coach. Psychologically inflexible individuals who are unable to deviate from hard and fast notions that they have held for years, despite evidence to the contrary, will not be effective in today's high-level competitions. Therefore, always investigate, read, compare, and analyze all information available, even if it seems unfamiliar at first. The best training methods have yet to be developed, so please keep an open mind!

On a final note, since it would be impossible to impart even a small percentage of everything pertaining to martial art sport science, a critical decision regarding this book's approach was necessary. Rather than merely *tell* the reader what to do, the *concepts and principles* of sport science are presented which should equip the reader with an ability to both understand and devise training "recipes" on his or her own.

By using this approach, it is possible that many readers may end up with more questions than they had before they read the book! For those thoughtful readers, please remember that the occasional discomfort of true learning is far preferable to the delusion of mastery. The discipline of learning requires a certain tolerance for "not knowing." This means a little psychological discomfort encountered by these new concepts is really a sign of progress!

FOUNDATION: PRINCIPLES OF SPORT TRAINING

"Practices are the what to do's, specific applications that fit specific circumstances. Principles are the why to do's, the elements upon which applications or practices are built."

—Stephen R. Covey

A single exercise, drill, or workout can rarely be deemed "correct" or "incorrect" in isolation. Observers need to know the overall context in order to make such an evaluation. For example, it's fine for a fencer to perform the bench press exercise as part of an overall strength training program, but too much emphasis on this exercise might have negative effects on upper body flexibility. So, the best way to make sure training is as safe and efficient as possible is to employ established principles as guideposts while designing a training program. Accordingly, six principles will be introduced next to provide these training program guideposts. Interestingly, the principles discussed in this chapter apply not only to physical training, but all forms of learning. Although I give specific examples of each, it is best to try and come up with other applications of these principles on your own. When you take an active approach to learning like this, you'll benefit much more than you would by simply reading and memorizing what someone else has prescribed.

The Principle of Foundation: The Training Factor's Pyramid

Mastery of a martial art is accomplished by developing a foundation before progressing to more advanced levels of training. Thus, the purpose of this chapter is to expose the reader to foundational training concepts derived from the world of sports science. And while martial art is not sport, the two disciplines have much in common from a physical point of view. Martial artists can learn much from recent developments in sport science if they will only "empty their cup," so to speak.

One development comes from Dr. Tudor Bompa, former Romanian rowing coach and currently a professor at York University in Toronto, Canada. Dr. Bompa developed a useful schema called "the training factor's pyramid," which can be used to develop long-term training plans, based on a foundational progression of factors over time.[1]

The training factor's pyramid helps identify a logical sequence of training factors and can be used by athletes and coaches alike to identify objectives and evaluate training programs and methods. When problems develop, as they inevitably do, the training factor's pyramid can be

used to determine what level these problems originate from, which speeds up the corrective process considerably.

Table 1-1 demonstrates that the pyramid consists of four ascending levels. The athlete enters the pyramid at the first level, *physical preparation.* This level is the cornerstone of an athlete's training, because without it, further progress is impossible. Physical preparation refers to developing certain "bio-motor abilities" such as strength, power, speed, balance, flexibility, agility, endurance, and coordination.

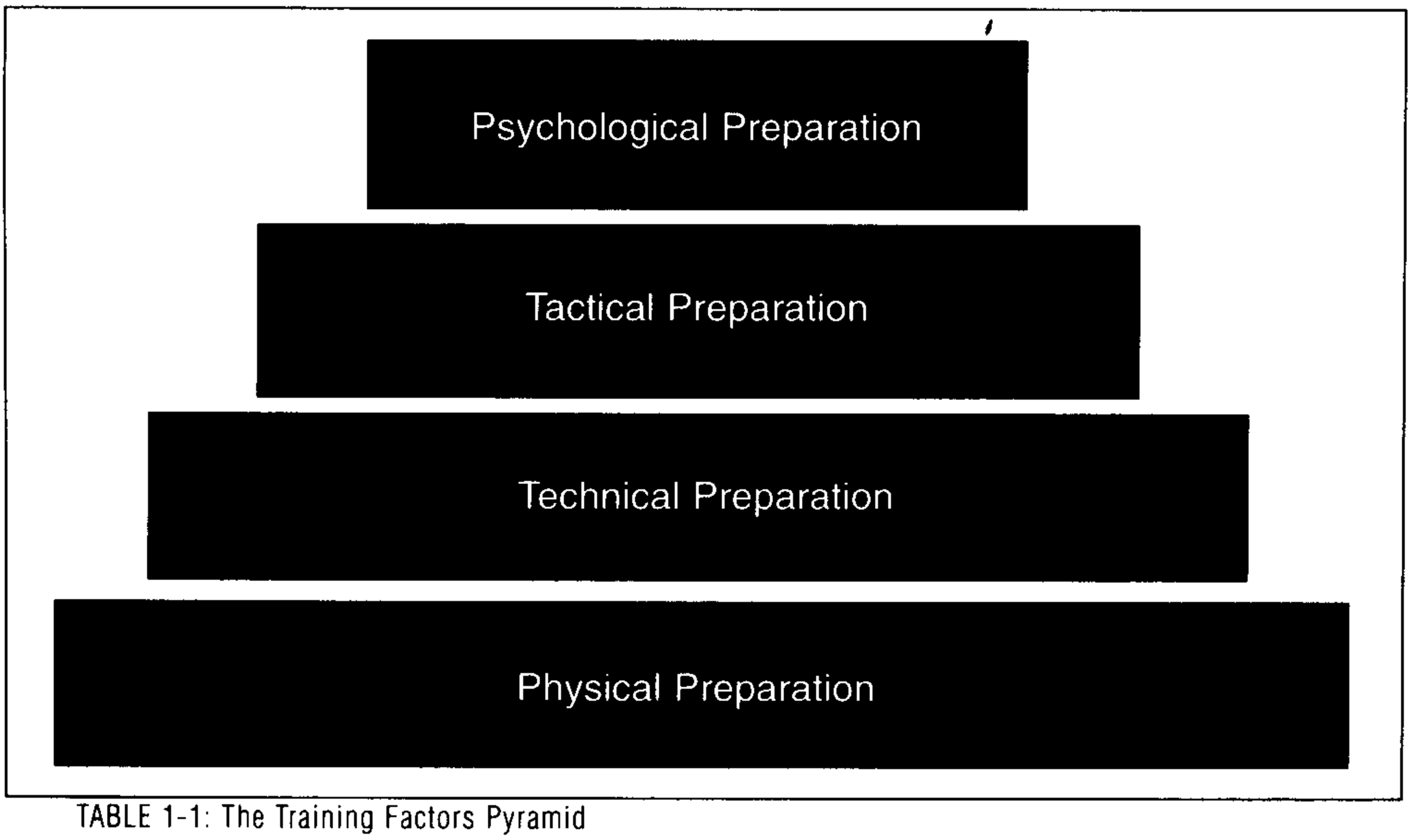


TABLE 1-1: The Training Factors Pyramid

The second level of the pyramid involves *technical preparation,* or perfecting physical techniques. While some techniques can be mastered with a low level of physical preparation, many cannot. For instance, a jump-spin crescent kick requires a high degree of dynamic balance, explosive strength, and flexibility. In the martial arts, where very difficult maneuvers are the norms, it is clear that physical preparation is a prerequisite for technical practice.

Of course, technical mastery is not the final objective for any martial artist. Many martial artists have beautiful and "correct" techniques, but lack the ability to apply them in a sport or combat setting. The third level of the training factor's pyramid addresses this deficiency by emphasizing *tactical preparation.* Tactics refer to the ability to successfully *apply* techniques in a sport (or combat) situation. Clearly, a technically sound technique must be established before entering level three. Furthermore, the athlete must have a high level of physical development before correct technique is possible.

The fourth and final stage is *psychological preparation,* which is a very important consideration for martial artists who, by definition, are preparing for life-or-death situations. Naturally, psychological preparedness, or confidence, cannot be established if an athlete has not successfully ascended through the previous three levels.

The training factor's pyramid can especially be useful in understanding training difficulties. Consider two athletes sparring when one athlete misses with a round kick and is scored upon by his opponent with a reverse punch. The question is, what happened? What's the

problem? By using the pyramid, instructors, coaches, and athletes can determine the root of the problem.

To find the root, the first question asks if the athlete is capable of executing a technically sound round kick. If the answer is no, go down a level and try to find symptoms in physical preparation. Perhaps someone lacks proper flexibility or balance, or both. Once the physical attributes are improved, the athlete should be more successful in delivering the kick.

If the answer is yes (the athlete can throw a proper kick), the problem lies in either tactical or psychological development. Both areas are closely intertwined. A lack of tactical skill can obviously impair confidence and vice versa. Martial artists commonly progress well through physical and technical training, but falter in tactical and psychological realms. One remedy is more time in the trenches, with careful progression through gradually more difficult encounters. When tactical successes begin to outweigh the failures, confidence increases along with tactical ability.

Although we are addressing the four training factors in isolation for the sake of discussion, in reality they must be integrated if a successful outcome is desired. For example, is a feint a technique or a tactic? Obviously, it is both. At high levels of skill, techniques and tactics are one and the same. Moreover, the direction of influence is not only ascending, but descending as well. For example, the techniques used determine the type of physical preparation that is needed.

In addition to daily considerations, the training factor's pyramid helps establish a template for long-term planning. Accordingly, the first several months of training should be dedicated to improving physical attributes, although basic technical and tactical skills may also be presented. The second phase of training is characterized by developing technical mastery. Good physical conditioning must be maintained, of course, but this involves less work than it took to develop it. Advanced stages of training target tactical and psychological concerns, with comparatively less time spent on physical and technical development.

While achieving mastery in a martial art involves years of hard work, those years yield far more results when sound sport science is used. The time spent developing a proper foundation is minuscule compared to the time it takes to correct long-entrenched errors from years of poorly-conceived and executed training.

The Principle of Progressive Overload

The great concert cellist Yo Yo Ma, like all beginning musicians, started with the simplest of skills. He learned how to hold the bow, how to depress a string against the fretboard, the ability to play a note, and so on. But if Ma had not continued to challenge himself with increasingly more difficult skills, he would never have attained even a small percentage of his ultimate potential.

The same applies to sports training. To the body, physical training (which can also be called "motor learning") is a form of stress. In fact, Soviet sports scientists refer to training as an "irritant," since it disrupts the body's attempts to stay the same. This attempt is called *homeostasis.*

Since training is a form of stress, it helps to learn a bit about how the body responds to stress in general. Unique research by Hans Selye[2] offers an explanatory schema which beautifully illustrates how the body responds to stresses of any type. Please refer to Table 1-2, titled "A Schematic Representation of the Recovery Process."[3]

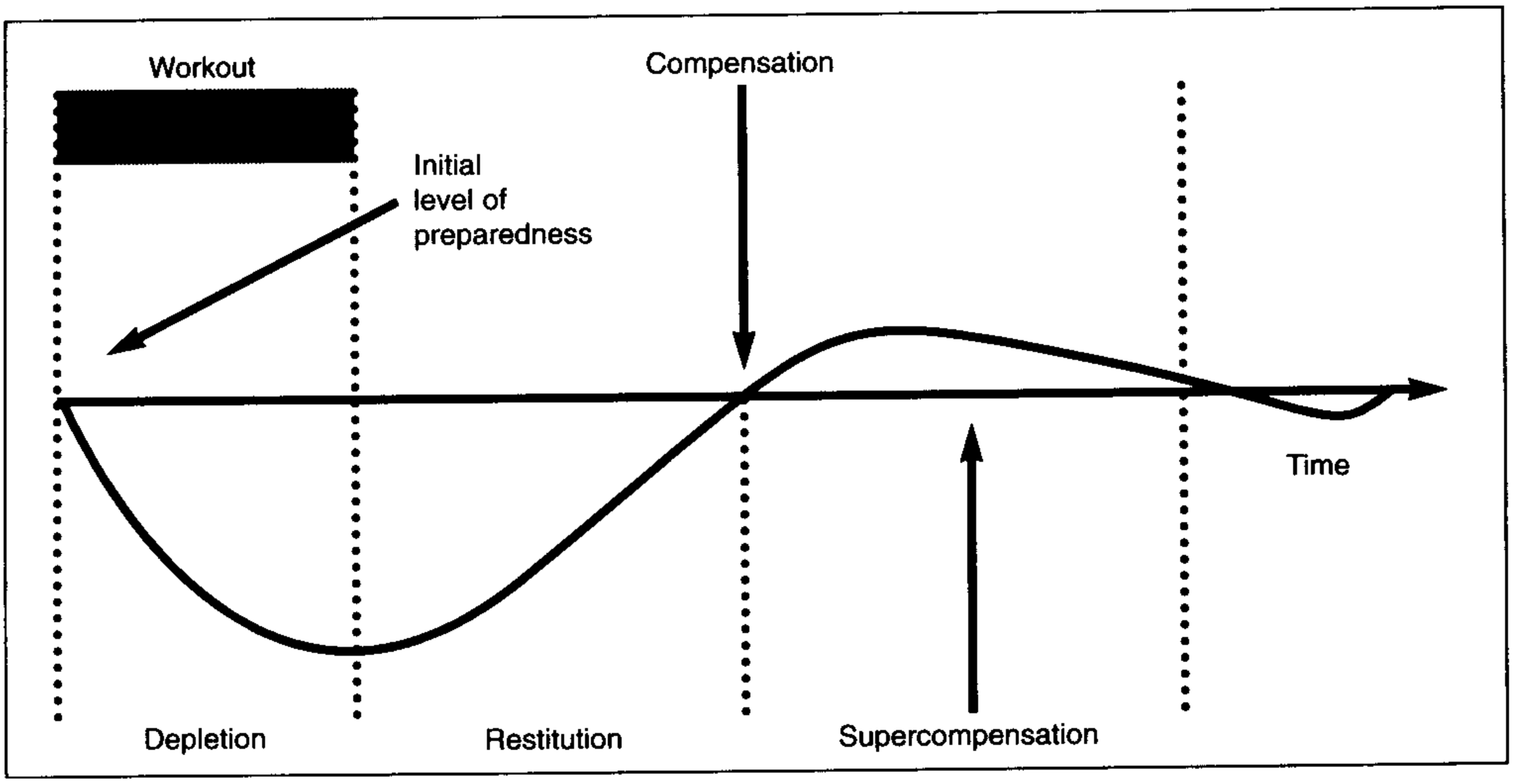


TABLE 1-2: A Schematic Representation of the Recovery Process

Upon the application of stress, the body temporarily goes into an alarm stage, and begins to make adaptations in an effort to successfully regain homeostasis. This adaptation process is called the compensation stage. Now here's where it gets interesting: Unlike machines, which eventually wear out after long periods of use, the human body actually grows stronger when it encounters stress, in an attempt to prepare itself for the next perceived stress, or "irritant."

There is one catch to this, however. If the stress applied is too sudden or severe, the body will be unable to successfully adapt, and injury, illness, and overtraining will result. Think of it this way: If someone takes on a new job as an auto mechanic and on the first day uses a wrench for eight hours, the hand will become severely blistered. The stress was too sudden and severe for the hand to successfully adapt. But, if this person worked with the wrench for an hour the first day, two hours the second day, and so on, the hand would successfully adapt by developing callouses. Training works exactly the same way.

Moreover, athletes must remember that each element trained has its own supercompensation curve. In other words, at any single moment in time, strength, speed, and endurance are all either improving or declining, depending on the nature of the current training program. Furthermore, the fatigue which is generated by a workout for one element (strength, for example) not only affects strength levels, but other components such as speed and endurance. Table 1-3, from Tom Kurz's excellent book *Science of Sports Training*, depicts how various components are affected by various types of workouts.[4]

An athlete's imperative is to develop a higher level of preparedness (also called "fitness"), and stress, when properly applied and supercompensated, is the critical ingredient. In this approach; applying the right kinds of stress, at proper intensities and frequencies, and knowing when to change gears when the body is no longer adapting is the key to ongoing progress. This is further explained in a subsequent section on the principle of variability.

The Principle of Reversibility

This principle illustrates the negative consequences of ignoring the principle of progres-

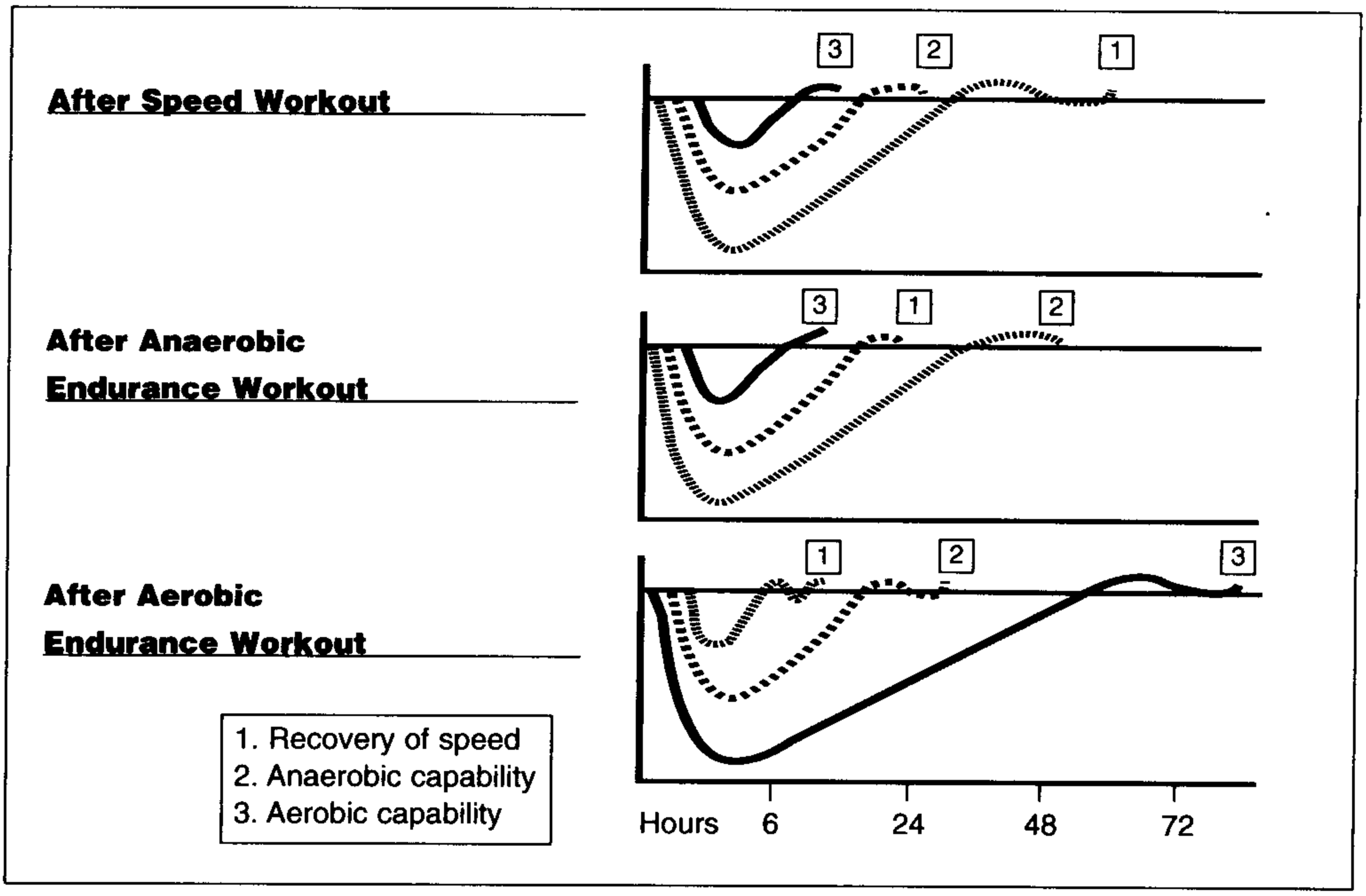


TABLE 1-3: Recuperation rates of three motor qualities after three types of workouts

sive overload. If an athlete discontinues the training process, the body responds by discontinuing it's adaptational response. After a period of time, the body will return to its previously untrained state. Although unsubstantiated by research, athletes over the years have recognized a certain "muscle memory" that makes it possible to make a "comeback" after a long period of inactivity, in a shorter period of time than it took to get to get to that level initially. However, conscientious athletes are better served by ongoing training than by gambling on "muscle memory."

The principle of reversibility suggests that an athlete stay in training year round, although the intensity and character of training will vary throughout the year. The sudden discontinuance of training (for example, after a professional athlete retires) is in itself stressful physically, as well as emotionally and psychologically. For this reason, many former Eastern-bloc sports programs utilize a planned and gradual reduction of training over several years upon an athlete's retirement from elite level competition. Perhaps if American boxers adopted this strategy, the sporting public would not be subjected to the oftentimes embarrassing comeback attempts of formerly retired competitors!

Readers may wonder how long an athlete can discontinue training before suffering the detraining effects inherent to the principle of reversibility. Please refer back to Table 1-2. This table describes the recovery process following a training session. As the body makes it's initial adaptation to the training bout, the level of readiness for the same type of training stress is well below initial levels for a short time. This is called the alarm stage. As time passes, the body begins a successful adaptation response and the level of training readiness climbs back to previous levels (the compensation stage). Eventually, the body will reach an even higher than normal state of readiness than it had prior to the training session (the supercompensation phase).

Table 1-2 also clearly illustrates that the body requires a certain period of rest following

training, during which time it will adapt to the stressor. This period of recovery may be accelerated by utilizing active recuperative techniques (please refer to Chapter Five for more information). The subsequent training session must be well timed—too soon and the body will not have time to supercompensate. Wait too long and the level of conditioning will decline in accordance with the principle of reversibility. The trick, of course, is to time each succeeding workout to coincide with the previous session's peak of supercompensation. This is an artful job which often takes years to master.

The Principle of Specificity

The body's adaptation to training is very specific to the *type* of training stimulus. Thus, the athlete must first decide which type of adaptation is desired (strength, speed, power, agility, or whatever) and then select the appropriate type of training that is known to produce the desired response, or training effect. This is sometimes referred to as the "S.A.I.D. principle," or Specific Adaptation to Imposed Demand. So, as an obvious example, to develop joint flexibility in the legs, one must perform flexibility exercises for the legs. To improve stamina for an upcoming fight scheduled for six, three minute rounds, cardiovascular training should be in intervals of three minutes work and one minute rest. Technically, someone experiencing difficulty defending against a jab should tailor training to specifically address that problem until it is resolved.

Perhaps less obvious than the previous examples are the fact that exercises must be done at specific speeds in order to elicit the desired result. For example, to improve flexibility in order to kick higher, athletes must perform dynamic (not static) stretching, since flexibility is velocity-specific.

Commonly, instructors and athletes make the mistake of thinking that if an exercise "mimics" the desired skill, it is specific and will produce results. A very common practice involves trying to improve punching speed by rapidly "punching" with light dumbbells as fast as possible. But this method is flawed, because the angle of resistance is incorrect, assuming that this exercise is done while standing erect. A better approach would to be to perform dumbbell bench presses, which correctly aligns the muscle fibers against the resistance used.

To make a point regarding specificity, recently I published the training logs of Joe Senate, an Olympic weightlifter who trains under me, on my popular web site (www.myodynamics.com). These documents show that during a 10 month period in 1998, Joe increased his lifetime best front squat from 295 pounds to 405 pounds. This is a startling improvement for an athlete who has trained for over 10 years. But consider this: Joe performed the front squat in training only six times during this period of time. Instead, I used other exercises such as trap-bar deadlifts, back squats, lunges, and step-ups to improve Joe's leg strength. The moral is that, at a quick glance, it would appear that we violated the principle of specificity, but in fact, this was not the case at all.

There are many aspects and applications of the principle of specificity, and you will find it necessary to evaluate your training program point by point. For instance, are you doing large volumes of aerobic endurance training when your sport demands anaerobic endurance instead? Or, are you performing lots of biceps curls, even though they are not needed for your event? Do you train your upper body to the neglect of your legs, which play a much more important role in your sport? Is your diet carbohydrate based even though you are a strength athlete? Or, are you a boxer who spends a great deal of time stretching, even though a great

degree of flexibility is not needed in boxing? It takes careful insight developed over years of experience in order to accurately make these assessments.

The Principle of Variability

One of the more paradoxical facts about training is that specificity must be balanced against variability within the context of a sound training program. In other words, specificity is necessary, but too much of it is just as much of a problem as not having enough! Here's why:

1) The effectiveness of any program is a function of the degree to which it challenges your body. The problem is that familiar programs are less challenging, because the body habituates (habituation is the gradual reduction of a response when an initially new stimulus is repeated over and over). Every time an athlete repeats a training program, it becomes less effective.
2) All programs have both negative and positive features, no matter how well designed or specific. Too much time on one program, and athletes demonstrate a tendency to habituate to the positive aspects and accumulate the negative ones. For example, the athlete who performs barbell bench presses every week may develop an imbalance between the front and rear deltoid muscles, despite the fact that he or she is not getting stronger on the exercise.
3) Unchanging training routines lead to overuse injuries. According to Dr. Sal Arria, Sports Medicine Director for the International Sports Sciences Association, "Adopting long-term training habits of any kind is very often a precursor to degenerative changes in the joints. Advanced athletes are particularly vulnerable, since their training tends to become more and more specific over time."[5]

Deane Juhan, in his insightful text *Job's Body*, observes: "Let us be on our guard against adopting any particular posture, mode of exercise, or repetitive discipline as being perfect, or ideal, or best. Only constant variation calls the full alertness of the system into being. It is, after all, constant variation that we are called upon to cope with throughout our lives, a condition from which we can only partially insulate ourselves no matter how hard we may try to cling to models, and no matter how 'right' those models appear to be from a particular theoretical point of view."[6]

For these three reasons, it's crucial to constantly change all aspects of training—everything from the frequency of sessions to their content. Alternatives include sparring in street clothes, in dim lighting, with obstacles such as tables and chairs on the floor, or any number of variables. Obviously, one must employ extra safety measures when implementing many of these suggestions, but the goal is to avoid habituation.

The Principle of Individual Response

While the previous principles are often regarded as the cornerstones of a scientifically planned training system, another very important factor—individual differences between athletes—must also be considered. While similarities frequently outweigh differences, an individual's physiological, as well as psychological and emotional characteristics, must be considered in the course of constructing the ideal training plan.

A recent real-life example illustrates the importance of recognizing an athlete's individual

differences. Two athletes, an Olympic weightlifter and a discus thrower, were tested for their maximum strength using the back squat exercise. Then, after a five minute rest, both athletes were retested to see how many repetitions they could perform with the barbell reduced to 80% of the weight they were able to lift for a single repetition. The result? The thrower got 14 reps, while the weightlifter only managed 7 reps. This result suggested that the weightlifter had a significantly larger proportion of fast-twitch muscle fiber than the discus thrower. To use the same or similar strength training methods for each athlete, one of them would fail to reach his potential, depending on which methods were selected. For example, fast-twitch muscle is more responsive to strength training consisting of heavy weights and low repetitions, so using this method would benefit the weightlifter more than the discus thrower, if increasing muscle mass was the primary objective.

If one applies the same training plan to one-hundred athletes, be assured there would be a corresponding number of different adaptational reactions (i.e., character of, and rate of progress) to that plan. Males and females differ in their recovery times between workouts, taller people have longer reaction times than shorter people, large-footed people have better balance than those with short feet, and so on. Sicknesses, injuries, lifestyle, and coaching background, as well as innate genetic differences further add to the differences among athletes.

Individuality is a dynamic concept. As an athlete progresses, his training must change to reflect his or her higher level of fitness. For example, it might take an athlete 16 weeks to reach a certain level of strength the first year he strength trains. The next year, even if he has not performed strength training for several months, it might take only eight to 10 weeks to meet or even exceed the strength levels of the previous year. In turn, an athlete may have an additional six to eight weeks to further increase strength levels or other aspects of the training plan.

In the next chapters, notice how the principles just discussed pertain to all aspects of the training process including nutrition and psychological preparation. But most important, use these principles to evaluate training programs and methods. Success will be the natural and unavoidable outcome!

CHAPTER 2

PLANNING: PERIODIZATION OF TRAINING

The term "training" refers to the planned, systematic presentation of gradually more difficult challenges in order to increase an athlete's state of preparedness, all for the purpose of achieving a specific goal or goals. To an athlete, these challenges are known as "workouts," but the important thing to realize is, without the bigger picture in mind, someone is not really training, but rather, simply exercising. This distinction reveals the significant differences between being an athlete and a fitness enthusiast.

There are two possible options regarding how an athlete might try to improve his sport performance: he can simply practice his sport, or he can use the sport and supplementary activities (such as specialized training to improve various "bio-motor abilities" such as speed, strength, flexibility, and endurance).

The former method tends to be effective only for beginners or athletes who are significantly deconditioned due to a long layoff from training. At this stage, simply practicing the various techniques and elements of a chosen sport will be sufficient to develop the various qualities needed to excel at that sport. For example, a beginning karate student can improve leg strength and flexibility by simply practicing front kicks. However, before long, this approach is no longer effective at developing the qualities just discussed, and specialized training to develop them must be introduced. Incidentally, this specialized training is often incorrectly referred to as "cross-training," which gives the erroneous impression that training for strength, endurance, or any of the various other bio-motor abilities is an "option" rather than a necessity.

The above discussion leads to a quandary of sorts: the athlete now has a wide spectrum of elements which must be addressed on a consistent and regular basis such as strength training, flexibility work, endurance development, speed and power training, agility and balance, and, of course, developing the techniques and tactics of the chosen sport. One solution to this quandary is use of periodization.

Simultaneous Versus Sequential Approach

The question now becomes, "How are these aspects managed in the context of a day, week, month, or longer period of time?" There are two possible answers to this important question: either one can attempt to develop all of these elements simultaneously, (an approach which invariably leads to the insanely voluminous training schedules so often published by martial arts magazines), or one can develop these elements sequentially.

Attempting to "cover all bases" on a daily or weekly basis is an "old school" approach

riddled with problems. Noted strength scientist Vladimir Zatsiorsky, in his superb text *Science and Practice of Strength Training*, observes that ". . . fitness gain decreases if several motor abilities are trained simultaneously during one workout, microcycle, or mesocycle . . . The (athlete) cannot adapt to so many different requirements at the same time . . . when the training targets are distributed over several mesocycles in sequence, the fitness gain increases."[7]

Zatsiorsky further notes that training ". . . is a trade-off between conflicting demands. On the one hand, an athlete cannot develop maximum strength, anaerobic endurance, and aerobic endurance all at the same time. The greatest gains in one direction (for instance, maximum strength) can be achieved only if an athlete concentrates on this type of training for a reasonably long time—at least one or two mesocycles. This way, strength will be improved more effectively than if a more varied program were pursued . . . one should train sequentially—one target after the other."[8]

Yet another problem with the "simultaneous" approach is that volume (the amount of training done during a given period of time) and intensity (the difficulty of training) are both necessary, but also antagonistic, facets of the training load. When volume is high, intensity is low, and vice-versa. (An ancient saying among weight trainers is "You can work hard, and you can work long, but you can't work hard for long.") Since athletes can't effectively emphasize both volume and intensity at the same time, the only remaining option is to emphasize them sequentially in training. Each phase of high volume training acts like a foundation for the phase of high intensity training which follows (which could be anywhere from one to sixteen weeks, depending on a host of factors, including one's personal philosophy of planning). By structuring training in this way, athletes derive more benefit and experience less risk than simply training "by the seat of the pants."

Enter Periodization

The problems illustrated above may be successfully solved through the concept of "periodization." The best definition for this term comes from Steven Scott Plisk, Director of Sport Conditioning at Yale University in New Haven, Connecticut. According to Plisk, periodization refers to the "planned variation (or distribution) of workload on a cyclic or 'periodic' basis."[9] Olympic weightlifting authority Arthur Drechsler, in his text *The Weightlifting Encyclopedia*, compares periodization to packing a suitcase for a trip.[10] Since the luggage presents a size constraint, the traveler must exercise a great deal of judgement during the packing process to ensure that only the most necessary items are packed. Similarly, the athlete has a finite period of time and energy to accomplish his or her goals, so training programs, including the workouts they contain, must be carefully designed.

Another very important goal of periodization is to achieve a peak level of sport-specific fitness at a predetermined date or date range. A big myth among martial artists is the idea that one should be "in top condition at all times." This is physiologically impossible, since *a peak, by definition, is surrounded by two valleys.* Correctly executed, a periodization plan allows the athlete to "peak" when it counts most, and allows for phases of recovery and regeneration (the "valleys" of training, so to speak) when they have little potential to disrupt fitness levels at important times of a martial art career.

Many martial artists make the mistake of thinking that periodization is only for competitive athletes, but nothing could be further from the truth. Even recreational athletes should structure their training around a goal or a set of goals. A "traditional" martial artist might have an upcoming rank test or demonstration wherein top shape is desired. With that objective, the conscientious athlete can periodize training in such a way to "peak" at the desired time.

If all of this sounds foreign or a bit intimidating, consider this: the traditional belt system of martial arts schools are in fact a form of periodization. Beginners have a long term goal (black belt rank), which is achieved by accomplishing short term goals (yellow through brown belt). The belt system is designed so that students learn the appropriate foundational skills before moving up to more advanced techniques and tactics. For example, one must learn how to adopt a proper fighting stance before learning to throw a front kick. And, one must learn how to execute a front kick in a "closed" environment before applying that front kick in gradually more realistic situations. Physical training—the development of bio-motor abilities—is no different. There are certain progressions which must be respected to achieve optimal results from training.

What are the Alternatives to Periodization?

Although some athletes and coaches are critical of the concept of periodization, one needs only to examine the alternatives to see their weaknesses:

- Non-periodized training would have no planning aspect; there would be no variation of training intensity, volume, or content.
- Athletes who did not periodize their training would always be in relatively the same condition, which incidentally, would be far below "peak." Any changes in condition would be spurious and unexpected.
- There would be no conscious integration of conditioning with technical or skill training. Decisions about how and when to incorporate various training components would be made in a "seat of the pants" manner, or done according to "how the athlete feels."
- When training is not periodized, positive training effects (e.g., hypertrophy, strength) are not well exploited, and negative adaptations (such as injury or overtraining) occur more often than are necessary.

Considering these limitations to a non-periodized approach, a deeper examination into the ways that athletes and coaches can better manage their training through conscious planning is apparent. Always keep in mind that there is no concrete "right" or "wrong" way of applying this concept. In fact, many leading coaches and sport scientists employ vastly different approaches to periodization with good results.

Organizing Training with Training Cycles

In order to optimally manage training, organize your training into "cycles" of time (please refer to Table 2-1 while reading this section of the chapter). The largest of these is the "macrocycle," or training year (in fact, the macrocycle normally lasts one year, however this may vary depending on various factors).

	THE ANNUAL PLAN (Macrocycle)			
Phases of Training	PREPARATORY		COMPETITIVE	Transition
Subphases	General Preparatory	Specific Preparatory	Pre Comp.	Competitive	Transition
Mesocycles					
Microcycles					

TABLE 2-1: The Annual Plan

The macrocycle is subdivided into "mesocycles" lasting (in most cases) one month's duration each (think of a mesocycle as a training month). Mesocycles are further subdivided into one week "microcycles," or training weeks.

Finally, the microcycle can be further broken down into "training units" or "workouts."

Training Periods

It helps to plan and clarify the gradually evolving training objectives within the context of the macrocycle by superimposing three "periods" of time over the table just reviewed. These periods are called the preparatory period, the competitive period, and the transition period. *To understand the relationship between training cycles and training periods, think of a macrocycle as a year, a mesocycle as a month, a microcycle as a week, and then think of the training periods as "seasons" such as spring, summer and fall.*

The Preparatory Period

The preparatory period (often called the "off season" in Western coaching terminology) is usually thought of as a "foundational" period of time, which, because it is still quite distant from any important competitions, allows athletes to address any "weak links" in preparation (based on an analysis of the previous macrocycle). Typically, preparatory periods are spent developing bio-motor abilities while technical and tactical abilities are maintained (or allowed to slightly decline). Please refer back to "the training factor's pyramid" in Chapter One to reinforce the concept of foundation.

The Competitive Period

As athletes enter the competitive period, a foundation is established, and fit athletes are ready to specify exact techniques and tactics needed to win. Training objectives gradually change from structural to functional. In other words, during the preparatory period, the primary goal is to improve the body, and during the competitive period, the objective is to

improve movement efficiency, or skills. These goals are not mutually exclusive, of course. Both conditioning and skill training are performed simultaneously all year round, but just in different proportions. The final stage of the competitive period is called the taper phase, which is discussed in detail later in this chapter.

The Transition Period

After the competition period, the transition period allows athletes to recover, regroup, and begin to make plans for the next macrocycle. This period might last from a week to a few months, depending on a number of factors. During the transition phase, fitness levels may decline slightly, but will return and even surpass previous levels in the next cycle.

The shifts between periods are gradual, such that each period slightly overlaps the period before and after it (again, much like seasons of the year). Thus, upon entering the competitive period, don't suddenly stop all weight training and other forms of conditioning, and immediately begin spending all training time working on skills. The changes in training emphasis shift in a *gradual* manner.

The Length of Each Period

Although there are many factors which influence the length of each training period, the most important ones include the following considerations:

1) *Length of macrocycle.* Obviously, an eight-month macrocycle will have shorter training periods than a twelve-month macrocycle. The length of the macrocycle is the primary restraint on the length of each training period.
2) *An athlete's experience level.* In general, less experienced athletes use longer preparatory periods and shorter competitive periods. Advanced or experienced athletes may use shorter preparatory periods, since their sport-specific fitness and conditioning levels have stabilized after years of training. Many experienced athletes find they can regain a large degree of their former abilities, even after very long layoffs.
3) *Number of competitions.* If an athlete has decided to compete in five competitions over a six-month time span, there obviously won't be time for a long preparatory period. Keep in mind that it helps to be selective in deciding which competitions to enter. In many martial arts disciplines, competitive opportunities are available throughout the year. Attempting to compete at every available opportunity may inhibit organizing training in such a way to reach a performance peak at an important competition or series of competitions.

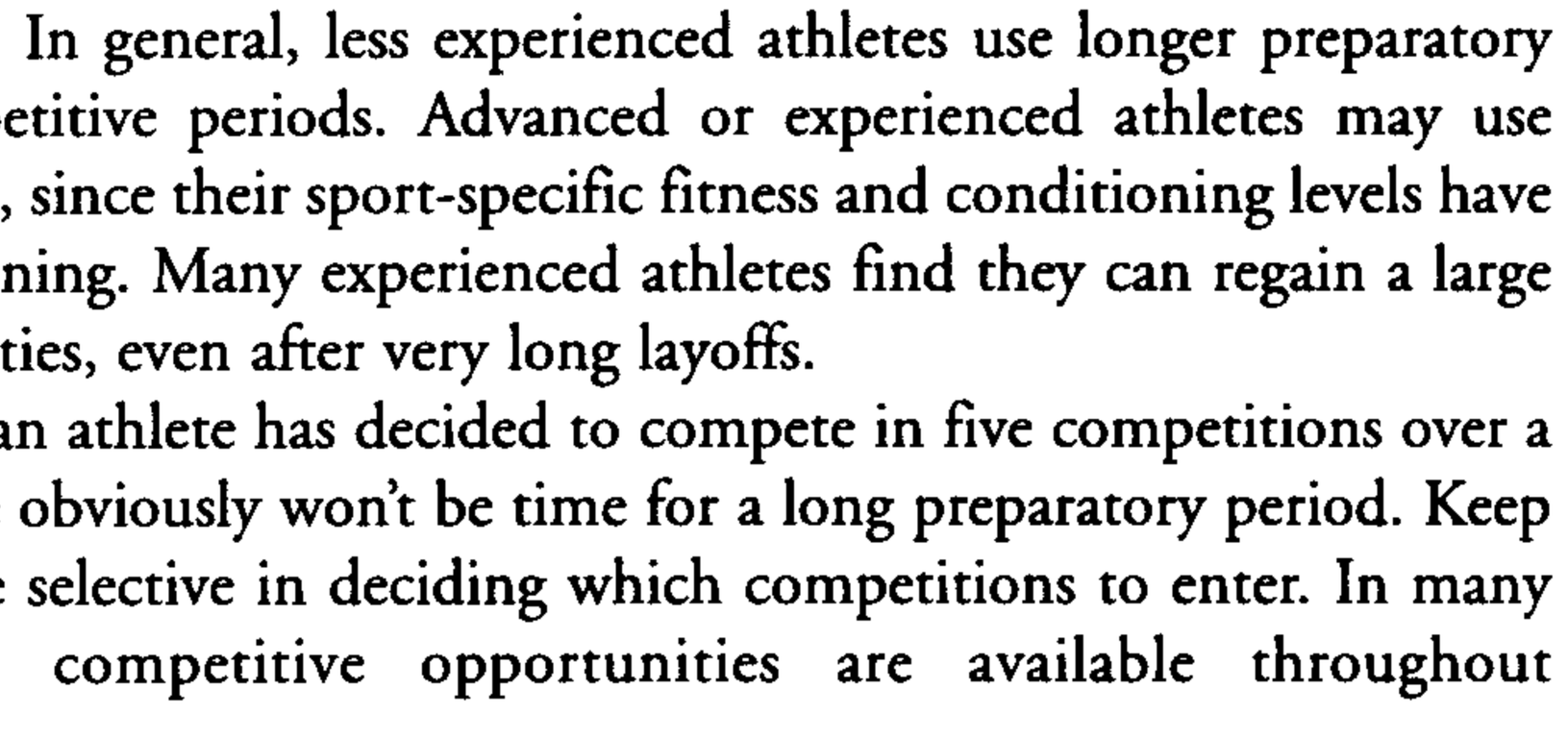


TABLE 2-2: Periodization of Intensity, Volume, and Technique[11]

One simple way to solve this problem is to subdivide the year into two macrocycles (sometimes called "double periodiza-

tion") instead of one. This way, athletes have the opportunity to peak twice a year. Double periodization is commonly used in track and field, which has an indoor (winter) and outdoor (summer) season.

Variations of the Training Load During the Macrocycle

The training load is defined as the sum total of all training content. It has two very important variables: volume and intensity. While volume refers to the *amount* of work performed during a given period of time, intensity refers to the *difficulty* of that training. Volume and intensity must always be balanced in the training load, throughout the cycle. When volume is high, intensity must be (relatively) low, and vice versa. An example of this concept frequently occurs during a strength training session. If the intensity is high (working with 95% of a one repetition maximum), athletes' won't be able to perform three sets of ten with that weight. Similarly, someone can't run a marathon at the same speed (intensity) as a 100-meter dash because the marathon is a much greater distance (volume) than the 100 meters.

For the most part, traditional macrocycles begin with relatively high volume and low intensity and, gradually (over the course of the cycle), intensity increases as volume decreases (see Table 2-2). In this manner, the athlete develops a conditioning foundation which paves the way for more rigorous skills training later in the competitive period. This type of progression also greatly reduces the risk of injuries, as high intensity work is undertaken only after the athlete is sufficiently prepared for it. As an example, a kickboxer will practice high and powerful kicking skills only after a solid strength and flexibility base have been established during the preparatory period.

Two training partners decide to do a 500 kick training session. They face each other in fighting stances and alternate throwing kicks at each other, counting as they go. The rationale is that the huge number of kicks will "toughen one up" and make kicking "second nature." This approach (correctly) assumes that each partner will benefit from experiencing a large number of kicks—for example, as one partner throws the kick, the other can practice defensive techniques, prevent flinching, etc.

A problem develops though: after about 200 kicks, techniques begin to erode. The partners continue however, and by about 350 kicks, technique looks like it used to after a month of martial arts classes, not like advanced athletes. The problem is this session is making a master of throwing bad kicks!

What went wrong? This sacrifices quality for quantity—an inarguably bad idea!

Here is a better scenario:

Develop a way to quantify technique. For example, when executing roundhouse kicks, set up a "technique monitoring" system. When throwing a kick, it must be toward a target at least mid-torso in height; the kicking knee must be inline with the hip and ankle and, each partner must maintain their guard while kicking and neither should lean backwards while throwing the kick. If either partner violates any of these parameters, the partner tells the other, and the kick doesn't count. Using this system, throw as many kicks as possible in the session until technique begins to fade. Count how many kicks were thrown, and the next session attempt to exceed that number.

Hypothetical Scenario: Emphasize Quality Not Quantity

Preventing and Managing Overtraining

Martial artists are well known for their extensive training regimes. In fact, the amount of time one puts into training is usually a matter of pride in martial art's circles. Over the years, interviews with top tournament stars suggest schedules typified by four to six-hour training sessions, often performed six or seven days a week! Those who have ever felt guilty or inadequate after reading accounts of such arduous training schedules will be pleased and surprised to learn that such regimes are not only unnecessary, but they're usually ineffective as well.

As mentioned earlier, volume and intensity are mutually exclusive qualities by definition. In other words, if the quantity of training is high, the quality is low, and vice versa (see the hypothetical scenario for a practical understanding of this concept).

Of course, martial artists require a certain amount of volume in their training schedules. The trick is to properly manage volume and intensity over a training cycle. Successfully managing this task is a necessity in order to minimize the risk of overtraining, and to maximize performance levels.

A second widely held precept of periodization theory holds that the training cycle begins with training of a very general nature, and gradually shifts to more sport or event-specific training as the competitive period looms near. In his excellent text *Science of Sports Training*, Tom Kurz classifies exercises into four groups, according to their level of specificity to the competitive sport or event.[12] These four categories are illustrated in Table 2-3.

1) General—Exercises designed to promote bio-motor qualities, such as strength training, flexibility exercises, endurance drills, and so forth.
2) Directed—Exercises which develop bio-motor abilities, but in a more specific manner. For martial artist, directed exercises might include rope skipping, hitting the speed bag, and throwing techniques in the air.
3) Special—Exercises designed primarily to improve technical and tactical skills. Hitting the heavy bag and sparring drills are examples.
4) Competitive—These are exercises which closely or exactly mirror the actual competitive event or task. Free sparring would be an example.

TABLE 2-3: Classification of Training Exercises

In general, experienced athletes require less in the way of general and directed exercises, since they are already at a high level of preparedness. Beginners, on the other hand, spend most (if not all) of their time performing general and directed drills. This concept is quite harmonious with the training factor's pyramid reviewed in Chapter One.

In order to plan out proper proportions of volume and intensity over a training cycle, one must have a reliable way of measuring these variables. The method of measurement varies depending on the activity. Table 2-4 depicts the most common ways of measuring training volume and intensity.

With regard to overtraining, volume is considered to be the critical variable to monitor. Sharp increases in volume are associated with performance decline which is one of the first and most reliable signs of overtraining. Further, when planning an increase in training volume, a "wavy" method is usually preferred (particularly for experienced athletes) over a "linear" increase. As Table 2-5 illustrates, linear progression involves continual increases, where a

To plan appropriate levels of volume and intensity for any given training cycle, accurate, reliable methods of measuring these two aspects of the training load must be established.

MEASURING VOLUME

Sparring—usually tabulated by time expressed in rounds.

Equipment Drills—(heavy bags, focus mitts, etc.)—expressed by time in rounds, or in repetitions.

Resistance Training—Amount of weight lifted, expressed in pounds or kilograms.

Endurance Drills—(both aerobic and anaerobic)—time spent or distance covered.

MEASURING INTENSITY

Sparring—ability of opponent (i.e., a black belt opponent is more difficult than a yellow belt opponent), size of opponent, amount of contact permitted and conditions (i.e., poor flooring, low light, injuries, etc.). Intensity can also be increased by "handicapping" (i.e., not allowing oneself to use certain techniques, etc.).

Equipment Drills—heart rate during and after an activity is a very reliable indicator of difficulty. Also, the peculiarities of the equipment being used (hitting a 100 pound bag is more intense than hitting a 60 pound bag) and the relative difficulty of the technique being used (a jump spin kick is more difficult, and therefore more intense than throwing a more basic kick).

Resistance Training—the amount of weight lifted, expressed as a percentage of the athlete's maximum determines intensity (see Chapter Three for further information on resistance training).

Endurance Drills—(both aerobic and anaerobic)—heart rate during or immediately after activity is the most common way to measure intensity for endurance drills.

TABLE 2-4: Measuring the Volume and Intensity of Commonly Used Training Drills

wavy progression is a "three steps up, one step down" approach. Linear increases in either volume or intensity are associated with overtraining and stagnation.

Tapering and Peaking

During the period which immediately precedes an important competition, the training load should be even further reduced. This procedure is called "tapering" or the "taper period." When done intelligently, tapering improves the athlete's performance capabilities, but only for a short time. When the taper period is administered improperly, however, performance will suffer as a result. The primary questions concerning this issue include:

1) How long the taper period should last.
2) How much the training load should be reduced.
3) How the taper period should be modified according to variations such as gender, training experience, type of athletic event, and other factors.

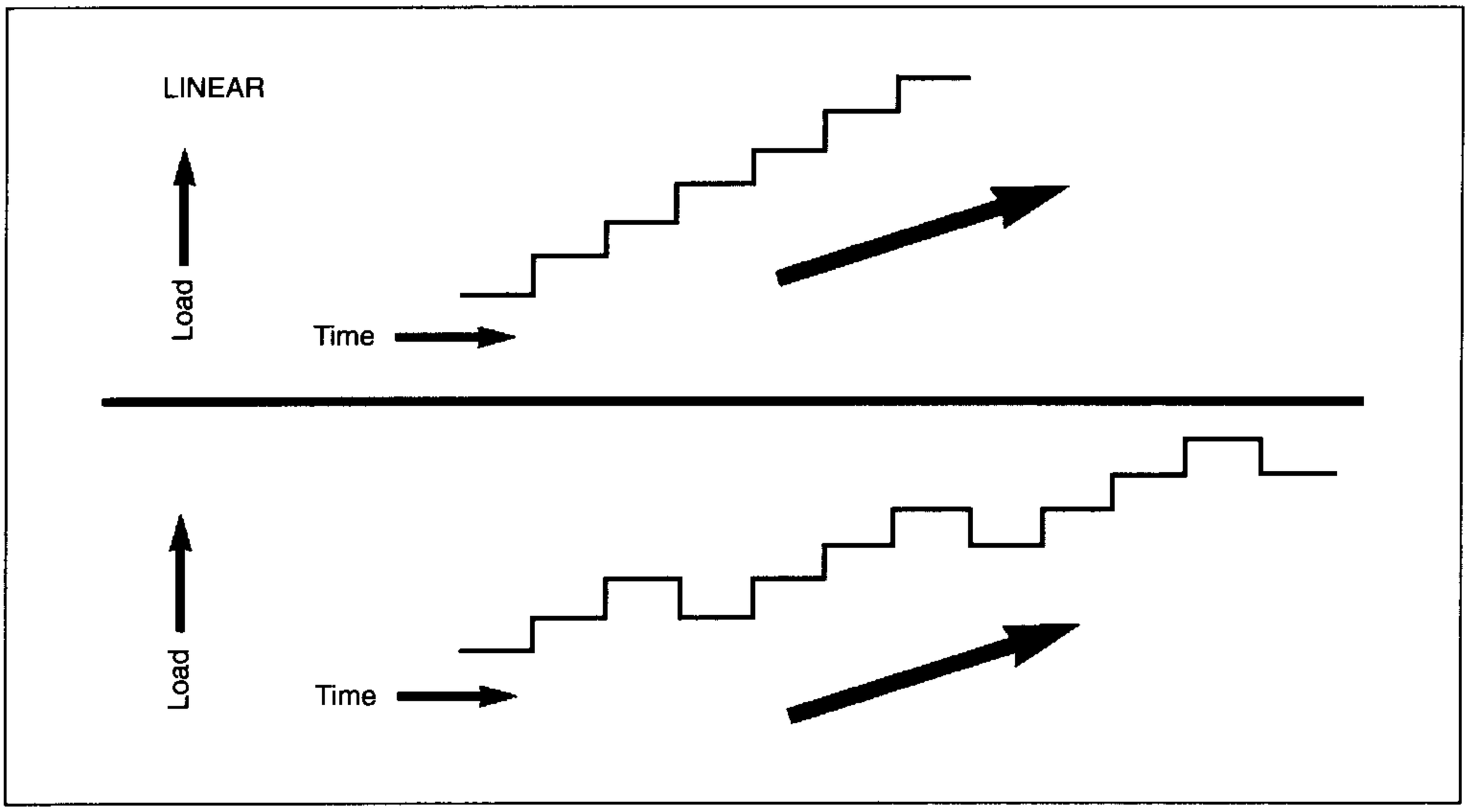


TABLE 2-5: Linear versus Undulating Progression

Tapering is based on the supercompensation theory of stress-adaptation presented in Chapter One. As a refresher, remember that high training loads cause a decrease in performance abilities, but when these loads are later reduced, performance improves beyond initial levels (i.e., before the high training loads were administered).

As a generalization, the higher the training loads, the more the athlete's performance abilities decline. The further they decline, the higher they rise once the loading is reduced. According to Drs. Siff and Verkoshansky in their excellent text *Supertraining*, performance ability will reach its peak at approximately twice the duration of the loading.[13] For example, if the loading phase lasts six weeks, the peak occurs at six weeks after the loading phase ends. This observation is expressed in a popular saying among strength coaches: "strength quickly built is quickly lost."

The purpose of the taper period is to enhance the supercompensation effect of the loading phase by eliminating any trace of fatigue just before an important competition. Tapering is a tricky process, however, since fitness levels will also decline if the taper period is too long. So the objective is to taper long enough to remove fatigue, but not long enough to impair fitness levels. Many authors contend that fitness levels erode more slowly than fatigue, and tapering depends on this premise. In fact, if fitness and fatigue dissipated at the same rate, there would not be any point in tapering!

For many martial artists, tapering seems counter intuitive. In fact, it is a common practice to increase training loads right up to the day of an important competition. But several studies suggest this is an inappropriate strategy. The considerations from these studies include:

- After a twenty-four week training program, a plateau in strength gain and thigh girth was reached after twelve weeks. At the end of twenty-four weeks, the patients were monitored for twelve weeks of detraining. Thigh girth and fat-free weight did not change, but the size of the muscle fibers decreased dramatically.[14]
- Eight to ten months after the onset of paraplegia, patients show muscle atrophy with a decrease in the percentage of Type I fibers and an increase in Type IIb fibers.[15]
- In amputees, the percentage of Type II fibers in the quadriceps (after lower leg amputation) is higher than in the "normal" limb.[16]
- Twenty weeks of training caused the percent of Type IIb fibers to decrease from 16% to near 0%. During thirty weeks of detraining, the percent of Type IIb fibers in the muscle rose to 24%. Then, after only six weeks of retraining, squat records that had been set after the initial twenty weeks were broken. Lean body mass also reached new heights.[17]

All of these studies address a curious phenomenon called "fiber fusion," which refers to the fact that during any form of heavy training, the Type IIb fibers—which are the largest and most significant contributors to force outputs—"fuse" to nearby Type IIa fibers. This "conversion" process significantly reduces muscle mass and the ability to contract muscles with explosive force. When training is either reduced or discontinued as in the taper phase, the Type IIbs reappear and usually in greater numbers than previously. This leads to significantly improved force output ability. See Chapter Three for more information on muscle fiber types.

In their excellent presentation in a recent issue of "Coaches Report," Guy Thibault and Alan Marion summarize six characteristics common to successful tapering procedures:

I. The training volume is markedly reduced throughout the taper phase.
II. The volume of high intensity training remains relatively high.
III. The level of difficulty of training sessions is reduced (by increasing the duration of recovery between repetitions and series).
IV. The weekly frequency of training sessions is reduced only minimally or not at all.
V. The duration of the taper period can vary between four and 21 days.
VI. Activities performed during the taper period are highly specific to the athlete's competitive demands.[18]

Peaking

As noted earlier in this chapter, it is a common misconception that an athlete should always be in peak condition. Since any training method capable of bringing an athlete to peak functioning levels will eventually lead to injury, overtraining, or both (over an extended period of time), training should be planned so that fitness levels are gradually improved over a period of weeks or months. Fitness should then stabilize and finally decline (for a brief period, perhaps one or two weeks) over a given training cycle. This sequence of events is repeated cycle after cycle, with each "peak" higher than the one before it.

A Practical Example of Planning

Most athletes are receptive to the idea of peaking for a competition. As an example, therefore, consider an athlete who wants to peak during three competitions. The first competition is on December 13; the second on January 5; the third is on January 26. This last competition is eight months from today (May 26). This time frame allows for a nine-month macrocycle (which further allows for a one month transition period after the last competition).

With the duration of the macrocycle established, the next step is to determine the durations of the three training periods. Planning these periods suggests an athlete will use the first five months for the preparatory period, the next three months for the competitive period, and a one month transition period (from January 27 to February 28). Please see Table 2-6 for a depiction of this hypothetical macrocycle.

PREPARATORY			COMPETITIVE					TRANS.
JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB

TABLE 2-6: Hypothetical Macrocycle

The first two mesocycles will focus on weak areas, both in conditioning and technique development. The heaviest volume of training occurs during the third and fourth mesocycles, and most of this work is relatively general. In the late preparatory to early competitive period (mesocycles four and five), conditioning work is reduced somewhat, and specific technique work is increased.

At this point, sparring and sparring-related drills take up most of the training time (for more specific information on the periodization of bio-motor abilities, please refer to Chapter Four).

The period from October 26 until the last competition on January 26 is considered the competitive period. Nearly all training will involve sparring-related work, including psychological and tactical preparation. Other details, such as travel and accommodations, having spare uniforms and safety equipment, entry forms, etc., should be addressed. This may seem odd to mention, but many competitors "blow" it due to a lack of planning concerning these details.

In the early preparatory phase, endurance training was aerobic in nature, for the purpose of building a base for intense anaerobic training later. If an event requires competing in two minute bouts, perform two to three minute intense bursts of activity during the late preparatory period.

Normally, in cases where an athlete is preparing for a single important competition, the last week before the meet is designated as the "taper phase." However, since this hypothetical example features three competitions, the suggestion is to completely rest (with the possible exception of stretching and easy technical/tactical drills) during the five to six days prior to each competition.

After the last competition, plan for a short transition phase. During this time, plan the next training cycle, and make whatever adjustments are deemed necessary based on the diffi-

A Hypothetical Microcycle from the Preparatory Period						
Day	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday
am	Anaerobic (steps)	Strength (back/triceps)	Pool Therapy	Strength (quads, hams, abs, lumbar)	Pool Therapy	Strength (pecs/biceps)
pm	Aerobic (swim)	Anaerobic (bike)	Sparring Drills	Massage	Sparring Drills	Aerobic (bike)

TABLE 2-7

A Hypothetical Microcycle from the Competitive Period						
Day	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday
am	Anaerobic (steps)	Strength (back/triceps)	Pool Therapy	Sparring Drills	Pool Therapy	Strength (quads/hams)
pm	Sparring Drills	Anaerobic (bike)	Sparring Drills	Massage	Sparring Drills	Aerobic (bike)

TABLE 2-8

culties of the last cycle. For example, if someone loses a match because reaction speed was too slow, he or she should prioritize that aspect of training during the next cycle.

Fine Tuning and Making Adjustments to the Plan

Of course, the loads planned for the macrocycle may never come to pass, due to sickness, injury, or other unforeseen circumstances. When this happens, athletes must decide to what degree they may have to "start from scratch," based on how much fitness was lost. For example, if an athlete loses two weeks of training in the middle of the preparatory period due to sickness, he or she may decide to reduce both the volume and intensity of the upcoming loads. While this compromise may result in lessened competitive results in the competitive period, there will probably not be enough time to create a whole new macrocycle. On the other hand, if the sickness occurred near the beginning of the macrocycle, there may be time to start all over again, although the total length of the macrocycle will be shorter. If sickness or injury occurs late in the preparatory period or later, there may be no choice but to cancel participating in the competition.

Conclusion

Many instructors and coaches make the mistake of applying the same periodization scheme for each and every situation. This reflects a "rote memorization" of the concept, but a poor understanding of how to apply it. As an example, periodization formats designed for novice or out-of-shape athletes are not specific enough to result in the most superior possible performances for advanced athletes, due to overly long preparatory periods consisting of high volumes of nonspecific training.

In his book *The Charlie Francis Training System*, Charlie Francis, coach of Ben Johnson,

former world-record holder in the 100 meter dash states that low volume, high intensity training was in large part responsible for Ben Johnson's world record, adding that "For mature athletes, you don't need an extensive general preparation phase consisting of long months of 'slogging'—of laying down a high volume base. This approach will take you too far away from the specific requirements of your event. In fact, with such an approach you are losing and detraining qualities which you had enhanced the previous year, only to have to relearn them again."[19]

Every athlete is different, and in fact, every time an athlete competes, the circumstances are at least slightly different from the last time. This means that although based on science, periodization is largely an art. It requires creativity, insight, willingness to make adjustments on the fly, and a certain amount of intuition. There are many situations where coaches and athletes make decisions based on "gut instinct" developed by years of training athletes or personal athletic experience. Every athlete and coach can develop their "gut instincts" over time, particularly among those who keep records of training and competition results.

Readers should consider using the information presented in this chapter in their own individual training. If things don't seem to be progressing properly, make changes. If a program seems to work well, don't be afraid to use it (or a variation of it) again. In time, every coach or athlete can become competent at the art of planning and periodization.

CHAPTER 3

PHYSICAL PREPARATION: MUSCLE ASSESSMENT AND TRAINING

This chapter first discusses the basics of neuromuscular physiology to develop an appreciation of how the body works, particularly in regards to force development. It also introduces the conceptual aspects of bio-motor development. Then, each muscle is described including its basic anatomy and function. Those portions on muscle anatomy include how to assess the length of that muscle, and how to stretch it if the length proves to be insufficient. Finally, specific strength training exercises and strategies for those muscles are featured.

Basic Neuromuscular Physiology

A basic understanding of some basic facts and principles will be of tremendous value to you as you delve further into this chapter.

Muscle is the largest organ of the body aside from skin. Depending on bodyfat levels, muscle accounts for between 40–70% of total body weight. A muscle's primary role is to move bones to create movement. For this reason, muscle is also called "contractile tissue." Without muscle, the skeleton would collapse against the force of gravity. Muscles have a profound role in keeping joints healthy and functioning. In fact, when a surgical patient is under general anaesthesia, great care must be taken when moving or repositioning the patient so that joints do not dislocate.

Although many people tend to think of muscles as individual entities, it may be more accurate to think of the body as having one muscle with many different compartments. Any movement, no matter how simple it seems, requires the coordinated effort of the entire neuromuscular system.

Consider the following eloquent passage from Deane Juhan's *Job's Body*, ". . . let us imagine ourselves observing a person who is standing erect and executing the simple gesture of raising their straight right arm to the side until it is horizontal. The fibers in the deltoid, the supraspinatus, and the upper trapezius will contract to produce the primary motion, while the fibers of the pectoral major, the pectoral minor, and latissimus dorsi must simultaneously extend to allow it. But the contraction of the right trapezius will not only raise the right arm, it will also tend to pull the neck toward the right; therefore the left trapezius, along with the other muscles of the neck, will have to contract as well in order to stabilize it. Furthermore, the extended right arm will overbalance the torso to the right, so the erector spinae muscles on the left side of the spine must contract to brace the whole torso and keep it erect. And since this contraction of the left erector spinae set will tend to pull the left side of the pelvis up. The gluteus medius and minimus of the left side must also brace to hold the pelvis level.

Since not only the torso, but the body as a whole is threatened with tipping by the overbalancing weight of the extended arm, the right leg must brace as well, using fibers in the hip, the thigh, the calf, the feet, the toes."[20]

Considering this complexity, it is probably not accurate for personal trainers, equipment manufacturers, and other fitness professionals to talk about "isolating" a muscle with a certain exercise or technique!

Muscle Contraction

Muscles are arranged in parallel bundles of "fascicles," which are in turn composed of parallel bundles of "fibers," which are in turn composed of parallel bundles of "myofibrils." Finally, the myofibril is composed of parallel bundles of "filaments." (see Table 3-1).

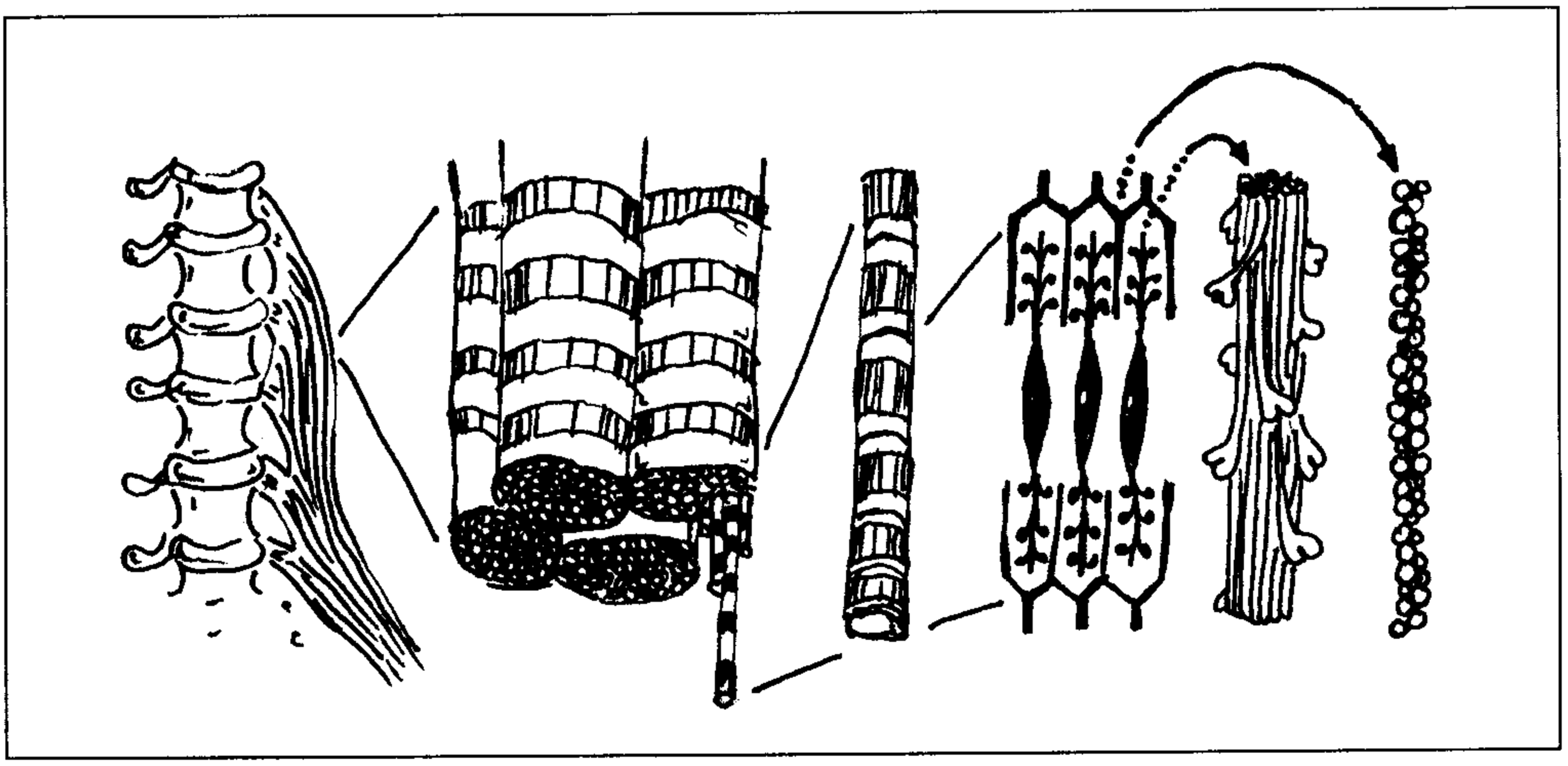


TABLE 3-1: Muscle Arrangement[21]

Filaments are ordered in repeating segments called "sarcomeres." The border of each sarcomere is called the "Z line." A single filament is about one centimeter long and is composed of thousands of sarcomeres arranged end to end along the entire length of the filament.

Within a sarcomere (which is often referred to as the "functional unit" of muscle), there are two types of proteins which together, through a process of interdigitation called "sliding filament theory," cause the two Z lines of the sarcomere to approach each other. When the nervous system gives the command for a muscle to contract, every sarcomere in the filament shortens, which causes the entire filament to shorten. This process, occurring throughout the entire muscle, is what allows the muscle to produce force (see Table 3-2).

Muscle Architecture

Muscles can be categorized by the orientation of their fibers in relation to that muscle's line of pull. The primary architecture types are described in Table 3-3. The important thing to understand about fiber orientation is the fact that muscles which have their fibers oriented obliquely to the muscle's line of pull (such as in the rectus femoris in Table 3-3) are stronger

than muscles whose fibers are arranged parallel to the direction of pull because there is more muscle in the same area. Think about the spaces in most parking lots: they're arranged diagonally to the curb rather than perpendicular, so that more cars can be parked in the same amount of space.

On the other hand, muscles which have their fibers oriented parallel to the muscle's line of pull (such as in the biceps in Table 3-3) are faster than muscle fibers which are arranged diagonally, since they produce a greater range of motion at a joint for any given degree of shortening.

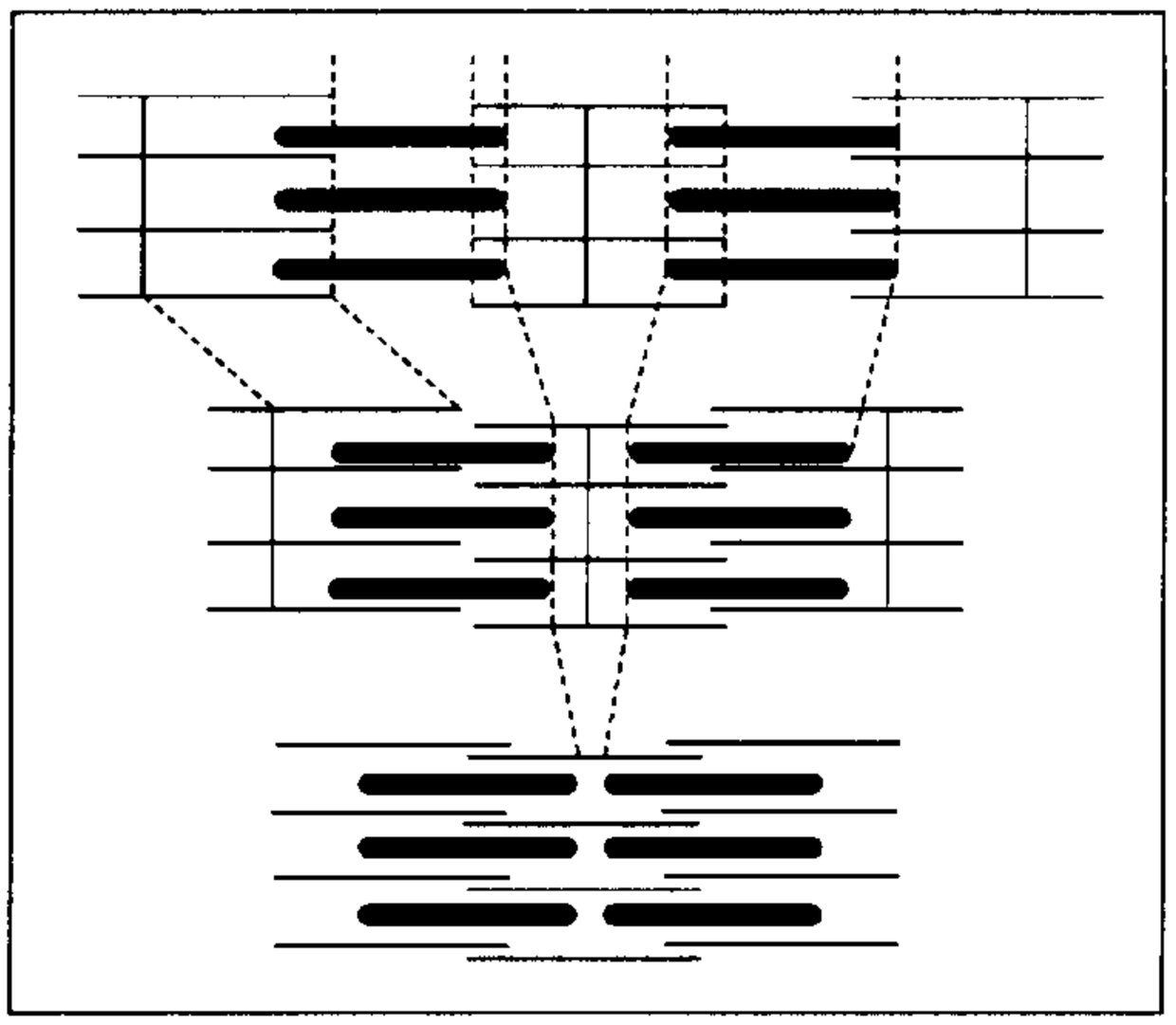


TABLE 3-2: Sliding Filament Theory[22]

Muscle Fiber Types

Muscles are composed of a wide variety of fibers, which scientists classify according to how they function. Traditionally, three categories are used:

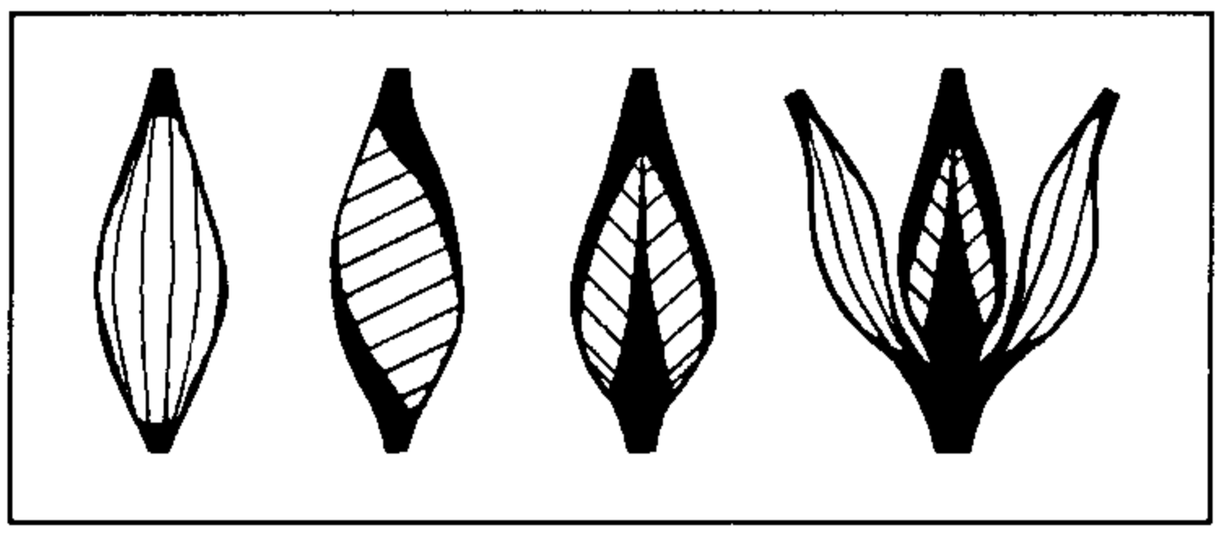


TABLE 3-3: Muscle Fiber Types[23]

- Type IIb. These are large diameter fibers capable of producing high levels of force at fast contraction speeds. Known as "fast-twitch" fibers, Type IIbs fatigue very quickly.
- Type IIa. These fibers are much like hybrids between IIbs and Type I fibers. They have moderate force producing capacities and moderate endurance capacity.
- Type I. These fibers are also known as "slow-twitch" fibers because they have small diameters, have fairly low force output characteristics, and high endurance capacity.

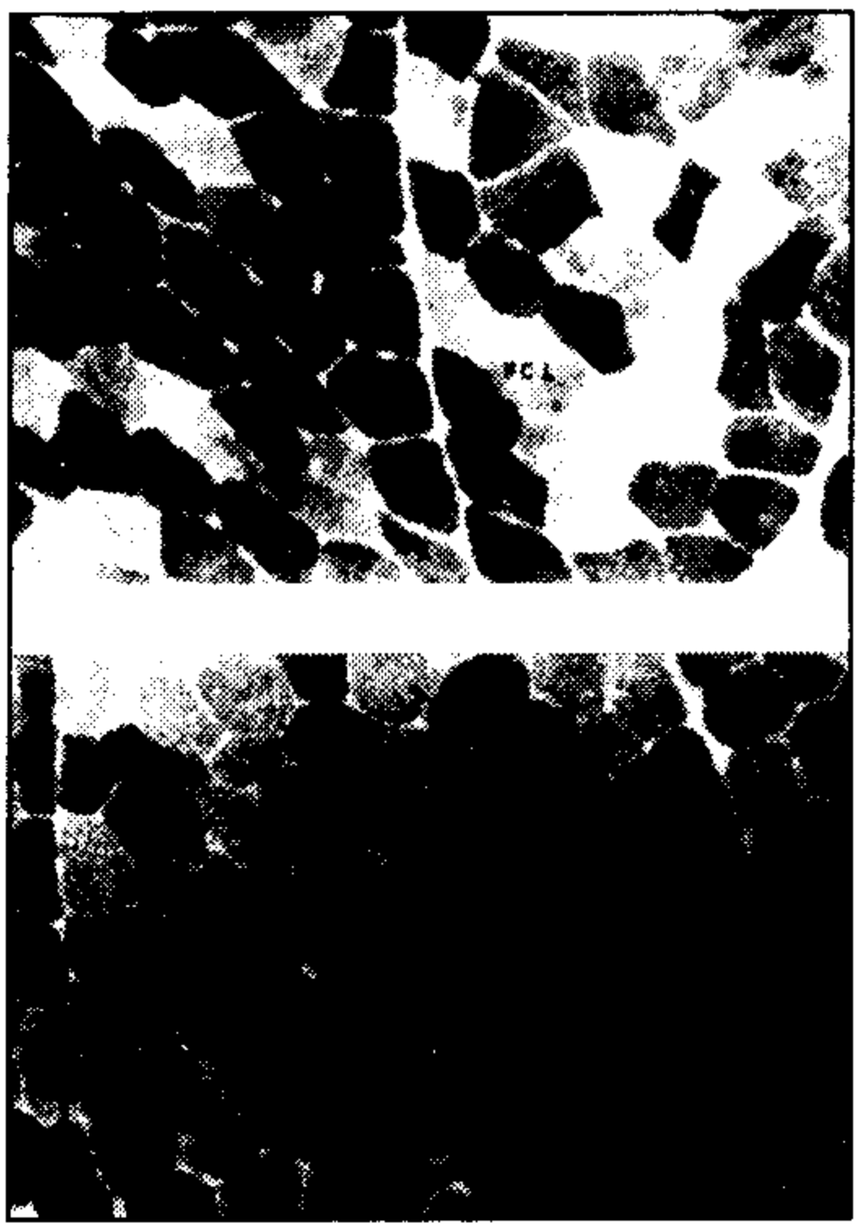


TABLE 3-4[24]

To illustrate this, a turkey's "white meat" is actually composed of mostly fast-twitch muscle fiber, while the "red meat" is mostly slow-twitch muscle.

While this classification format is useful for a basic understanding, the important thing to remember is that in reality, there are not three, absolutely distinct types of fibers but rather a "spectrum." On the one end are the biggest, fastest, strongest fibers which require a very high tension to activate (hence, they are often referred to as "high threshold" fibers), and on the other end are the smallest, slowest, and weakest (but least fatiguable) fibers, also called "low threshold" fibers, since it takes only small amounts of muscular tension to activate them. This is further illustrated in Table 3-4.

Everyone is born with a certain proportion of fast- and slow-twitch muscle fiber, (called "fiber ratio") and

this proportion tends to vary from muscle to muscle. For example, muscles like the pectorals, lats, hamstrings, and gastrocnemius tend to have a greater proportion of fast-twitch muscle fibers, while other muscles like the deltoids, abdominals, and soleus tend to have larger proportions of slow-twitch muscle fibers.

As a whole, most people tend to have about a 50/50 ratio of fast- and slow-twitch muscle fibers, with the extreme cases reaching to a 40/60 ratio in both directions. Those individuals born with a high proportion of fast-twitch muscle may have greater potential for strength and power sports, where people in the other end of the spectrum tend to excel at endurance related events such as distance running, cycling, swimming, and so forth. Although extensive endurance training may make fast-twitch fibers behave a bit more like slow twitch fibers, it seems the reverse does not hold true.

There are many ways to assess one's own fiber ratio, ranging from laboratory tests (such as submitting to a needle biopsy) to simple observation. Since few athletes either want to undergo, or have access to lab tests, here are some keys to determining fiber ratio through observation.

Athletes with a fast fiber ratio tend to be strong, well-muscled, and fast. They also tend to have poor endurance capacity, and have an innate dislike of anything requiring endurance output. These people often exhibit "explosive" personalities and are often aggressive, hot-tempered, impatient, and driven (not that they don't have more admirable personality characteristics as well!). "Fast-twitchers" can be identified in the weight room by carefully watching for certain patterns. Many people have seen someone lift a weight that seemed very difficult, even a maximal effort, and then, surprisingly, add even more weight and successfully lift it. This is a sign of someone with a fast fiber ratio.

Conversely, "slow-twitchers" excel and naturally gravitate toward endurance activities. In general, women tend to have slower fiber ratios as compared to men which may explain why aerobic exercise is so high on the list of favorite exercise options for women. "Slow-twitchers" also tend to have more "even" or "laid back" personalities, for lack of better terms.

In the weight room, a "slow-twitcher" might lift say, 135 pounds for twelve repetitions, and then, on the next set, only manage six repetitions with 155 pounds. Later in this section, some field tests for speed-strength are presented which also helps indicate fiber ratio.

Many coaches suggest that athletes who have a high proportion of fast-twitch fibers should emphasize high intensity, low volume training, and that people who have a high proportion of slow-twitch fibers should emphasize high volume/endurance training methods. While this is sound to a point, it must be remembered that most athletes have close to a 50/50 ratio and this fact warrants both types of training to some degree (please refer to "the rule of thirds" later in this chapter).

How Muscles Produce Force

*1) **Motor unit recruitment (intramuscular coordination).*** All muscle fibers are one component of what physiologists call "motor units" (MU). A MU is defined as a motor neuron (or nerve cell) and all the muscle fibers it innervates or "recruits." There are several essential facts that athletes and coaches should further understand about the functioning of MUs:

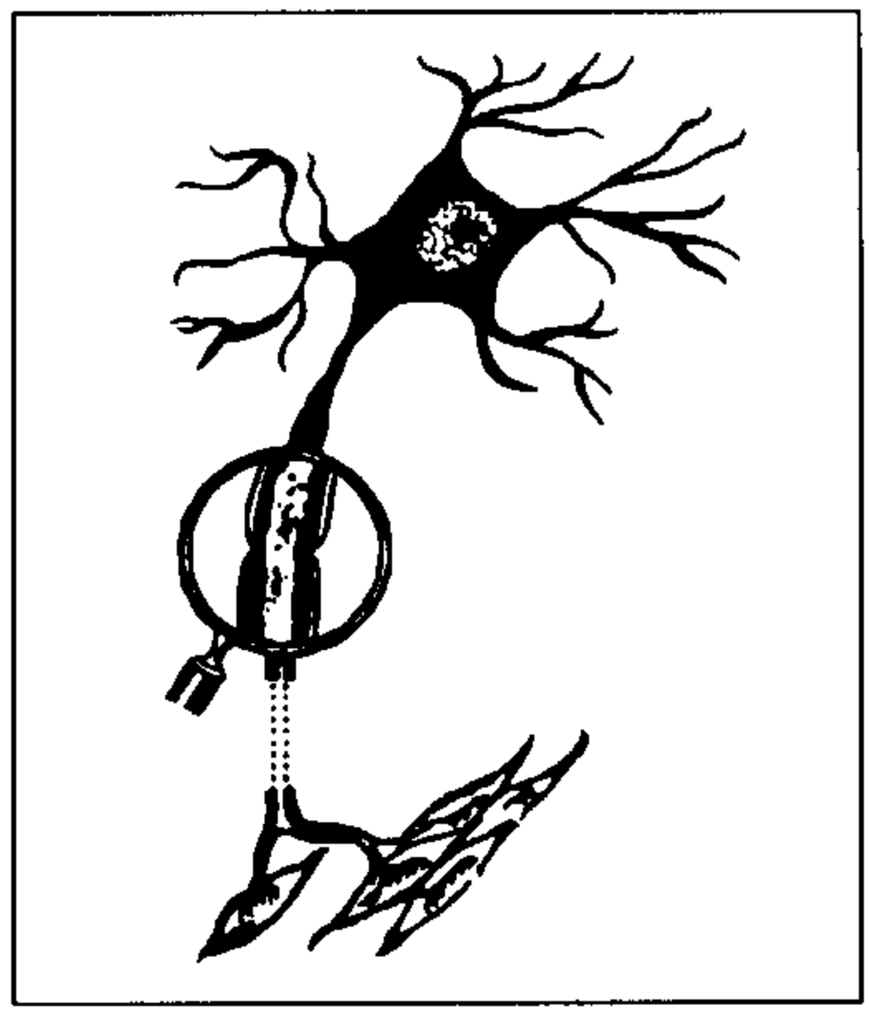


Table 3-5: The Motor Unit

- All the fibers of a MU tend to have the same characteristics. When all the fibers are type II, the motor unit is said to be a high threshold or "fast" MU. If the fibers are Type I, it is a low threshold or "slow" MU.
- The all or none principle. When an action potential (the command from the nervous system) is sent from the nerve cell to the muscle fibers, one of two events will occur. If the action potential is strong enough, all the fibers of that motor unit will contract maximally. If the action potential is not strong enough, nothing will happen. In a nutshell, muscle fibers either contract all the way, or not at all. When the body needs to apply more force, it simply recruits more MUs, increases the firing rate of those MUs (see "rate coding" below), or both. Generally, untrained people have limited ability to recruit high threshold MUs because they are unfamiliar with high-tension efforts.
- The size principle. When contracting a muscle to overcome a resistance, the MUs involved are recruited in order of size, small to large. This explains why people can use the muscle to pick up something light (a pencil) or heavy (a dumbbell). As resistance increases, the body recruits more MUs.

2) ***Intermuscular coordination.*** This is the ability of different muscles to cooperate during the performance of a motor task. Muscles can function in several different ways depending on the task at hand. The most fundamental roles muscles assume are listed in Table 3-6.

- **Prime Mover:** The primary muscle responsible for a movement around a joint at any given point in time. For example, during the bench press, the pectoralis major is the biggest and strongest muscle involved, and as such it provides the most force during most of the exercise.
- **Synergist:** A synergist is a muscle which dynamically assist the prime mover. Going back to the bench press example, the front deltoid muscle and tricep would be considered synergist in this exercise.
- **Stabilizer:** Stabilizers are muscles which anchor or stabilize one part of the body (through static activity), allowing another part to move. In other words, they assist the prime movers and synergist through static or "isometric" muscular contraction. The stabilizer role of the muscles can be trained with exercises conducted in an unstable environment, which might involve dumbbells, Swiss balls, wobble boards, or other devices designed for this purpose. Unilateral (one limb at a time) strength training exercises can also be used, such as performing a leg curl with the left leg only, which will cause a compensatory contraction of the right lumbar and abdominal muscles.

  For clarification, be aware that prime movers, synergist, and stabilizers are not different types of muscles; they are ways in which muscles perform. A single muscle might be a prime mover in one situation, and a stabilizer in another situation.
- **Agonist/antagonist relationship:** (not to be confused with the roles described above). For every muscle in the body, there is another muscle capable of resisting its force. If this were not the case, controlled human movement would not be possible. When throwing a punch for example, the tricep is one of the primary agonists, as it is the muscle which extends the elbow (readers can distinguish these two terms by remembering that "the agonist is the one in agony"). The primary antagonist during punching is the bicep, which acts eccentrically to control the extension force created at the tricep so that punching doesn't hyperextend the elbow at the end of the movement. This is evident by the exceptional punchers in the sport of boxing who have well-developed lats and biceps.

TABLE 3-6: The Role of Muscles During Movement

3) ***Rate Coding.*** The nervous system can vary the strength of muscular contraction not only by varying the number of MUs recruited, but also by varying the firing rate of each MU. This is known as rate coding. The tension that a MU develops in response to a single action potential from the nervous system is called a "twitch." As the stimulus from the nervous system becomes stronger and stronger, the twitches per millisecond become more and more frequent until they begin to overlap, causing greater amounts of tension to be generated by the muscle fiber. The mechanism behind rate coding is very similar to the way in which increased vibrational frequency of a sound increases its pitch.

As an example, a muscle comprising 100 MUs would have 100 graded increments available to it. In addition, each MU can vary its force output over about a tenfold range by varying its firing rate (e.g., from ten to fifty impulses per second). For any set of conditions, the force of contraction is greatest when all MUs have been recruited and all are firing at the optimal rate for force production.

The size of a given muscle may in part determine the relative contribution of rate coding to total muscular force development.[25] In small muscles, most MUs are recruited at a level of force less than 50% of maximal force capacity. Forces that require greater tensions are generated primarily through rate coding. In large proximal muscles (such as the pectorals and lats), the recruitment of additional MUs appears to be the main mechanism for increasing force development up to 80% of absolute strength and even higher. In the force range between 80% and 100% of absolute strength, force is increased almost exclusively by intensification of the MU firing rate.

Strength Development

On January 11, 1994, a boxing commentator stated to his television audience that he felt weight training was deleterious to fighters, adding ". . . muscle weighs more than fat." This statement is interesting in two regards. First, boxing coaches have been expressing the same opinion for years. It's just incredulous to hear such an assertion in the 1990s! Second, muscle does weigh more than fat, but does this mean boxers should strive to accumulate as much fat as possible to become better fighters?

To be fair, getting stronger doesn't automatically in and of itself make anyone a better martial artist. But it does create the *potential* for enhanced athletic performance, and therefore, better fighting skills. In fact, strength is a determining factor in how much speed, power, agility, cardiovascular endurance, and technical ability a martial artist can attain. Of all the bio-motor abilities, strength is by far the easiest to develop, and as such, pays fantastic dividends to any athlete who pursues it diligently. For these reasons, strength is the "root" bio-motor ability for all athletes.

For years, resistance training has contributed significantly in nearly every sport and event, including jumping, sprinting, throwing, football, skating, to name a few. What makes martial artists so different that they can't benefit as well? It can't be the need for flexibility, quickness, speed, power, endurance, or agility, because resistance training has a proven track record for improving all of these qualities! Perhaps because the martial arts are based on efficient technique, i.e., getting the biggest result out of the smallest effort, it is somehow viewed as "cheating," to use strength training methods. The assumption is that the athlete is trying to compensate for bad technique by getting stronger. Of course, adopting such a strategy would be a mistake. All four tiers of the training factor's pyramid (physical, technical, tactical, and

psychological) must be developed to the fullest.

It should also be noted that the benefits of strength training go far beyond the fact that the athlete becomes stronger, faster, and more powerful. Strength training also helps to correct bilateral (left to right) muscular asymmetries, create muscular support for joints, reduce bodyfat, and enhance the psychological feeling of readiness.

Strength Defined

Those readers whose idea of strength training evokes images of 500 pound clean and jerks, or 1,000 pound squats are not alone. In fact, most people, athletes included, still cling to the idea that "strength" and "endurance" are bio-motor opposites—either train for one or the other. But nothing could be further from the truth. In fact, for most fighters, strength training could be the very key that unlocks vast quantities of unimagined athletic potential!

The International Sports Sciences Association (ISSA) has established a comprehensive, as well as functional, definition of this often misleading term: "Strength is the ability to exert musculoskeletal force, given constraints stemming from the following components:

1) Structural/anatomical factors
2) Physiological/biochemical factors
3) Psycho neural/psycho social factors
4) External/environmental factors[26]

TABLE 3-7: Constraining Factors for Strength Development

Strength: The Multi-Faceted Motor Quality

Strength as a bio-motor ability has many expressions. All human movement requires strength of one type or another, and for this reason, all athletes must concern themselves with developing their strength levels to the utmost. In the following sections, various types of strength are summarized which are important to athletes in all sports.

Absolute Strength

This is defined as the amount of musculoskeletal force that can be generated for one all-out effort, regardless of time or bodyweight. Absolute strength is the athlete's "foundation," however, it can only be demonstrated or tested in the weight room during the performance of a maximal lift. While only powerlifters need to maximize and demonstrate this type of strength, martial artists need to develop high levels of absolute strength as a foundation for other bio-motor abilities such as power, speed, strength endurance, and others. For this reason, absolute strength is brought to peak levels in the preparatory period, and then "converted" to more event-specific forms of strength later in the macrocycle (more details on the periodization of strength later in this chapter). Absolute strength can be displayed through three types of muscular actions:

1) *Concentric Strength.* The amount of weight lifted one time (1RM) with an all-out muscular effort.
2) *Eccentric Strength.* The amount of weight that can be lowered without losing control (such as lowering the bar to the chest in the bench press exercise). Eccentric strength is

normally 30–50% greater than concentric strength, meaning most athletes can lower more weight in good control than they can actually lift. This may be due to increased intramuscular friction during the eccentric portion of a lift.

3) *Static Strength.* This describes how much weight can be held stationary without losing control (the momentary pause between the eccentric and concentric portions of the lift).

Relative Strength

Whereas absolute strength refers to strength irrespective of bodyweight, relative strength is a term used to denote an athlete's strength per unit of bodyweight. It can be used as a modifier for other categories of strength, such as speed strength or strength endurance. Thus if two athletes of different body weights can power clean 275 pounds, they have equal speed strength for that lift, but the lighter athlete has greater *relative speed strength.*

All athletes who compete in weight class events depend heavily on relative strength, as do sports where the athlete must overcome his or her bodyweight to accomplish a motor task (i.e., long jump, sprinting, etc.). Further, sports which have aesthetic requirements (figure skating, gymnastics, etc.) require the athlete to rely heavily upon the development of strength without a commensurate gain in bodyweight.

Strength can be developed through two very different means—by applying stress to the muscle cells themselves, or by targeting the nervous system. The former method is accomplished through the application of bodybuilding protocols (repetitions between six and 12), and results in strength improvements through an increase in muscle size. The latter are accomplished through higher intensity training (repetitions between one and four), and increases in strength are the result of the body's improved ability to recruit more of its existing motor unit pool.

For athletes who need absolute strength (throwers in track and field, football linemen, etc.), both methods are used extensively. First, bodybuilding methods are used, followed by nervous system training. The result is an increase in bodyweight and absolute strength. Relative strength decreases as the athlete grows larger.

For martial artists and other athletes who depend upon relative strength, bodybuilding methods should be used sparingly, unless a higher weight class is desired. Most strength training should be characterized by high intensity, low repetition sets, which improve strength through neural adaptations rather than increases in muscle cross section (size).

Speed Strength (Rate of Force Development)

Speed Strength (SS) is a hot topic in athletic circles. The term simply means strength divided by time, or put another way, strength per unit of time. SS is defined as work divided by time, where work is defined as force x distance. Therefore, SS is defined as force x distance, divided by time. SS is characterized by three distinct components:

1) *Starting strength.* This is defined as the ability to recruit as many motor units (MUs) as possible instantaneously at the start of a movement. Common examples include the lunge in fencing, coming off the line in football, and the start in short sprints.
2) *Explosive strength.* This quality refers to acceleration or rate of force development. In other words, once a maximal number of MUs is recruited, how long can an athlete keep them recruited? In his seminars, Dr. Fred Hatfield, cofounder of the International Sports Sciences Association and the first man to officially squat 1,000 pounds, compares start-

ing strength to the flash bulb of a camera, and explosive strength as a flash that stays on and becomes brighter and brighter the longer it stays on.

With regards to the above distinctions, different sporting skills and events can be classified as either starting or explosive strength events, depending on the relative proportion of speed and strength required. The javelin event in track and field would be classified as a starting strength event because the implement is very light, which permits the athlete to impart a great degree of speed during the throw. Conversely, the shot is relatively heavy, which means that less speed can be achieved. This makes the shot put an explosive strength event. Thus, it logically follows that athletes interested in starting strength emphasize relatively lighter weight loads in strength training than do explosive strength athletes.

3) *Reactive strength* (stretch-shortening cycle). Although traditionally classified as a component of SS, reactive strength can be thought of as an independent motor quality. It involves the storage of potential kinetic energy during the eccentric portion of a movement, which is then converted to actual kinetic energy during the subsequent concentric phase, much like stretching and releasing an elastic band.

During many skills (jumping rope, for example), the working muscles attempt to maintain static contraction, with force output provided by the storing and release of elastic energy through the tendons. Since static muscular activity requires less energy than dynamic muscular activity, reactive strength is an energy efficient way of moving—it's performing more work with fewer calories. This is why novice exercisers can always be seen doing exercises in the easiest possible manner (using quick, choppy movements) whether it's on the bench press or the stair climber. Reactive strength is also the method of choice when someone who is tired and/or weak gets up out of a chair. Instead of simply standing up, individuals will actually lean back first, and then quickly reverse this action, springing out of the chair. In fact, when someone attempts to rise out of a chair using pure concentric movement, it looks very unusual.

To appreciate the effect of reactive strength on force production, perform a vertical jump in a normal manner. "Normal" means to first crouch and then rapidly switch and jump upwards as explosively as possible. Alternatively, crouch, but pause for five seconds (this pause will dissipate most of the stored potential kinetic energy), and then jump upward. The jump where the crouch (or eccentric phase) was immediately followed by the jump results in a higher jump. The key to preserving as much potential kinetic energy as possible is to switch from eccentric to concentric as rapidly as possible.

In the sport of powerlifting, the squat and deadlift events further reveal the effects of reactive strength. The deadlift is essentially a squat with the bar in the hands instead of on the back. In every weight class, the world record squat is greater than the world record deadlift.

Why? One reason is that the squat is a stretch-shortening cycle (SSC) activity (because it starts with the eccentric phase of the lift) while the deadlift starts concentrically.

Further evidence of the SSC can be seen in any videotaped boxing match. View the match in slow motion, and note how almost all fighters "cock" their punches before throwing them, be it ever so slightly. The best fighters manage to minimize this preparatory movement, because observant opponents can pick up on it.

In order to respect the principle of specificity, strength training methods should reflect the SSC nature of athletic skills, at least during high-specificity phases of training

(i.e., late preparatory period). The best form of resistance training technologies to accomplish this task is constant resistance, or free weights.

Absolute Strength Forms the Basis for Speed Strength

Despite the current preoccupation with plyometrics, specialized shoes, and the like, improving absolute strength remains the most efficient way to improve SS. In fact, the Romanian strength and periodization specialist Tudor Bompa suggests that ". . . no visible increments of power are possible without clear gains in maximal (absolute) strength."[27]

To appreciate the importance of absolute strength on SS, imagine a rocket weighing 1,000 pounds, with an engine capable of 1,200 pounds of thrust. This rocket has only 200 pounds of reserve force to propel itself. The same rocket, when equipped with an engine rated at 3000 pounds of thrust, will have 2,000 pounds of reserve thrust that can be used for propulsion.

Now, returning to an example in the gym, a 200-pound man capable of squatting 250 pounds for a single repetition will have a mere 50 pounds of reserve strength available to propel his body upward during a vertical jump. Contrast this with a 200-pound elite-class powerlifter capable of squatting 600 pounds. That equates to 400 pounds of strength reserve available, and all things being equal, the elite lifter will have a vastly superior vertical jump compared to the novice squatter.

Speed-Strength Training Methods

Since SS comprises speed and strength, it becomes important to consider what can be done to improve these two qualities independently, since an improvement in either aspect will improve the whole.

Traditional Strength Training

Since speed is primarily a genetically-inherited characteristic of the nervous system, it responds poorly to training, as compared to strength, which is perhaps the easiest motor quality to improve (this is why there is not a "speed development" section in this book. Speed is best improved through technical training sessions). For this reason, and because safer methods should be considered before more risky ones, the starting point for all athletes who wish to improve their SS is traditional strength training. (The term "traditional" refers to common weight room exercises performed in a traditional bodybuilding manner using a variety of intensities and techniques).

Compensatory Acceleration Training (CAT)

CAT training is a distinct form of accelerative lifting coined by Dr. Fred Hatfield.[28] It refers to speeding up movement in such a way so that improved leverages are created. For example, when ascending out of a deep squat position, mechanical leverage begins to improve once past the "sticking point." This improving leverage reduces the tension on the working muscles, and in turn, the training stimulus is compromised. Deliberately accelerating through these movement paths increases muscular tensions. CAT technique takes time to master, because the acceleration must continue past the sticking point, yet end before the antagonist muscles are trig-

gered into decelerating the movement in an effort to prevent joint hyperextension or loss of control. This 'braking"action would be antagonistic to normal coordination patterns involved with common athletic skills such as hitting, throwing, jumping, and kicking.

Ballistic Training

William Kraemer, perhaps America's most respected and prolific strength researcher, uses the term "ballistic training" to describe movements that are ". . . accelerative, of high velocity, and with projection into free space."[29] Ballistic training involves plyometrics, modified Olympic lifting, jumping, throwing, and striking movements (such as punching or kicking a heavy bag).

Kraemer argues that, in traditional barbell training, a significant portion of the movement path (specifically, the end of the concentric phase) is spent decelerating the bar, a protective response assumed by the antagonists to maintain joint integrity (in upper body movements such as bench pressing), or to prevent the athlete from leaving the ground in exercises such as the squat. If Kraemer's contention is correct, one would choose to gradually reduce the volume of traditional barbell drills as the training cycle progresses, in favor of ballistic exercises which lack this deceleration phase, making them easier to learn and more coordination-specific for most athletes.

Plyometric Training

Although plyometrics are overused by many athletes in their quest for the "magic pill" solution to their training problems, plyometric drills can be a valuable component of a speed strength development program.

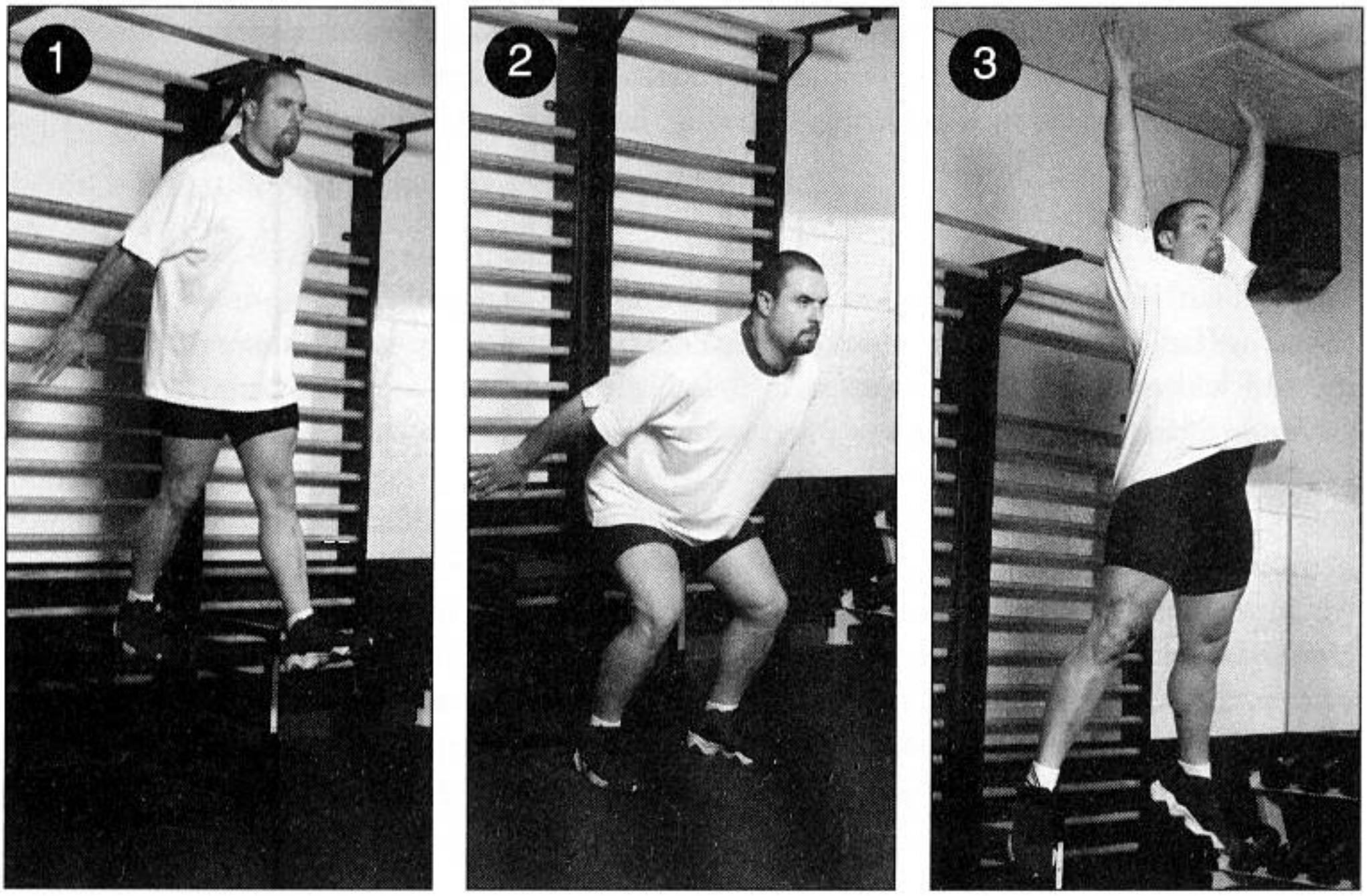
Plyometric workouts must be designed with sufficient recovery periods to ensure that fatigue does not take the "elasticity" out of the athlete's movements, since it is this repeated elastic neuromuscular control of impact which provides the training effect.

Depth Jumps

A thorough description of all available plyometric exercises is beyond the scope of this book. Instead, the performance of depth jumps, one of the most commonly used and researched plyometrics exercises, is described. For more information on plyometric training and exercises, please see the appropriate references at the end of this book.

Warm-up thoroughly by jogging, jumping rope, or something similar to produce a light sweat. Do not stretch unless a particular problem such as short muscle groups in the hamstrings, quads, or hip flexors are a concern.

Technique. From a standing position at the top of a raised platform (see discussion on how to select the ideal height below), extend the dominant-side foot forward to clear the platform, and then drop off of the platform (as opposed to jumping off). Hit the ground with both feet simultaneously, with both arms extended behind the torso. Upon immediate contact with the ground, reverse and propel upward, assisting with a vigorous upward swing of both arms in an attempt to attain the highest possible jump. Imagine landing on a hot stove and how that would mean immediately repelling off of the surface. However, do not attempt to land with straight knees in order to hasten the jump. Allow the knees to flex somewhat upon landing.



As for the proper height selection, choose a box-height that equals one's best vertical jump (if known). However, those who cannot prevent their heels from making contact with the ground should incrementally lower the height of the box until the jump can be performed completely from the forefeet.

Rest for two to three minutes between jumps (use a stopwatch). If on any given repetition the heels contact the ground, terminate the workout rather than lowering the box-height. Then, during the next workout, attempt to increase the number of repetitions using the same platform height without allowing the heels to contact the ground.

Medicine Ball Training

Another form of plyometric training involves the time-honored boxer's medicine ball which has undergone a resurgence of popularity lately. Medicine balls are no longer bulky, leather-covered objects! Today, numerous types and sizes are available, in a variety of weights, colors, and construction (please see resources section for product recommendations).

Medicine ball training offers the following advantages:

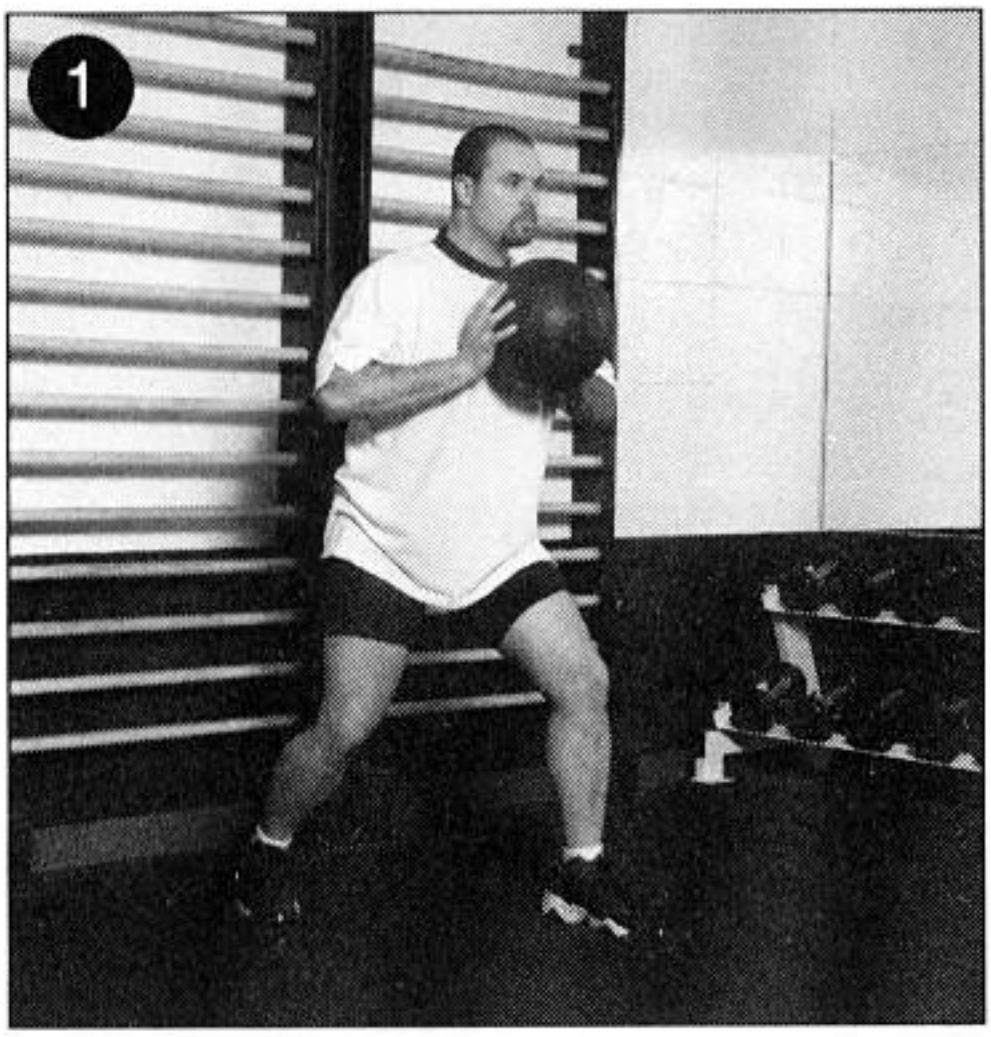
1) Medicine balls may be accelerated and projected into free space, which closely resembles the coordination and velocity patterns of martial arts skills.
2) Medicine balls can be used as a plyometric ally, utilizing the stretch-shortening cycle, as described earlier.
3) Medicine balls are superior tools for strengthening the stabilizers, particularly the abdominals. Training on weight machines (and even barbells) restricts the user to only one plane of movement, which limits stabilizer activity. But medicine balls allow multi-plane movements, which heavily recruit the stabilizers.
4) Medicine balls may be used to help students learn how to absorb and reflect impact (by dropping the ball onto the abdominal region, for example).

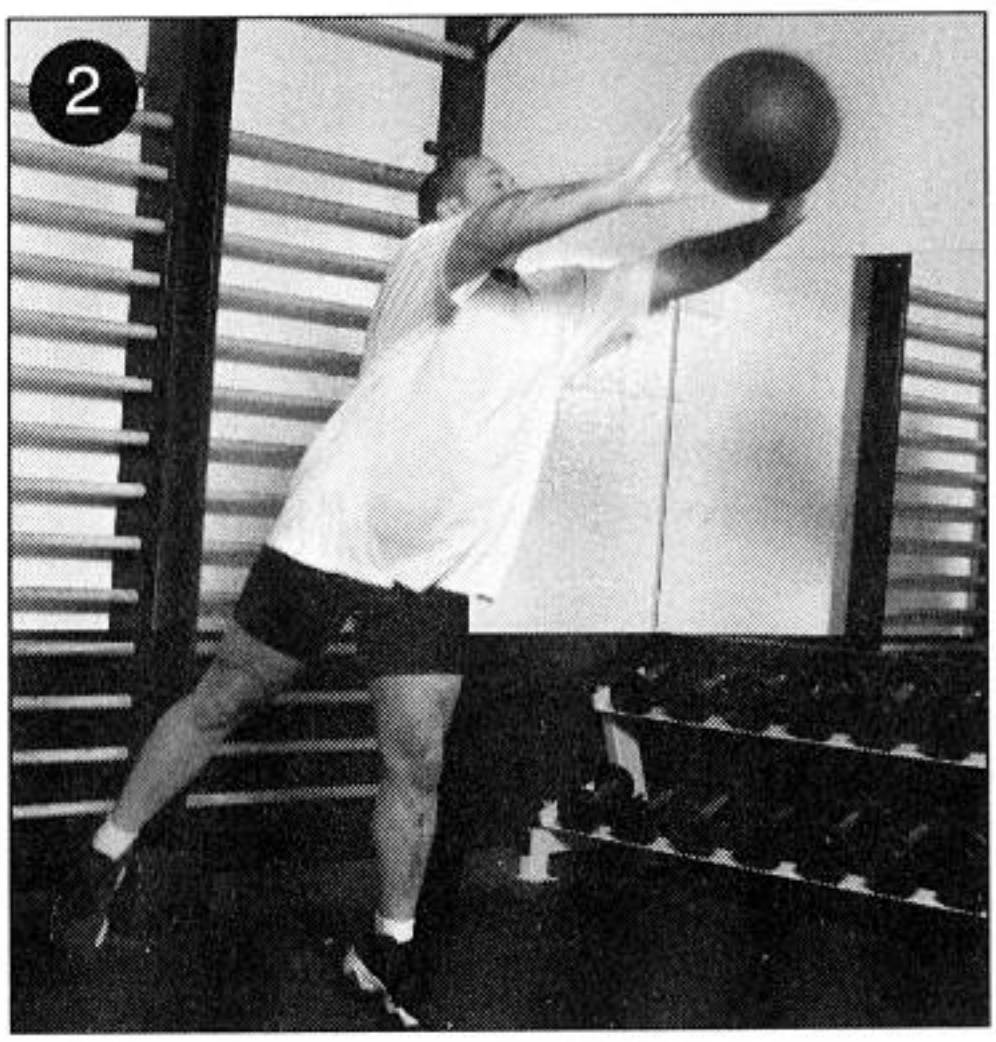
5) Larger medicine balls can be used as striking targets.
6) Many medicine ball drills can be used by two people simultaneously, which make them time and cost-efficient in school settings. One example is to line up twelve people in two lines, with one ball per pair. The pair stands back to back and pass and receive the ball by twisting at the waist (see "two-man side twists" in exercise descriptions below). This can be used during the warm up period as a more functional alternative to the traditional jumping jack.
7) Medicine balls are small and safe, as compared to weight machines or barbells.

Here are some considerations in choosing a particular medicine ball:

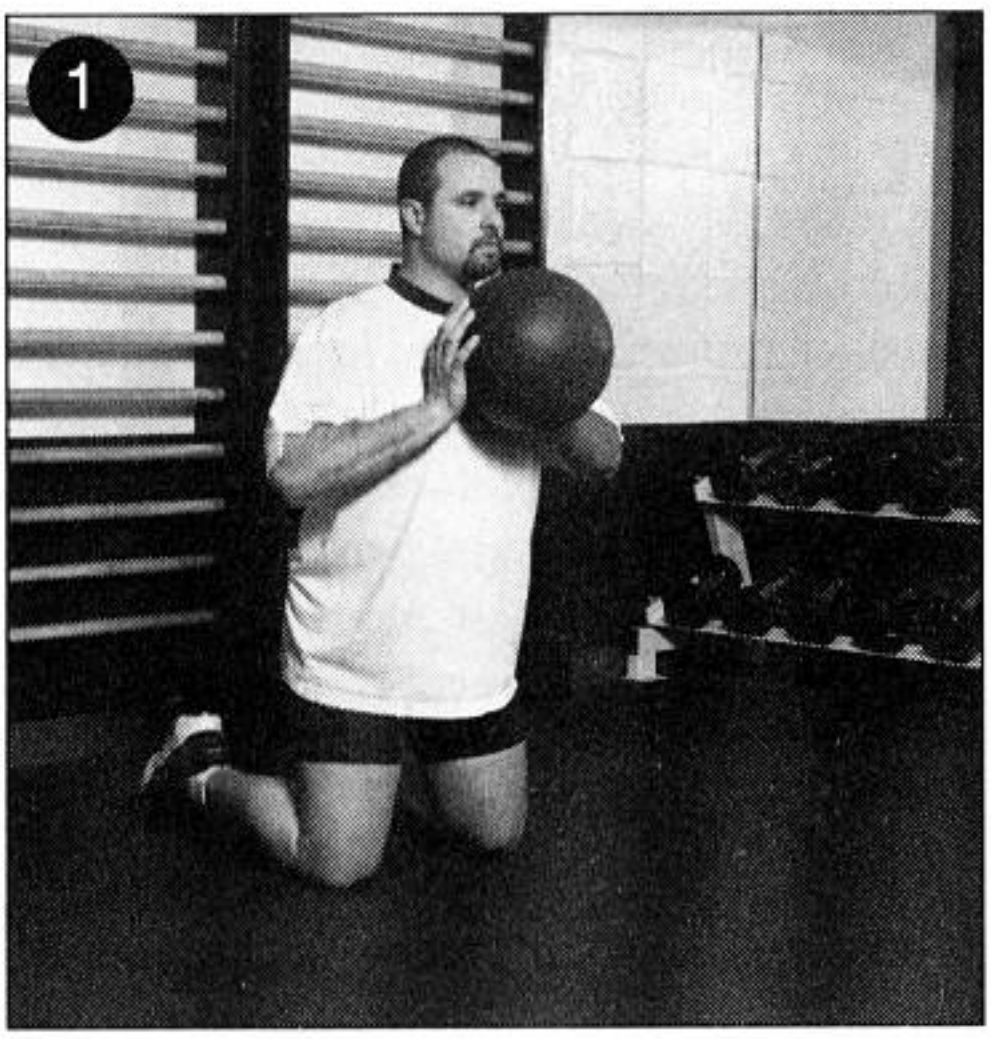
1) The densities of various medicine balls can vary. A six-pound ball may be as small as seven inches in diameter, or as large as fourteen. Larger balls are easier to catch, and are less likely to jam fingers.
2) Medicine balls can be gel-filled (which bounce) or filled with lead shot or some other type of material (which does not allow the ball to bounce). Balls that bounce are useful for solo training (i.e., bounce against the wall after a throw in the absence of a partner), but in a school setting, they may become a safety problem.
3) Some medicine balls have a smooth, plastic-like surface while others have a textured surface. Select a ball with a textured surface, as the non-textured balls are very slick when used with sweaty hands.
4) Some medicine balls have handles, which allow for a better grip and a wider variety of exercises. One version has a detachable rope which runs through the center of the ball, allowing the ball to be used with or without the handle.
5) When deciding upon what weight to choose, opt for a lighter ball when in doubt. Nine pounds might not seem like much, but during many drills, it feels like a ton! Also consider who will be using the ball. Instructors should buy lighter balls (three to six pounds) which can be used by all students. Later, consider purchasing a few heavier balls for larger, more advanced students.

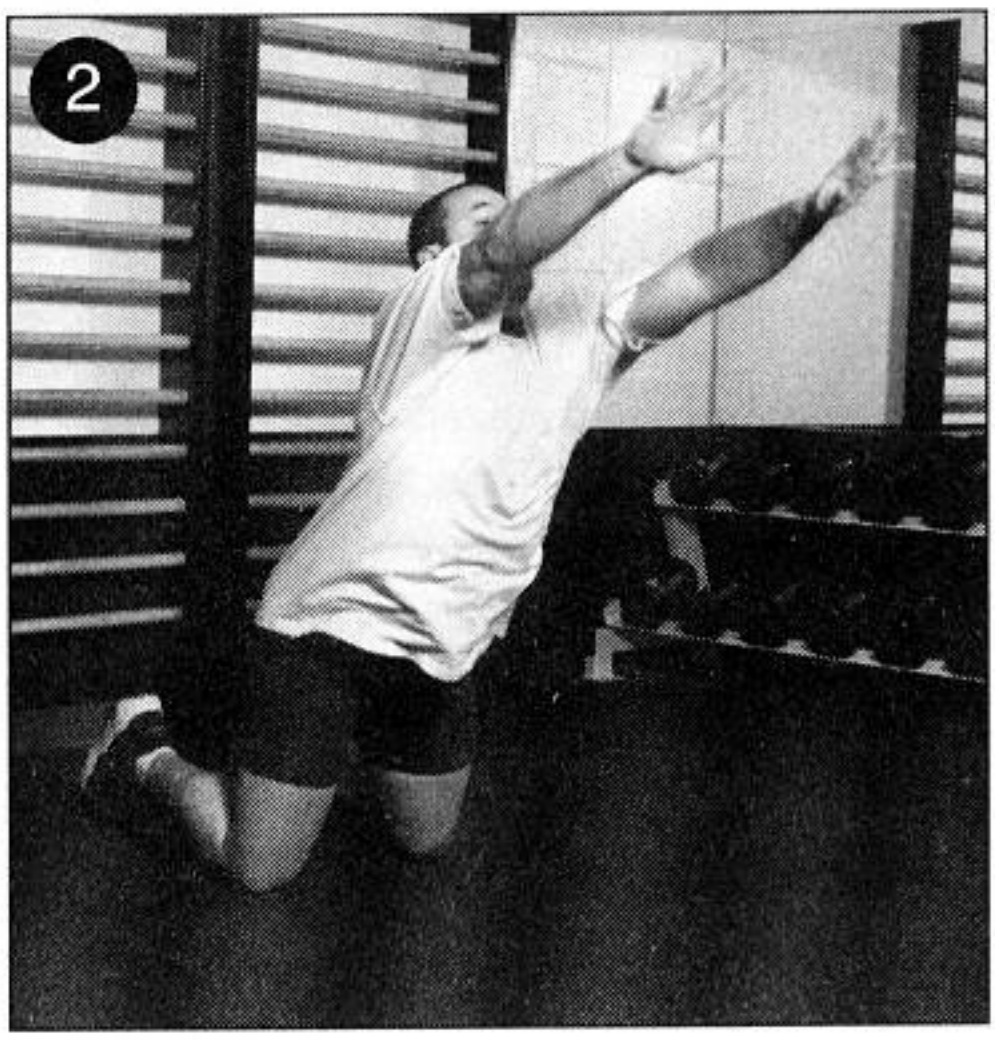
There are a half-dozen ballistic and/or accelerative exercises to perform with the medicine ball. Obviously, many other variants are possible, so use these examples as a template for further exploration and experimentation. (For an exhaustive collection of medicine ball exercises, please refer to Paul Chek's videotapes on the subject in the references section).



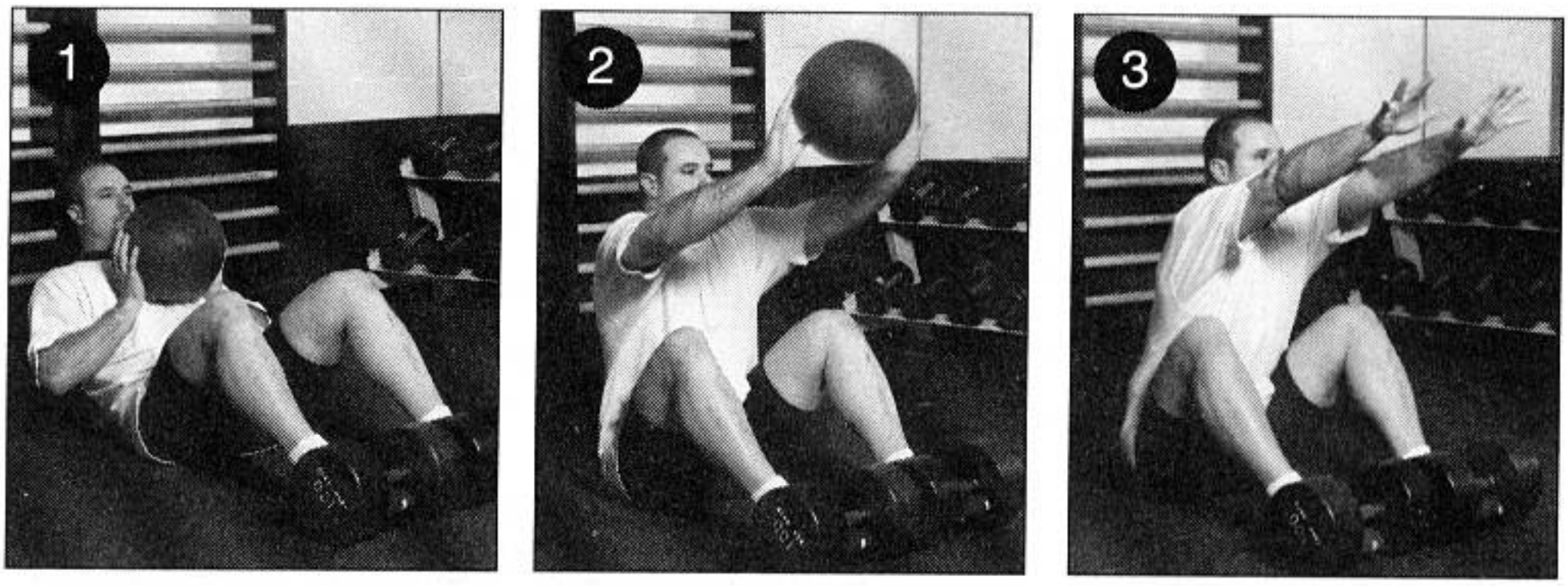


Chest Pass or Throw. This is one of the best speed strength exercises for the chest, shoulders, and arms. From a fighting stance, bring the ball close to the chest, then rapidly fire it forwards, or up and forwards. Fire the ball from flexed knees, and then explosively extend them during the throw. Repeat for the desired number of repetitions.

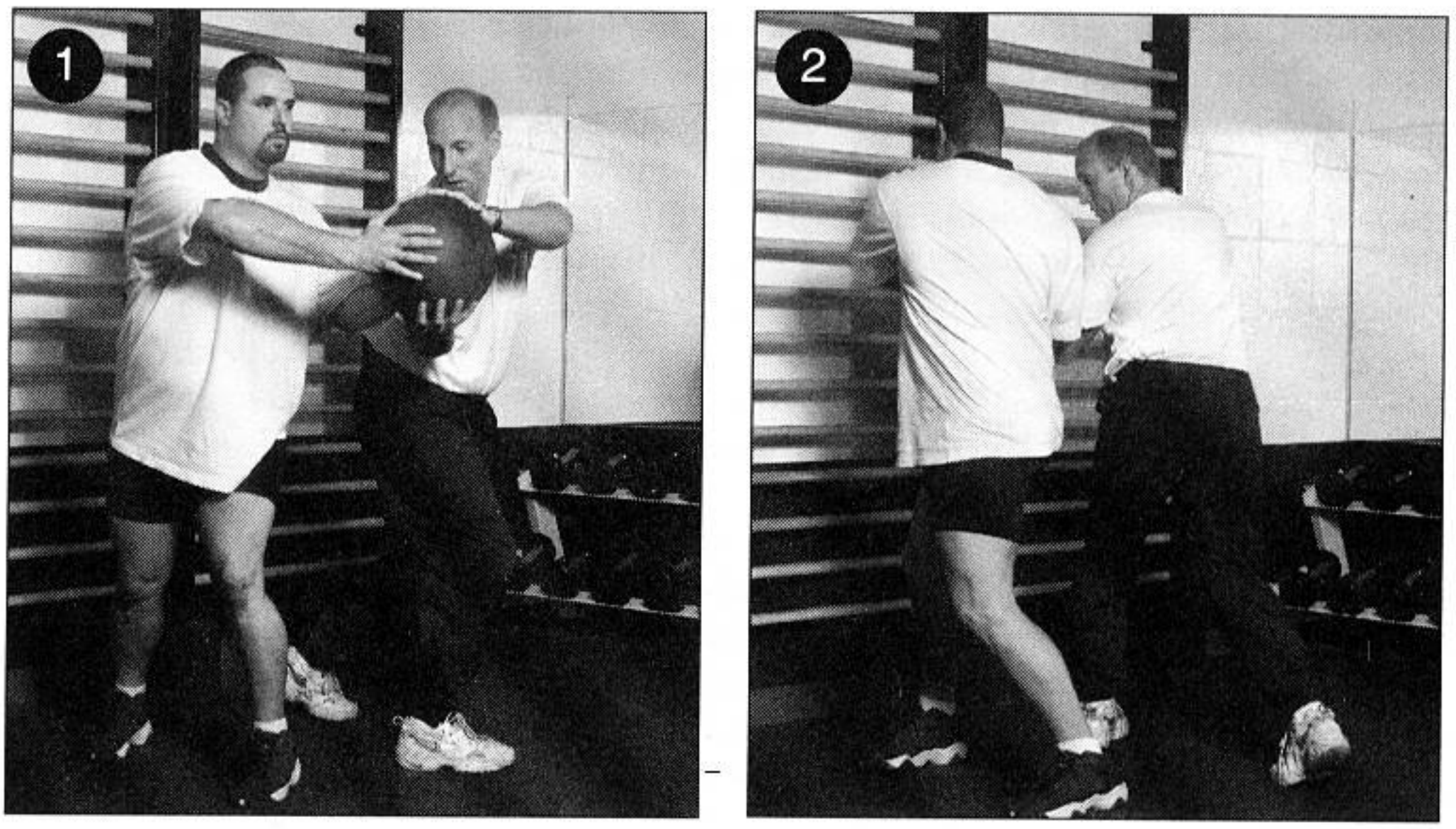




Kneeling Chest Pass or Throw. Throw the ball, then follow through with the whole body, catching oneself with the hands. Repeat for the desired number of repetitions. This develops strength throughout the entire upper body.

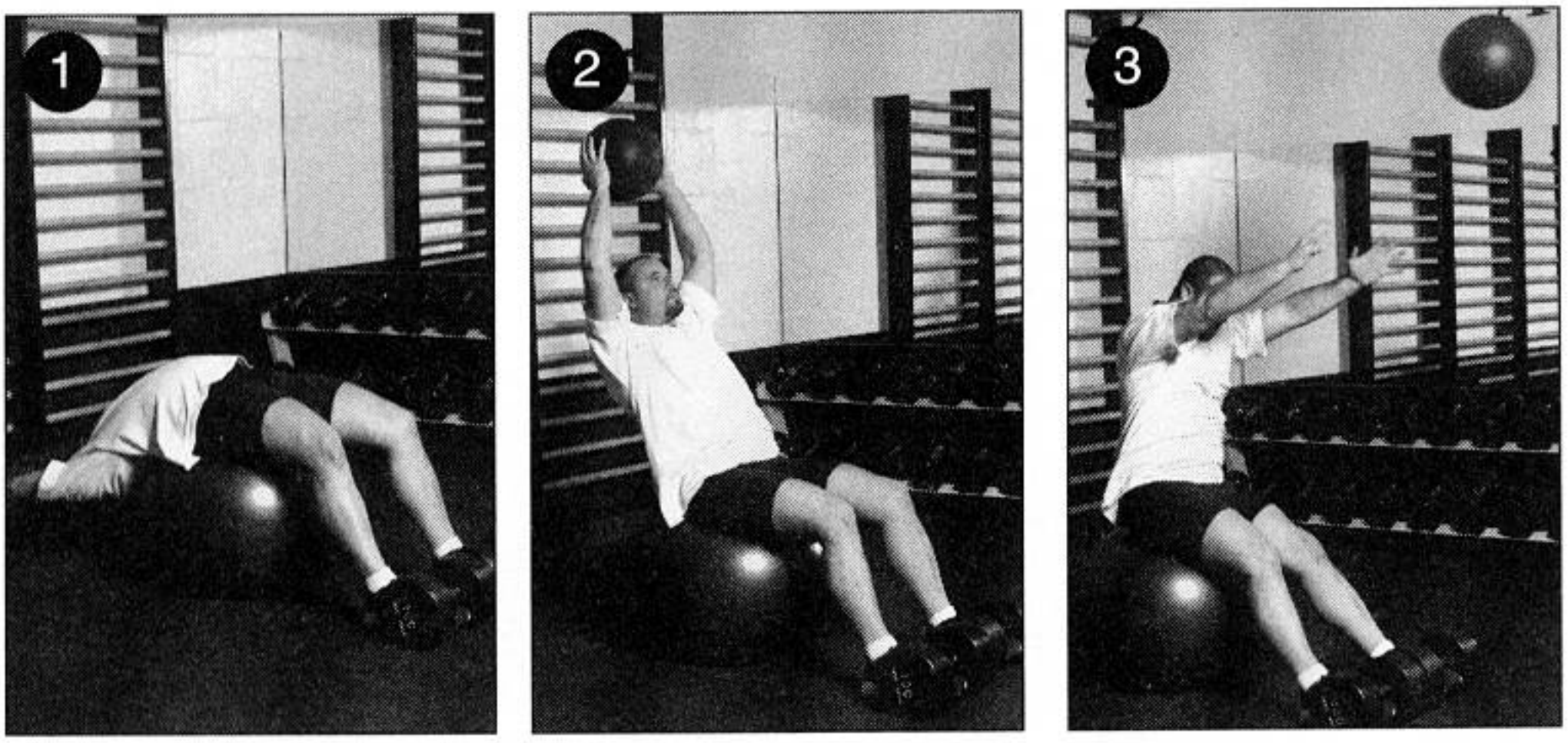


Plyometric Sit-Ups. Performed either bent or straight legged, this is an excellent drill for the hip flexors and abdominals. Return the ball explosively back to the partner, and repeat for the desired number of repetitions.



Two-Man Side Twists. This develops strength and flexibility in the hips and mid-section. Stand back to back with a partner and pass the ball between one another in a circular fashion. After the desired number of "repetitions," reverse direction.

Russian Twist and Throw *(not illustrated).* This is simply a plyometric version of the Russian twist described in the abdominal training section later in this chapter. It is an excellent speed-strength training method for the entire mid-section.



Swiss Ball Sit-Up/Medicine Ball Throw. Sit on a ball in the same position used to perform crunches. With feet anchored under heavy dumbbells, a partner passes a light (four to six-pound) medicine ball to the athlete (the ball will be passed high so that the athlete must reach up overhead to catch the medicine ball). The athlete catches and allows himself to lower eccentrically until he can touch the medicine ball to the floor behind his head. He then performs the concentric phase of the sit-up, passing the ball back to his partner.

Modified Olympic Lifts

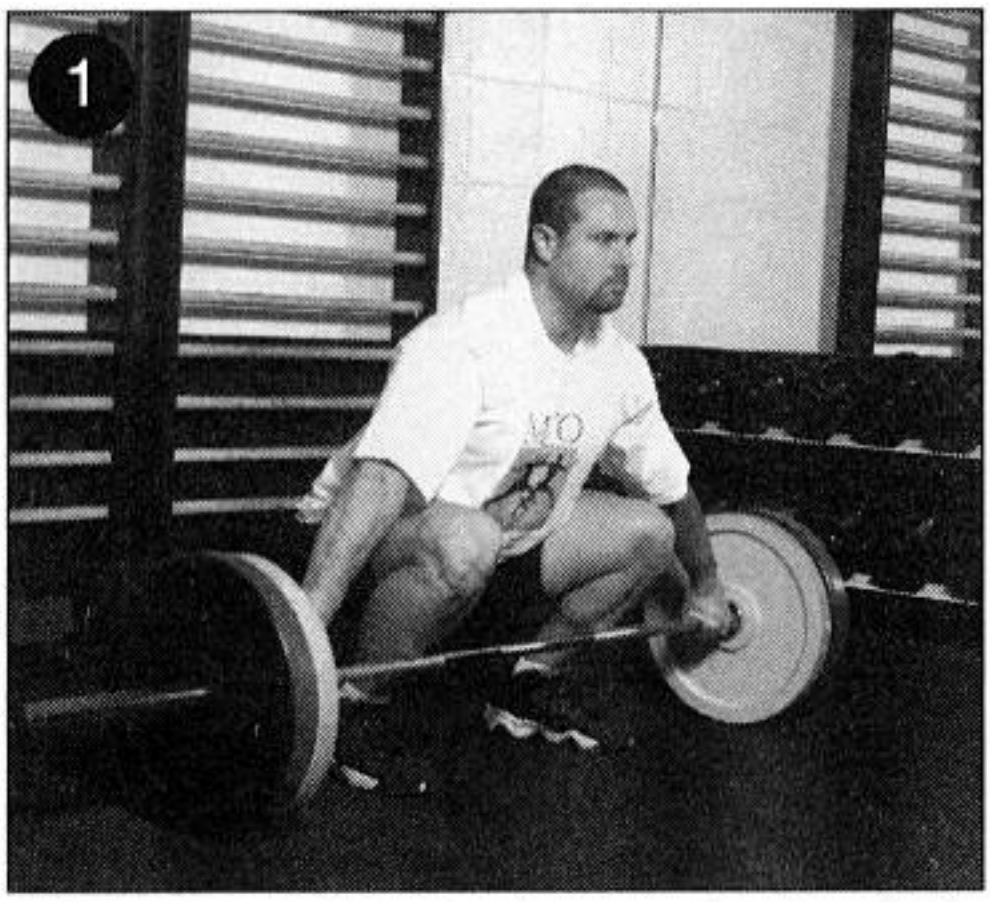
The sport of Olympic weightlifting contests features two separate lifts. The first is the snatch, where the barbell is grasped with a wide grip, and explosively pulled to an overhead position in a single movement. The second is the clean and jerk, where the barbell is grasped with a narrower grip, "cleaned" to the shoulders, and finally "jerked" to an overhead position.

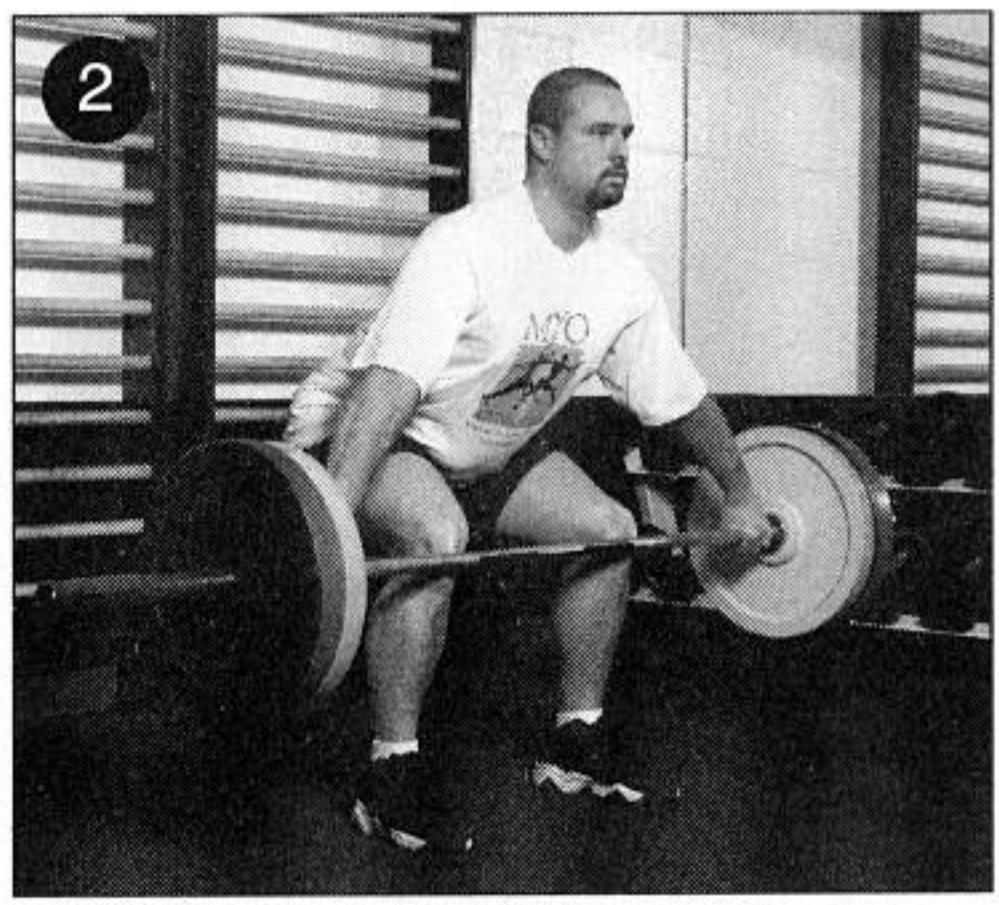
Competitive Olympic lifting requires competitors to assume very deep squat positions as they struggle to "jump" under big weights prior to achieving the overhead position. But when slightly lighter weights are used, the lifter can manage to get under the weight without going "below parallel," meaning that the top of the thighs never goes past the point of being parallel to the floor. When a lifter can accomplish this, the lift is called a power clean (or power snatch). The term "power" indicates that the load was not maximal, since the lifter didn't have to squat to "rock bottom" to get under it. Thus, a power clean has less of a force component and more of a speed component than a competitive "squat clean."

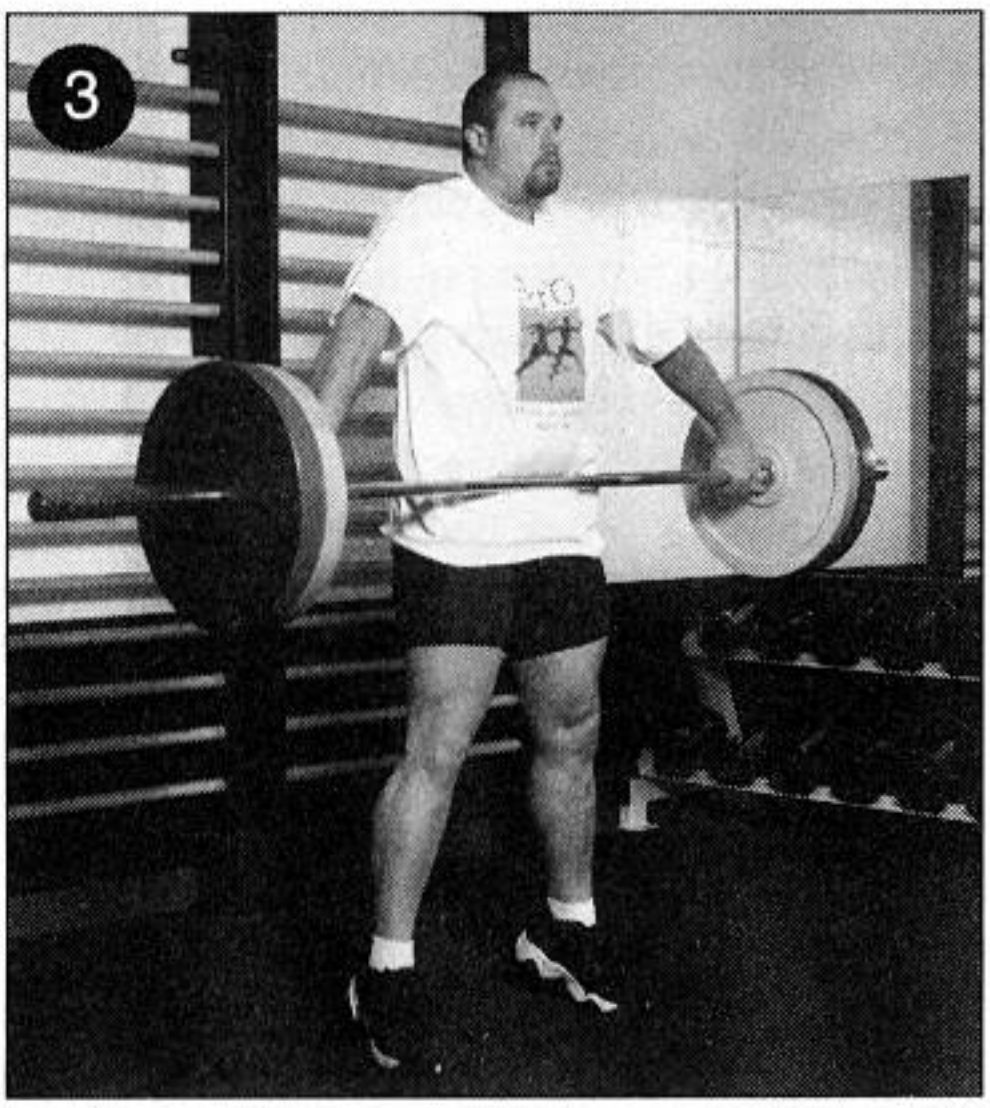
Arthur Dreshler, MSS, author of *The Weightlifting Encyclopedia,* eloquently describes the benefits of Olympic lifting and its derivatives for athletes.

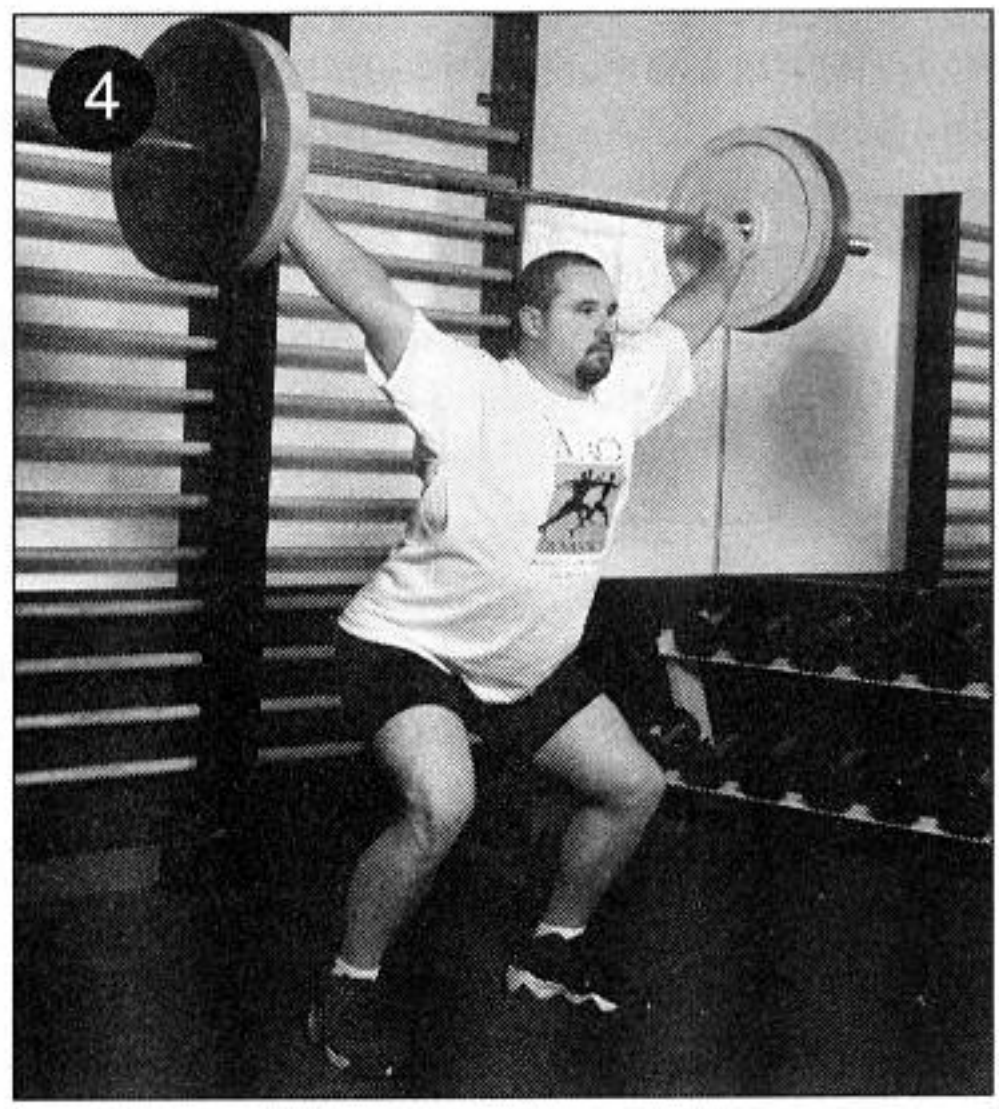
1) Olympic lifts teach an athlete how to explode (to activate a maximum number of motor units rapidly and simultaneously).
2) Olympic lifts teach the ability to apply force with muscle groups in the proper sequence (i.e., from the center of the body to the extremities). This is a valuable technical lesson for any athlete who needs to impart force to another person or object.
3) Olympic lifts teach how to accelerate objects (including other people) under varying degrees of resistance.
4) Olympic lifts teach how to effectively receive forces from another moving body.
5) The actual movements performed while executing the Olympic lifts are among the most common and fundamental in sport.
6) The Olympic lifts are commonly used to measure an athlete's force output capabilities.[30]

Although the following photos and captions introduce the modified Olympic lifts, readers should consult either an ISSA-certified Specialist in Sports Conditioning, or a USA Weightlifting certified coach to assist with these exercises. (Please see the resources section for ISSA and USAW contact information). These lifts, though not beyond the capabilities of most athletes, are more complex than the majority of strength training exercises.









Power Snatch. With the bar on the platform, stand over the barbell, look down and line the bar over the balls of the feet. The feet should be hip-width or slightly wider apart. Assume the starting position by bending the knees and lowering the hips while gripping the barbell with a wide grip.

The grip should be wide enough to allow a semi-squat with the bar at arms length overhead. In the starting position, the shoulders should be over the bar and the back should be arched tightly.

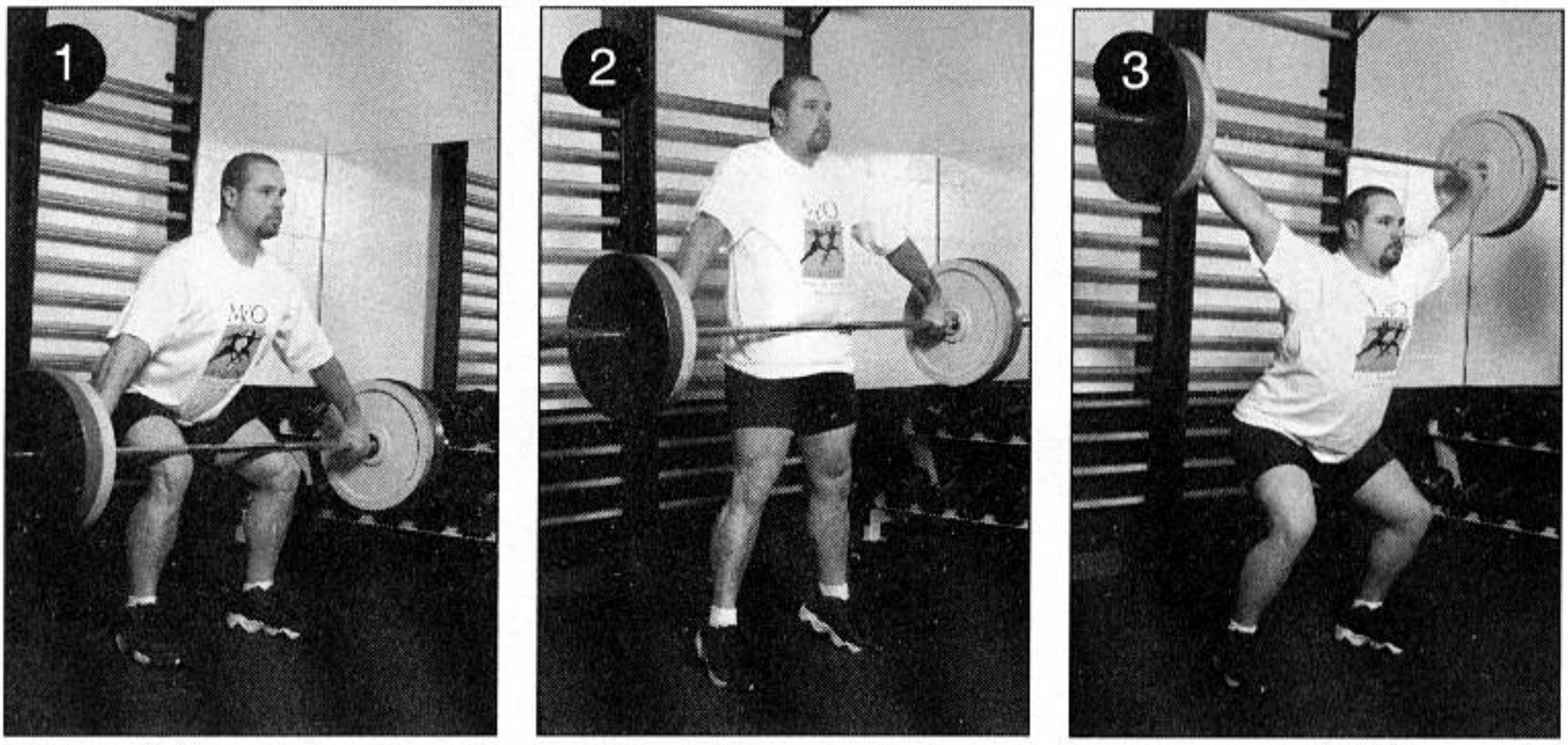
To start the pull, imagine pushing one's feet though the floor. As the barbell reaches knee height, the back stays arched and maintains the same angle to the floor as in the starting position.

When the barbell passes the knees, vigorously shrug the shoulders, keeping the bar as close to the legs as possible.

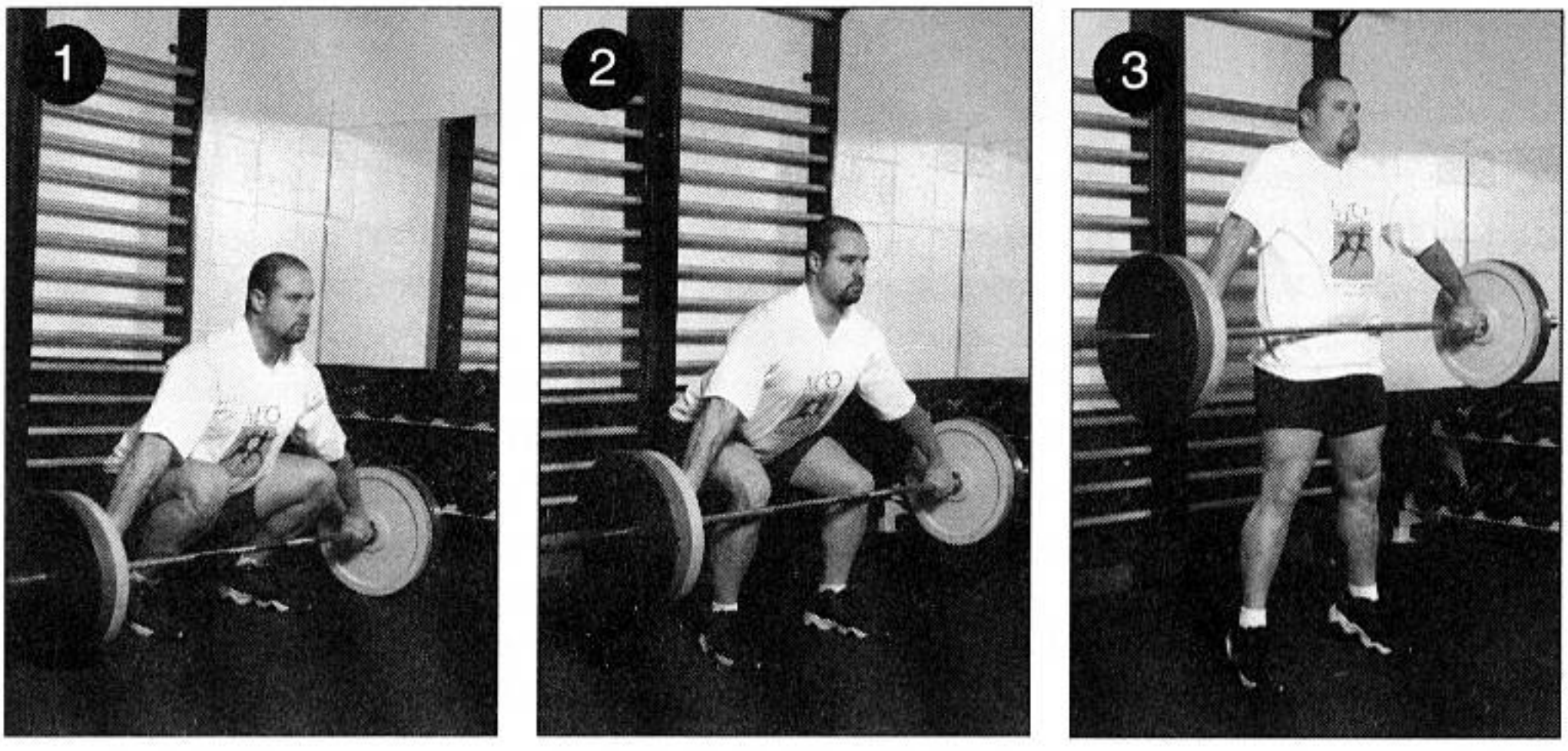
When the bar passes the upper thighs it should touch the thighs. At this point, drive with the legs in a vertical jumping motion and finish the full extension of the body.

Once the body is fully extended, shrug the shoulders and start pulling with the arms, still

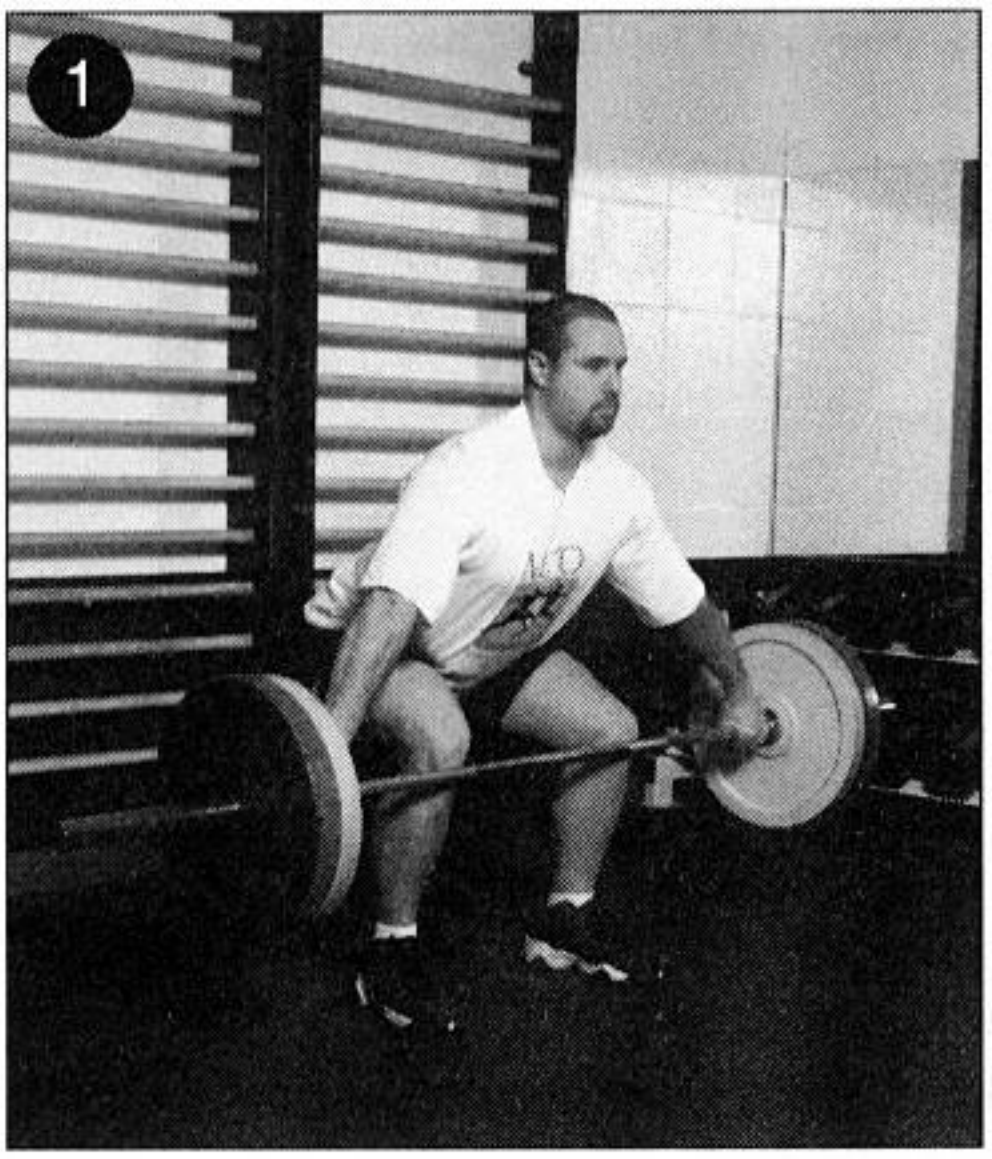
keeping the barbell close to the body. (This is accomplished by lifting the elbows out to the side, keeping them over the bar as long as possible.) From this position, aggressively pull one's body under the bar. Catch the bar at arms length overhead while jumping into the semi-squat position. As soon as the barbell is fixed on locked-out arms in the semi-squat position, complete the lift by returning to a standing position.

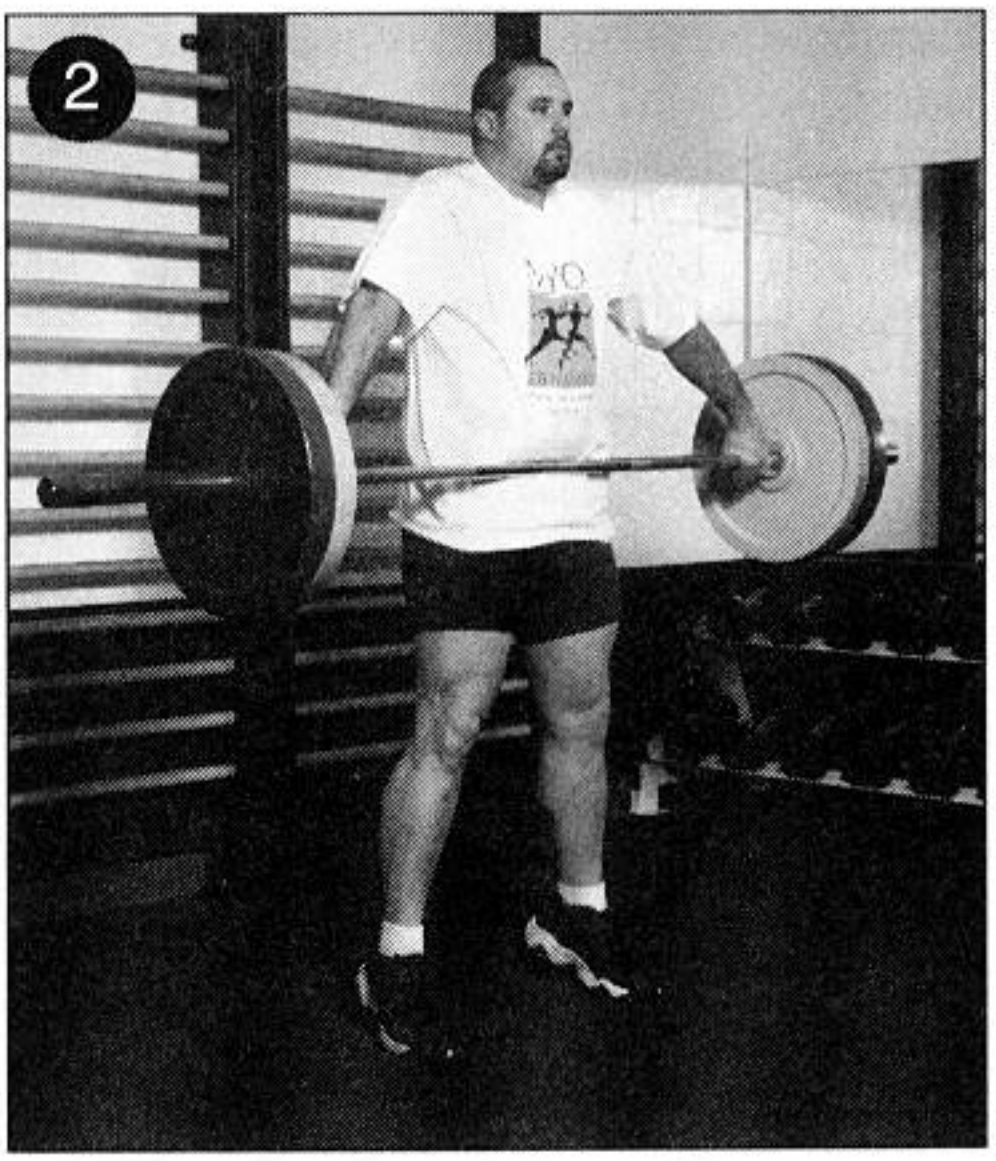


Power Snatch from "Hang" Position. The hang position simply means that the lift is not initiated from the floor, but from a standing position while holding the bar with arms straight. In this technique, dip by flexing at the knees and hips and then reverse motion, exploding upward and aggressively pull one's body under the bar. This motion biomechanically resembles a vertical jump.

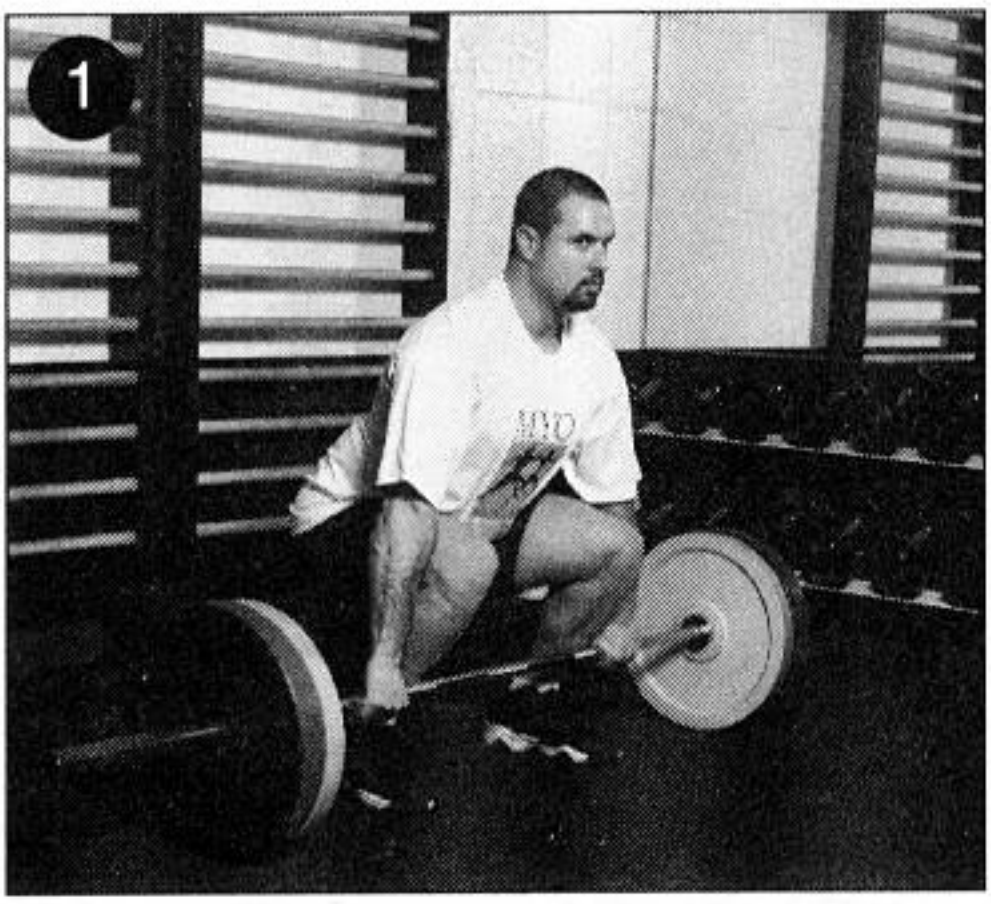


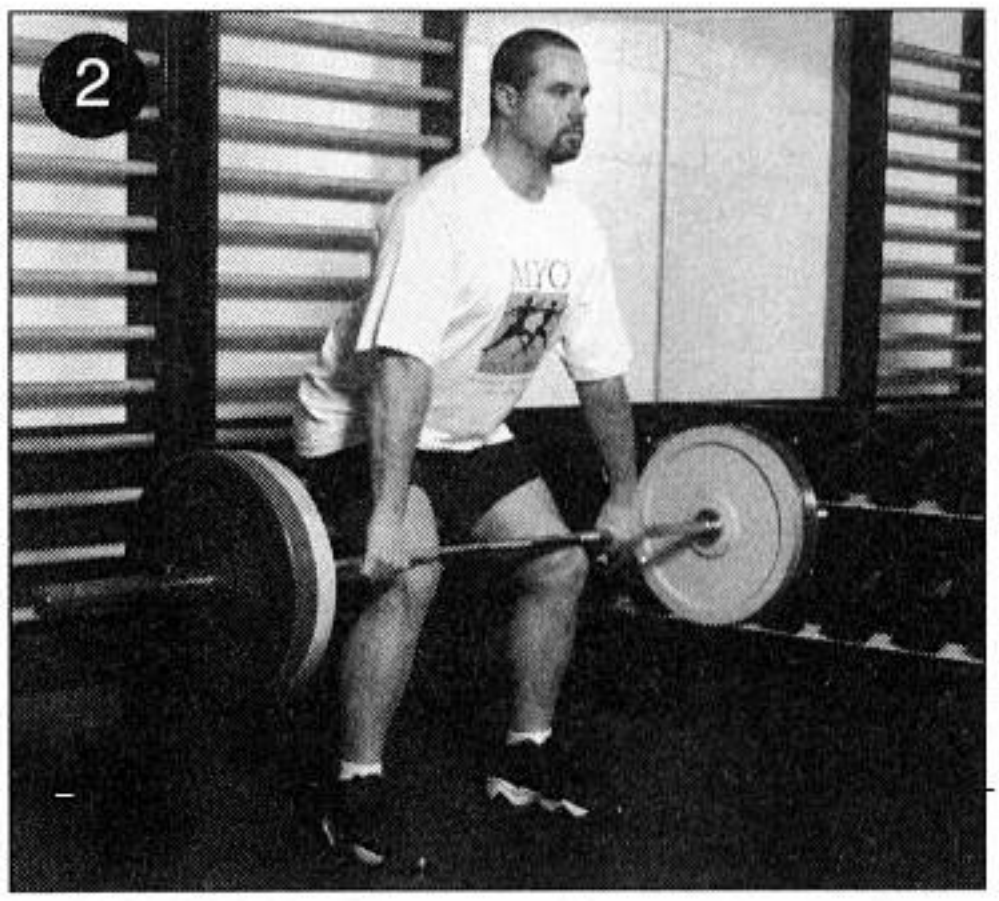
Snatch Pull. The snatch pull is identical to the power snatch previously described except that the pull commences at the top of the shrug, rather than continuing upward to catch the bar at arms' length. This greatly simplifies the lift, while maintaining the majority of its benefits. When first learning the power snatch, a good place to start is the snatch pull.

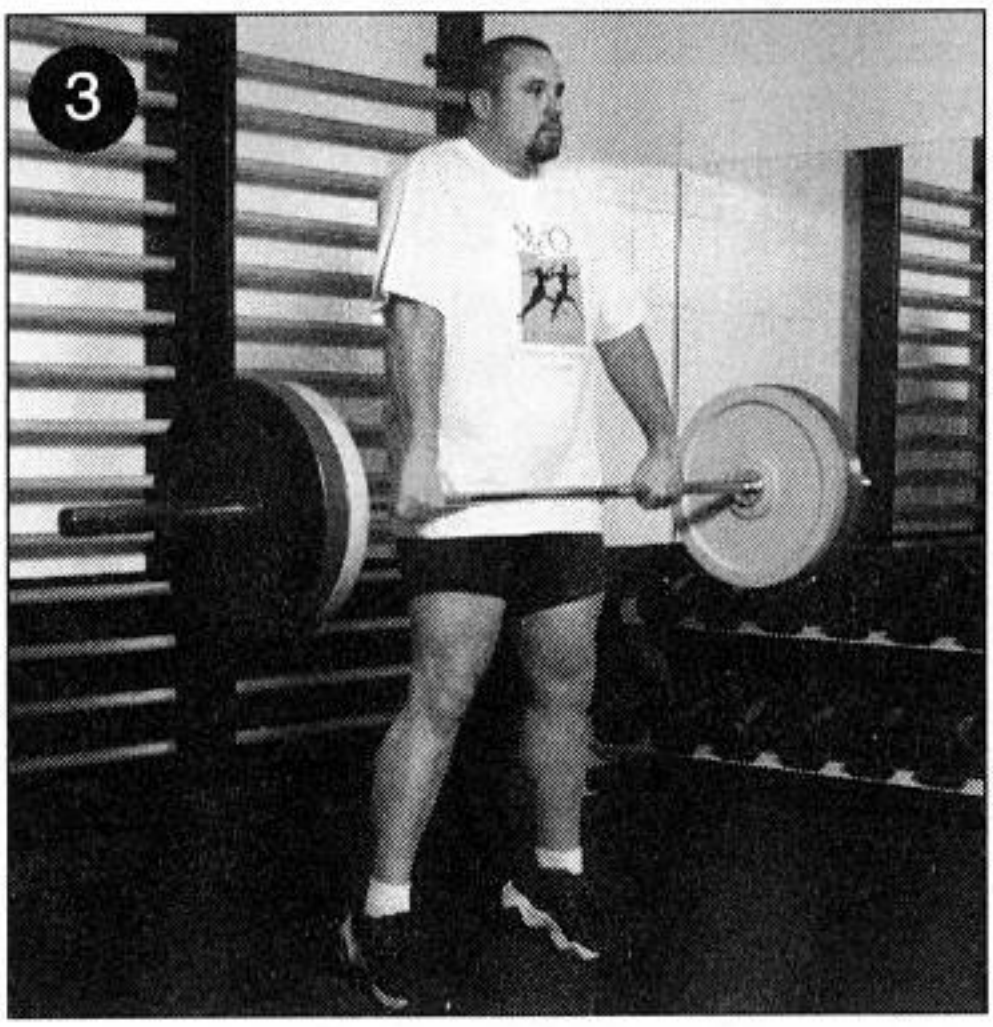


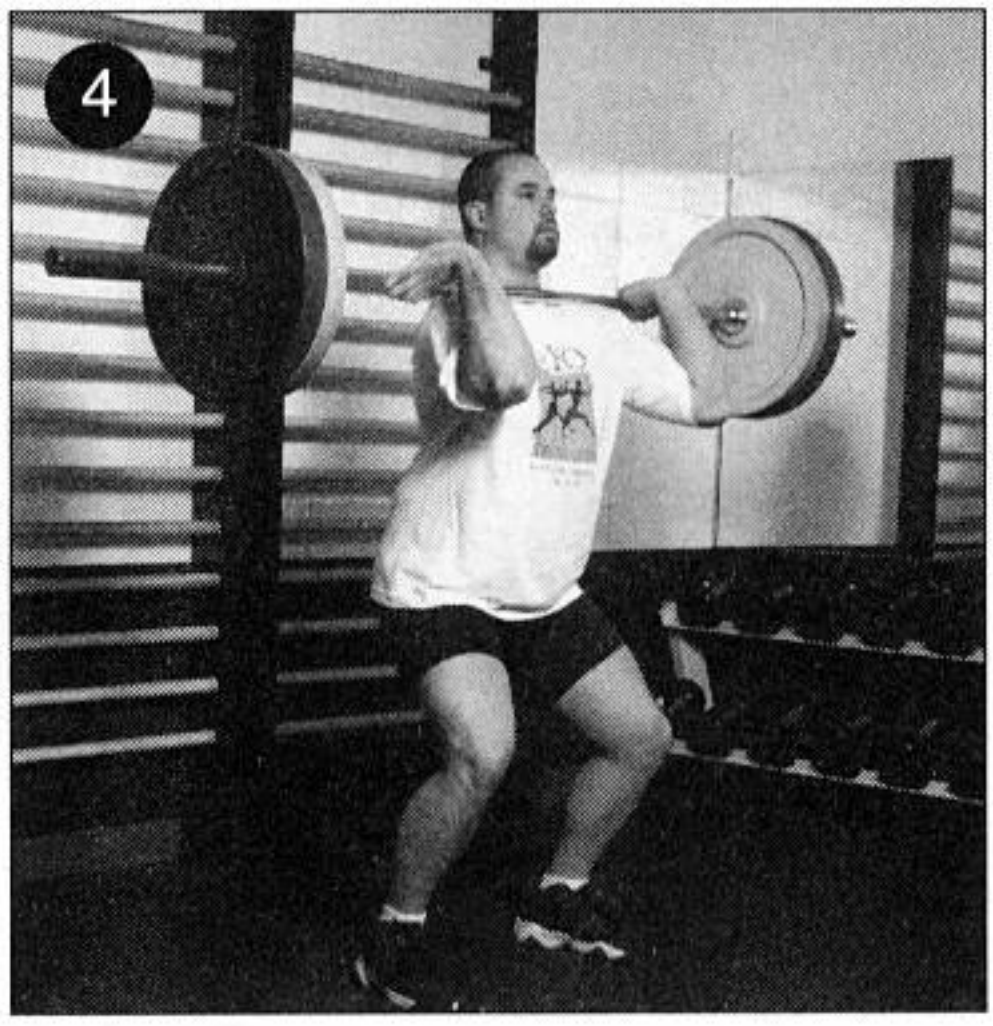


Snatch Pull from "Hang" Position. This is a snatch pull performed from the hang position rather than from the floor. The start and "rack" positions are shown.







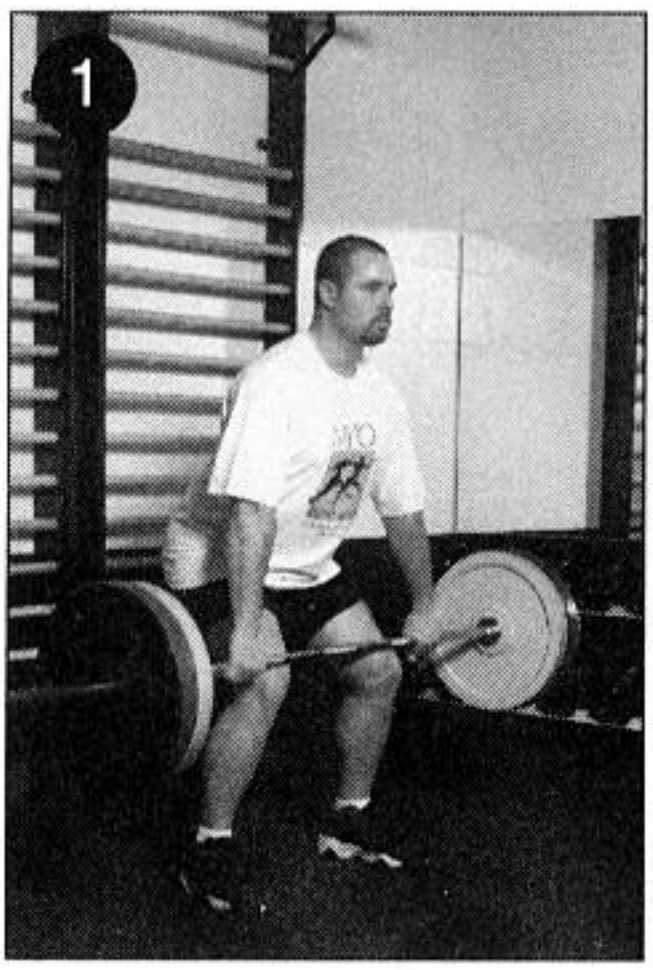


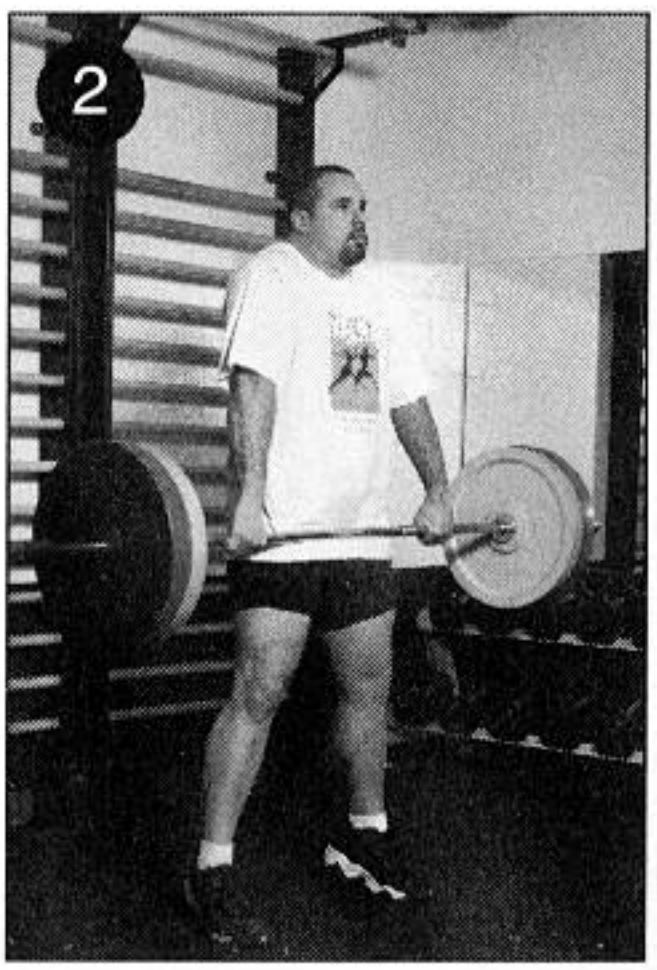
Power Clean. The clean, like the snatch, start off with the athlete standing over the barbell looking down, and position the balls of the feet under the bar. The feet will be slightly wider apart than hip-width. The lifter assumes the starting position by bending the knees, lowering the hips while gripping the bar with a slightly wider than a shoulder-width grip. In the starting position the shoulders will be over the bar and the back should be arched tightly.

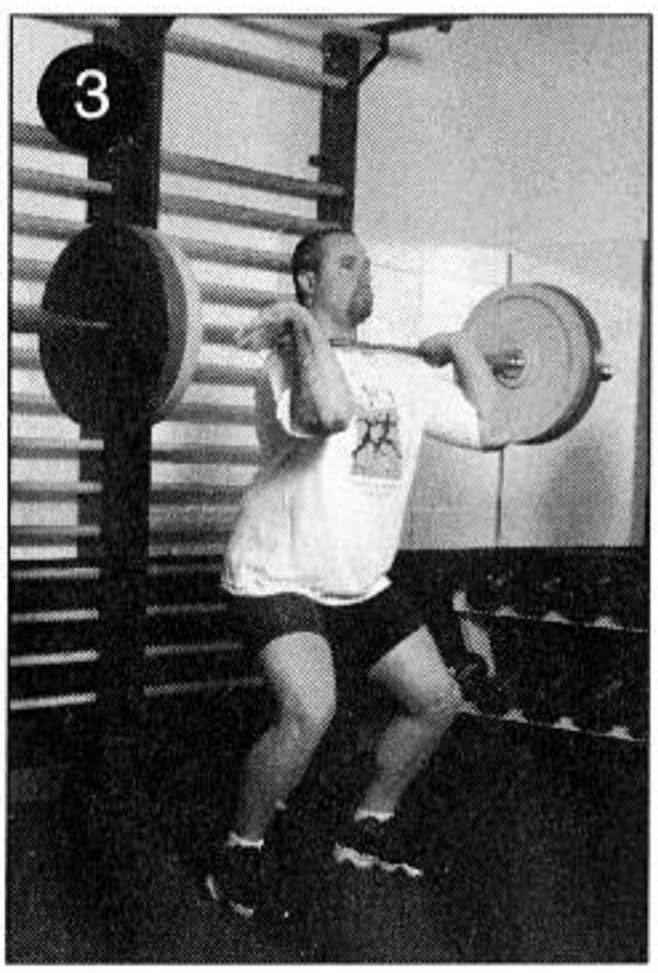
The pull is initiated by the mental picture of "pushing the feet through the floor." As the bar reaches the knees, vigorously raise the shoulders while keeping the barbell close to the thighs.

When the barbell passes mid-thigh, it will touch the thighs (because of the closer grip, it will touch lower on the thighs than in the snatch). When the bar touches the thighs the lifter will drive with the legs to do an attempted vertical jump (don't leave the ground, of course) and finish by extending the body.

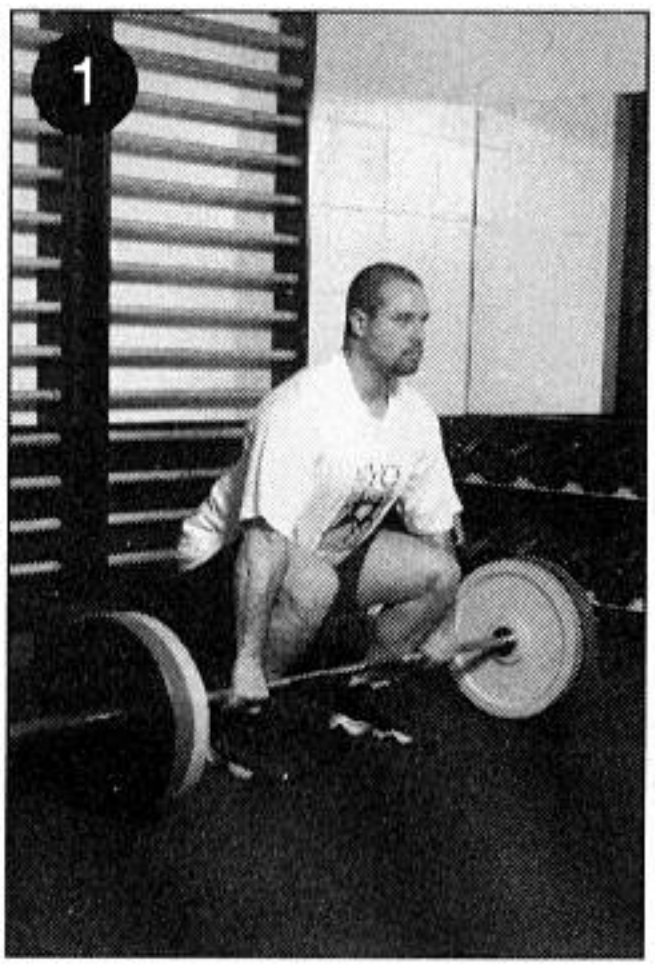
When the body is fully extended, shrug the shoulders and begin pulling with the arms. When pulling with the arms, the elbows will go out to the sides (this helps keep the bar close to the body). At this point, aggressively pull one's body "under the bar," rotating the elbows around the bar and receiving the bar on the shoulders while moving into the semi-squat position. The lift is completed by returning to a standing position.

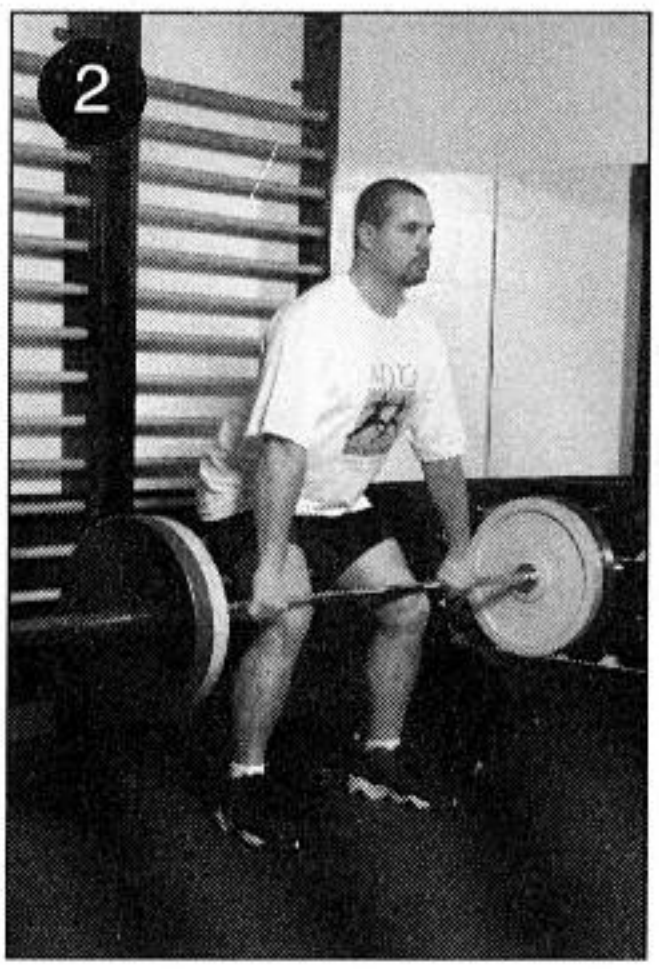


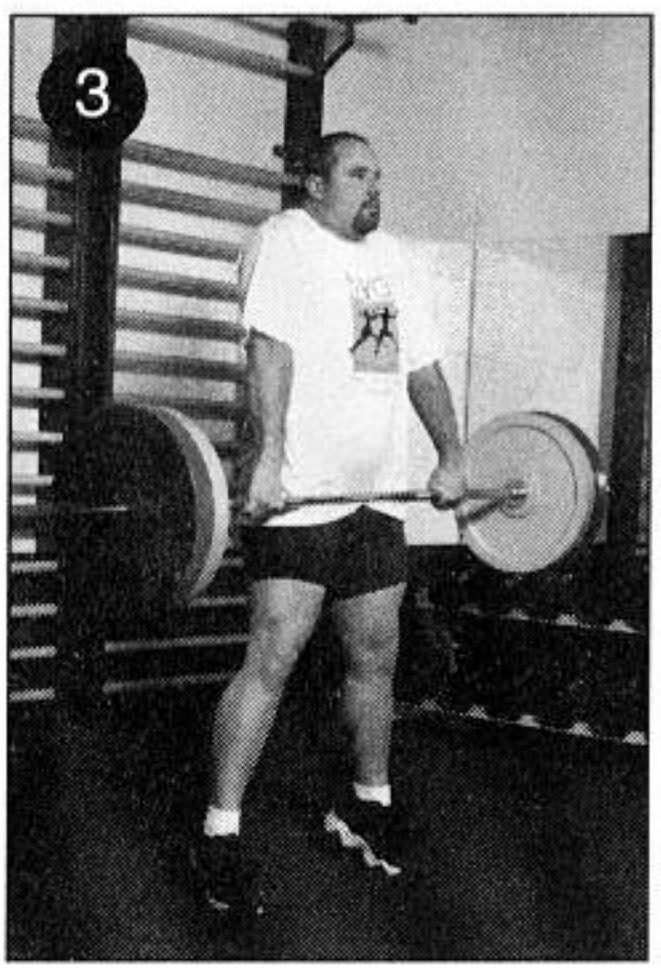




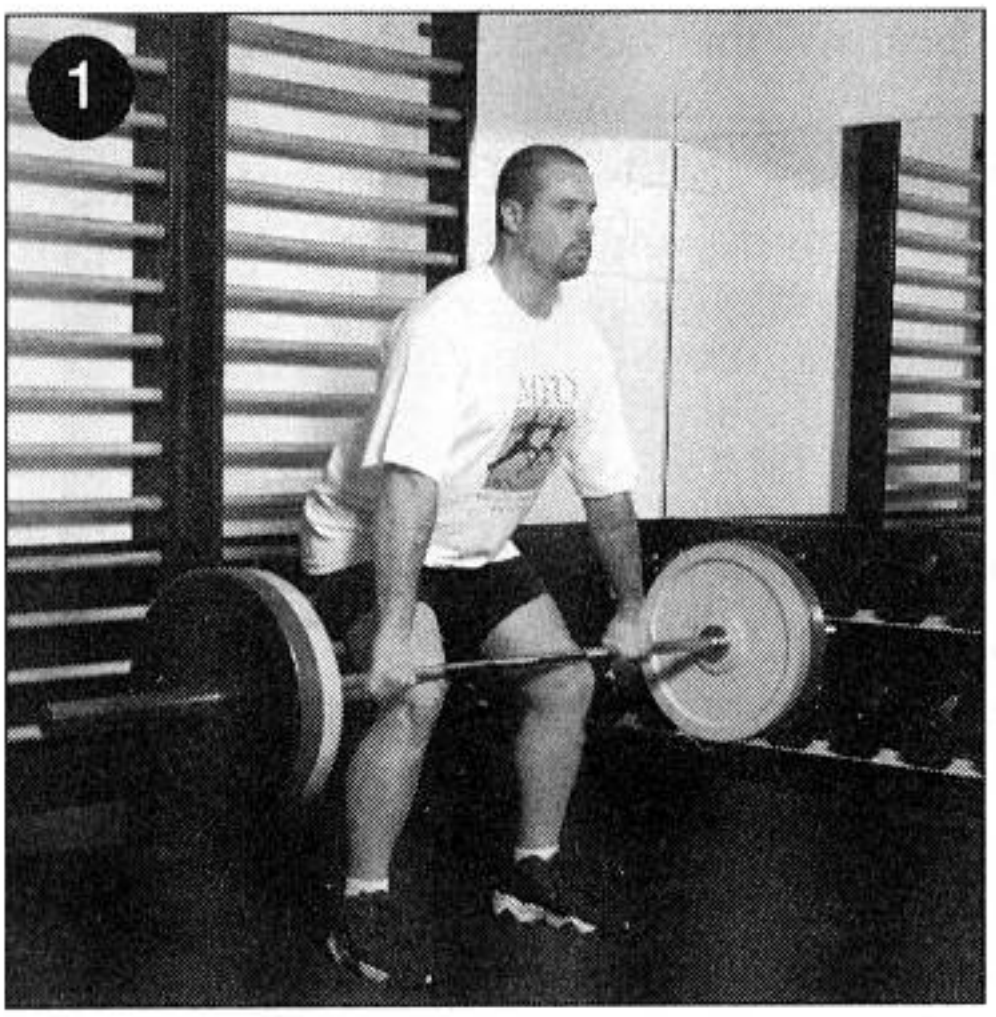
Power Clean from "Hang" Position. The hang position simply means that the lift is not initiated from the floor but from a standing position while holding the bar with arms straight. Following the same general guidelines presented above, dip by flexing at the knees and hips, and then reverse motion, exploding upward and then aggressively pulling the body under the bar, racking it on the shoulders. This motion biomechanically resembles a vertical jump.

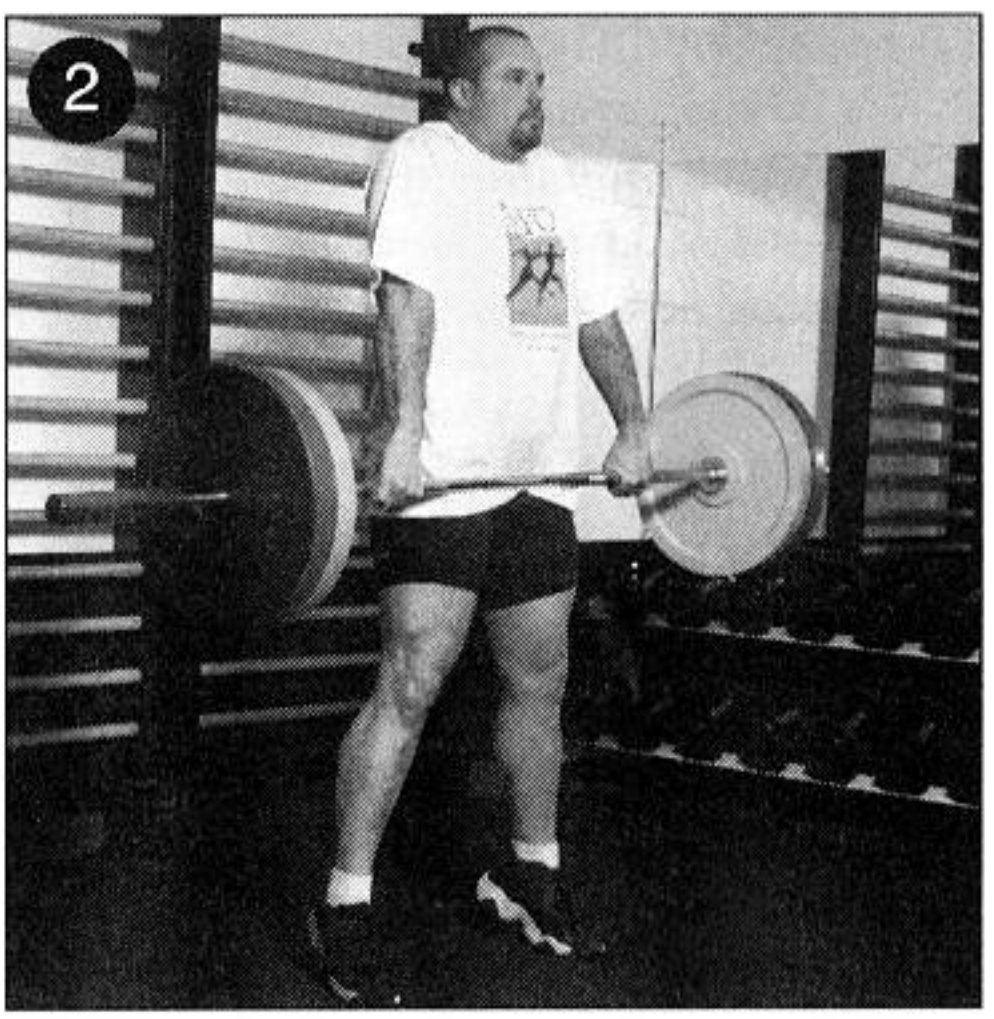




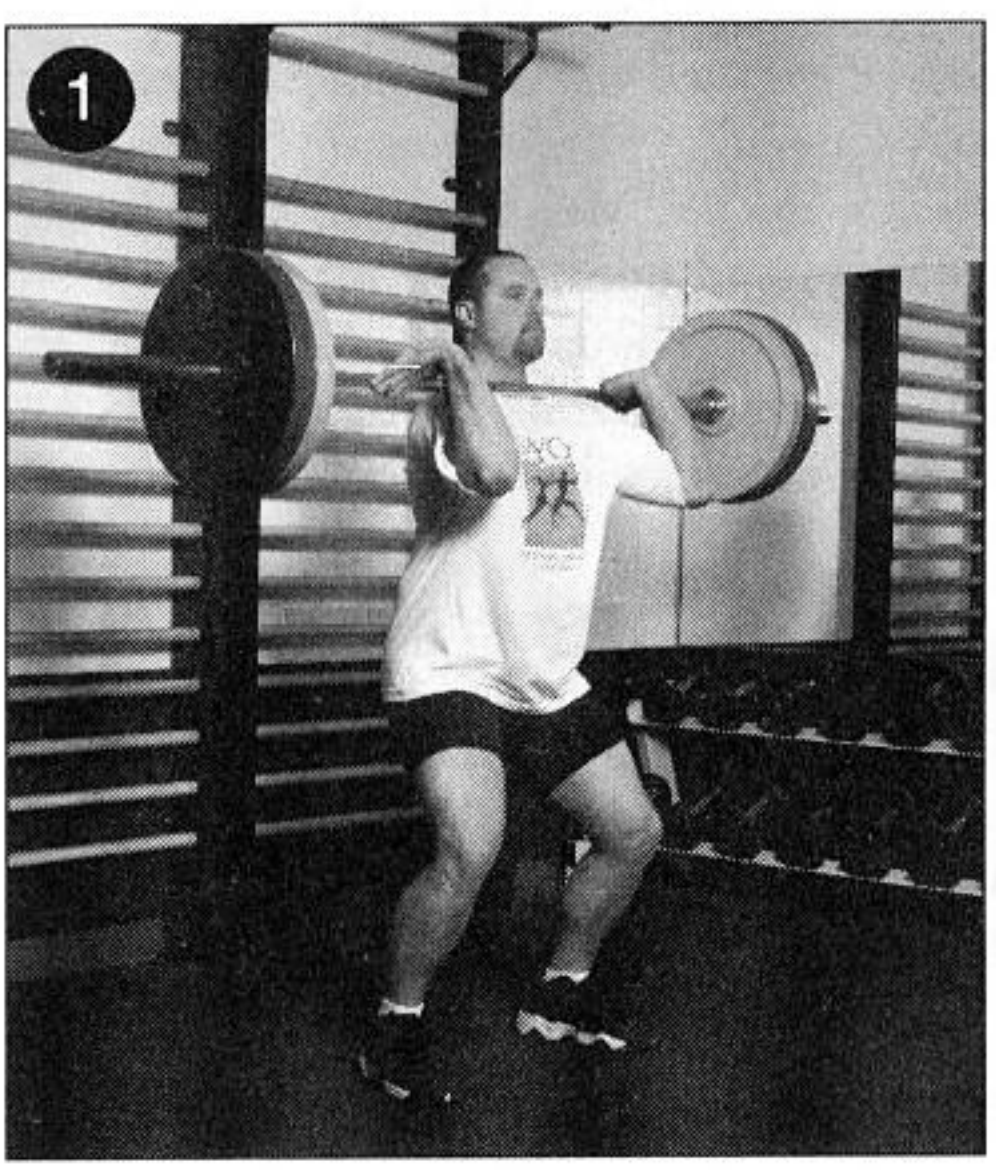


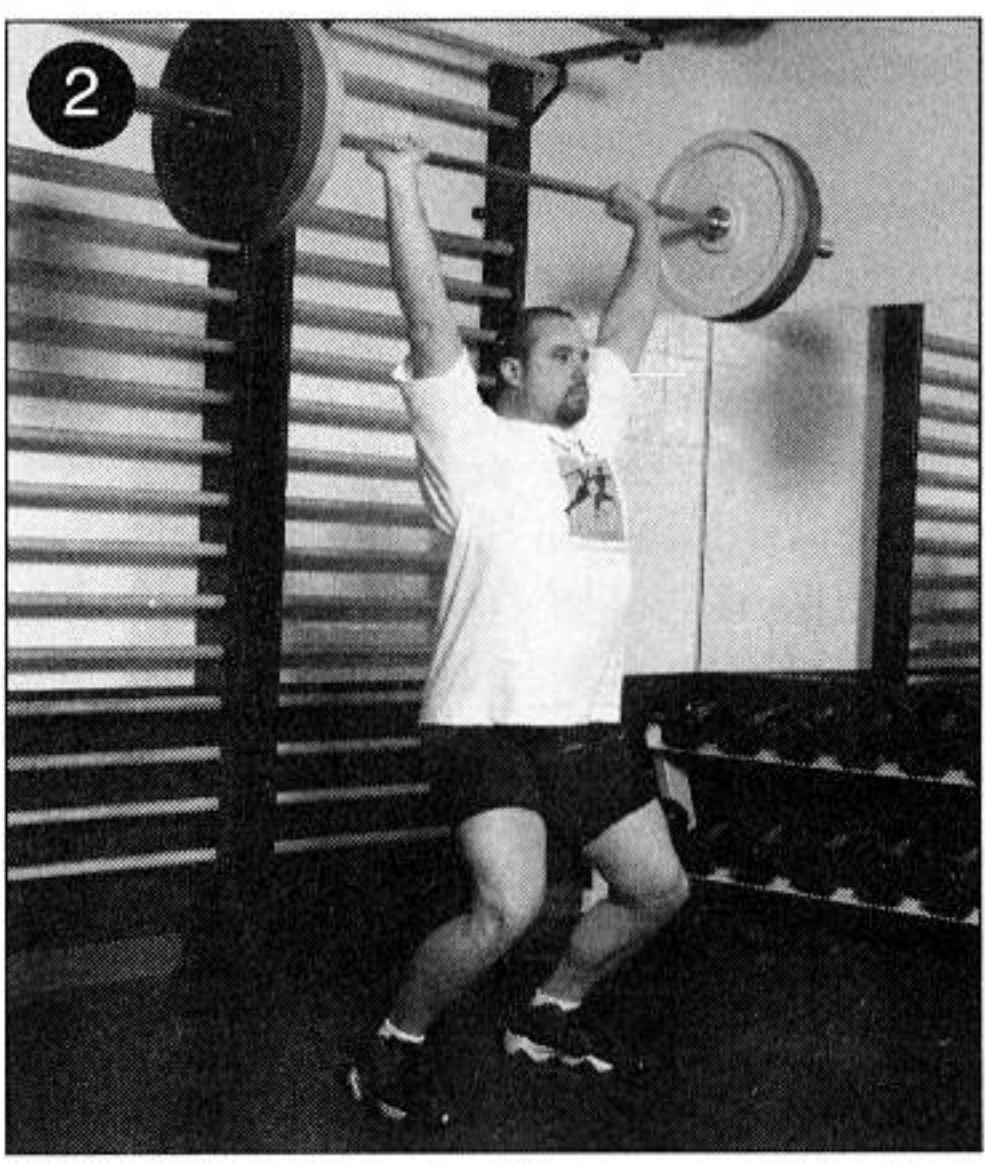
Clean Pull. The clean pull is identical to the power clean (described above), except that the pull commences at the top of the shrug, rather than continuing upward to catch the bar on the shoulders. This greatly simplifies the lift, while maintaining the majority of it's benefits. When first learning the power clean, a good place to start is the clean pull.





Clean Pull from "Hang" Position. This is a clean pull performed from the hang position, rather than from the floor. The start and "rack" positions are shown.





Push Jerk. Position the barbell on the support pins of a power rack, such that it is at mid-chest level. Grasp the bar with a grip slightly wider than shoulder-width and rotate the elbows up, positioning the bar on the deltoids (if the elbows remain pointing downward, the bar will rest on the clavicles, which is too painful when the weight load becomes significant). Fill the lungs with air and keep the chest up and torso tight. Unrack the bar and step back away from the rack.

Keeping pressure on the heels, dip down by bending the knees and ankles slightly, then explosively drive upwards with the legs, driving the barbell vertically off the shoulders. Now change directions and split the feet out to the sides as fast as possible, while vigorously extending the arms overhead.

When in the split position the front shin should be vertical to the floor and the front foot

flat on the floor. The rear knee should be slightly bent and the rear foot on the toes. The back should be straight and the bar directly over the ears at arms length.

To recover from the split, simply straighten the knees and step back, one foot at a time, to a normal standing position. When the bar is under control and the feet are in line, the lift is complete.

Testing Speed Strength: The Max Jones Quadrathlon (MJQ)

Few athletes are aware of this unique and very useful testing implement created by the English track and field coach of the same name. The MJQ can be used to regularly monitor levels of speed strength, and can also be used as a fun competition several times a year. This test is very easy to administer at any local high school or college track and involves only a tape measure and a stopwatch. One note of caution, however. The four test drills, although relatively simple, take a toll on the body (particularly the hip flexors) if never done before or if it's been years since performing them. For those in this category, practice these drills at a reduced intensity before going at them "full bore." Start with very low volume (just a few repetitions of each drill) and progress gradually over a series of four to six sessions.

The test drills are as follows:

Three Jumps. With feet together, hop three times and land in a long-jump pit. Measure from the starting position to the closest disturbance of the sand where the jump landed.

Standing Long-Jump. Standing at the edge of a long-jump pit with toes slightly over the edge of the board, perform a standing long-jump into the pit. Measure from the lip of the board to the closest disturbance of the sand where the jump landed.

Thirty Meter Sprint. Using starting blocks, begin on the command of a timer at the finish line (a partner may place his or her foot behind the jumper's lead foot to simulate a block). The timer starts the watch when the back foot makes contact with the ground on the first step, and stops when breaking the finish line.

Sixteen Pound Overhead Shot. Standing on top of a shot-put stopboard (back to the pit), dip down (much like the preparatory crouch for a vertical jump), swing the shot between the legs, and then extend and throw the shot overhead backwards. It is not necessary to remain on the stopboard. Measure from the lip of the stopboard to the first point of impact.

Please see Table 3-8 for the Quadrathlon scoring tables. Simply convert the results into the numerical scores provided for a total MJQ rating.

The Periodization of Strength (Long-Term Programming Considerations)

Although periodization was previously covered in Chapter Two, this section specifically covers the periodization of strength training. The strength periodization system recommended for martial athletes is modeled after the system conceptualized by Dr. Tudor Bompa. The system features apportioning the macrocycle into phases named for the most significant adaptation they cause. These include anatomical adaptation, hypertrophy, absolute strength, conversion to speed-strength, maintenance, and transition. Although the duration of each phase may vary, the order or progression always stays the same. Each phase creates a foundation for the next, leading to the highest possible level of event-specific fitness during the competitive period, when it's most needed. This section describes each phase, detailing the suggested loading parameters, objectives, and a sample training microcycle from each.

Points	3 Jumps	S.L.J.	30m	O.H. Shot	Points	3 Jumps	S.L.J.	30m	O.H. Shot
1	3.00	1.00	5.80	4.00	51	7.04	2.36	4.38	12.58
2	3.08	1.02	5.77	4.17	52	7.12	3.39	4.35	12.75
3	3.16	1.05	5.74	4.34	53	7.20	2.41	4.33	12.92
4	3.24	1.08	5.71	4.51	54	7.28	2.44	4.30	13.10
5	3.32	1.10	5.68	4.68	55	7.36	2.47	4.27	13.27
6	3.40	1.13	5.66	4.85	56	7.44	2.50	4.24	13.44
7	3.48	1.16	5.63	5.03	57	7.52	2.52	4.21	13.61
8	3.56	1.19	5.60	5.20	58	7.60	2.55	4.18	13.78
9	3.64	1.21	5.57	5.37	59	7.63	2.58	4.16	13.95
10	3.72	1.24	5.54	5.54	60	7.76	2.60	4.13	14.13
11	3.80	1.27	5.51	5.71	61	7.84	2.63	4.10	14.30
12	3.88	1.30	5.49	5.83	62	7.92	2.66	4.07	14.47
13	3.96	1.32	5.46	6.06	63	8.01	2.69	4.04	14.64
14	4.05	1.35	5.43	6.23	64	8.09	2.71	4.02	14.81
15	4.13	1.38	5.40	6.40	65	8.17	2.74	3.99	14.98
16	4.21	1.40	5.37	6.57	66	8.25	2.77	3.96	15.16
17	4.29	1.43	5.34	6.74	67	8.33	2.80	3.93	15.33
18	4.37	1.46	5.32	6.91	68	8.41	2.82	3.90	15.50
19	4.45	1.49	5.29	7.09	69	8.49	2.85	3.87	15.67
20	4.53	1.51	5.26	7.26	70	8.57	2.88	3.85	15.84
21	4.61	1.54	5.23	7.43	71	8.65	2.90	3.82	16.02
22	4.69	1.57	5.20	7.60	72	8.73	2.93	3.79	16.19
23	4.77	1.60	5.17	7.77	73	8.81	2.96	3.76	16.36
24	4.85	1.62	5.15	7.94	74	8.89	2.99	3.73	16.53
25	4.93	1.65	5.12	8.12	75	8.97	3.01	3.70	16.70
26	5.02	1.68	5.09	8.29	76	9.06	3.04	3.68	16.87
27	5.10	1.70	5.06	8.46	77	9.14	3.07	3.65	17.05
28	5.18	1.73	5.03	8.63	78	9.22	3.10	3.62	17.22
29	5.26	1.76	5.01	8.80	79	9.30	3.12	3.59	17.39
30	5.34	1.79	4.98	8.97	80	9.38	3.15	3.56	17.56
31	5.42	1.81	4.95	9.15	81	9.46	3.18	3.53	17.73
31	5.50	1.84	4.92	9.32	82	9.54	3.20	3.51	17.90
33	5.58	1.87	4.89	9.49	83	9.62	3.23	3.48	18.03
34	5.66	1.90	4.86	9.66	84	9.70	3.26	3.45	18.25
34	5.74	1.92	4.84	9.83	85	9.78	3.29	3.42	18.42
36	5.82	1.95	4.81	10.01	86	9.86	3.31	3.39	18.59
37	5.90	1.98	4.78	10.13	87	9.94	3.34	3.36	18.76
38	5.98	2.00	4.75	10.35	88	10.03	3.37	3.34	18.93
39	6.07	2.03	4.72	10.52	89	10.11	3.40	3.31	19.11
40	6.15	2.06	4.69	10.69	90	10.19	3.42	3.28	19.28
41	6.23	2.09	4.67	10.86	91	10.27	3.45	3.25	19.45
42	6.31	2.11	4.64	11.04	92	10.35	3.48	3.22	19.62
43	6.39	2.14	4.61	11.21	93	10.43	3.50	3.20	19.79
44	6.47	2.17	4.58	11.38	94	10.51	3.53	3.18	19.96
45	6.55	2.20	4.55	11.55	95	10.59	3.56	3.15	20.14
46	6.63	2.22	4.52	11.72	96	10.67	3.59	3.12	20.31
47	6.71	2.25	4.50	11.89	97	10.75	3.61	3.09	20.48
48	6.79	2.28	4.47	12.07	98	10.83	3.64	3.06	20.65
49	6.87	2.30	4.44	12.24	99	10.91	3.67	3.03	20.82
50	6.95	2.33	4.41	12.41	100	11.00	3.70	3.01	21.00

Additional Points

3 Jumps:	1 point extra for each 8 cms above 11.00	30cm:	1 point for each 0.03 below 3.01
S.L.J.:	1 point for each 3 cm above 3.70	O.H. Shot:	1 point for each 7 cm above 21.00

TABLE 3-8: Quadrathlon Scoring (1992)[31]

In general, the absolute intensity of strength training starts out low, and steadily increases throughout the macrocycle, although it may fluctuate up and down within the context of each week or month (see "rule of thirds" discussion later in this section). Also, a general trend is to start with exercises and loading parameters which have a fairly low degree of event-specificity, and steadily progress to higher levels of specificity. By way of example, the performance of relatively high repetitions performed on machines is common early in the macrocycle, where fairly low repetitions performed in an accelerative manner on large muscle group exercises predominate later in the cycle.

Although alluded to earlier, it bears reiterating that there are many philosophies of periodization, and a myriad of factors which influence the construction of periodized training programs. To completely address these issues would require a book unto itself (several can be found in the resources section of this book). Therefore, the goal of this section is to present a rational way of organizing long-term strength training programs as a starting point for the reader. Through further study and experimental application, each individual will develop his or her own style and methods.

Training Period:	Preparatory		Competitive		Transition
Type of Training: Rehabilitation	General	Specific	Early	Late	
	anatomical adaption followed by hypertrophy	absolute strength	conversion to speed strength	maintenance of speed strength	

TABLE 3-9: Bompa's Periodization Format (Macrocycle)[32]

Phase 1: Anatomical Adaptation (AA)

Description: This is the first phase in any formal program. It is also the first step on the intensity "ladder." Therefore, novices or out-of-shape athletes will spend considerable time in this phase. Healthy, more experienced athletes will use a shorter AA phase, or in some cases, may bypass it.

Goals: This type of training develops and stabilizes proper exercise technique, enhances anaerobic endurance, and strengthens connective tissues (thus the term "anatomical adaptation"). It also serves as a "warm-up" for higher intensity phases to follow, much like warm up sets prepares the lifter for more intense sets to follow.

Loading Parameters:
Training frequency: Three to five times per week.
Exercise type: Various, concentrate on weaknesses
Number of exercises per session: four to six.
Number of sets per exercise: three to five.
Number of repetitions per set: 13 to 25 or 50–60% of 1RM.
Lifting speed: Slow to moderate.
Rest between sets: One to two minutes.

Factors Affecting Duration of Phase: The length of the AA phase should be determined by the athlete's current fitness level. If the athlete is a relative beginner or an experienced athlete who has been out of training, the phase is relatively longer. If the athlete is well trained and has been training consistently, the phase is relatively shorter as well as the length of the entire macrocycle (the AA phase of a 12-week cycle will be longer than the AA phase of a 26-week cycle).

Exercise	Speed	Rest	Sets X reps
Monday:			
A-1: Leg Press	Rhythmic	90 SEC	4x15
A-2: Seated Row (machine)	Rhythmic	90 SEC	4x15
A-3: Swiss Ball Crunch	Rhythmic	90 SEC	4x15
A-4: Triceps Pushdowns	Rhythmic	90 SEC	4x15
A-5: Seated Dumbell Curl	Rhythmic	90 SEC	4x15
Wednesday			
A-1: Lat Pulldown	Rhythmic	90 SEC	4x15
A-2: Standing Calf Raise	Rhythmic	90 SEC	4x15
A-3: Standing Hammer Curl	Rhythmic	90 SEC	4x15
A-4: Hip Extensions	Rhythmic	90 SEC	4x15
A-5: Barbell Shrugs	Rhythmic	90 SEC	4x15
Thursday			
A-1: Leg Curls	Rhythmic	90 SEC	4x15
A-2: Bench Press	Rhythmic	90 SEC	4x15
A-3: Alternating Lunges	Rhythmic	90 SEC	4x15
A-4: Arnold Press	Rhythmic	90 SEC	4x15
A-5: Swiss Ball Reverse Trunk Twist	Rhythmic	90 SEC	4x15

TABLE 3-10: A Sample Microcycle from the Anatomical Adaption Phase

Phase Two: Hypertrophy

Description: Once the athlete has established a general strength-fitness "base" during the AA phase, he or she progresses to the hypertrophy stage of training, where training loads are increased.

Goals: The primary training adaptation during this phase will be an increase in lean body mass, and hence, improved body composition. For martial artists who need considerable mass (particularly competitive fighters wishing to move up a weight class), this phase may last for eight to sixteen weeks. For athletes who depend more on relative strength (such as fighters in lighter weight classes, or kata competitors), this phase will be of lesser duration (one to three weeks). In some cases, for instance, athletes who are already at the upper limit of their weight class, it may be bypassed.

Loading Parameters:

Training frequency: Three to five times per week.

Exercise type: Compound exercises focusing on large muscle groups.

Number of exercises per session: Four to six.
Number of sets per exercise: Three to five.
Number of repetitions per set: Five to 12 (60–85% of 1RM) to momentary exhaustion.
Lifting speed: Slow to moderate.
Rests between sets: Between one and two minutes.
Factors Affecting Duration of Phase: The length of this phase depends on the athlete's need for increased muscle mass and the length of the macrocycle.

A common error made by martial artists (and the reason why many martial artists and boxers have become disenchanted by weight training) is to train like a bodybuilder, spending most, if not all of their strength training in a hypertrophy phase. Hypertrophy methods can be very exhausting, and lead to injury and/or overtraining if continued for too long a time. Martial artists reach this state even earlier than strength athletes, since they are concurrently training for strength, as well as technical and tactical objectives.

One of the most important decisions to be made early in the training plan regards how much hypertrophy (increased muscle size) is needed. To answer this question, the athlete's age, training experience, athletic event, objective, and health must be considered. If an athlete is constantly injured during sparring and a quick glance shows that he simply "doesn't have any meat on his bones," a more extensive hypertrophy phase may be appropriate.

On the other hand, athletes who are already densely muscled should spend relatively less time on hypertrophy, and more on other training objectives. The common bodybuilder's practice of performing extended sets of twenty repetitions or more causes an enlargement of the non-contractile elements of the muscle cell, such as the sarcoplasm, connective tissue, and capillaries. This adaptation is called "sarcoplasmic hypertrophy," and may account for the fact

Exercise	Speed	Rest	Sets X reps
Monday:			
A-1: Military Press	Rhythmic	120 SEC	4x60 secs*
A-2: Standing Hammer Curl	Rhythmic	120 SEC	4x60 secs
B-1: 45 degree Incline Dumbell Press	Rhythmic	120 SEC	4x60 secs
B-2: Dumbell Curl on Preacher Bench	Rhythmic	120 SEC	4x60 secs
Wednesday			
A: Back Squat	Rhythmic	120 SEC	4x60 secs
B-1: Swiss Ball Crunch	Rhythmic	120 SEC	4x60 secs
B-2: Back Extension	Rhythmic	120 SEC	4x60 secs
B-34: Standing Calf Raise	Rhythmic	120 SEC	4x60 secs
Friday			
A-1: Lat Pulldown	Rhythmic	120 SEC	4x60 secs
A-2: Close Grip Bench Press	Rhythmic	120 SEC	4x60 secs
B-1: Seated Row	Rhythmic	120 SEC	4x60 secs
B-2: Tricep Pushdowns	Rhythmic	120 SEC	4x60 secs
* Perform the set for 60 seconds using a moderate lifting speed, rather than counting reps			

TABLE 3-11: A Sample Microcycle from the Anatomical Adaption Phase

that many bodybuilders, though strong, are not as strong as would be expected for their size. This type of adaptation should generally be avoided by martial artists.

Phase Three: Absolute Strength

Description: The third step on the intensity ladder, the absolute strength phase sets the foundation for speed-strength development in subsequent cycles.

Goals: The primary training adaptation during this phase will be an increase in absolute strength. However, the higher level of a stimulus experienced during this phase will also help to maintain hypertrophy levels.

Loading Parameters:

Training frequency: Three to four times per week.

Exercise type: Accelerative weight training, plyometrics, modified Olympic lifts, medicine ball training.

Number of exercises per session: Three to five.

Number of sets per exercise: Six to 10.

Number of repetitions per set: One to five (85–100% of 1RM)

Lifting speed: Accelerative.

Rests between sets: Three to five minutes (complete recoveries between sets)

Factors Affecting Duration of Phase: The length of this phase is a function of the individual's fitness level, need for absolute strength, and the length of the total training cycle. Athletes with a greater need for absolute strength, such as grapplers, will spend considerable time in this phase, while athletes who do not need great levels of absolute strength, such as fencers, will spend only brief periods in this phase. Since hypertrophy in part depends upon motor unit recruitment, more strength often equates to more muscle mass, which is of interest to those who wish to gain "functional" body weight.

Exercise	Speed	Rest	Sets X reps
Monday:			
A-1: Military Press	Accelerative	120 SEC	6x4
A-2: Standing Hammer Curl	Accelerative	120 SEC	6x4
B-1: 45 degree Incline Dumbell Press	Rhythmic	60 SEC	6x4
B-2: Dumbell Curl on Preacher Bench	Rhythmic	60 SEC	6x4
Wednesday			
A: Back Squat	Accelerative	120 SEC	6x2
B-1: Swiss Ball Crunch	Rhythmic	90 SEC	6x6
B-2: Back Extension	Rhythmic	90 SEC	6x6
B-34: Standing Calf Raise	Rhythmic	90 SEC	6x6
Friday			
A-1: Pull-ups	Accelerative	120 SEC	8x2
A-2: Close Grip Bench Press	Accelerative	120 SEC	8x2
B-1: Machine Seated Row	Accelerative	120 SEC	8x2
B-2: Lying Dumbell Tricep Ext.	Rhythmic	90 SEC	8x2

TABLE 3-12: A Sample Microcycle from the Absolute Phase

Phase Four: Conversion to Speed-Strength

Description: This phase represents the fourth successive increase in training intensity (intensity is not increased by using a higher percentage of 1RM, but by lifting the weights more explosively).

Goals: During the last phase, absolute strength was brought to the highest possible level, given the time constraints of the macrocycle. The goal of this phase is to exploit this increase in strength and "convert" it into improvement in speed strength. Therefore, the primary training adaptation during this phase will be an increase in speed-strength. However, the high level of the stimulus experienced during this phase will also help to maintain absolute strength, and to a lesser degree, hypertrophy.

Loading Parameters:

Training frequency: Three to four times per week.

Exercise type: Accelerative weight training, plyometrics, modified Olympic lifts, medicine ball training.

Number of exercises per session: Three to five.

Number of sets per exercise: Six to ten

Number of repetitions per set: One to five (85–100% of 1RM)

Lifting speed: Explosive

Rests between sets: Three to five minutes (allow for complete recovery between sets).

Factors Affecting Duration of Phase: This duration of this phase is affected by the overall length of the macrocycle, as well as the athletes relative need for speed-strength improvement (as compared to hypertrophy or maximal strength). For example, an athlete who can express high levels of maximal strength, but who scores poorly in speed-strength tests such as the Max Jones Quadrathlon, should spend relatively more time in this phase than an athlete with relatively poor hypertrophy or absolute strength but good speed-strength (see the example below).

Test	Dianne	Lori
1RM back squat:	315	225
1RM bench press:	205	145
MJQ:	140	155

Comments: Dianne has a much higher level of absolute strength (as measured by 1RM tests in the squat and bench press) than Lori, who shows very good levels of speed-strength (as indicated by her MJQ), given her strength levels. Therefore, Lori should plan a relatively longer absolute strength phase when constructing a macrocycle, whereas Dianne should spend more time improving her speed strength.

Phase Five: Maintenance

Description: Once absolute strength has been converted to speed-strength, it must be maintained for the duration of the competitive season. This is achieved primarily through a significant reduction in training volume. During this phase, speed-strength capacity will decline slightly, however this is considered a necessary trade off to allow the athlete to concentrate on technical, tactical, and psychological concerns.

Exercise	Speed	Rest	Sets X reps
Monday:			
A-1: Push Jerk	Accelerative	3–5 min.	6x2
A-2: Eccentric Hammer Curl	Accelerative	3–5 min	6x2
B-1: 15 degree Incline Dumbell Press	Accelerative	3–5 min	6x2
B-2: Standing Dumbell Curl	Accelerative	3–5 min	6x2
Wednesday "A" Session: A. Depth jumps: Perform 10 jumps, with 2 minutes of rest between jumps (use a stopwatch). If on any given repetition the heels contact the ground, terminate the workout rather than lowering the box-height.			
"B" Session			
A-1: Front Squat	Accelerative	3–5 min.	6x2
B-1: Ball Crunch/Medicine Ball Pass	Accelerative	3–5 min	6x2
B-2: Reverse Hyper	Accelerative	3–5 min	6x2
Friday			
A: Power Clean From Hang	Accelerative	3–5 min.	6x2
B: Medicine Ball From Chest Pass	Accelerative	3–5 min	6x2
C: Machine Seated Row	Accelerative	3–5 min	6x2
D: Lying Dumbell Tricep Ext.	Accelerative	3–5 min	6x2

TABLE 3-13: A Sample Microcycle from Conversion Phase

Goals: To maintain speed strength capacity while the athlete concentrates on technical, tactical, and psychological concerns.

Loading Parameters:

Training frequency: One to two times per week

Exercise type: Accelerative weight training, plyometrics, modified Olympic lifts, medicine ball training.

Number of exercises per session: One to three

Number of sets per exercise: Two to five

Number of repetitions per set: One to five (85–100% of 1RM)

Lifting speed: Accelerative/explosive

Rests between sets: Three to five minutes

Factors Affecting Duration of Phase: Athletes with longer competitive seasons utilize a long maintenance phase, as opposed to athletes with shorter competitive seasons.

Phase Six: Transition

Description: The transition phase entails a brief change of pace from competitive stresses and high level training activities.

Goals: To recover, both physically and psychologically, from the previous macrocycle. During this time, the athlete may attend to postural and/or flexibility concerns, rehabilitation from injuries, and planning of the next macrocycle.

Loading Parameters: There are no formal loading parameters for this phase. The training

Exercise	Speed	Rest	Sets X reps
Monday:			
A-1: Push Jerk	Accelerative	3–5 min.	3x2
A-2: Eccentric Hammer Curl	Accelerative	3–5 min	3x2
B-1: 15 degree Incline Dumbell Press	Accelerative	3–5 min	3x2
B-2: Standing Dumbell Curl	Accelerative	3–5 min	3x2
Wednesday "A" Session: Depth jumps: Perform 5 jumps, with 2 minutes of rest between jumps (use a stopwatch). If on any given repetition the heels contact the ground, terminate the workout rather than lowering the box-height.			
"B" Session			
A-1: Front Squat	Accelerative	3–5 min.	3x2
B-1: Ball Crunch/Medicine Ball Pass	Accelerative	3–5 min	3x2
B-2: Reverse Hyper	Accelerative	3–5 min	3x2
Friday			
A: Power Clean From Hang	Accelerative	3–5 min.	3x2
B: Medicine Ball From Chest Pass	Accelerative	3–5 min	3x2
C: Machine Seated Row	Accelerative	3–5 min	3x2
D: Lying Dumbell Tricep Ext.	Accelerative	3–5 min	3x2

TABLE 3-14: A Sample Microcycle from Maintenance Phase

load depends on the context and circumstances of the situation. Often, the athlete may avoid strength training during this phase in favor of more aerobic and flexibility work.

Factors Affecting Duration of Phase: The transition phase lasts as long as is necessary for the athlete to recover from the stresses (and possibly, injuries) which have accrued over the macrocycle. The length of the transition phase also depends, in part, on the available time-frame for the next important competition (i.e., if the next competition is soon, there may be an urgency to start the next macrocycle as soon as possible, rather than to prolong the transition phase).

Intra phase Variation: The "Rule of Thirds"

This is a strength training periodization concept originating in work with both martial artists and other athletes. It evolved from the fact that too much work devoted to one motor ability (perhaps speed-strength) leads to a decline in other motor abilities (such as absolute strength).

For example, numerous athletes from explosive sports like Olympic weightlifting reach what seems like an impenetrable plateau from years of high intensity (between one and three reps per set) strength training. Their nervous systems are burned out, and to add insults to injury, they have no structural hypertrophy to protect their joints from the intense loads they lift. One the other side of the coin, many bodybuilders reach complete stagnation which could be overturned if they were willing to do some work in lower repetition brackets in order to get stronger by training their nervous systems.

In addition to these considerations, inserting an occasional microcycle devoted to develop-

ing a "complimentary" motor ability promotes recovery. So, based on these observations, consider experimenting with three week mesocycles where the first two weeks are spent training the "target" motor ability and the final week is spent training a complimentary quality to provide recovery and balance to the program. The following chart depicts how the rule of thirds can be implemented in each of the training phases.

Phase	Weeks 1–2	Week 3
AA	Use AA parameters	Use hypertrophy parameters
Hypertrophy	Use hypertrophy parameters	Use absolute strength parameters
Absolute Strength	Use absolute strength parameters	Use hypertrophy parameters
Conversion	Use SS parameters	Use absolute strength parameters
Maintenance	Use SS parameters	Use absolute strength parameters

Short-Term Programming Considerations

This section addresses some of the more common questions about strength training programming and administration asked by athletes and coaches. A "Q&A" format is used to organize these topics.

Q: Why is there so much disagreement about the best type of strength training for martial artists?

A: Learning how to design short term strength training programs is always a source of confusion and frustration for novice athletes and coaches. Many sources of information (books, videos, coaches, etc.) fail to give exact recommendations. Those that do often conflict with one another.

Although frustrating for many, this state of affairs is actually based in reason. The cold, hard truth is that there are various successful "philosophies" of program design. Some advocate multiple sets for each exercise, but others implement only one. Some emphasize machines, others free weights. Some insist on slow movement speed, but others use primarily accelerative tempos. Some athletes use basically the same program indefinitely, other change it almost every week. The list goes on ad infinitum. The following factors help to explain why there is so much diversity with respect to strength training programs:

1) Put plainly, many approaches work (at least temporarily)! In American football, there are two major training philosophies: "HIT" (High Intensity Training), and "Explosive" training. The HIT philosophy advocates machine-based training using one (or recently, few) sets to complete momentary failure, using moderate lifting speeds. The "explosive" camp argues for multiple sets of mostly free weight exercises (including the modified Olympic lifts and plyometric exercises, hence, the label "explosive"), often performed with accelerative or explosive movement speeds. The HIT camp claims their methods are safer and more effective while the explosive faction claims that their methods are also safe and more specific to the ballistic nature of what player's experience on the playing field. While it appears the explosive camp is closer to the truth, the point that must be made is that neither side has been able to conclusively prove their method is superior through team win/loss records. There seems to be some merit in both approaches, which perhaps can be explained, in part, by the following considerations.
2) The athlete's training history determines the effectiveness of the program. Because of the

principle of habituation, an athlete who has HIT training exclusively for several years may get a better result from explosive training methods, at least temporarily, because it represents a novel stimulus to that athlete's nervous system. This phenomenon not only applies to broad training styles, but also to all program elements, such as number of sets and repetitions, exercise selection, lifting speed, and rests between sets.

3) A moderate approach usually works best. It seems to be a universal law that the best approach lies somewhere between the extremes, and training is no exception. When one coach declares that free weights are evil, and another proclaims machines to be useless, allow common sense to prevail!
4) The context of the present situation determines the program. This is partly related to the point in two, above. Program design must take into account the athlete's age, training history, injury status, posture, access to facilities and equipment, personality, learning style (kinesthetic, visual, auditory, etc.) objectives, and so forth.
5) The coach in part determines the effectiveness of his or her methods. In the martial arts, often it's the teacher, not the style, that determines effectiveness. To a small extent, the same is true in strength training. Coaches will naturally gravitate toward programming philosophies that suit their own experiences, sensibilities, and sense of logic. This enables the coach to carry out the program with confidence, which is an important element when it comes to the athlete's trust in the coach.

Q: How should I warm up for a strength training workout?

A: Few aspects of strength training are as misunderstood as the warm-up. Athletes tend to make a full-blown workout out of the warm up, which creates so much fatigue they don't profit from the actual workout, or they minimize the warm up so much that they risk serious injury at worst, or fail to reach their workout objectives at best.

To properly warm-up for a strength training session, first engage in any form of cardiovascular activity for three to five minutes to achieve a light sweat. Jujitsu players like to use ground-based drills such as rolling, stretching, kip-ups, and footwork drills. Boxers and kickboxers often will skip rope, and throw easy kicking combinations. Any activity that raises body temperature will do the job.

Next, set up for the first exercise on the menu for the day's workout. The rule of thumb for warm up sets is two sets for every 100 pounds of weight planned for work sets. So, to perform leg presses with a plan of 425 pounds for six sets of five repetitions, perform about eight warm-up sets. Apportion these sets equally from 0–425 pounds. The following example describes the right and wrong way to warm up.

Do This	**Not This** (Too extensive)	**Or This** (Too Brief)
Warm up set 1: 90x6	Warm up set 1: 225x15	Warm up set 1: 225x10
Warm up set 2: 90x6	Warm up set 2: 225x15	Warm up set 1: 315x8
Warm up set 3: 180x6	Warm up set 3: 270x12	Warm up set 1: 360x6
Warm up set 4: 225x5	Warm up set 4: 315x10	Work set 1: 425x5
Warm up set 5: 270x4	Warm up set 5: 360x8	
Warm up set 6: 315x3	Warm up set 6: 380x6	
Warm up set 7: 360x3	Warm up set 7: 400x5	
Warm up set 8: 390x1	Warm up set 8: 410x5	
Work set 1: 425x5	Work set 1: 425x5	

When the warm-up is insufficient, the athlete's work sets never feel quite "right" (athletes don't feel "warmed up" until the workout is nearly over). When the warm-up is too extensive, the work sets starts hard, and they get more difficult as the workout progresses. When the warm-up is optimal, the "middle" work sets are the easiest to perform (in a six work set, the third and fourth sets). Look for these tendencies during workouts and learn to recognize the need for longer or shorter warm-ups.

Q: What about the use of "spotters" during strength workouts?

A: Fitness trainers frequently spot their clients too closely. Occasionally, a competent coach or trainer will employ tactile cuing in order to teach the athlete how to engage the appropriate muscles. Also, during heavy squats or bench presses, or difficult exercises such as ball crunches, always employ a good spotter. Otherwise, unwarranted close proximity to the athlete is distracting and even dangerous.

The following section identifies some keys to perform an effective spot. The squat and bench press are good examples since these two lifts require spotting most frequently.

Guidelines for spotting an athlete who is squatting include these six factors.

1) As the athlete is warming up, look at his technique. Does he lean forward excessively? If so, it will be difficult to extricate him out of a failed attempt.
2) How experienced is the athlete? Novices are more prone to misjudging their abilities, and may fail unexpectedly. Experienced lifters can almost always judge their current maximal abilities, however.
3) The spotter should be in a position that maintains good leverage in the event that considerable force is needed to help the athlete. For example, a short, weak person may not be capable of spotting a tall, strong person during the squat.
4) Spotters must "stay on their toes." Unfortunately, many lifters failing with a weight receive no help from the spotter, who is distracted by something at the other end of the gym! A partner's well-being depends on the spotter's vigilance!
5) Stay close, but not too close. When lifting a challenging weight, it's easy to become distracted by a partner who is only inches away. Give the lifter enough room to breathe!
6) Communicate! A man asked for a spot on incline dumbbell presses. He must have weighed 160 pounds at the most, and he was preparing a pair of 120 pound dumbbells! In reality, he didn't want a spot. He wanted someone to lift the dumbbells for him. The "spotter"ended up lifting more than half the weight right from the first rep. So, find out exactly what the lifter wants before the set begins.

A good power rack (a favorite is made by Atlantis Fitness Equipment) can eliminate the need for spotters in most cases. Simply set the safety pins at a level slightly below the lowest point the bar will travel during the lift, and if one fails, just lower the bar until it hits the pins. First, however, make sure to set the pins properly by testing with an empty bar.

Q: Should I use equipment such as belts, wraps, and so on?

A: The judicious use of belts, wraps, straps, and other equipment can be useful, but what tends to happen is that athletes gradually become dependent on these items. The use of weightlifting belts is particularly controversial among strength professionals. Belts may potentially help stabilize and protect the spine during heavy lifting but not in the way that most people think. During a heavy lift, people instinctively hold their breath and "bear down" with the abdominal muscles. This creates what is called "intra-abdominal pressure" which can

actually decompress the spine significantly, reducing the amount of pressure on the spinal disks. With a belt, one can actually exert pressure against the belt with the abdominals, which allows athletes to obtain even greater intra-abdominal pressure, and hence, more unloading of the spine.

While this would appear to be beneficial, whenever using an aid of any kind, muscles are doing less work respective to the load they are lifting. During a recent study at the Albany Medical Center in Albany, New York, scientists compared the progress of fifty weight lifters, half of whom wore weightlifting belts. All the men followed the same program, and their results were essentially the same. But there was an important difference: The men who did not use belts possessed better abdominal and back strength. This result illustrates the disadvantages of assistance equipment.

Should conscientious martial athletes use equipment to lift? This should be an informed decision based on collecting as much information as possible about the pros and cons of doing so. If equipment is used, "periodize" its use in such a way that it is used only during the heaviest phases of lifting, and even then, only during the heaviest attempts.

Q: How should I organize strength training workouts into a microcycle?

A: First, determine the length of the microcycle. In strength training, microcycles might last anywhere between five and ten days. Some trial and error are necessary to determine the optimal length, but in general, less experienced athletes use shorter microcycles and more experienced athletes use longer ones. Most athletes opt for a seven-day microcycle because it corresponds to a weekly interval.

Second, divide the body into thirds. Apportion all the body's muscle groups into three groups. One possible group might look like this:

Group 1	Group 2	Group 3
pectorals	quadriceps	lats
biceps	hamstrings	shoulders
abdominals	calves	triceps
traps	tibealis	external rotators

Another possibility:

lats	quadriceps	shoulders
chest	hamstrings	biceps
abdominals	calves	triceps
tibealis	external rotators	

Third, assign each third (or group) to a workout. For example, by using the first grouping pattern:

Workout 1	Workout 2	Workout 3
pectorals	quadriceps	lats
biceps	hamstrings	shoulders
abdominals	calves	triceps
traps	tibealis	external rotators

Fourth, determine the ideal spacing of workouts. Usually, non-consecutive days are chosen as follows:

Monday	Wednesday	Friday
pectorals	quadriceps	lats
biceps	hamstrings	shoulders
abdominals	calves	triceps
traps	tibealis	external rotators

The above grouping conveniently permits the middle workout to be shifted a day prior (Tuesday) or after (Thursday) without compromising recovery. Note that in the above microcycle, it initially appears that each muscle is trained only once a week. However, since the front deltoids and triceps receive significant stress during the pectoral workout, and because the rear deltoids and biceps are stressed during the back workout, the arms and shoulders are really trained twice a week, while the larger muscle groups are trained once a week.

Finally, determine the length of the mesocycle. In other words, how many microcycles of the above should one do before changing the program? Extensive observation of athletes suggests between two and six, depending primarily on training experience. Lesser experienced athletes should repeat between five and six times, advanced athletes between two and three times. Use four repeats as a middle ground if unsure how to initially plan. Knowing what to change, and which variables to manipulate, is a fine art. Options range from changing everything (exercise selection, number of sets and reps, lifting speed, and rest periods) to changing only a few variables, such as sets and repetitions. In general, training experience will dictate the extent of change: more experience, more change; less experience, less change. One option with proven success is a four-week mesocycle, repeated eight successive times, where the exercises remain the same for the entire eight weeks, but all other variables change for the last four mesocycles. After this eight-week period, select a new exercise menu and start again.

Q: Is it correct to use strength training exercises that resemble martial art's skills?

A: While this seems logical on the surface, closer analysis proves this theory to be flawed. In fact, the more specific weight room training mimics martial art skills, the more skills may be negatively affected.

For example, punching with dumbbells in the hand is very similar to the act of punching, yet the additional weight would certainly disrupt the correct motor patterns used in punching. Some martial artists claim they perform such drills to improve punching speed, but since anyone can punch much faster without the added weights, it's clear that this is not the case.

Other martial artists will say that the above drill will improve strength for punching, but since only very light weights can be used (necessary to avoid traumatic injury to the shoulders and elbows), this theory is also incorrect. So, punching with dumbbells does not improve speed or strength!

In the sport of track and field, shot putters often use a slightly underweight shot to improve speed and overweight shots to improve specific strength, but it is widely known that shots which vary too much from the competition weight will disrupt proper motor skills.

On the other end of the spectrum, exercises which have very low specificity could also be detrimental, or at least inconsequential. For example, in the case of a boxer, using a nautilus hip and back machine. The exercise might possibly help the athlete in some way, but the point here is whether or not it will help, hurt, or have no effect on punching skills.

In the middle of these two extremes, consider a barbell bench press. This is an exercise

which develops the muscles used in punching, yet it is still dissimilar enough that it would not "mimic" punching, which could perhaps create motor "confusion" as described above.

The following analogy helps explain the adverse consequences involved in trying to mimic sport skills in the weight room. People who borrow a friend's car frequently have difficulty finding the ignition, locating the brake pedal, or getting used to the steering wheel. This scenario doesn't occur when riding a bike, or a motorcycle, or a riding mower. It seems to only appear in vehicles which are very similar to one's own car. This is because people develop highly-ingrained motor patterns. In a similar manner, performing squats and bench presses won't adversely affect striking skills, but spending lots of time imitating strikes with added weights certainly will.

Research seems to support the notion that martial artists should emphasize heavy loads in weight training in order to improve inter-and intra-muscular coordination, recruitment of fast-twitch muscle fibers, and maximal strength.

The best advice? Get stronger in the weight room, and then during a period of reduced strength training, the body will learn to use its newfound strength in skill practice sessions.

A Few Additional Thoughts About Designing Athletic Training Programs

With these points in mind, here are a few additional "philosophical" considerations to contemplate while developing a sound martial art training program.

1) Designing training programs is always a matter of managing compromise. In other words, there is no such thing as a perfect training program. The success of any program should be assessed only by the degree of progress the athlete is experiencing.
2) An approach utilizing the "law of least effort" is preferred to an approach of "covering all the bases." Sports conditioning specialist Charles Poliquin states that the objective is to find the least amount of training that will improve an athlete's condition, not the most.[33]
3) With regard to the previous statement, keep in mind that the overwhelming majority of athletes in all sports are overtrained, meaning that the training load is excessive with respect to the athlete's ability to recover from it. In nearly all cases, an athlete will improve their performance capacity when the training load is significantly reduced.
4) Use common sense and intuition! Athletes who are shaking and quaking during a set of squats are clearly lifting too heavy a load! If one's legs are "fidgeting" all over the place during bench presses, yes, the weight is too heavy! Athletes who perform a heavy workout the day before a competition should expect a poor result. Athletes with a cold, or a minor nagging injury should rest until the situation improves. The list goes on and on, but the moral is, listen to that little voice inside! Athletes with chronic illnesses or injuries should be referred to an appropriate healthcare provider.
5) Don't merely mimic the training programs seen in books, magazines, or those used by other coaches or athletes! Training is a highly individualized concept, and a program that works well for someone else (who has different skills, weaknesses, and objectives) will not work for everyone.
6) Successful athletes tend to be well organized. This includes planning and record- keeping. Maintaining accurate records allows athletes to see what works and what doesn't work. It also helps to track the progress of an athlete, and when to change gears when things aren't working as well as planned. An excellent way to monitor progress is through

the use of specialized tracking software, such as the "Myo-Dynamics Training-Nutrition Manager" (see reference section for more information).

Q: Do you recommend the use of specialized techniques such as pyramids, drop sets, etc.?

A: Over the years, a variety of specialized weight training techniques and methods have been developed for the purpose of either intensifying the workout (and ideally, the results one will see from the workout) and/or providing variation to the training program (which in itself has great potential for improving any training program) above and beyond the age-old "sets and repetitions" format. The following techniques (and this is an incomplete list of the more commonly used methods only) should be viewed as an advanced option rather than standard operating procedure. Nevertheless, all have value when thoughtfully used.

Circuit Training. To most athletes, circuit training (CT) is thought of as a method of integrating resistance and aerobic exercise by performing several (nine to twelve) exercises in "vertical" progression. This means performing one set of each exercise on the session "menu" until all have been completed, as opposed to finishing all sets of the first exercise before progressing to the second with little or no rest between exercises. The supposed benefit of this type of exercise is improving aerobic and anaerobic functioning at the same time.

Unfortunately, this narrow definition has done a disservice to circuit training and to those who have dismissed this method as an ineffective fringe variant used by only the profoundly unfit as a way of regaining some semblance of fitness. In truth, CT has much to offer, for athletes at all levels.

CT is not defined by the number of repetitions per set, the length of rests between sets, the number of exercises performed, or even the exercises chosen. It is defined by the fact that athletes progress from one exercise "station" to another in sequence, until the entire circuit of stations is completed. Athletes then continue until completing the prescribed number of circuits. (Incidentally, "non-circuit training" is any exercise format where all prescribed sets of a particular exercise are completed before moving onto the next exercise.)

No exercise method is perfect of course (if there was such a thing, it would have been discovered long ago!), but CT comes close. Compared to the alternatives, CT is more efficient, safer, highly motivating, and far more versatile.

CT allows for more work to be done in the same time frame. For example, imagine performing dumbbell incline presses and close-grip lat pulldowns. Further imagine that each set takes thirty seconds to complete while resting two and one-half minutes between sets.

To perform this workout "non-circuit" style as most people do means two and one-half minutes rest between sets of exercises. But to perform this session CT style, try one set of incline presses, rest, then do a set of pulldowns, rest, and so on. Here, an athlete obtains five and on half minutes of rest between two sets of the same exercise! This is more than double the rest, yet the total exercise duration does not increase. Now it is true this means doing a set every two and one-half minutes, but fatigue from different exercises (particularly if they are for different muscle groups) tends to be specific. This means that even though someone may still be too fatigued to accomplish another set of the same exercise, that person will still be able to complete a set for another exercise. For this reason, CT is clearly a better way of managing fatigue through the workout.

Furthermore, athletes who arrange exercises stations in antagonistic fashion (i.e., a hamstring exercise is followed by a quadriceps exercise), further enhance the efficiency of CT through a principle known as "reciprocal inhibition." Since muscles work in antagonistic pairs,

when performing a set for the agonist (in this case, the hamstring), the antagonist (quadriceps) achieves a better contraction because the hamstrings are too fatigued to oppose it.

Further specified benefits of CT include these important considerations:

1) *Safety.* The fact that CT is a better way of managing fatigue makes it safer than other forms of training. In his excellent book The Sports Medicine Bible, Dr. Lyle Michelli outlines the process whereby fatigue leads to injury.[34]
2) *Motivation.* For many people, "sampling" from each item on the menu is more satisfying than sequentially finishing off, perhaps, swordfish, then rice pilaf, then vegetables, and so on. Similarly, in a work environment, it's more productive to alternate between tasks than it is to spend a huge block of time on a single task. Training is no different. Somehow, it's intrinsically more satisfying to move from exercise to exercise as opposed to "slugging it out" on a single exercise until finished.
3) *Versatility.* CT can be integrated with any favorite training techniques, such as rest-pause training, drop sets or eccentric training. CT athletes can also use any exercise technology, including free weights, machines, plyometrics, Olympic lifts or whatever are appropriate considering individual circumstances. CT accommodates all set/repetition schemes as well.

Drop or Strip Sets. Although drop sets are normally used only in the hypertrophy phase, an interesting study hints at their value for absolute strength development. More than thirty years ago, the venerable researcher Richard Berger[35] took a group of untrained college men and had them do sets of 10 using the bench press with about 80% of 1RM. The contrast group performed drop sets of ten repetitions per set where every repetition was the lifter's momentary 1RM (in other words, a set to failure of one repetition with a maximum weight, quick weight reduction, another set to failure of one repetition, quick weight reduction, etcetera for ten repetitions).

The results? The ten sets of one repetition group gained about 40% more strength despite the fact that the one set of 10 actually lifted slightly more total weight than the contrast group!

Jerry Telle has developed what may be the most evolved system of drop sets, called "wide-spectrum, varied-tempo"(WSVT) drop sets.[36] Here's how it works:

During a warm-up, do just enough to prepare for the work sets without experiencing fatigue in the process. The last warm-up will be a one to two repetition "post-tetanic twitch potentiation" set, or in plain English, a neural preparation set. The objective here is to prepare the central nervous system for the ensuing set and determining a beginning working weight.

After this, rest about a minute, and begin the WSVT drop set. Start with a weight which allows two to four repetitions.

SET	REPS	TEMPO (E-S-C)	REST
One:	2–3	2-1-X	10 seconds
Two:	2–3	2-1-X	10 seconds
Three:	2–3	2-1-X	5 seconds
Four:	6	3-1-2	5 seconds
Five:	5	5-0-5	2 seconds
Six:	5	7-0-7	

Wave Loading. This is a system of nervous system training popularized by Canadian strength specialist Charles Poliquin.[37] The system involves warming up to a three repetition set with approximately 90% of your maximum capacity (1RM). After a rest, perform a two

repetition set with about 95%1RM, rest again, then a 1RM set. Now, back down and repeat the three repetition set, which you should now be able to perform with 92.5%. Then repeat the two repetition set again, but with 97.5% of 1RM, and finally, a new 1RM which should now be possible using 102.5% of your previous 1RM.

Forced Repetitions. Forced repetitions operate on a similar principle as strip sets. After completing as many reps as possible with a given weight, a partner helps complete more repetitions by manually assisting the movement.

Pyramids. This is similar to a formal warm-up. Although the application of this method varies, basically, the lifter performs perhaps twelve repetitions on set one, then adds more weight for ten repetitions on set two, and so on until he arrives at a "top set" which may consist of perhaps two to four repetitions.

One Set to Failure (OSTF). This is the hallmark of the "HIT" philosophy alluded to earlier. HIT proponents believe in one set of eight to 12 repetitions for each exercise (after warm-up sets) to momentary muscular failure. The concept behind OSTF is that by training hard enough, one set should be optimal to train the target muscles used in the exercise.

Proponents of this method suggest that one set is sufficient to recruit a maximal number of motor units. While this may be true (although there is little solid data to support this statement), this approach assumes that simply recruiting a motor unit once is sufficient to fatigue it, which is a prerequisite to hypertrophic adaptations. For beginning trainees, it may be that single exposures to a training stimulus are sufficient to provoke an adaptation. But athletes with even moderate experience are likely to require multiple exposures (sets) in order to fatigue the target motor units. Hypertrophy of other biological tissues is accomplished not by stressing the tissue close to its limits, but by applying a stress which is slightly beyond what it normally encounters. Bone, as an example, hypertrophies when forces equaling approximately one-tenth it's breaking point are applied. This example supports the contention that gradual progression is the ideal method for achieving muscular growth.

This method is perhaps best employed to maintain strength-fitness by reducing the volume of training, or when training muscles which ordinarily don't receive considerable training stress (such as the tibealis anterior) or muscles without recent training.

Partials. In every strength training exercise, there is a "strong" portion of any exercise's range of motion (ROM). In extension exercises like squats and bench presses for example, athletes are significantly stronger during the "top" part of the movement, close to joint lockout. When using partials, stay in that strongest ROM, which allows for the use of heavier weight loads.

Intermittent Sets ("Rest-pause" system). This is a method of increasing intensity by "breaking up" standard sets into smaller, more manageable sets. For example, rather than performing 225 for 10 repetitions (standard set), perform perhaps 240 for six repetitions, rest for 20–30 seconds, and then perform four more reps. Over time, the objective is to gradually reduce the rest between the two segments until one can perform ten repetitions continuously. This method's success lies in the emphasis on good form rather than adjusting the intensity to get a certain number of reps.

Negatives. This refers to lowering a supramaximal load (more than a one repetition maximum) under control. This normally requires the help of a skilled training partner to help raise the weight back to the starting position in between repetitions but it can be done alone with a bit of creativity. For example, with the leg curl exercise, lift the weight with both legs, and then lower it with only one, which creases a supramaximal load for that leg. Negative (or

"eccentric") training can be very useful for both strength and hypertrophy development, but extreme care must be used for the sake of safety. Because this type of training can cause extreme soreness and muscular weakness, it should not be used during the competitive period, or prior to difficult skill-development workouts.

Two-a-days. Training a muscle twice in one day is pretty much what a muscle least expects. This severe approach is effective when used judiciously, but don't attempt it during periods of heavy skills emphasis, or the fatigue and microtrauma it produces will impair speed and coordination at best, or lead to an injury at worst.

Endurance Development

Endurance is the ability to maintain a high quality of work in the face of fatigue. All athletic skills and events require endurance to some extent, however, the energy requirements of extremely brief skills (such as a single punch, for example) are normally met with ease.

$V0_2$ Max: The Ability to Utilize Oxygen

Whenever athletes discuss endurance capacity, the term "$V0_2$ max" (or "max 0_2") is used. $V0_2$ max is a measure of how much oxygen is consumed and used aerobically, and is specified as milliliters of oxygen per kilogram of bodyweight per minute, or mls/kg/min. Although athletes with a higher $V0_2$ max have a greater potential capacity to use oxygen aerobically, (and, by inference, should have better endurance abilities), in reality, there is a significant difference between aerobic capacity (as determined by $V0_2$ max) and actual endurance performance ability, which is determined by something called the "lactate threshold." A big $V0_2$ max determines the ceiling for the athlete's sustainable work rate. It is a measure of the size of an athlete's "engine." However, it is the lactate threshold that determines the actual percentage of that engine power that can be used continuously.

The Lactate Threshold

When muscles perform intense work, they produce a waste product called lactic acid. This lactic acid is familiar to anyone experiencing an intense muscular burn after performing a hard sprint or an extended set of bench presses in the gym.

Up to a point, the body can "clear" this lactic acid by using it as fuel for energy (which is called "oxidation"). This point is the definition of the lactate threshold. While working at a low intensity, the body is capable of clearing the lactic acid "on the fly" and performance may continue indefinitely (in theory, at least). This is called "aerobic endurance." If, on the other hand, someone works at a high percentage of maximal abilities, so much lactic acid is produced that the body will be unable to clear it, unless work output is reduced or stopped, allowing the body's aerobic processes to clear the lactic acid. This process is sometimes called "oxygen debt" because, although someone can work very hard without oxygen for a brief period, at some point the high energy requirements force athletes to stop and undergo heavy respiration as a "pay back" to the body.

According to Jerry Robinson and Frank Carrino in their text *Max 0_2*, the average sedentary person has a $V0_2$ max anywhere between 20 and 40 mls/kg/min and a lactate threshold at about 50% of their $V0_2$ max.[38] Of course, well-trained endurance athletes have much higher $V0_2$ max scores (please see Table 3-15), with lactate thresholds approaching 80–90%

Event	Men	Women
Cross-country Skiing	82	63
Running 3000 meters	79	—
Speed Skating	78	54
Orienteering	77	59
Running 800–1500 meters	75	—
Bicycling	74	—
Biathalon	73	—
Walking	71	—
Canoeing	70	—
Downhill Skiing	68	51
Running 400 Meters	67	56
Swimming	66	57
Ski Jumping	62	—
Rowing	62	—
Gymnastics	60	—
Table Tennis	58	44
Fencing	58	43
Wrestling	56	—
Weight Lifting	55	—
Archery	—	40
Untrained	43	39

TABLE 3-15: Average Maximal Oxygen Uptake of Team National Athletes[39]

of their $V0_2$ max. This means that athletes who wish to improve their endurance performance capabilities can train to improve their $V0_2$ max, their lactate threshold, or both.

Smart athletes work on both aspects in their training, although most people can only hope to improve their $V0_2$ max about 20–40% over an entire athletic career. In other words, there are more significant genetic restraints on $V0_2$ max than there are on improving the lactate threshold. It should be obvious by now that an athlete with a lower $V0_2$ max, but a higher lactate threshold can have a better endurance performance than a peer with a higher $V0_2$ max but a lower lactate threshold. A hypothetical comparison illustrates this point:

	Larry	**David**
$V0_2$ Max*	67	60
Lactate threshold	70	85
Performance capacity*	46.9	51

*Measured as milliliters of oxygen per kilogram of bodyweight per minute (mls/kg/min). David, who may have significant genetic limitations on $V0_2$ max, has still managed to develop a superior endurance performance capacity compared to Larry by raising his lactate threshold.

The Periodization of Endurance Training

In a periodized training program, it's important to develop $V0_2$ max, improve the lactate threshold, and also the third aspect of endurance development, technical efficiency (which means refining technical skills to the utmost.

In phase one, the accumulation of training volume early in the macrocycle is known as laying down an "aerobic base." This is accomplished primarily through training which is well below the lactate threshold. This usually occurs through continuous, "steady state" activities

such as running, cycling, stair climbing, swimming, rope-skipping, and so forth. This aerobic foundation is what creates the necessary "machinery" which will serve to create a better anaerobic working capacity later in the cycle. In other words, as aerobic fitness improves, athletes are able to work harder and longer before reaching the lactate threshold.

When attempting to develop or improve aerobic capacity, training should take place between three and six days a week. The total duration of work in each session might be anywhere from ten minutes to an hour or more. Longer durations are inappropriate for martial artists, unless they expect their competitive event to require more than 30 to 45 minutes of continuous activity. The intensity of training should, by definition, be low (if it was high intensity, it would be anaerobic, not aerobic). Although many heart-rate formulas have been used with success, the age-old "talk test" is very accurate. If someone can carry on a conversation during the aerobic workout, the intensity is appropriate. If unable to talk, reduce the intensity. Save super-intense training for the anaerobic interval phase later in the training cycle. Remember, the goal here is not to raise the lactate threshold. Instead, athletes in this cycle are developing the foundation; the peak will be added later. One last point: while progressing through the macrocycle, the content of aerobic activities should gradually progress from a wide selection of different activities, to a smaller, more specific group of activities. For example, when establishing an aerobic base, one might cycle on Monday, swim on Tuesday, run on Wednesday, and so forth.

When it comes to aerobic training, "the more is better" philosophy of so many athletes is counterproductive, particularly with regards to strength and body composition, as the following findings suggest:

- According to a recent study published in *Muscular Development* magazine, muscle necrosis (tissue death) and inflammation can be observed in the calves of marathon runners seven days after a race.[40]
- According to Dr. Marc Breehl, a leading anaesthesiologist specializing in cardiac surgery, the enlarged hearts of aerobic athletes are weaker, not stronger than those with anaerobic backgrounds.[41]

So, the idea is to "get the most bangs for the buck" by doing as much aerobic training as it takes to maximize aerobic capacities, but also to stop when experiencing diminishing returns. Too much aerobic exercise, at too hard a pace, impairs strength training sessions and inhibits recovery from the training program.

Two Hypothetical Eight-Week Aerobic Endurance Training Programs

In Table 3-16 two programs illustrate the basic ways that aerobic endurance programs can be constructed: "steady-state," which means performing a single bout of continuous activity (at the highest heart rate that one can manageable for the entire duration), and "aerobic-interval training," which utilizes a handful of shorter bouts, separated by short rests. Although both options can be used by any athlete, the aerobic-interval method is more appropriate for experienced athletes, since the shorter durations allow for higher heart rates which are obviously more stressful than the steady-state method. Another option is to first use the steady-state program, followed by the aerobic-interval program, which serve as an intermediate-intensity zone leading up to the anaerobic intervals to follow later in the macrocycle. For the sake of clarity, both programs involve exactly the same overall volume of training, as measured by time.

Steady-state method:

Week	Mon	Wed	Fri
1	Cycle, 20 mins	Swim, 25 mins	Run, 30 mins
2	Rowing, 25 mins	Sparring Drills, 35 mins	Cycle, 35 mins
3	Swim, 30 mins	Run, 35 mins	Rowing, 40 mins
4	Sparring Drills, 35 mins	Cycle, 40 mins	Swim, 45 mins
5	Run, 40 mins	Rowing, 45 mins	Sparring Drills, 50 mins
6	Cycle, 45 mins	Swim, 50 mins	Run, 55 mins
7	Rowing 50 mins	Sparring Drills, 55 mins	Cycle, 60 mins
8	Swim, 55 mins	Run, 60 mins	Rowing, 65 mins

Aerobic-interval method:
(Note: rest intervals are always 1/2 the duration of the work intervals being performed that day)

Week	Mon	Wed	Fri
1	Cycle, 2x10 mins.	Swim, 5x5 mins	Run, 3x10 mins
2	Rowing, 5x5 mins	Sparring Drills, 3x10 mins	Cycle, 7x5 mins
3	Swim, 3x10 mins	Run, 7x5 mins	Rowing, 4x10 mins
4	Sparring Drills, 3x5 mins	Cycle, 4x10 mins	Swim, 9x5 mins
5	Run, 4x10 mins	Rowing, 9x5 mins	Sparring Drills, 5x10 mins
6	Cycle, 9x5 mins	Swim, 5x10 mins	Run, 11x5 mins
7	Rowing 5x10 mins	Sparring Drills, 3x10 mins	Cycle, 6x10 mins
8	Swim, 11x5 mins	Run, 6x10 mins	Rowing, 13x5 mins

TABLE 3-16: Aerobic Endurance Training Modalities

In phase two, after developing the highest amount of aerobic efficiency possible within the confines of a training cycle, it's time to throttle back a bit on training volume to make way for anaerobic interval training for the purpose of raising the lactate threshold. The aerobic base just established will now be downshifted to "maintenance" level by reducing the total volume of aerobic training down to between 25–50% of the original volume. Efforts will now be dedicated primarily to improving the ability to tolerate a lactic acid buildup, which is really a more significant limiting factor than aerobic capacity for most martial artists.

Understanding Intervals. An interval is defined as a period of time or a specified distance. For athletes, it means repeated bouts of high intensity exercise with intermittent rest periods. Since the 1960s, interval training has come to be thought of as the key to endurance performance success. In some training programs, it accounts for 50–75% of the total training volume. Intermittent exercise allows a higher total volume of high intensity work, and also accumulates a greater volume of stress on the blood pumping capacity of the heart. According to exercise physiologist Dr. Steven Seilor, the periodic elevations and decreases in intensity may create special loading stresses on the heart that are adaptive. Seilor suggests that during an interval, heart rate climbs high, then at the moment the interval stops, heart rate immediately starts to drop, but venous return remains high. These exposures to additional ventricular stretch may help trigger ventricular remodeling (increased heart ventricle volume).

Training Parameters for Anaerobic Interval Training. This phase of the endurance training program should be tailored to the actual event duration that is anticipated. For example, a kickboxer entering a match composed of six, two minute rounds, there is no point in

engaging in three hour runs to improve endurance for the fight! In fact, even twenty minute intervals with five minute rests means using 10 times the volume of the upcoming fight! Athletes who believe excessive endurance training improves "wind" actually train the wrong energy system for the job. It would be like trying to improve 100 meter speeds by running 1,000 meter intervals!

When performing anaerobic intervals, athletes should work as hard as possible for the duration of each interval. But perhaps more important, focus on the quality of the effort. After all, what's the point of doing repeated two minute intervals on the heavy bag if technique is atrocious?

Two Hypothetical Anaerobic Interval Training Programs: Although two programs for anaerobic training are demonstrated, always make modifications as needed based on present performance capacity. For example, if someone is unable to go "all out" with an opponent for 30 seconds without falling apart, neither of the following programs will be appropriate. In turn, such an athlete must reduce the duration of the intervals, at least for now. The rule-of-thumb is to first establish quality, then increase quantity.

For purposes of illustration, consider two athletes, one with better strength than endurance, and the other with better endurance than strength. There are eight weeks to go before a competition. Here is a hypothetical interval training program for each athlete:

Jim: strong, but needs better short-term endurance.

Week	Mon	Wed	Fri	
1	10x90 sec	11x90 sec	12x90 sec	(rests = 120 secs)
2	9x120 sec	10x120 sec	11x120 sec	(rests = 120 secs)
3	10x120 sec	11x120 sec	12x120 sec	(rests = 120secs)
4	9x150 sec	10x150 sec	11x150 sec	(rests = 90secs)
5	10x150 sec	11x150 sec	12x150 sec	(rests = 90secs)
6	9x180 sec	10x180 sec	11x180 sec	(rests = 90 secs)
7	10x180 sec	11x180sec	12x180 sec	(rests = 60 secs)
8 (taper)	8x150 sec	4x120sec	2x90 sec	(rests = 60 secs)

Joe: good stamina, but needs more strength and speed.

Week	Mon	Wed	Fri	
1	8x150 sec	9x150 sec	10x150 sec	(rests = 90 secs)
2	10x150 sec	11x150 sec	12x150 sec	(rests = 120 secs)
3	9x120 sec	10x120 sec	11x120 sec	(rests = 120 secs)
4	10x120 sec	11x120 sec	12x120 sec	(rests = 150 secs)
5	9x90 sec	10x90 sec	11x90 sec	(rests = 150 secs)
6	10x90 sec	11x90 sec	12x90 sec	(rests = 150 secs)
7	9x60 sec	10x60 sec	11x60 sec	(rests = 180 secs)
8 (taper)	8x60 sec	4x60 sec	2x60 sec	(rests = 180 secs)

As the above scenarios indicate, strength is developed by performing intervals which are slightly shorter than the competitive event-duration, while endurance is developed by performing slightly longer intervals.

Anaerobic Interval Training Content. Unlike the aerobic build-up period, the activities

performed must be much more event-specific during this phase. Use primarily competitive skills and skill-elements in a controlled, yet challenging environment to prevent injury in the final weeks leading up to an event. Athletes can spar with safety equipment or by "handicapping" themselves. One example is to rotate opponents to keep them fresh. Another example of a handicap is to spar without using a favorite technique, which will force development of weaknesses.

Finally, in phase three it's time to maximize technical efficiency. It is established that high level endurance performance depends on a high VO_2 max and a high lactate threshold. VO_2 max sets the upper limit for sustainable work potential. The lactate threshold indicates how much of one's cardiovascular capacity can be used in a sustained effort. Multiplying VO_2 max by lactate threshold provides a measure of the size of the "endurance engine." In sport, however, victory does not automatically go to the athlete with the biggest engine. Efficiency (or technical skill) is critical to maximizing performance capacity. Someone might have a VO_2 max of 85 and a lactate threshold of 90%, but if, during a grappling session, precious energy is wasted by attempting techniques from poor positions of leverage, or an athlete gets caught in a neck crank, it's all for naught!

Of course, technical skill is something to work on all the time, but it must receive particular energy and attention during the late preparatory and early competitive periods. So again, it all goes back to the training factor's pyramid discussed in Chapter One. Sport performance is based on technical preparation, which is based upon physical preparation. Just like strength and flexibility development, endurance training is a means to an end, not an end unto itself.

Flexibility Development

Martial artists generally need higher levels of joint flexibility than the general population. Despite this, many martial artists continue to use outdated methodologies in their quest to improve joint flexibility.

The International Sports Sciences Association (ISSA) offers the following definition: "Flexibility is your ability to flex, extend, or circumduct your body's joints through their intended full range of motion without a substantial decrement in limit strength."[42]

The term "flexibility" refers only to joints, and never to muscles or other soft tissues. The terms "loose," "supple," and "stretched," "extended," and "elongated" are more appropriate descriptions for these tissues.

Most martial artists typically tend to overemphasize flexibility training to the neglect of developing functional strength while in the stretched position. Significantly improving a joint's range of motion without also improving the strength of the surrounding musculature (especially at it's "new" range of motion) can be an invitation for injury.

For example, when an individual has improved his or her flexibility (in a given joint or group of joints) to the point where an additional five degrees of motion exists, the affected muscles now have a reduced amount of overlap between the actin and myosin filaments, resulting in a substantial reduction in force output ability. For this reason, strength and flexibility training programs must occur concurrently.

Whenever human movement is discussed, terms such as "strength," "flexibility," "endurance," and "speed" are used for the purpose of identifying and describing various qualities of that movement. These qualities are isolated only for conceptual purposes. Please

realize that all human movement reflects various degrees of strength, flexibility, endurance, and speed simultaneously.

Anatomical and Physiological Basis of Stretching

Understanding flexibility starts with a basic knowledge of cellular muscle anatomy and physiology. Of particular importance is the basic unit of the muscle cell which includes the sarcomere and the three primary inhibitory proprioceptors (the Golgi tendon organ (GTO), the muscle spindle, and the Pacinian corpuscles).

The Sarcomere. Muscle fibrils have the ability to change length because they are constructed of overlapping strands of protein polymers called actin (the thin strands) and myosin (the thicker strands). The "boundaries" of the sarcomere are called "Z disks," where the actin filaments are attached. In the center of the sarcomere are the myosin strands, which, during contraction, can "pull" the Z disks closer together by attaching to the actin filaments with specialized heads called "cross bridges." These cross bridges function much like boat oars as they reach out, attach, and pull on the actin filaments, causing the Z disks to move toward one another.

When stretching a muscle, the opposite occurs. During the stretch, the fibers elongate as each sarcomere extends to the point where no overlap between the thick and thin filaments exists at all (specialized elastic filaments called "titin" keep the sarcomere together in the absence of overlap). At this point, the remaining stress is taken up by the surrounding connective tissue (sarcoplasmic reticulum, sarcolemma, and endomesium). If the stretch tension continues to escalate beyond this point, however, microscopic tears develop both in the connective tissues and within the sarcomere itself. Such microtraumatic injuries eventually heal, but at the cost of scarification and micro-adhesions that may leave the muscle fiber less capable of contraction and extension. Unique research conducted at the University of London by Drs. Pamela Williams and Geoffrey Goldspink from the University of London[43] suggest that over long periods of prolonged muscle elongation, the body detects that the overlap between actin and myosin has been reduced, and resynthesizes new sarcomeres at the ends of the myofilament in order to reestablish normal amounts of actin-myosin overlap within each sarcomere. Greater overlap means improved force production potential, so this may be another important reason for martial artists to include stretching in their training programs.

The Proprioceptors. The neuromuscular system has built in safeguards against severe muscular injury. These safeguards take the form of proprioceptors that can sense changes in muscle tension. When these changes are too sudden, too intense, or both, the proprioceptors act to inhibit the nervous impulse sent to the muscle. There are three primary proprioceptors involved in stretch inhibition: the Golgi tendon organ (GTO), the pacinian corpuscle, and the muscle spindle.

The Golgi tendon organ is located at the musculo-tendinous junction, and it detects the magnitude of mechanical stress on the muscle. When excessive tension develops, the GTO causes the motor cortex of the brain to "shut off" muscle contraction. The GTO is not sensitive to the rate of force development, only the absolute value of tension that develops within the muscle.

Pacinian corpuscles are small, elliptical bodies which lie in close proximity to the GTOs. They are sensitive to quick movement and deep pressure. As compared to the GTO and muscle spindle, the inhibitory role of this organ is not well understood.

The muscle spindle is actually a specialized muscle fiber which detects excessive stretch

within the muscle. Muscles which are responsible for fine movements (such as those around the eyes) contain more muscle spindles per gram than do muscles responsible for gross movements (such as the quadriceps). Unlike the GTO, the muscle spindle does not relay signals through the motor cortex; as such, it is not considered a feedback loop, but rather an inhibitory knob. Resetting the muscle spindle is the mechanism of PNF and contract-relax stretching methods.

The implications for athletes and others trying to improve their joint mobility includes the following recommendations. Rather than short, intense bouts of stretching (which tend to trigger the proprioceptors), opt for longer, frequent periods of stretching where lesser tensions are used. Soreness after a stretching session is a sign that hydroxyproline and other biological "mortars" have been released into the muscle fiber to help repair damaged tissues. It's probably a sign of stretching too hard.

Inflexibility and Injury Potential

Sometimes, repetitive, limited range of motion activities over a prolonged period of time can create shortened muscles. The hip flexors (psoas and iliacus) can become shortened due to extended periods of sitting and bicycling—activities where the hip flexors maintain a limited range of motion. Weight training exercises, if habitually performed in a shortened range of motion (i.e., sans full extension and/or flexion) can also lead to shortening.

Chronically shortened muscles can be the first step in a series of events leading to injury. For example, shortened hamstrings can, over time, lead to a reduction of the normal lordotic curve of the lumbar spine, which can impair the spine's load-bearing and shock absorption capacity. When the spine cannot function normally, a wide range of injuries (from chronic to acute) can result.

In another example, over tight quadriceps can pull the patella upward (proximally), causing it to track abnormally high on the femoral groove (called "patella alta"). Such a condition can potentially result in a roughening of the underside of the patella (chrondromalacia patellae), leading to pain, inflammation, and eventually, debilitation.

Specificity and Flexibility

Specificity is one of four core principles of physical training as indicated in Chapter One. Like all other bio-motor abilities, joint flexibility can only be enhanced if the training methods are specific to the desired result. Flexibility is specific to two criteria:

1) *Joint Specificity.* A flexibility training program for the hips will not improve flexibility in any other joint. The joint-specific nature of flexibility training does not necessarily mean that all joints must be targeted with flexibility exercises. Flexibility training can be prioritized toward joints which are most in need as a way of maximizing training efficiency.
2) *Position and Speed Specificity.* For maximum effectiveness, stretching exercises must reflect the positions and speed of the skill designated for improvement. Slow, static stretching, for example, will not improve high and fast kicking movements nearly as well as dynamic stretching movements. Conversely, dynamic stretching methods have limited ability to improve a static skill, such as a split on the floor.

Resistance Training Contributes to Increases in Joint Flexibility

Properly designed resistance training programs can have a beneficial effect on flexibility levels. In fact, whatever the level of flexibility, the primary concern is that there is adequate strength throughout the joint's full range of motion. Two key points are to perform resistance

exercises through the involved joint's full range of motion, and to work antagonistic pairs of muscles equally.

How Much Flexibility is Enough?

This of course varies from individual to individual, but it can safely be said that individuals need enough flexibility for any situation that they will normally encounter in day to day life with a little bit more. This "little bit more" is called the "flexibility reserve." Conversely, if adequate flexibility is lacking, the difference between what one possesses and what one needs is called the "flexibility deficit." Of all the bio-motor abilities, joint flexibility is one of the simplest to develop. The methods involved are well understood, and they require little time, effort, or specialized equipment.

The Effect of Body Temperature on Flexibility

Body temperature is an important consideration when attempting to improve joint flexibility. Increased temperature helps to facilitate increases in range of motion (ROM), while decreased temperature tends to preserve increases in muscle length. Prior to performing stretching exercises, body temperature must be elevated through a warm-up. The warm-up can be passive, meaning a hot bath or shower, or preferably, active, meaning a brief session of cardiovascular activity. Although many individuals use stretching as a warm-up, such a practice is ineffective and counterproductive. Pre-stretch muscular activity (of a resistance training or cardiovascular nature) is important in two regards.

First, body temperature is elevated. Second, muscles are subject to thixotropy, which is the tendency of gels to become less viscous after being shaken or otherwise disturbed by outside forces. This explains why periods of inactivity tend to cause muscular stiffness (probably resulting from microscopic bonding and adhesions between actin and myosin strands), and why muscular viscosity is restored when muscles are subjected to movement. The most appropriate time to stretch a muscle (from the perspective of body temperature and the thixotropic effect) is either after resistance training in the weight room, or after engaging in cardiovascular activity, such as sparring, bag work, or similar activities. In this way, the target muscle tissues are warm and viscous (which facilitates lengthening), but in the process of cooling (which tends to preserve long-term improvements in length).

Humidity also plays a factor in stretching and flexibility development. Athletic experience suggests certain temperatures have varying "quality" depending on the humidity. In other words, an athlete will have an easier time warming up in 70 degree temperature at 90% humidity than in 70 degrees at 70% humidity. Although the exact mechanisms of this phenomenon are not yet fully understood, most coaches and experienced athletes acknowledge that increased humidity has the effect of intensifying the effect of temperature.

Tension Magnitude During Stretching

Muscle tension is another important consideration when stretching. Stretching methods can range from intuitive "cat nap" limbering (which is useful for releasing adhesions and microscopic tissue bonding after periods of inactivity) to aggressive stretching regimes designed to radically increase a joint(s) range of motion (as performed by dancers, martial artists, and gymnasts). Of course, discomfort and pain are subjective experiences, and individuals have varying tolerances to both. Stretch to the point of mild discomfort if the goal is to improve range of motion, but short of discomfort if the primary objective is to speed up

the removal of waste products during or after a workout. When stretching a partner, carefully observe his or her facial expression—it should be calm and placid. Any hint of facial tension may indicate excessive stretch tension.

Duration

Ideal stretching duration can vary depending on many factors, primarily the type of stretching method being used (described subsequently). Dynamic stretching for instance, involves several "swings" that last only a moment or so each. Static-active and contract-relax methods involve longer periods lasting up to a minute or more. Stretching sessions rarely last more than twenty minutes, with each individual muscle normally taking two to three minutes at most. The agonizing stretching sessions used by martial artists, gymnasts, and dancers are probably no more effective (and may actually result in scarification) than longer sessions of lesser intensities.

Breathing and Relaxation

Much has been made of proper breathing patterns while stretching yet athletes should not overanalyze a function that should come naturally and instinctively. Athletes should breathe normally and visualize the muscles, tendons and ligaments lengthening during the stretch. Since breath holding can increase blood pressure and general muscular tension, it should be avoided. Correct breathing functions to enhance relaxation while stretching, particularly when the exhale is timed to coincide with the elongation phase of the stretch. Of course, it should be intuitively recognized that it is difficult to maintain muscular tension while exhaling!

Stretching as a Means of Preventing Delayed Onset of Muscle Soreness (DOMS)

Although research is still inconclusive, low to moderate intensity stretching exercises may be effective in reducing post-exercise muscle soreness (perhaps the best rationale for most people to stretch regularly). Stretching (or massaging) the affected muscle can be seen as roughly analogous to wringing out a sponge, which serves to help rid muscles of hydroxyproline and other waste products that result from exercise-induced microtrauma. A note of caution, however: aggressive stretching, as described earlier, may actually cause microtrauma. If the goal of stretching is to increase joint ROM, this is an unfortunate but unavoidable side effect. If on the other hand the objective is reduction of DOMS, stretching must be performed with reduced tensions.

Periodization of Stretching

Like all training components (including nutrition), stretching exercises should be periodized throughout the training cycle. For individuals who do require high levels of ROM, the following points will be helpful when designing an overall training schedule:

1) If flexibility is a weakness, it should be brought to high values late in the preparatory period, and then maintained through the competitive period. Problem joints should receive priority attention all through the preparatory period.
2) Excessive flexibility appears to be detrimental to some athletes involved in strength and power sports, because it may reduce the amount of elastic energy the muscle can store during a stretch-shortening cycle (described earlier in this chapter). For example, too much hip flexibility can weaken the stability of the low position in the squat.
3) If the objective is to increase ROM, intensive stretching should not be performed every

day, as the muscle and connective tissues need time to heal. A schedule where adaptive tension stretching occurs every other day, interspersed with days of light tension stretched should be considered.

4) When reduction of DOMS is the objective, stretching exercises can be performed every day, or nearly every day. The most effective method involves stretching muscles immediately after they have been resistance trained. Those wish to plan static stretching on a day where no resistance training occurs should perform ten to fifteen minutes of cardiovascular warm-up at low intensity or take a hot shower, steambath, or jacuzzi prior to stretching.

Assessing Range of Motion

Over the years, physical therapists, orthopedists, and other professionals have created standards for the minimal acceptable length for nearly every muscle in the body. The most important assessments for martial artists. They include tests for length of the hamstrings, quadriceps, hip flexors, abdominals, external and internal rotators of the hip, adductors of the hip, the internal rotator of the arm, and the rotators of the head. These assessments involve skills that may be beyond the current abilities of some coaches and athletes. However, they represent the complete resources for a full assessment.

While learning to perform these assessments, remember they represent minimal standards for optimal health and functioning. In many cases, martial artists require much more flexibility in order to perform their skills efficiently and safely.

Regardless of the muscle's length, however, it is of particular importance that there is equal length on both left and right sides of the body. For example, if an athlete's left quadriceps has normal length but the right quad is significantly short, try to determine the cause (perhaps a former or present injury) and take steps to correct it. Otherwise, this asymmetry could present the athlete with a variety of problems, such as dysfunctional joint mechanics, which could eventually destroy the joint.

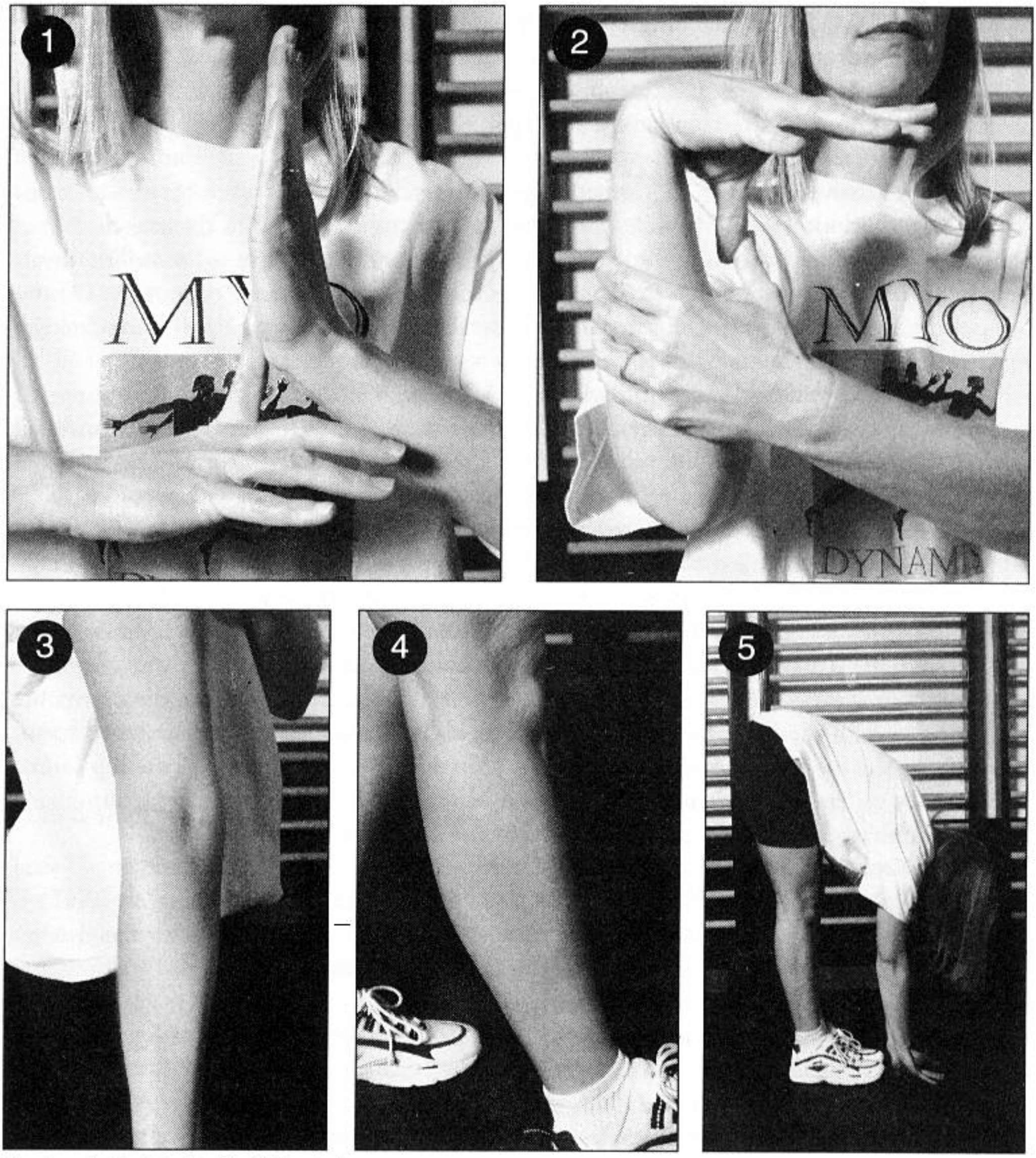
The Rocabado 9-Point Flexibility Index[44]

The following assessment was designed by physical therapist and author Mariano Rocabado. The index measures an individual's inherent or "constitutional" level of joint flexibility. The index is conducted by performing the following tests:

1) Pull the little finger back as far as possible. If it makes a 90-degree angle with the back of the hand, score one point. If able do the same with the other hand, score another point.
2) Push the thumb toward the inner part of the wrist, as shown in the photo. If able make it touch, score one point. If able to do the same with the other hand, score another point.
3) Extend one elbow as far as possible. If the arm hyperextends ten degrees or more, score one point. If able do the same with the other arm, score another point.
4) Extend one knee as far as possible. If the leg hyperextends ten degrees or more, score one point. If able to do the same with the other leg, score another point.
5) While standing, try to place both palms on the floor with legs straight and together. If able, score one point.

Scoring

0–2 points: Low level of flexibility
3–4: Moderate level of flexibility
5–9: High level of flexibility.



The Rocabado 9-Point Flexibility Index

The above classification system can be used to identify the relative proportion of flexibility training that should be included in an athlete's training cycle, and can be used as a talent identification tool for young athletes considering sports which require exceptional flexibility, such as taekwondo or wushu.

Methods of Increasing Joint Range of Motion

Static Stretching. This is the form most commonly practiced by athletes and fitness enthusiasts. While possibly effective for recovery purposes, the static method is not as effective as contract-relax method (to be discussed shortly) in terms of achieving long term

increases in ROM. Static stretching is contraindicated prior to resistance training, as it can temporarily lower strength levels. Two types of static stretching are identified.

In static-active stretching, assume the desired position, move slowly toward one's extreme range of motion for the stretching joint, and upon reaching the desired level of tension, hold for ten to sixty seconds.

In static-passive stretching, a partner helps the stretching athlete reach his or her maximum range of motion (ROM) while the athlete relaxes and "submits" to the stretch. Never bounce or jerk while performing static stretches. It is sometimes effective to "pulse" rhythmically several times, assuming the stretch is well within one's present range of motion. During the pulsing rhythm, one's nervous system will be able to anticipate and accommodate the movements, resulting in an effective stretch.

Dynamic Stretching. Used primarily by athletes who need to increase their range of motion for sports skills, dynamic stretching involves swinging the arms or legs in a controlled manner. Various patterns can be utilized. When stretching dynamically, care must be taken not to exceed the present range of motion for the joint(s) stretched, or injury could result. Several methods can be used to ensure the safety of this type of stretching.

First, an even, controlled rhythm must be established, with swinging movements initially well within the current range of motion, and then gradually increase the amplitude of the movement until reaching the desired level of tension at the endpoint of the movement.

Second, the stretch reflex can be averted by stopping the moving limb prior to the target joint reaching the end of it's range of motion. As an example, during a standing dynamic hamstring stretch, the individual can swing (kick) his or her leg into an outstretched hand, which stops the foot at the end of each swing, prior to the extreme range of the hip joints. The nervous system will anticipate this, and as a result, the "stretch reflex" will be minimized or even eliminated. These are specialized movements and must be carefully used.

PNF Method. Originally developed by Dr. Herman Kabat, and later refined by physical therapists Dorothy Voss and Margaret Knott,[45] proprio-neuromuscular facilitation (PNF) is defined as "methods of promoting or hastening the response of the neuromuscular mechanism through stimulation of the proprioceptors." True PNF requires specialized training and is normally used only in a clinical setting with paralytic patients. Although there are many different PNF methods, most forms involve dynamic, rotational and angular movements done in accordance with verbal cues from a registered physical therapist.

Contract-Relax (CR) Method. This method of stretching is commonly referred to as PNF by individuals within the fitness industry. However, the term "contract-relax" is distinguishable from true PNF. The contract-relax method is performed with a partner who carefully provides resistance for the stretched muscle prior to actually stretching it. The rationale here is that when contracting a muscle before stretching it, the stretch reflex (the body's protective reflex) is inhibited. This reflex prevents one from reaching the maximum range of motion. This built-in safety mechanism is set very conservatively, however, and "fooling" it through this type of stretching is quite safe when done properly. The contract-relax method is particularly effective during the latter part of the warm up, as the muscular exertions promote an increase in body temperature.

One benefit of contract-relax stretching is that the targeted muscles become stronger in their extreme ranges of motion. Keep in mind that the moment a joint reaches a new (higher) level of flexibility, the associated muscles now have a small region that has never experienced contraction. For this reason, gains in flexibility should be coupled with strength gains in the

newly-acquired ranges of motion, to mitigate the chances of injury.

Contract Antagonist-Relax (CA) Method. This is very similar to the contract-relax method. CA stretching facilitates an increase in muscle length through a maximum isometric contraction of the antagonist immediately prior to a static stretch of the agonist. Because the antagonist is momentarily fatigued from the isometric exertion, it becomes less able to oppose the lengthening of the agonist.

When using CR and CA stretching methods, athletes will sometimes find that a single stretch will result in a large improvement in range of motion. In other instances, several repetitions of a stretch will have little results. In the former scenario, the tightness is due to neural regulation of muscle length. This is why a single contraction will yield so much improvement. In the latter scenario, the tightness is more structural (due to adhesions or micro-trauma) in the muscles and/or connective tissue. In these cases, athletes should consult a skilled soft-tissue therapist, who can loosen the tissues through a variety of tissue manipulations.

Fascial Stretching. As mentioned earlier, fascia (the elastic, membranous "sheath" which encases muscles and muscle groups) can bind and constrict the muscles that surround a joint. Dr. Ida P. Rolf was largely responsible for raising awareness of this phenomenon by developing Structural Integration (or Rolfing, as it is commonly known), a method of improving the body's natural alignment with gravity by "releasing" fascial restrictions to efficient, natural movement.[46] Fascial stretching involves deep tissue manipulation and should only be performed by a competent physical therapist or certified Rolfer. Although fascial stretching is still a new and evolving practice, it holds great promise for those who wish to achieve a permanent increase in their range of motion.

Introduction to Muscle Training Section

The strength training and stretching exercises presented in this chapter are not exhaustive! The techniques presented are those movements considered particularly effective through extensive experience as a strength specialist. Nevertheless, there are many other exercises available, many of them very effective, which are available to martial artists seeking to improve their strength.

Although this book can be a valuable step along the way to understanding strength and flexibility training, it must not be viewed as the last step. Exercise biomechanics include many subtle nuances which are not fully apparent in "the written word" (or even though videotape for that matter). So please consider this book as a tool to orient oneself in the right direction. Readers are also strongly urged to consider hiring a competent specialist for personal tutoring and coaching. For a list of competent professionals, please call the International Sports Sciences Association at 800-892-ISSA.

Abdominals and Trunk Muscles

Description: The "core" region of the torso consists of the abdominals (the rectus abdominus, transverse abdominus, and the external and internal obliques), the back extensor muscles (erector spinae), and the side flexors (the quadratus lumborum). The abdominals include the rectus abdominus, internal and external obliques, and transverse abdominus.

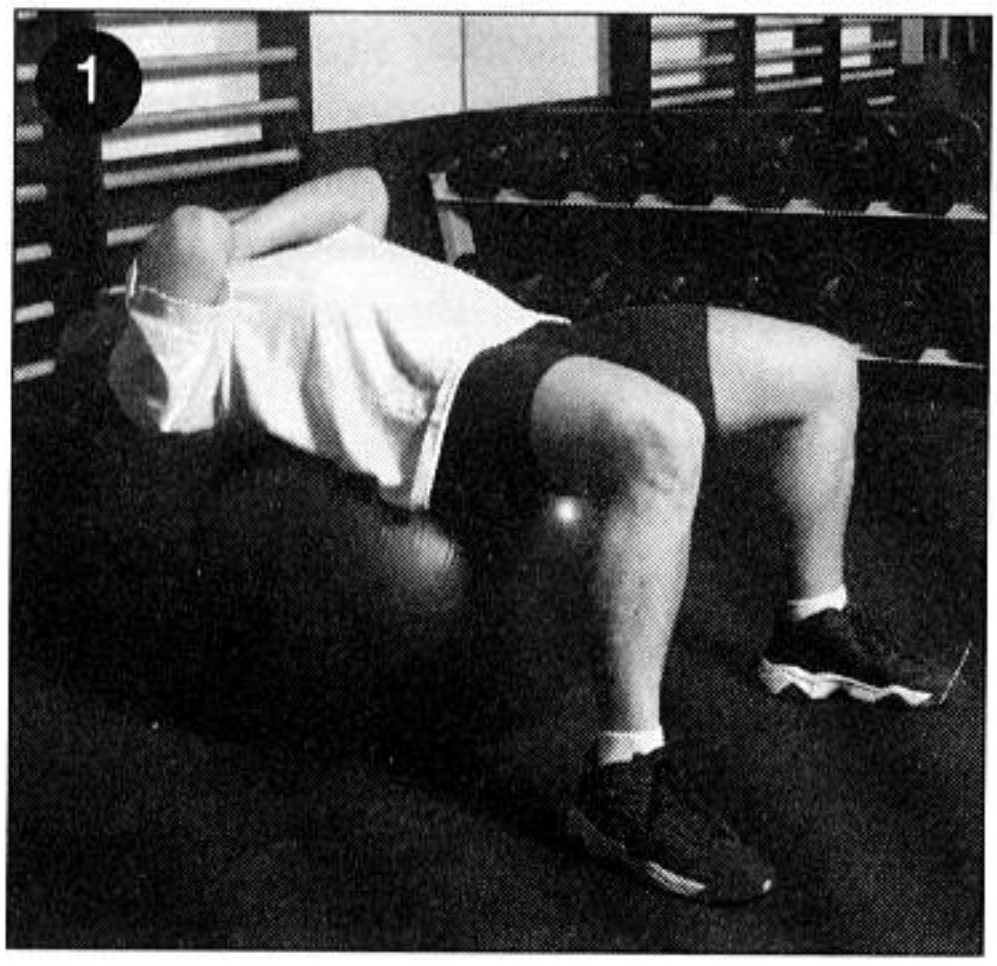
The rectus abdominus originates at the diaphragmatic arch, and inserts into the

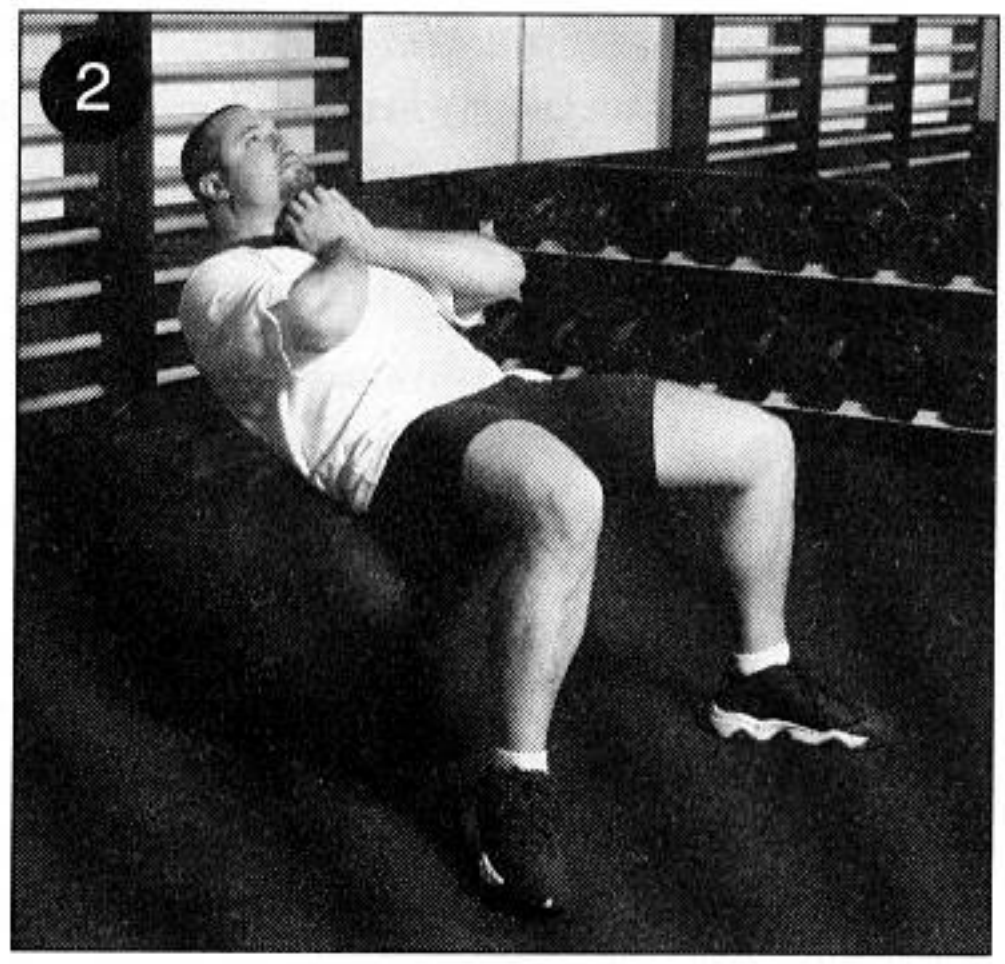
pubic symphysis of the pelvis. It functions to cause trunk flexion, such as when performing the crunch exercise.

The primary role of the rectus abdominus is trunk flexion (seen when the sternum and pelvis are drawn toward each other). Therefore, the most direct and effective exercises are those which cause trunk flexion, such as the various types of crunch exercises.

Although the rectus abdominus can be trained through "hanging leg-raises" and related movements, these exercises are extremely difficult to perform properly, even for very strong athletes. Usually, athletes performing these exercises tend to use primarily hip flexion, with the abdominals contracting statically to stabilize the movement. Think of hanging leg raises as a hip flexor exercise, unless 90 degrees of hip flexion can be maintained while flexing and extending the trunk.

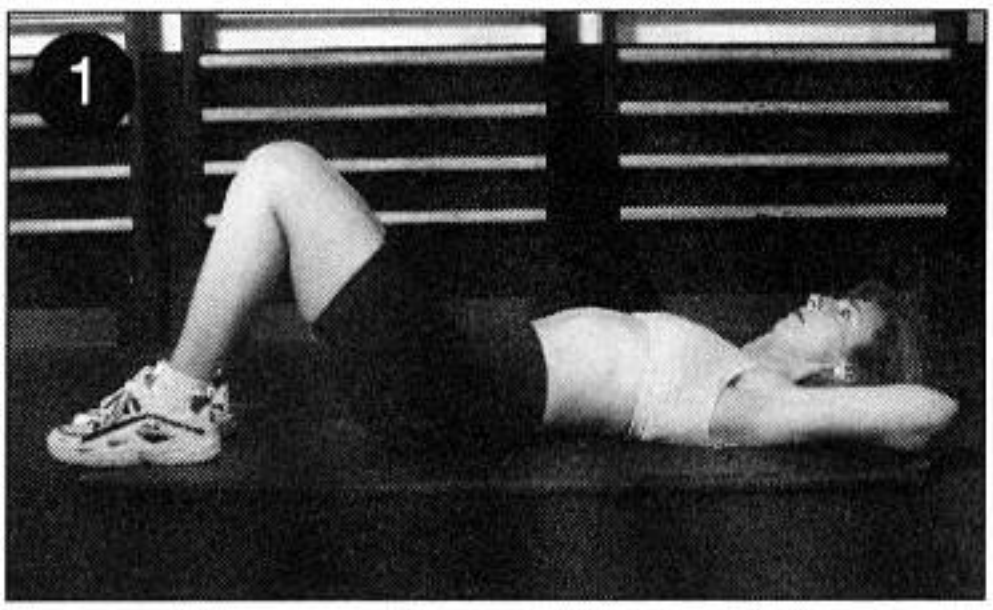
Exercises

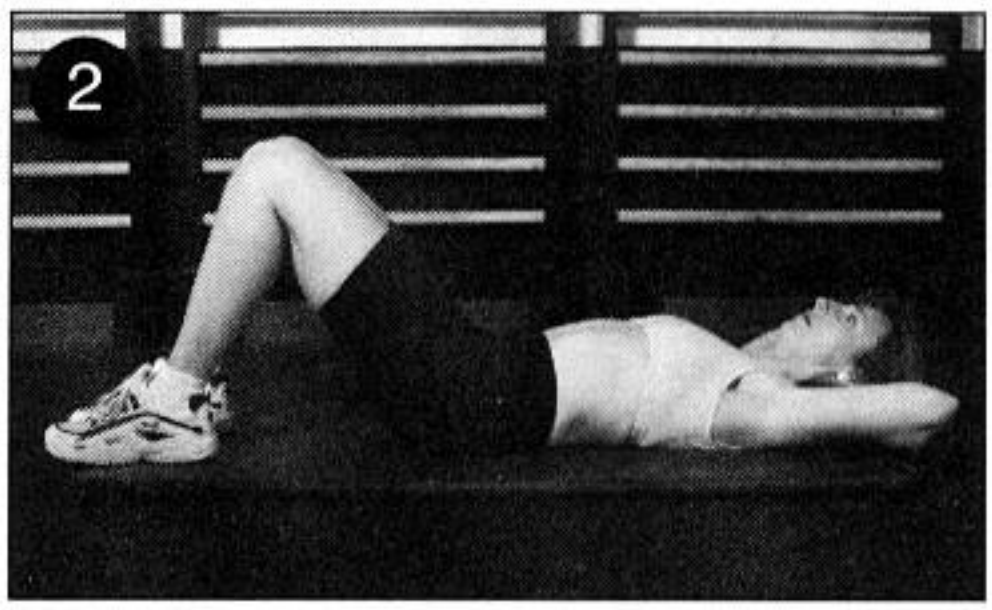




Swiss Ball Crunch. Sit on the ball, and "walk" forward until lying on the ball. Perform crunches in the normal manner, keeping in mind that a greater range of motion is achieved as the back drapes over the ball. The ball's instability and curved surface increase the level of difficulty of the crunch exercise, while simultaneously increasing the comfort of the movement.

During crunches, modify arm position in order to adjust the level of resistance. The least resistance occurs when the arms are straight and outstretched along the side of the body during the movement. A more difficult variation is to cross the arms against the chest. The most difficult variation is to place the hands such that the fingers are touching the head at a point just behind the ears. Avoid interlacing the fingers and clasping behind the head, which can strain the cervical vertebrae, and encourage participation from other muscles. Additional resistance (in the form of a medicine ball or weight plate) can be used when bodyweight is no longer sufficient to cause an improvement in strength. When using additional resistance, it becomes necessary to anchor the feet under an immovable object to stabilize position.

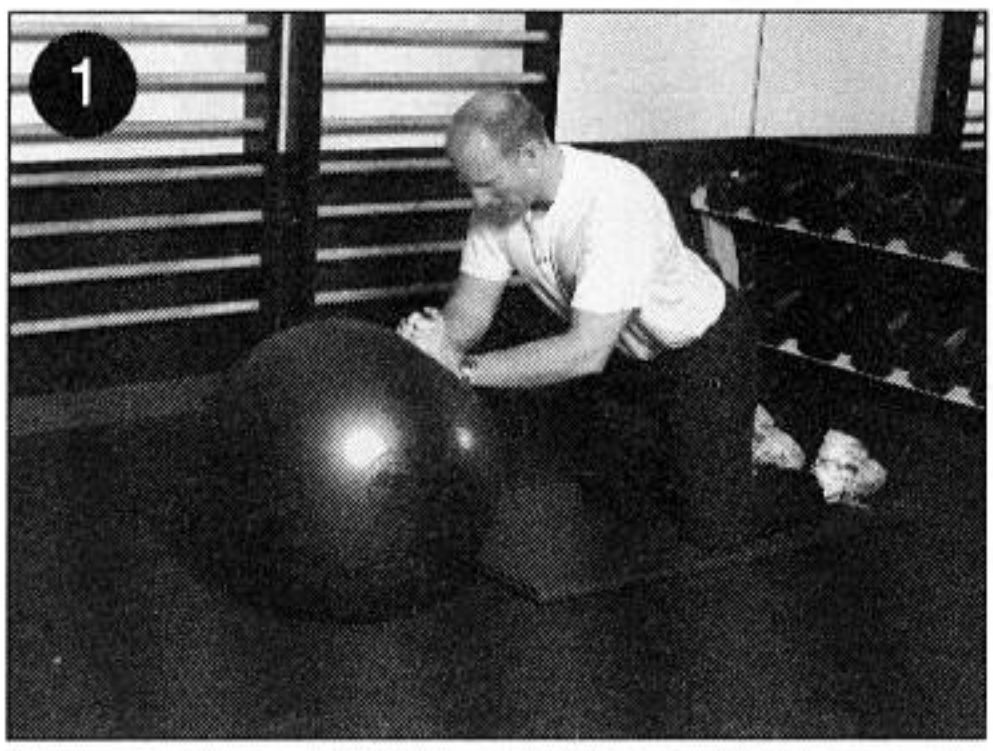


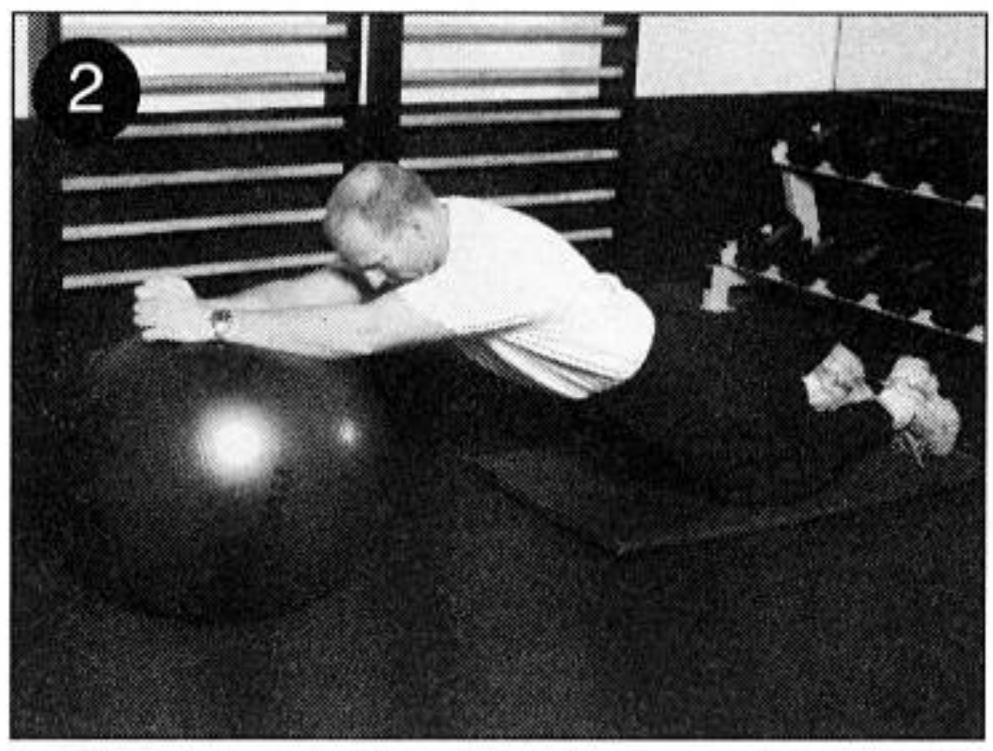


Lying Pelvic Tilt. This exercise trains the "lower abdominal function" of the rectus abdominus (stabilizing the pelvis during lower body movements such as running and kicking). Because it requires a higher degree of skill and coordination than other abdominal exercises, it should always be trained while the abdominals are still fresh. So, for example, if pelvic tilts and a second abdominal exercise are scheduled for the same workout, perform the pelvic tilts first.

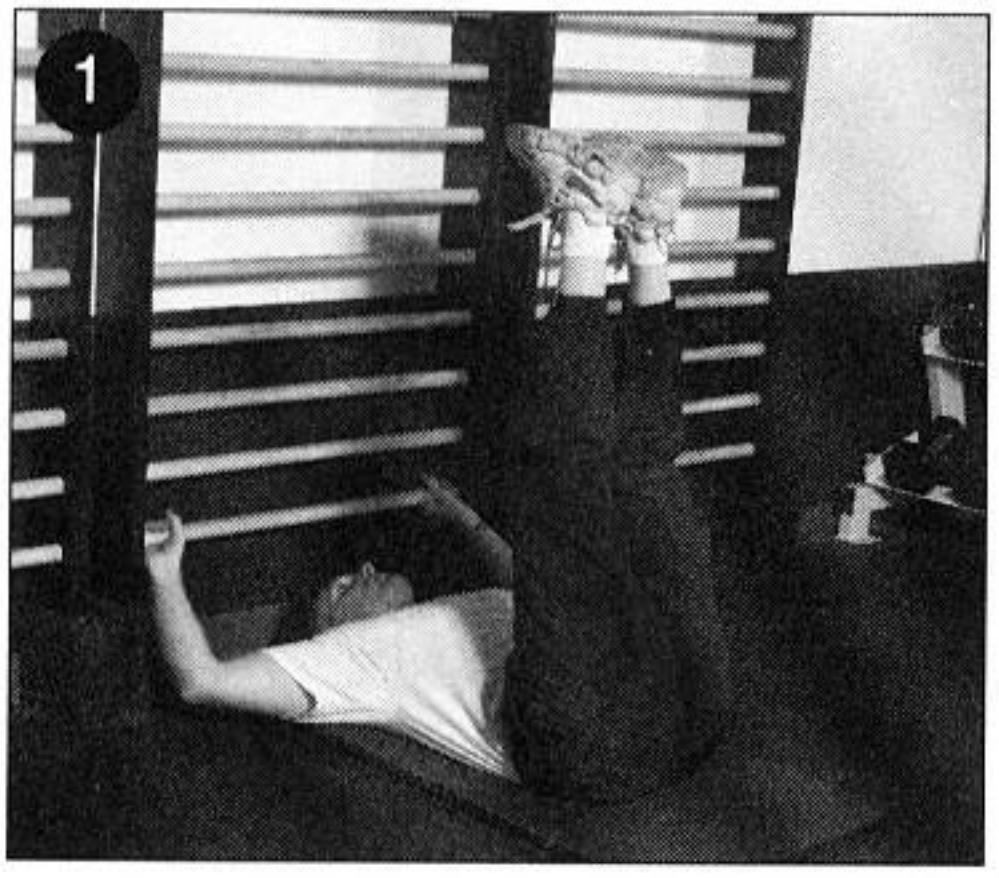
Lie back with knees bent to a 90-degree angle, feet on the floor. Contract the abdominals and force the lower back into the floor, breathing normally. There is a tendency to tense the neck and upper torso during this exercise, so monitor for unwanted muscular contractions from other muscle groups. This is primarily a static exercise which may be held for increasing periods of time as strength levels increase.

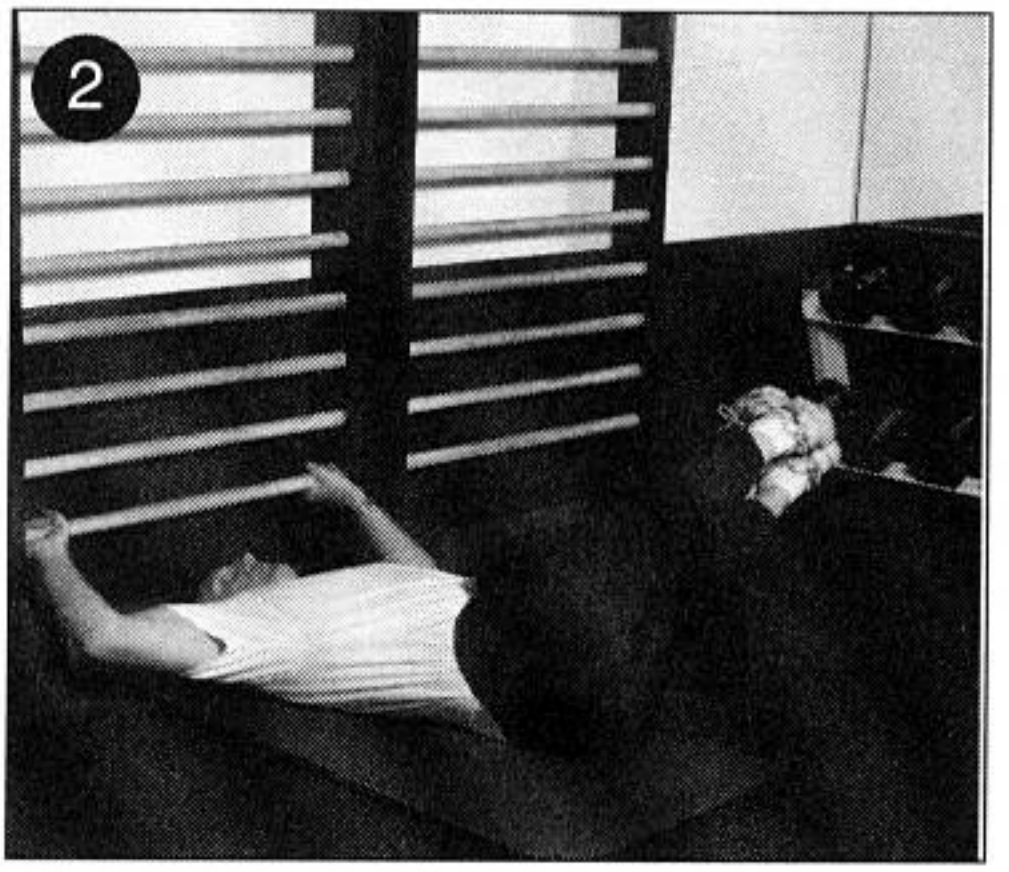
The internal and external obliques form the middle layer of the abdominal wall. They cause flexion-rotation of the trunk (visualize this by "crunching" the torso so that the right hip and left shoulder approach each other). Acting together, the left and right obliques assist the rectus abdominus in pure trunk flexion.



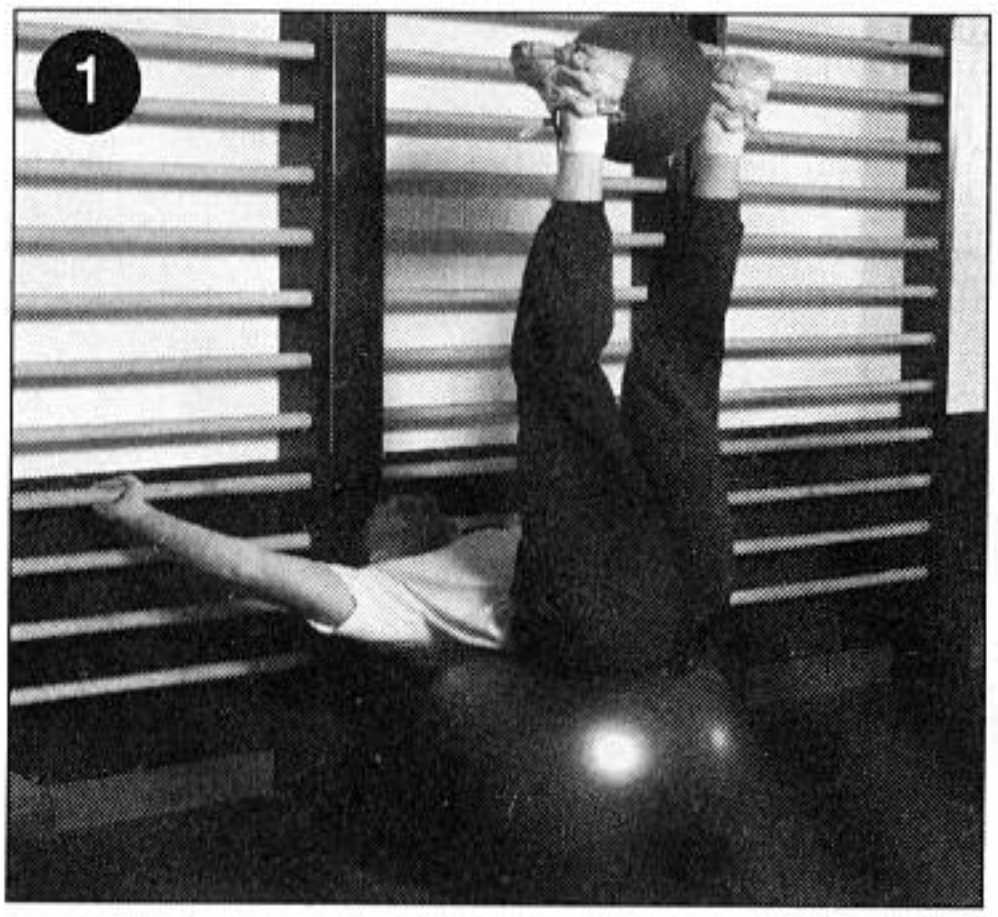


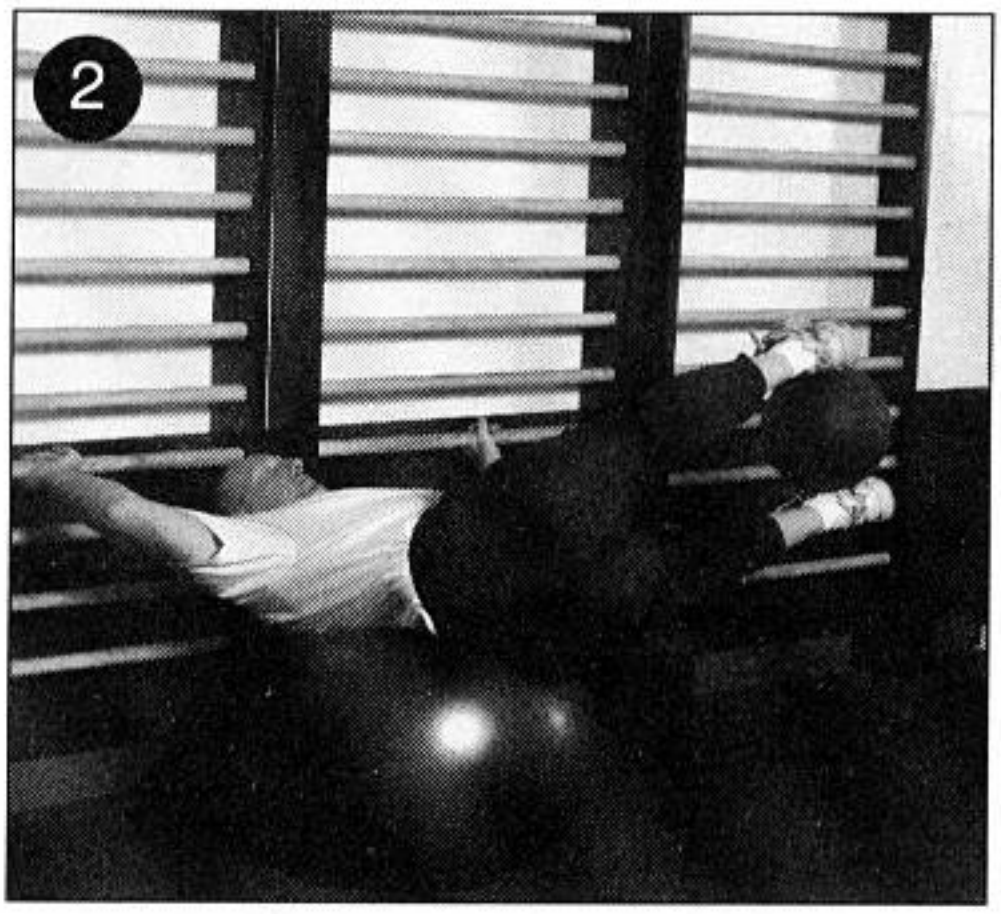
Prone Ball Roll. From a kneeling position (use an exercise matt to cushion the knees), with a Swiss ball directly in front, place clasped hands on top of the ball. Extend forward until the hips, shoulders, and elbows are fully extended. Return back to the starting position by reversing the motion. While extending, the increased load on the abdominals will cause the tendency for the curve of the lower back to increase. The goal is to counteract this tendency by tilting the pelvis posteriorly (as during the pelvic tilt exercise) while extending. If unable to maintain constant low back curvature during this exercise, spend more time working on the pelvic tilt described earlier in this section.



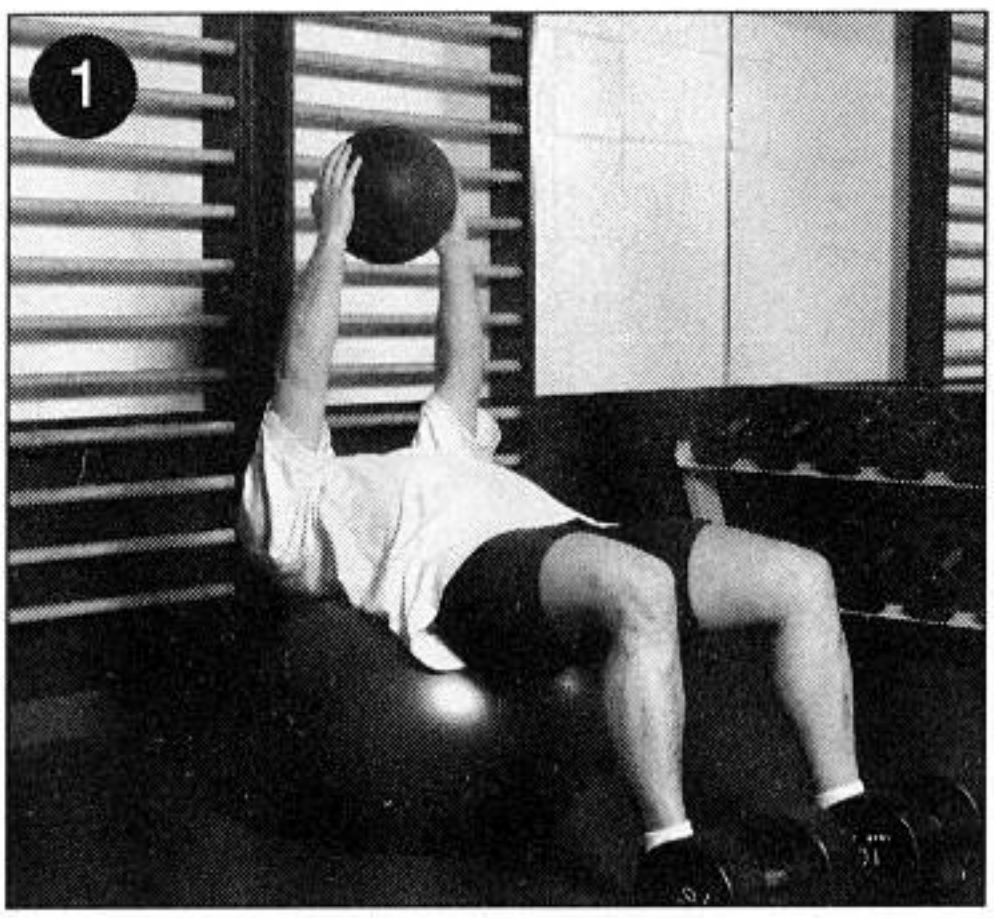


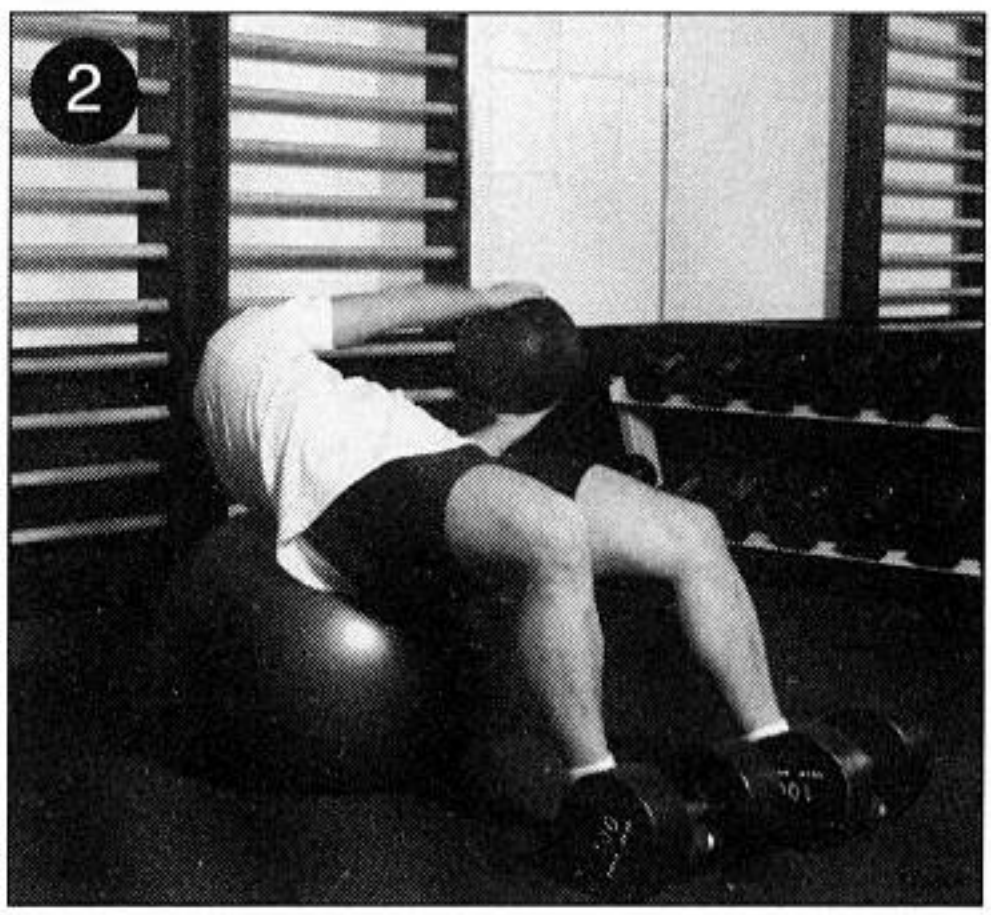
Reverse Trunk Twist. Lie supine on the floor, with arms abducted 90 degrees to the torso to stabilize the body. Keeping knees straight, lift the legs until they are at a 90-degree angle to the torso (legs are perpendicular to floor). Maintaining straight knees, and keeping the legs together and 90 degrees to the trunk, lower the legs to the right until the feet contact the floor. The opposite side shoulder should still be in contact with the floor. Raises back to center and then down to the left. Repeat for indicated number of sets and repetitions.



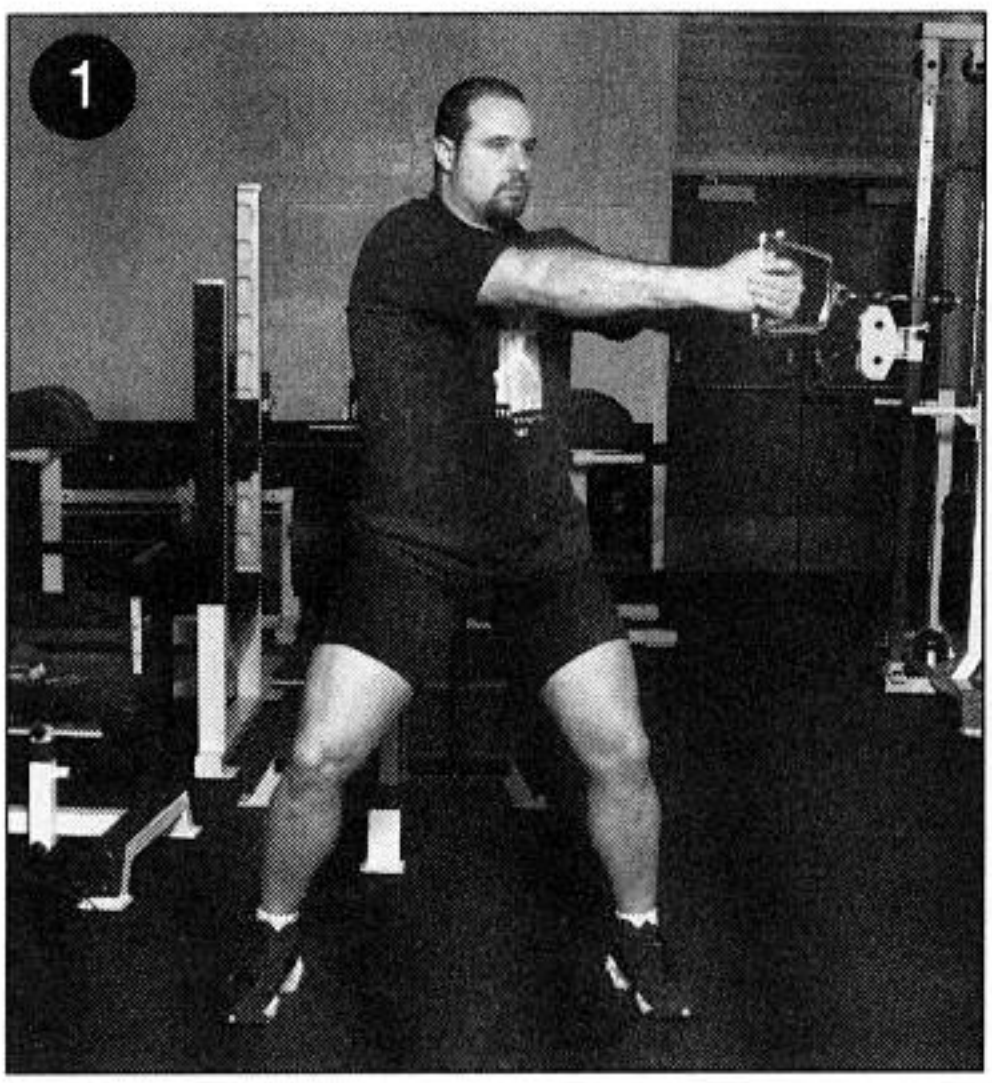


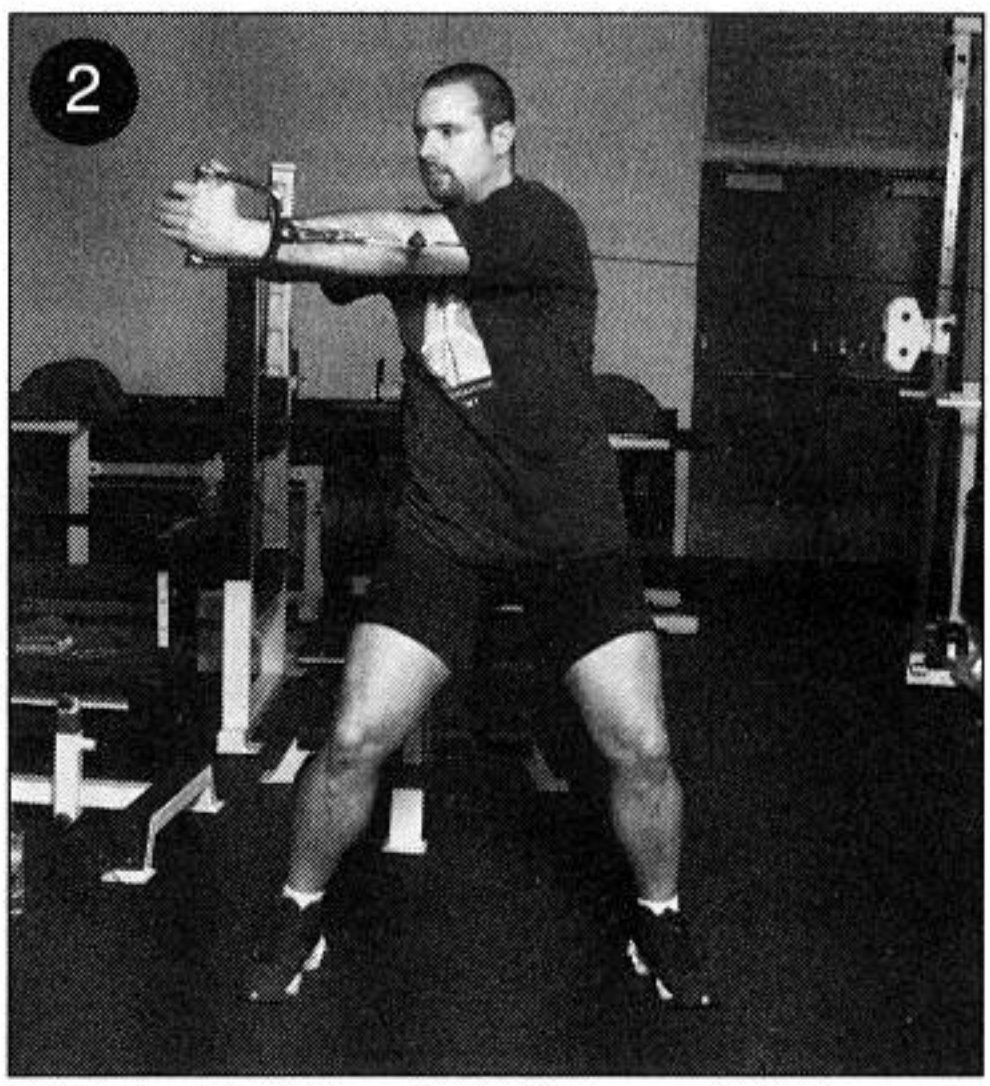
Swiss Ball Reverse Trunk Twist. Lay face up on the ball, which is positioned in a power rack. Grab the sides of the rack for support. Flex the hips to 90 degrees with legs straight and together. The apex of the ball should be just under the lower back. Start with feet pointing up at the ceiling, and then, in a "windshield wiper" like movement, allow the legs to lower to the right side until they are parallel to the floor. Then return back to center and repeat on the left side. Do not allow the shoulder girdle to turn toward the direction that the legs are moving in, as this unloads the obliques muscles. When the legs are completely to the left, the right shoulder should be down, and vice versa. Repeat for the indicated number of repetitions. Use a medicine ball between the feet if an additional load is necessary. The difficulty of the exercise may be increased by using a heavier medicine ball, or by increasing the speed of the movement. Repeat for indicated number of sets and repetitions.



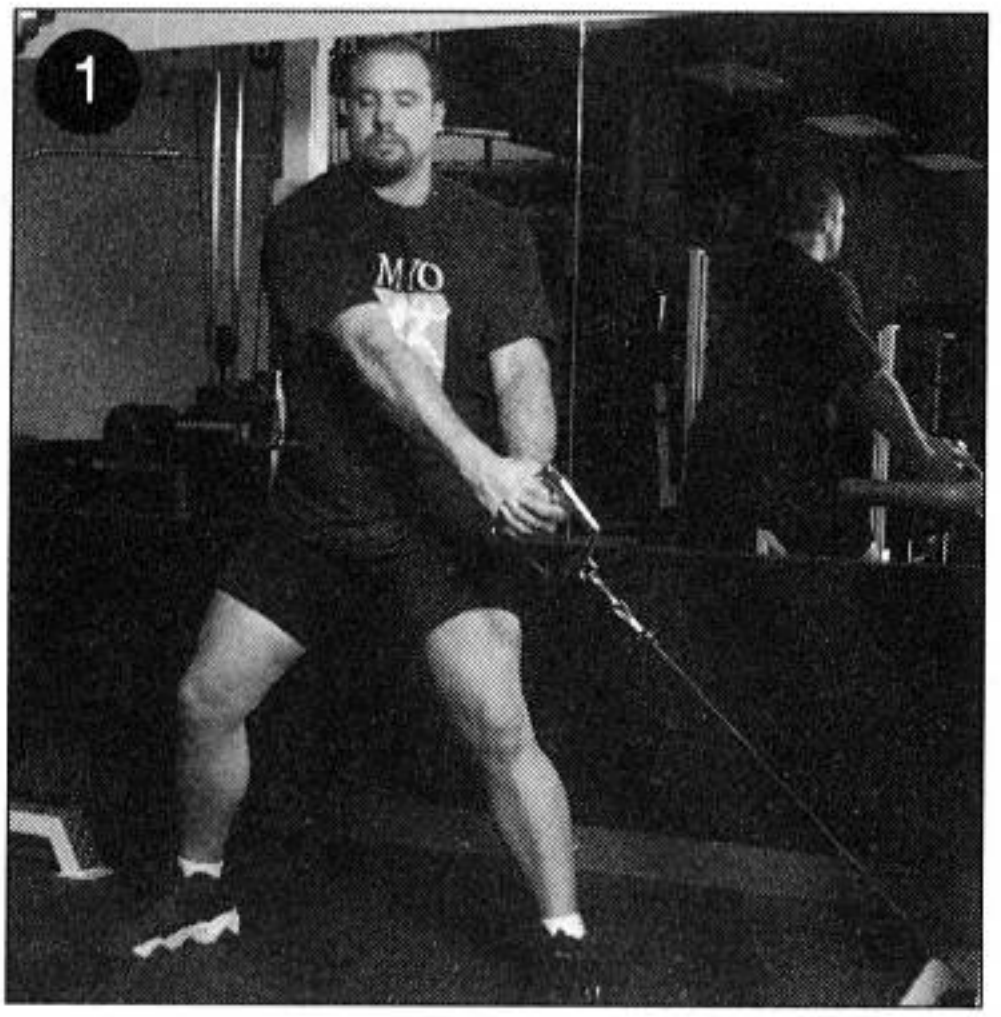


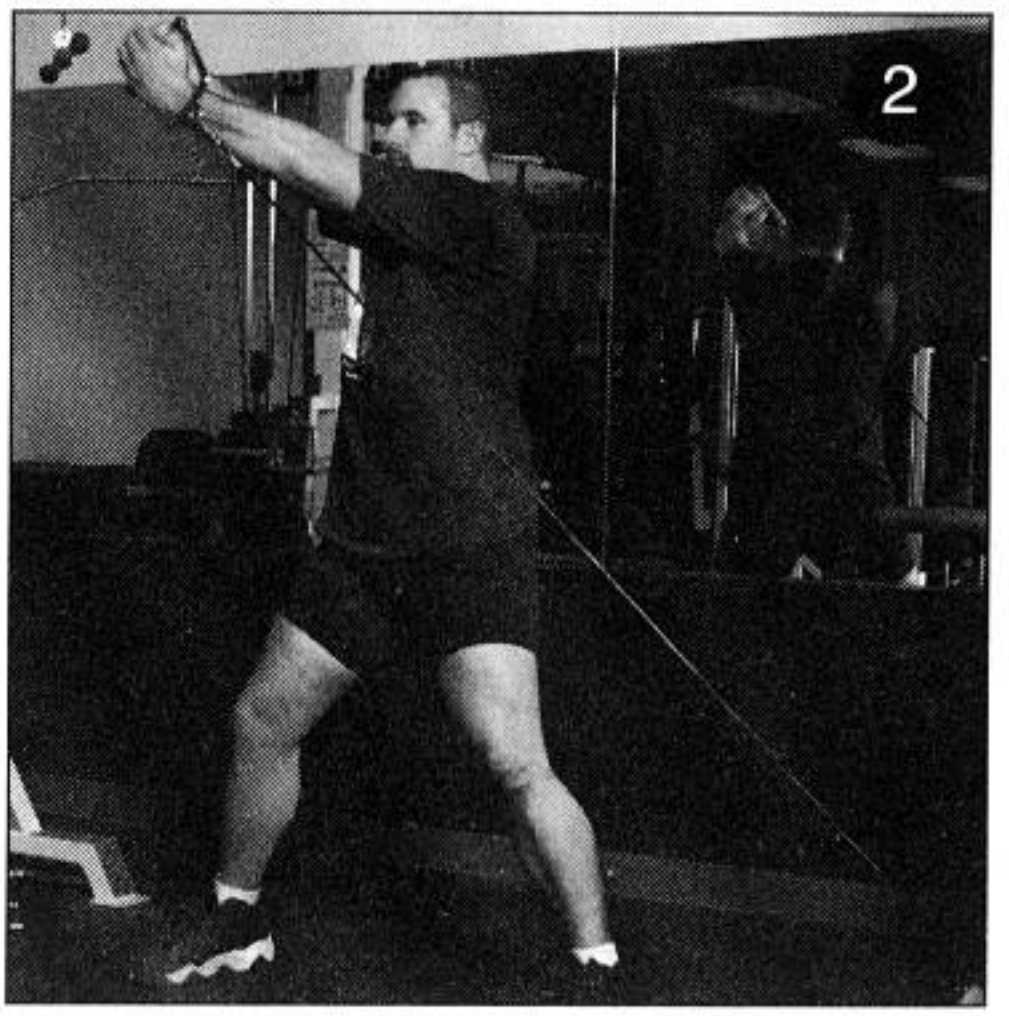
Swiss Ball Russian Twist. Assume a position on the ball as when performing crunches. Grasp a medicine ball with both hands. Keeping the elbows extended and arms perpendicular to the torso, rotate to either side. Maintain neutral head and neck position, with the tongue on the roof of the mouth. Also, do not allow the pelvis to rotate with the torso while turning from side to side, as this unloads the obliques muscles. The difficulty of the exercise may be increased by using a heavier medicine ball, increasing the speed of the movement, or by positioning further back on the ball (anchor the feet to prevent falling backward over the ball).



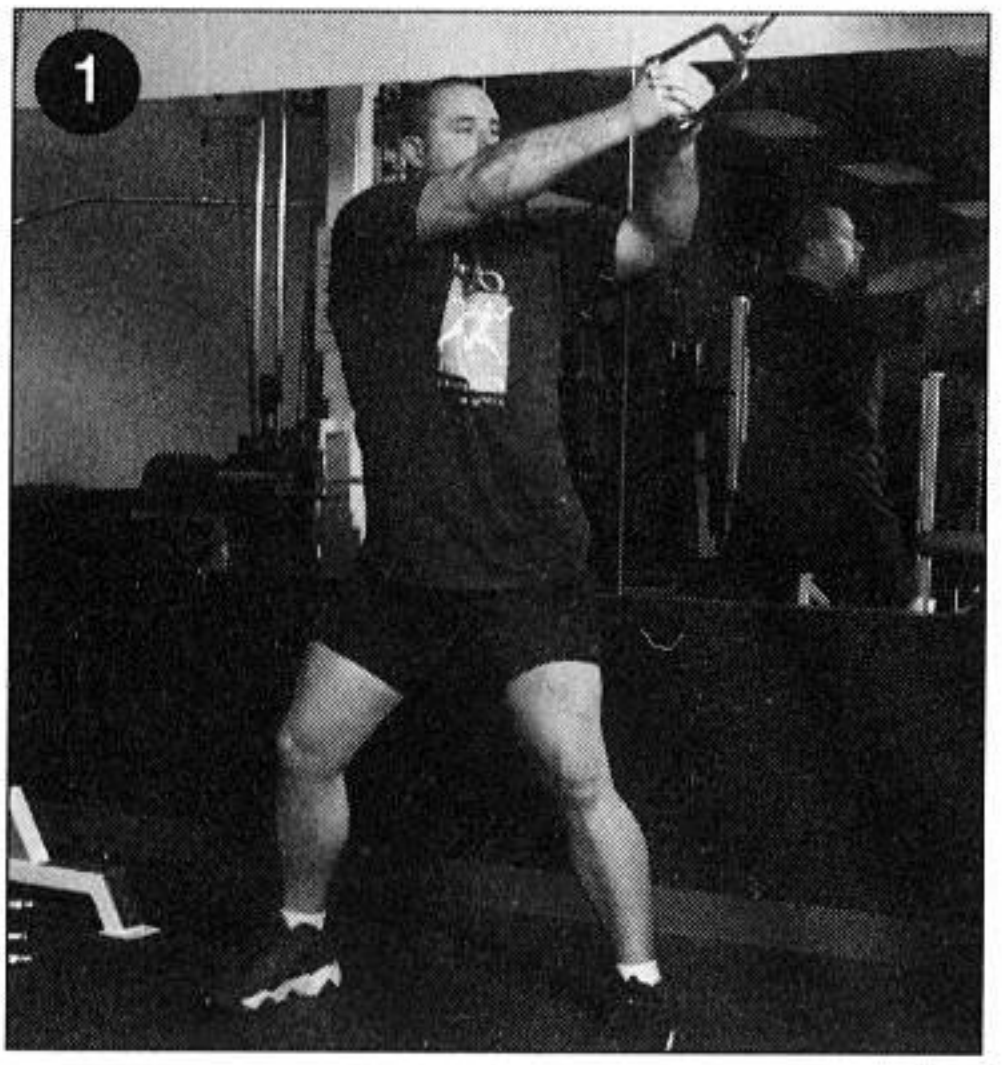


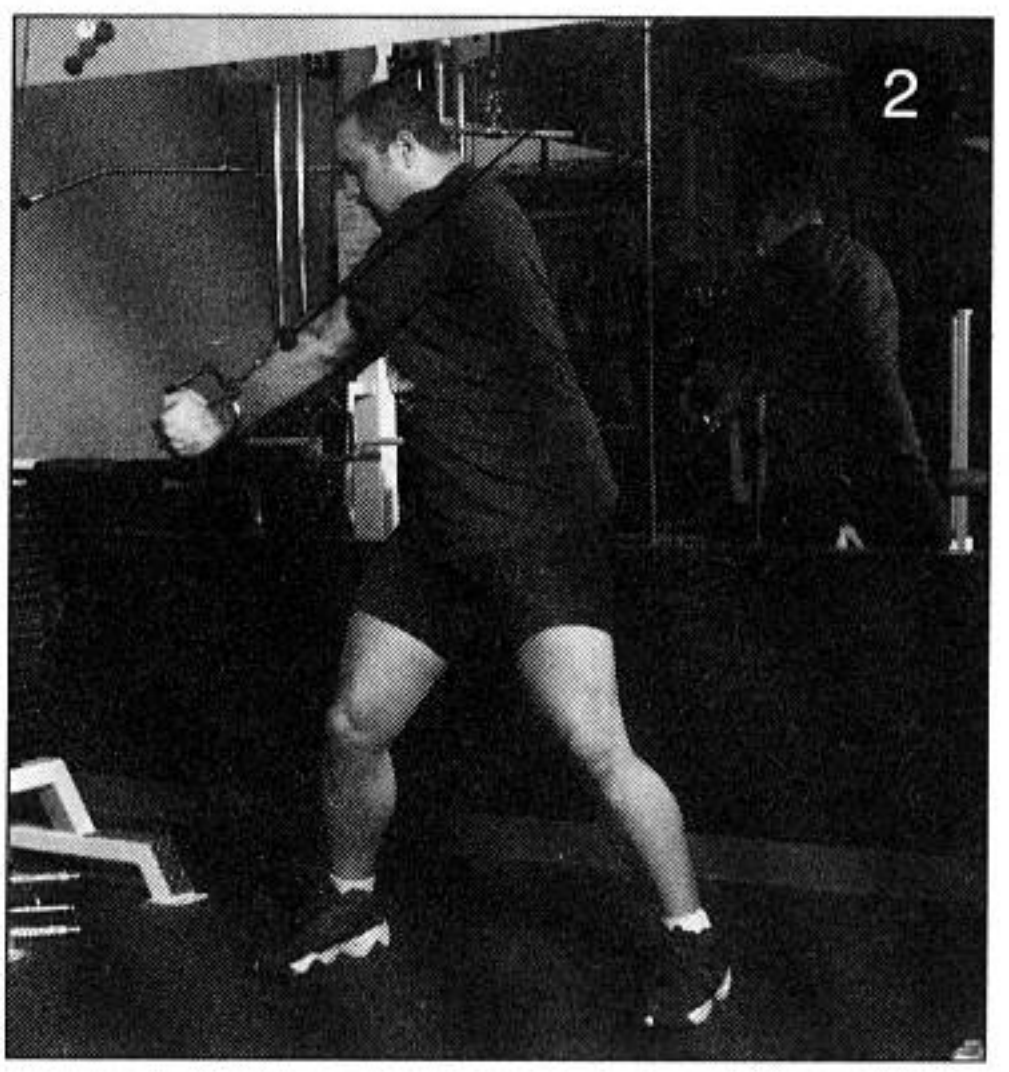
Horizontal Cable Rotation. Position the cable transducer so that it is level with the shoulders. Grasp the handle with both hands, and assume a wide stance, right side facing the machine. Maintaining normal spinal curvatures (don't flex at the hips), start with the arms pointing 45 degrees to the right side. Keeping the pelvis stabilized, contract the oblique muscles and pull the handle until facing 45 degrees to the left. Return to starting position. (These instructions pertain to training the left obliques; simply reverse for the opposite side).





Low/High Wood Chop. This exercise is performed on a cable unit with the transducer in the bottom position. Grasp the handle with both hands, and step away from the machine far enough so that the weight stack will not "bottom out" at the end of the eccentric portion of the exercise, but not so far that the stack will hit the top of the machine at the end of the concentric portion. Using a side stance as shown, pull the handle diagonally from low to high, using only the oblique muscles. Keep the pelvis stabilized throughout the movement, and monitor oneself for leaning forward at the waist.





High/Low Wood Chop. This exercise is performed on a cable unit with the transducer in the top position. Grasp the handle with both hands, and step away from the machine. Using a side stance as shown, pull the handle diagonally from high to low, using only the oblique muscles. Keep the pelvis stabilized throughout the movement, and monitor for leaning forward at the waist.

Note: all wood chop exercises can be performed from a seated (on a bench), kneeling, or standing position.

Transverse Abdominus

The transverse abdominus are the deepest layers of the abdominal wall, and are one of the primary respiratory muscles. It is quite difficult to "train" in a pure sense. Athletes come closest to training the transverse abdominus during a *"kiai"* while executing a strong technique, when performing a heavy squat or deadlift, or during a hard sneeze or cough. The abdominals are antagonistic to the spinal extensors.

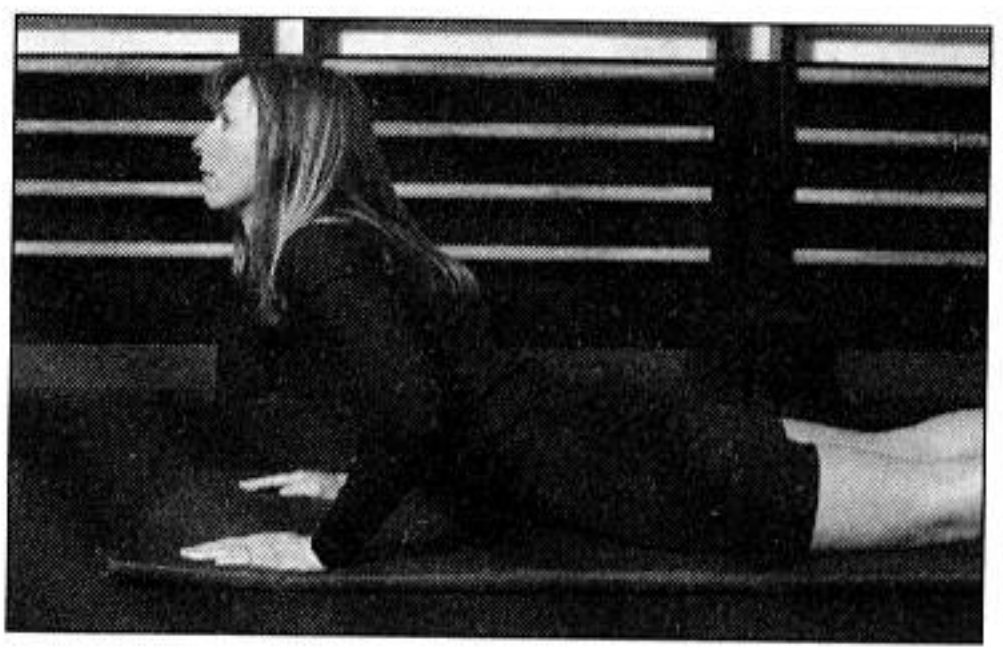
The abdominals function as part of a kinetic chain, which also includes the neck and hip flexors. Interestingly, many abdominal "rollers" sold through infomercials ignore this fact, creating devices which allow trunk flexion with no tension on the neck flexors. Although occasional use of these devices should cause no harm, chronic use might negatively alter the functional relationship between the links of the flexor chain.

Martial Arts Applications. The abdominals constantly engage to help stabilize the torso during almost all movements. Abdominal training expert Paul Chek suggests that when stabilizer muscles possess insufficient strength, the motor cortex of the brain will not allow the prime movers to contract to their expected potential.[47] This appears to be a protective mechanism. If the body realizes it can't stabilize a certain movement, it simply won't allow the movement to be performed.

Athletes in a variety of sports collaborate this theory. In fact, a simple way to make almost anyone stronger is to improve abdominal strength. Many martial artists intuitively recognize this fact, but still cling to outdated and ineffective methods for training the core muscles of the body. The following section presents methods and justifications for training the core musculature.

Abdominals are also involved in respiration and, of course, in flexing and rotating the trunk. Most strength coaches think of the abdominals as the muscles which transmit forces from the lower body to the upper body as in transmitting the forward rotation of the rear hip to the shoulders when executing a front punch. Therefore, weak abdominals can at least potentially be a weak link in total development. No wonder the abdominals are considered an important muscle group!

Unique Characteristics. Abdominal training does not significantly affect the layer of fat which oftentimes covers these muscles. Many people become slaves to crunches, sit-ups, and television infomercial devices, when the real issue is bodyfat, not abdominal conditioning. In fact, many of these people probably have superbly conditioned abdominals. Bodyfat is reduced through a comprehensive training program incorporating resistance training and caloric manipulation, not merely abdominal training! One competitive bodybuilder has startling abdominal development, particularly when he is closing in on a competition. When asked what he does to get his abdominals in such great shape, his standard reply is "four sets of nothing," which isn't too far from the truth. He usually only trains these muscles during the weeks leading up to a competition.



Length Assessment. To assess minimal standards for abdominal length, athletes lie prone (face down), as if about to perform a push-up. Hands are directly under the shoulder joints. Keeping the anterior superior illiac spine (the hip bones at the front) on the floor, extend the arms as far as possible.

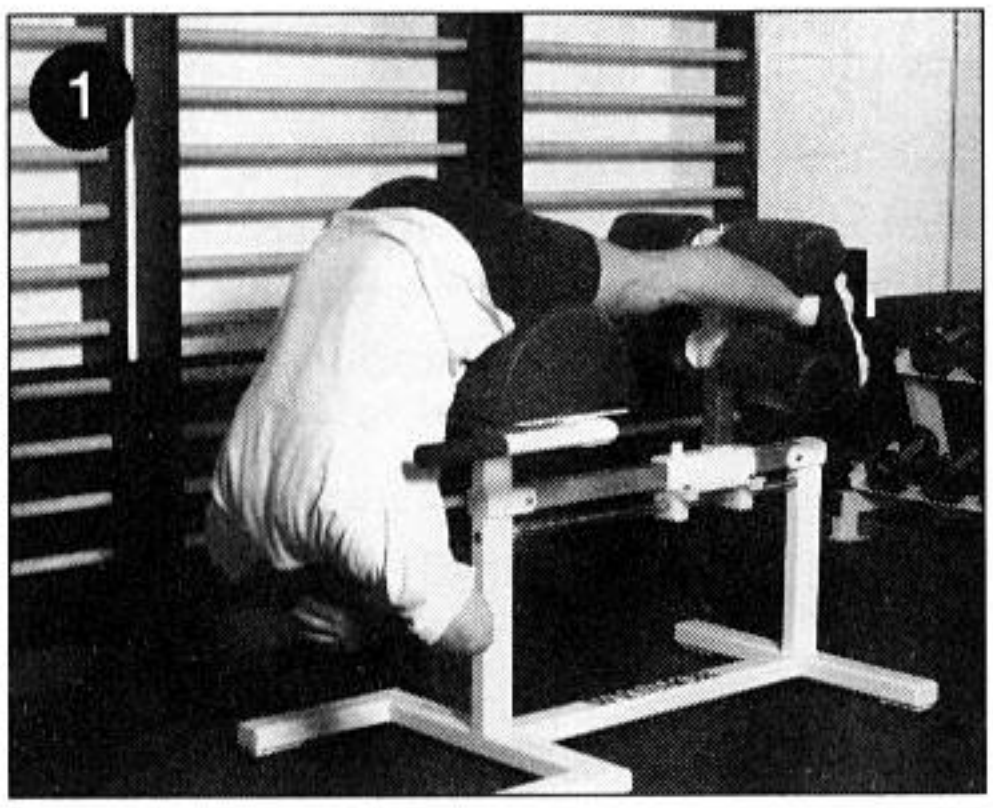
Athletes with adequate abdominal length should be able to fully extend their arms while keeping the hips on the floor.

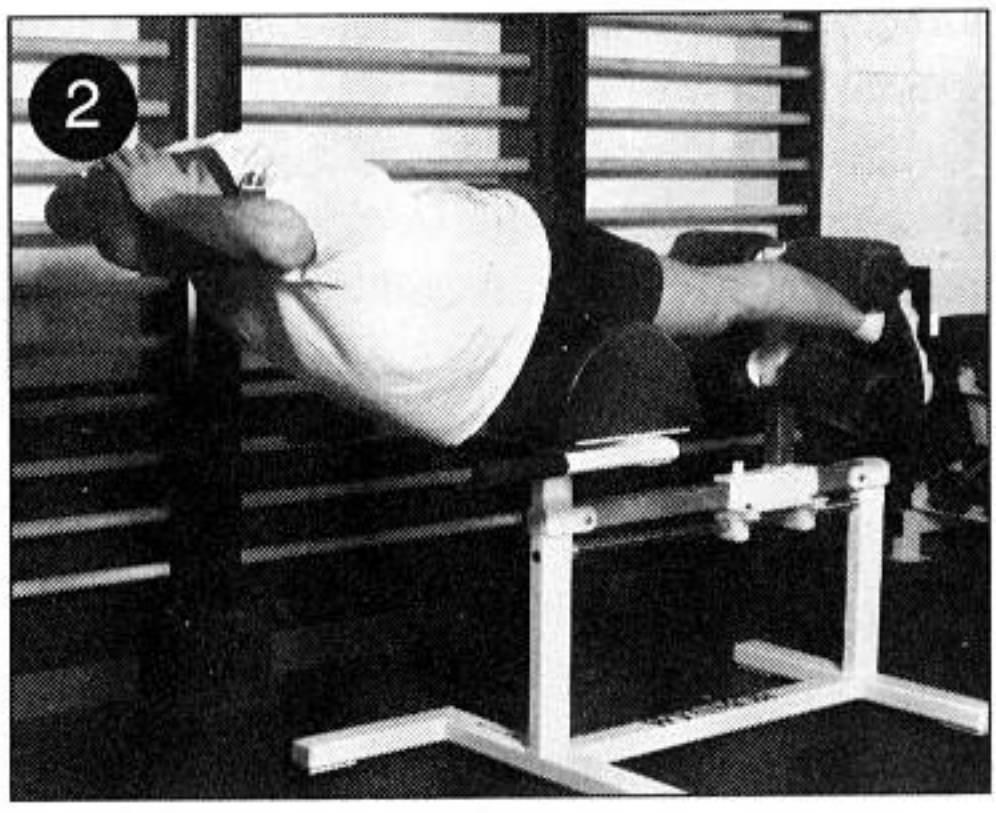
Stretching Methods for the Abdominals. The stretching method used for the abdominals is virtually identical to the position used in testing their length. Just extend the arms as far as possible and hold. Initially, hands may be placed ahead of the testing position, and the hips may leave the floor a bit until able to progress to the testing position.

Abdominals can also be stretched by lying supine on a Swiss ball. Secure the ankles under an unmovable object (such as a pair of heavy dumbbells), and arch backward, extending over the ball.

Trunk Extensors (Erector Spinae)

The erector spinae muscle groups are the predominant trunk extensors. Strong trunk extensors are necessary to balance the strength of the rectus abdominous, and to maintain efficient postural stabilization and control. They are most commonly trained through the use of the back extension exercise, performed on a specialized apparatus designed for this purpose (below).





Back Extensions. Perform on a standard machine made for this purpose. Assume a position so that the navel is on the pad and the pelvis is stabilized. If the pelvis rotates during this exercise, the gluteals and hamstrings will also be recruited (this is not bad, per se, but undesirable if trying to maximally target the erector spinae).

Side Flexors *(not illustrated).* One of the most common "abdominal" exercises seen in commercial gyms and health clubs today is the dumbbell side bend. Most exercisers view this movement as an exercise for the obliques, but in reality, it is an exercise for the quadratus lumborum—the primary side flexor. For aesthetic purposes, this exercise has no significant effect on reducing the waistline, since the quadratus lumborum is such a deep-lying muscle, and also because there is no direct metabolic connection between muscle and nearby fat deposits.

For martial artists who rely heavily on kicking skills, the side flexors should be trained. But most other athletes (who don't have a reason) should minimize training for this muscle, since overdeveloped side flexors are occasionally associated with low back pain.

Tips for Maximizing Strength Training for Core Musculature:

1) Because one of the deep neck muscles attaches to the tongue, keeping the tongue on the roof of the mouth during abdominal exercises will help stabilize the head and minimize neck discomfort.[48]

2) Avoid flexing the neck. The chin should not approach the chest during abdominal exercises.
3) In general, the abdominals should be trained using the same set/repetition formats used for other muscles.
4) During crunch and sit-up type exercises, maintaining 90 degrees of hip flexion and keeping the feet unanchored maximize stress to the abdominals and minimize stress to the hip flexors. Straight legs and anchored feet tend to do the reverse.
5) When targeting the back extensors, the pelvis must not be allowed to move.

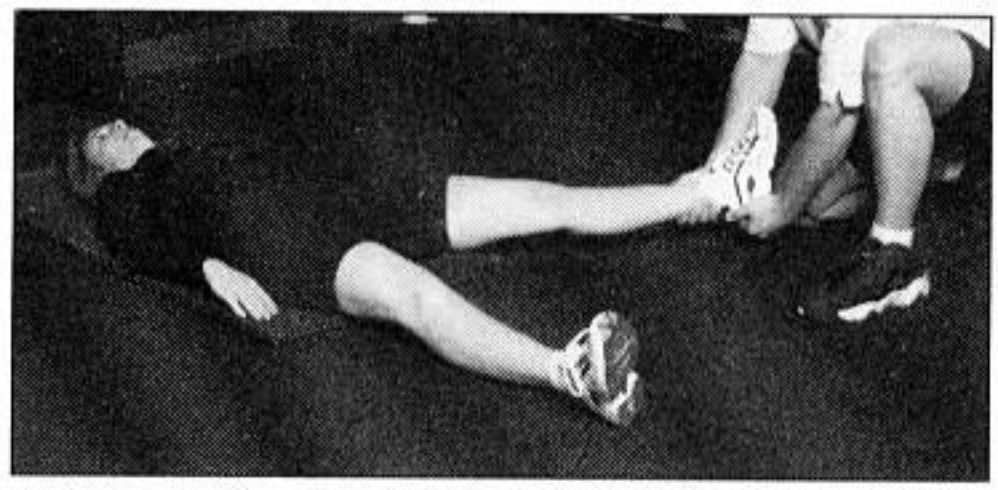
Abductors and Adductors

Description. These muscles are named for their function at the hip joint. The adductors cause adduction (movement of the leg toward the body's center line), and consist of the adductor magnus, brevis, and longus, as well as the pectinius and gracilis. Also, the medial portion of the hamstrings as well as the sartorius may assist in adduction. The primary hip abductor (abduction is defined as movement of a limb away from the body's center line) is the gluteus medius, a small muscle which receives far too much attention from women trying to lose fat from their hips. The abductors and adductors are antagonistic to each other.

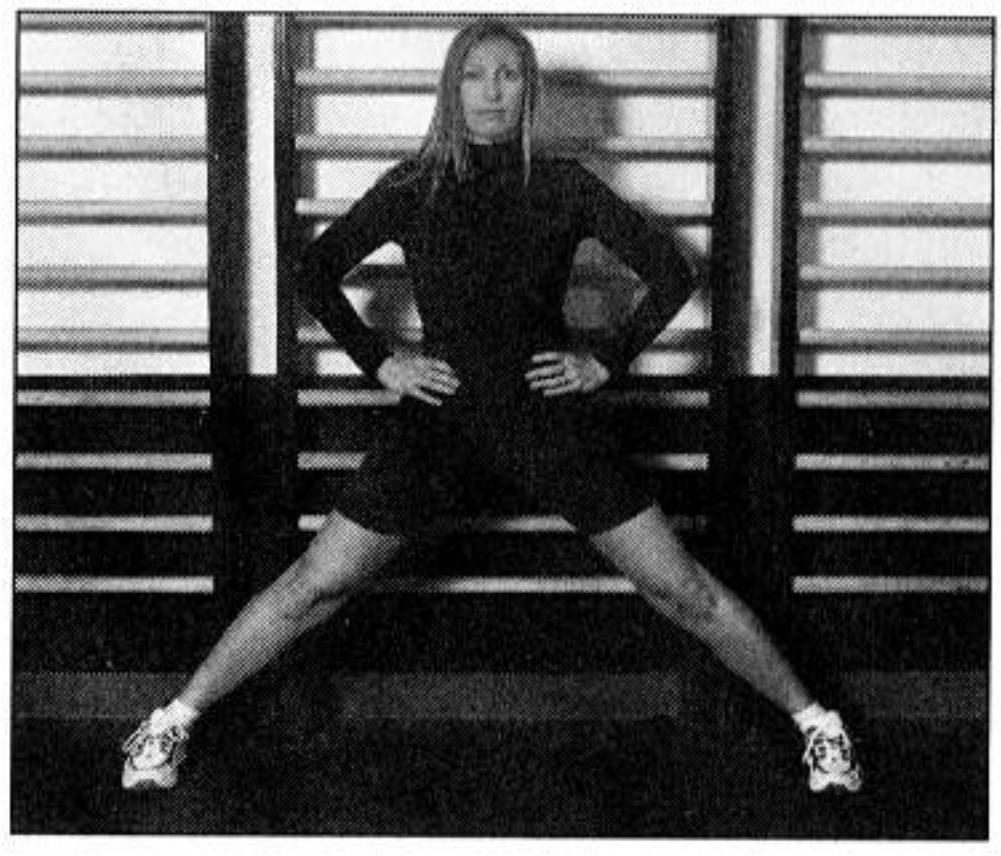
Martial Arts Applications. Strong adductors are quite important for traditional practitioners and kata competitors who seek strong stances. Superior abductor length is important for the ability to perform strong and high kicks as well. The adductors strongly contribute to maintaining the mount position in jujitsu.

Unique Characteristics. Adductor strength (or lack of it) may be a primary limiting factor in attaining a split.

Interestingly, three of the five adductors are thought to contribute to internal and external rotation of the lower leg, but a recent analysis of several leading anatomy texts showed conflicting information on the role of the adductor longus, brevis, and pectinious in rotation of the femur. Clearly, more research is needed.



Length Assessment. Laying face up on the floor, the athlete should be able to abduct each leg to a 45-degree angle from the midline, as shown.



Stretching Methods for the Adductors

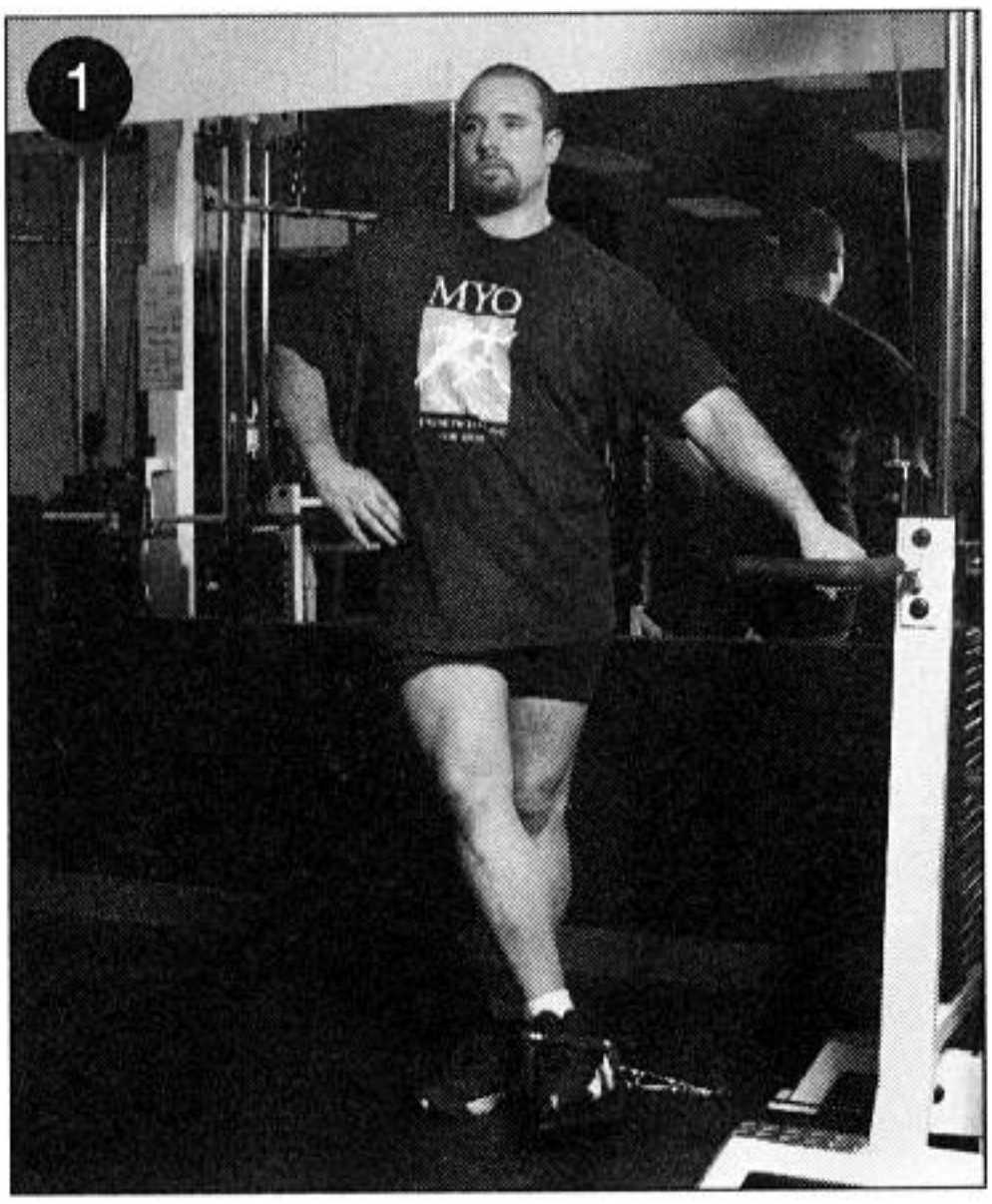
Isometric Split Stretch. With hands on hips (do not use any external support), "walk" out into a comfortable split position, with feet parallel to each other. After reaching a position of slight tension in the adductors, "clench" the legs together, as if trying to slide the feet together. Hold for a count of six to eight seconds, then relax, then walk out

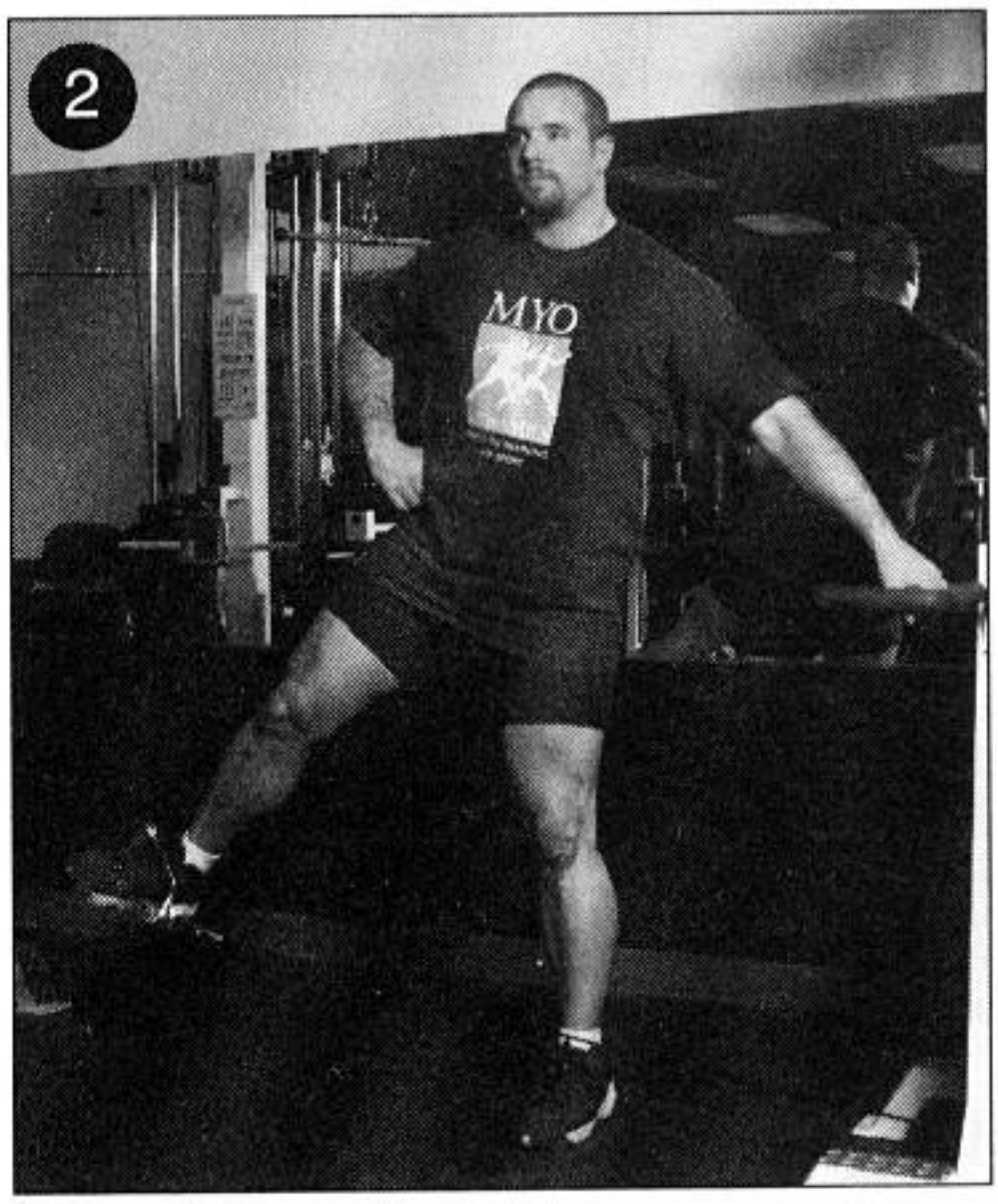
into a deeper split position. From this new, deeper ROM, perform the count again. Repeat for three to five repetitions, or until subsequent repetitions do not increase the range of motion. Upon completion of the stretch, "walk" back to a standing position without relying on external support.

Note: certain knee injuries and pathologies preclude the use of this stretch. Athletes who experience pain and/or inflammation of the knee during or after performing this stretch should discontinue and consult a qualified health care provider for further guidance.

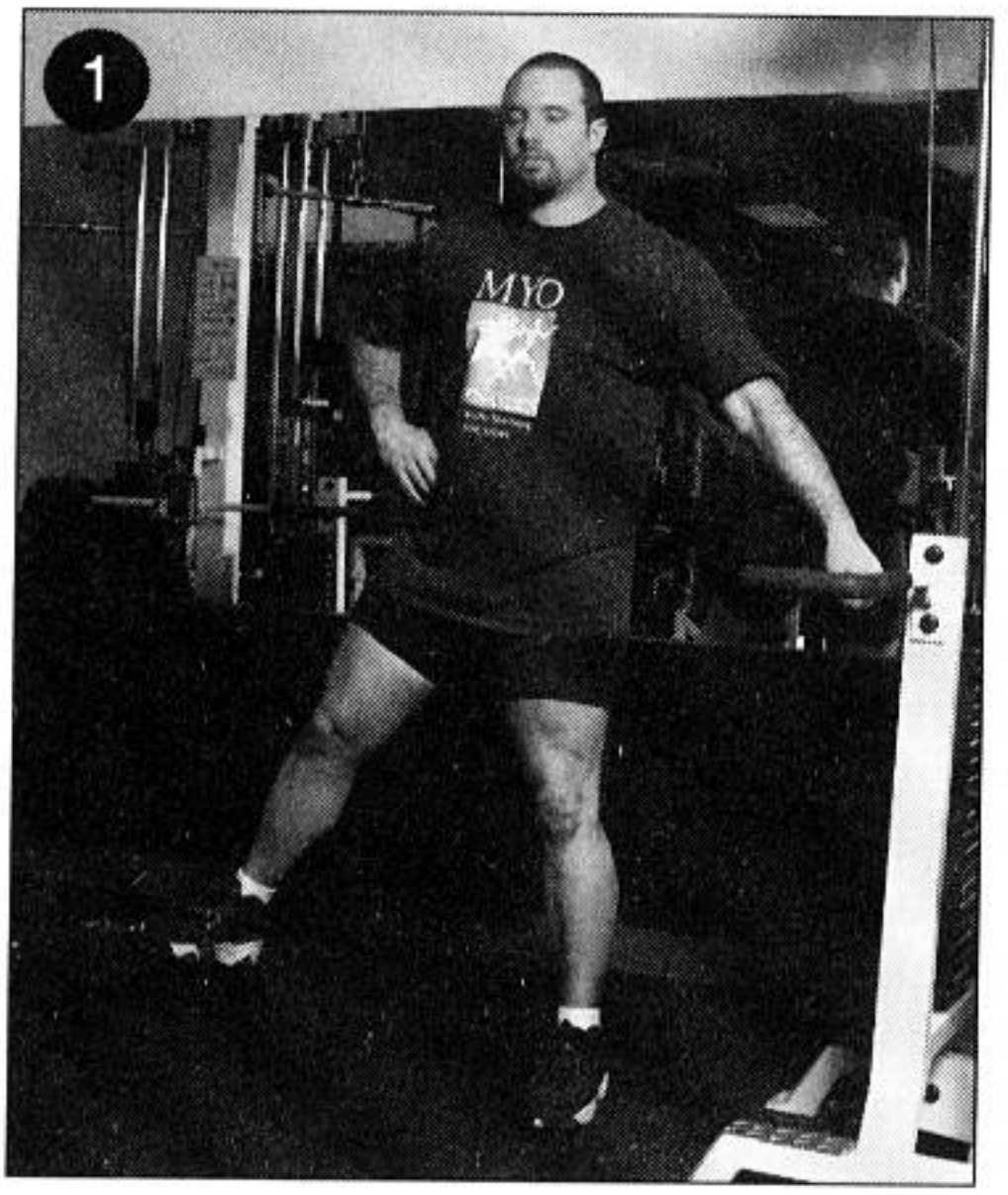
Stretch Machines. Several companies have produced stretching machines which enable the athlete to use (in most instances) a hand crank which forces the legs into a seated split position. Although such machines can be used successfully, the principle of specificity dictates that standing positions are more suited for athletes involved with kicking disciplines. If seeking to purchase such a machine, make sure it features a "quick release" mechanism to disengage from the machine in case of sudden cramping or onset of a muscle strain.

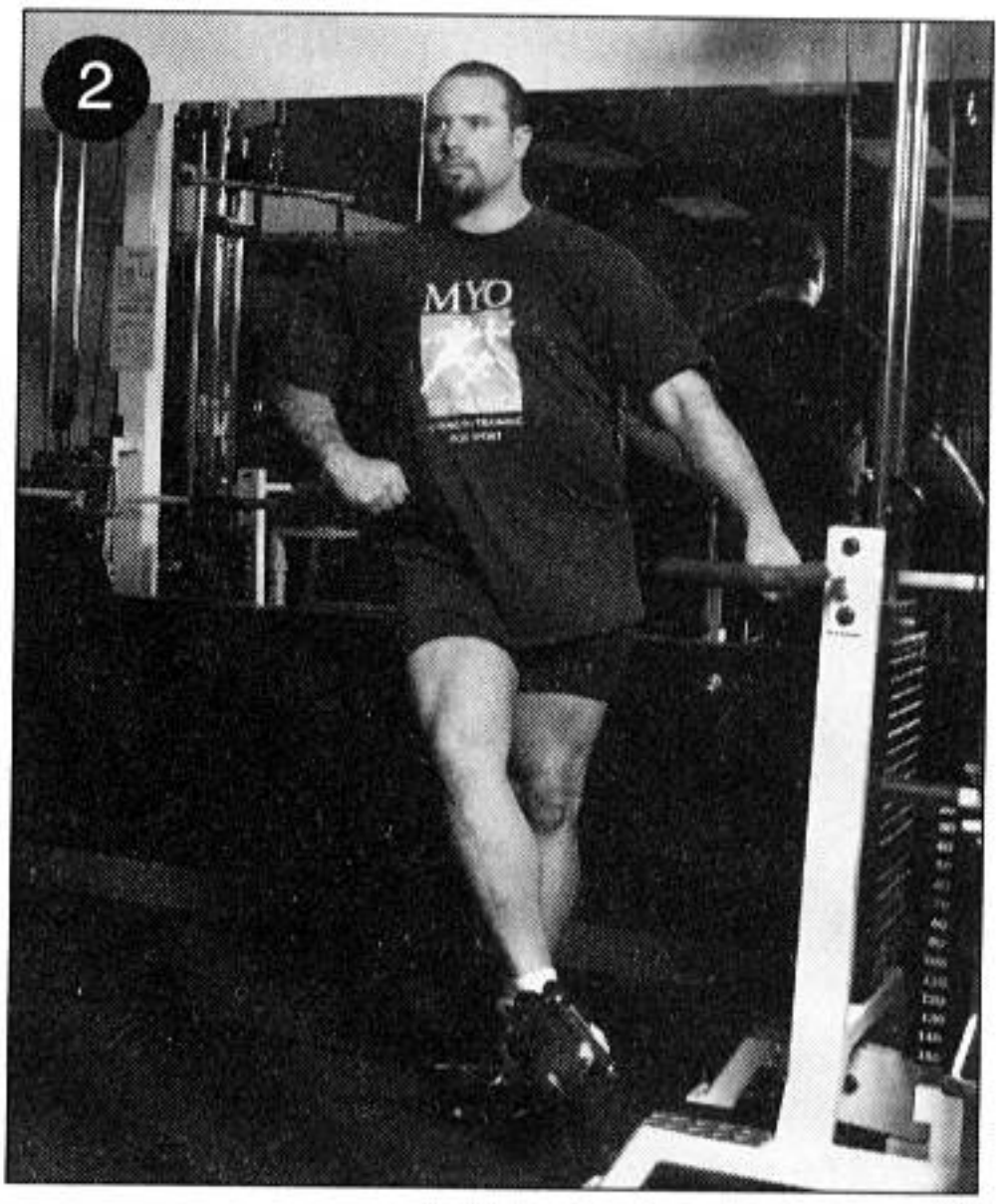
Strength Training Exercises for the Abductors and Adductors



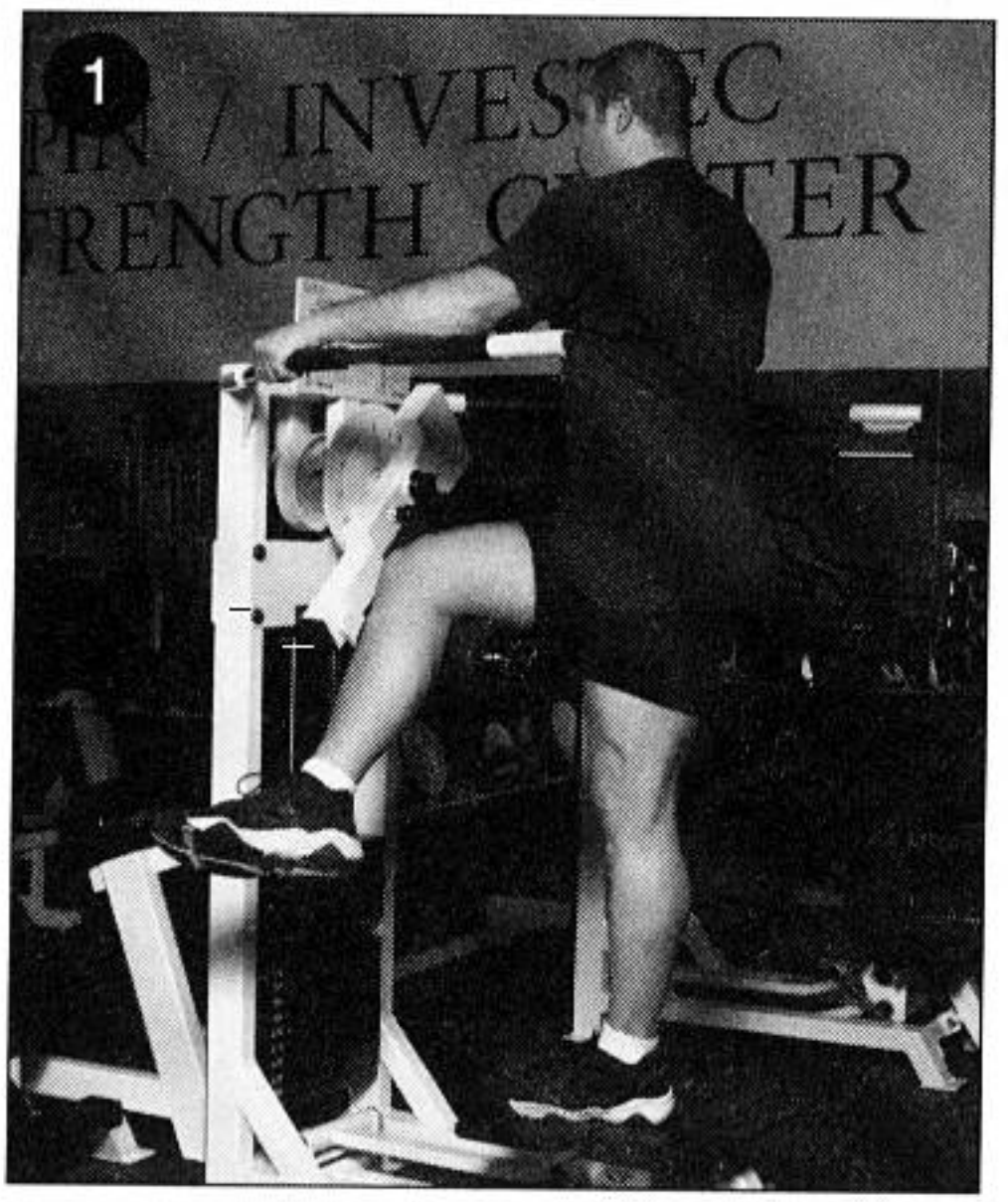


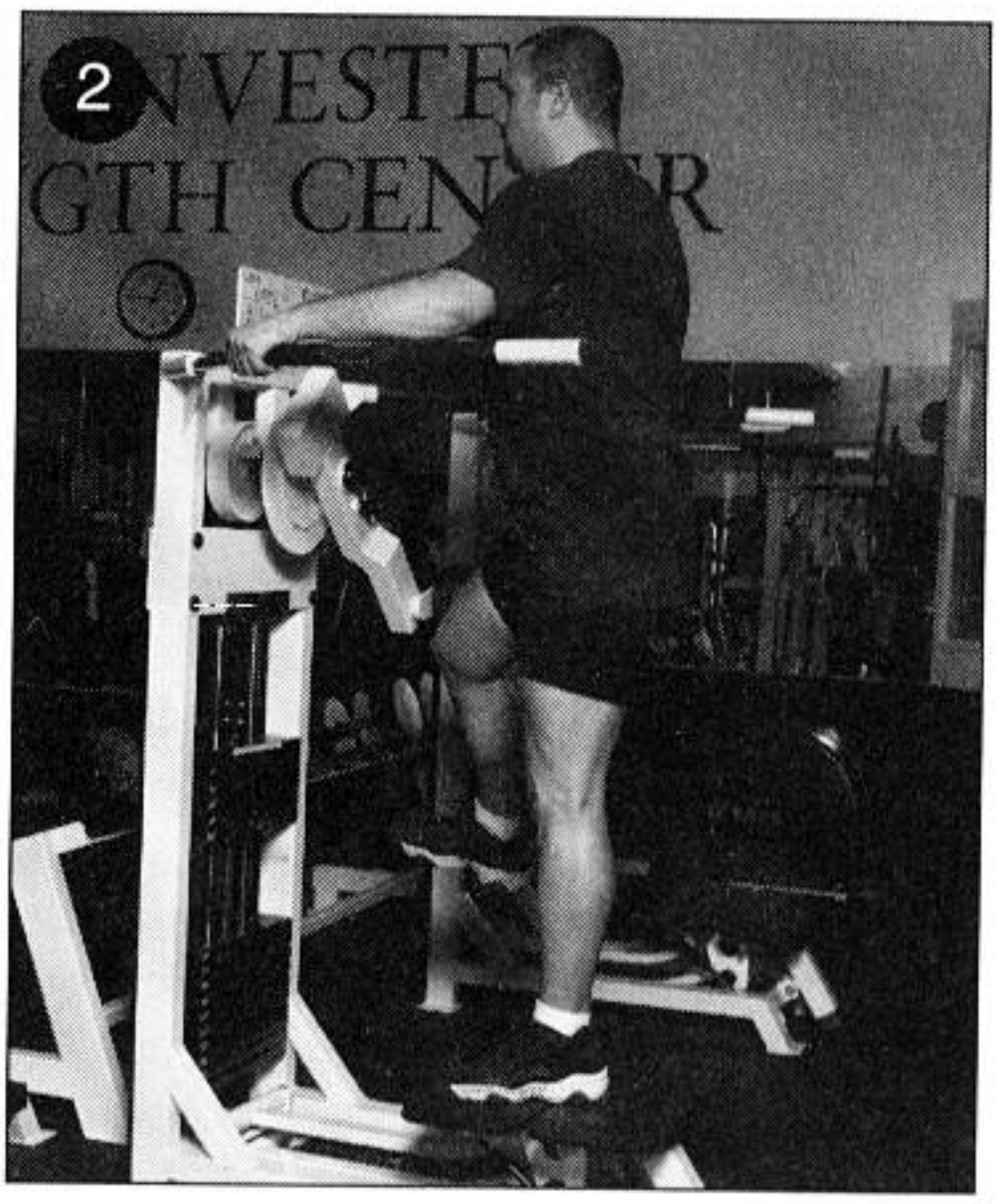
Low Cable Abductions. This exercise is performed by abducting the leg against the resistance supplied by a low cable. Attach the cable to the ankle with a cuff, bracing against the machine's upright or support handle, and abduct the leg while keeping the torso erect. Monitor for leaning in the opposite direction, which reduces stress to the target muscle. To increase the exercise's range of motion, allow the working leg to pass in front of and beyond the support leg, as shown.





Low Cable Adductions. This exercise is performed in a very similar manner as the cable abductions, except here, adduct the leg against the resistance. Attach the cable to an ankle with a cuff, bracing against the machine's upright or support handle, and adduct the leg while keeping the torso erect. Monitor for leaning in the opposite direction, which reduces stress to the target muscle.





Multi-Hip Machine. Stabilize the body by grasping the handles, and then adduct or abduct the leg against the resistance provided by the machine.

Tips for Maximizing Strength Training for Abductors and Adductors

It is paramount that the pelvis remains stabilized during any standing adductor or abductor exercises. If leaning sidewards even slightly, much of the training stress will be transmitted to the trunk muscles.

Deltoids and Rotator Cuff

Description. The deltoid is a single muscle with three heads. The front head causes flexion of the shoulder joint, the rear head causes extension of the shoulder, and finally, the middle head is responsible for pure abduction of the arm.

The rotator cuff is a group of four muscles whose tendons join to form a tendinous "cuff" which strongly contributes to the stability of the gleno-humoral joint. These muscles can be remembered through the acronym "SITS," supraspinatus, infraspinatus, teres minor, and subscapularis. Of these, the infraspinatus is the only pure external rotator of the arm, while subscapularis is the purest internal rotator (assisted by the pectorals and lats). Supraspinatus assist the middle deltoid during the first 30 degrees or so of arm abduction. The deltoids are antagonistic to the lats and teres major.

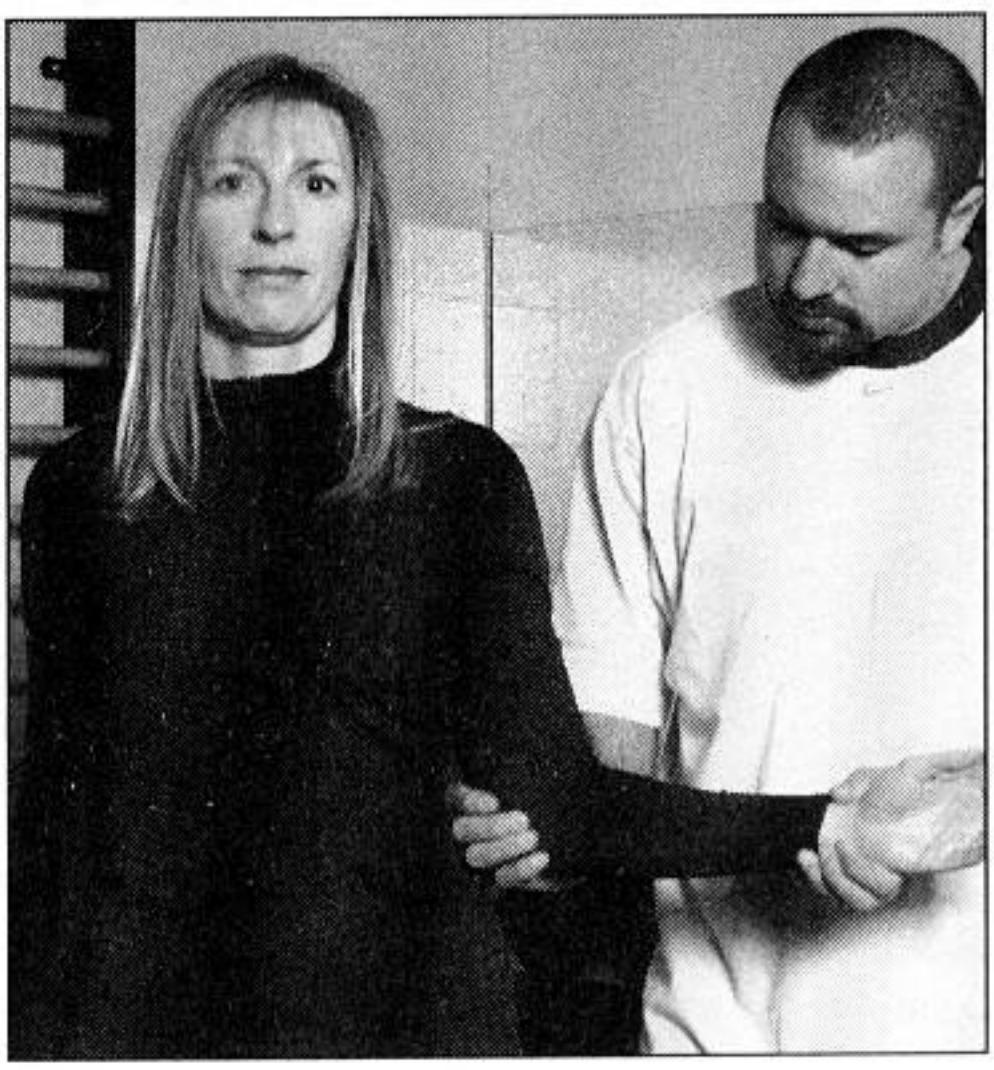
Martial Arts Application. The deltoids are involved whenever there is movement of the upper arm. They are strongly active during elbow strikes, as well as all punching, striking, and blocking skills. The rear deltoid is active in pulling movements, such as pulling opponents toward oneself in preparation for a sweep, throw, or knee strike.

Unique Characteristics. The deltoids seem to have a fairly large proportion of slow-twitch muscle fibers.

The infraspinatus, the primary external rotator of the arm, is opposed by large muscle masses, including the pectorals, lats, teres major, and subscapularis. Add to this the fact that the infraspinatus tendon has a very poor blood supply (studies on seniors have actually shown that many older people have no function in the infraspinatus at all due to adhesions and scarification), the infraspinatus is easily overpowered by its antagonists, which can potentially lead to dysfunctional biomechanics at the GH joint. For these reasons, virtually all athletes should perform regular infraspinatus training. For further discussion on mechanics and training of the rotator cuff, please refer to the excellent book Seven Minute Rotator Cuff Solution.

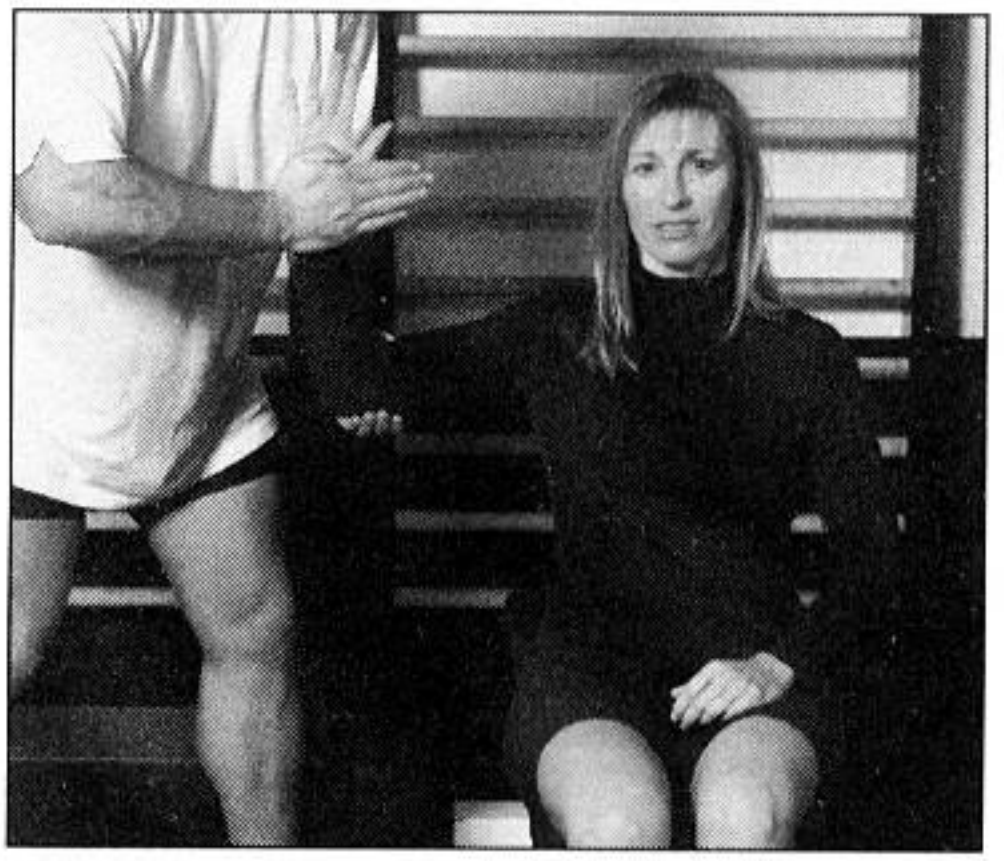
Length Assessment. Subscapularis (directions are for the right side): From a standing position, bend the right elbow to a 90-degree angle, and externally rotate the arm. Minimal acceptable length allows the entire lower arm to be placed in the frontal plane, as shown. People with extremely tight subscapulari are unable to outstretch their arm to the front and turn supinate (turning the palm up).

Length assessment for the infraspinatus (directions are for the right side): From a standing position, the athlete should be able to touch the lower aspect of his left scapulae with the tip of his right middle finger.

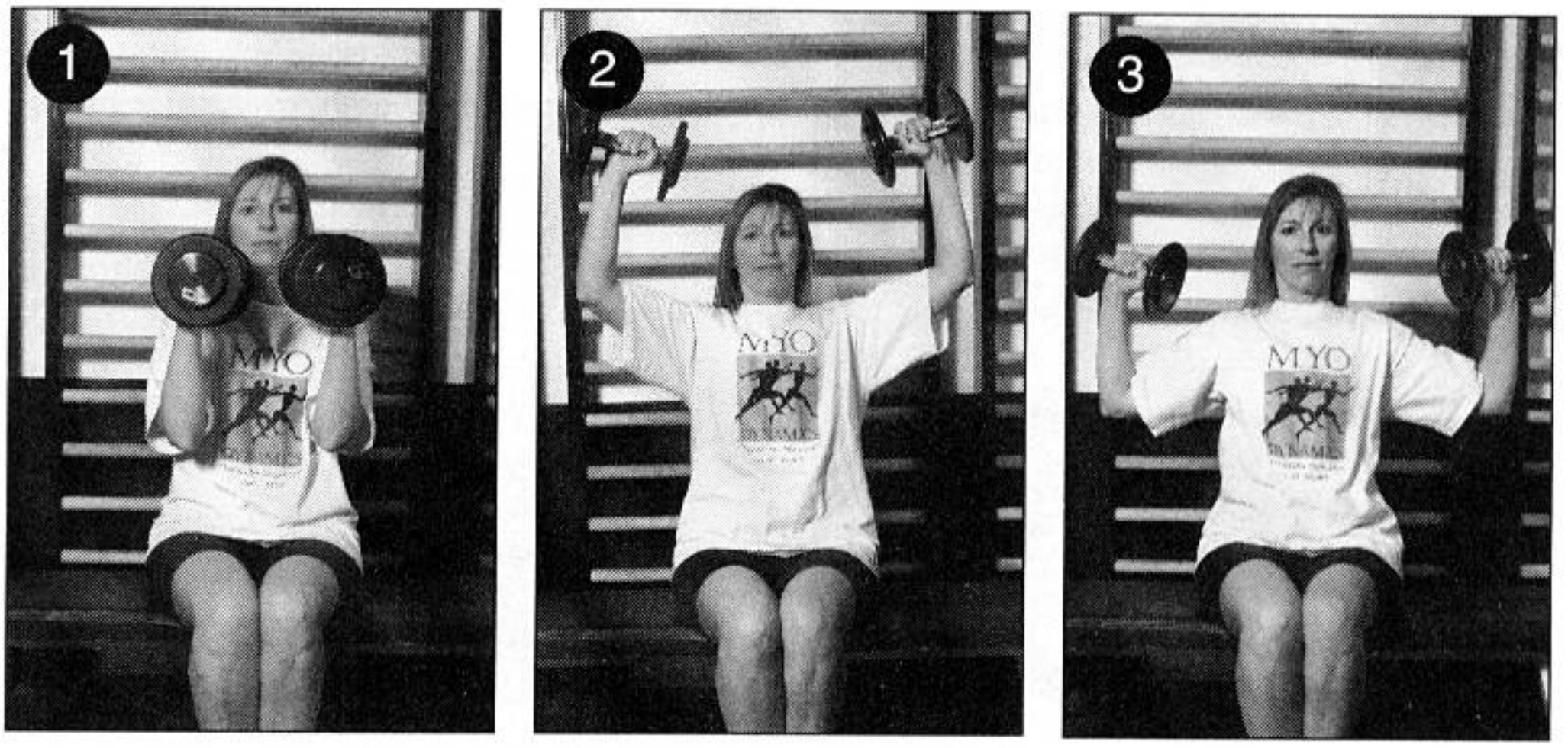


Stretching Methods for the Deltoids and Rotator Cuff

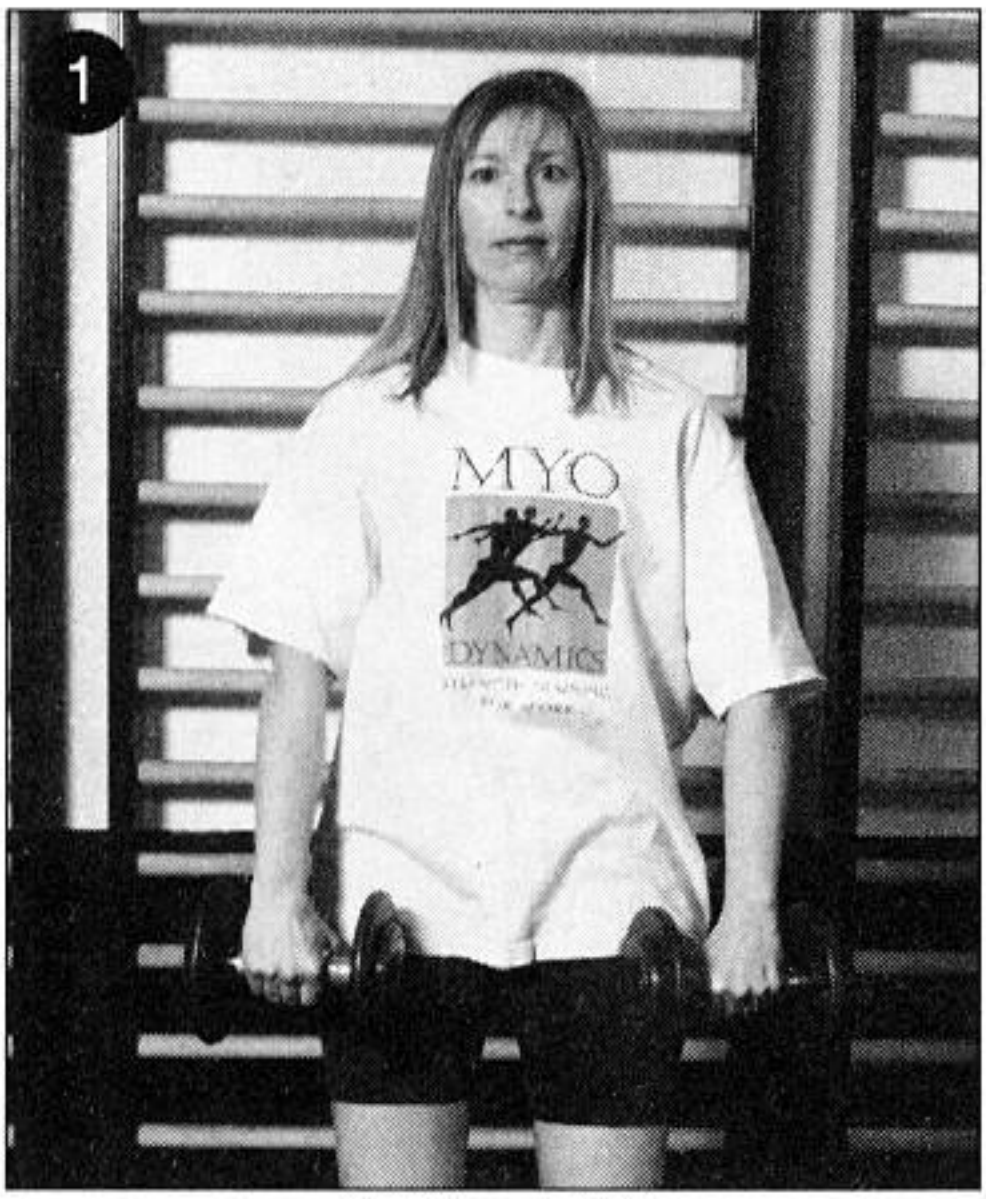
Subscapularis Stretch. This stretch is performed from a seated position with the arm abducted and externally rotated, the elbow at a 90-degree angle. This description is for the left side. Standing to the side of the athlete, stabilize his left elbow with the right hand, and place the right palm against his left palm. Ask him to apply pressure to the tester's hand by attempting to internally rotate from the shoulder, using approximately 35–50% of maximal effort. Give the subject an audible count of six to eight seconds, then both partners release the pressure. Next, prompt the athlete to attempt to increase his range of motion, deepening the stretch. From this new, deeper ROM, perform the count again. Repeat for three to five repetitions, or until subsequent repetitions do not increase the range of motion.

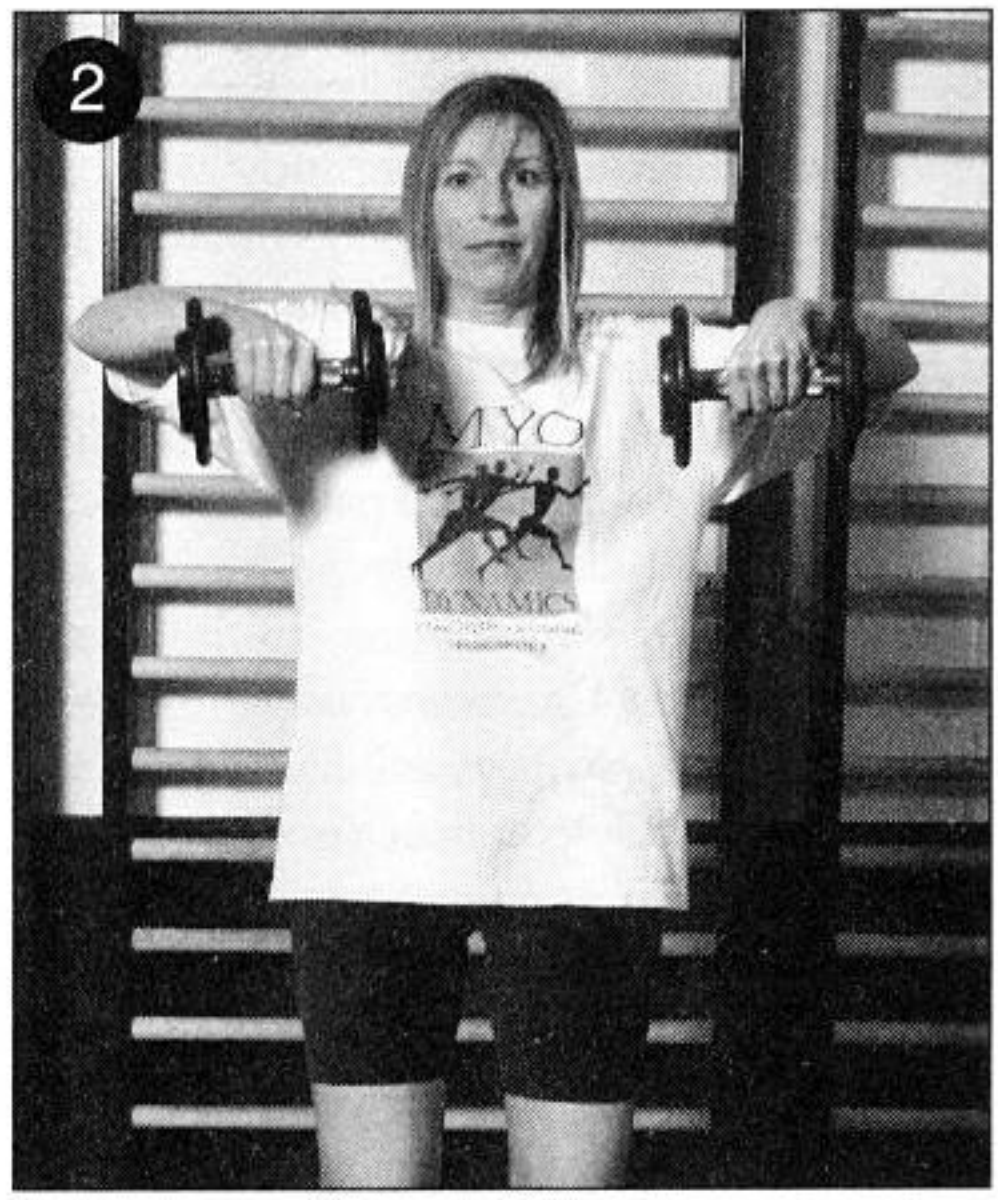


Strength Training Exercises for the Deltoids and Rotator Cuff

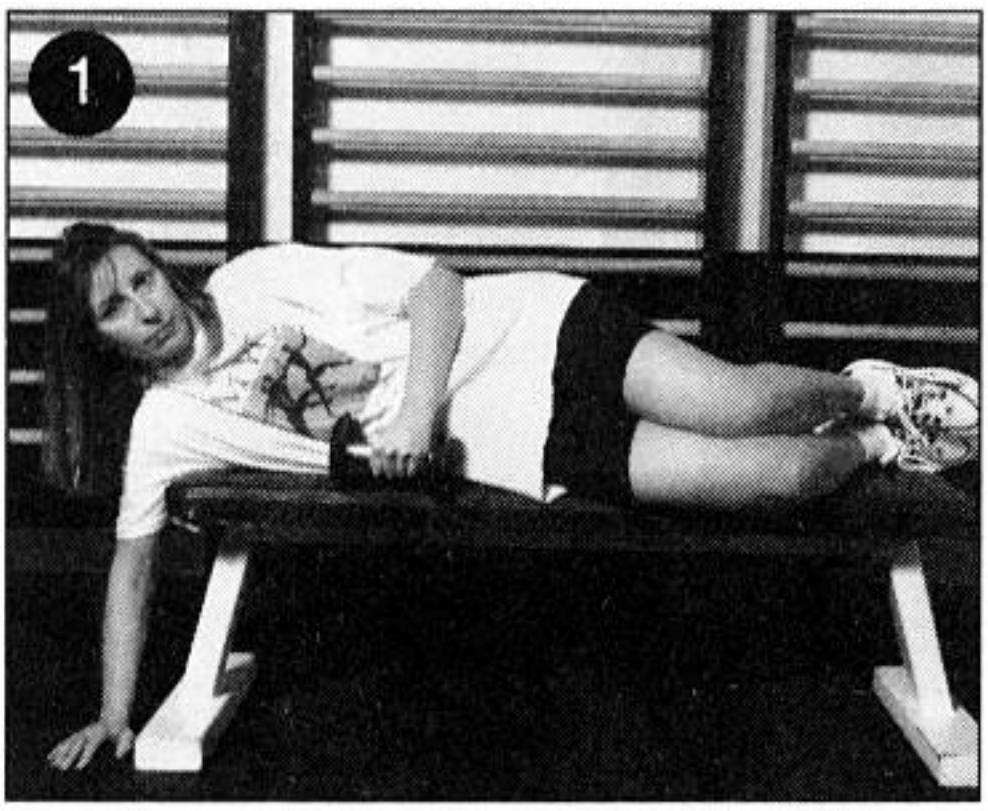


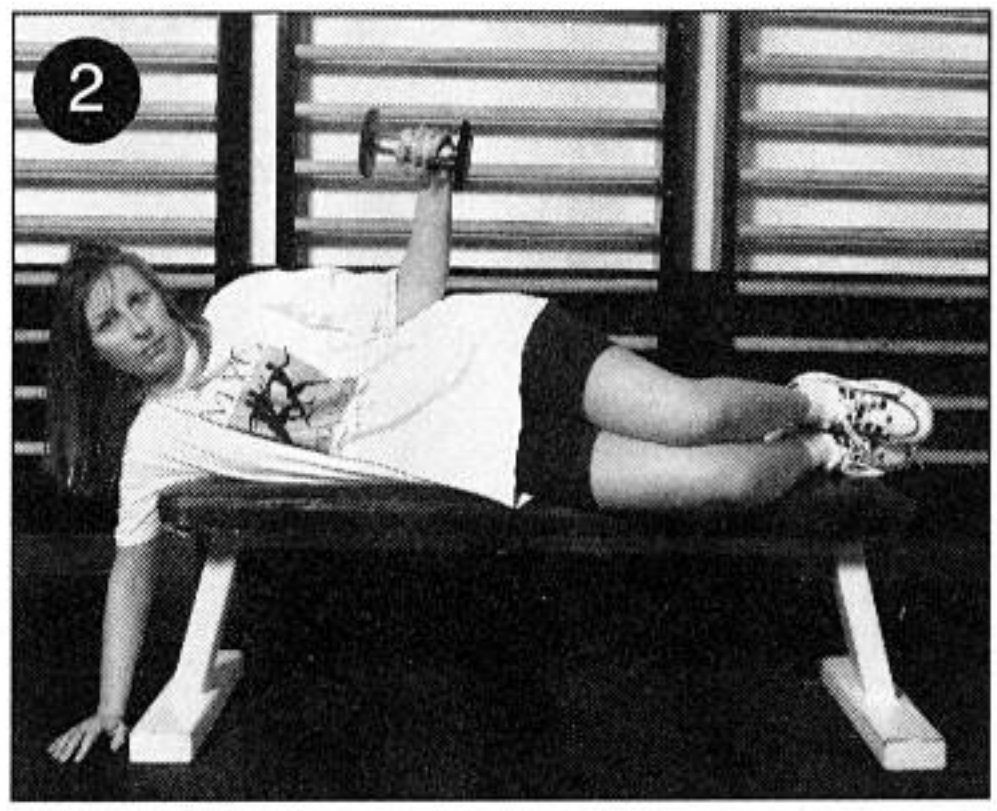
Arnold Press. From a seated position, begin with arms in front with elbows flexed. Raise the dumbbells upward using the anterior deltoid, then "open" the elbows into a standard seated press position, and lower. Next, "close" the elbows, and start again for the indicated number of sets and repetitions.



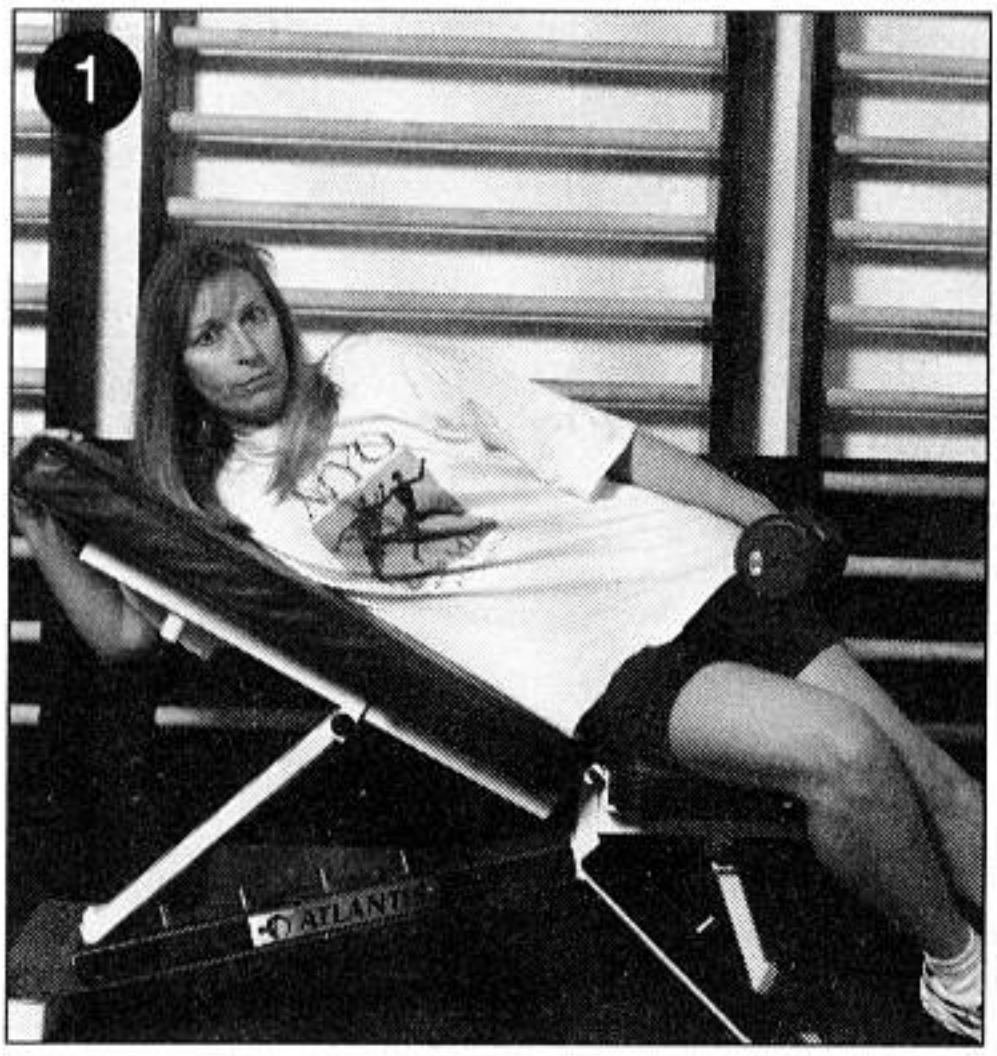


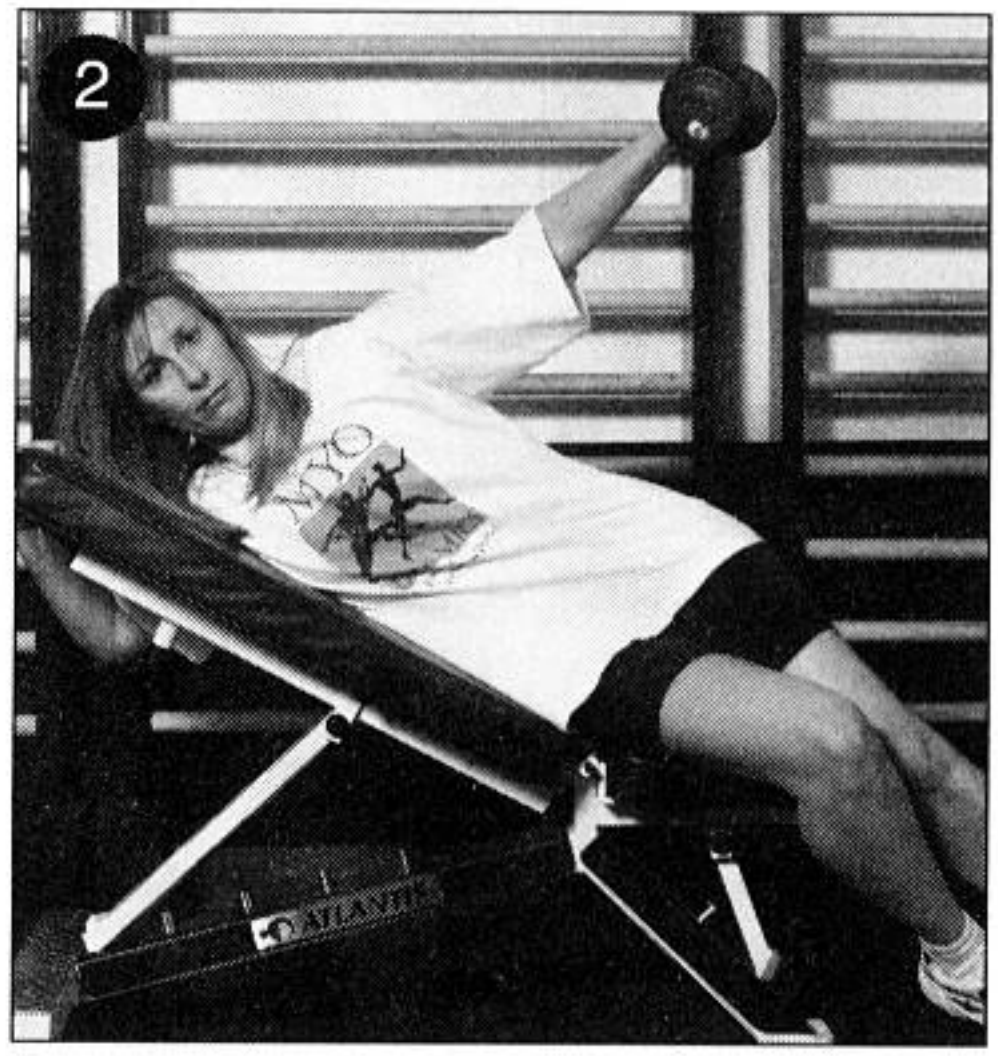
Dumbbell Upright Row. At the top of movement, shoulders, elbows, and hands should all be the same distance from the floor (all in a straight line from a front view). Keep the bells as close to the body as possible throughout.





Lying "L" Flyes. (Directions are for the right side) Lie on a bench or the floor, on the left side. If on a bench, stabilize by placing the left palm on the floor. Using a very light dumbbell (even an empty hand is sufficient in many cases), start the exercise with the right arm fully against the right side, with the right elbow flexed to 90 degrees and "pinned" to the left ASIS (hip bone). Raise the dumbbell by externally rotating the right arm, maintaining the 90-degree elbow position. At the bottom position, the right arm will drape across the waist. Repeat for the other side. Note that this is a very small muscle. Use light weight/high repetition protocols. Strictly monitor to prevent any movement of the torso during the exercise.





Supraspinatus Raise. (Directions are for the right side) Lie on a bench or the floor, on the left side. If on a bench, stabilize by placing the left palm on the floor. Using a very light dumbbell, start the exercise with the right arm fully against the right side. Raise the right arm directly upward until it forms a 45-degree angle with the floor, and return. At the bottom position, do not rest the arm against the side, but instead, keep tension on the target muscle. Repeat for the other side. Once again, this is a very small muscle so use light weight / high repetition protocols.

Tips for Maximizing Strength Training for Deltoids and Rotator Cuff.

Virtually everyone overtrains their shoulders, not realizing how often shoulders are used during chest and back exercises. In fact, using an approach like the program outlined previously, deltoids are trained five times a week, including the back and chest workouts.

The same bodybuilder referenced earlier about abdominal training was also asked what he did to develop his impressive deltoid muscles. His answer, "three sets of nothing." He was alluding to the fact that he performs direct deltoid exercises only rarely, usually only the three to four weeks immediately before a bodybuilding competition.

When training the deltoids, it's critical to use slow movement speeds, and to keep the elbows pointing sidewards. By externally rotating the arms even slightly, the lion's share of the stress falls onto the front deltoid, which receives more than enough training from the pressing movements in a full strength training program.

Elbow Flexors

Description. The elbow flexors consist of three muscles: the biceps brachii, the brachialis, which lies directly under the biceps, and the brachioradialis. Although most people think of these muscles as elbow flexors only, the biceps also contribute to shoulder flexion and supination of the hand.

Martial Arts Applications. The elbow flexors play an important role in all choking maneuvers, and in protecting the elbow joint during punching and striking. In grappling arts such

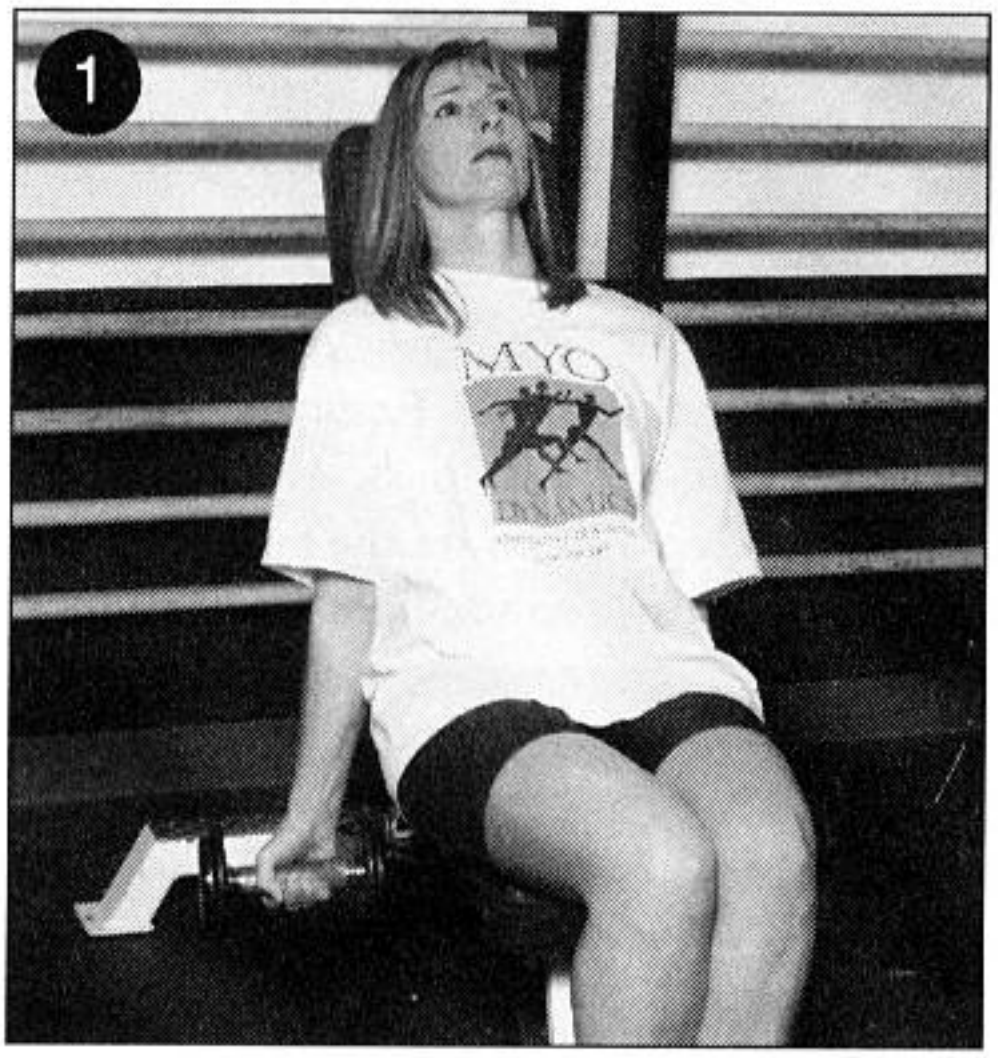
as jujitsu and judo, the arm flexors are statically engaged during times when the athlete is gripping the opponent's *gi* (uniform).

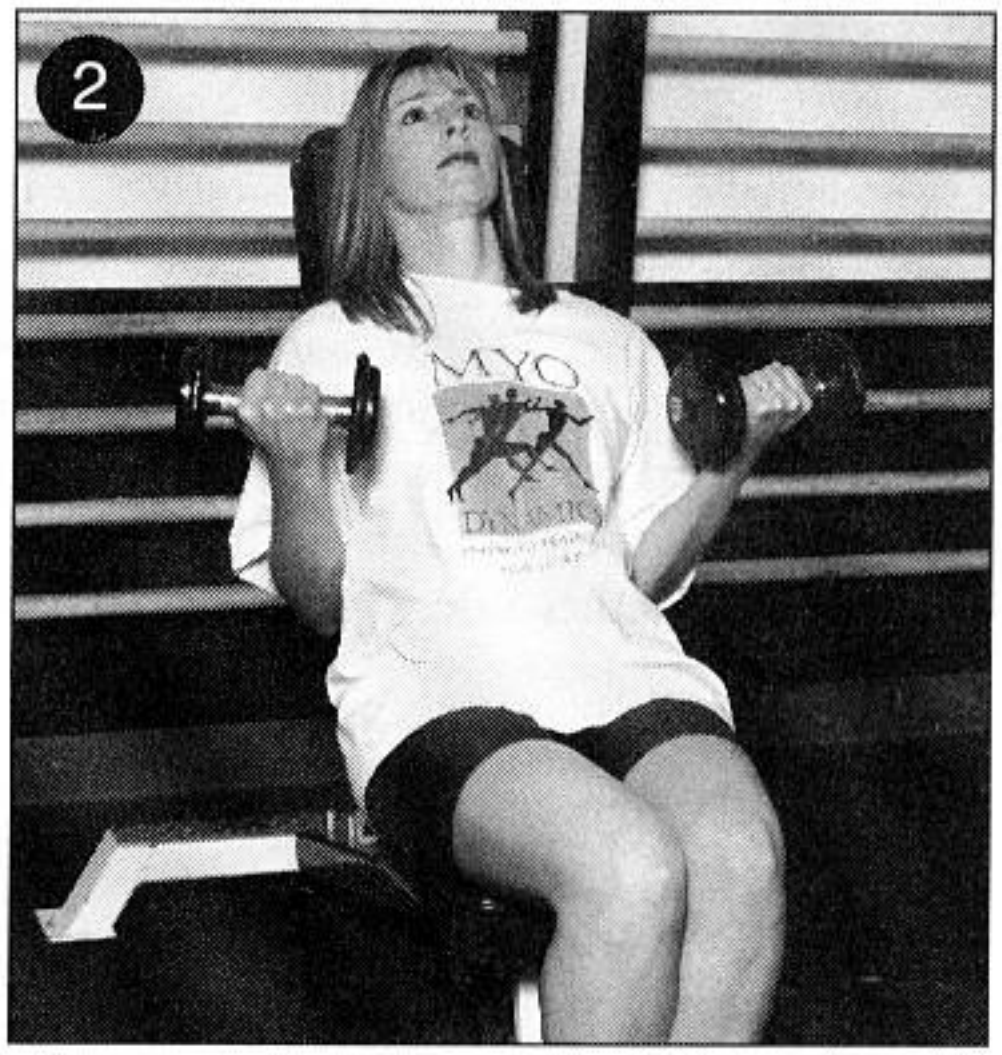
Unique Characteristics. The arm flexors tend to be a mix of fast- and slow-twitch fiber, and therefore are best trained through the use of varied intensities. Since the biceps has two heads, it can be selectively trained by varying the shoulder position during the exercise.

Since the biceps is often thought of as a "show" or "beach" muscle, biceps training is often over-worshiped by young male trainees, but also excessively discouraged by well-meaning coaches and instructors!

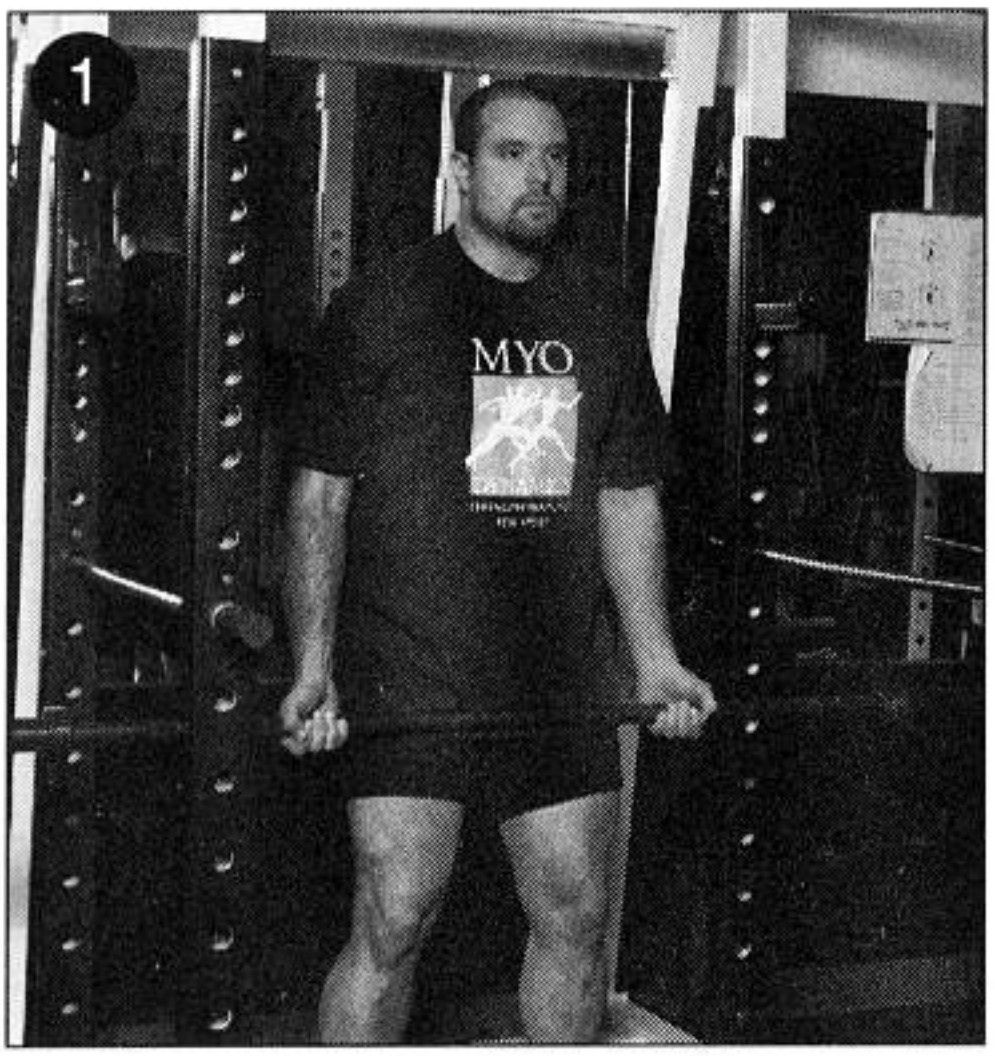
Length Assessment and Stretching. As long as the athlete can fully flex and extend his elbow and supinate the hand, the biceps has adequate length.

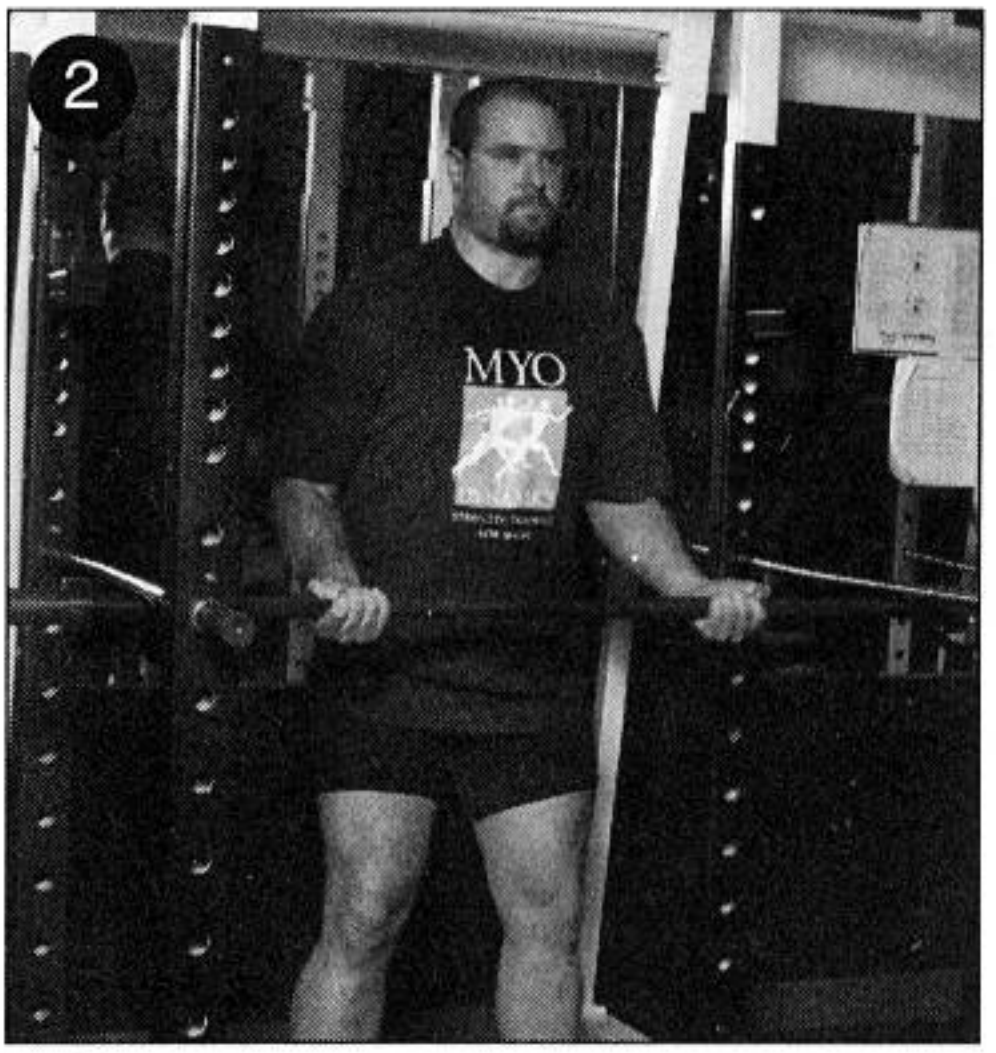
Exercises



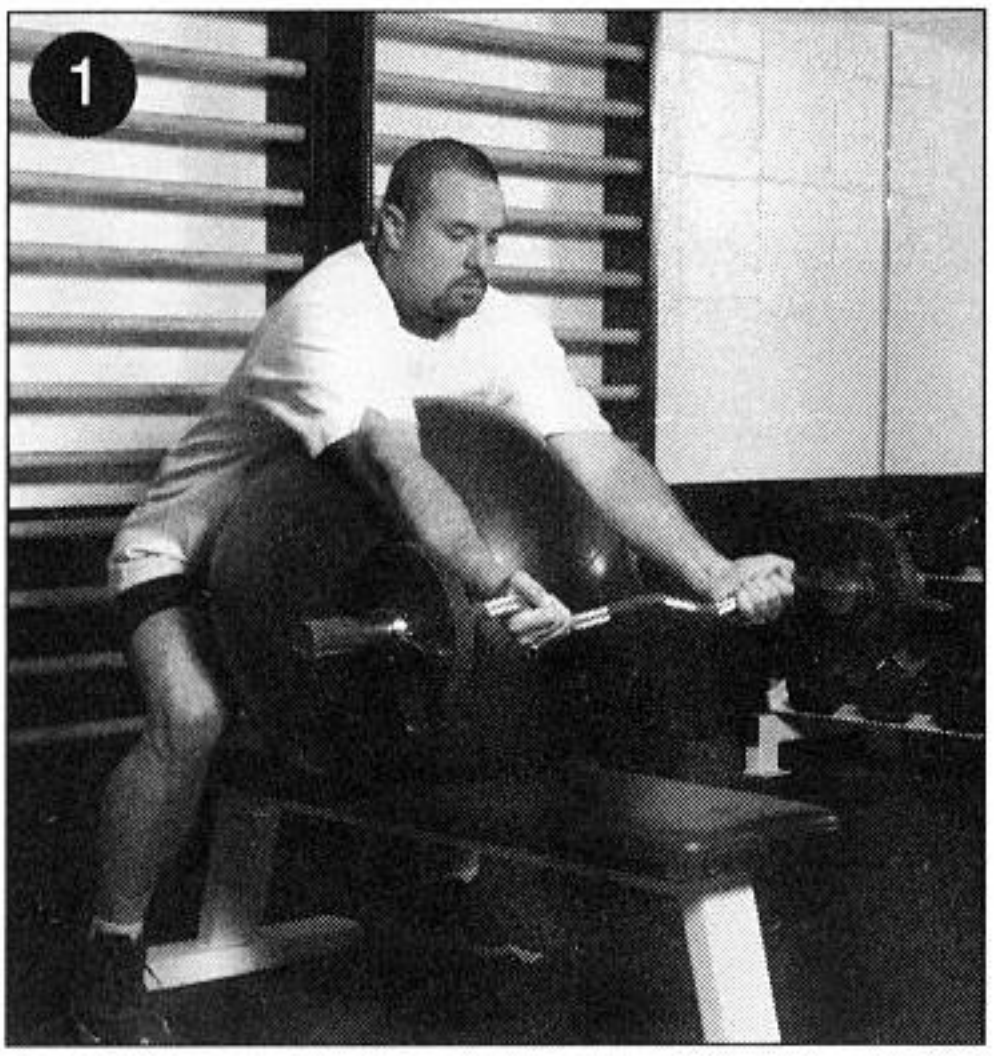


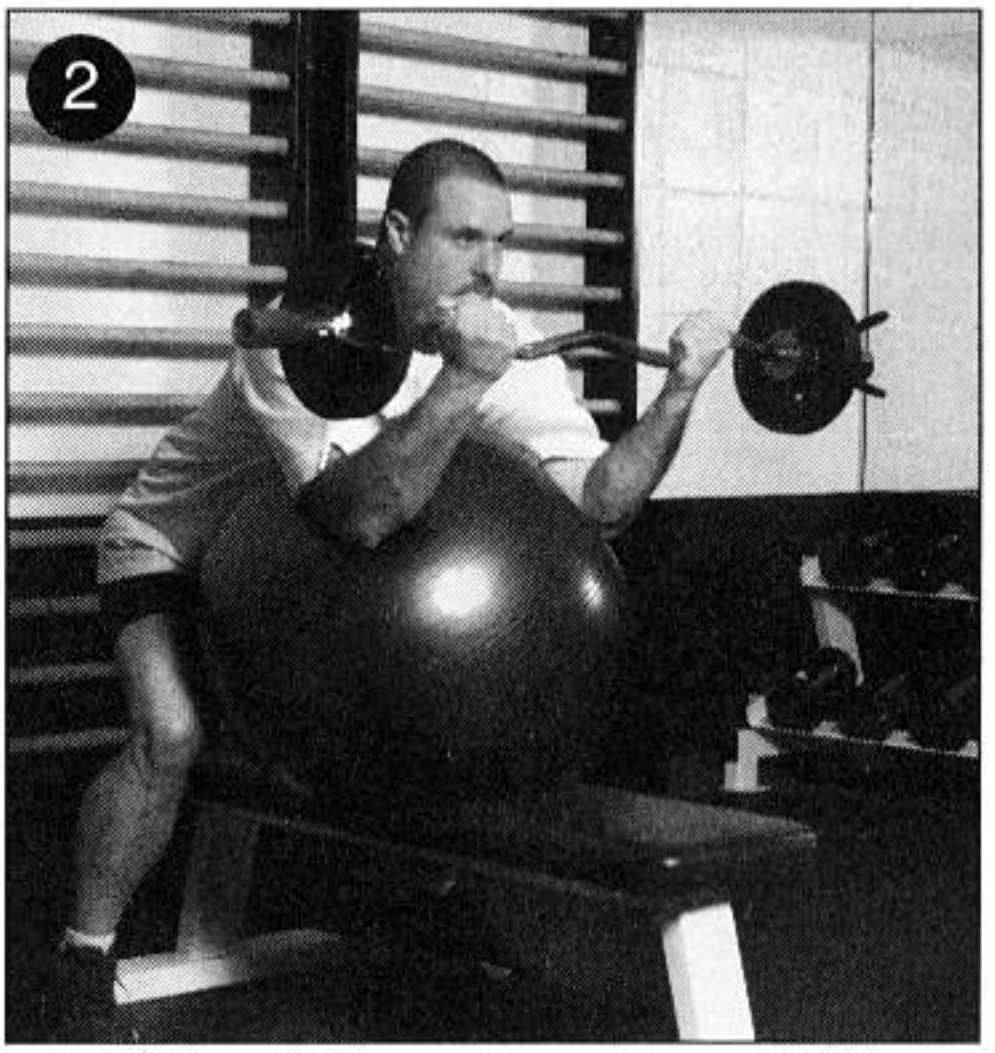
45-Degree Incline Dumbbell Curl. Do not allow the elbows to shift forward during the concentric portion of the lift! Allow the arm to completely straighten on the bottom. Squeeze hard at the top.





Static Barbell Curl. Load a barbell and place it on pins inside of a power rack. Set a second pair of pins at a height where the bar will hit them when the elbows are flexed at approximately a 90-degree angle. Grip the bar so that the hands are slightly wider than shoulder-width. Curl the bar, and press against the pins with maximal force for six seconds, then release. This is one set. Two important considerations are holding one's breath throughout the repetition and not allowing the lower back to increase or decrease it's normal curvature. Static curls may also be performed at the end of a "standard" set, by touching the pins at the end of each repetition for the desired number of repetitions, and then performing the static hold on the last repetition.

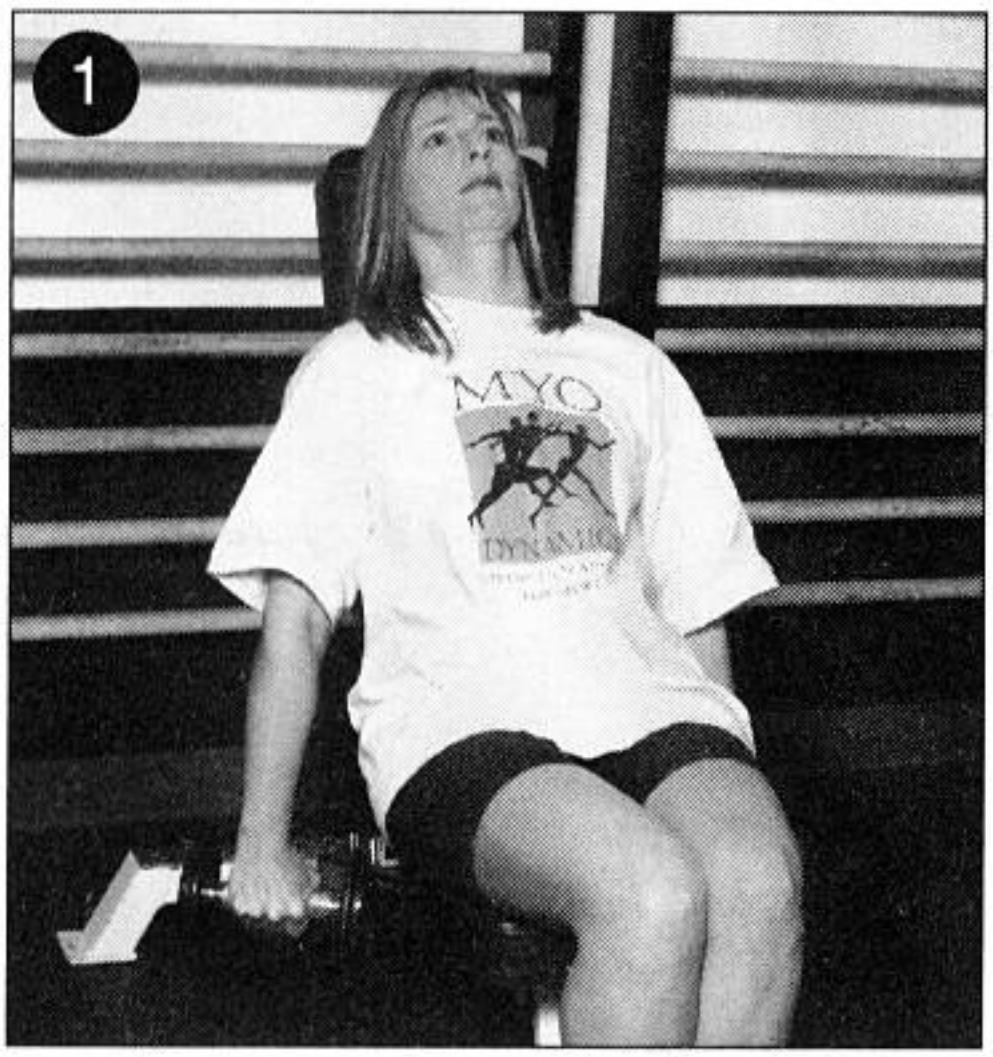


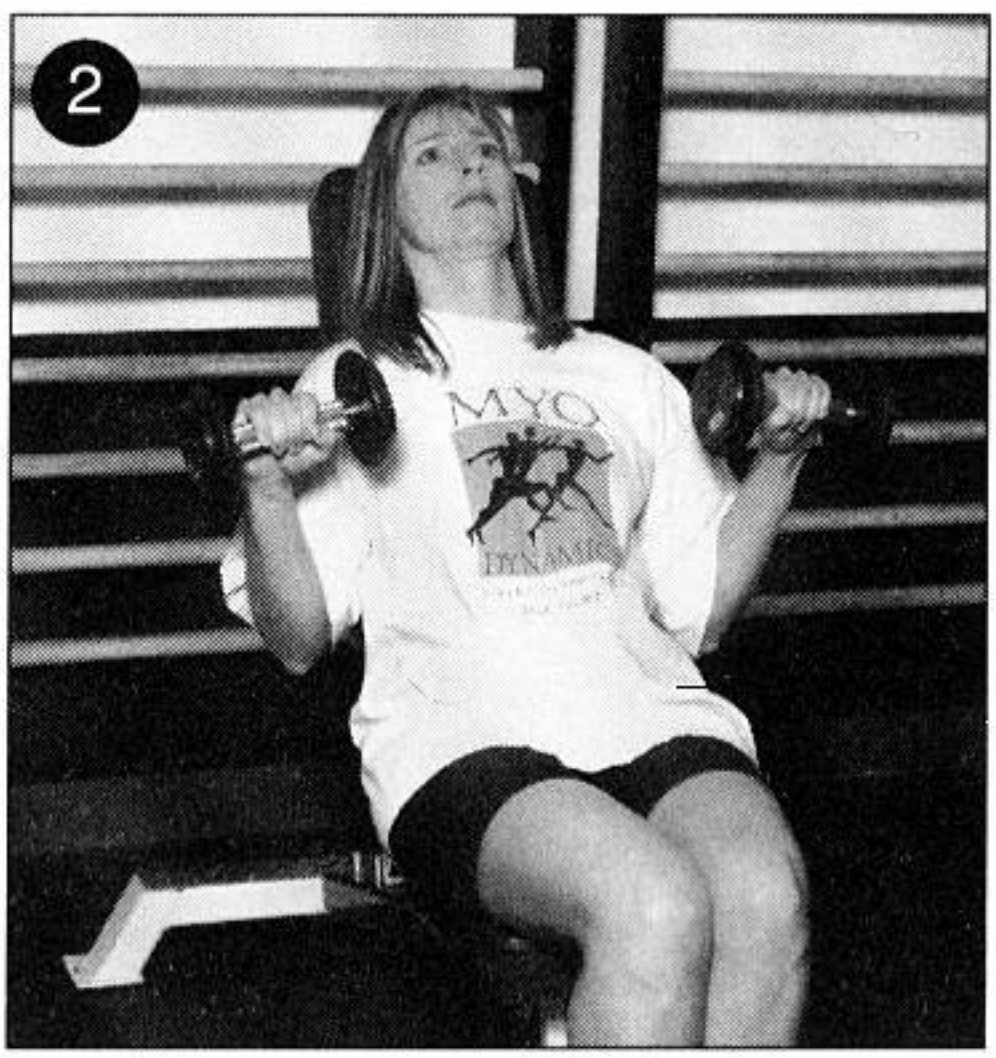


Swiss Ball Preacher Curl. Position the upper arms over the ball as when using a preacher bench. Use either a straight handle, pair of dumbbells, or a handle attached to a low cable, and perform the curls for the desired number of sets and repetitions.

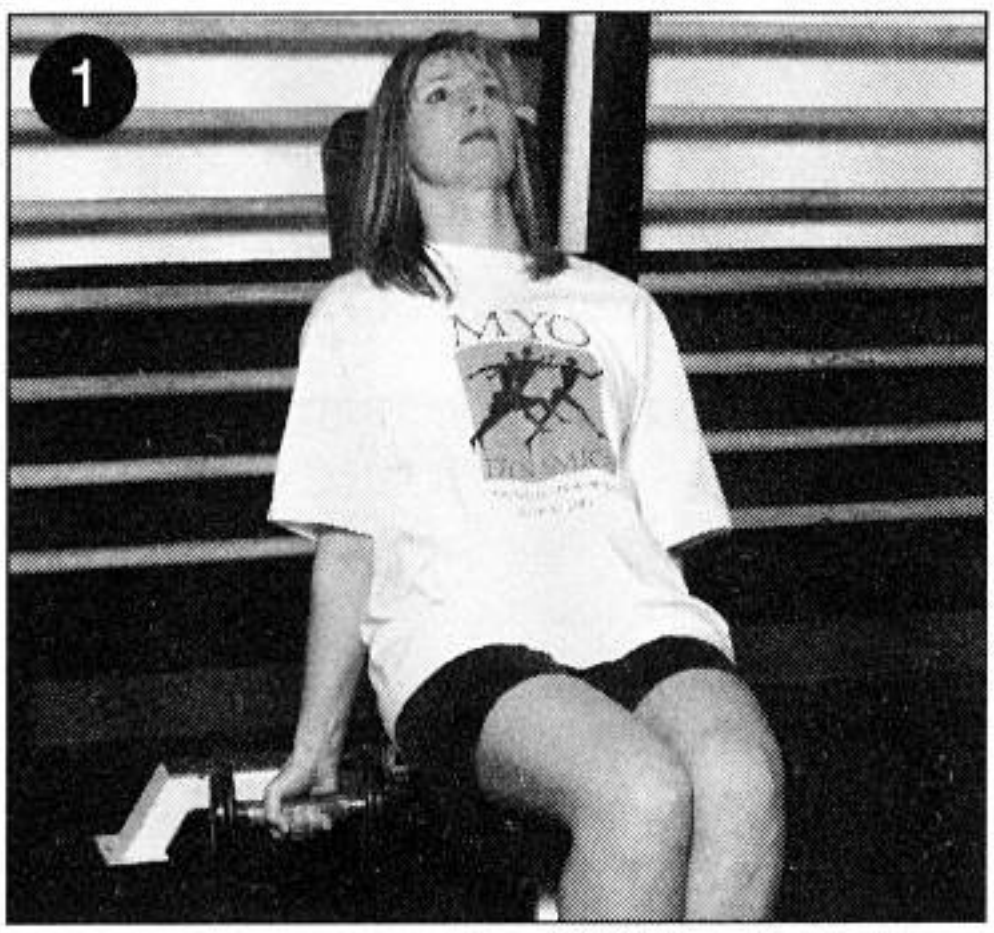
Hammer Curl. This is simply a curl performed with a "thumbs up" position, which increases the involvement of the brachialis muscle (an important muscle for grip strength). Grapplers must implement this exercise judiciously since the gripping muscles are exposed to constant stress during skills sessions.

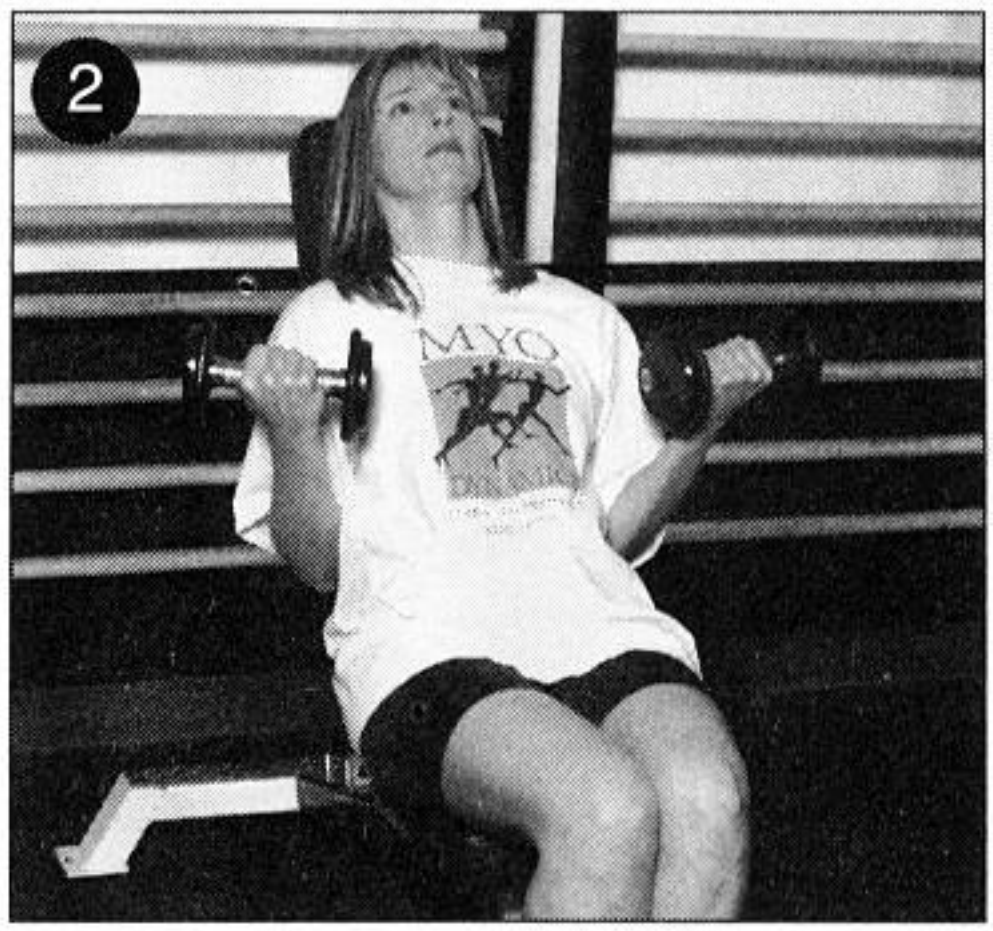
Low Cable Hammer Curl *(not illustrated).* Attach a triceps rope to the low cable. Sit on a bench positioned perpendicular to the cable's line of pull. Sit on the bench, bracing the feet against the floor or, if possible, against the lower supports of the cable unit. Lean back to a 45-degree angle, anchoring the elbows to one's sides (similar to performing a triceps push-down), and perform a hammer curl. Once again, grapplers must implement this exercise judiciously since the gripping muscles are exposed to constant stress during skills sessions.

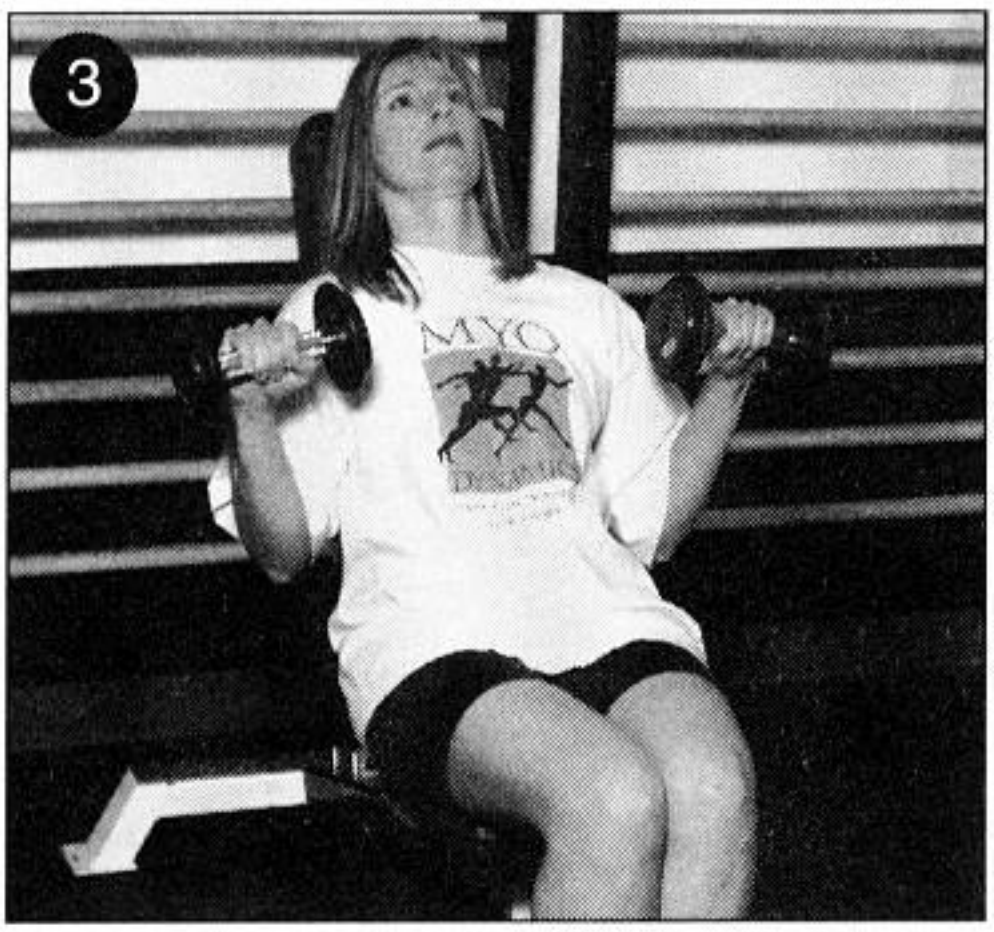


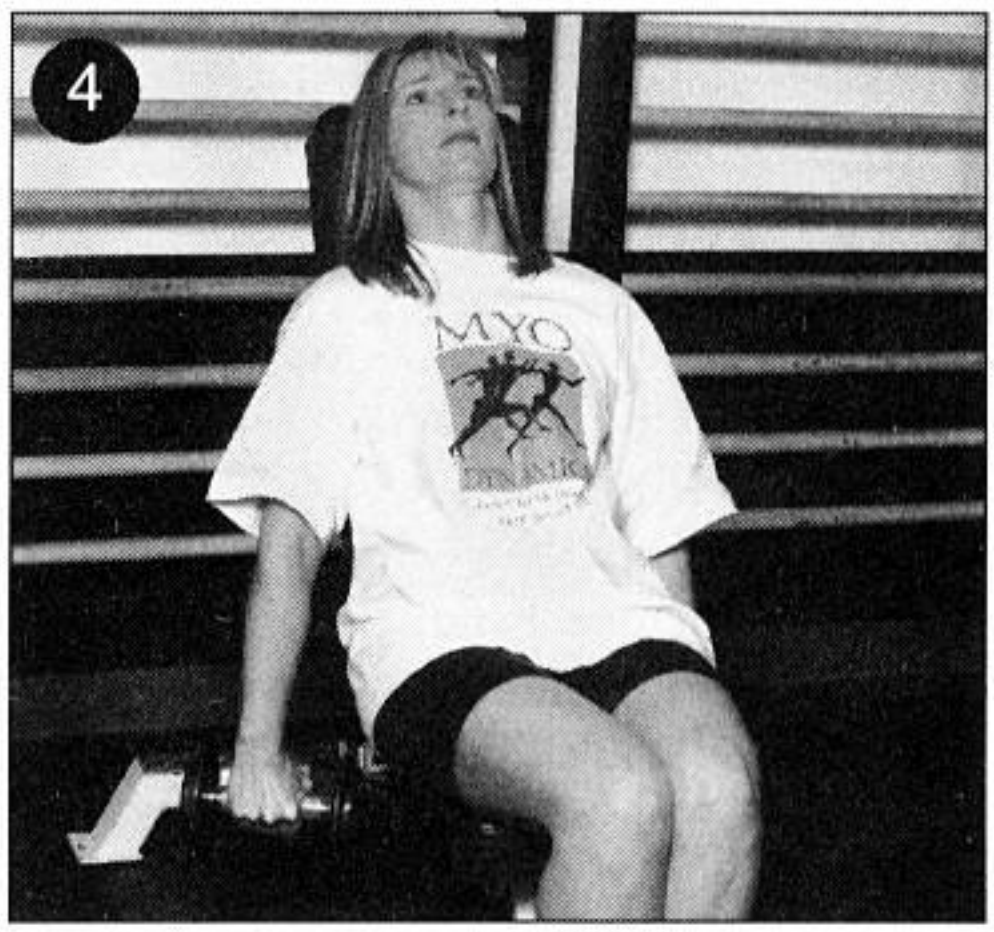


Reverse Curl. This is simply a curl performed with a "palms down" position, which increases the involvement of the brachio radialis muscle (an important muscle for grip strength). As in the previous two exercises, this is yet another method that grapplers should use judiciously.



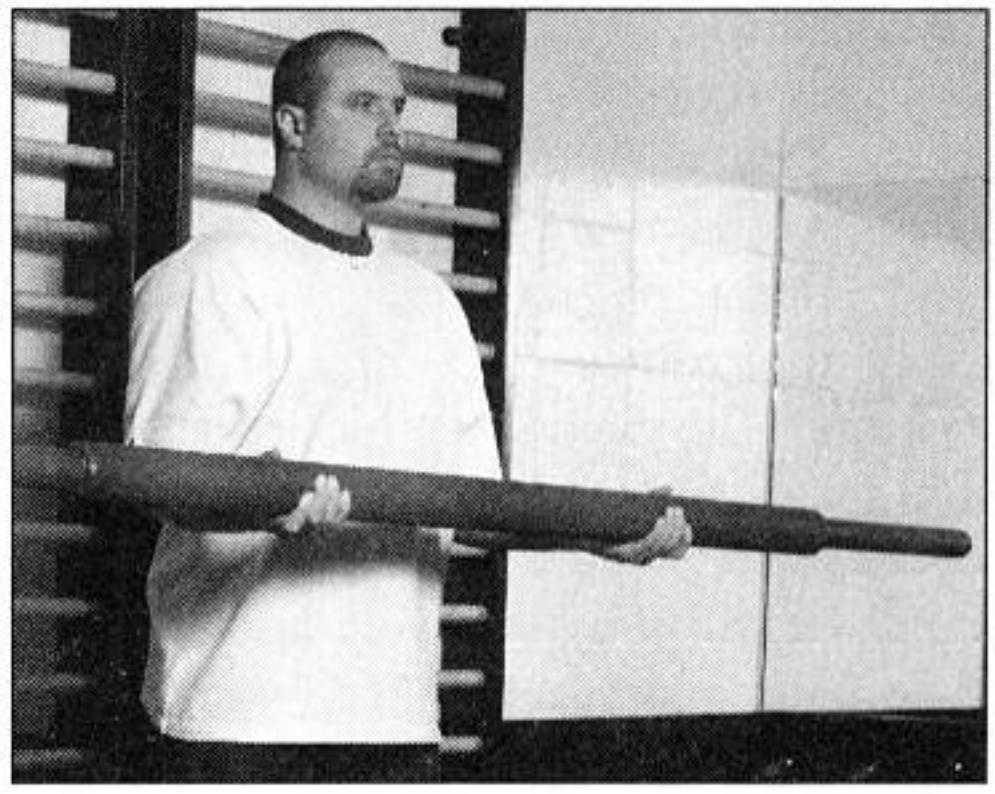






Zottman Curl. Performed with dumbbells, the Zottman curl is a hybrid between the standard curl, the reverse curl, and the hammer curl. Performed seated or standing, curl the dumbbells up with a palms-up grip, then, at the top of the concentric phase, turn the palms down and lower back to the starting position. The caution for grapplers applies again.

Fat Bar Curl. A standard curl performed with an "oversized" barbell to increase the difficulty. Final caution exercise for grapplers.



Gastrocnemius, Soleus, and Tibealis

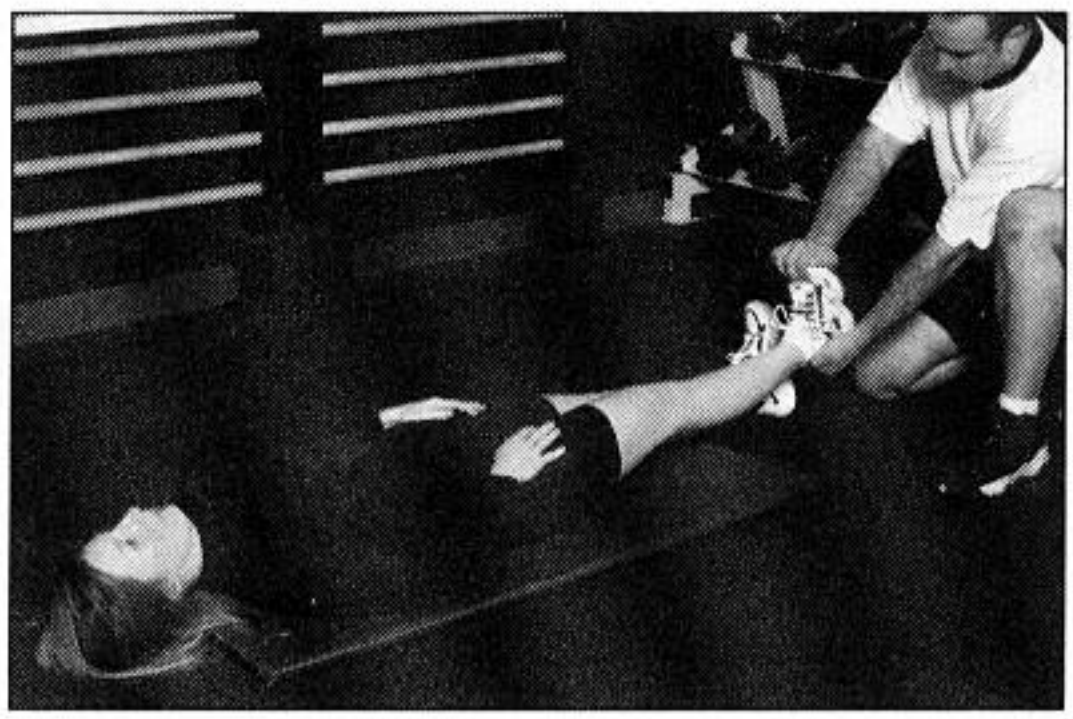
Description. These are the three significant muscles below the knee. The "gastroc" plantar flexes the ankle when the knee is straight, and the soleus does the same when the knee is flexed. The tibealis is the primary dorsiflexor of the ankle. The gastrocs and soleus are antagonistic to the tibealis anterior.

Martial Arts Applications. The gastrocs are strongly involved in all sprinting, jumping, and kicking activities. The tibealis is important in grappling disciplines for controlling the opponent's position. In kicking, it allows extension of the heel for more focused kicks. The soleus helps to provide overall ankle stability during walking, running and jumping.

Unique Characteristics. Many people do not realize that the gastrocs, in addition to their role as ankle plantarflexors, also contribute to knee flexion in certain positions. For this reason, dorsiflexing the ankles during hamstring exercises makes these movements easier. Another interesting fact is that the gastrocs are mostly fast-twitch muscle fiber so training them with low to moderate intensities may be less than productive! Conversely, the tibealis are mostly slow-twitch. Try rapidly dorsiflexing and then plantarflexing either foot back and forth a few times. Which is faster? This is a great exercise for understanding the difference between fast- and slow-twitch muscles!

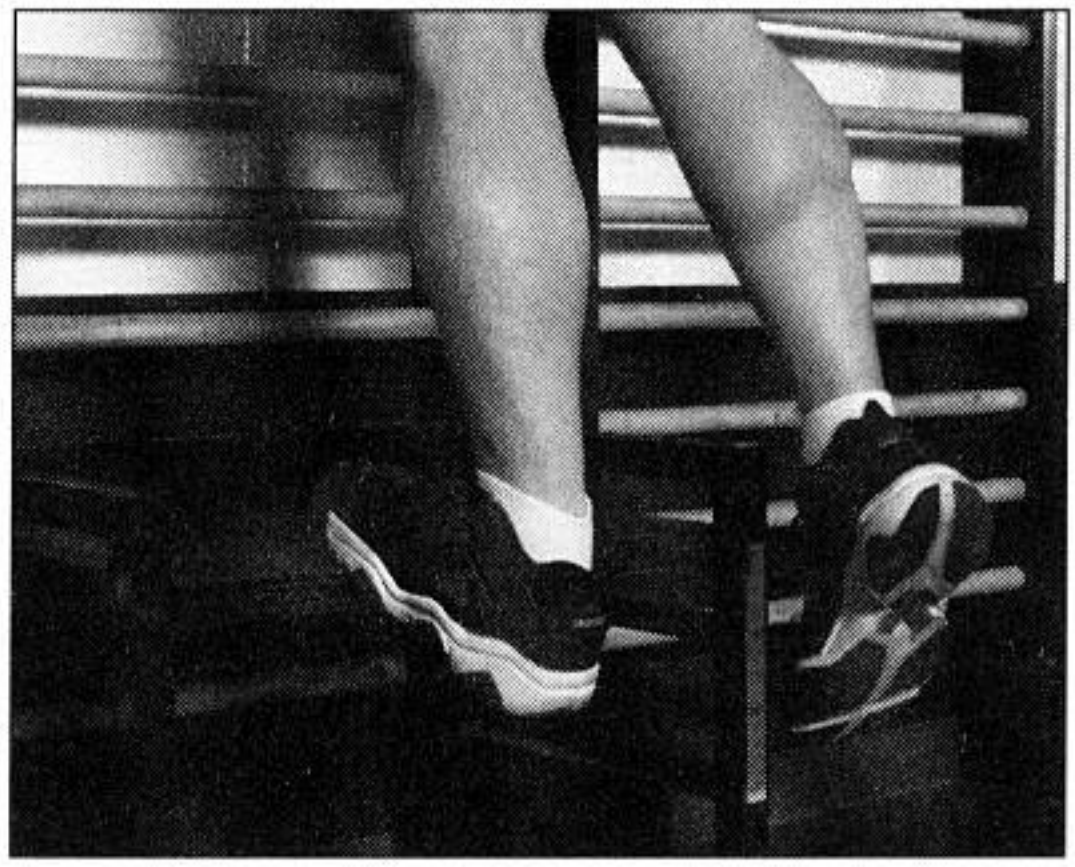
In bodybuilding circles, the belief is that calf size is a genetically-inherited trait—one either has it or not.

Length Assessment. To assess minimal standards for gastroc length, the athlete lies supine (face up) on the floor, with hips, knees, and ankles neutral. Cupping the heel with one hand, use the other hand to direct the foot into dorsiflexion. Minimal acceptable length is indicated by a 20-degree angle of the sole of the foot to the lower leg. Limited ROM at the ankle causes the athlete to lean forward during squatting and deadlifting exercises, exposing the low back to unnecessary risk.



Stretching Methods for the Gastrocnemius and Soleus

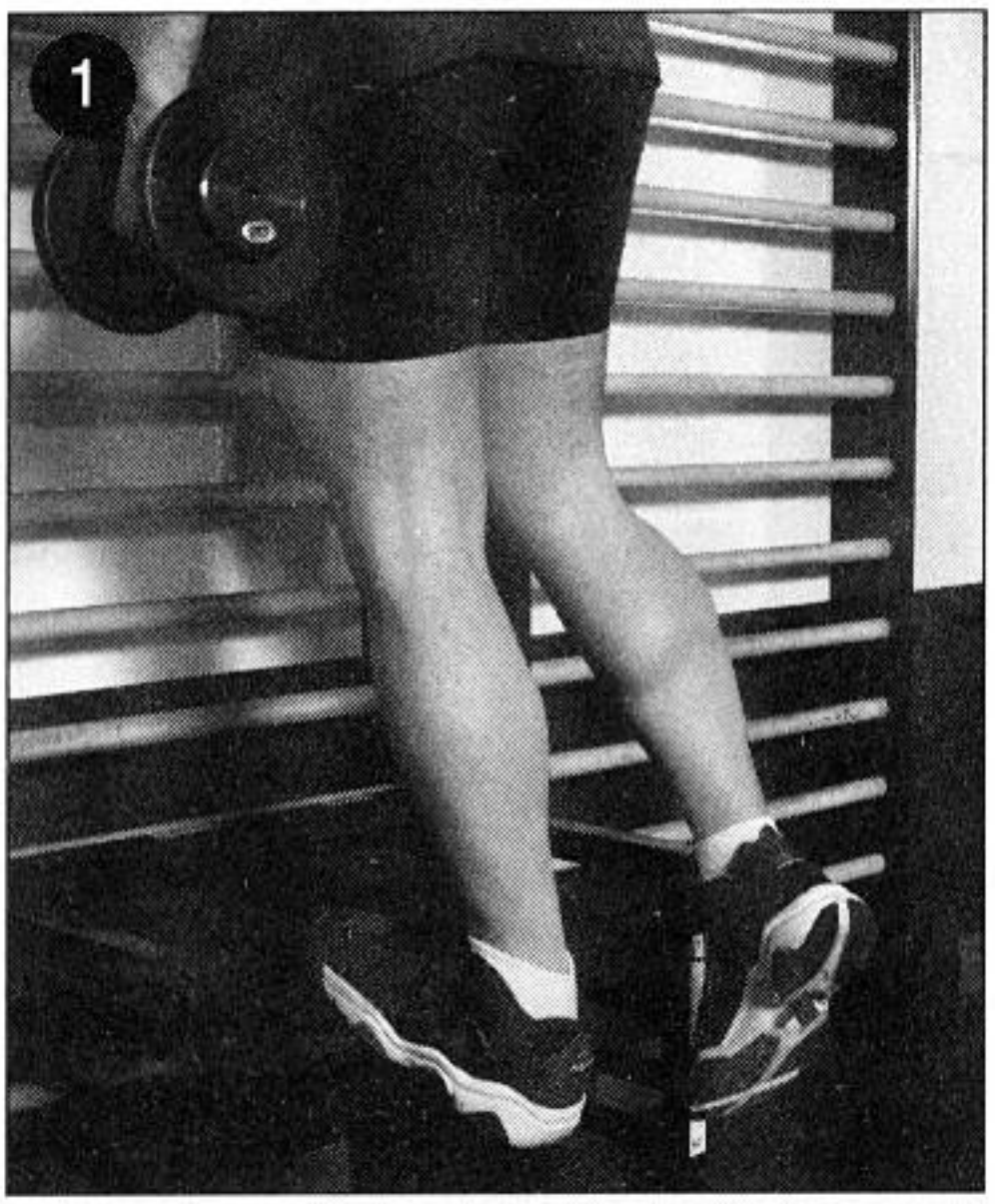
Gastrocnemius. Instruct the athlete to stand on an elevated surface as if performing unilateral standing calf raises. The athlete plantar flexes his ankle, using approximately 35–50% of maximal effort (he should raise his heel about one inch). Give the subject an audible count of six to eight seconds, at which point he will relax, allowing himself to drop into a deeper ROM. From this new, deeper ROM, perform the count

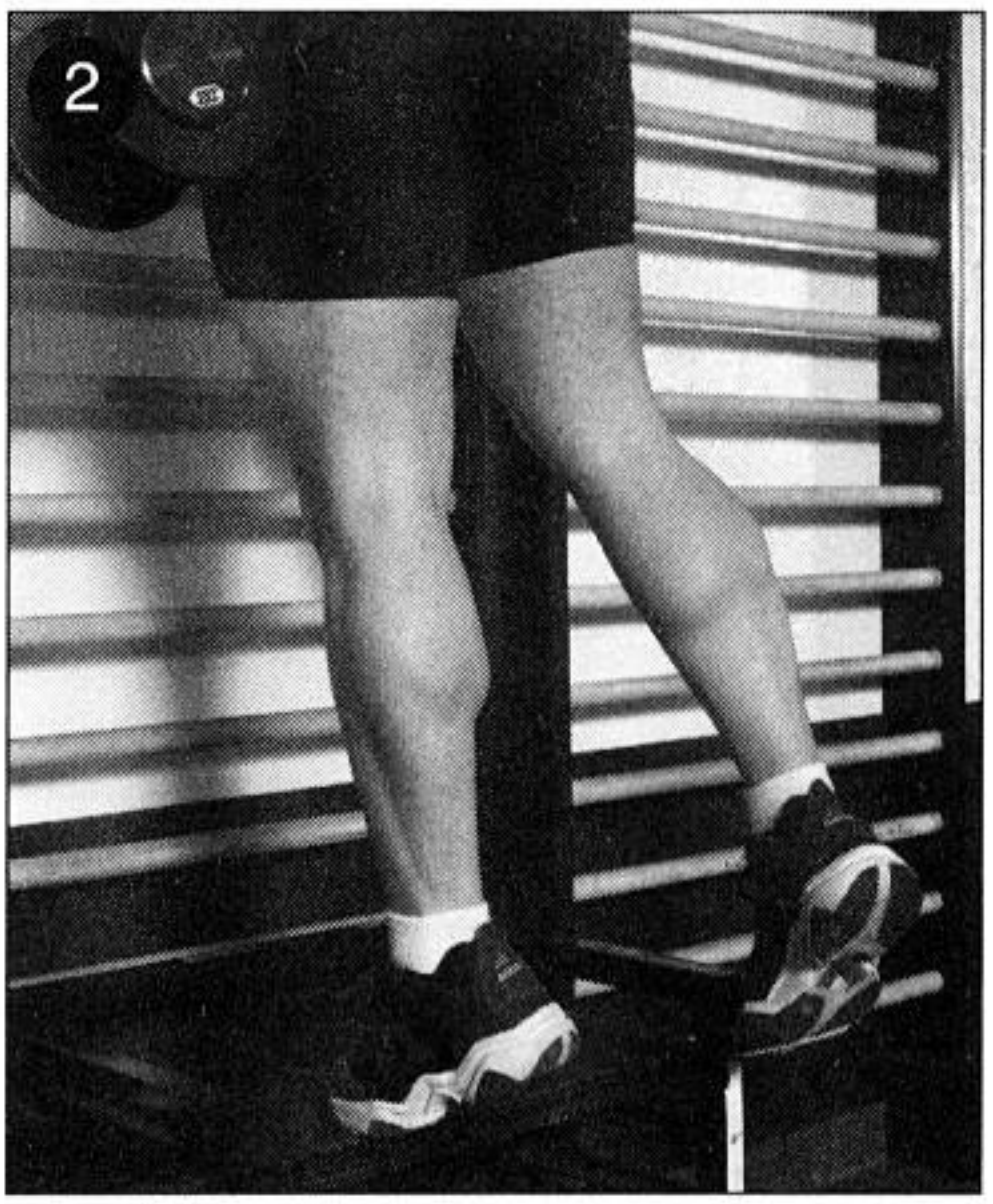


again. Repeat for three to five repetitions, or until subsequent repetitions do not increase the range of motion.

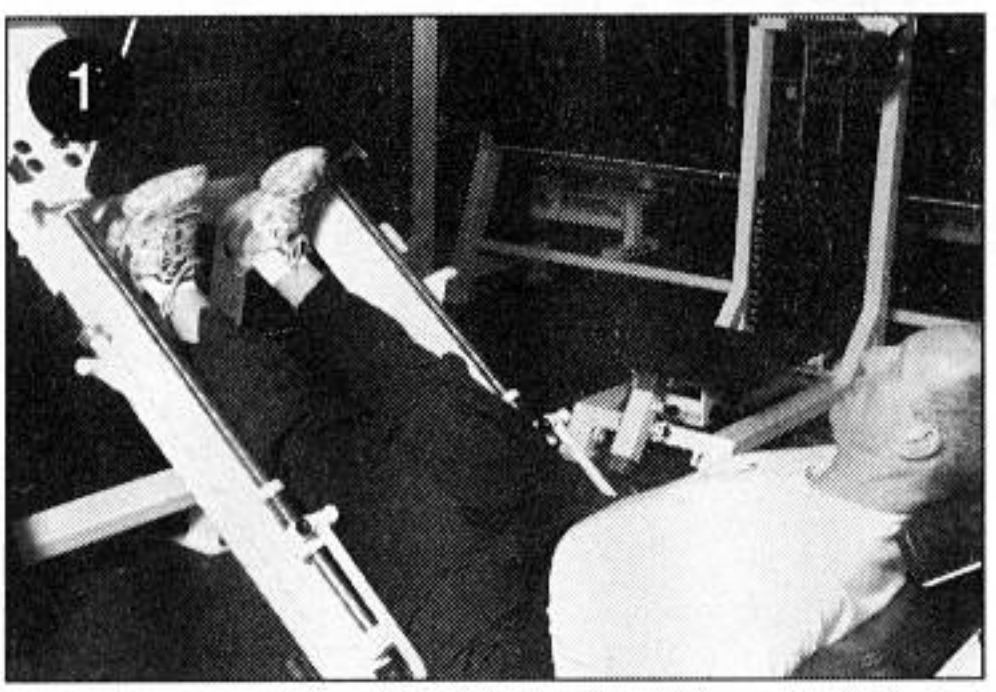
Soleus. Same as gastrocnemius stretch, but performed on a seated calf machine.

Strength Training Exercises for the Gastrocnemius, Soleus and Tibealis

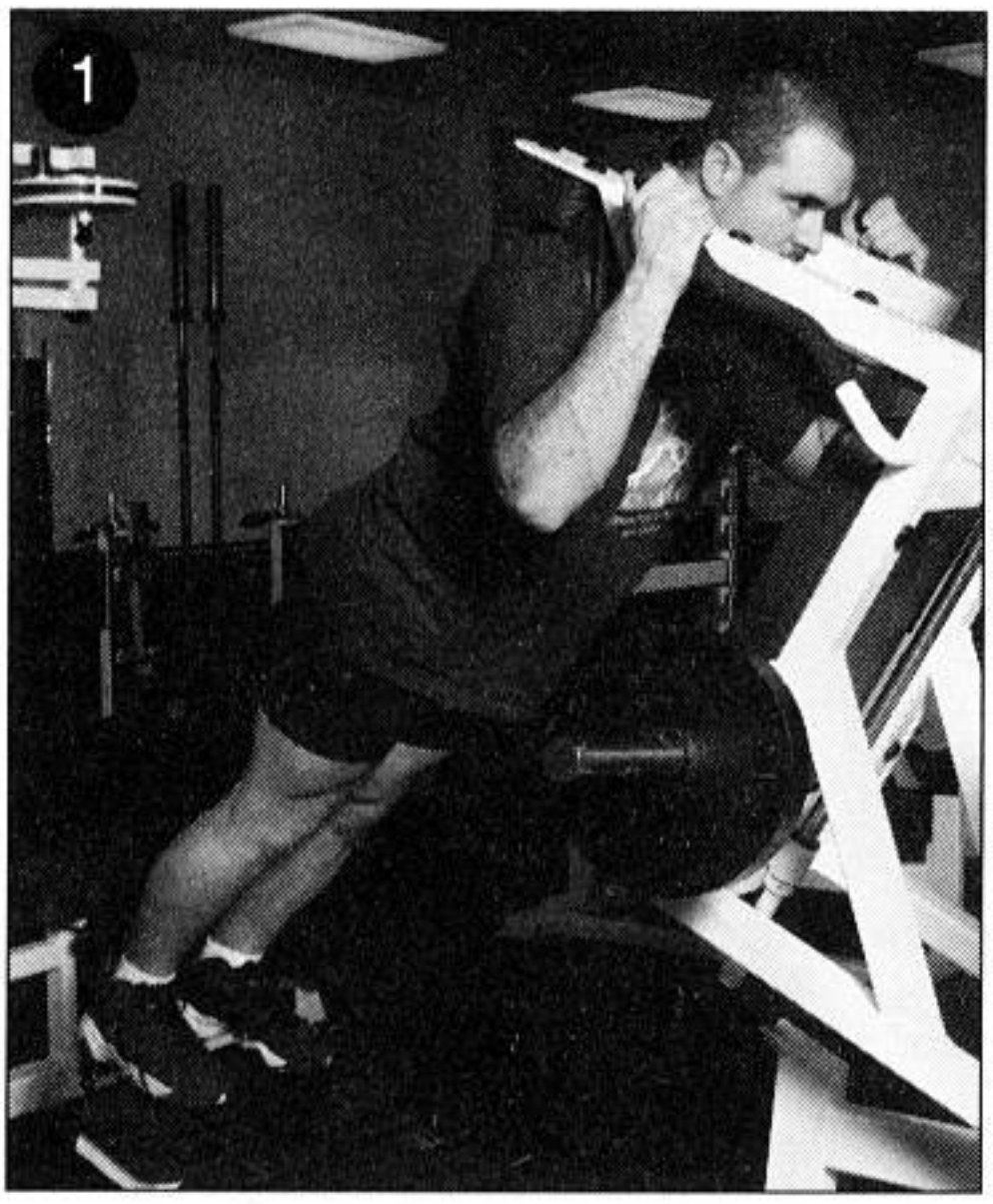


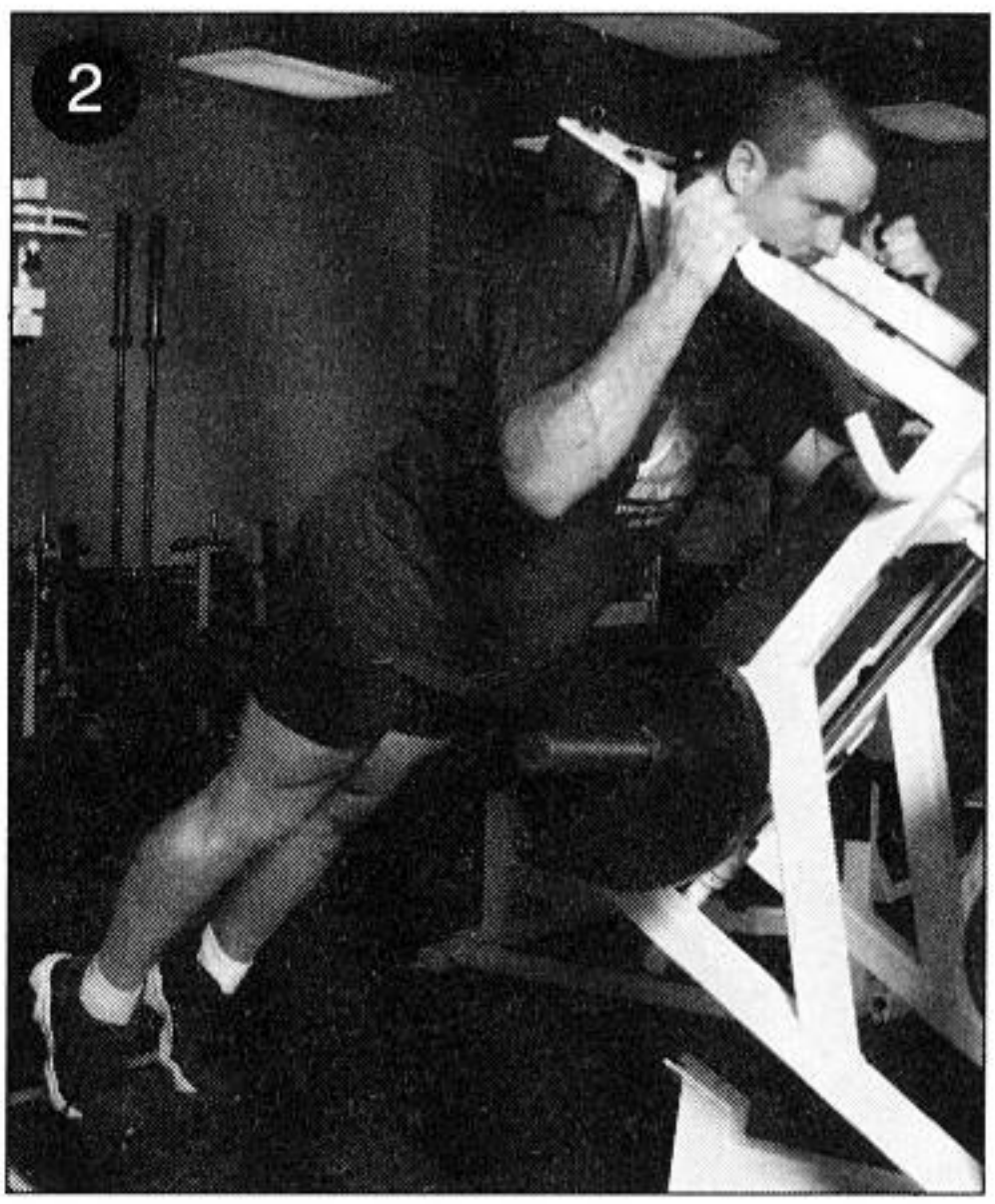


Standing Uni-Lateral Calf Raise. If possible, perform these standing on the handle of a large hexagonal dumbbell. This allows for better conformity to the gastroc's strength curve.



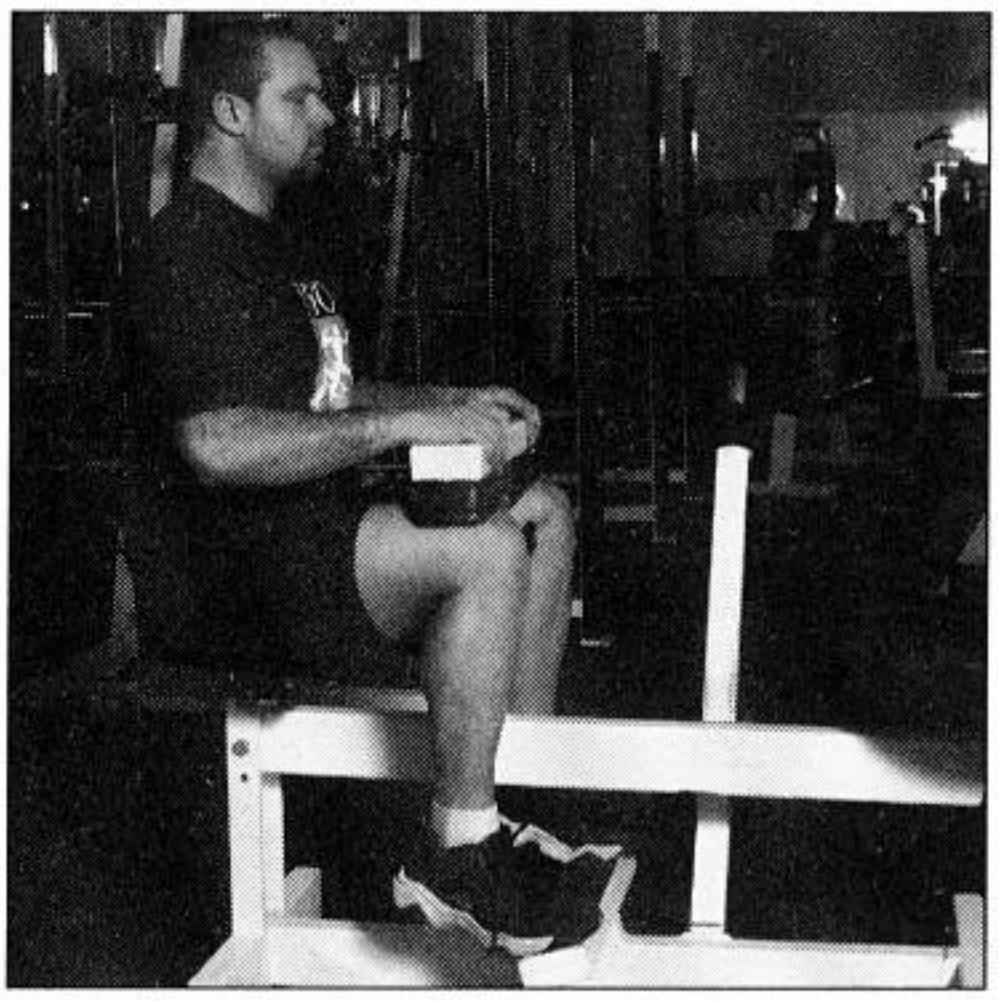
Leg Press Calf Raise. Assume a position in a leg press machine and press the platform to a straight leg position. Move both feet down until only the forefeet are in contact with the platform. From this position, plantarflex the ankles against the resistance. Relax to return back to the starting position. This exercise may also be performed unilaterally. Ensure the feet don't slip off of the platform which could result in serious injury.





Standing Calf Raise. Step onto the raised platform, wedge under the shoulder pads, and extend the entire body to lift the weight. From here, position the forefeet onto the platform, and plantarflex the ankles against the resistance. Relax to return back to the starting position.

Seated Calf Raise. Performed on a seated calf machine. Sit on the machine and wedge the lower thighs under the pads, positioning the forefeet onto the platform. Plantarflex the ankles against the resistance. Relax to return back to the starting position. Since the soleus is a predominantly slow-twitch muscle, low weight / high repetition protocols are most effective.



DARD (Dynamic Axial Resistance Device) *not illustrated.* This is a very useful device created by John Abdo. Sit on a bench, with legs extended and ankles hanging off of the end of the bench. Attach the DARD, and keeping the knees stabilized, plantarflex the ankles, which will lengthen and stretch the tibealis. Then fully plantarflex against the resistance provided by a weight plate attached to the DARD. Repeat for the desired number of repetitions. Since the tibealis receives very little stress under normal conditions, perform this exercise cautiously at first, using a limited number of sets and repetitions. Otherwise, traumatized "tibs" will be unable to prevent one's toes from dragging on the ground while trying to walk!

Tips for Maximizing Strength Training for Gastrocnemius, Soleus and Tibealis

For the gastrocnemius and soleus, experiment with varying foot angles. The gastrocs

respond best to intense loads, while the soleus and tibealis respond best to extensive (high repetition) loads.

Gluteals

Description. The gluteals are one of the largest and strongest muscles in the entire body, covering the entire posterior portion of the pelvis. The largest and most superficial glutei are the gluteus maximus. The glutes are antagonistic to the quadriceps and the hip flexor muscles.

The glutes function as part of a kinetic chain, which also includes the hamstrings and low back muscles, as well as the gastrocnemius to a somewhat lesser extent.

Martial Arts Application. The roles of the glutes are critical in all jumping, kicking, and sprawling maneuvers.

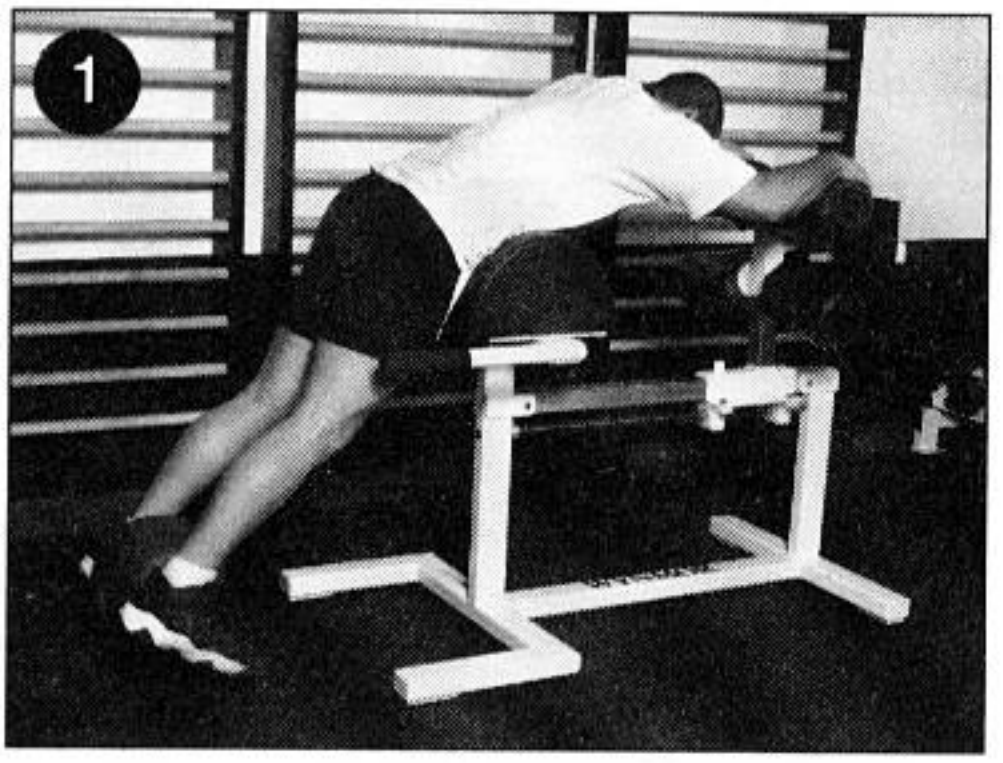
Unique Characteristics. Sources differ regarding the ratio of fast versus slow-twitch muscle fiber in the glutes. Nevertheless, the glutes are certainly powerful extensors of the body, and should be trained as such through the use of relatively high intensity (low repetition) strength training. Over tight glutes often contribute to the "toes out" posture often seen in jujitsu practitioners. Over time, this excessive external rotation may lead to knee, pelvic and spinal dysfunction in some athletes.

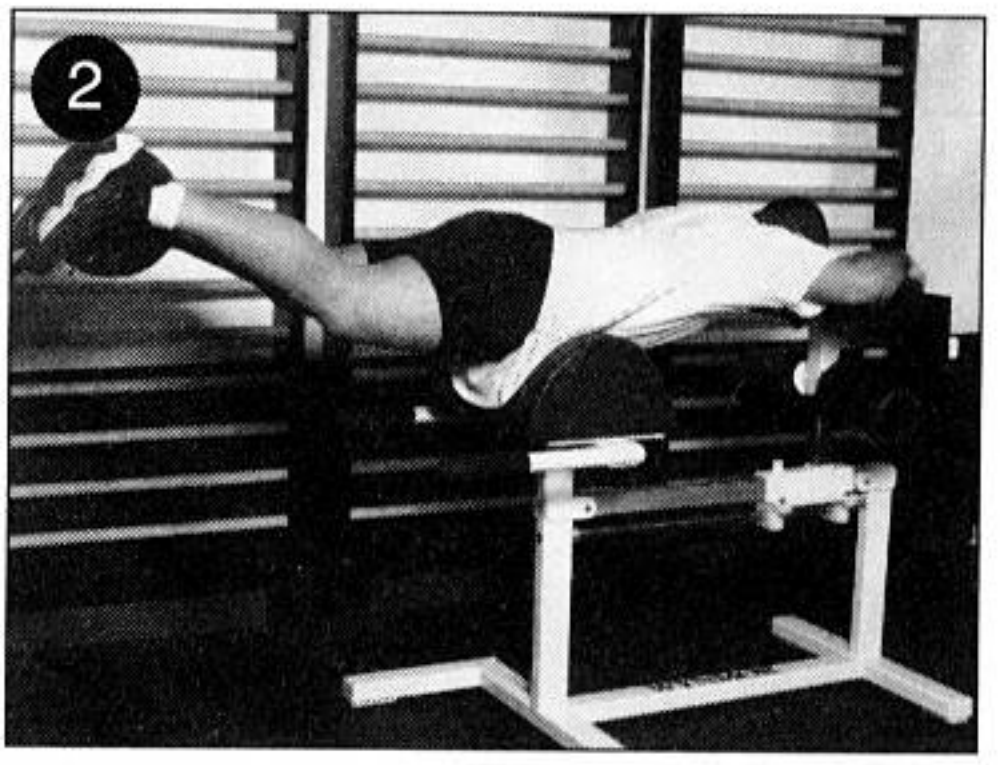
Length Assessment. From a supine position with the test leg flexed to 90 degrees at both hip and knee, internally rotate the leg. Proper length is indicated when able to achieve at least a 40-degree angle from the midline (starting) position, when viewed from above.

Stretching Methods for the Glutes

The glutes can be stretched from the length assessment position. Ask the subject to apply pressure to the tester's hand by attempting to internally rotate the thigh, using approximately 35–50% of maximal effort. Give the subject an audible count of six to eight seconds, then release the pressure. Next, prompt the athlete to attempt to increase his range of motion, deepening the stretch. From this new, deeper ROM, perform the count again. Repeat for three to five repetitions, or until subsequent repetitions do not increase the range of motion.

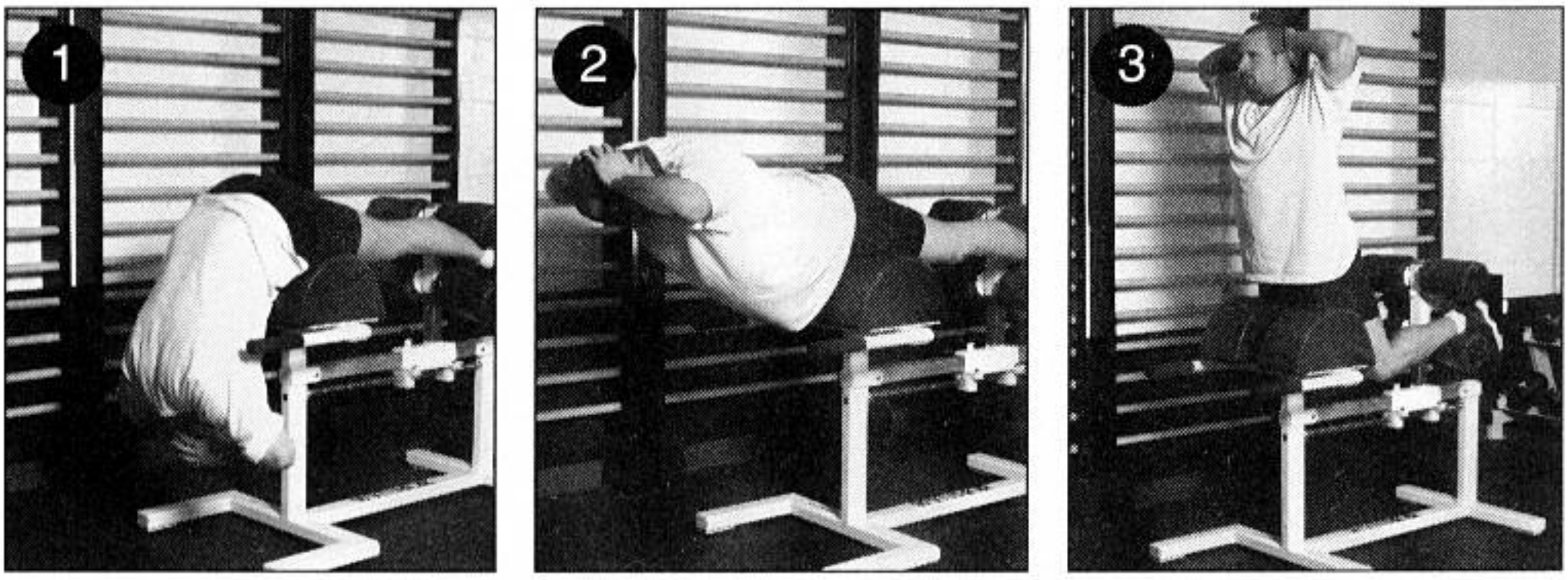
Strength Training Exercises for the Glutes





Reverse Hyper. This unique exercise allows an open-chain extension of the torso, essentially the reverse of the hip extension exercise. Assume a prone position on the machine, holding securely onto the handles. Clasp a dumbbell between your feet for added resistance. Using

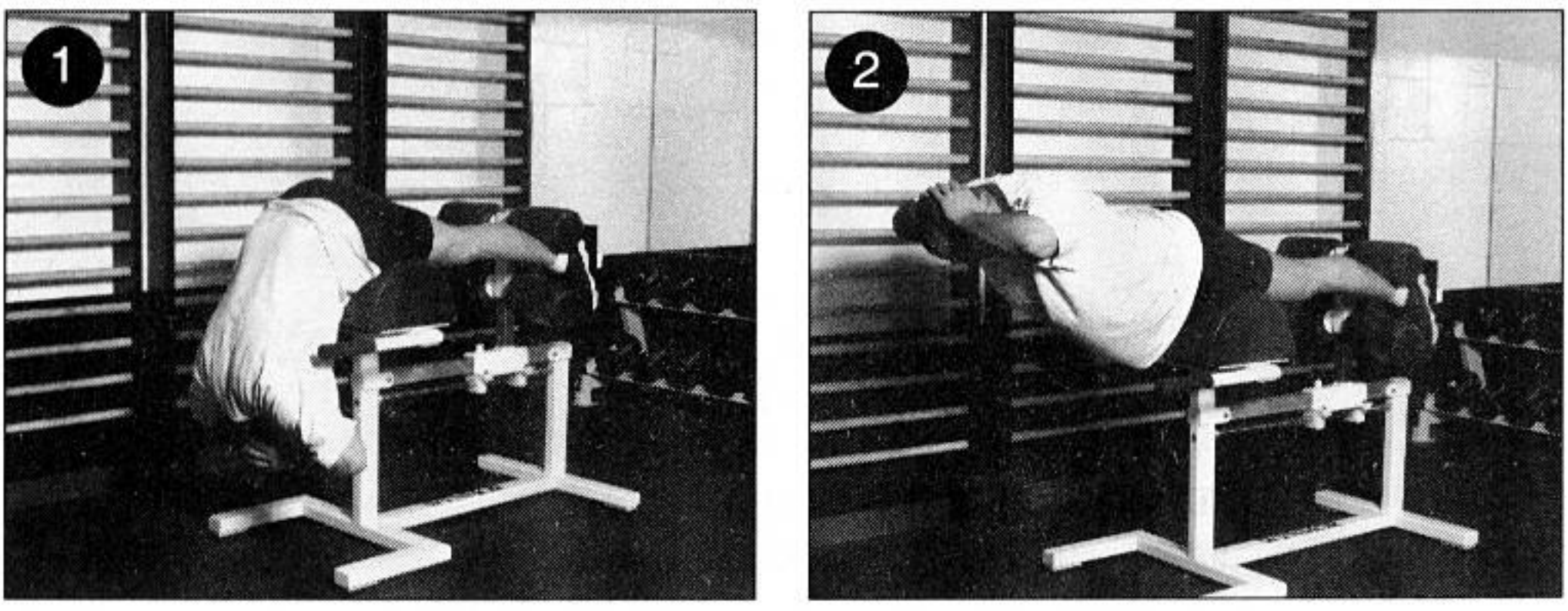
a strong contraction of the erector spinae, glutes, and hamstrings, raise the lower body until the entire body is parallel to the floor. Maintain a consistent curvature of the lower back. If the curve of the lower back increases during the exercise, contract the abdominals during the movement to prevent this from occurring.



The Glute-Ham-Gastroc Raise. The unique value of this exercise is it's ability to train the hamstrings with it's kinetic "siblings," the glutes and gastrocs. To perform this movement, use a GHG machine, such as the one made by the IM&M company (see resources section). To perform the exercise, assume a position on the GHG machine so that the ankles are between the two pairs of rollers, and the mid-thigh rests directly over the curved pad. Begin the movement by allowing the upper body to lower while flexing from the hips. When the torso is perpendicular to the floor, first rise up until the entire body is parallel to the floor, and then continue by contracting the glutes and hamstrings so that the torso reaches a position 45 degrees to the floor, as indicated in the illustrations. Repeat for the desired number of repetitions.

Special Instructions for this exercise include:

1) Athletes should fold their arms over their chest if new to the exercise. After developing the ability to do the movement properly, add resistance in the form of a weight plate or medicine ball held against the chest.
2) Use a slow to moderate tempo.
3) Do not attempt to perform this exercise on a standard back extension machine! Although they look similar, back extension units cannot accommodate this exercise.



Hip Extensions. Perform this exercise on a standard machine made for this purpose, or on a glute ham-gastroc unit described above. Assume a position so that the hips are on the pad, which ensures that the pelvis can rotate during the exercise. Keep the feet pointing straight down, do not allow them to turn outward. Starting with the hips flexed at a 90-degree angle, raise up to a horizontal position by contracting the spinal erectors, glutes, and hamstrings. Pause, and lower back down to the starting position. It's common to feel a bit dizzy when performing this exercise, and the low back "pump" which results often feel like low back pain to those unfamiliar with the exercise. However, the benefits are more than worth the minor discomfort. Athletes with short, tight glutes (those with a tendency to walk with their feet pointed outward) should avoid or minimize this exercise.

Tips for Maximizing Strength Training for Glutes

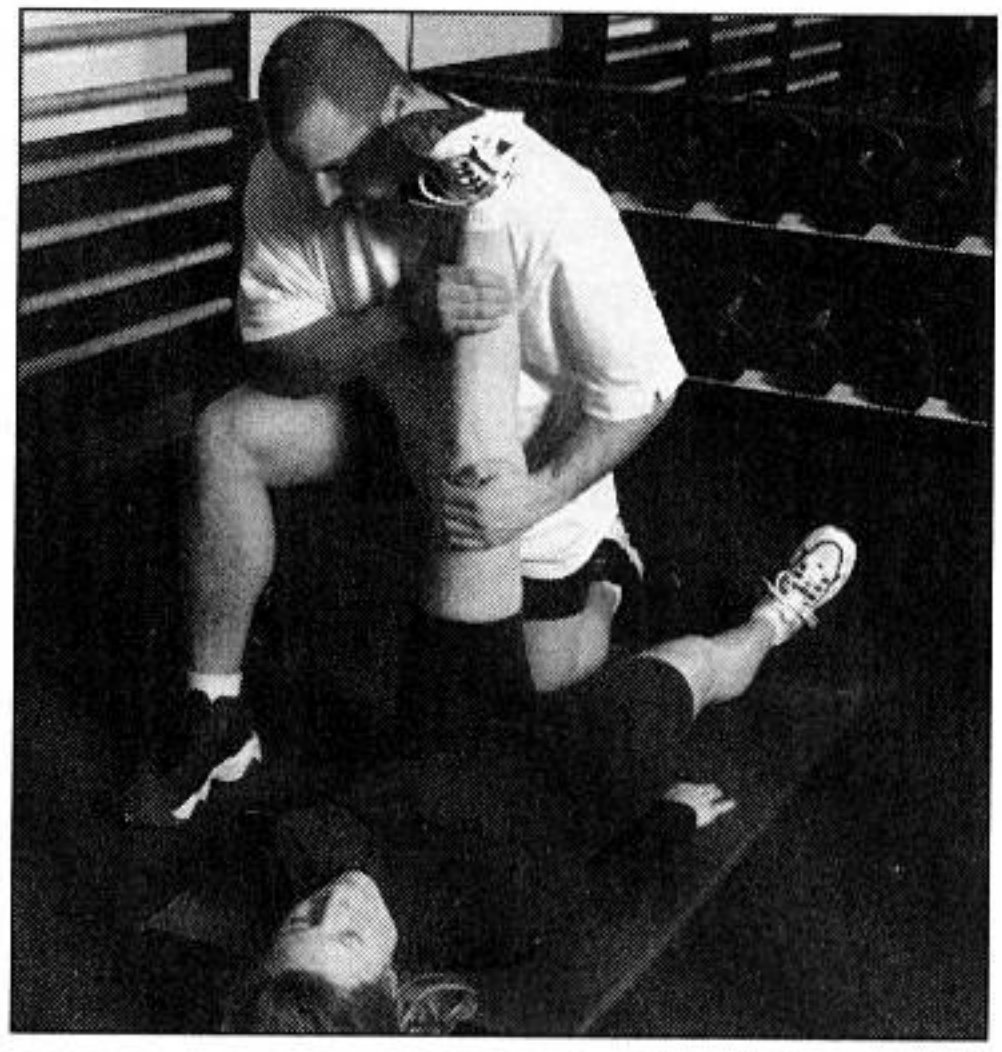
Since the glutes are the body's primary hip extensors, all glute exercises must start from a position of complete hip flexion. In exercise like lunges, squats, and leg presses, deeper positions involve the glutes more strongly.

Hamstrings

Description. The "hamstrings" are a slang term for three muscles: the biceps femoris on the lateral (outside) side of the leg and the semimembranosis and semitendinosis on the medial (inside). The hamstrings collectively originate on the ischial tuberosity (posterior and inferior pelvis) and insert into the tibeal tuberosity (back of the upper shin bone) and posterior aspect of the upper fibula. Although most people think of the hamstrings as the muscle that causes flexion at the knee, this muscle also causes hip extension, and inversion (turning in) and eversion (turning out) of the foot. The hamstrings are antagonistic to the quadriceps and the hip flexor muscles.

The hamstrings function as part of a kinetic chain, which also includes the glutes and low back, as well as the gastrocs to a somewhat lesser extent.

Martial Arts Applications. The hamstrings are most involved in kicking and sweeping maneuvers, particularly hook kicks, roundhouse kicks, and sweeps. In grappling arts, the hamstrings are important for arm-bars, sprawling maneuvers, and in skills where the supine athlete is attempting to gain a better position by lifting his hips off the floor by pushing against the floor with his feet.



Unique Characteristics. Most people's hamstrings are 50–60% fast-twitch muscle fiber, since the muscle's primary function is to rapidly decelerate the shin bone during running. Therefore, strength training for the hamstrings should emphasize higher intensity training using heavy weights and, of course, low repetitions.

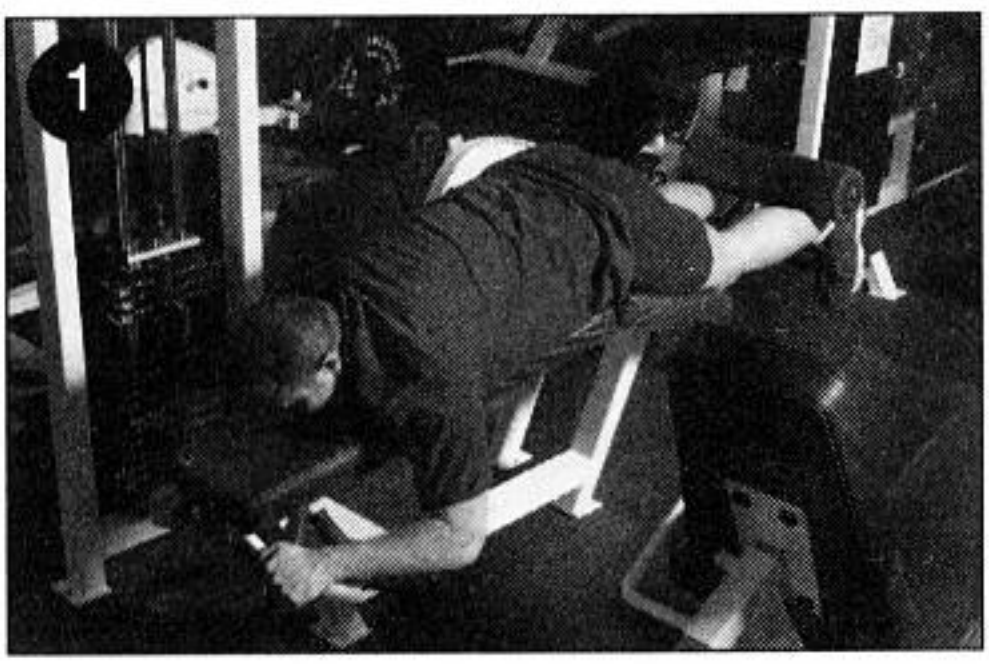
Length Assessment. To assess minimal standards for hamstring length, have the athlete lie supine (face up) on the floor or on a

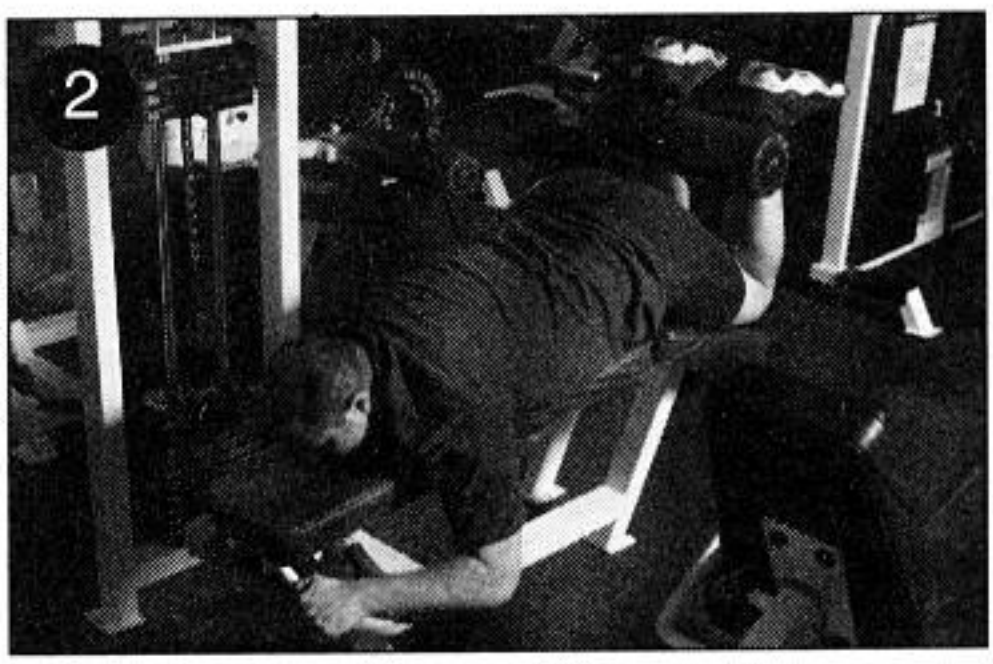
treatment table, with his or her head in a neutral position and relaxed. The subject relaxes as the right hip and knee are bent to 90 degree angles. Support the athlete by placing a knee behind his knee, and then ask him to extend at the knee as far as is comfortable. He should be able to extend the leg until it is 180 degrees or fully straight. Repeat on both sides, and check to see that the hamstring length is the same on both sides. If not, concentrate on stretching the shorter side until this discrepancy is resolved. Many martial artists, especially those who utilize high kicks, must achieve a much higher level of hamstring length than the minimal standard described above.

Stretching Methods for the Hamstrings

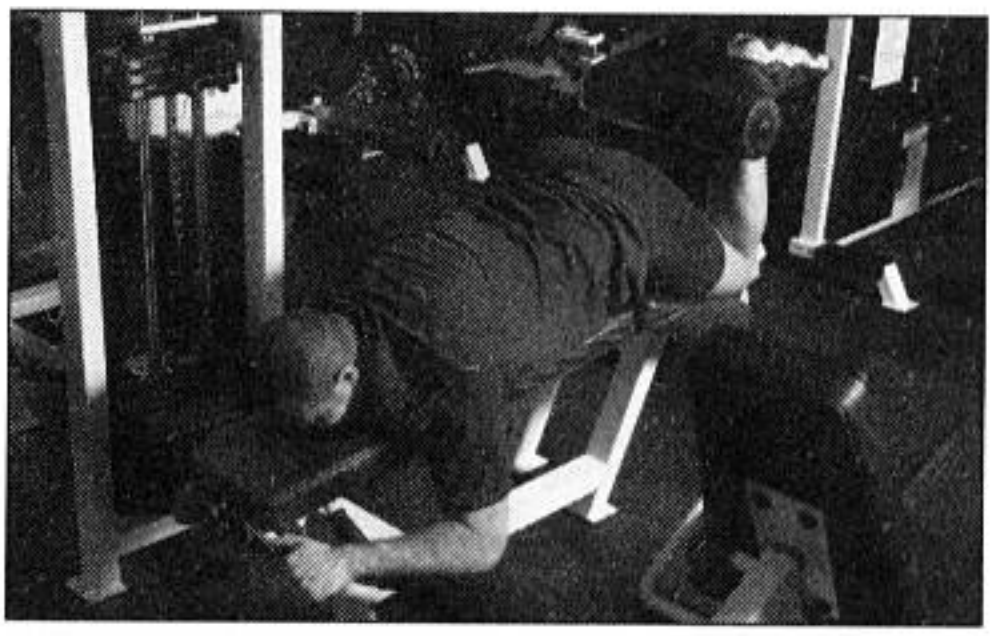
Perform a contract-relax stretch for the hamstrings from the same position used to perform the length assessment. The athlete lies supine on the floor, with his head in a neutral position and relaxed. The subject relaxes while his leg is supported by a partner's (as shown). Keeping the knee fully extended, flex the leg at the hip until the hamstrings reach the end of their range of motion. From this position, instruct the athlete to apply pressure against the partner's shoulder and hands by attempting to extend the hip, using approximately 35–50% of maximal effort. Give the subject an audible count of six to eight seconds, then release the pressure. Next, prompt the athlete to attempt to increase his range of motion, deepening the stretch. From this new, deeper ROM, perform the count again. Repeat for three to five repetitions, or until subsequent repetitions do not increase the range of motion.

Strength Training Exercises for the Hamstrings

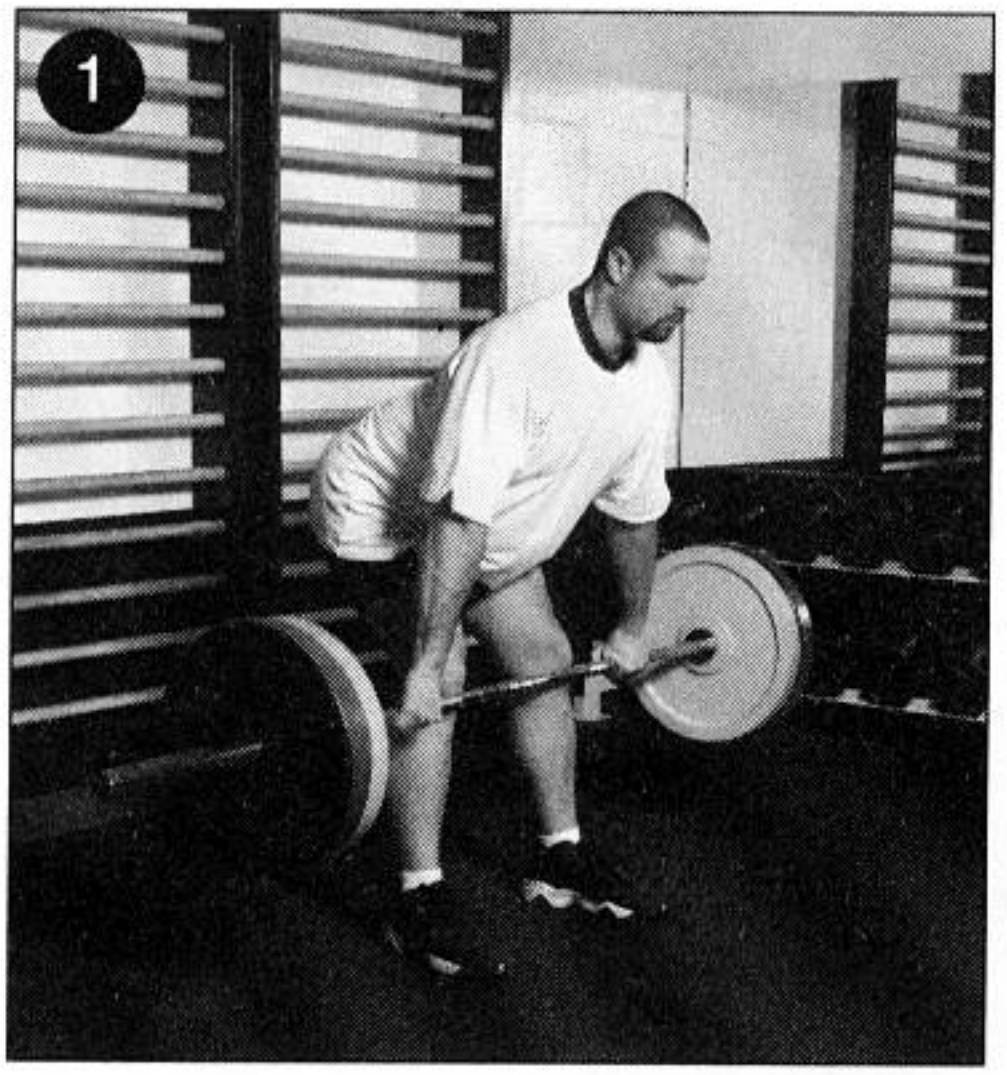


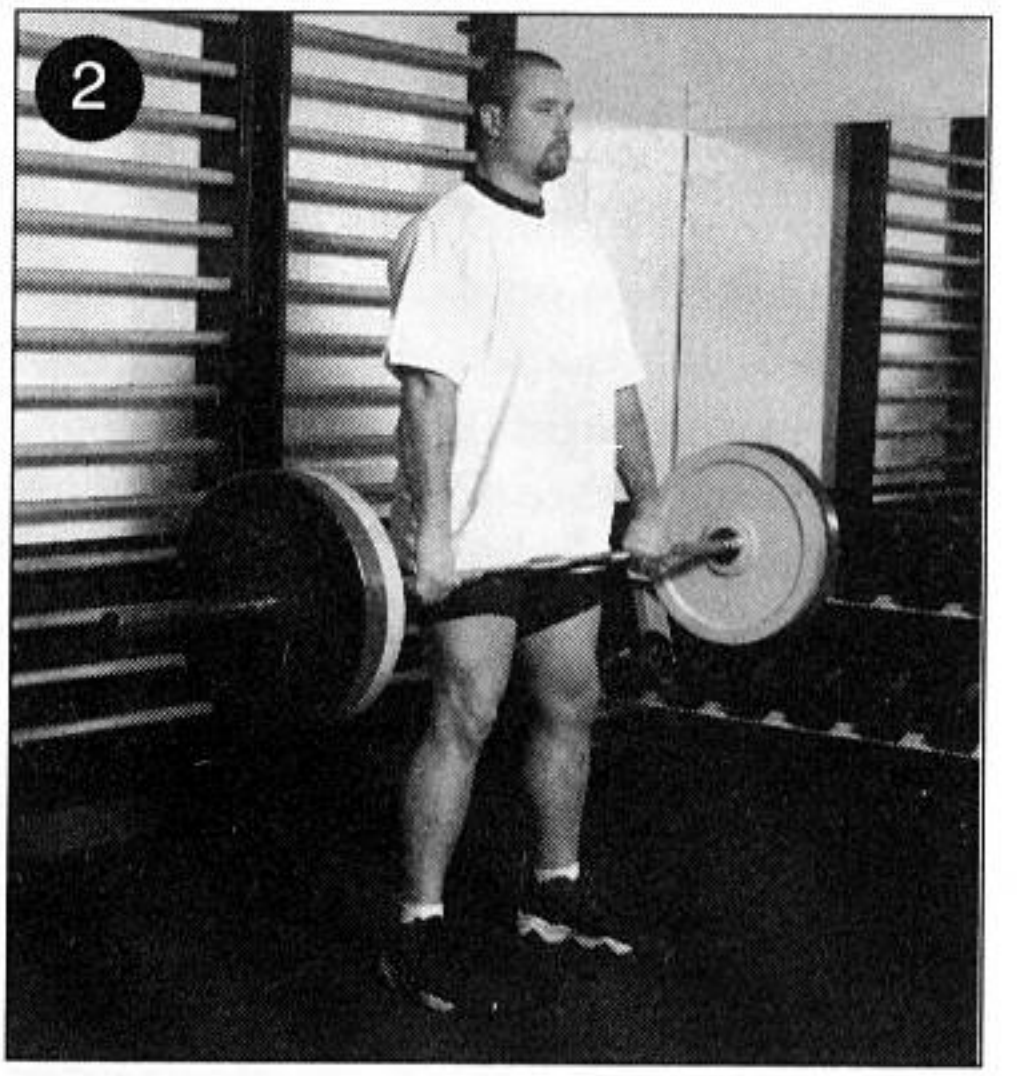


The Prone Leg Curl. The best leg curl machines (like the Atlantis unit pictured here) feature a raised or arched bench, which facilitates a greater range of motion throughout the movement, as opposed to a flat bench. Keep the head down and pelvis stabilized (i.e., immobilized) during the movement. The knees should be aligned with the axis of the machine. If the roller behind the calves seems to slide up or down during the movement, adjust alignment by sliding forward or back on the bench. "Curl" the weight by contracting the hamstrings. Pause at the top, and then lower back to the starting position. One useful characteristic of prone leg curl machines is they allow for eccentric training. This is accomplished by raising the resistance with both legs, and then lowering with only one leg. The most common mistake during leg curls is "hiking" the pelvis as the hamstrings become fatigued.



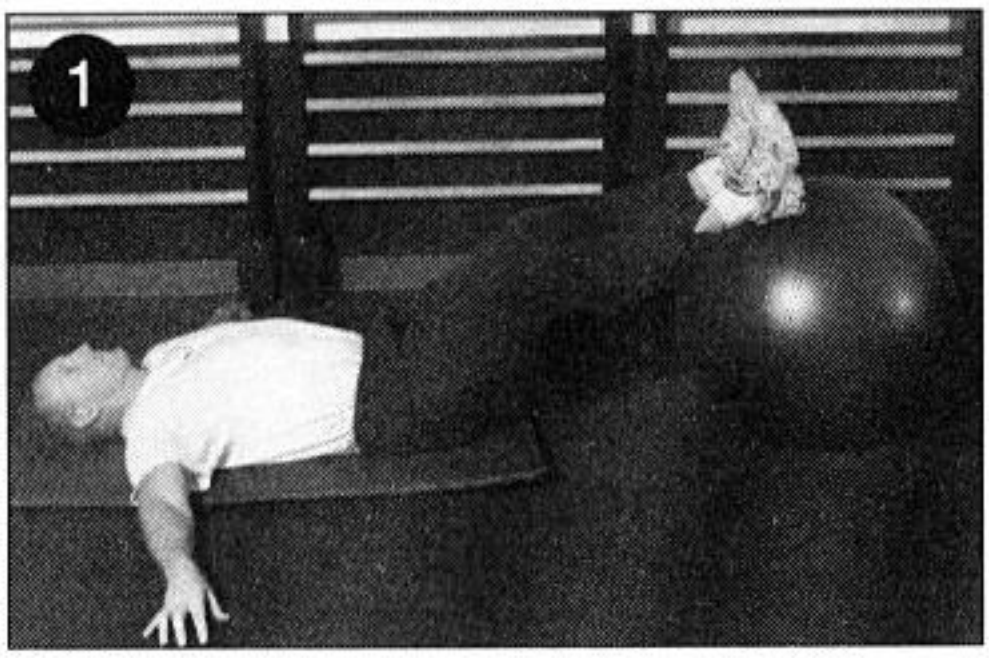
The Unilateral Leg Curl. There are two versions of this machine. One is when the opposite foot stays on the floor, and another where the opposite knee is supported by a pad. Some machines require standing with hips neutral, others ensure the hips are flexed (a better position, in general). Regardless of the above variations, create a position so that the working knee is in line with the pivot point of the machine. Curl the weight by contracting the hamstring, then return back to the starting position.

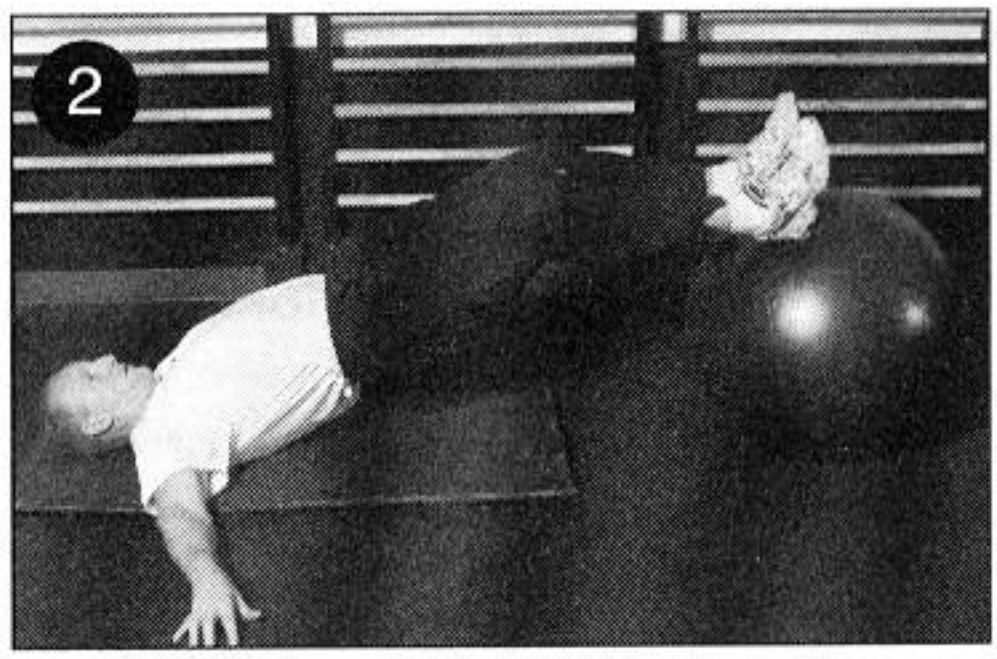


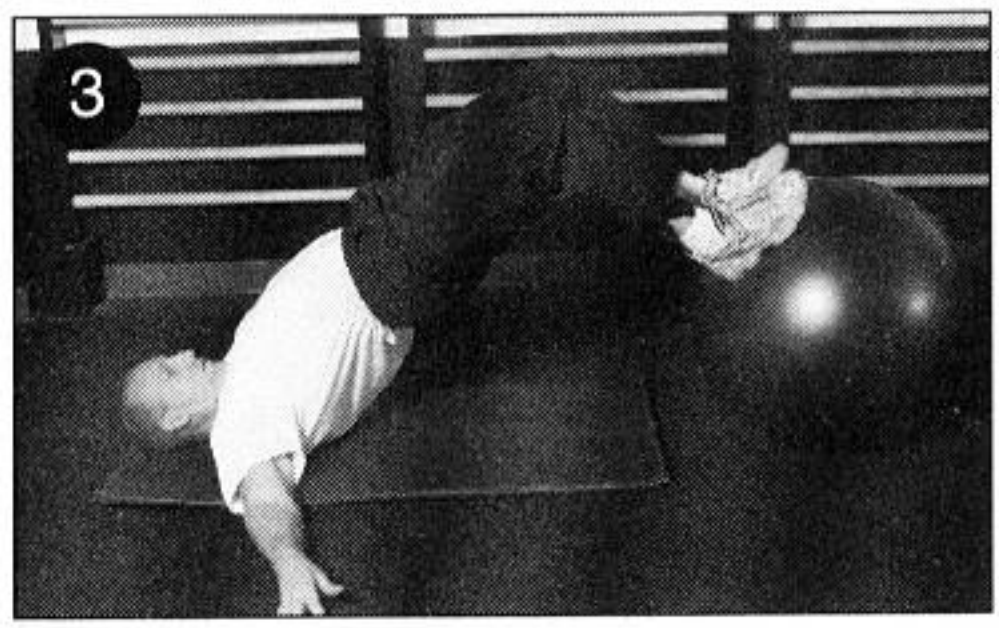


Stiff-Leg Deadlift. Set up a barbell at slightly higher than knee level (use a power rack, or set the barbell on blocks). Using a pronated grip (palms facing oneself), grab the bar with a shoulder-width grip, and step back just enough to clear the rack. Inhale, slightly bend the knees, and begin the movement with one's bodyweight over the heels. Allow the bar to descend, while ensuring it maintains contact with the front of the body. While descending, maintain the normal curvature of the lower back and neck; and allow the glutes to move rearward. Do not look up or down, but instead, maintain a normal head and neck alignment. This exercise is made more effective by maintaining bodyweight over the heels. Always use a controlled movement speed with this exercise. Never perform it rapidly or explosively. People frequently perform this exercise standing on a block, lowering the bar until it contacts the shoes. However, when maintaining proper spinal curvatures and knee position, few people, even those with very good hip flexibility, can lower the bar much past their knees.

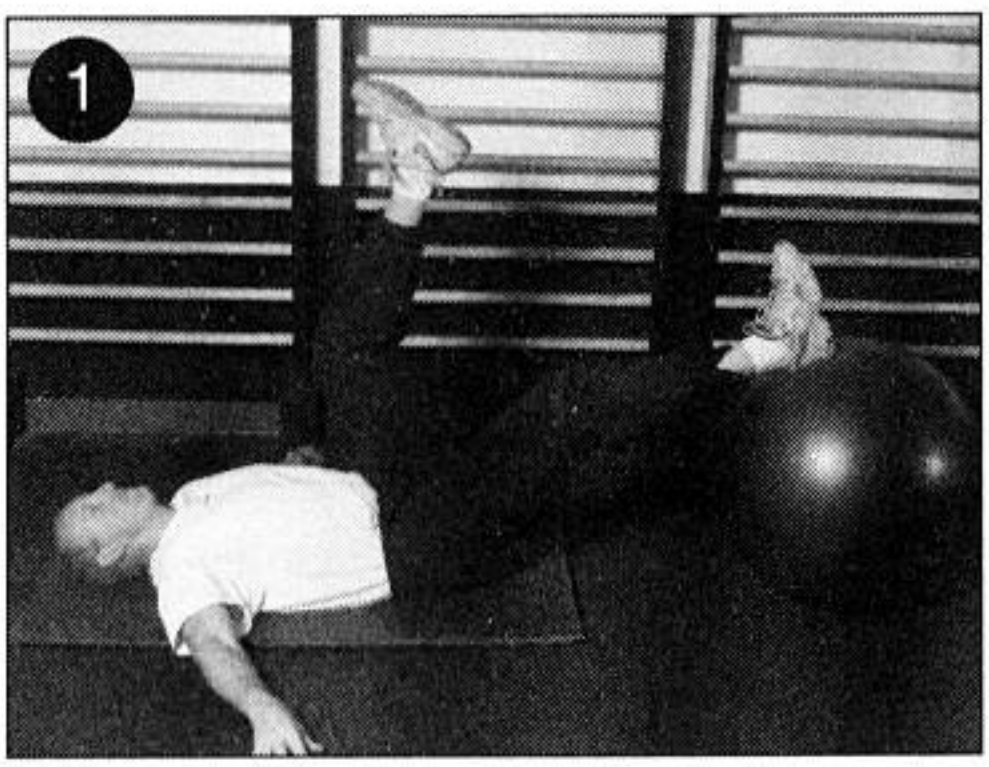
Seated Leg Curl *(not illustrated).* The benefit of this exercise is that the curl is initiated from 90 degrees of hip flexion and full knee extension, which "strings tight" the hamstrings at the start of the exercise. This exercise may be performed unilaterally as well.

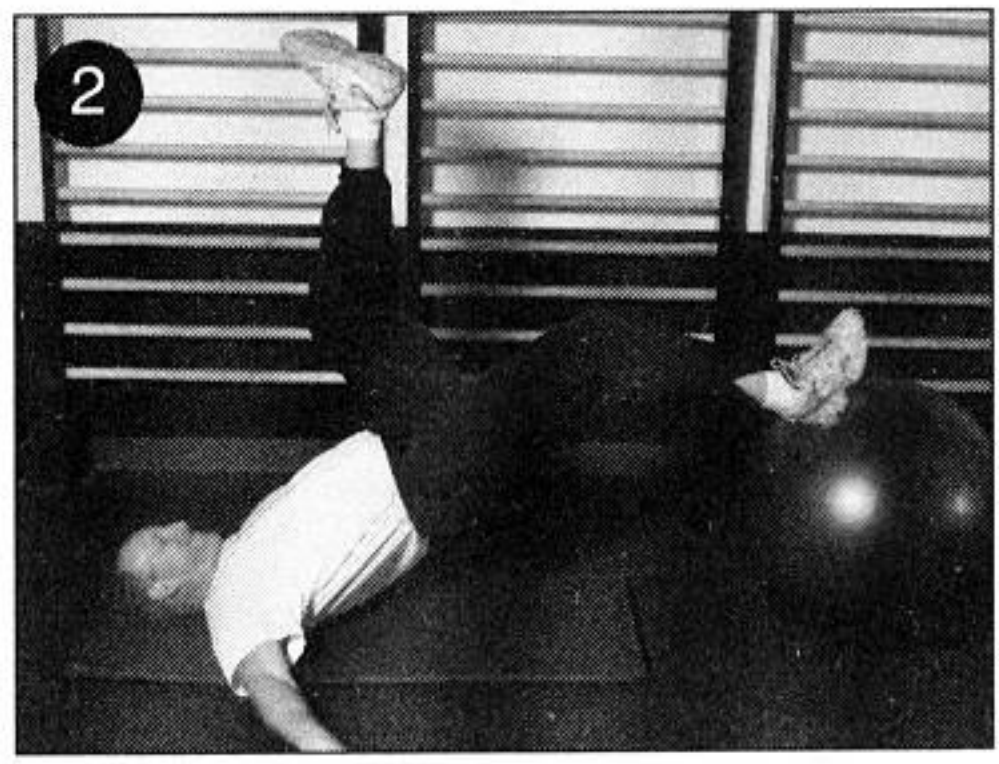




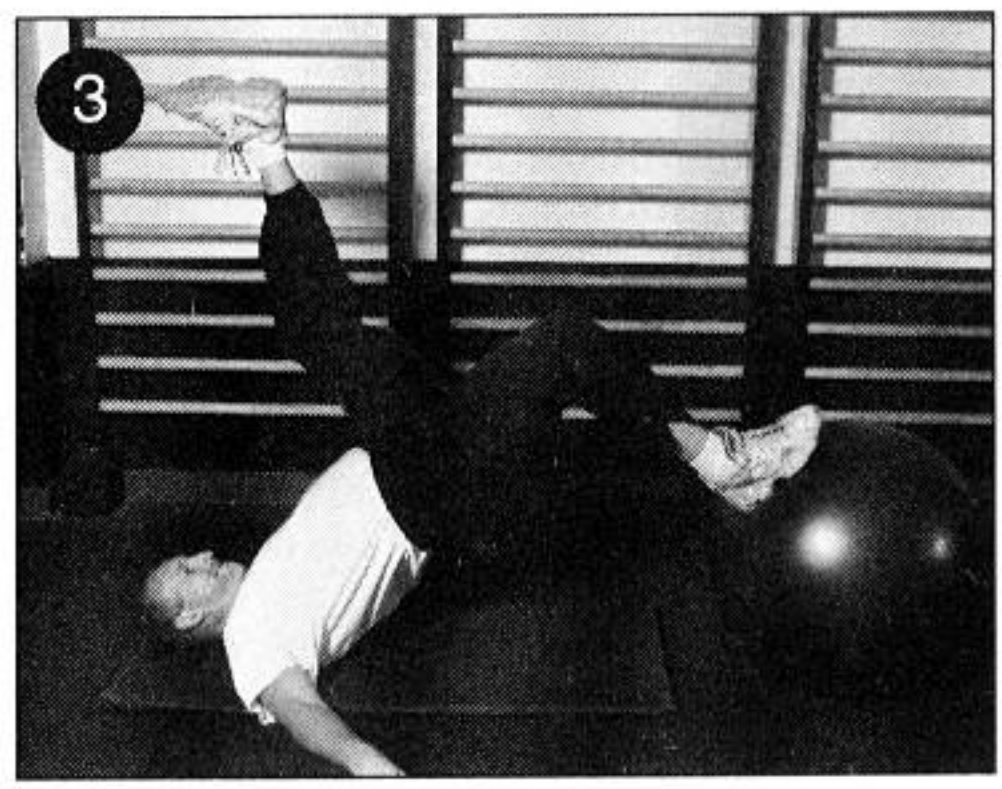


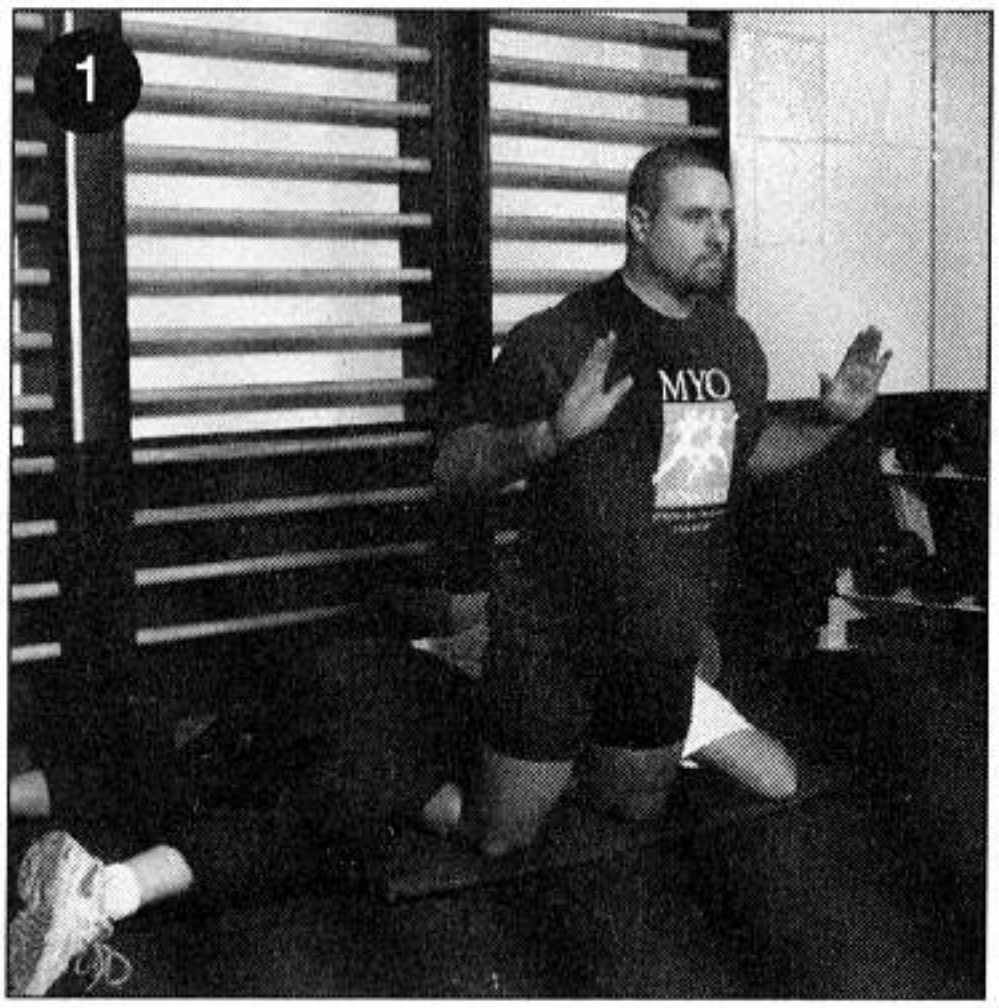
Ball Bi-Lateral Leg Curl. Lay face up on the floor, with the arms perpendicular to the torso, palms down to stabilize position on the floor. Legs are held straight and together, with feet on the top of a ball. Step one: raise the hips off the floor, so that the entire body forms a straight line. Step two: maintaining a straight (neutral) hip position, "curl" by flexing the knees until they are just past 90 degrees of flexion. Return to start position (hips up) and repeat for indicated number of repetitions.

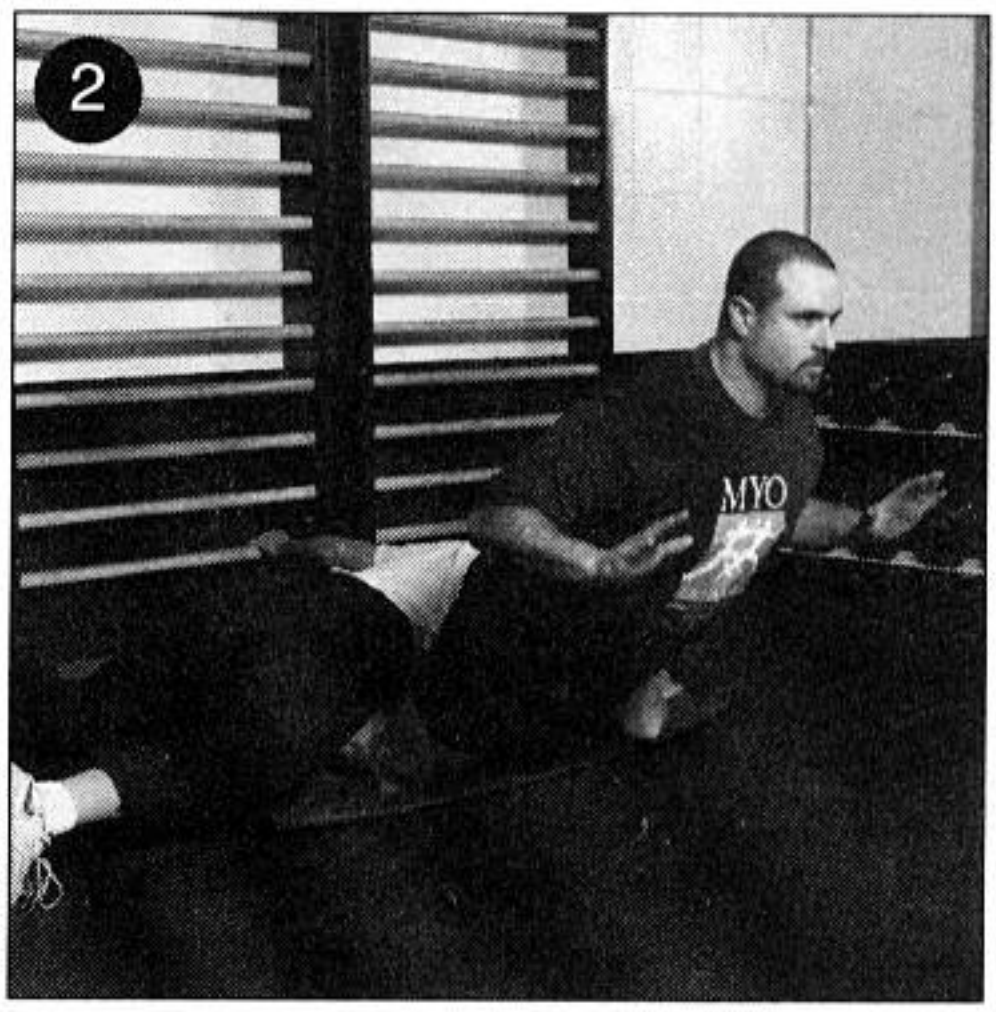




Ball Unilateral Leg Curl. This is performed in the same manner as the bilateral curl, except of course, it is done one leg at a time, which makes the exercise far more difficult to perform.







Harrop Curl. To perform this very demanding hamstring exercise, anchor the lower legs, either by wedging the feet under the rollers of an adjustable sit-up board, or by having a partner lay across the calves with his torso (shown). Slowly lower oneself eccentrically, keeping hips neutral. Return to the starting position by pushing back with the hands, push-up style. After gaining more strength in this movement, progressively use less and less assistance from the upper body until able to complete both eccentric and concentric portions of the exercise. One way to do this is to progress to the point of a push off with only three fingers of both hands, then with one hand, then just three fingers of one hand, etc.

Tips for Maximizing Strength Training for Hamstrings

In open-chain hamstring exercises, knee flexion can be assisted through ankle dorsiflexion. In closed chain hamstring exercises, it helps to keep bodyweight as far back on the heels as possible.

Hip Flexors

Description. The hip flexors consist of three major muscles—the illiopsoas, the illiacus, and the rectus femoris, which is actually one of the four quadriceps muscles. The hip flexors are antagonistic to the hip extensors (the glutes and hamstrings).

Martial Arts Applications. The hip flexors are strongly involved in all kicking and kneeing skills, particularly when chambering the knee for a kick.

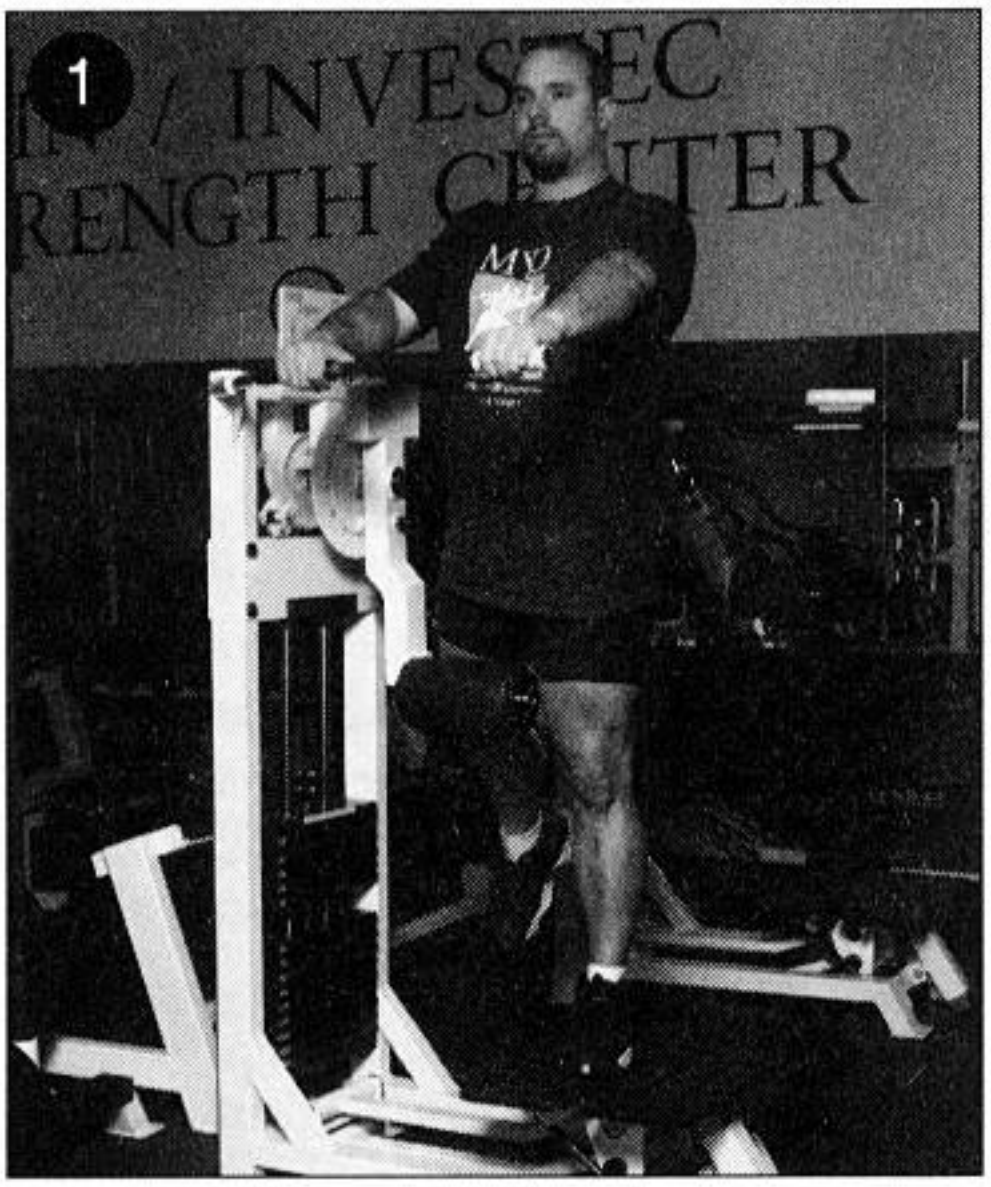
Unique Characteristics. Due to the Western habit of spending long hours in the seated position, the hip flexors (as well as hamstrings) have a tendency to undergo adaptive shortening, especially in older age.

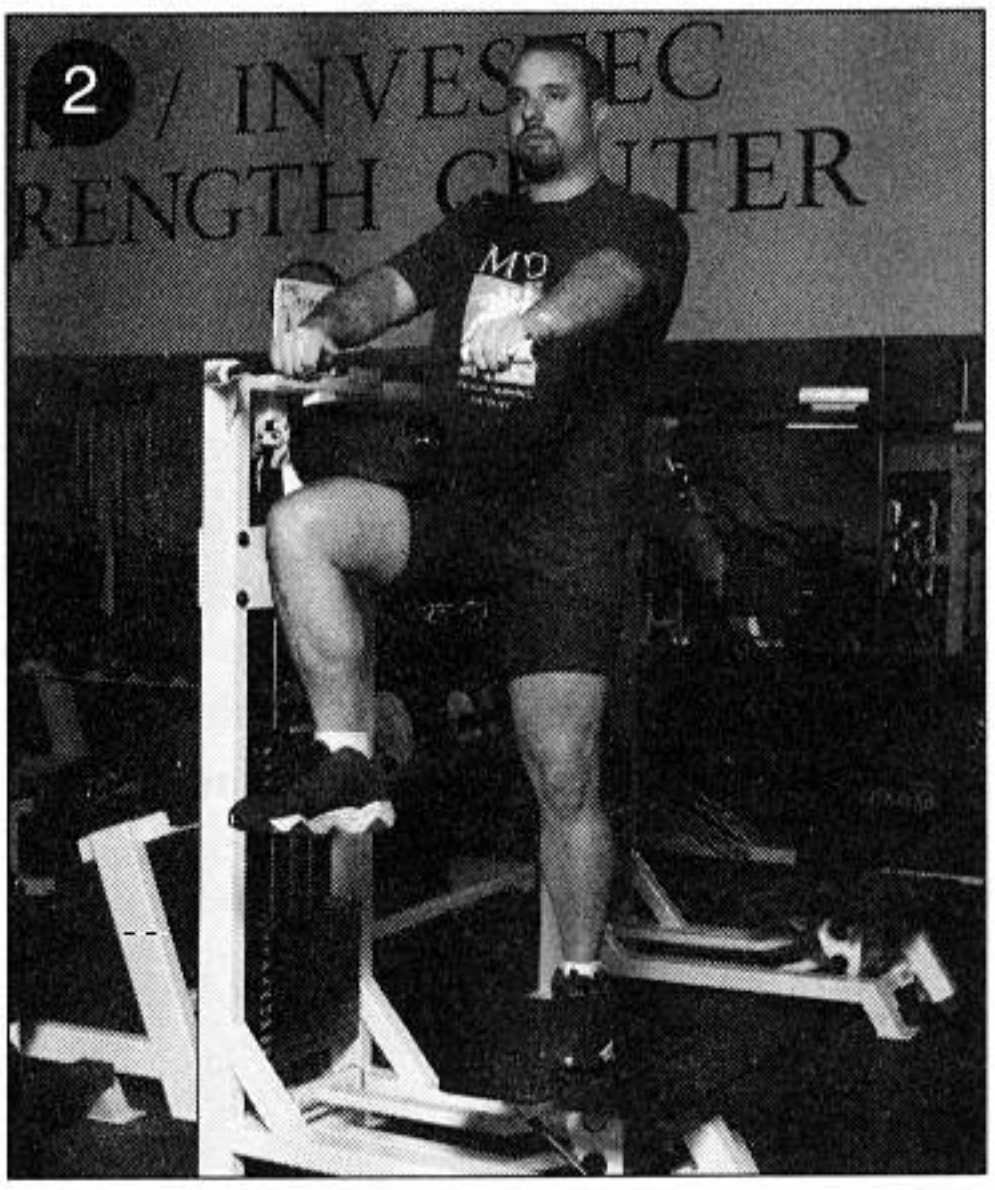
Length Assessment. To assess minimal standards for the length of the rectus femoris, have the subject lay prone on the floor. Stabilize his pelvis with one hand and flex his knee to 90 degrees and pull his foot toward the ceiling. The goal is to form at least a 30-degree angle between the thigh and the floor. To check psoas length, perform the same test, but with the leg straight (grasp the leg just under and slightly above the knee). Again, a 30-degree angle represents the minimal length standard.

Stretching Methods for the Hip Flexors

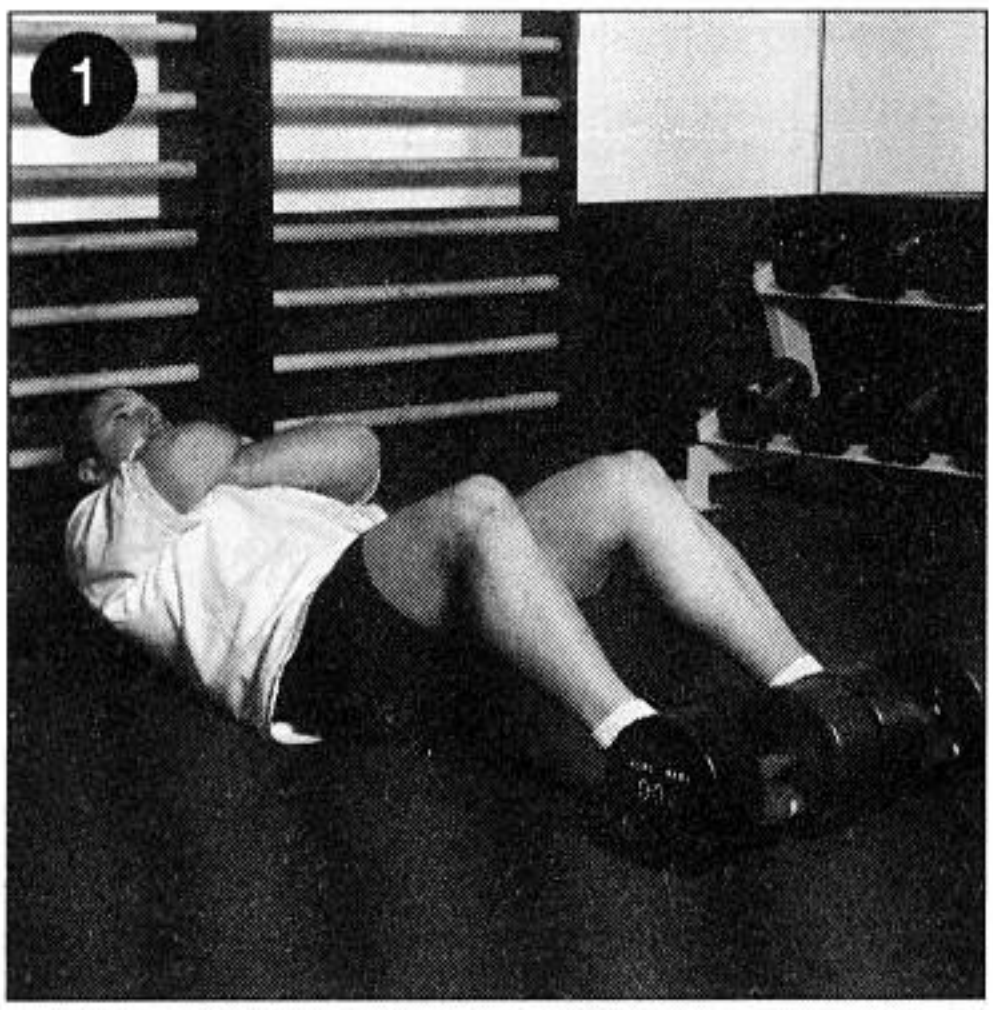
Both the rectus femoris and psoas can be stretched from their length assessment positions. Ask the subject to apply downward pressure to the partner's hand by attempting to push the thigh toward the floor, using approximately 35–50% of maximal effort. Give the subject an audible count of six seconds, then release the pressure. Next, prompt the athlete to attempt to increase his range of motion, deepening the stretch. From this new, deeper ROM, perform the count again. Repeat for three to five repetitions, or until subsequent repetitions do not increase the range of motion.

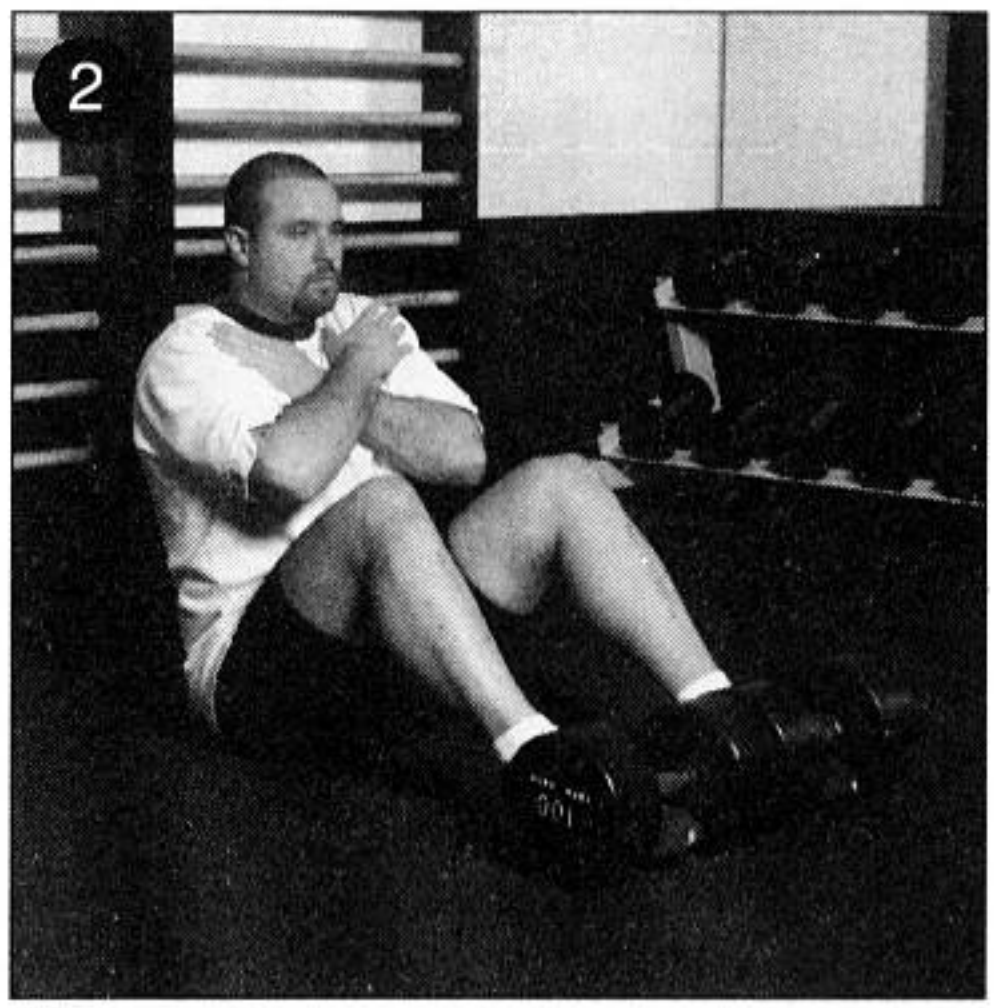
Strength Training Exercises for the Hip Flexors



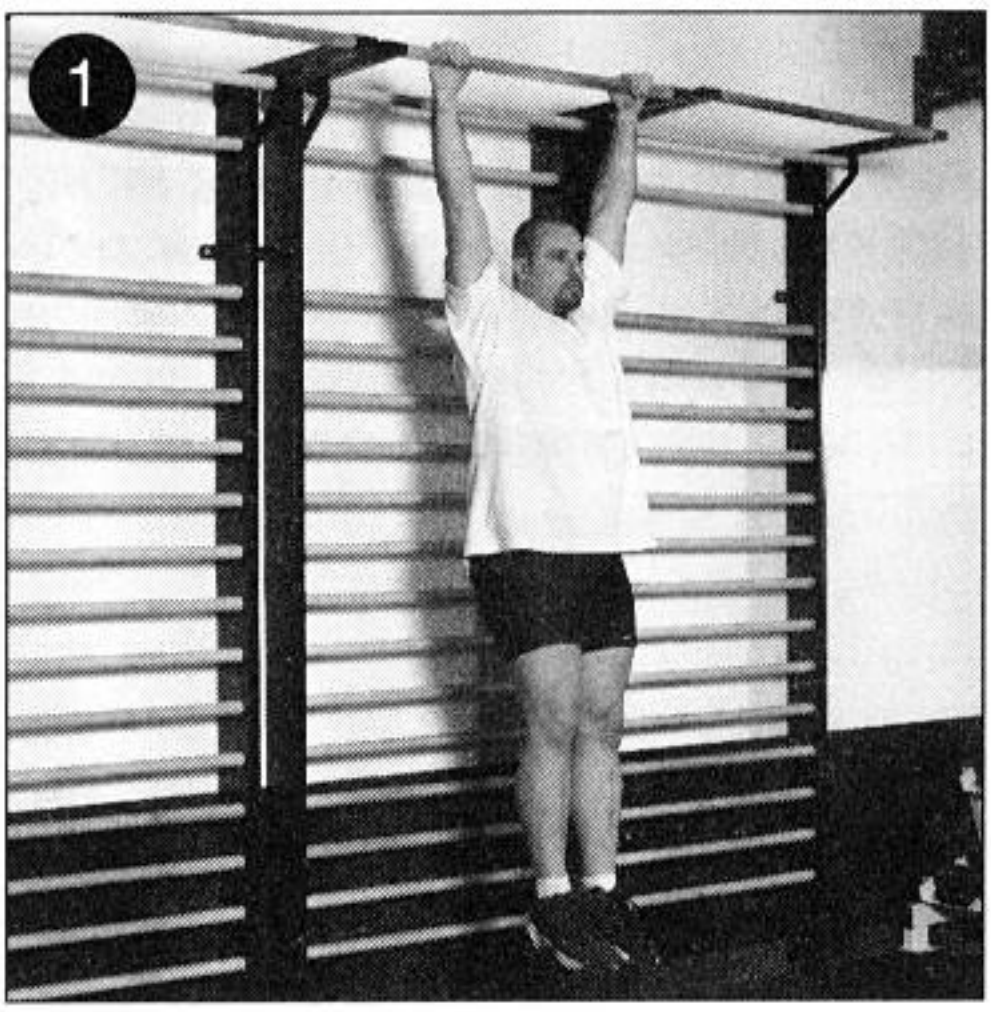


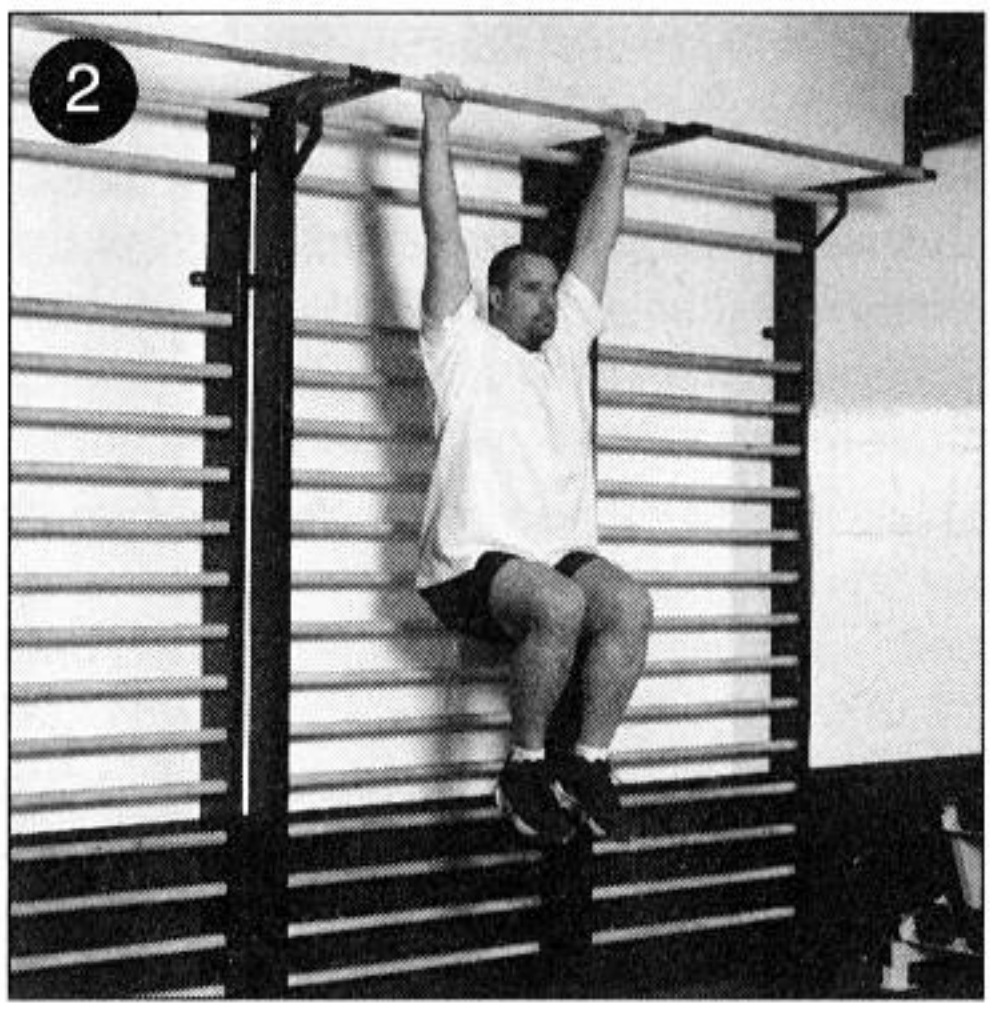
Multi-Hip Machine. Achieve a stable position by grasping the handles, and then extend the hip against the resistance provided by the machine. The advantage of this exercise is that it is performed from a standing position, one leg at a time.





Sit-Up. Sit-ups are performed much like crunches (see abdominal section), except that the motion is taken beyond pure trunk flexion into hip flexion. Sit-ups can also be performed using pure hip flexion, with no trunk flexion involved.





Hanging Knee-Up. Hanging from an overhead support, start with the entire body fully extended. Flex at the hips and knees simultaneously until the tops of the thighs are parallel to the floor, and then relax and return to the starting position. Repeat for the desired number of repetitions.

Tips for Maximizing Strength Training for Hip Flexors

Individuals with reduced lumbar curvature should be careful to perform all hip flexion exercises with an exaggerated lumbar curve, and never with a "flat" lower back. Athletes with excessive low back curvature are advised to avoid hip flexor exercises, as they may exacerbate their condition.

Latissimus Dorsi

Description. The "lats" are strong internal rotators of the upper arm. They function to adduct the upper arm as well as extend the shoulder joint. The lats are antagonistic to the front and medial deltoids. The lats function as part of a kinetic chain, which also includes the glutes and low back, as well as the gastrocs to a somewhat lesser extent.

Martial Arts Applications. The lats are strongly involved in all pulling skills in grappling disciplines, as well as all rearward elbow strikes.

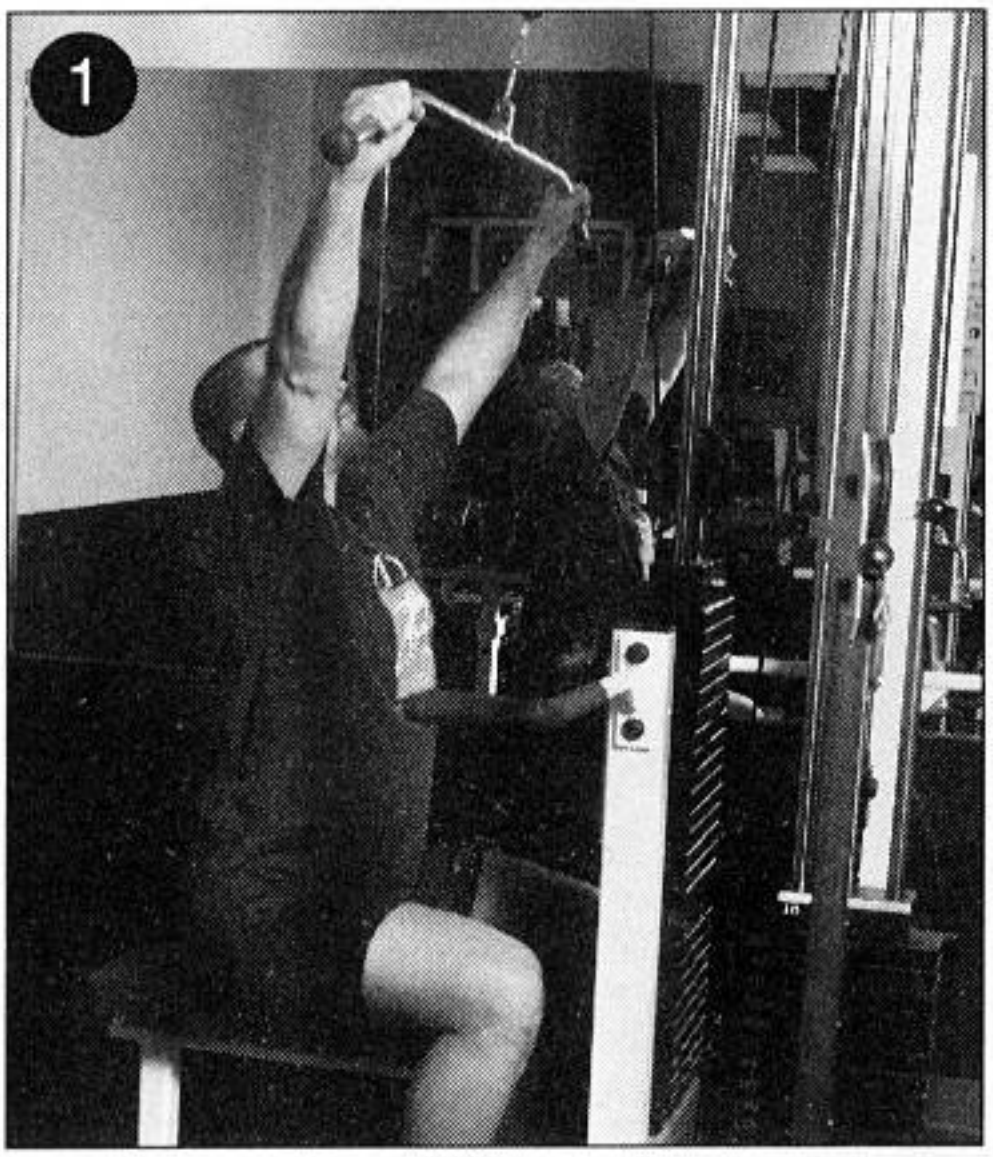
Unique Characteristics. The lats are a huge muscle, and the only direct muscular connection from the arm to the spine.

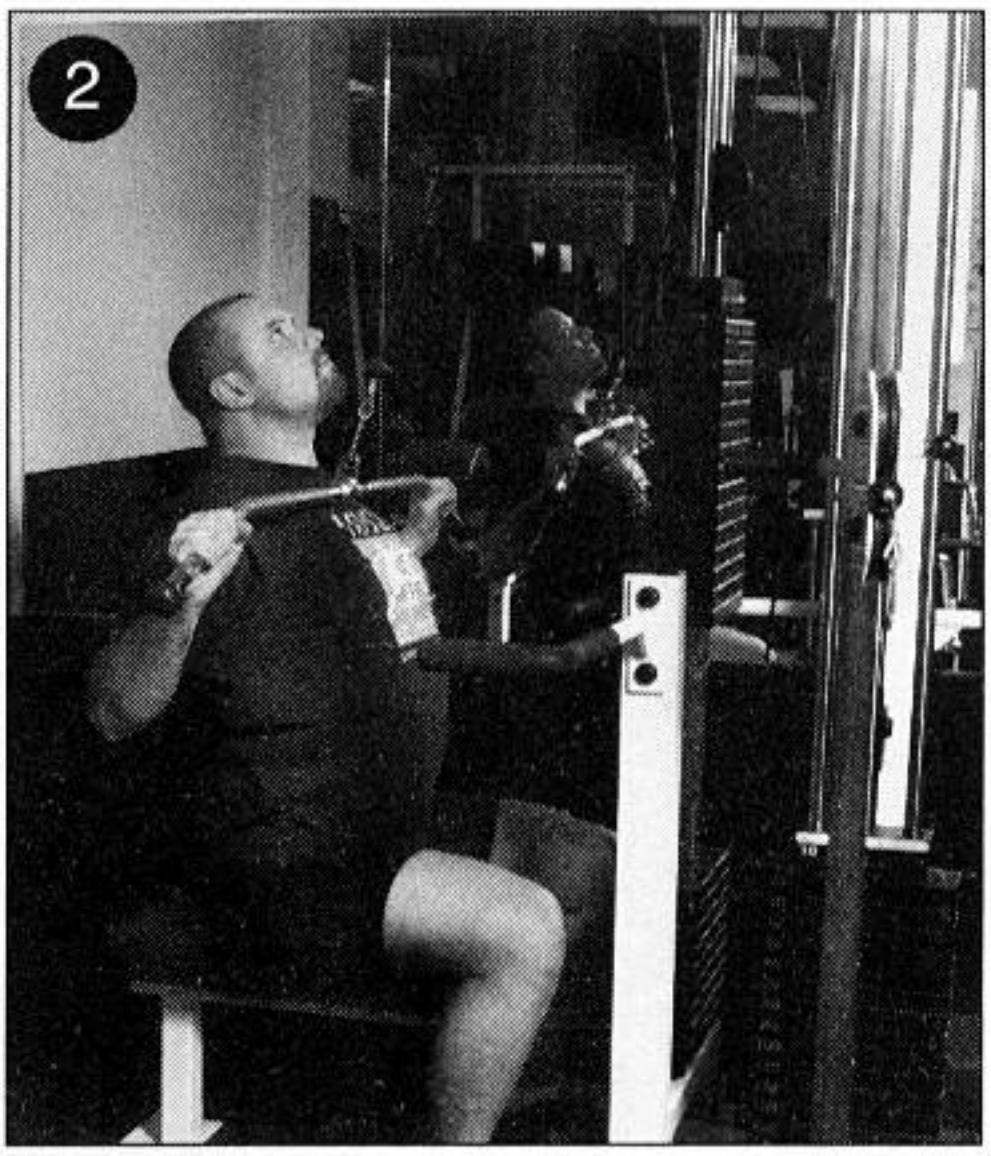
Length Assessment. When the lats have adequate length, the athlete will be able to fully abduct the arms to the sides (frontal plane), and fully extend the shoulders until the arms are overhead.

Stretching Methods for the Latissimus Dorsi

The subject sits with arms abducted and elbows flexed, with hands behind the head. Ask him to apply pressure to the partner's hands by attempting to adduct his arms, using approximately 35–50% of maximal effort. Give the subject an audible count of six to eight seconds, then release the pressure. Next, prompt the athlete to attempt to increase his range of motion, deepening the stretch. From this new, deeper ROM, perform the count again. Repeat for three to five repetitions, or until subsequent repetitions do not increase the range of motion.

Strength Training Exercises for the Latissimus Dorsi



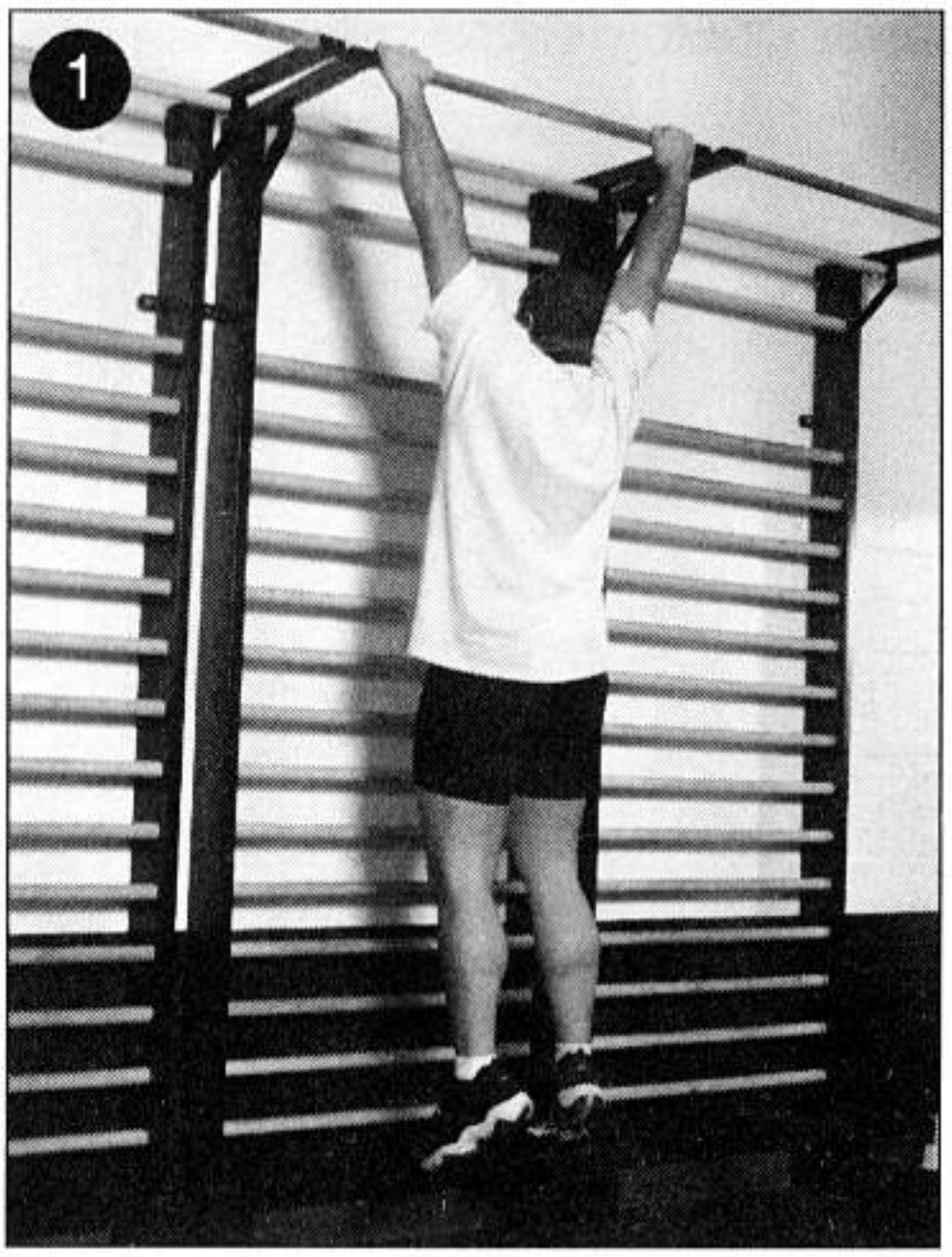


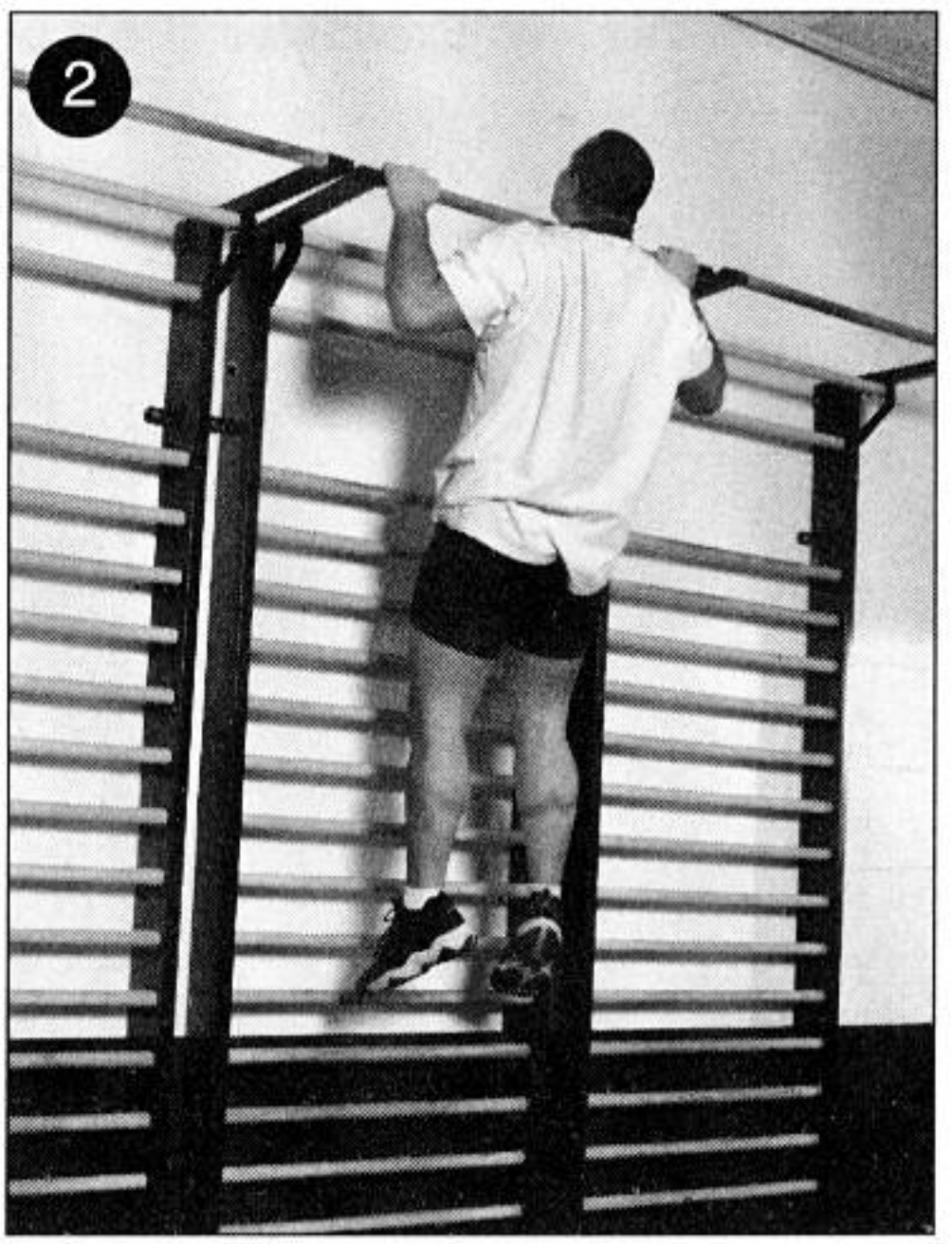
Lat Pull-Downs. These are only prescribed when an athlete's training facility does not permit chin-ups or pull-ups, or when the athlete cannot perform more than two repetitions on these exercises. This is because chin-ups and pull-ups develop the ability for athletes to overcome their own bodyweight, and also because lat pulldowns present too many opportunities to "cheat" by employing the low back musculature during the exercise.

Typically, lat pulldown stations feature a variety of bars (for different grip positions). Most also feature a support pad to wedge the knees under, which prevents being pulled upward during the exercise.

The grip on the bar should be equidistant from the center, and about 1.5 times shoulder width. Lifting straps may be used to secure bar grip. Assume a seated position under the bar, and pull the bar down to the clavicles (never behind the neck, which lessens the exercise's benefit and increases the possibility of neck injuries). This is done not simply by flexing at the elbows, but also by simultaneously retracting the shoulder blades and arching the back slightly. Think of "pushing the chest to the bar" rather than pulling the bar to the chest. Do not lean backward during the pull, even slightly. Many lifters unconsciously do this as a matter of habit as fatigue increases.

When using a close grip, the same general technique applies, except that athletes will experience a greater degree of elbow flexion, which increases involvement of the biceps muscle. Despite myths to the contrary, varying grips do not have different effects on the ultimate shape of the lats. However, regularly varying the grip will probably result in more complete development, and better strength through a variety of angles.

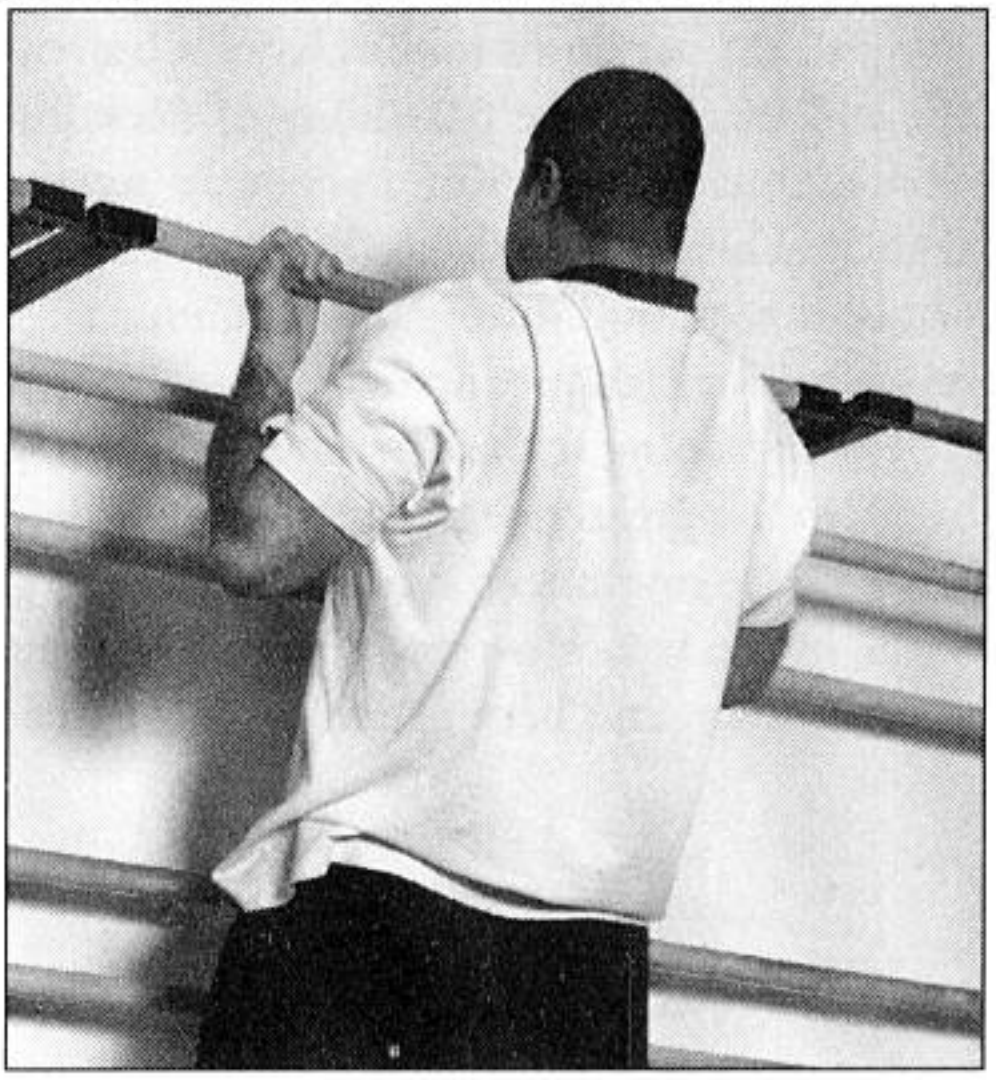


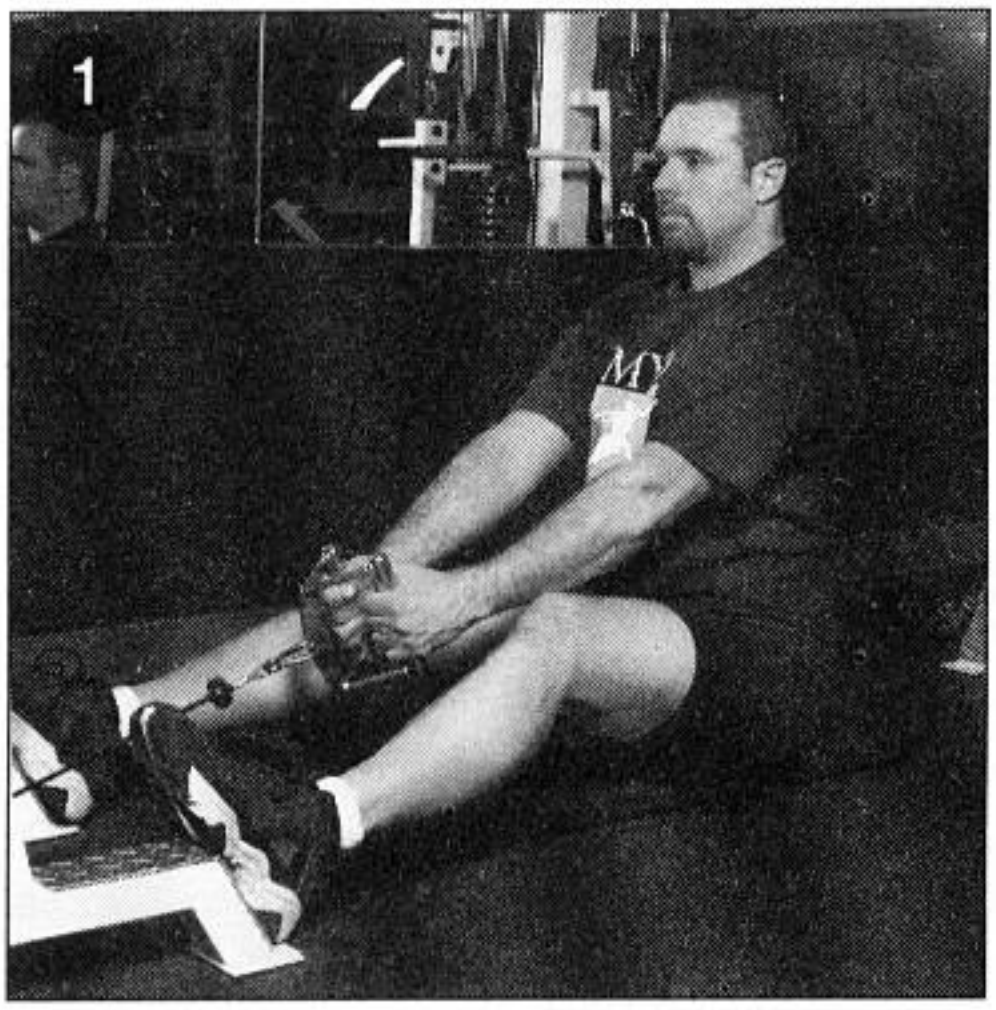


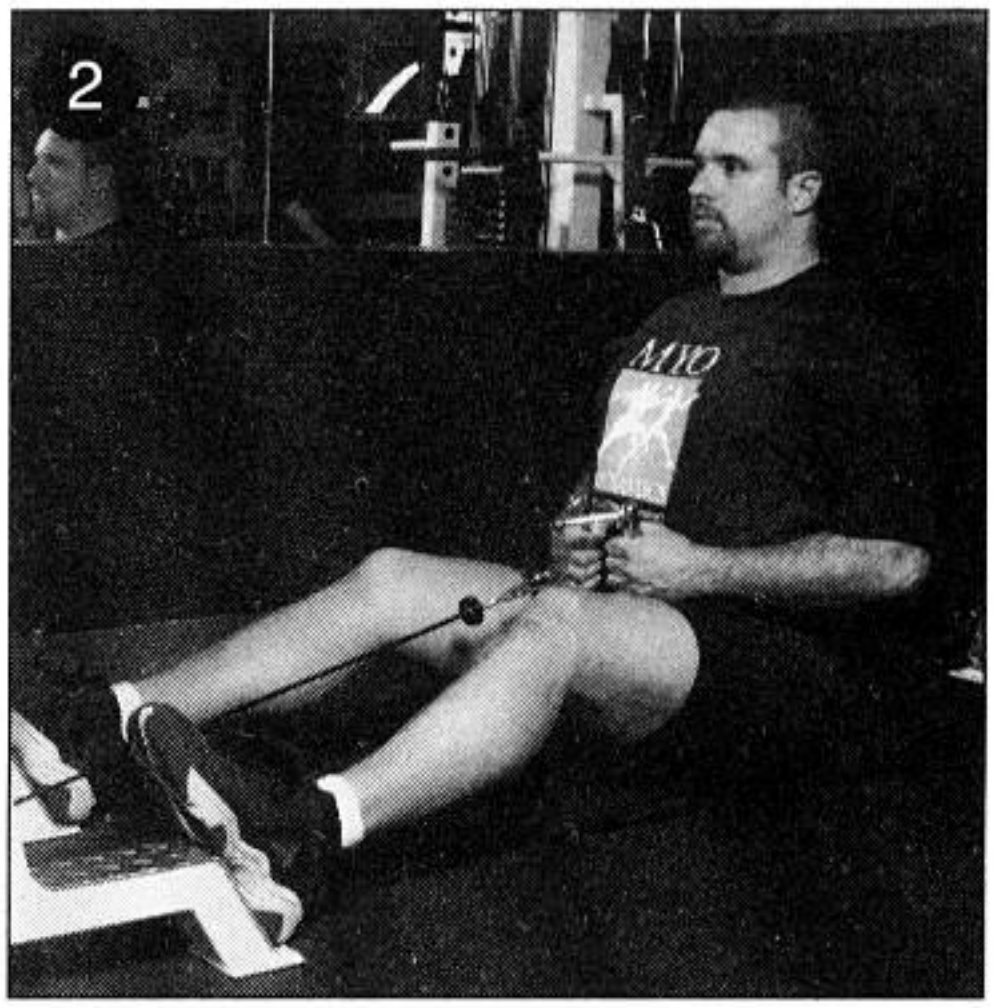
Pull-Ups. Pull-ups are performed with palms pronated (facing away from onself). Perform the pull-up just like a lat pulldown, except that the body rises up to the bar, rather than the reverse. Keep the hip's neutral (knees may be flexed to avoid contact with the floor). A common technical error is to flex at the hips as fatigue accumulates. Ensure clearing the bar with the chin at the top, and fully protract the scapulae at the bottom position. Think of "pulling the elbows to the ribs" rather than lifting the chin over the bar. Chalk or lifting straps may be used to enhance the grip.

Repeat for indicated number of repetitions. If needed, extra resistance may be provided through weight plates attached to a belt, or by placing a dumbbell between the calves.

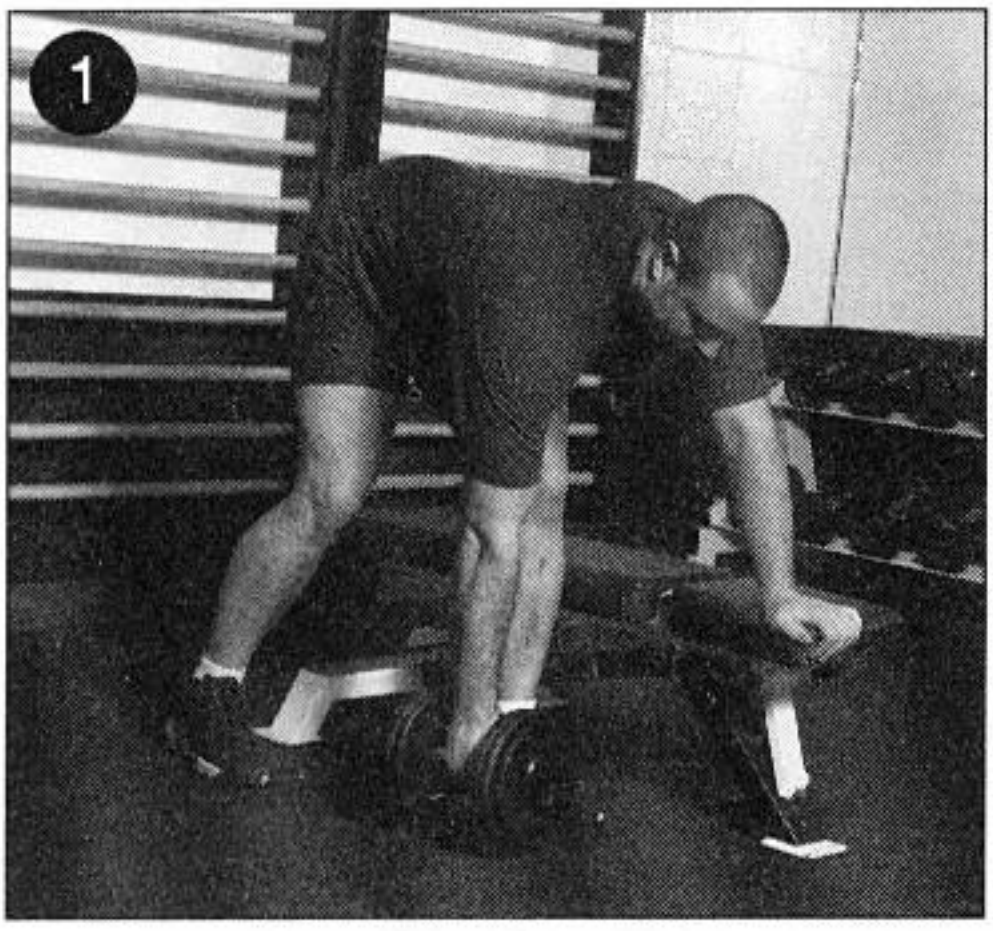
Chin-Ups. Performed the same as pull-ups, except that chin-ups are performed with a supinated (palms facing) grip, which increases biceps involvement. The closer the grip, the more the biceps are involved. Chalk or lifting straps may be used to secure a good grip.

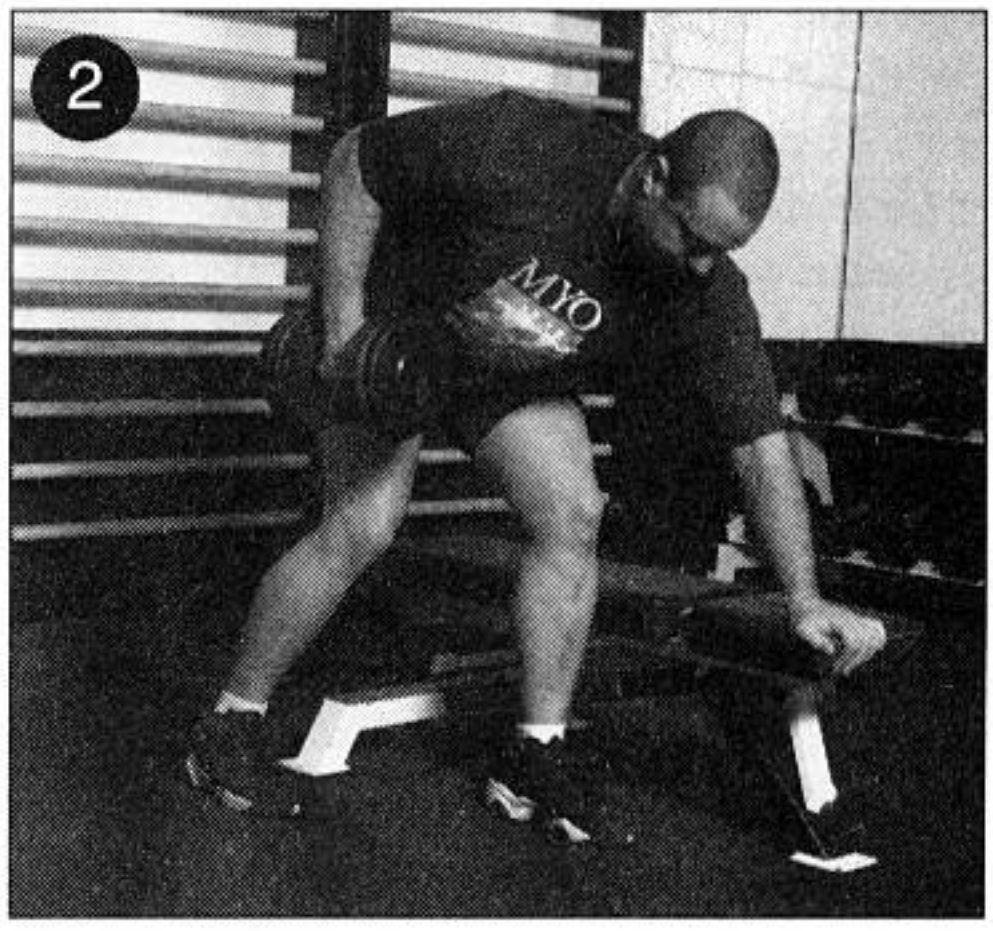






Seated Row. Performed on a machine or with a low cable. A variety of grip positions are possible. In all cases, the following points should be observed. Maintaining normal spinal curvatures, pull the handle to the torso at about navel height (not higher). At the finish of the concentric phase, shoulder blades should be retracted. Next, allow the shoulder blades to separate while returning back to the starting position. When using a low cable, a variety of torso inclinations are possible, but keep the torso perpendicular to the floor, or lean slightly back. Whichever position is chosen, maintain it throughout the exercise.





Dumbbell Row. (These instructions pertain to training the right side). Rest the left knee and hand on the bench, as shown. Grasp a dumbbell with the right hand, palm facing in toward the body. Maintaining neutral spinal curvatures and keeping the torso parallel to the floor, pull the dumbbell upward in a straight line, keeping the elbow close to the torso throughout. At the top of the movement, the right hand should be adjacent to the right ASIS (hip bone). Slowly lower back to the starting position, and repeat for the desired number of repetitions. As with all back exercises, the exercise should start with fully protracted scapulae, and finish with fully retracted scapulae.

Tips for Maximizing Strength Training for Latissimus Dorsi

During virtually all lat training exercises, initiate the concentric phase of the exercise from a position of complete scapular protraction (shoulder blades as far apart as possible). Start the movement by simultaneously retracting the scapula and pulling the elbows toward the torso. Arch and "throw" the chest toward the direction of the resistance.

Because the lats are active in movements on several planes, use a variety of exercises and movement angles in the lat training program.

Pectorals

Description: The "pecs" have three distinct lobes, which all insert into the upper humerus. The "clavicular" aspect originates from the clavicle, while the two sternal lobes originate from the upper and lower sternum. The pecs draw the upper arm across the body.

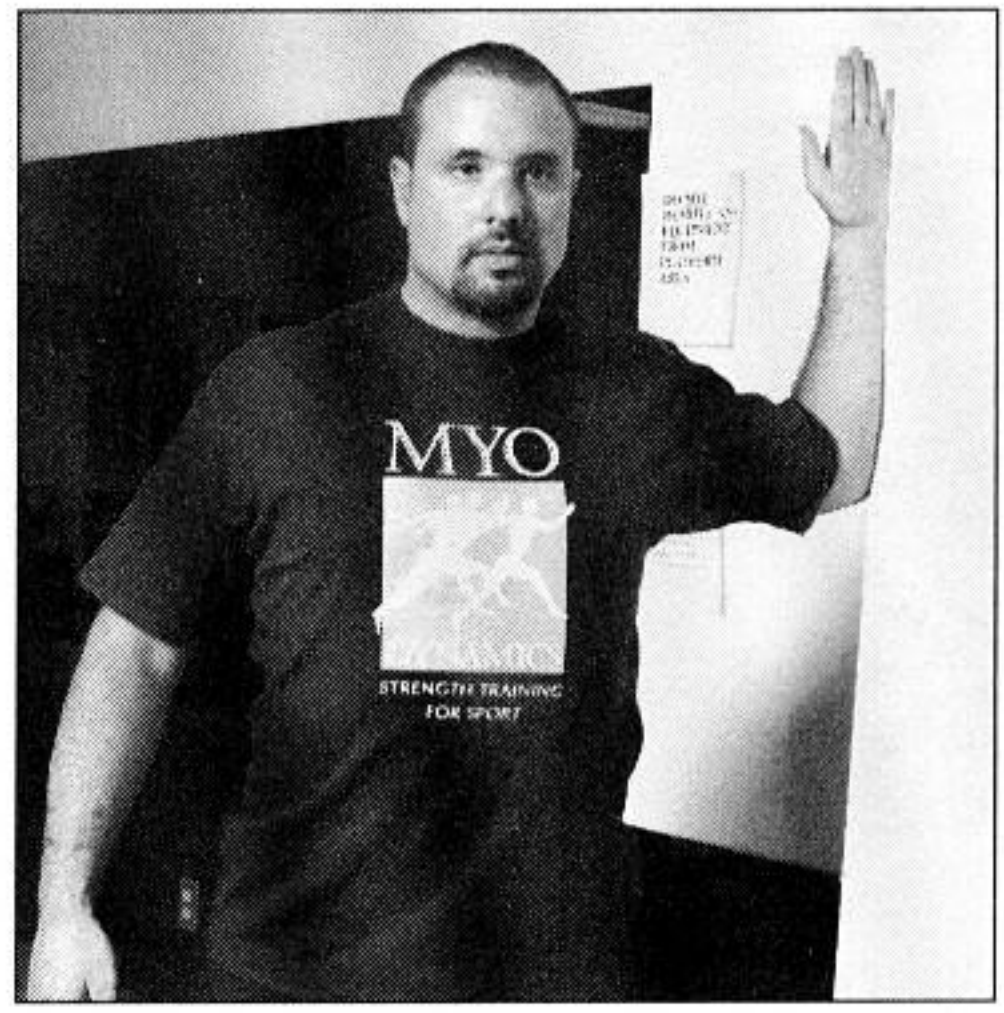
Martial Arts Applications: The pecs contribute strongly to all punching and striking skills

Unique Characteristics: The pectoral muscles can be trained to a very high level of strength. In fact, a few elite-level powerlifters have bench pressed over 700 pounds in competition. However, excessive pec training can result on postural mis-alignments (specifically, forward shoulders), and can exacerbate the imbalance between the pecs and the much smaller external rotators. Both factors often lead to shoulder pathologies of various types, many of which are career-ending.

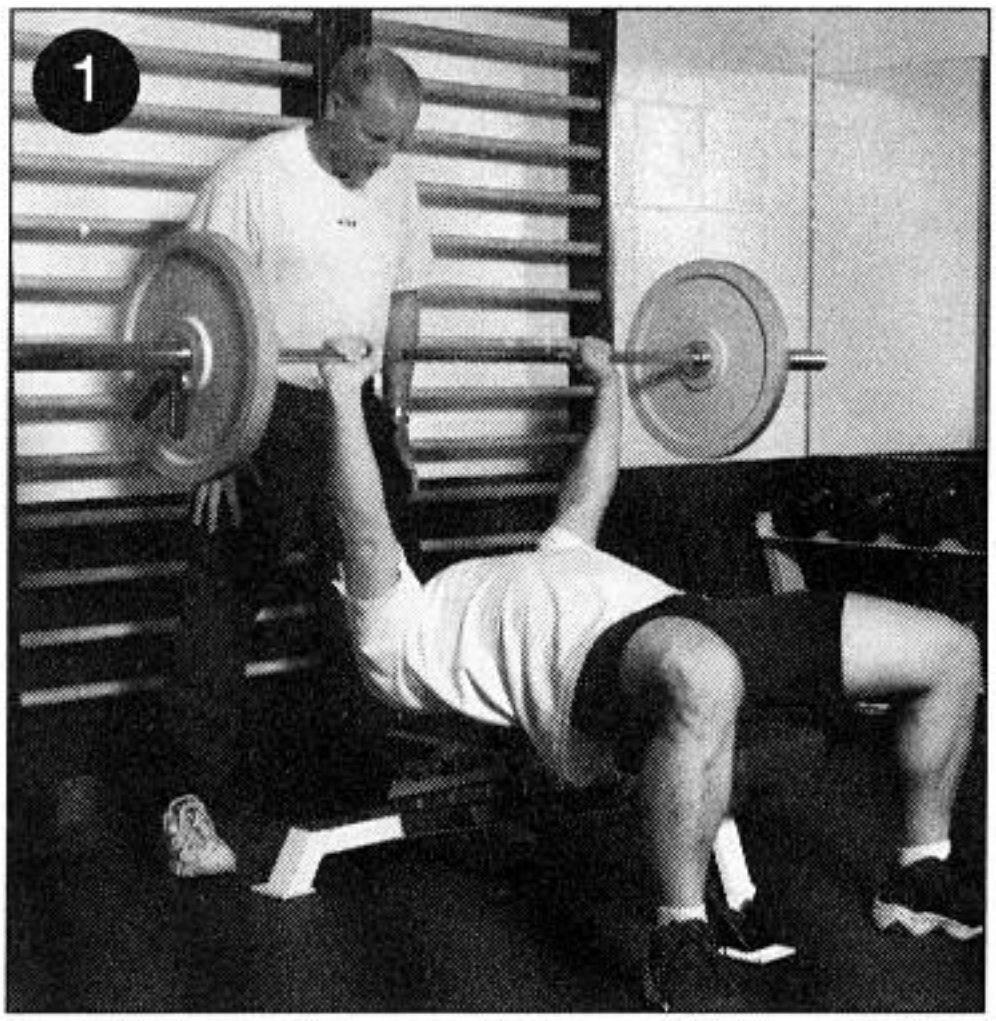
Length assessment: When the pecs have adequate length, the athlete will be able to fully abduct the arms to the sides (frontal plane), and fully extend the shoulders until the arms are overhead.

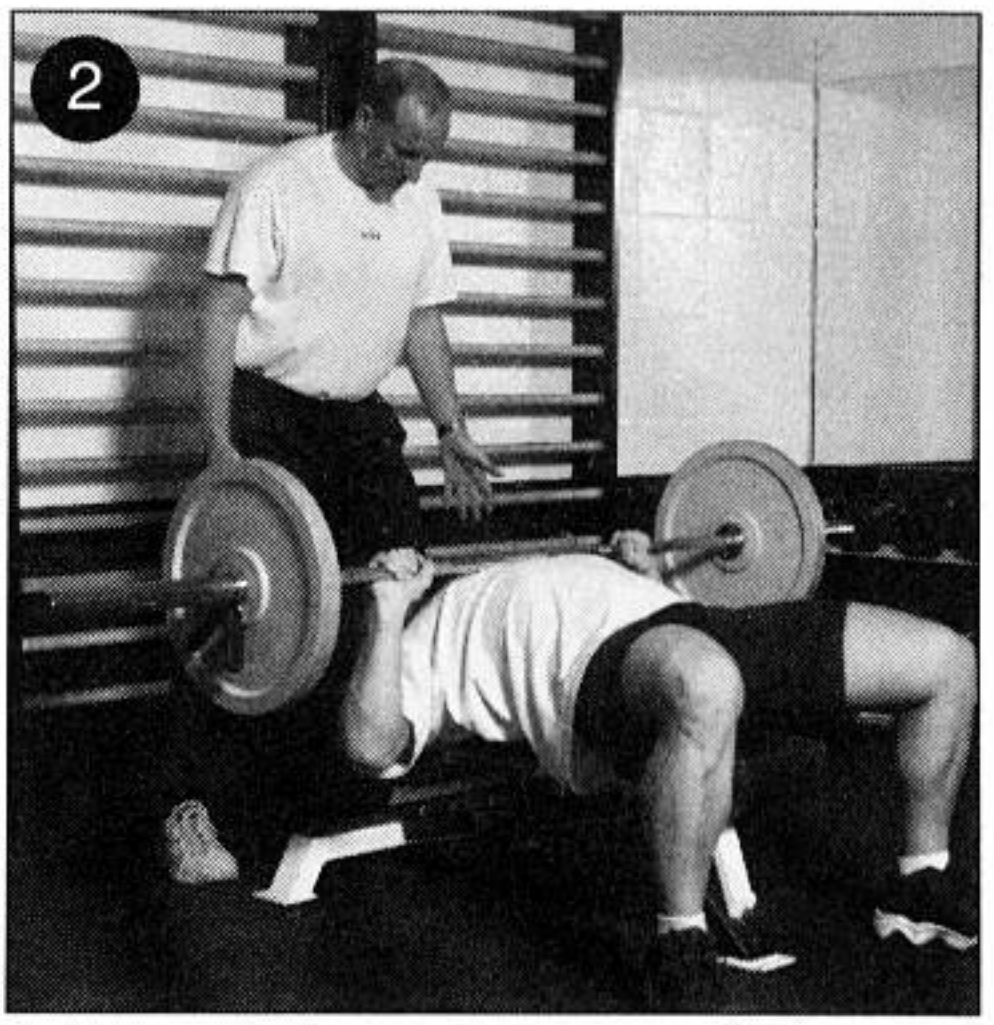
Stretching methods for the pecs

The pectoral muscle can be effectively stretched along by placing your lower arm against a doorjamb, as shown. Apply pressure against the doorjamb by attempting to push your torso through the doorway, using approximately 35–50% of maximal effort. Use a count of 6–8 seconds, at which point you release the pressure. Next, try to increase your range of motion, deepening the stretch. From this new, deeper ROM, perform the count again. Repeat for 3–5 repetitions, or until subsequent repetitions do not increase the range of motion. You can target different areas of the muscle by placing your arm at varying heights during the stretch.



STRENGTH TRAINING EXERCISES FOR THE PECS





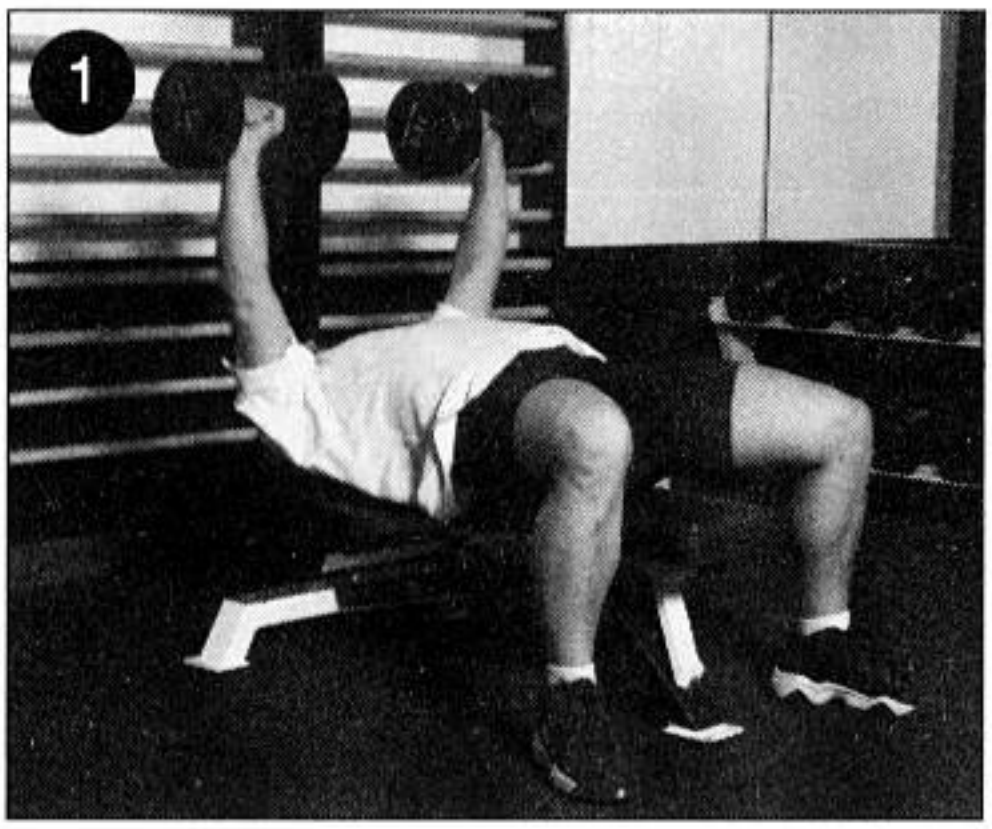
Bench press. Bench presses may be performed with a bar or with dumbbells. The bench may be flat (overall pectoral stress), inclined (more stress to the clavicular pectorals), or declined (more stress to the lower pectorals). Lay on the bench, placing both feet on the floor (if this causes the curvature of your low back to increase, find a lower bench or place your feet on solid blocks to elevate them). Grasp the bar such that both hands are equidistant to the center, and make sure your thumbs are wrapped around the bar, rather than on the same side as your other fingers. At the start, the bar should be directly over your nose—if it isn't, slide yourself up or down on the bench until it is. Inhale and unrack the bar from the supports. As you lower the bar to your chest, keep your elbows directly under the bar, rather than in front of, or ahead of the bar. At the bottom of the movement, the bar lightly touches your chest at nipple level. Return the bar to the starting position (it should actually travel up, as well as slightly back) by contracting your pectorals.

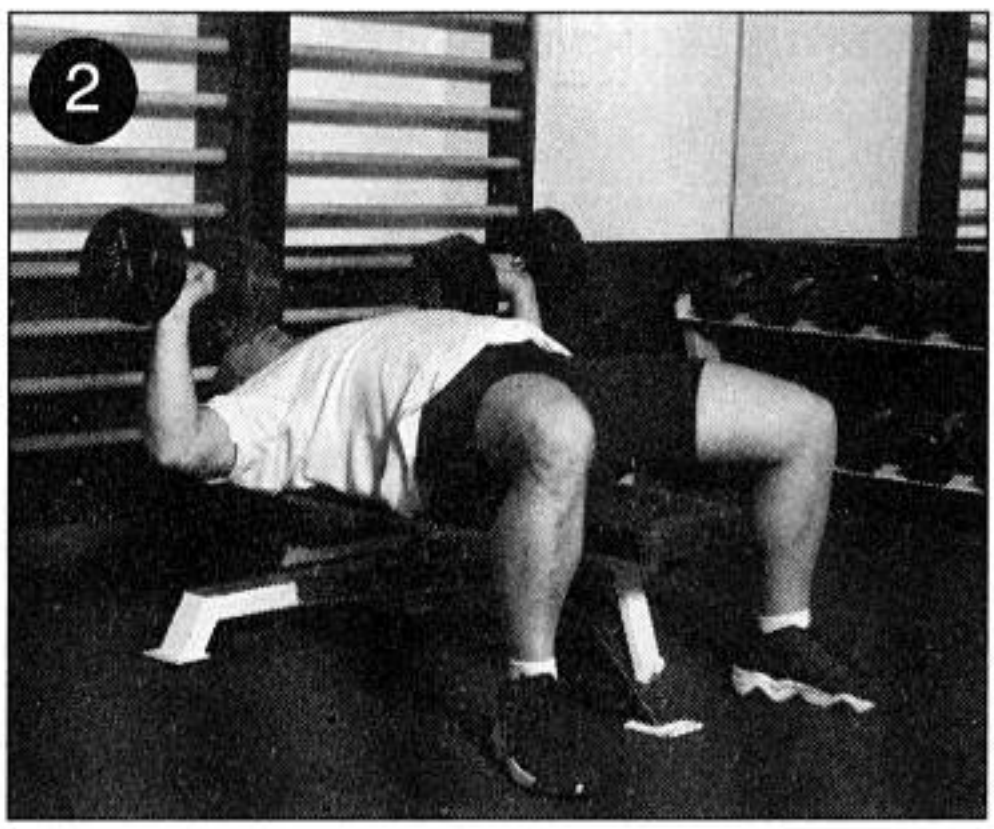
Grip width: Viewed from the head of the bench, your forearms should be perpendicular to the floor at the bottom position.

Depth: Although the most common variant is to bring the bar down until it touches the chest, for some athletes with poor shoulder flexibility, this position may be too deep. As a rule of thumb, the bottom position you choose should not use up all the shoulder flexibility you have—you should be able to go deeper with no discomfort if you had to. For novice athletes with adequate shoulder flexibility, you can use depth as a method of progression, by using a constant weight over several workouts, slightly increasing the depth every session.

Transition position: most bench press injuries occur during the transition between the eccentric and concentric phase, according to Dr. Sal Arria, Executive Director of the International Sports Sciences Association. A common technique flaw involves the fatigued lifter allowing the bar to "bounce" or "chop" down onto the chest, which subjects the pectoral attachments to sudden loads, which is often the stimulus for injury. A 200 pound bar lowered very slowly exerts about 200 pounds of pressure. But this same bar lowered quickly, may put many hundreds of pounds of tension on the target muscles and their attachments.

ALWAYS employ a competent spotter when performing any bench press variation.



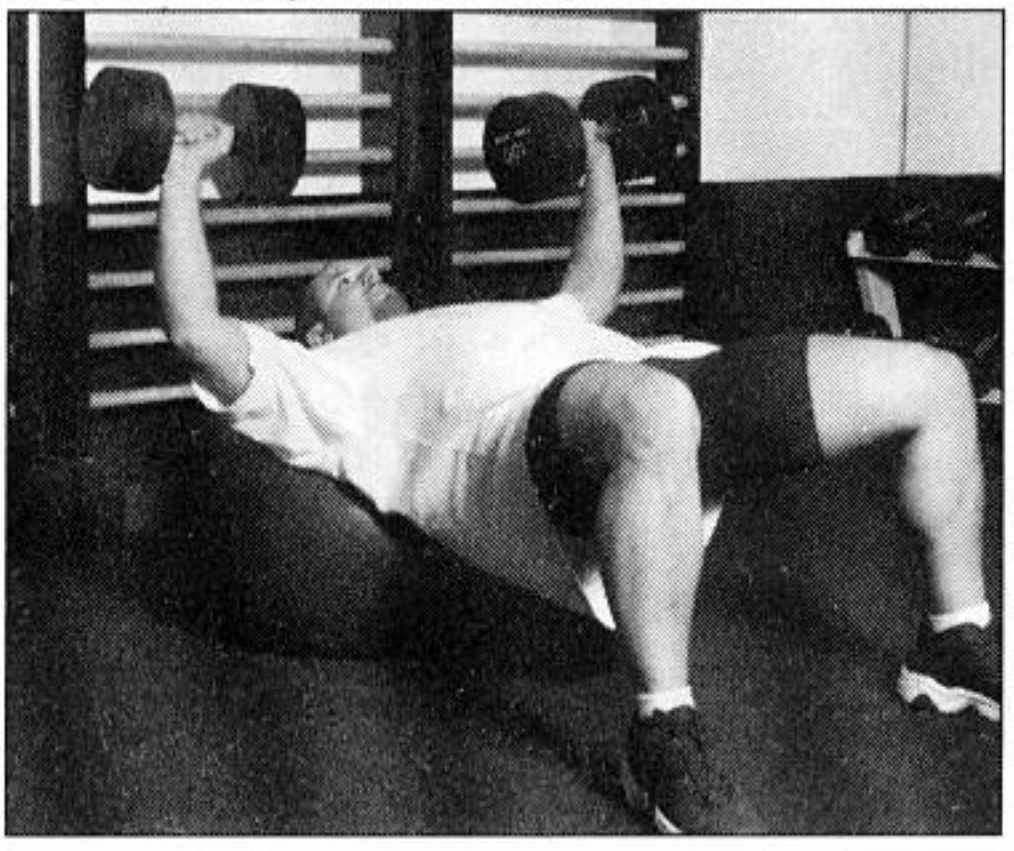


Dumbbell bench press. Performing the bench press with dumbbells adds an element of difficulty because of the instability and balance which is required. Using proper lifting technique (refer back to squat and deadlift descriptions), remove the dumbbells from their rack, and walk back to the bench (if possible, position the bench adjacent to the dumbbells you'll use beforehand). Sit down GENTLY to avoid spinal compression, with a dumbbell on each thigh, as shown. Carefully lay back on the bench, allowing the dumbbells to move into the starting position. Press the dumbbells upward until your elbows are extended, but do not allow the dumbbells to touch at the top. Repeat for indicated number of reps.

Exiting the bench after a set: there are two ways to exit the set safely. If the dumbbells are light enough, you can return them to your thighs and roll forward to a seated position, and then stand up and return the dumbbells to their rack. However, if the dumbbells are too heavy, this won't be a viable option. In this case, lower the dumbbells, under as much control as possible, one at a time, to the floor. DO NOT lower them simultaneously, as this is likely to exceed the range of motion in your shoulder joints and cause injury.

ALWAYS employ a competent spotter when performing any bench press variation.

Ball dumbbell bench press. This is performed much like the preceding exercise, except that you'll use a Swiss ball instead of a bench. Although very effective, this is a difficult exercise and certain precautions must be observed:

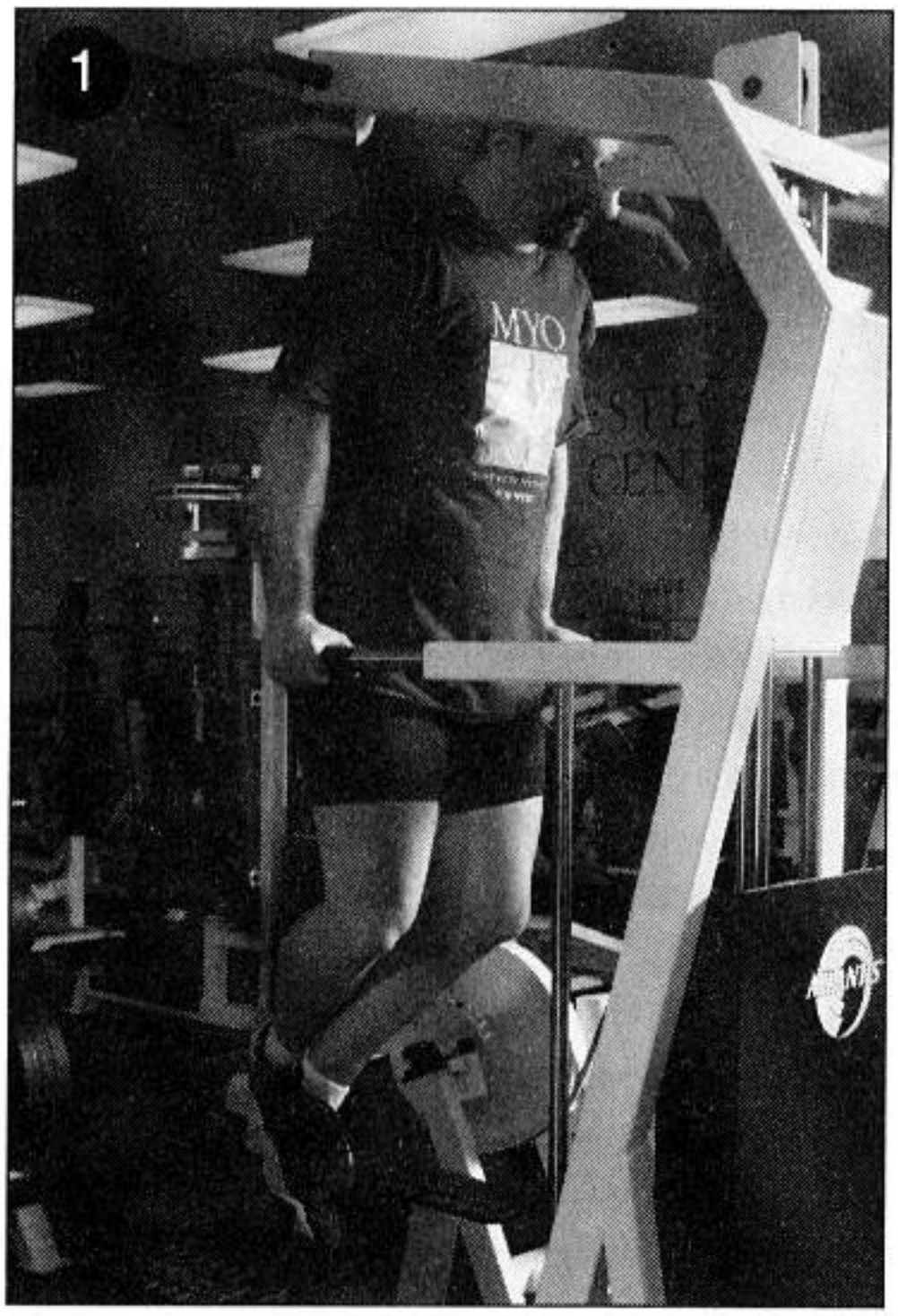


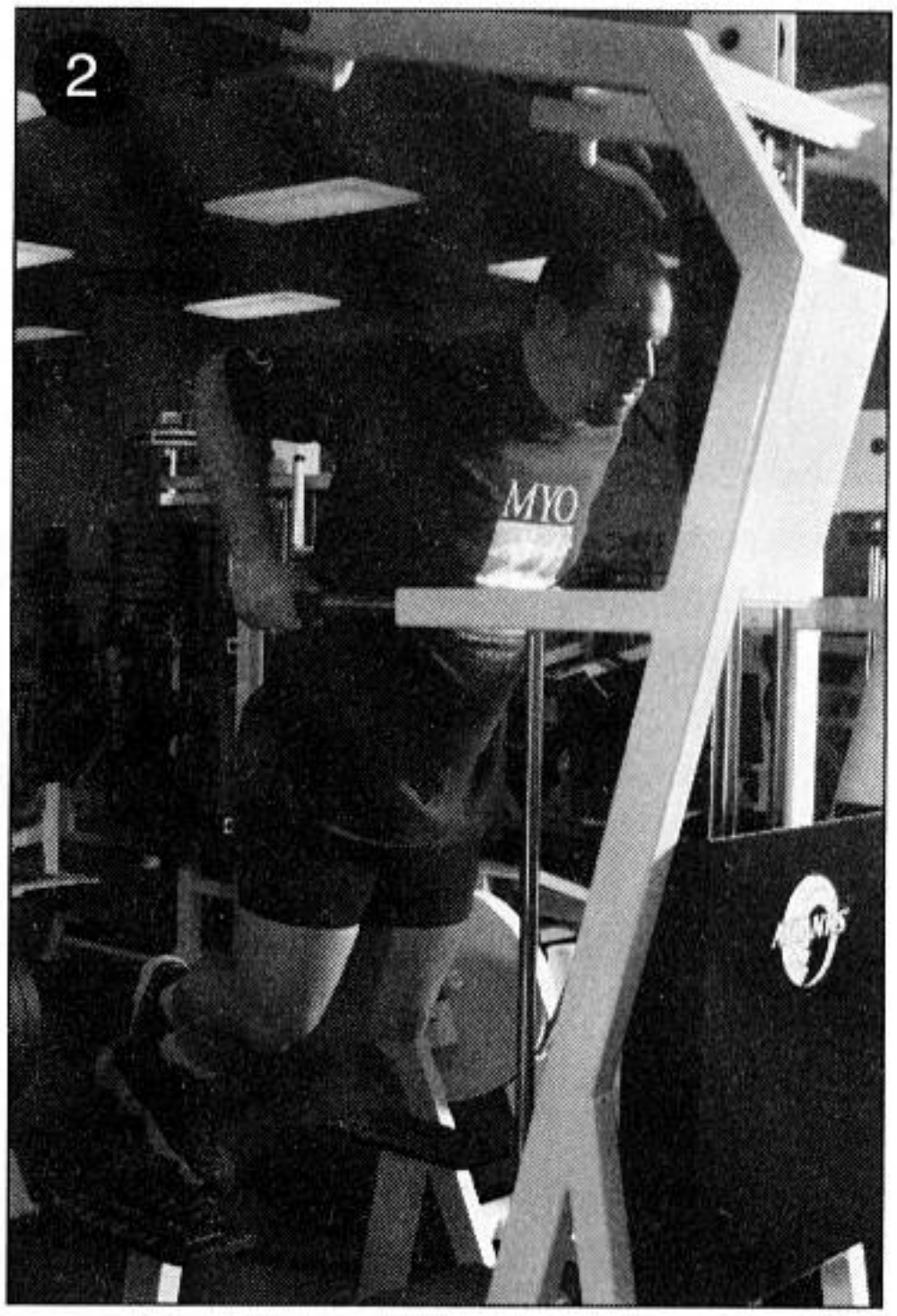
1) Only use a Duraball from Durabody (please see resources section for more information). This is the only ball on the market guaranteed never to burst (I've tested these balls personally many times).
2) Check the ball surface and the floor for sharp objects such as staples, gravel, etc.
3) Ensure that you don't have zippers, rivets, or anything else on or in your pockets that might puncture the ball.
4) Replace Swiss balls every 6 months.
5) Always use a competent spotter.

6) Stay well within your capabilities; this is not the place to try for a new 1RM. Start conservatively, and progress gradually.

Using proper lifting technique, remove the dumbbells from their rack, and walk back to the ball (if possible, position the ball adjacent to the dumbbells you'll use beforehand). Sit down carefully, with a dumbbell on each thigh, as shown. Carefully lay back on the ball, allowing the dumbbells to move into the starting position. Position your feet apart to form a stable base, and lift your hips until your torso becomes parallel to the ground. Press the dumbbells upward until your elbows are extended, but do not allow the dumbbells to touch at the top. Repeat for indicated number of reps. Exit the set by dropping the dumbbells to the floor one at a time.

ALWAYS employ a competent spotter when performing any bench press variation.





Dips. Dips are contraindicated for athletes with shoulder pathology, but for all others, it is a very effective exercise for the pectorals, front deltoids, and triceps. Maintain a vertical torso for more shoulder and tricep involvement, and a forward lean to increase pectoral recruitment. Descend slowly and under complete control, and be careful not to exceed your shoulder's range of motion. Return back to the top position by contracting your pecs, deltoids, and triceps. Repeat for indicated number of reps. If needed, extra resistance may be provided through weight plates attached to a belt, or by placing a dumbbell between your calves.

One & 1/4 bench press. (See bench press description above for general technique guidelines). Lower the bar (or dumbbells) to your chest, then raise it 1/4 of the way back up, then back to the chest, and then back up to arm's length; this constitutes one repetition. Complete for the indicated number of reps for each set. ALWAYS employ a competent spotter when performing any bench press variation.

45/30/15 dumbbell bench press. (See bench press description above for general technique guidelines).You'll need a partner to complete this exercise. Set the bench at a 45° incline. Perform 4 repetitions, and then have your partner drop the bench to a 30° incline. Perform 4 more reps, and re-set to a 15° incline, and then perform 4 more reps. Complete for the indicated number of sets.

ALWAYS employ a competent spotter when performing any bench press variation.

Tips for maximizing strength training for pecs

The pecs cause the upper arms to draw across the body, When performing bench pressing exercises, it helps to think of "pulling across" with the upper arms, rather than simply pressing the weight up.

Quadriceps

Description: The quadriceps is a single muscle with four heads. Three heads (vastus medialis, lateralis, and intermedius) act to extend the knee, while the fourth (rectus femoris) extends the knee and helps to flex the hip. All four heads converge on the patellas tendon, which passes through the kneecap on it's way to it's insertion into the front of the upper tibea bone. The quadriceps are antagonistic to the hamstrings and the hip extensor muscles.

Martial Arts Applications: The quadriceps are strongly involved in kicking skills as well as in grappling skills such as the sprawl.

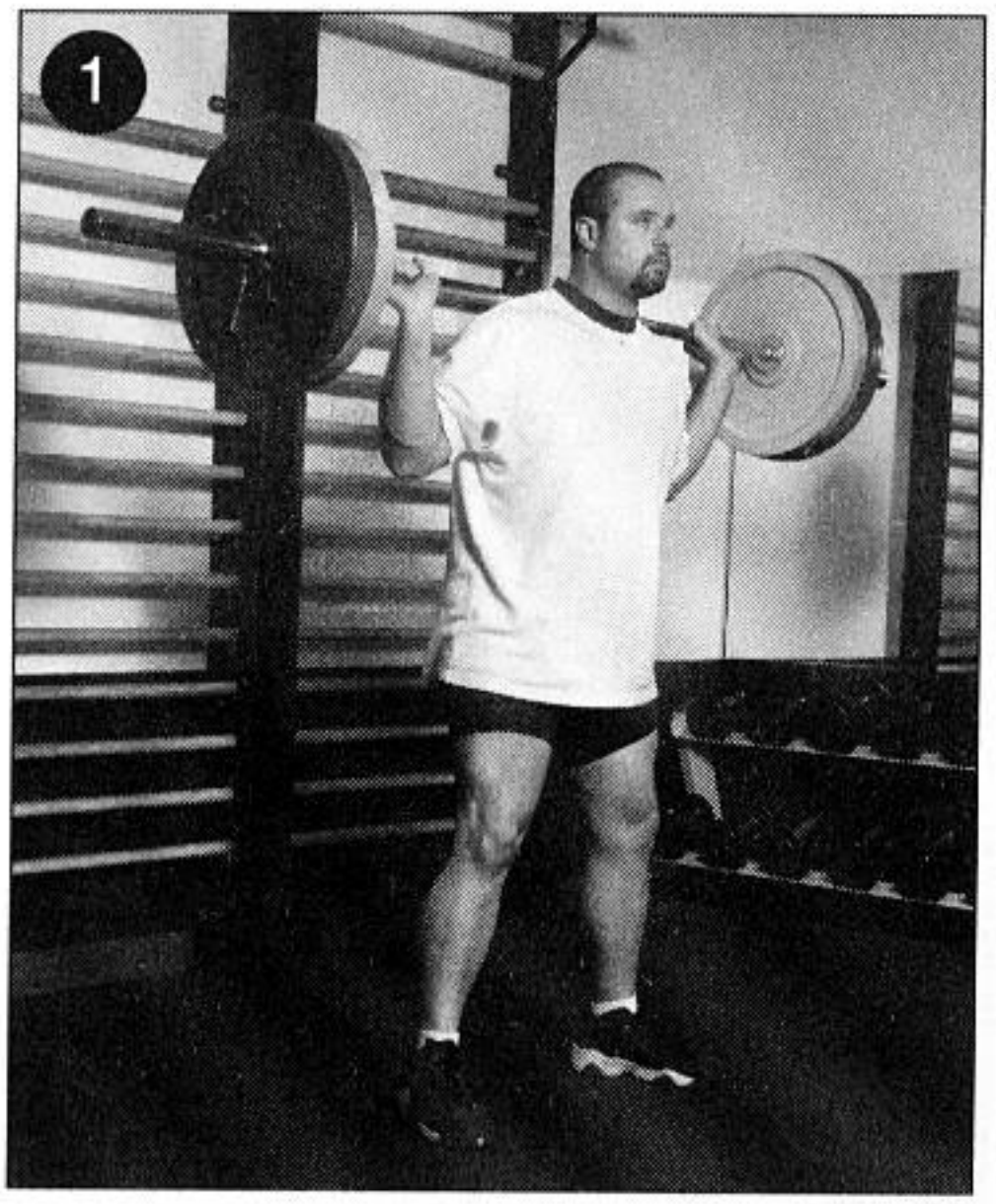
Unique Characteristics: Quadriceps fiber ratio can vary significantly from person to person. Therefore, strength training for the quads should emphasize varied intensities. Imbalances between the medial and lateral portions of the quadriceps are widely regarded as contributing factors in tracking disorders of the kneecap. Usually, the vastus medialis is too weak relative to the lateralis. This problem can often be resolved through the use of low step-ups.

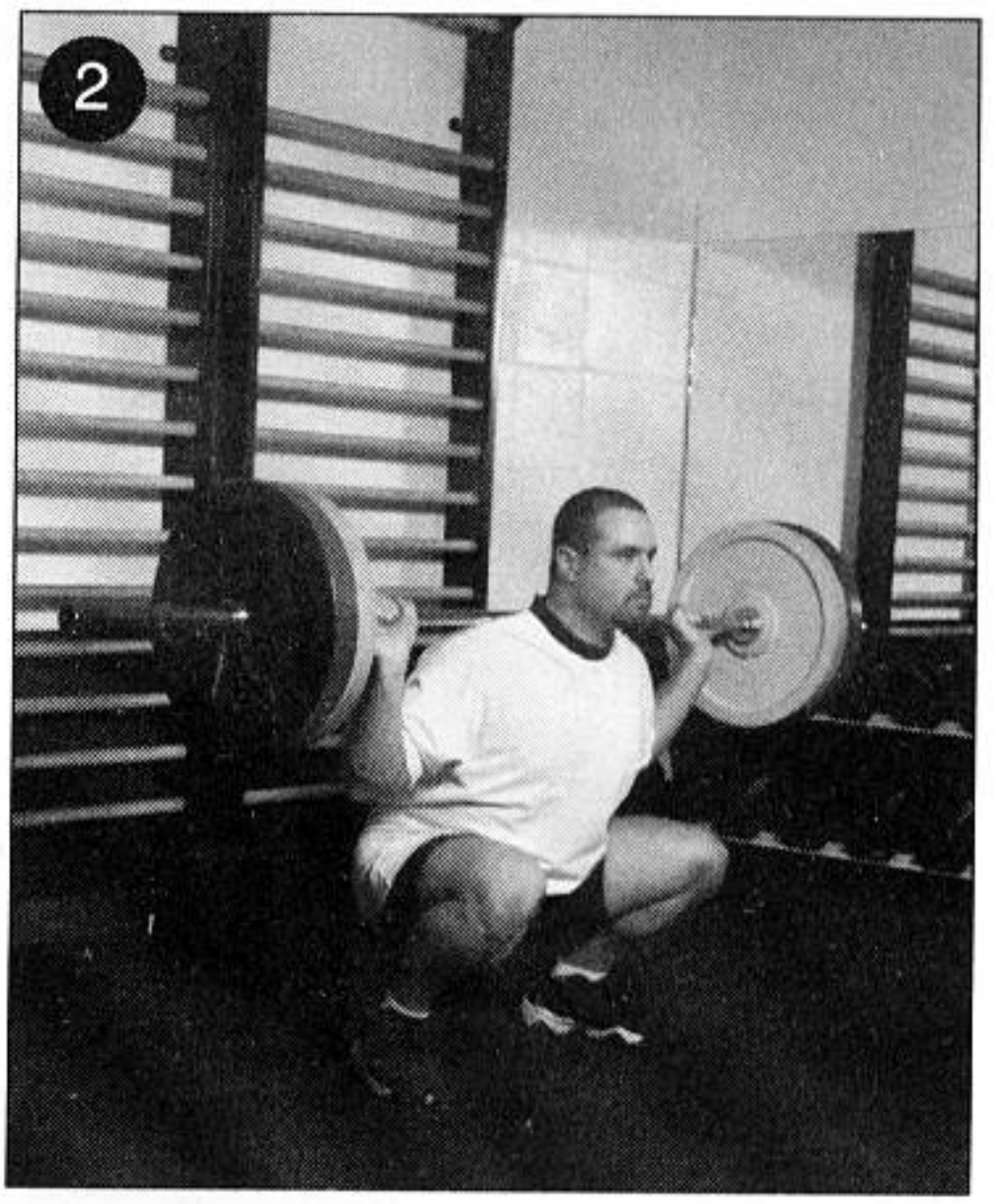
Length assessment: To assess minimal standards for quadricep length, have the athlete lie prone (face down) on the floor, with his or her head down and relaxed. The subject relaxes as you bend the right knee. Ideally, you should be able to touch the heel to the butt on the same side. Repeat on both sides, and check to see that the quadricep length is about the same on both sides. If not, concentrate on stretching the shorter side until this discrepancy is resolved.

Stretching methods for the quadriceps

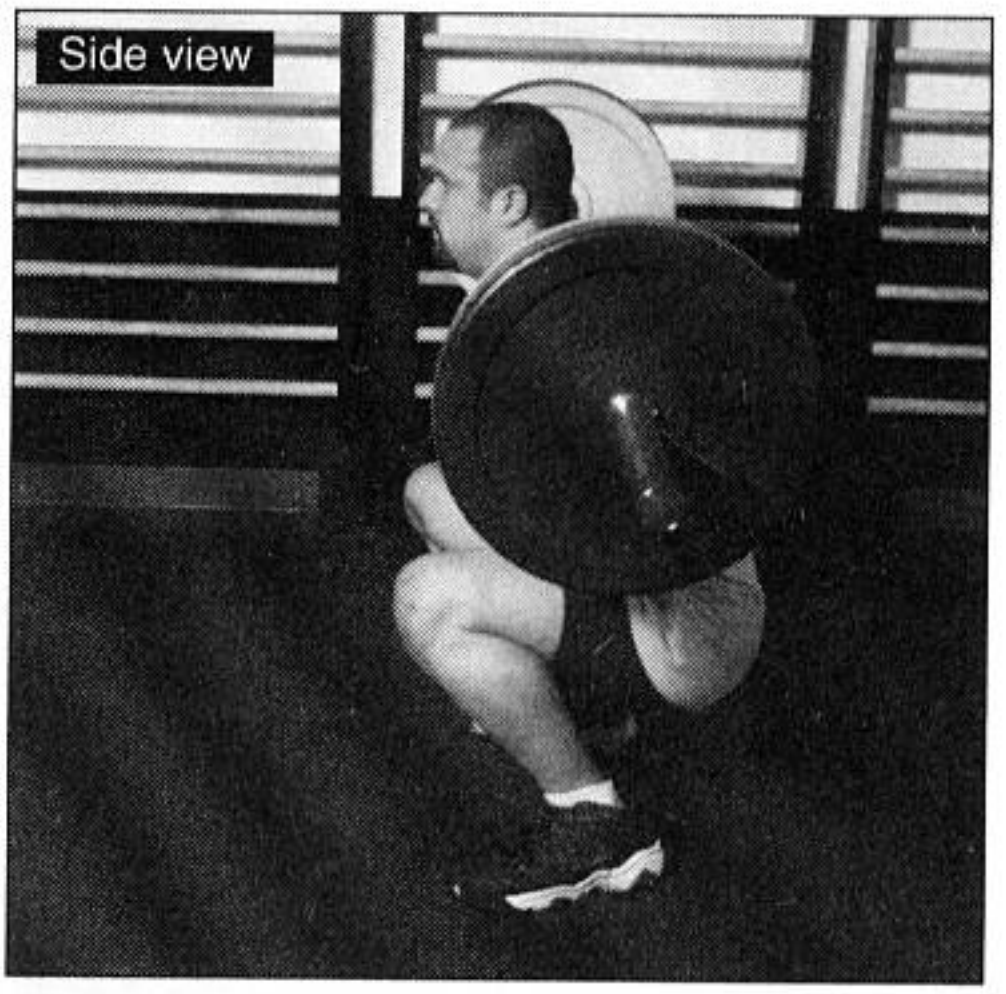
From the length assessment position, instruct the athlete to apply pressure against your hand by attempting to extend the knee, using approximately 35–50% of maximal effort. Give your partner an audible count of 6–8 seconds, at which point you will both release the pressure. Next, prompt the athlete to attempt to increase his range of motion, deepening the stretch. From this new, deeper ROM, perform the count again. Repeat for 3–5 repetitions, or until subsequent repetitions do not increase the range of motion.

Strength training exercises for the quadriceps



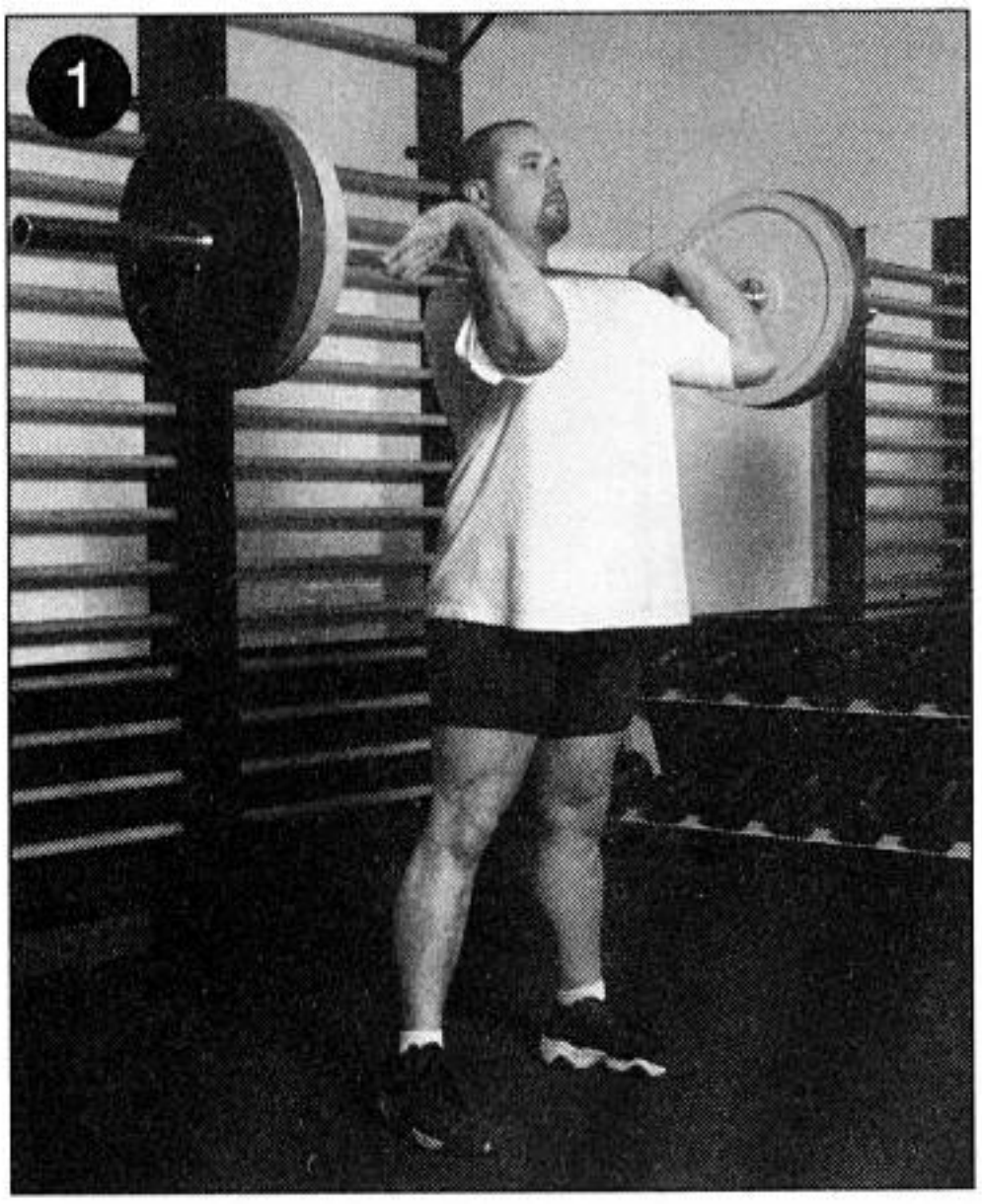


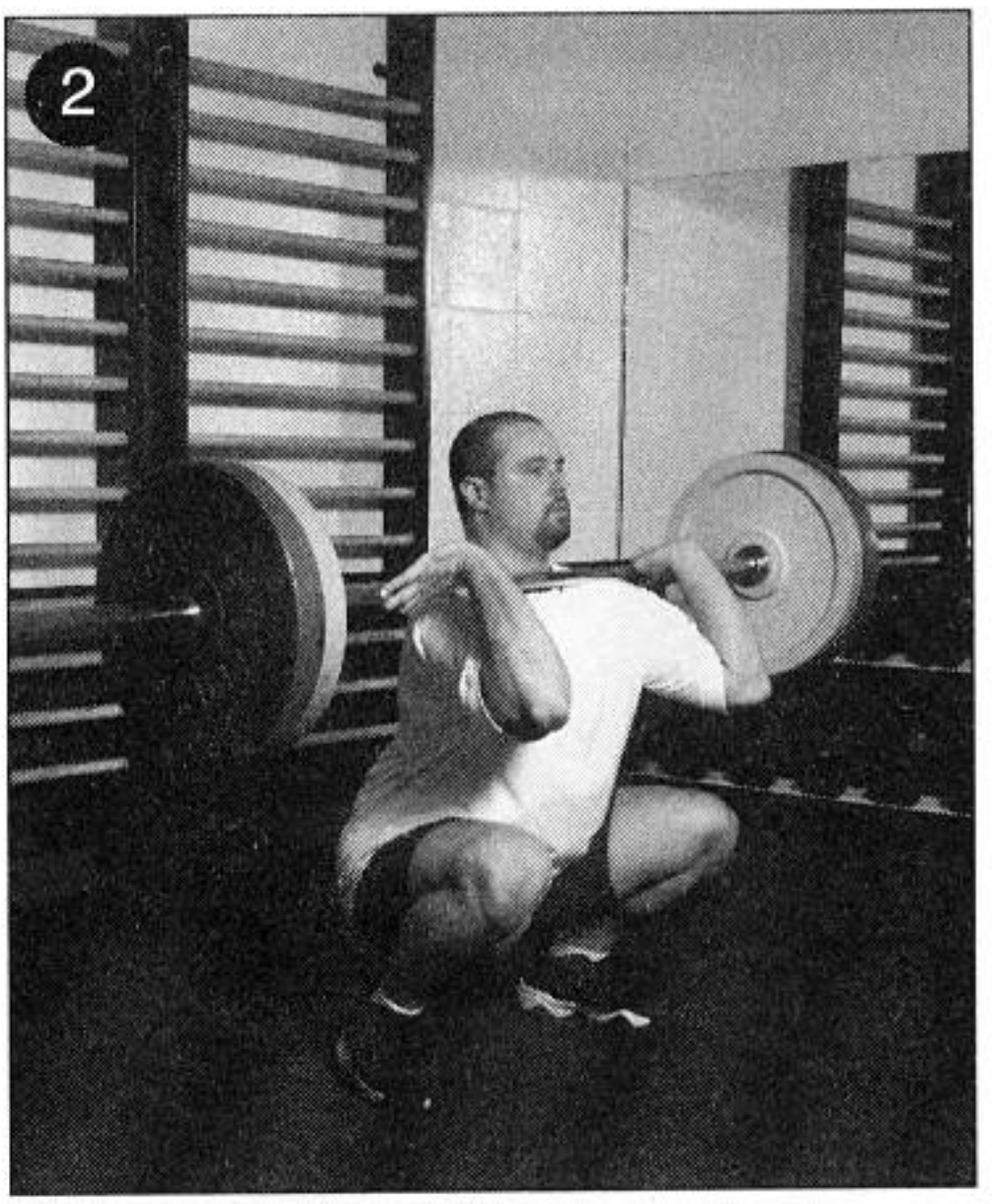
Back squat. Position the barbell on the support pins inside of a power rack, such that the bar is level with your mid-chest. Place safety pins on each side, at a position slightly lower than your intended deepest position. Place your hands evenly on the bar (a close grip with elbows under the bar will allow for a more upright posture) and, with your feet squarely under the bar, lift it from the rack by extending your legs.



Next, step back just enough to avoid bumping the rack during the exercise, and position feet at approximately shoulder width. The weight should remain centered over the back half of the feet, not on the heels or toes. Slowly descend into a near-bottom position, keeping the torso and back erect so that the hips remain under the bar at all times. Do not allow the hips to drift backward or the torso to incline forward.

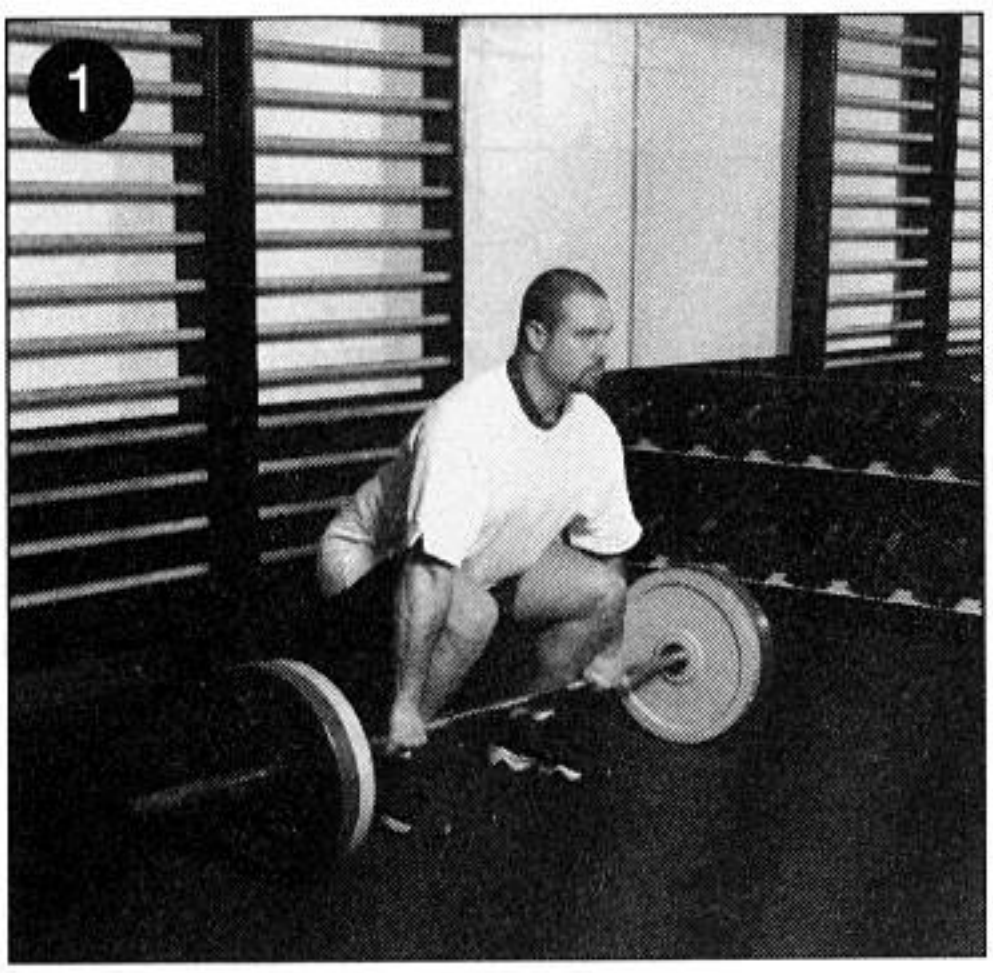
When viewed from the side, the angles formed at the knee joint and hip joint should be close to being equal. Also, your hips and shoulders should ascend together—if the hips rise before the shoulders, it means you're using your back rather than your legs. Rise out of the squat position following the same path that you descended—your torso and back should remain erect and the hips remain under the bar throughout the ascent.

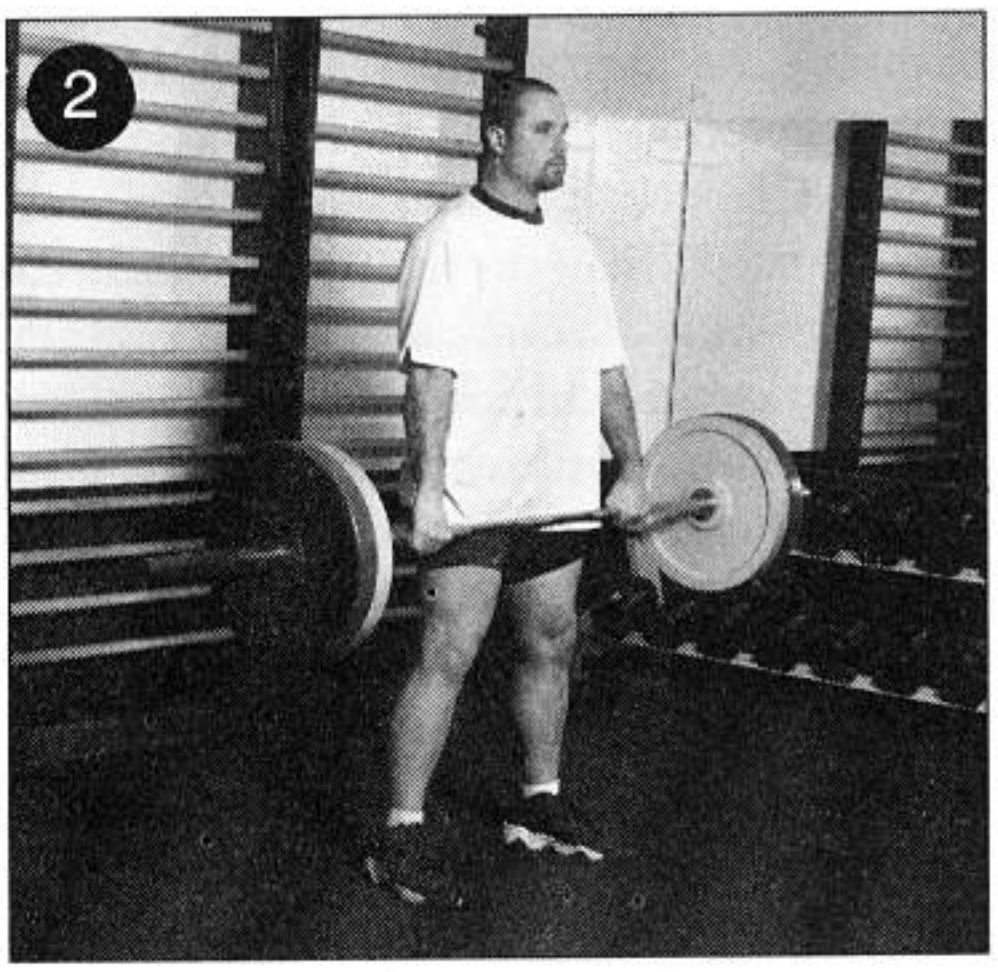




Front squat. The front squat is performed in much the same way as the back squat, with the exception that the bar is positioned in front of your neck, resting on your deltoids.

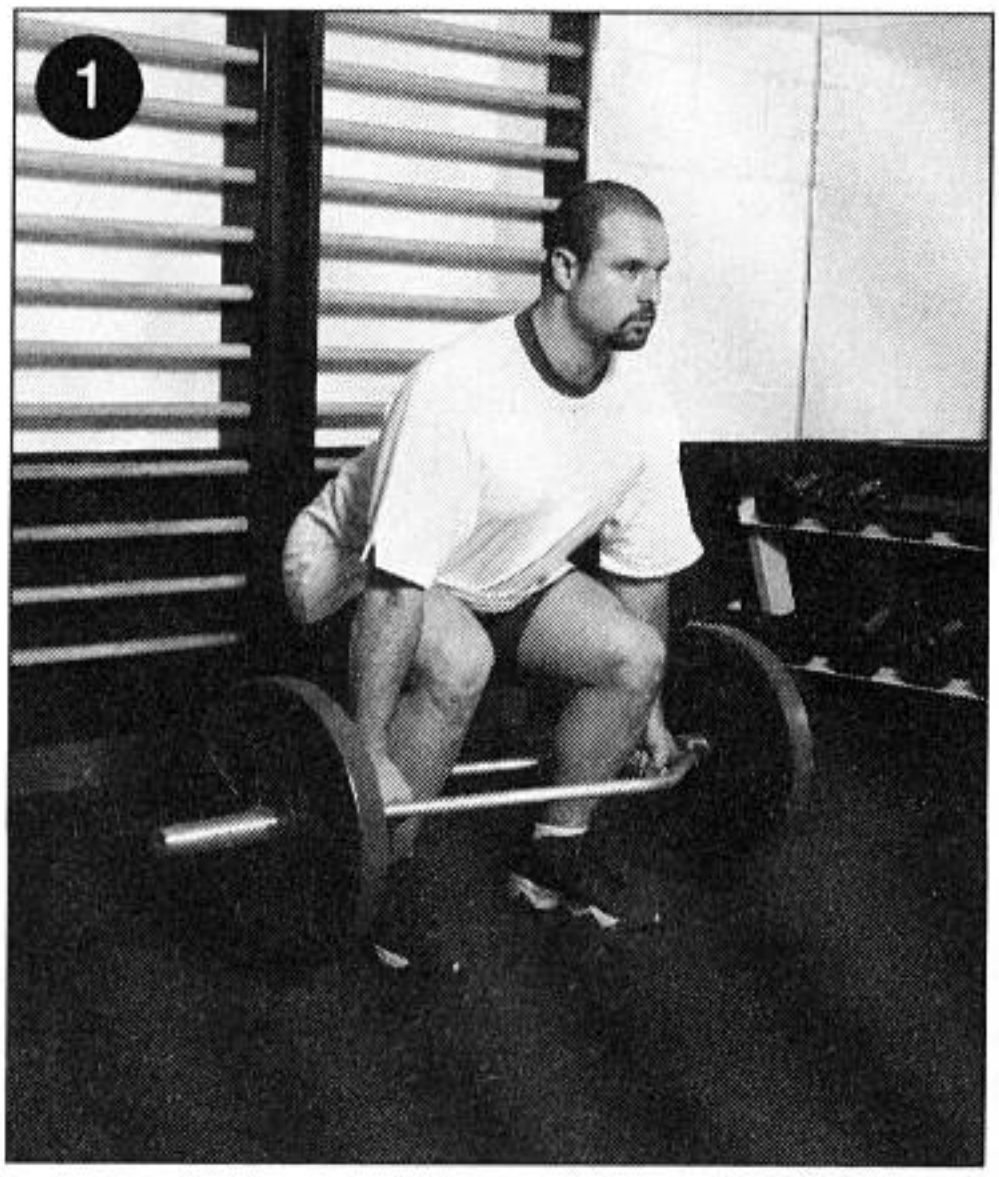
Position the barbell on the support pins of a power rack, such that the bar is level with your mid-chest. Step right in to the bar, and simultaneously grasp the bar using a slightly wider than shoulder-width grip. Rotate your elbows up, positioning the bar on your deltoids (if the elbows remain pointing downward, the bar will rest on your clavicles, which is too painful when the weightload becomes significant). Fill your lungs with air, and keeping the chest up and torso tight, unrack the bar and step back away from the rack.

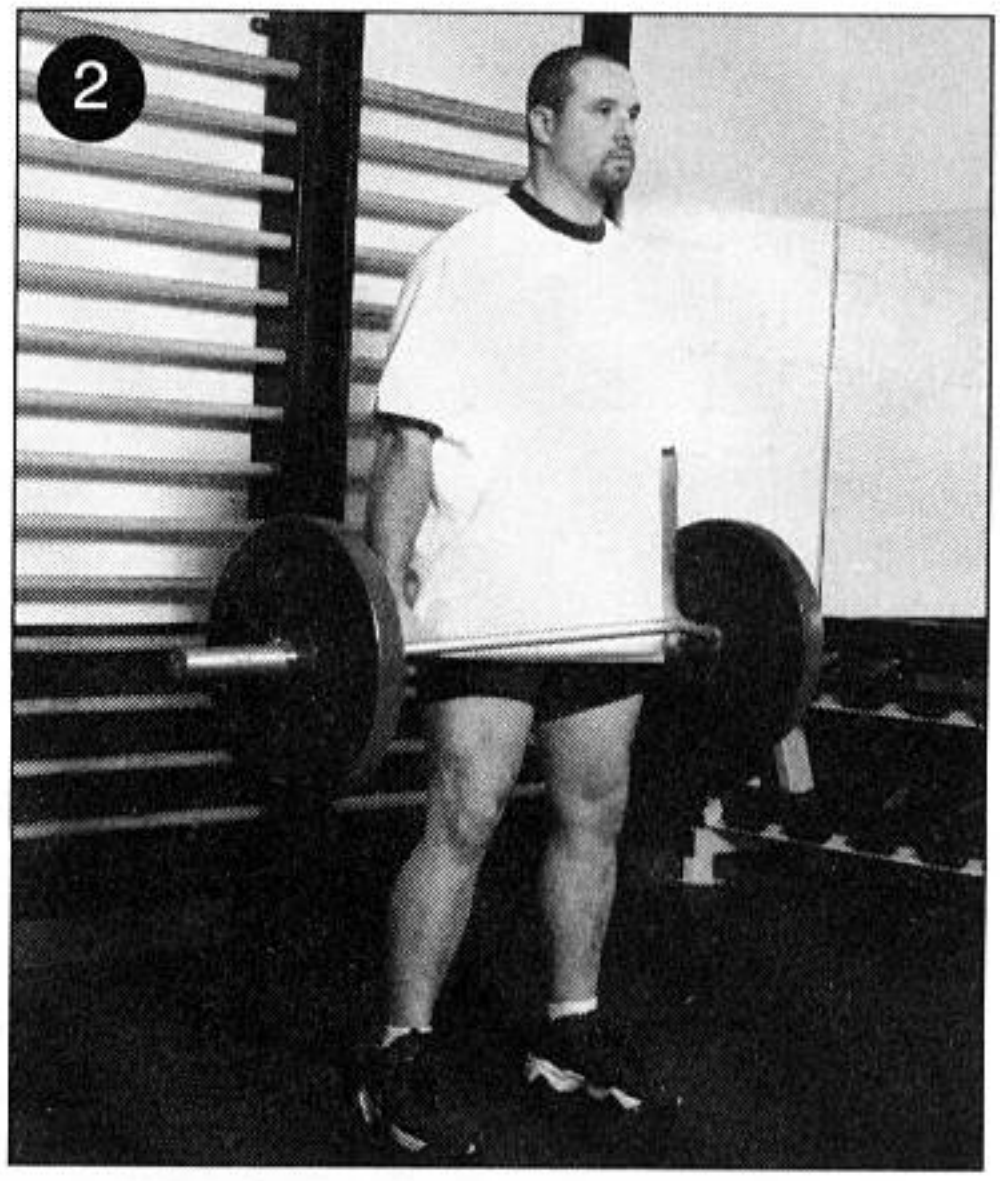


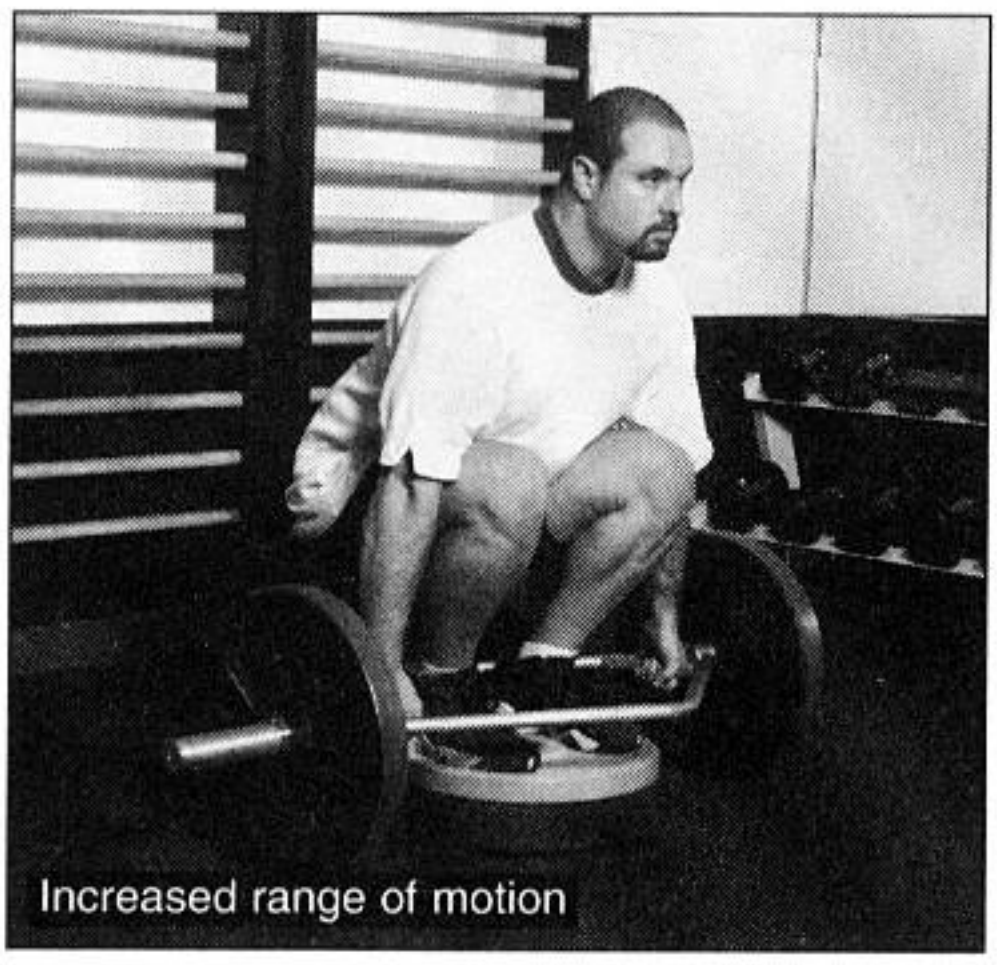


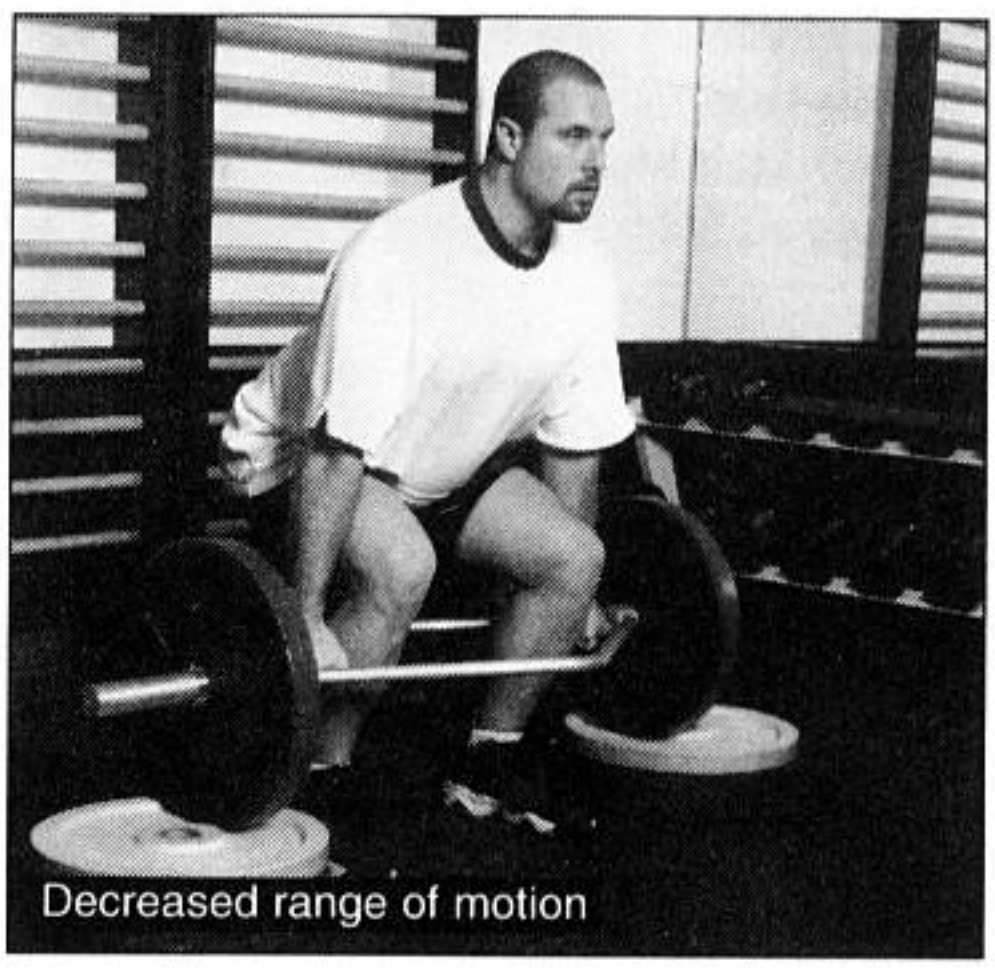
Deadlift. Note: although I've listed this as a quadriceps exercise, the deadlift also strongly involves almost every muscle in the body. This exercise is normally safe when performed correctly. Place your feet so that they point straight ahead, or slightly angled out. Maintain neutral

spinal curvatures, keep your weight on the middle of your feet, and make sure that the bar stays in close contact with the front of your shins throughout. Use a deliberate tempo with minimal momentum. When viewed from the side, your hips and shoulders should ascend together; if the hips rise before the shoulders, it means you're using your back rather than your legs. Think of a deadlift as a squat, only the bar is in your hands rather than on your back.

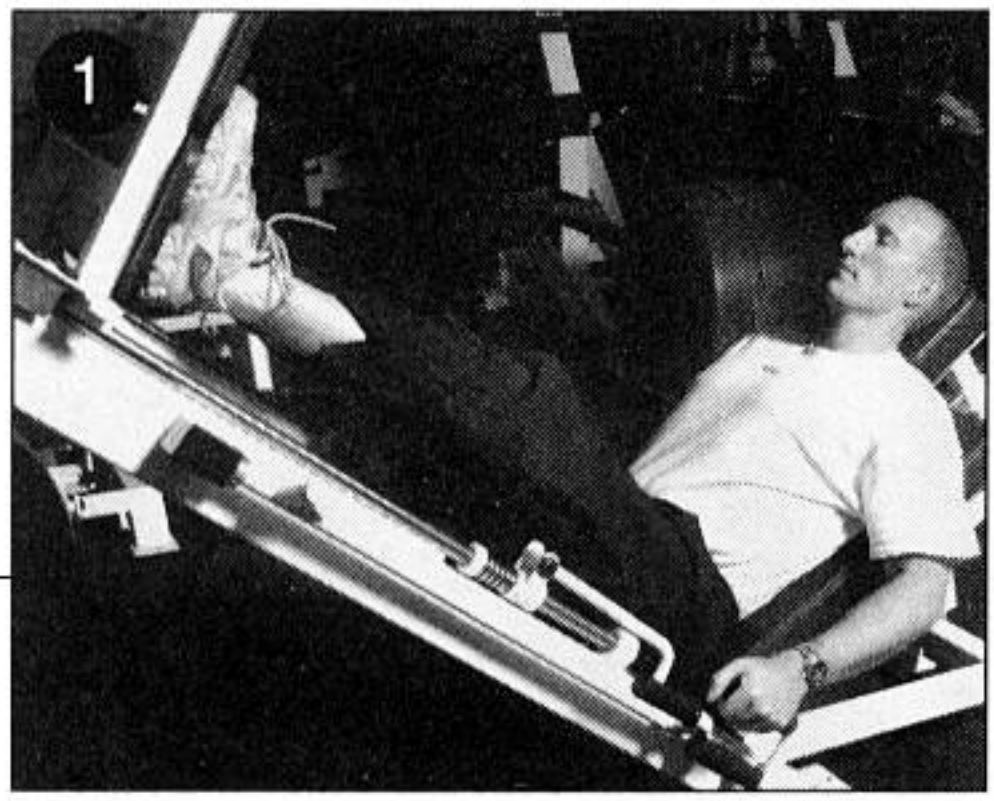


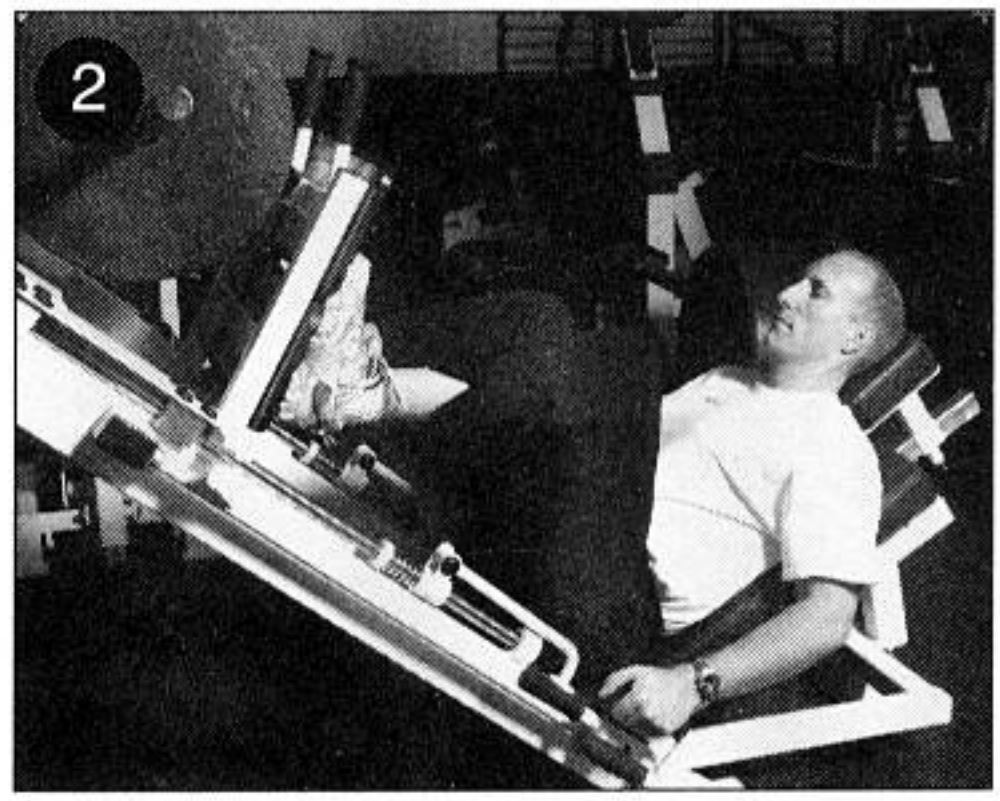



Increased range of motion


Decreased range of motion

Trap-bar deadlift. This specially-designed bar is safer and more effective than a straight bar because it allows the combined center of gravity of the weight and your body to stay closer to the mid-line of your body. This reduces the amount of forward lean, and allows the quadriceps to take over a greater share of the work from the glutes, spinal erectors, and hamstrings. The trap bar may also be used for stiff-leg deadlifts and shrugs.You may either increase or reduce the range of motion by either standing on a 45 pound plate (to increase) or by placing 45 pound plates under the plates attached to the bar (to decrease).

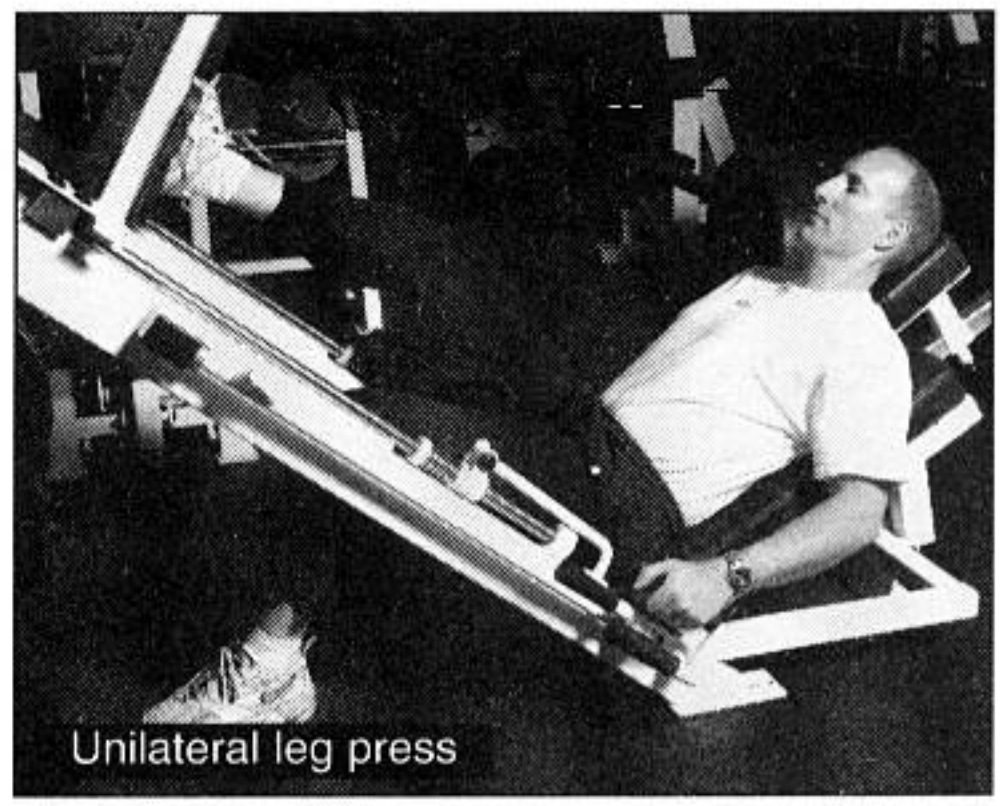


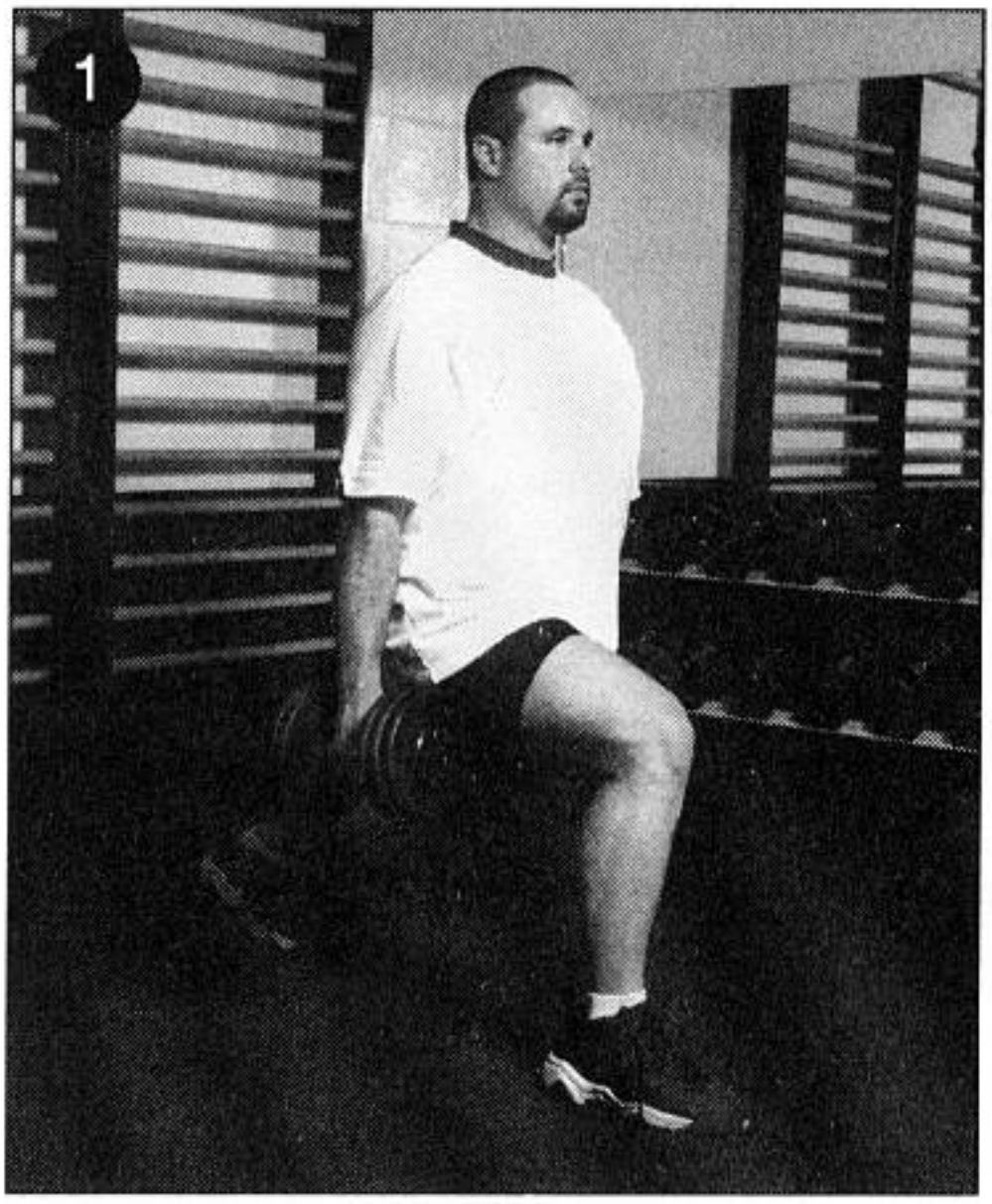


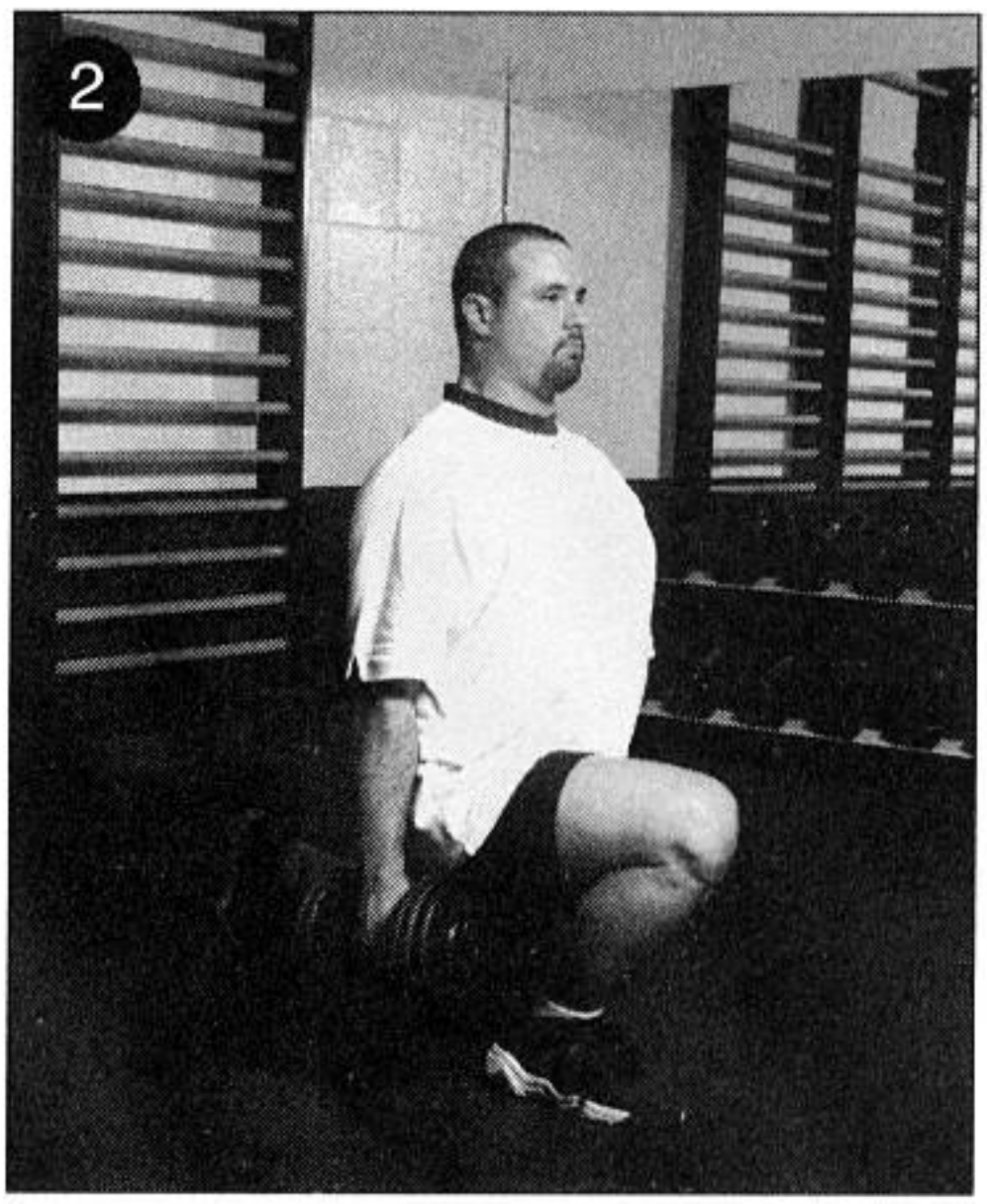
Leg press. The leg press can be a valuable tool, when used properly. The problem is that this machine often becomes a demonstration station for those looking to say that they lifted 1200 pounds! Loading the press with as many 45s as you can find, and then performing choppy, 1/4 range of motion reps may not be the most productive method for athletes, at least not most of the time.

Leg presses require many of the same technique parameters as squats: a parallel or slightly turned-out foot position, keep your knees tracking over your feet, and maintain normal spinal curvatures. At the "bottom" position, do not allow the weight to descend so far that your hips "tuck under." Lifting the heels off of the platform intensifies the load to the quadriceps and minimizes stress to the hamstrings. Pressing with the heels maximizes contribution from the hamstrings.

Leg presses may also be performed unilaterally (see photo), but make sure that your non-working knee is kept out of harm's way in case you fail to complete a repetition.

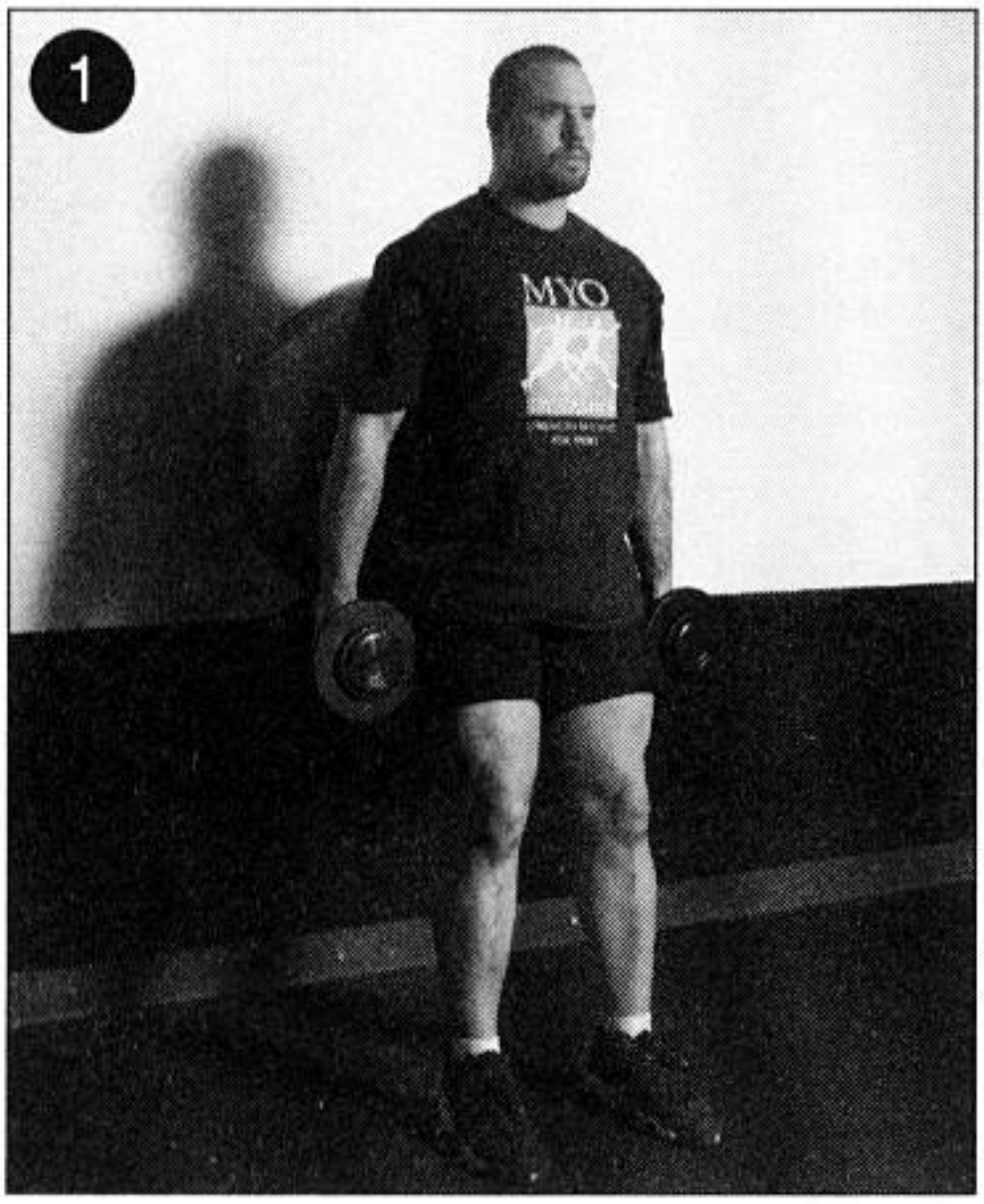

Unilateral leg press

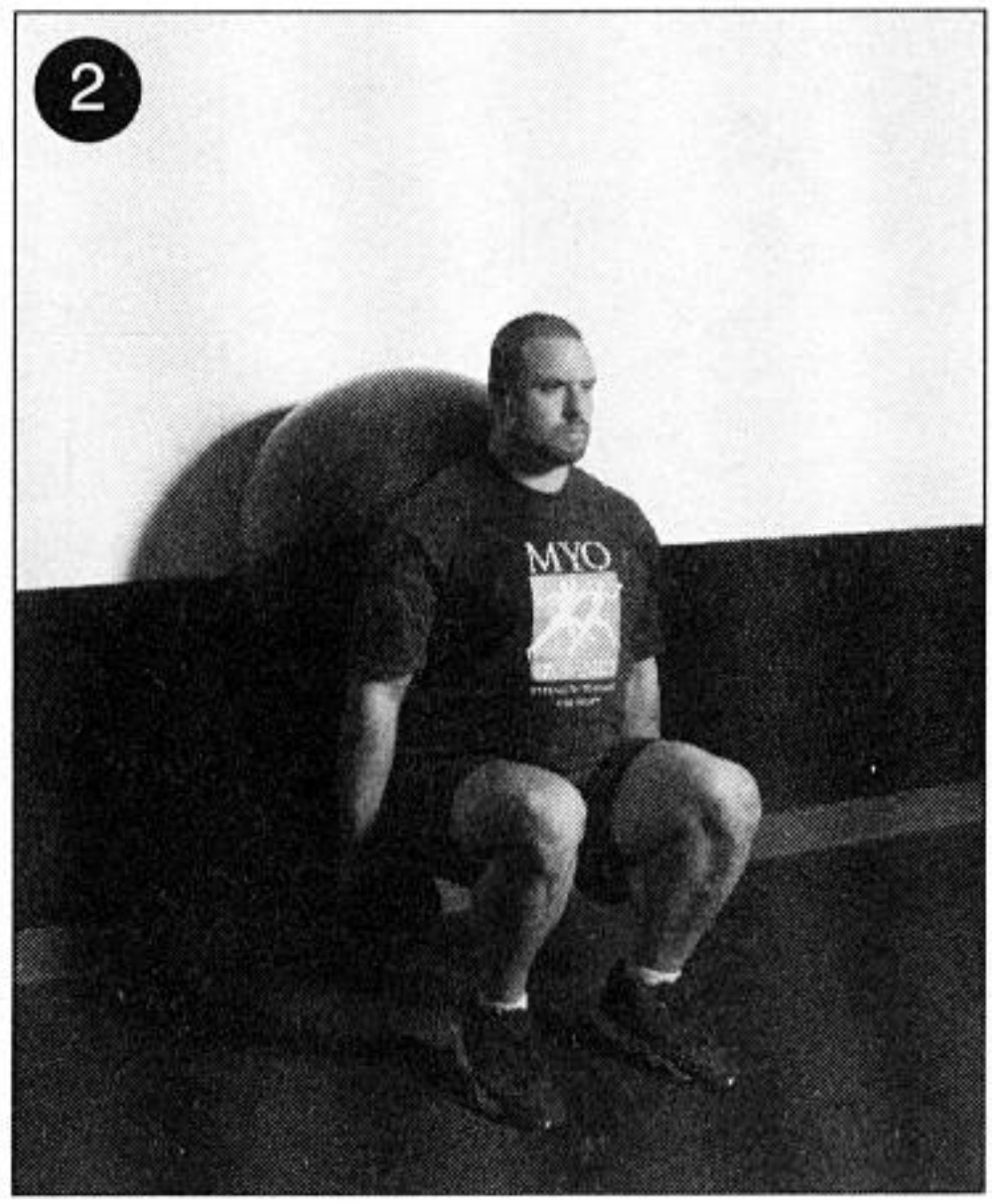




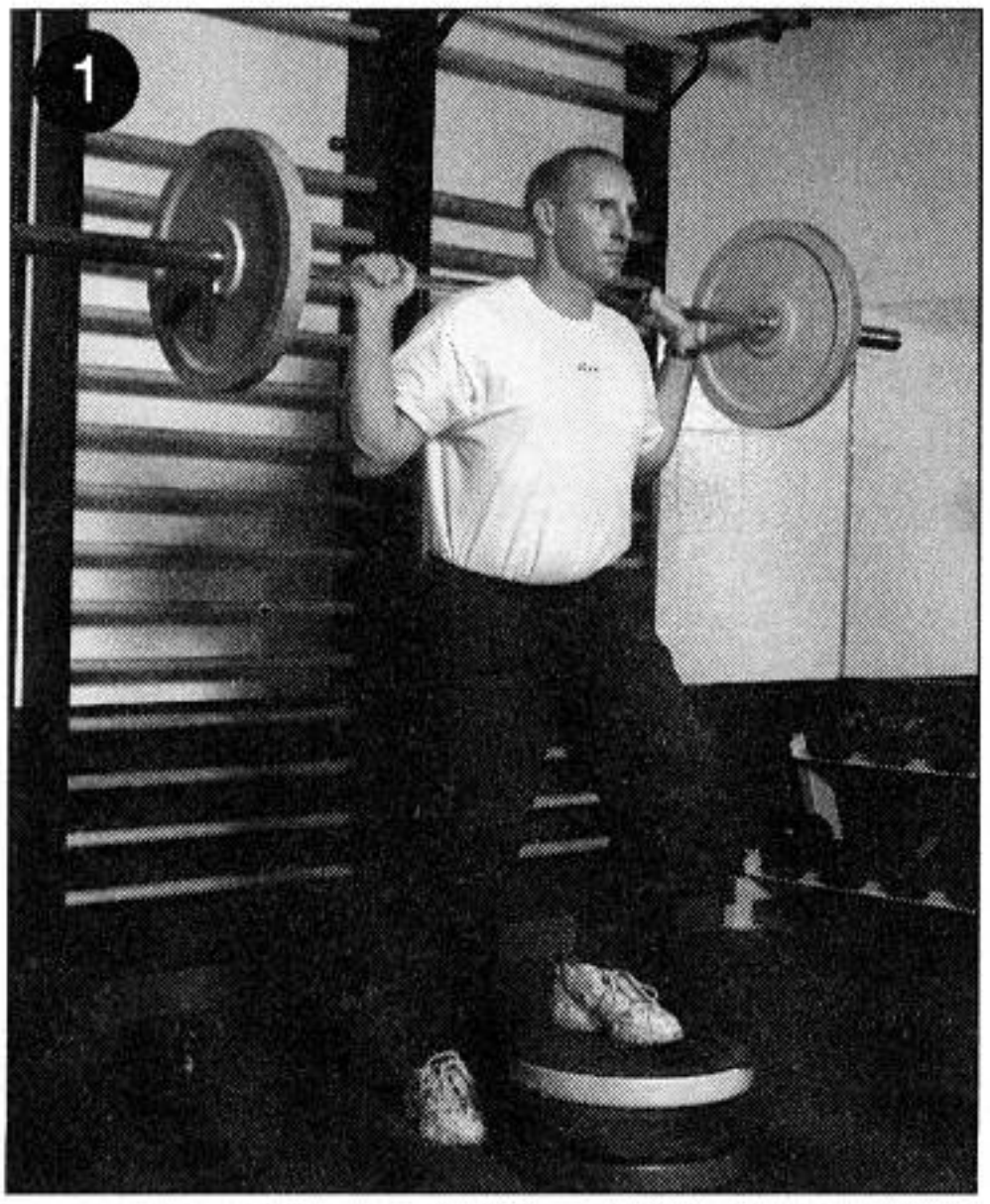
Lunge. With hands on hips, step forward with your weaker leg. You will not alternate legs each rep, but instead, complete all reps on the first leg, rest 30–60 seconds, and then switch legs. Keep chest up, and eyes forward. Rear heel will come up off of the floor as you sink down. On your first lunge session, keep the lead shin perpendicular to the floor. If you do not experience any knee pain and/or inflammation, you may allow the lead knee to more more forward as you sink down—this will increase the stress to the front quadriceps. Use dumbbells when additional weightloads are needed—not a barbell. If you ever lose your balance, you'll thank me for this advice! Often, tight hip flexors cause the athlete to lean forward from the waist during lunges—monitor yourself for this, and implement the appropriate stretches if you seem to be tight in the hip flexors.

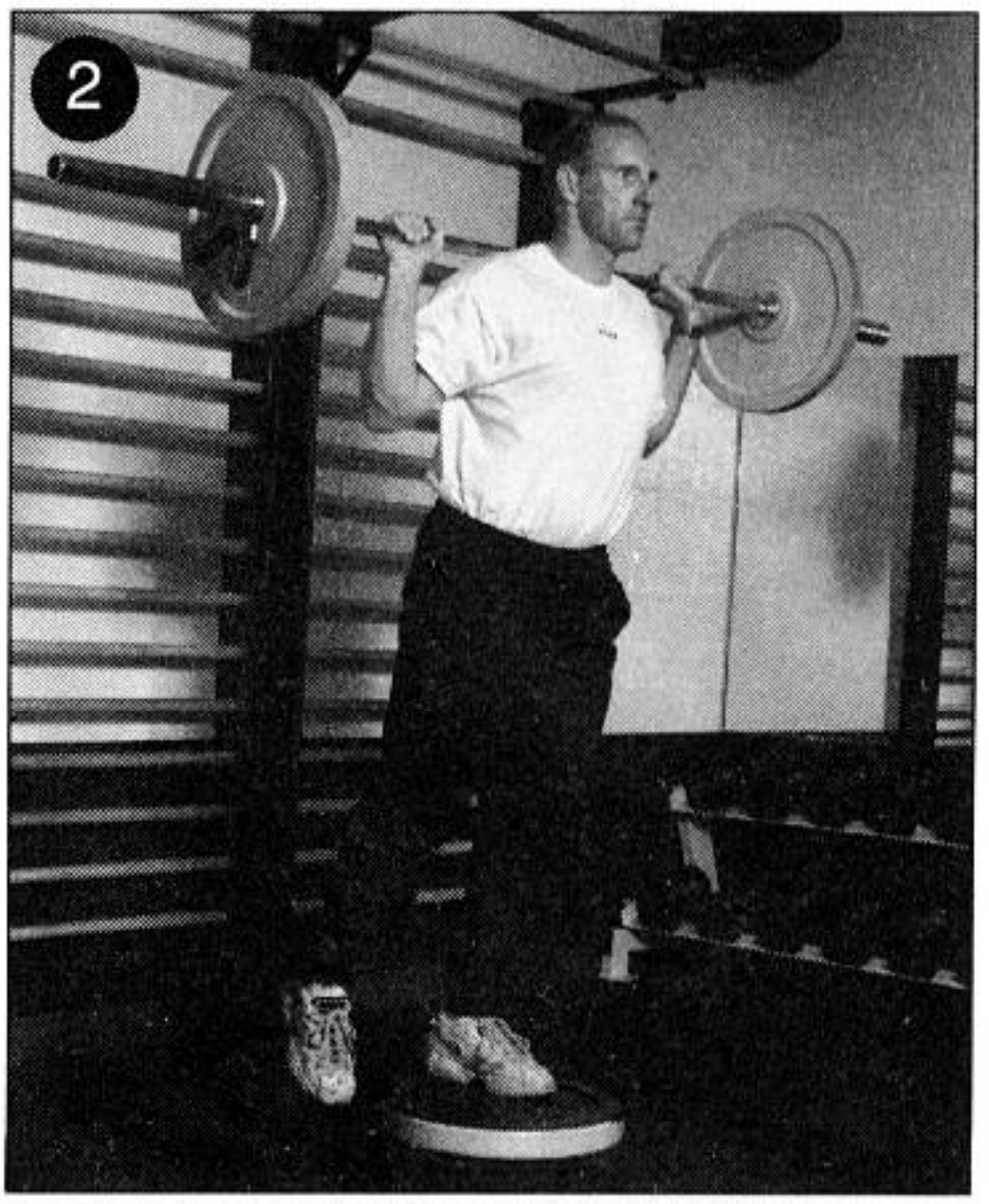
Variations: Lunges may be performed with either the front or rear foot on a block to increase hip and knee range of motion, respectively.





Swiss ball squat. Have a partner place a Swiss ball at approximately waist height against an empty wall. Place your back against the ball and set your feet about shoulder distance apart, with toes pointing outward at about a 10° angle. Maintaining a vertical torso (this is essential to minimize compressive stress to your lumbar discs), inhale, hold your breath, and descend into a squat, keeping your knees in line with your feet (i.e., do not allow the knees to drift medially, or inside the feet). Exhale once you pass the sticking point of the ascent. Use dumbbells for additional overload.





Step-ups. Perform on a low (6–8") step. To keep the stress on the quads, do not allow the non-working leg to rest on the floor at all. make sure that your working knee stays directly over the middle of the working foot (commonly, as the exerciser fatigues, the knee will begin to wobble from side to side).Complete all reps for first leg, then rest and complete reps for other leg. Refined exercise technique is critical to the success of this movement. Go as slowly as possible, and keep the tension on the quadricep at all times.

Tips for maximizing strength training for quadriceps

As noted earlier, exerting pressure from the forefoot (as opposed to the heels) increases quadriceps involvement. In squats, deadlifts, step-ups, and leg presses, exercises performed near the extended position maximize stress to the vastus medialis (inner aspect), while movements executed near full knee flexion require more contribution from the vastus lateralis (outer aspect).

Trapezius & Neck

Description: The "traps" are a large, kite-shaped muscle which covers the majority of the upper back. The uppermost fibers cause elevation of the shoulder blades, as during shrugging. The middle fibers cause retraction of the shoulder blades, and the lower fibers cause depression of the shoulder blades.

The middle trapezius fibers, along with the rhomboids and rear deltoids, are antagonistic to the serratus anterior. Interestingly, the upper fibers may be antagonistic to the lower fibers!

In their role as scapular retractors, the traps function as part of a kinetic chain, which also includes the rhomboids and rear deltoids. Interestingly, it is very hard to "isolate" the rear deltoids during scapular retraction, since the bigger and stronger traps and rhomboids are so actively involved.

Martial Arts Applications: The traps and neck muscles, when strong and well-developed,

can hamper an opponent's attempt to apply choking maneuvers. In striking disciplines, these muscles can help the athlete to absorb blows to the head.

Unique Characteristics: In weight-trained athletes, there is a tendency to over-develop the scapular-elevation function (upper fibers) of the traps, relative to the scapular retraction (middle and lower fibers) aspect. When asked to perform scapular retraction, athletes with this imbalance will unconsciously compensate by retracting and elevating their shoulders.

Length assessment: Although there is no length assessment test for trapezious length, you should be capable of fully elevating and depressing your scapula, and also be able to rotate your head to 90 degrees to each side.

Stretching methods for the trapezius & neck

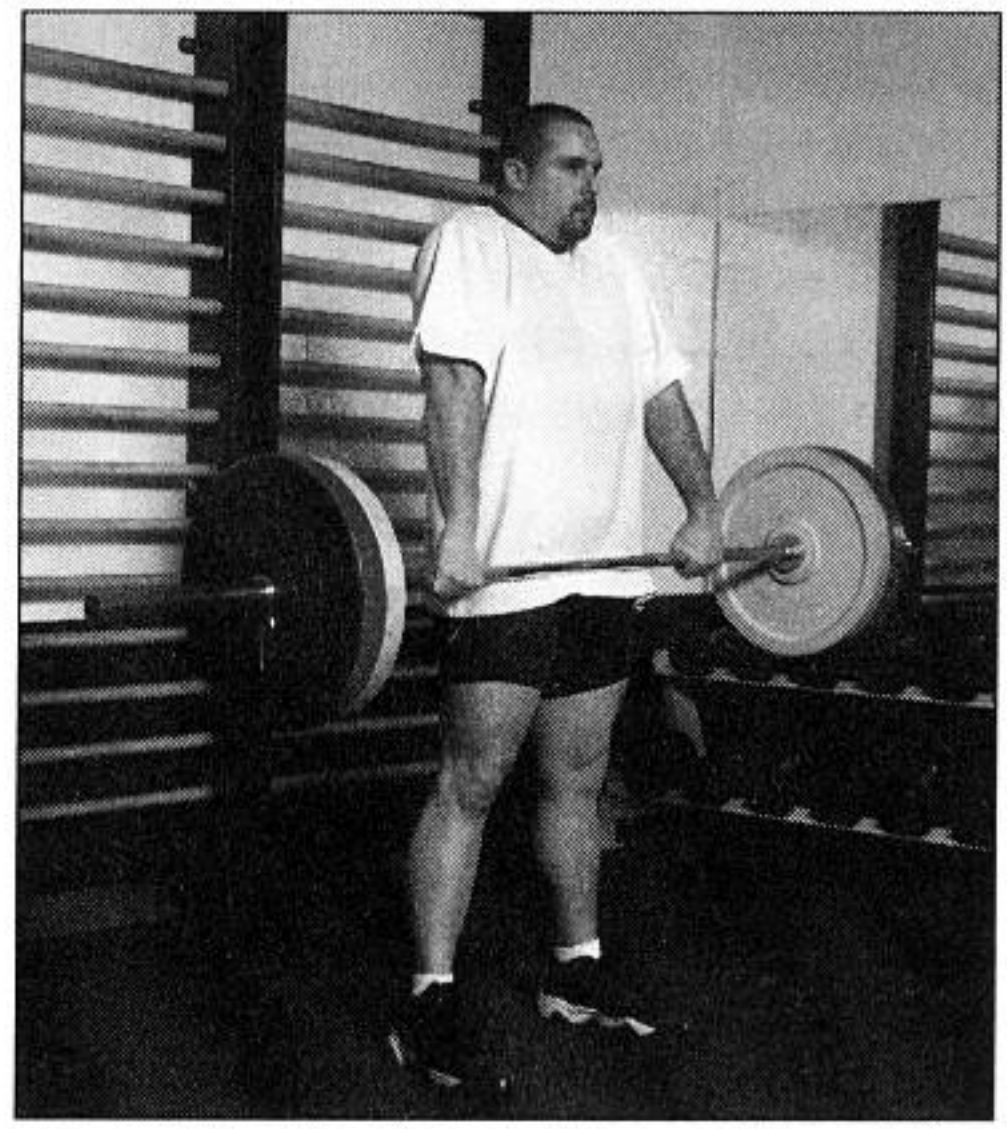
Side flexion with distraction (directions are for right side). Standing with a dumbbell in your right hand, allow your right trap to stretch as you slowly and carefully side flex your head to the left. Breath normally.

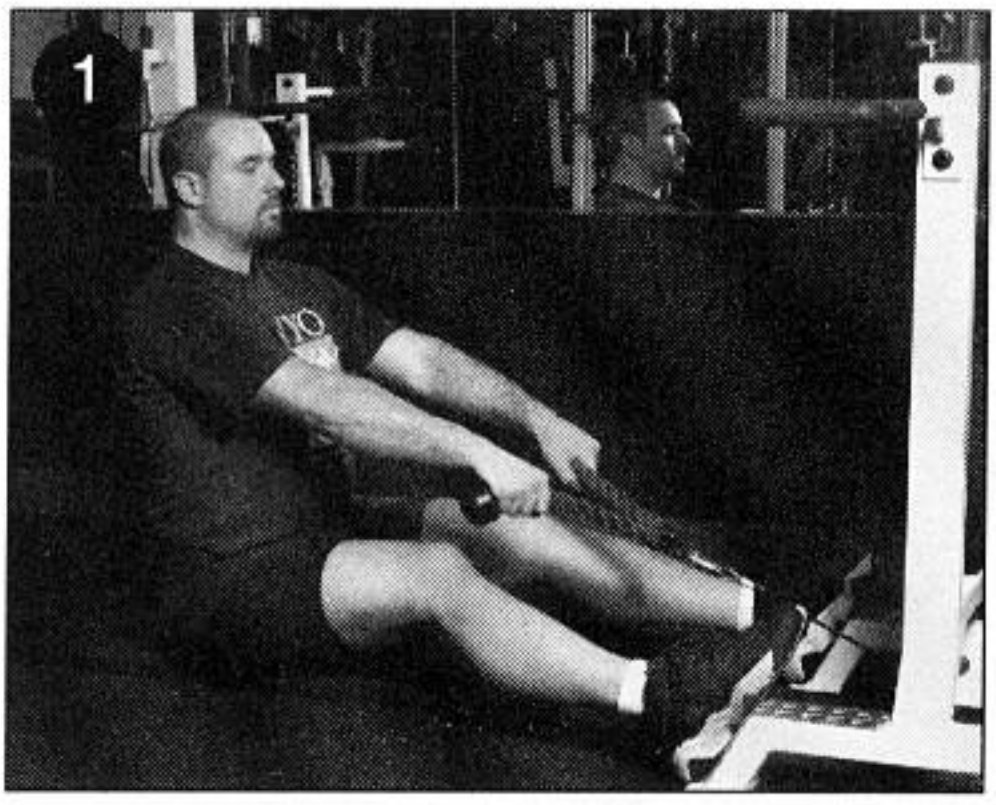
Strength training exercises

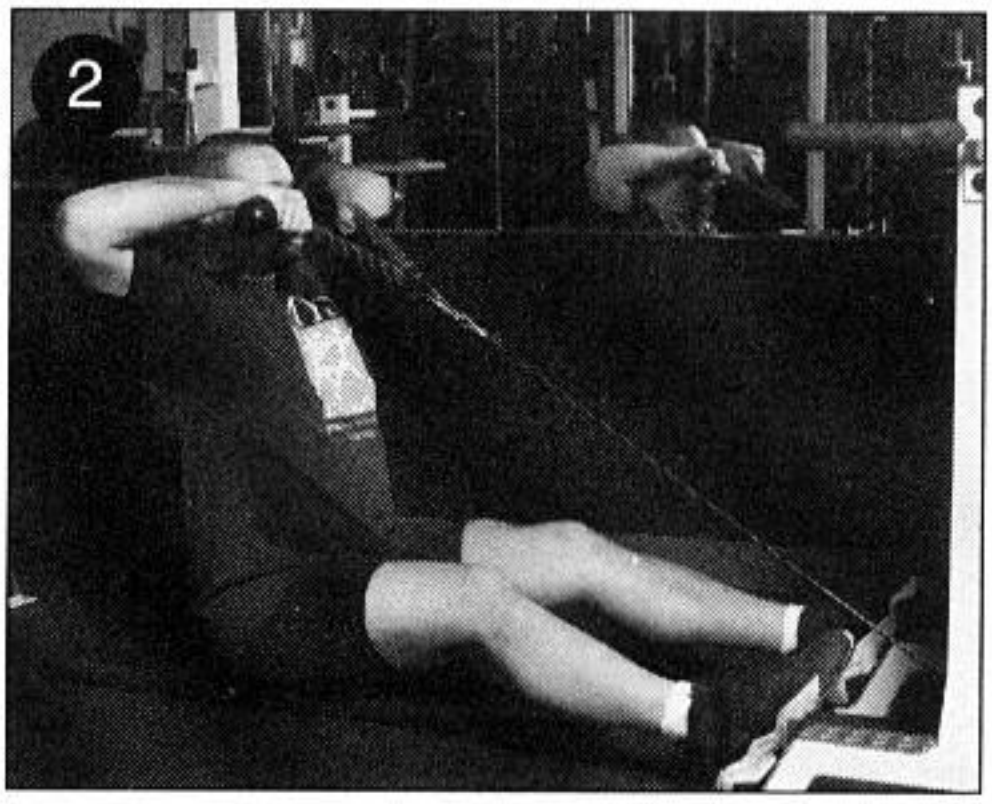
Note: all clean and snatch variations shown in the speed strength section heavily involve the trapezious.

Shrug. This exercise can be performed using either a barbell or a pair of dumbbells for resistance. Additionally, when using a bar, it can be positioned in front of, or behind your body. The dumbbell variant may be performed seated or standing.

Position the barbell on a rack at approximately knee level. Face the bar, grasp and unrack it, stepping backward just enough to clear the rack. From this point, simply "shrug" the barbell, straight up, and back down, for the desired number of reps.

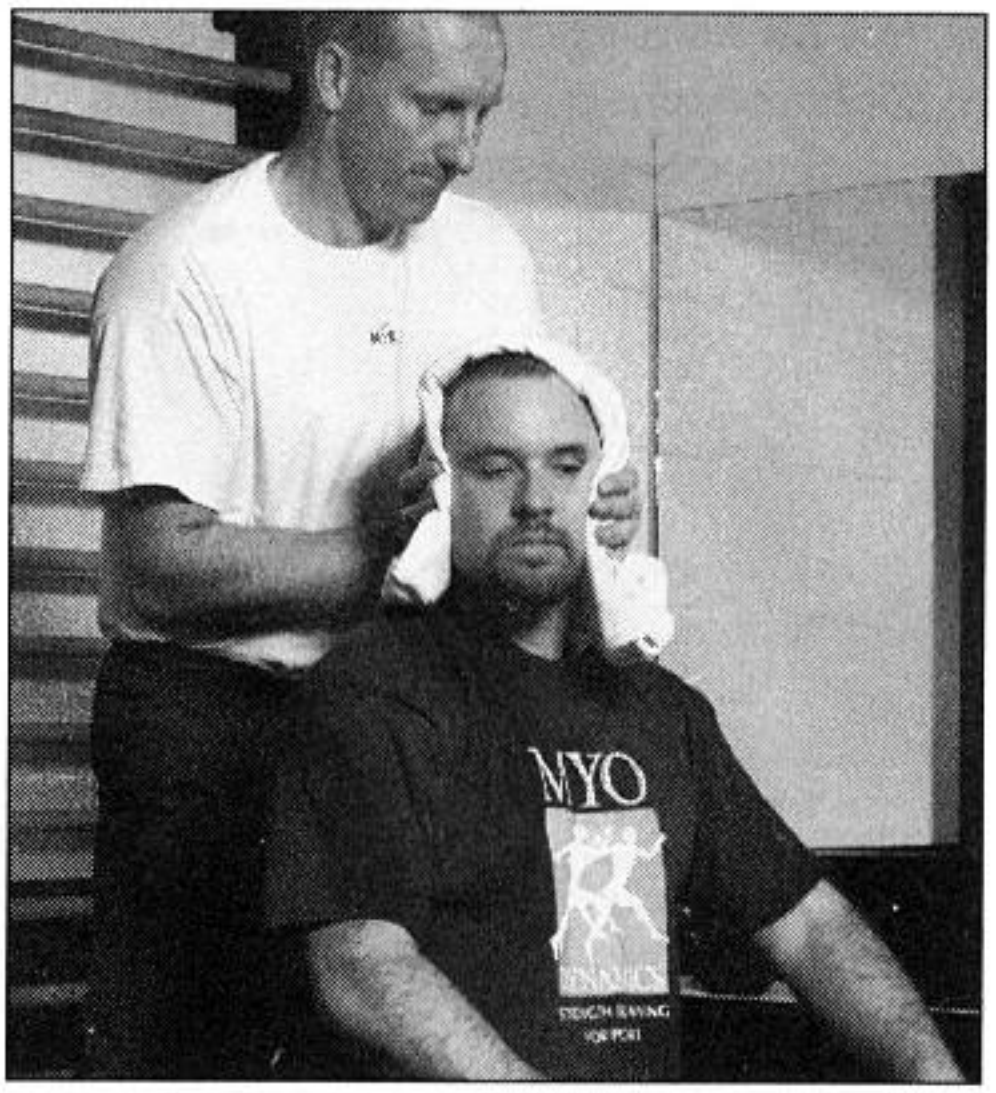






Low pulley row to neck. This is a seated row done with a rope handle. Pull your hands to your neck, keeping elbows high. At the end of the concentric phase, your elbows will be high, as in an upright row.

Manual Neck strengthening exercises. The athlete assumes a seated position. With both hands, hold the athlete's head firmly, as he attempts to flex forward, backward, or to either side as you resist his movement. Avoid rotational or twisting movements.



Tips for maximizing strength training for trapezius & neck

Do not "circle" your shoulders during this exercise. Positioning the head forward, which is considered poor posture on almost all exercises, increases the range of motion on shrugs. Strength training for the neck muscles must be applied with caution. Start with light resistances, progress very gradually, and always use slow, controlled speeds.

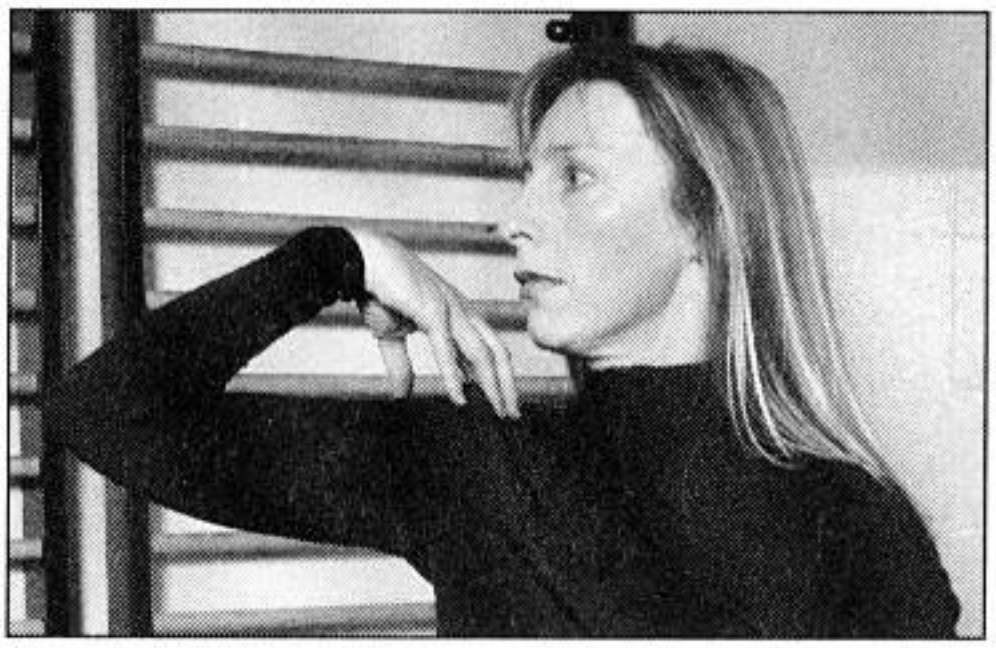
Triceps

Description: The triceps, as its name implies, is a three-headed muscle which functions to extend the elbow and flex the shoulder joint. The triceps are antagonistic to the elbow flexors.

Martial Arts Applications: The triceps are heavily involved in punching and striking skills, as well as upward elbow strikes.

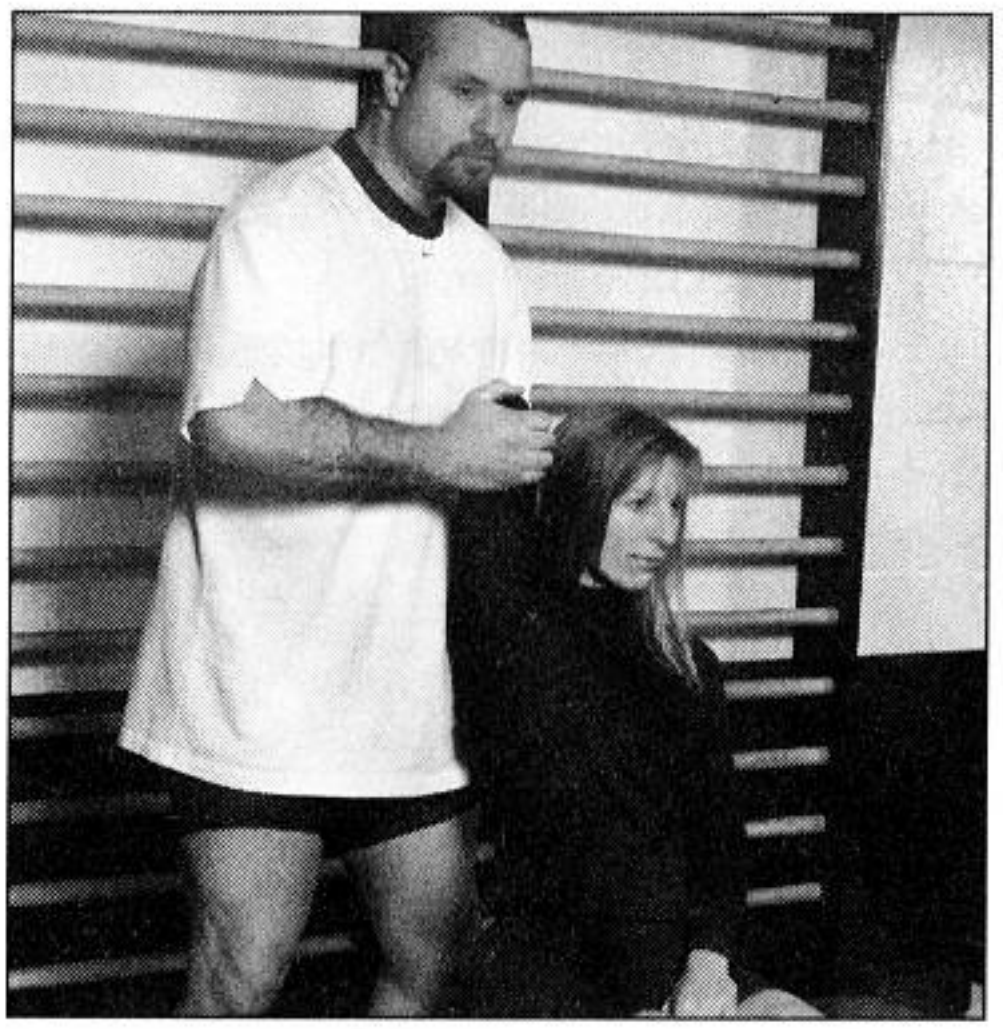
Unique Characteristics: The triceps are the only muscle which extends the elbow. It accounts for a majority of the muscle mass of the upper arm. The long head, which attaches to the scapula, can be preferentially recruited with strength training exercises which feature shoulder flexion, such as the lying triceps extension (explained below). The medial and lateral heads are not affected by shoulder position.

Length assessment: The athlete should be capable of touching the front of his same-side shoulder with his fingertips, as shown. In some cases, highly-developed biceps and/or forearm musculature may prevent the athlete from achieving this ROM.



Stretching Methods for the Triceps

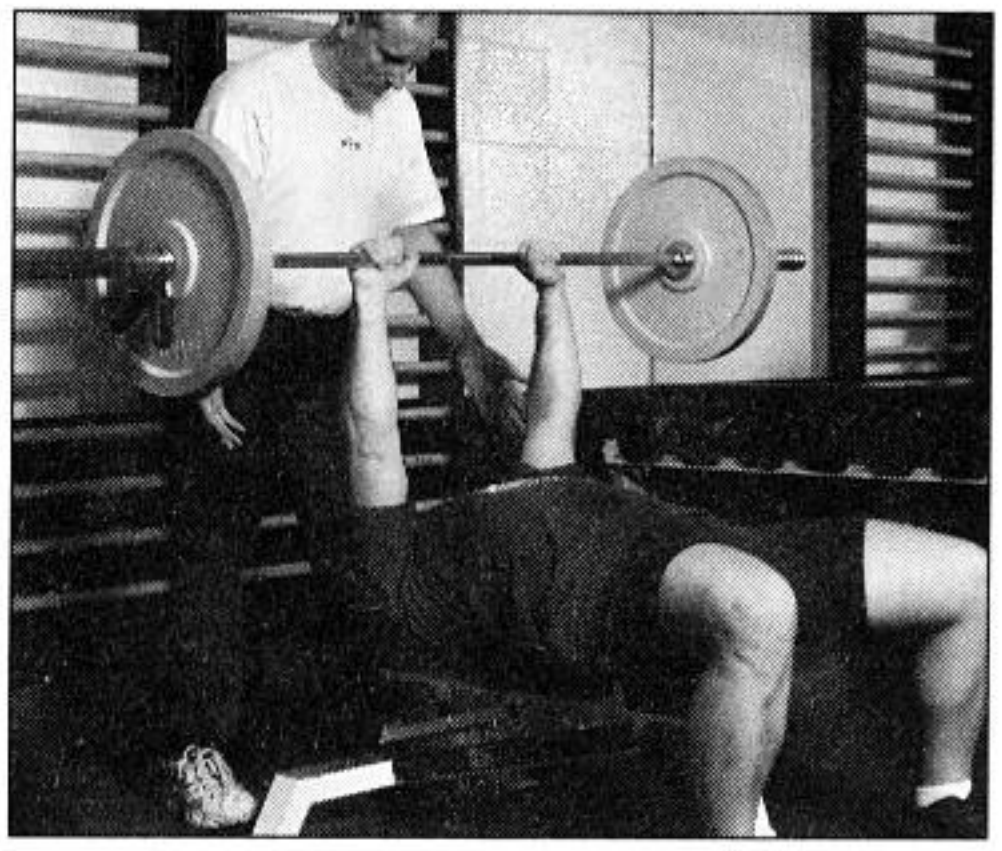
(Directions are for right arm) With the athlete in a seated position, stand to his right side and position him so that his right shoulder and elbow are fully flexed. His right elbow will point to the ceiling, with his right palm against his back. With your left hand grasping his right wrist, and your right hand against his lower triceps, instruct the athlete to apply pressure against your right hand by attempting to extend the elbow and shoulder simultaneously, using approximately 35–50% of maximal effort. Give your partner an audible count of 6–8 seconds, at which point you will both release the pressure. Next, prompt the athlete to attempt to increase his range of motion, deepening the stretch. From this new, deeper ROM, perform the count again. Repeat for 3–5 repetitions, or until subsequent repetitions do not increase the range of motion.

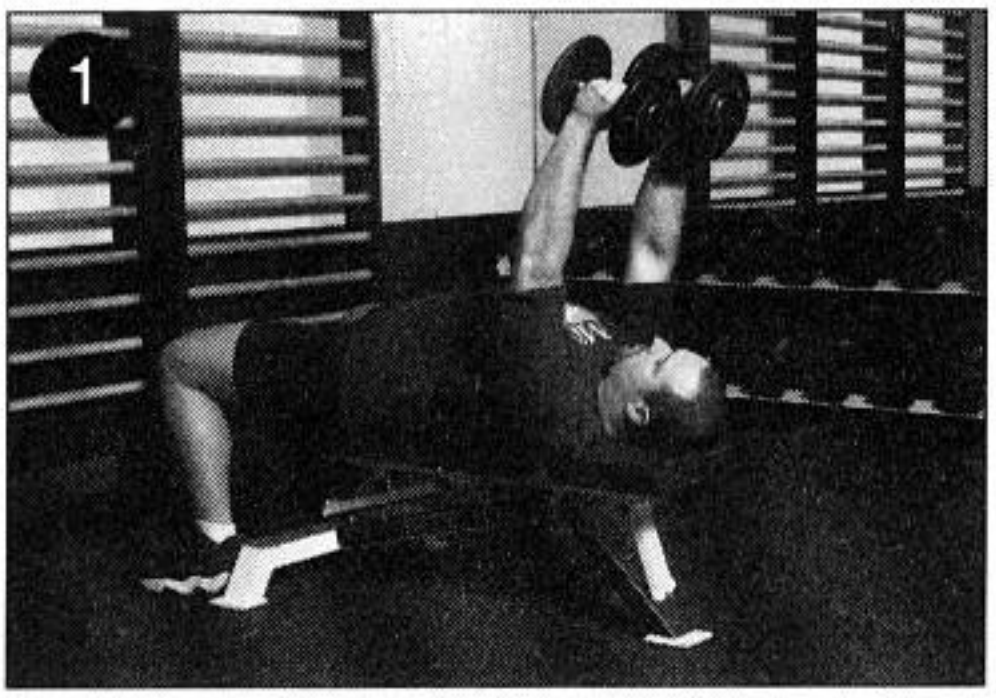


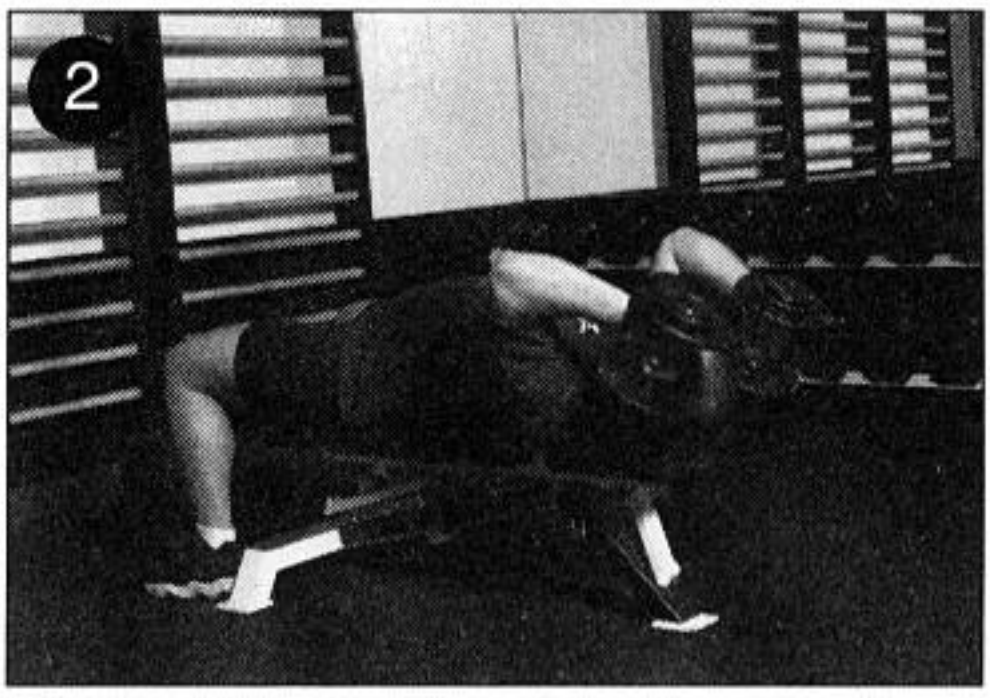
Strength Training Exercises for the Triceps

Close-grip bench press. Bench presses performed with a close (10–16" between the thumbs) grip preferentially recruit the triceps, since the elbows achieve greater flexion at the bottom of the movement. Be careful that your grip is not so narrow that you compromise control of the bar, especially at the end of the set when you're fatigued. Also make sure to avoid a "thumbless" grip, described in the bench press section of this chapter.

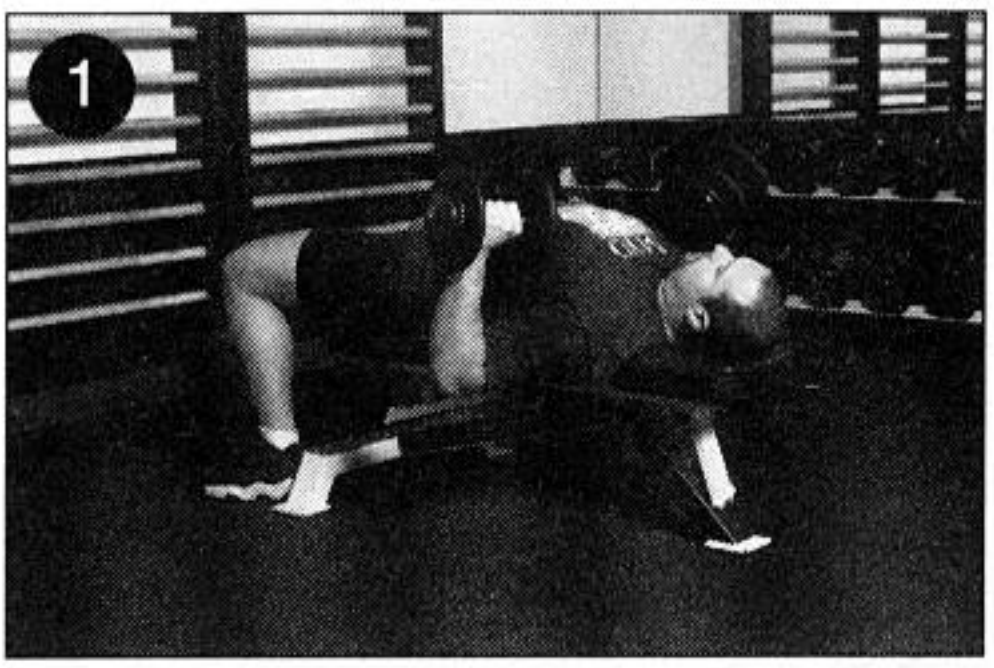
ALWAYS employ a competent spotter when performing any bench press variation.

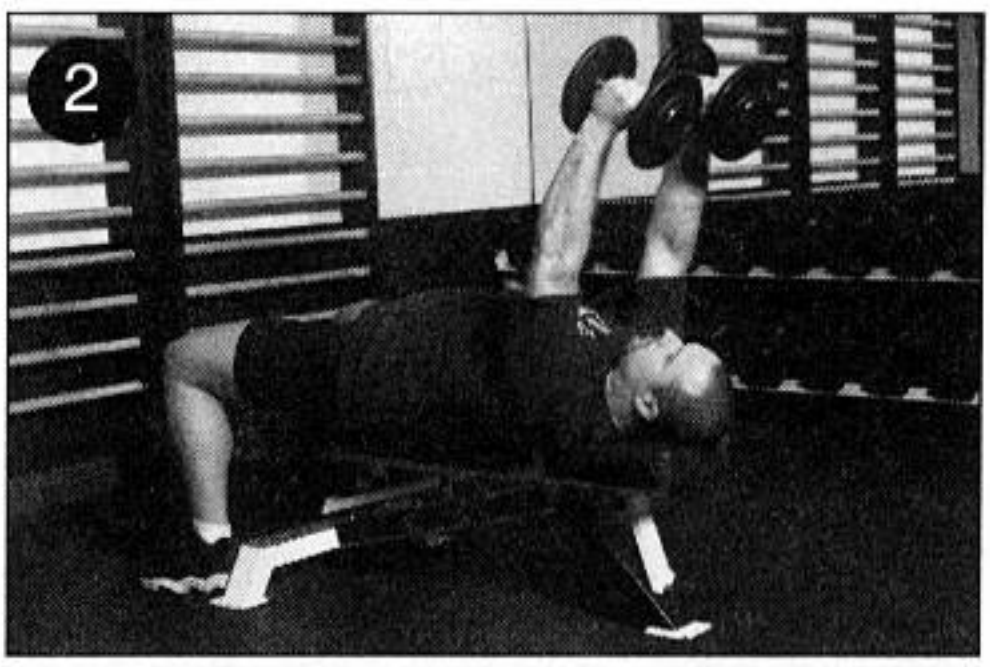


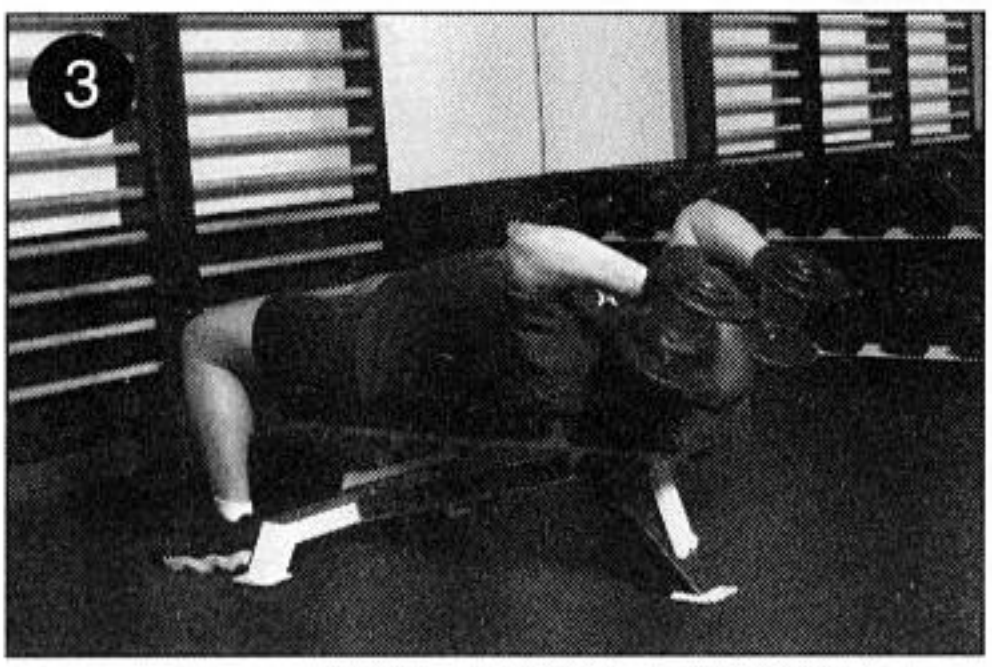


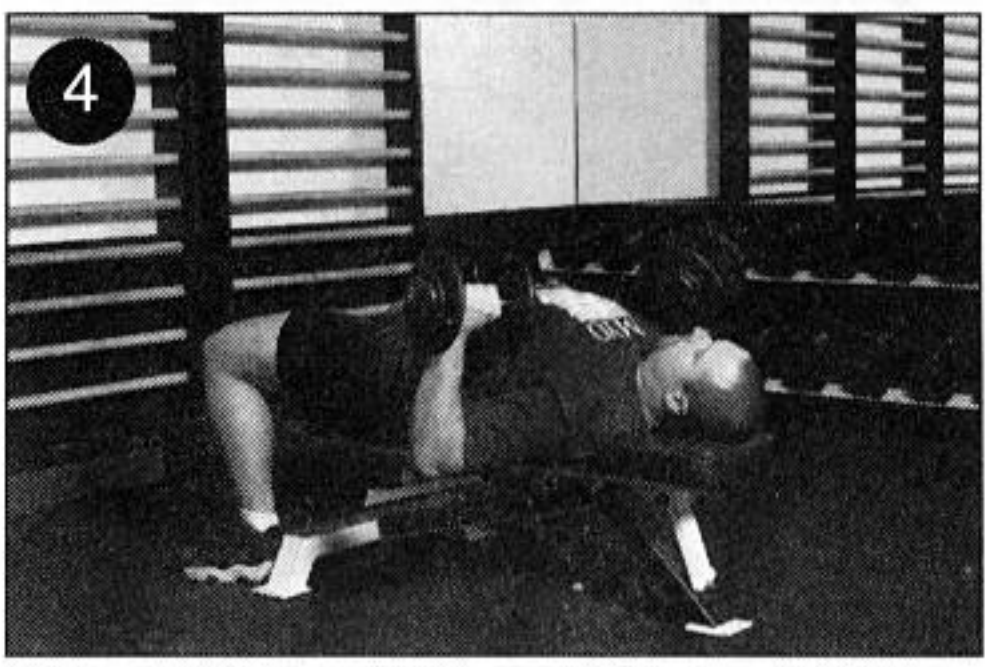


Lying dumbbell triceps extensions. Position yourself face up on a bench or Swiss ball. Using dumbbells (shown) or a straight bar, extend your arms until they are perpendicular to your torso. From this position, relax your triceps to allow your elbows to flex until the dumbbells touch your shoulders (when using a bar, full flexion is realized when your biceps make contact with your forearms). Reverse this action to return to the starting position, keeping your elbows stabilized (motionless) throughout the exercise.

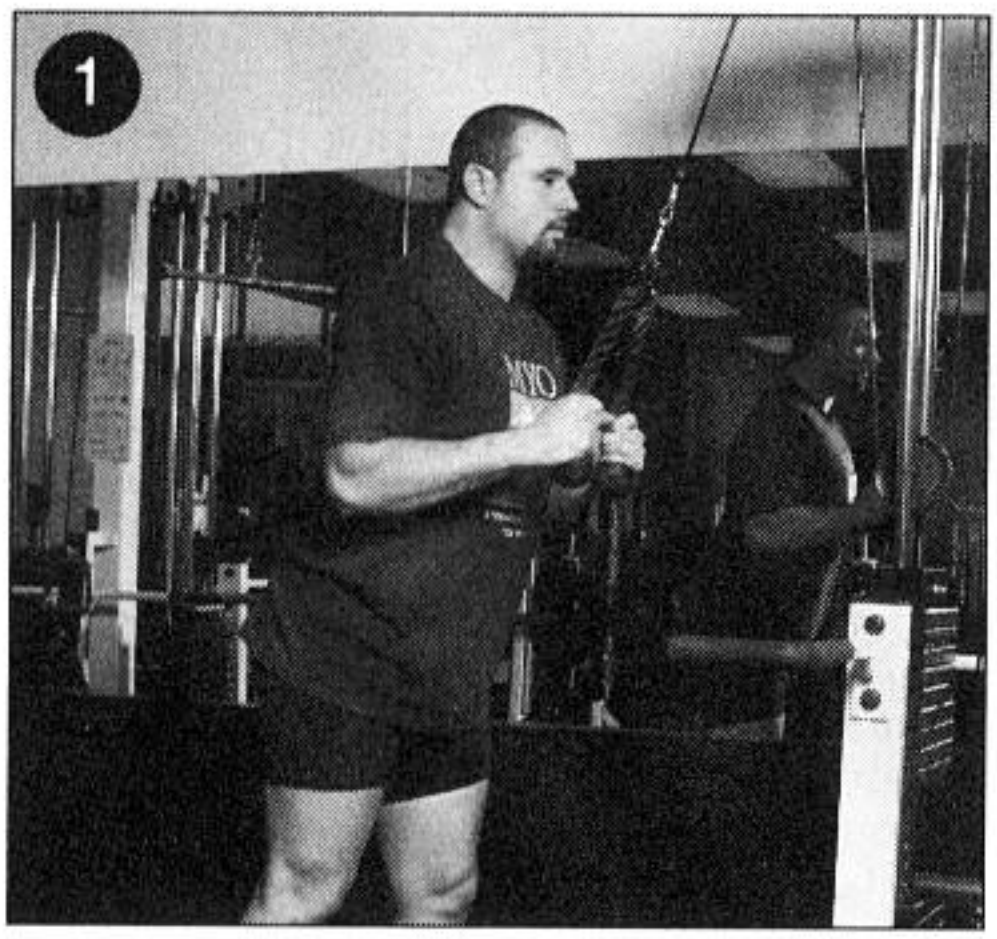


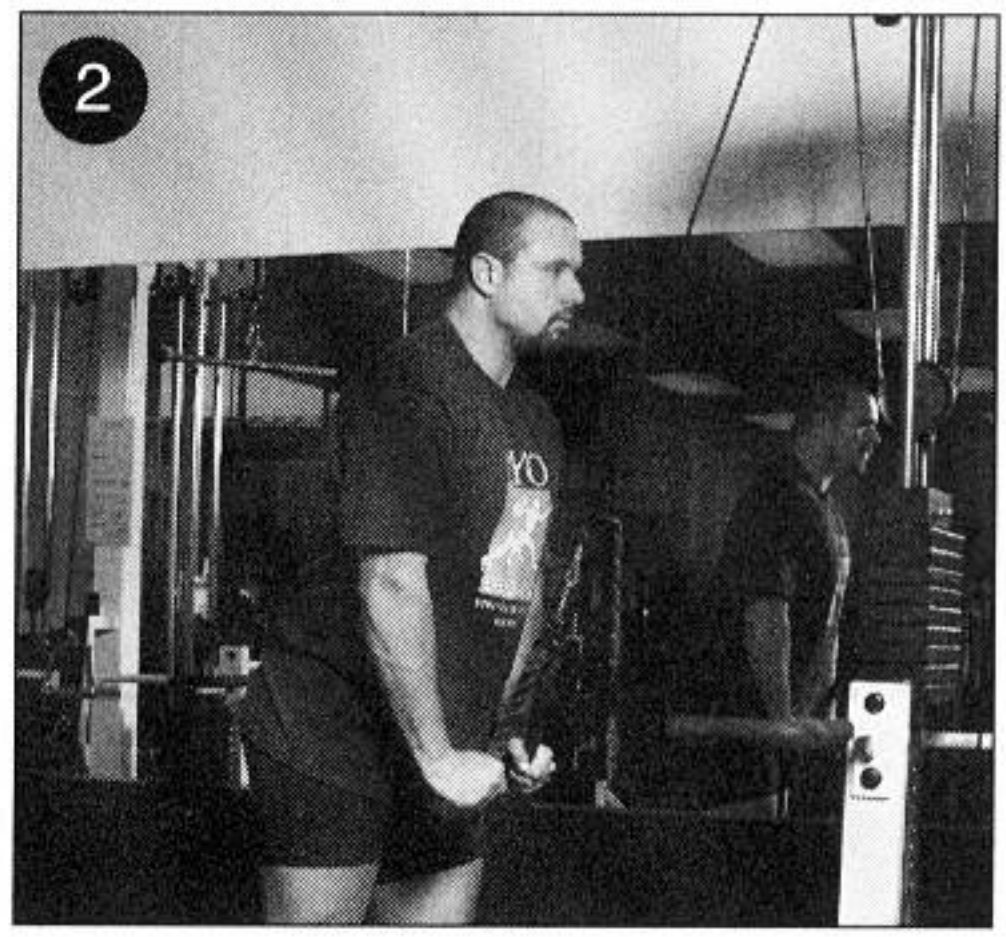




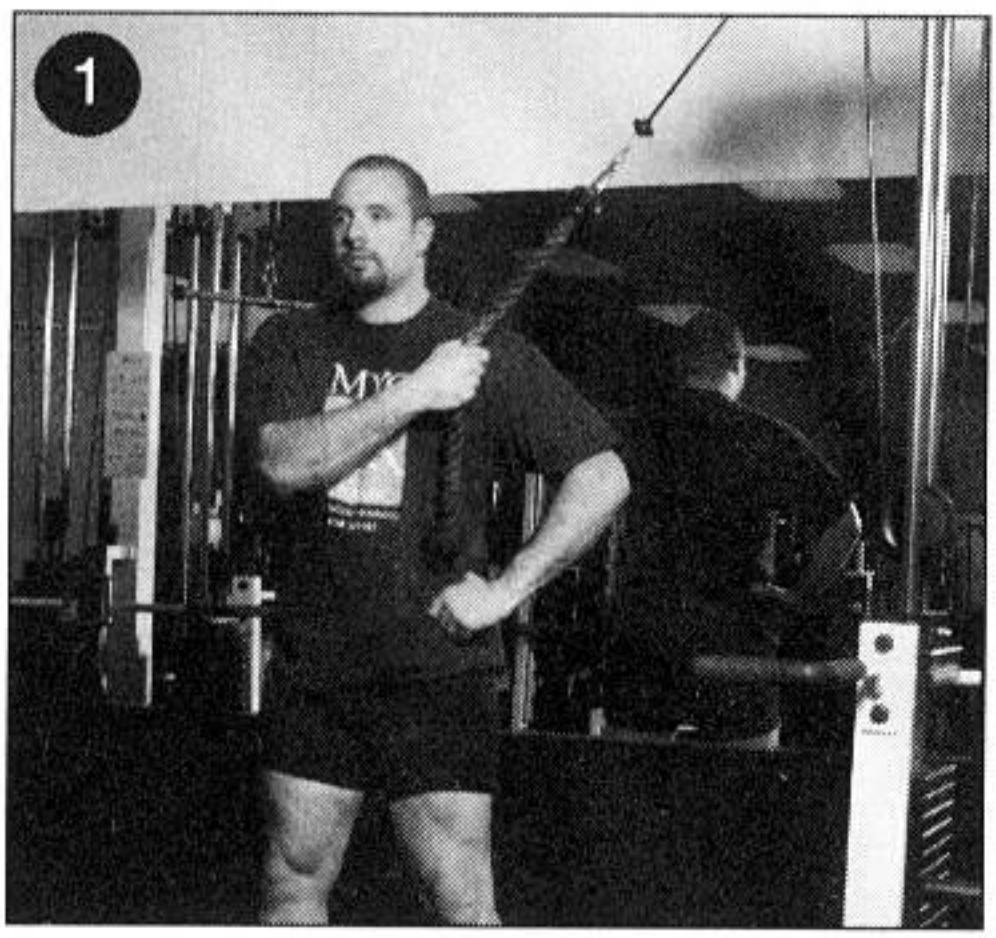


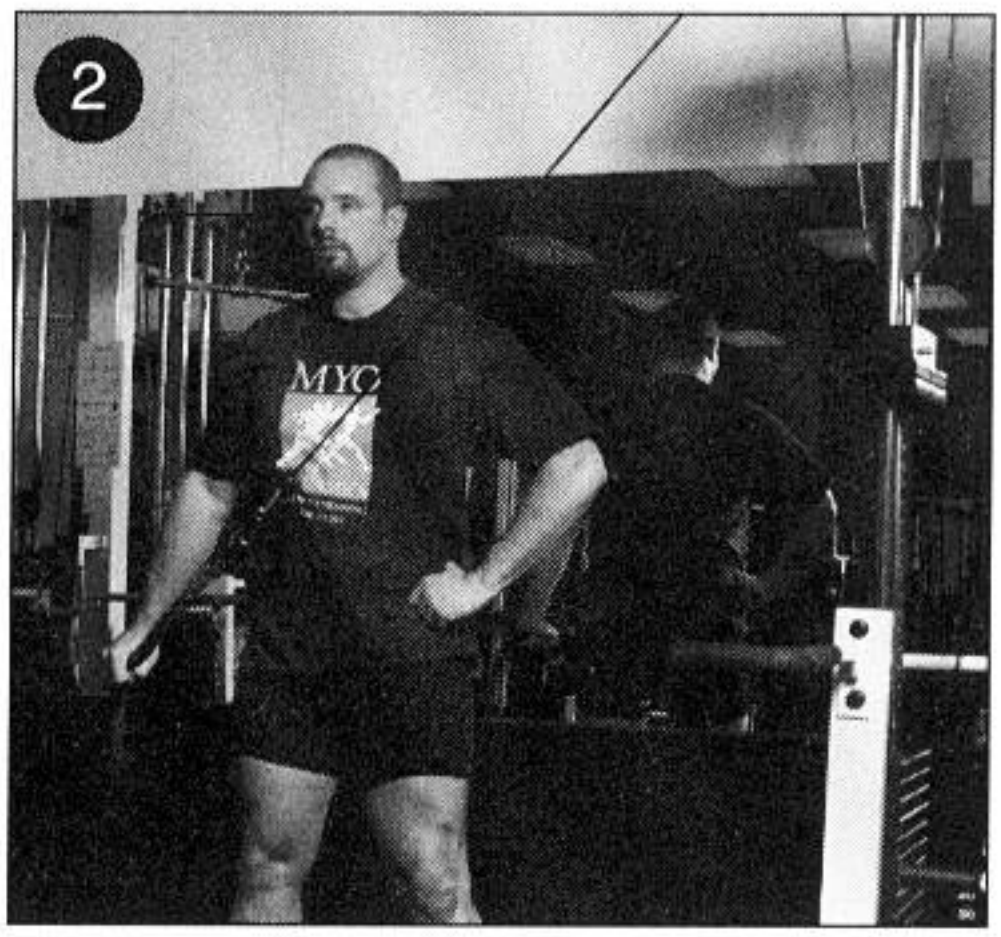
California press. This is a hybrid between a close grip bench press (concentrically) and a lying triceps extension (eccentrically). Position yourself face up on a bench or swiss ball. Using dumbbells (shown) or a straight bar, "bench press" the weight until your arms are perpendicular to your torso. From this position, stabilize your elbows while relaxing your triceps to allow your elbows to flex until the dumbbells touch your shoulders (when using a bar, full flexion is realized when your biceps make contact with your forearms). Return to the starting position by extending your shoulders until you arrive at the starting position for the press.



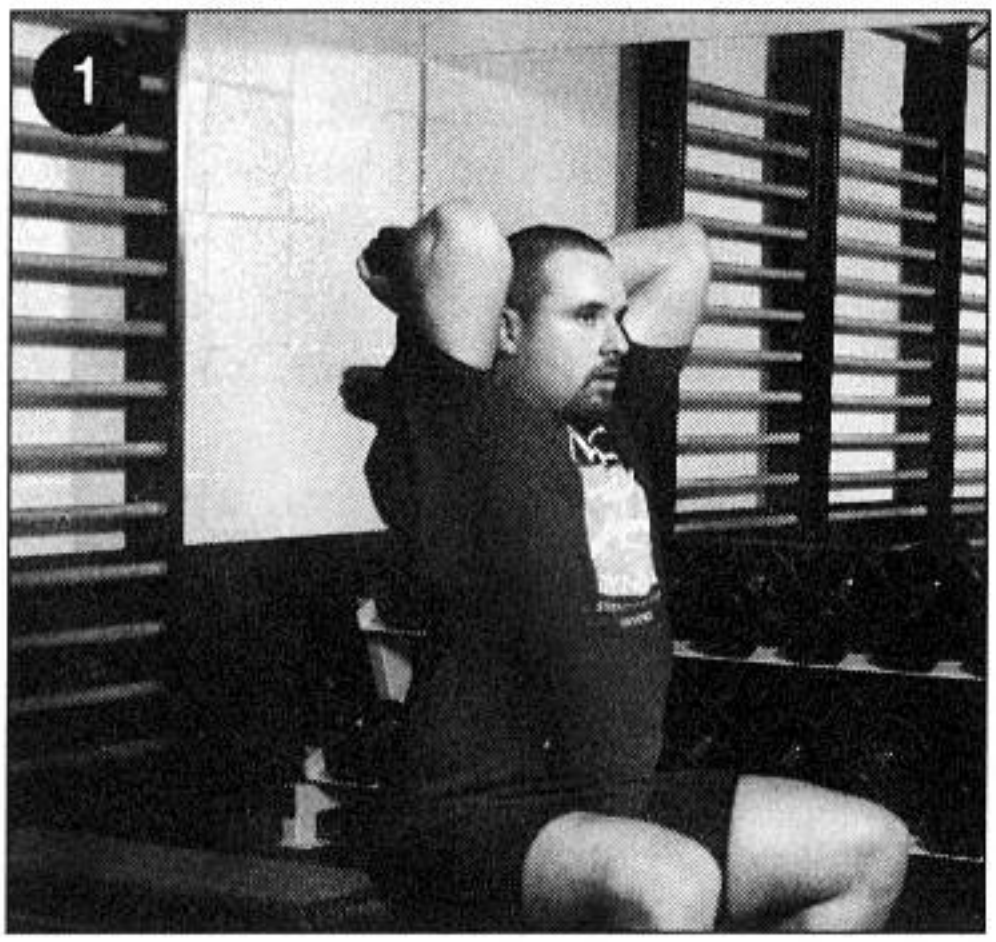


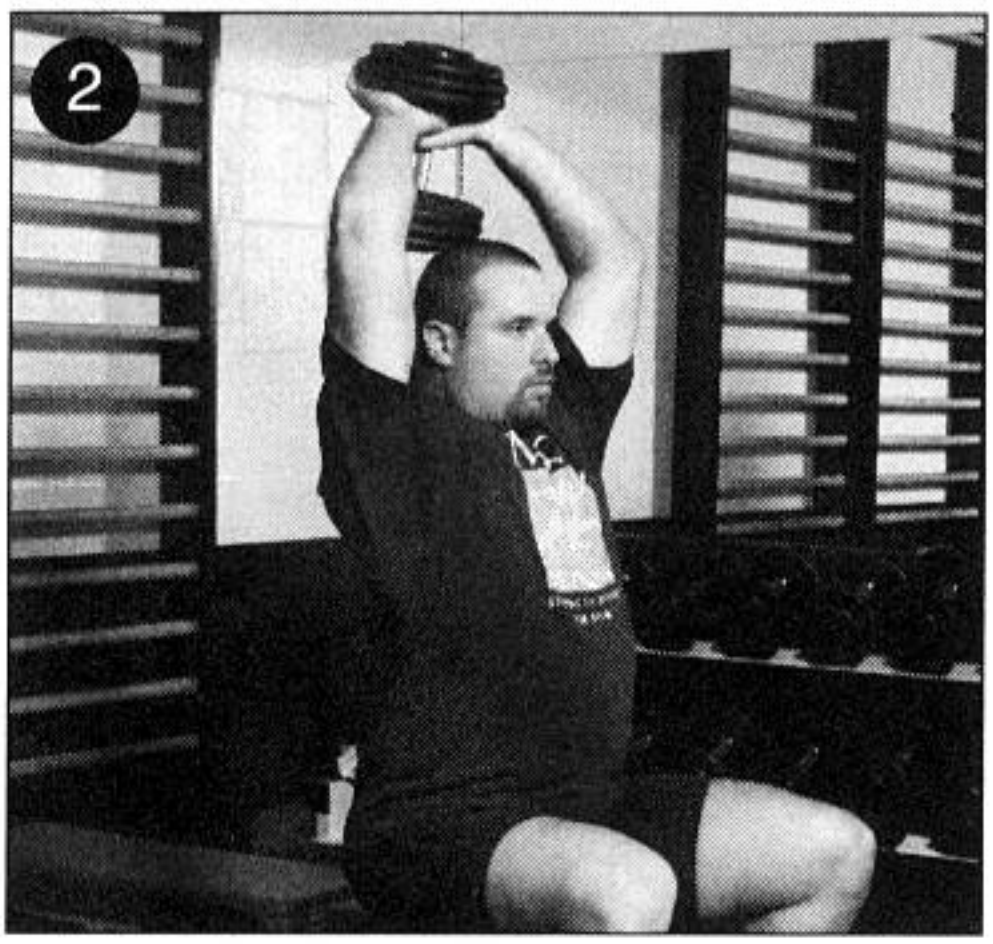
Pushdowns. This is performed from a high cable attachment, using either a bar or a "triceps rope." Grasp the handle and pull yourself into position using your lats to extend your shoulders until your elbows are against your sides. From here, fully flex and extend your elbows while keeping your elbows "pinned" to your sides. With heavier weights, it will become necessary to lean forward somewhat—athletes will also tend to place one foot ahead of the other to stabilize their position. Note: With all triceps exercises, keep the back of the wrists flat.





Tellekinetic unilateral triceps pushdown. (Directions are for right arm) Performed from a high cable attachment, using a triceps rope. Grasp the rope with your right hand and pull yourself into position using your lat to extend your shoulder until your right elbow is against your right ASIS (hip bone). From here, fully flex and extend your right elbow while keeping it pinned to your ASIS. The movement pattern is somewhat diagonal as your right hand travels from your left shoulder down across your body. Note: With all triceps exercises, keep the back of the wrist flat.





French press. Grasping a single dumbbell with both hands as shown, assume a seated position at the end of a bench. Work the dumbbell to one shoulder, and then maneuver it behind you. From here, press the dumbbell to a straight-arms position by contracting your triceps, being extremely careful not to lose your grip and risk dropping it on your head (a competent spotter is strongly advised). Relax your triceps to return to the starting position. Note: your elbows must remain stabilized, pointing to the ceiling, throughout.

Tips for maximizing strength training for triceps

The triceps are comprised of three separate heads—the medial and lateral heads originate on the humerus, while the long head originates from the scapula. For this reason, exercises where the shoulders are flexed (such as lying triceps extensions) target the long head of the triceps more than exercises where the shoulders are extended (such as triceps pushdowns).

Questionable or Non-productive Exercises

When evaluating any exercise, use the "risk-benefit profile." Exercises should have high benefit and low risk, not the reverse. The following exercises, commonly used in martial arts schools, have questionable risk-benefit profiles at best:

1) ***Push-ups.*** In the right context, push-ups can be a beneficial exercise for the pectorals, front deltoids, and triceps muscles. The problem is that, once you get to the point where you can perform more than say, 15–20 repetitions, the exercise is no longer of sufficient intensity for developing strength or hypertrophy. As a side-note, knuckle pushups are often used to "develop the fists" or simply to create more discomfort in an effort to "build discipline," however from a physiologic viewpoint, there is no evidence that they benefit the martial artist any more than standard pushups, and in fact, they may be injurious to some athletes.
2) ***Jumping jacks.*** Although jumping jacks do elevate the heart rate, that's essentially ALL they do. Therefore, it may be more time and energy efficient to use other, more useful drills, such as abdominal exercises, footwork drills, lunges, or easy sport skills for the same purpose.

3) ***Sit-ups.*** A recent study (1998) conducted by Swiss scientists D. Juker, S. McGill, P. Kropf, and T. Steffen demonstrated that all forms of sit-ups activated the hip flexors more than the crunch exercise. Add this to the large amounts of hip flexion demanded by kicking maneuvers and the hip flexors get perhaps more than their fair share of work. This is potentially a problem since hypertonic (over-tight) hip flexors are commonly implicated as a significant cause of low back pain, an affliction affecting more than 80 million Americans.
4) ***Lying leg scissors.*** This exercise requires too much hip flexor involvement, which can expose the spine to excessive stress for the limited benefits it may provide.
5) ***Static stretches.*** Static stretches are non-specific to most athletic skills, and are less effective than contract-relax stretches. They also tend to temporarily reduce strength.
6) ***"Duck" walking.*** This drill exposes the knees to too much stress, given the limited benefits they may provide.

CHAPTER 4

NUTRITIONAL SUPPORT FOR TRAINING

Although this book deals primarily with conditioning methods, optimal nutrition and supplementation are critical for athletes, particularly with respect to energy for training, and recovery and repair between training bouts. This chapter is not designed to be a comprehensive treatise on nutrition, but rather a primer on the subject, with emphasis on the most important issues and practices for athletes. Those in need of more extensive discussions of the subjects of nutrition and supplementation should consult the resources section.

All martial art disciplines and combat sports involve wide-ranging skills and movement abilities. They require not only speed and strength in short, explosive bursts, but also a high level of anaerobic strength endurance, flexibility, and agility. Often the martial arts are very ballistic in nature, and, as such, recovery, tissue repair, and peak speed-strength are year-round objectives. Nutritionally, that calls for an emphasis on short-term energy needs and maximizing the body's recovery and tissue repair processes.

Macronutrients (Protein, Carbohydrates, and Fats)

All nutrients are classified either as macronutrients, which are the sources of calories, and micronutrients, which, although not sources of calories, are vital "co-factors"which help the body make better use of the macronutrients.

PROTEINS

Athletes should construct their meals based on protein. In fact, the word "protein" actually comes from the Greek word Protos meaning "first." Protein provides four calories of energy per gram of weight.

Protein needs depend upon body weight (specifically, lean body weight), and activity levels. For athletes, a good "rule of thumb" is to consume one gram of high quality protein per pound of bodyweight per day, divided into five to six meals over the course of the day. The post-training meal can contain a larger proportion of protein than the other meals, since the body is capable of utilizing more protein after training than at any other time.

Individuals familiar with governmental nutrition guidelines will notice that this recommendation is more than three times the RDA for protein. The reason? Athletes are in the business of excelling, not merely surviving. And although conservative nutritionists love to warn of the supposed dangers of an excessive protein intake, Peter Lemon, one of the World's foremost protein researchers, disagrees. In a recent interview, Lemon notes that no study conducted on healthy humans have ever demonstrated ill effect from high levels of protein ingestion.[52]

Many people do not realize that protein is used by the body for two purposes: energy, and growth and repair. When calories are restricted, the body will prioritize energy over growth and repair. This means that protein needs increase during periods of caloric restriction.

Carbohydrates

Carbohydrates are an important source of energy, and the only source of dietary fiber, which is essential for good digestion and to lower the glycemic index of foods. Carbohydrates are usually categorized as either "simple" or "complex," depending upon the length of the sugar molecule. Sources of simple carbohydrates include the various sugars such as glucose, sucrose, fructose, and dextrose. Complex carbohydrates are found in grains, vegetables, legumes, and some fruits.

Although it is commonly suggested to emphasize complex carbohydrates over simple carbohydrates, a more valuable way of rating carbohydrates is by the "glycemic index" (GI) (please refer to Table 4-1). The GI rates carbohydrates by the rate at which they break down and enter the bloodstream as glucose. High GI carbohydrates cause a rapid increase in blood

BREADS	
French baguette	95
Bagel, white (frozen)	72
White bread	70
Whole-wheat bread	69
Pita, white	57
Sourdough rye	57
Whole-meal rye	41
CEREALS	
Corn Flakes	84
Rice Krispies	82
Cheerios	74
Cream of Wheat (instant)	74
Shredded Wheat	69
Oatmeal, instant	61
Special K	54
CEREAL GRAINS	
Rice, instant	87
Rice, white	56
Rice, brown	55
Couscous	65
Barley	27
DAIRY	
Ice cream	61
Ice cream, low fat	50
Milk, skim	32
Milk, whole	27
Yogurt, lowfat, w/sugar	33
Yogurt, lowfat	14
FRUIT	
Watermelon	72
Pineapple	66
Pineapple juice (unsweet)	46
Raisins	64
Bananas, overripe	52
Bananas, underripe	30
Orange	43
Orange juice	46
Grapes	43
Apple	36
Apple juice, unsweetened	41
Pear	33
Apricots, dried	31
Peach	28
Peach, canned, lt. syrup	52
Grapefruit	25
Grapefruit juice, unsweet	48
Plum	24
Cherries	22
LEGUMES	
Baked beans (canned)	48
Navy beans	38
Pinto beans	39
Black beans	30
Chickpeas, canned	42
Lima beans, baby	42
Lentils	29
Kidney beans	27
Kidney beans, canned	52
Soybeans	18
Peanuts	14
PASTA	
Macaroni & cheese	64
Spaghetti, white	41
Spaghetti, whole meal	37
VEGETABLES	
Potato, baked	85
Potato, instant	83
Carrots	71
Corn	55
Sweet potato	54
Yam	51
Peas	48
Tomato soup	38
SUGARS	
Maltose	105
Glucose	100
Honey	73
Sucrose	65
Lactose	46
Fructose	23
MISC FOODS	
Tofu frozen dessert	115
Rice cakes	82
Waffles	76
Corn chips	72
Life savers	70
Mars bar	68
Soft drink	68
Popcorn	55

Table 4-1: The Gylcemic Index of Common Foods
(Source: American Journal of Clinical Nutrition, 1995; 62:87 1S-93S)

glucose levels followed by just as rapid a drop), while lower GI foods cause a slower, more steady rise in blood sugar, without the resultant drop.

High GI foods cause the pancreas to release insulin in response to the influx of blood glucose. Insulin acts to store ingested calories as body fat. This is why the GI's of some foods can be surprising. For example, ice cream has a relatively low GI, because of the fat content. So while many people seek out low or nonfat ice cream, it actually will have a very high GI and is probably a poorer choice than the higher fat version for weight-loss purposes (although, certainly, total calorie content must also be considered).

Of course, what's really important is the GI of meals, not individual foods. Although the GI's of various meals has not been established, fats and/or fibers reduce the GI of ingested foods. This leads to the recommendation that all meals should include all three macronutrients. While an insufficient carbohydrate intake can lead to impaired cognitive function and reduced energy levels, past and current research findings strongly suggest that this rarely if ever is a problem, particularly in Western cultures. Most Westerners eat an excessive amount of carbohydrate, most of it coming from processed sources, which are typically calorie dense and nutrient sparse. A recent report which tallied the twenty-five most popular carbohydrate sources among Americans contained only one vegetable—potatoes! When carbohydrate sources are limited to fruits, vegetables, and unprocessed whole grains, it becomes nearly impossible to eat 60% or more of daily calories from carbohydrates, which is what traditionally trained nutritionists recommend.

Fats

Fats contain nine calories per gram of weight, and can be generally classified as either saturated (solid at room temperature) or unsaturated (liquid at room temperature). As a general recommendation, no more than one-third of total fat intake (as a percentage of total calories) should come from saturated fats.

Although an excessive fat intake can increase bodyfat levels, an inadequate amount of so-called "good" fat (the unsaturated variety, particularly the Omega-3 essential fatty acids) has been associated with reduced serum testosterone and a lowering of LDL ("good") cholesterol levels.

Most studies indicate that the amount of fat (measured as a percentage of total caloric intake) consumed by Americans has remained relatively constant over the past several decades. What has changed over this time period is the relative proportion of saturated (from animal products) and processed fats (such as the so-called "trans-fats" found in french fries, potato chips, cookies, doughnuts, and other heavily processed convenience foods). This shift (not fat intake per se) may be behind the accelerated rate of heart disease, cancer, and other chronic diseases.

Optimal fat intake also appears to facilitate the oxidation of stored bodyfat for energy. This is because the body tends to access whatever type of fuel is most abundant. When stored blood sugar is low, and free fatty acids are high, the fatty acids become the preferred source of fuel.

These studies all suggest the same conclusion—eating a reasonable amount of dietary fat (25–35%) promotes good health and physical performance, as long as the majority of this fat is from unsaturated sources, which include nuts, seeds, olive oil, flax oil, avocados, fish oils, and peanut butter. Minimize saturated fats found in animal products such as butter, cheeses, lard, and high fat meats, as well as high processed fats such as convenience foods, margarines, and fried foods.

Macronutrient Ratios

Performance nutrition has evolved through several generations of paradigms over the past several decades. The first paradigm focused on energy balance. In this perspective, one simply looked at how many calories were consumed versus how many calories burned during the day's activities. To burn more calories than consumed meant losing weight.

While there is an element of truth in this simplistic analysis, another paradigm eventually developed: a calorie was no longer a calorie. Nutritionists claimed that there were "good" and "bad" calories. Carbohydrates were good, protein was acceptable, and fats were definitely bad. Experts reasoned (through a misinterpretation of available research) that carbohydrates were the body's preferred form of energy, and that fats, which have more calories per gram of weight, led to obesity.

This second paradigm seemed more sophisticated, but its premise was flawed. Eventually, a third paradigm emerged, initiated through developments made by the Balance Bar Company in Carpenteria, California. This new approach looked at the hormonal effects of foods. Hormones are like the chemical "software" for the human body. They determine how the body will process consumed foods.

It turns out that diets too high in carbohydrates, especially the wrong kinds of carbohydrates (see discussion on glycemic index), result in excessive secretion of insulin. Insulin is a hormone which directs the body to store digested foods as body fat. Fats and proteins stimulate production of glucagon and other hormones which help the body use digested foods as energy and also to preserve lean tissue, which allows the metabolic rate to remain high, particularly during periods where caloric intake is low.

When I first saw the "40-30-30" nutrition plan in the popular media, I dismissed it as fast as I would dismiss one of those ab-gadget info-mercials. But after looking into the concept, and using it myself and with my athletes, I now am convinced that higher fat, lower carb nutritional strategies are in fact superior to the old way of thinking. In fact, while many dismiss it as "radical" or "faddish," it complies with the fat intake guidelines established by the American Heart Association. And, despite common recommendations that carbohydrates should occupy 60–70% of total calories, if all ingested carbohydrates derive from natural, unprocessed sources such as fruits and vegetables, it's actually very difficult to exceed 40%.

Optimal macronutrient ratios have a dramatic effect on the nutrient density of the diet. Table 4-2 compares a pasta-based meal with a chicken-based meal. The table clearly shows the startling difference in nutrient levels between the two meals. Interestingly, the pasta-based meal has about 150 more calories than the chicken-based meal, with significantly less nutritional value.

Micronutrients

Vitamins

Athletes need an abundance of vitamins for optimal performance. The physical demands of training use up these substances and make it more critical for replenishment. Conservative nutritionists frequently state that eating five or so carefully balanced meals every day will make supplementation with vitamins unnecessary. However, and this is a very important "however," who does that? Almost no one! In the interest of "insurance," it's probably wise to take a low to moderate dosage multivitamin/mineral supplement three times daily. The classes of vitamins known as "antioxidants" (A, C, E) are particularly valuable for their ability to protect the body from oxidative stress which results from hard exercise.

Pasta Meal
2 cups cooked fettuccini
1/2 cup marinara sauce with mushrooms
1 slice of garlic bread
1/3 oz grated parmesan cheese
1 cup tossed salad

Calories: **646.9**
% calories from fat: 19
% calories from protein: 15
% calories from carbohydrates: 66

Chicken Meal
3oz chicken breast
1 cup frozen broccoli
1 cup frozen carrots
1/2 raw cucumber
1 cup shredded lettuce
1 medium raw tomato
1 1/2 tbsp vinegar & oil dressing
1/2 cup cooked long-grain brown rice

Calories: **494.4**
% calories from fat: 29.2
% calories from protein: 30
% calories from carbohydrates: 43

Percentage of nutrients based on a 2,000 calorie per day diet:

Nutrient	Pasta Meal	Chicken Meal
Calories	25	19
Protein	25	39
Carbohydrates	27	13
Total fat	19	16
Saturated fat	15	14
Mono. fat	7	21
Poly. fat	12	30
Cholesterol	**2**	**27**
Fiber	**14**	**52**
Caffeine	0	0
Vit A	**72**	**318**
Vit C	**46**	**189**
Vit D	0	0
Vit E	59	64
Thiamine	45	33
Riboflavin	25	27
Niacin	**27**	**84**
Vit B6	**19**	**61**
Bit B12	6	14
Folate	**19**	**102**
Sodium	**31**	**14**
Calcium	27	27
Magnesium	**19**	**40**
Potassium	13	22
Iron	**55**	**22**
Zinc	14	18

Notes: The most significant disparities and comparisons are in bold for emphasis. Interestingly, the chicken meal has much higher levels of fiber than the pasta meal. The superior concentration of vitamins and minerals is also noteworthy. The chicken meal contains significantly more cholesterol, however, for most people, there is no significant correlation between ingested cholesterol and serum cholesterol levels.

Table 4-2: Comparison of a Pasta-based Meal with a Chicken-based Meal
(Source: 40-30-30: A Platform for Balanced Nutrition. Phil LeClair, the Balance Bar Company)

Minerals

Through vast research, it is now known that minerals play a very significant role in various bodily functions essential to physical movement. And, a deficiency in any mineral can be disastrous to peak performance. Minerals are found in plants and animal foods, as well as drinking water. Many times the quantities of minerals found in these sources are too small. Since the stresses associated with sport activities promote the loss of various minerals, it becomes important to increase mineral intakes.

Supplementation

Although the fitness and sports training market is literally overwhelmed with thousands of supposedly anabolic or ergogenic aids and new ones emerging every month, very few have any proven value. This may reflect the "magic pill" mentality that seems so ingrained in current culture. Therefore, the following review only addresses the supplements which have proven track records for improving health and physical performance. Anabolic steroids are omitted since they are illegal and, in many cases, dangerous.

Vitamin and Mineral Supplements

For most athletes, a vitamin and mineral supplement is a good place to start when developing a supplementation plan. Many products are available, and theories abound as to the optimal proportions of various nutrients that should be present in a multivitamin. Seek a reputable performance nutrition specialist for advice on the best formulation to use.

Meal Replacement Shakes (MRPs)

One of the more difficult aspects of eating well is the preparation involved. On this front, MRPs can really make a significant difference in the overall quality of a nutritional plan. MRPs normally consist of all three macronutrients in various ratios, along with vitamins, minerals, and quite often, an array of the latest anabolic substances, such as creatine, branch-chain amino acids (BCAAs), HMB, and so forth. Most MRPs are designed to be mixed with water, milk, or fruit juice, and many mix well with a spoon, precluding the need for a blender.

Athletes not satisfied with the macronutrient ratio of a particular MRP can adjust it by adding fruit, flax oil, whey protein, or milk of varying fat levels. Be cautious of products that are overly-processed with dozens of artificial ingredients and unproven ergogenic substances which are often included as an excuse to increase the price of the MRP.

Sports Drinks

The excessive amount of carbohydrate contained in these drinks causes insulin to go into overdrive and pack away too much sugar as the storage fuel glycogen in the muscles and liver. While this storage leads to an initial boost of energy, when the glycogen runs out it actually deprives the brain of its only fuel (glucose). The result is a low blood sugar syndrome characterized by a loss of long-term energy and lack of extended concentration and focus, both of which are a martial artist's enemy. Another leading sports nutritionist, Dr. Ann DeWees Allen, calls these sports drinks "the worst thing you can put in your body."[55]

Protein Shakes

Protein shakes are available in many formulations, but the most effective products are based on whey protein.

Use protein shakes as MRPs by adding milk, fruit, and/or flax oil as a way to create the optimal macronutrient ratio. In this way, it's easier to avoid all the processing and artificial ingredients which are so common in MRPs.

Don't try to live off of protein shakes or MRPs. Athletes need "real" food as well! Alternate between MRPs and whole food meals throughout the day, planning it in such a way that a MRP will occur post-training, if a session takes place that day.

Branch-Chain Amino Acids (BCAAs)

BCAAs are considered to be "conditionally essential" when the body is under stress. During strenuous bouts of training, these three amino acids are catabolized at more rapid rates than the other amino acids, creating a "limiting amino acid condition." This means that BCAAs can rapidly accelerate recovery rates when ingested with juice immediately after every training session.

L-Glutamine

Once categorized as a "nonessential amino acid," (nonessential means that the body can synthesize it on it's own if inadequate amounts are not ingested). L-glutamine has recently attained "conditionally essential amino acid" status, meaning that in certain cases where the body is under stress, the need for L-Glutamine outpaces the rate at which it can be made by the body. These conditions of stress include trauma, surgery, infections, fasting, and intense or prolonged exercise.

Studies on L-Glutamine point to it's ability to boost immunity, promote protein synthesis (muscle growth), increase GH (growth hormone) release, and improve carbohydrate metabolism. All of these benefits are highly useful for athletes. Although L-Glutamine may be obtained in a normal diet, exercise scientist Jim Wright, M.D., states it's unlikely that hard training athletes can get enough through diet alone.[51] Wright recommends taking L-Glutamine in five gram doses (a slightly rounded teaspoon) two to four times a day. Suggested times include upon waking, before and after training, and just before going to bed. Take L-Glutamine mixed in water, or by placing it under the tongue for a few minutes, following up with water.

Flaxseed Oil

As a source of essential fatty acids, flaxseed oil helps to lower cholesterol levels, nourish nervous and brain tissue, reduce inflammation, and regulate the cardiovascular, immune, and digestive systems. Flaxseed oil does not contribute to bodyfat deposition like other fats because it must be converted metabolically in order to become saturated fat. Because the fatty acids in flaxseed oil are essential nutrients, they are the starting point, or the "mortar and bricks" for manufacturing all other fatty acids and hormone precursors necessary to support and build strong lean muscle, while prolonging stamina required for endurance sports. Flaxseed oil may be taken by itself, or put in shakes or on salads.

Creatine Monohydrate

Of all the thousands of ergogenic (work enhancing) nutritional substances that have emerged over the past twenty years or so, one has distinguished itself—creatine monohydrate. A natural substance found in all meats, creatine significantly increases short term endurance capacity, and is thought to aid in the process of protein synthesis (muscle repair after train-

ing). It is perhaps the most thoroughly investigated nutritional supplement, and the bulk of the scientific evidence strongly suggests that creatine is safe and effective. Although many dosing schedules are possible, the most common recommendation is to "load" for five consecutive days by consuming one gram of creatine for every ten pounds of bodyweight per day (divided into five gram doses spread throughout the day), followed by a "maintenance" schedule of one gram per 2.5 pounds of bodyweight per day, taken in single does (immediately after exercise on training days). Creatine is more easily assimilated by the body if ingested with a small quantity of a high GI carbohydrate, such as grape juice. As a matter of principle, all nutritional supplements should be "cycled," and creatine is no exception. After ten to twelve weeks of continuous use, take a week or two off before starting another cycle.

Pro-Hormones

Recently, a new class of substances has emerged, called "pro-hormones" because they supposedly promote an increase in the body's own levels of anabolic hormones, such as testosterone and human growth hormone. Although these substances are banned in many (if not most) sport's governing bodies, they are otherwise legal. Furthermore, due to the discovery that baseball home run record holder Mark McGuire used androstenedione (a pro-hormone), and because these substances may indeed have anabolic and ergogenic properties, a brief discussion is warranted.

Pro-hormones are chemical substances which, when ingested, provide the raw building blocks which enable the body to increase it's endogenous (internal) levels of testosterone, the primary anabolic hormone. To date, most studies have focused on androstenediol (which was the first of the pro-hormones to emerge on the open market), and the conclusions of these studies vary widely. Nevertheless, many studies did show an increase in testosterone levels after androstenedione ingestion. Subsequent to these findings, several new pro-hormones have emerged, including 5-androstenediol, 19-nor-5-androstenediol, 19-norestosterone, and 4-androstenediol. These substances all have a potential anabolic effect, but appear to vary with respect to possible negative side effects, such as gynocomastia (breast development in men), according to Patrick Arnold, the man generally credited with bringing androstenediol to the U.S. market.

At the time of this writing, the benefit to risk profile of pro-hormones is still an open question. If an athlete's particular sports governing body does not ban these substances, any use should be conducted under medical supervision to stay on the safe side.

Hydration

Another nutrient, almost always overlooked is water. Water is especially important for martial artists. A vast majority of martial athletes are arguably dehydrated at any given time. In such cases, increased water intakes might lead to better performance improvements than any other supplement! The "old school" practice of not allowing athletes access to water during workouts is antiquated and, in some cases, dangerous. After all, the goal of training is to produce superior performances, not to see how much pain and discomfort may be endured! Although no exact hydration recommendations have been established, the old adage of "eight glasses of water a day" is only marginally acceptable for most people. Athletes with very demanding training schedules will need to increase their water intake accordingly. A simple "rule of thumb" guideline suggested by Donald Baker[52] of The Balance Bar Company is to take bodyweight in pounds, convert that number to ounces, and that's the amount of water to drink each day.

Guidelines for Maximum Athletic Performance

Unfortunately, most athletes don't understand proper nutritional practices, or simply don't follow these procedures long enough to see the results. Martial athletes, however, must be willing to take the long-term approach. Remember, eating habits either support or sabotage training efforts. Science can show one how, individual athletes then take advantage of this knowledge and reach the next step of athletic potential.

The first guideline is that each meal should include all three macronutrients This recommendation is based on the following information:

1) Metabolic nutritionist Dr. Ann DeWees-Allen has found that protein, when eaten alone, causes a high-glycemic response from the body, similar to eating a high GI carbohydrate.[53] Adding carbohydrate and/or fats to the protein negates this response.
2) The GI of carbohydrates is lowered upon the addition of fats.
3) No meal should be devoid of protein, which should be ingested every three hours for optimal recovery and repair. There is a limit on the amount of protein that can be absorbed in a single meal (depending on lean body mass, activity levels, and proximity to training events, this could range between 20 and 60 grams, with the average around 30 grams). If one's daily protein requirement is 190 grams, and that individual tried to eat protein in only half of six daily meals, he or she would have to eat sixty-three grams per meal. Most of this large volume could not be utilized and would most likely be stored as fat.
4) All meals should contain carbohydrates, not only for energy, but also because they are the only source of fiber which is essential for digestion.
5) All meals should include fats, particularly the essential fatty acids (such as Omega-3 fatty acids), which promote satiety and slow the GI of meals.

The second important guideline is to eat every three hours. Two or three meals per day simply aren't enough. If the body is deficient in calories, it will resort to cannibalizing muscle tissue for energy. That's the same muscle tissue athletes spend weeks and months earning in the gym! The body is a conservative machine, and it won't grow unless given a reason (through weight training). Furthermore, athletes must provide plenty of calories so that the body is "convinced" it can afford to add additional lean mass. Unless someone is near the upper limit of a competitive weight class, don't be afraid to sacrifice a bit of definition while attempting to gain muscle. This small amount of extra bodyfat can be removed later through the "zigzag" method of caloric intake, to be explained shortly.

Meal frequency becomes even more critical when athletes "diet down" to make weight for a fight. A 1996 study conducted at Nagoya University in Japan divided twelve boxers into two groups.[54] The first group ate two meals day, and the second group consumed six meals a day. Both groups ingested 1,200 calories a day for two weeks.

Although there was no difference in change of body weight by food restriction between the two groups, the decrease in lean body mass was significantly greater in the two-meals group than in the six-meals group. This loss in muscle tissue would certainly reduce all force output characteristics, running the gamut from absolute strength to long-term endurance.

The third important guideline is to optimize macronutrient ratios. As stated earlier, the 40-30-30 ratio of carbohydrates, proteins, and fats is the suggested starting point. Macronutrient ratios may vary slightly based on the training emphasis. When engaged in very heavy strength training, athletes may find that a 30-40-30 ratio works best and during phases of extensive endurance training may alternatively select a 50-25-25 ratio.

The final guideline for this section regards the question of calorie distribution. Calories should be ingested according to activity level. As discussed earlier, the body is able to utilize greater amounts of nutrients after a heavy training session so adjust daily caloric intake accordingly. Upon waking, the body is near the end of a long fast, which began at the end of yesterday's final meal. Subsequently, the first meal of the day should have slightly more calories to compensate for depleted glycogen levels in the muscles and other tissues. On the other hand, pre-training or event meals should be relatively small to avoid gastric distress and large blood sugar fluctuations.

This daily approach to caloric apportionment can also be extended to longer periods of time. For example, during a transition phase when not training as hard as usual, downgrade caloric intake accordingly.

Gaining and Losing Weight

Trying to gain muscle and lose fat at the same time is difficult at best, as discussed earlier. But there are at least two strategies which can be employed to make both processes safer and less harmful on conditioning levels.

The first strategy is to use a very slow, gradual approach, regardless of whether trying to gain or lose weight. The slower the process, the more favorable the muscle to fat ratio. In other words, to lose weight, a slow approach will minimize muscle loss, and while trying to gain weight it will minimize fat deposition.

The second strategy is called the zigzag method of caloric intake. Here's how it works: Consider a jujitsu competitor who presently weighs 240 pounds with a bodyfat level of 20%. The goal is to weigh 220 with 10% bodyfat. Very simply, reduce caloric intake for four to five days. Achieve this by subtracting 100 calories per day under the "baseline." Then add the calories back to the baseline for a day or two. When this zigzag method is maintained for two to three weeks, athletes should lose approximately one pound of fat with minimal loss of lean mass. If this doesn't occur after two to three weeks, reduce an additional 100 calories a day during the "down" period, until the desired loss is achieved.

In another example, consider a boxer who is close to the upper limit of his weight class and it's becoming more and more difficult to make weight. A decision is made to move up a weight class. The challenge is how to do this without adding fat. The solution is to reverse the zigzag procedure just discussed. Increase caloric intake for four to five days, then bring it back down to normal levels for a day or two. If eating at least five times daily, fat-storage enzymes will be at very low levels, and therefore, when a normal caloric intake is resumed for one to two days, the body will be unable to store the excess calories as fat. When continued over months and years, these procedures will result in added lean mass without the fat!

Testing for Adverse Food Reactions

According to exercise scientist Jerry Telle, many people are sensitive to, allergic to, or have unusual/excessive insulin reactions to certain foods when ingested.[55] One common reaction is fluid retention, which is a nightmare for competitive athletes trying to come down to fighting weight. Other reactions include fatigue, cognitive impairment, loss of coordination, immune responses, and congestion.

The most common foods seem to occur with wheat products, sugars, dairy products,

and, paradoxically, any "craved" foods. Telle suggests the following testing protocol to determine one's personal sensitivity levels to various foods:

1) Eat normally for seven days. During this time period, check the pulse each morning upon waking, and check it again immediately before, and 15 to 20 minutes after meals. Record these numbers for future use. Also, keep track of body composition during this period.
2) For a period of five days, eat only lean poultry and/or red meat from game animals, fish, and vegetables. No dairy, grains, or favorite foods! Continue to monitor the waking, and pre- and post-meal pulse. Also, record any changes in energy, mental or physical.
3) On day six, reintroduce dairy products. Continue to monitor the waking and pre- and post-meal pulse, as well as energy levels. On day seven, reintroduce wheat products. Continue to monitor the waking and pre- and post-meal pulse. On day eight, reintroduce sugars. Continue to monitor the waking and pre- and post-meal pulse. On day nine, reintroduce everything desirable to eat, including alcohol, fast foods, etc. During this "reintroduction phase," use a different type of the food reintroduced at each meal. For example, when reintroducing dairy foods, use milk on the first meal, cottage cheese on the second, yogurt on the third, etc.
4) During each "reintroduction" day, did the waking pulse increase significantly (more than eight beats per minute?). How about the post-meal pulse? An increased pulse signals an adverse reaction to the ingested food. Did energy levels improve?
5) Now, construct a nutritional regimen which should be devoid of the foods determined as detrimental one's individual health status.

Performance Nutrition: The Mature Athlete's Edge

Of all of the aspects of a training program, nutrition might seem paradoxical because the benefits of a well-conceived nutritional strategy, although irrefutable, are realized gradually—over months and years, rather than days and weeks. The word "mature"denotes the ability to forgo immediate pleasure in order to realize long-term benefits. When talking to serious athletes in any sport, there seems to be a direct correlation between their age and the degree to which they understand the importance of optimal nutrition. The older they are, the more they stress it's importance. With age comes maturity. And even though the aging process eventually limits athletic progress, nutrition is (for many) an undiscovered key to renewed progress. Be one of the wise few who don't wait until an athletic career is nearly over to take advantage of the benefits of a sound diet.

With that exhortation, here are three final considerations concerning nutrition.

First, never experiment with new or unusual foods, particularly before a competition. Athletes may discover a food that doesn't " agree" at the worst possible time! Instead, stick with familiar foods that work well. As mentioned earlier, meals containing low-glycemic carbohydrates are best.

Second, referring again to pre-fight meals, there is no substantial benefit, in terms of energy, to any single meal. It's what athletes consume over the long-term that really counts. With this in mind, the idea is to "play it safe," and seek a pre-fight meal that won't cause any problems such as gastric distress, abdominal distention, heartburn, or fatigue. Large meals take energy to digest. Remember this when planing a pre-workout or pre-competition meal. Finally, all martial athletes must develop personal discipline in nutrition matters. Many mar-

tial artists are highly disciplined when it comes to training, but poorly disciplined in terms of nutrition. One facet of this discipline involves meal planning. Very little is written about the fact that to eat properly, athletes must plan their meals in advance. Many athletes use excuses like "Well, at work I just don't have access to good food" or, "I'm always so busy" or "My wife just doesn't cook" and the list goes on.

All of these problems can be solved through simple planning. Bring a cooler to work, or buy a small refrigerator. Cook some chicken breasts (anyone can do it) and mix them with some chopped vegetables and salad dressing. Make enough for two to three meals, and it will last for a few days. Use MRP's that can be mixed with milk—an easy, low preparation way to eat well at work. Or, use food bars (such as Balance Bar) as an occasional meal when time gets tight. The options are many for those who plan them.

CHAPTER 5

PREVENTION AND MANAGEMENT OF INJURIES

Although the martial arts have a surprisingly good track record in regards to injuries, the astute instructor must do everything possible to prevent injuries before they happen, as well as know how to handle them once they do happen. This chapter covers the most commonly seen injuries within martial arts training and competition venues.

Guidelines for Instructors and Coaches

Instructors are not expected to serve as a doctor, nurse, physical therapist, or in any other medical capacity while in the role as martial arts instructor. In fact, to attempt assuming these roles, instructors act both improperly and illegally. Follow these simple guidelines while working with students.

1) Never attempt to diagnose an injury or any other medical or health condition.
2) Never attempt to prescribe or dispense any kind of medication whatsoever (including over-the-counter medications) to anyone.
3) Never attempt to treat any health condition or injury under any circumstances whatsoever (except as standard first aid procedure may require).
4) Never prescribe exercise for anyone with a known medical problem unless clearance is obtained that also includes instructions from the attending sports medicine expert.
5) When a medical problem is suspected, refer students to a competent sports medicine specialist. Furthermore, refuse continued assistance to this individual until the medical problem has been eliminated, or until instructions are forthcoming from that individual's attending sports medicine expert. In some cases instructors are required to render "first aid" to students who are obviously ill, injured in some way, or in some other way physically at risk. Do so, but summon competent assistance immediately upon recognizing the problem.
6) Ensure CPR and first aid certification is current. There are good courses which leads to certification through the Red Cross and other civic and private organizations).

After reading these common sense guidelines, readers may wonder why the following information on sports and fitness-related problems is presented. In response, knowledge and understanding of such problems can assist individuals to avoid them (in consultation with the attending sports medicine expert). Furthermore, information is presented to prescribe exercise protocols that will assist in the recovery process or in avoiding further complications resulting from the exercise.

The Role of Recovery in Injury Prevention

(*Author's note:* The following sections on the role of recovery in injury prevention are presented by Dianna Linden, MT. Dianna is an experienced and highly-credentialed soft-tissue therapist who treats athletes in the Los Angeles Area. Her contribution to this book reflects years of "in the trenches" experience with a wide variety of injuries that occur in a variety of disciplines including jujitsu, weightlifting, cycling, and recreational weight trainers. Dianna believes that athletes can prevent the vast majority of potential injuries through smart training, awareness, personal discipline, and knowing a handful of simple techniques to employ when injuries do occur.)

Awareness of the need for active recovery techniques and methods is possibly the most critical aspect of injury prevention. Above and beyond scheduling recovery cycles in Periodization phases and ensuring optimal nutritional support for cellular repair and regeneration, there are several other tools available to accelerate recovery. Charlie Francis, author of *The Charlie Francis Speed Training System* asserts that "an athlete who is receiving regular regeneration methods and treatments is able to increase the volume of high quality, high intensity work by as much as 40% . . . this process involves massage, saunas, whirlpools, showers, baths, and electronic muscle stimulation (EMS)."[56]

These, combined with well-planned workout schedules, help accomplish recovery and regeneration of the athlete and thus prevent injuries. Think of recovery efforts in three phases: pre-training, during training, and post-training:

Phase One: Pre-Training Recovery

The application of pre-training recuperative techniques will ensure not only a better training performance, but more effective post-training recovery as well. The following two suggestions enhance recuperative abilities.

1) Pre-training salicylate (aspirin). Aspirin is perhaps the most powerful anabolic drug available (legally). This effective substance operates on a variety of levels. First, Aspirin improves blood flow by reducing the body's output of thromboxane, a natural chemical which causes blood platelets to become "stickier." Even as little as 30 mgs (about one-tenth of a normal tablet) of aspirin prior to training can thin the blood to the point where muscle tissue is exposed to greater amounts of nutrient carrying blood, thus speeding up recovery between training intervals.

Additionally, lactic acid and other waste products (the result of heavy training efforts), will be flushed from muscle cells with greater speed and efficiency. Aspirin also reduces edema (swelling), another result of hard training. Local tissue swelling and inflammation (usually not visible) is universally regarded by experts as the enemy of healing. Recovery simply does not begin until edema has subsided.

Aspirin also reduces pain associated with training. While there is no benefit in masking pain resulting from injury, aspirin can often make the difference between a "ho-hum" workout and a really supercharged effort, which when coupled with an effective recovery regimen, will lead to increased progress.

Experiment with dosages. In many cases low dosages of aspirin work just as well as large doses with less possibility of stomach irritation. Instead of assuming that "more is better," it is a wiser practice to seek the smallest possible dose that enhances recuperative efforts. To protect the stomach lining even further, try crushing the aspirin tablets between two spoons and

mixing them into a glass of milk. Since the body eventually develops a tolerance to it, use aspirin judiciously—perhaps prior to the most difficult training sessions. Finally, check with a physician before implementing a regular schedule of aspirin therapy, no matter how small the dose.

2) *Leg Elevation.* Many people either sit or stand while at work for eight or more hours before going to the gym or *dojo.* During this time, the legs can often become edematous and swollen. Training with legs in this condition impedes training efforts right from the start. To help remedy this condition, spend between twenty and thirty minutes (both during the work day and prior to the training session) lying face-up on the floor, legs up against the wall or up against the side of a couch. Positioning the legs in this way allows gravity to assist the body in returning blood back to the heart, restoring optimum circulation.

Additionally, use this opportunity to listen to some relaxing music or take a light nap. This promotes an important physical and psychological transition between work and training.

Phase Two: Recovery During Training

The recovery process starts each time training ends. This means between the positive and negative portion of each repetition, between repetitions, between exercises, and between workouts. In the larger sense, recovery is needed between heavy training cycles, which sometimes last months! The following aspects of recovery during the training session must be addressed.

1) *Time between intervals (i.e., sets or rounds).* Time is the most elemental unit of recovery. The amount of time spent between training intervals has a significant effect on performance in succeeding intervals, and on future training sessions. In fact, one can raise the overall difficulty of the workout simply by decreasing the time between intervals. One can employ either objective or subjective methods of monitoring time between intervals.

Objectively, the pulse rate is commonly used to determine when to begin the next interval. Usually, the athlete waits until heart rate has fallen to below 60% of maximum (maximum heart rate is estimated as 220 minus current age). The downside of this method is that the pulse only measures metabolic fatigue, and is not a reliable assessment of neural fatigue. The more intense the training, the less reliable the pulse is in determining recovery.

Another objective method is to use the clock. For example, performing a set every three minutes. The limitation with this method is that the body's functioning varies from workout to workout, depending on recovery from previous training efforts. Therefore, using a standard time unit can be a hit or miss proposition at best.

Most people use a subjective assessment to determine time between intervals. Many resume the next interval when they "feel ready." While there is merit in trusting and listening to the body, athletes are best served by pre-planned time increments, perhaps tempered with subjective assessment, to determine time between intervals.

2) *Move between intervals.* Many individuals mistakenly sit down and move as little as possible between intervals. While this feels like the thing to do from an intuitive perspective, faster recovery can be realized by moving around a bit between intervals. Why?

Consider the importance of the warm-up and cool-down in the context of a workout and then think of moving between intervals as both a cool-down for the previous set and a warm-up for the next interval. Movement serves as a "transition" between all-out efforts during the interval and relative inactivity between intervals. This practice aids circulation and helps reduce swelling of muscular tissues.

3) *Peripheral Heart Action Training (PHA).* PHA is the practice of structuring workouts so that upper and lower body exercises are alternated with one another, instead of first training legs, then back, and so on. The effectiveness of PHA is that it keeps the blood moving between major areas of the body, which accelerates recovery per body part.
4) *The "Light Day."* Instead of performing each and every workout at gut-busting intensity, incorporate planned, easier workouts about every third or fourth session. An example of such a session would be four sets of fifteen repetitions at 50–55% of maximum. This type of moderate intensity training is quite effective in "feeding" sore muscles with fresh blood, reducing scar formation on the micro-level, and flushing waste products from affected tissues. Planning light days into the training schedule not only accelerates recovery times, it also provides variety for athletes, which in itself assists in the recovery process.

Phase Three: Post-Training Recovery

Post-training recovery methods complete the integrated recuperation format. These methods are designed to assist the body in rapidly accelerating the recovery process when it is needed most, directly after training. Two techniques in particular give the most "bangs for the buck" in terms of immediate results:

1) *Contrast Showers.* Done immediately after training (use the gym's shower if possible) expose the lumbar area to alternating bursts of hot and cold water as hot as one can reasonably stand for two minutes, followed by two minutes of progressively colder water up to the point of discomfort. This procedure is then repeated for four to six cycles. Since hot water is a vaso-dilator, and cold water a vaso-constrictor, the net effect of contrast showers is vastly improved circulation to the affected areas.

The effectiveness of contrast showers is markedly increased when combined with trunk stretching. Facing away from the shower nozzle, slowly bend forward at the waist while rounding the spine (forward flexion). Then return to an upright position and extend slightly backwards to extend the spine. Finally, flex the spine laterally by bending to each side at the waist. Use a handrail and non-slip rubber "skids" for safety! All four stretches are repeated for each contrasting cycle.

2) *Cryo-kinetics.* Immediately after leaving the shower, construct an ice pack by placing crushed ice in a "zip-lock" bag. Laying down on the floor with feet propped over a bed or couch, place the ice pack under the lumbar spine. To increase the effect of this procedure, try stretching the spine while on the ice. Gently perform lateral (side to side) flexions, alternated with pulling the knees into the chest.

Mobilizing the spine in this way will counteract the stiffening effect possibly experienced while icing one's back in the past. Cryo-kinetic therapy is very beneficial in reducing contracted, tightened muscle tissue as well as pumping these tissues free of accumulated training-induced waste products. Spend at least five, but no longer than twenty minutes on the ice.

Any athlete who feels that a body part is overworked and detects signs of micro- or macro-trauma can mitigate what would otherwise become a chronic problem right as it is about to occur by using ice treatments for just five minutes *immediately* after trauma signs are detected. The signs include excessive soreness, stiffness, and/or pain at the site of an old or recovering injury.

This "fast five" enables athletes to continue training uninterrupted by an injury caught and deterred in time. Micro-trauma is often present after tough workouts without symptoms until it builds to macro-trauma and has some pain, inflammation or swelling associated with

it. Individuals who tune into their bodies and detect and treat these things when they are almost imperceptible are way ahead of the game in prevention and remaining symptom free. The value of such a simple resource as ice cannot be overemphasized.

Ongoing Professional Assistance

Many forms of therapy, including various types of "bodywork" are available to athletes at moderate cost, and are highly recommended. Chiropractic adjustments, massage, whirlpool, sauna, acupuncture and acupressure are among the most readily available and effective of these therapeutic modalities.

Massage speeds up recovery and improves flexibility as well as offering feedback in a more in-depth way to the coach and athlete regarding the texture, tone and state of muscles, tendons, and the athlete's psycho-emotional-physical state. Well applied, it can relieve stiffness, soreness and muscle spasms, thus making the muscles more receptive to the training stimuli. If muscles remain too stiff, they are susceptible to injury.

The type of massage applied before and after a competition will be different from work of a more clinical nature, intended to relieve deep adhesions or spasms which should be done more than 72 hours before an event. This is because the deep work lowers the tone of the muscle too much and could negatively affect its strength and an individual's performance at the event.

The light work before the event is usually performed without oil, using compression strokes, slapping and jostling on muscle bellies and light friction massage on tendons and their attachments. These methods are designed to stimulate blood flow through the muscles, warm-up the tendons, and to help the athlete feel alert, awake, primed and ready for the competition. After the event, the massage is best performed after the cool down and after eating. It is given to flush the remaining by-products from the muscles, restore proper tonus, remove areas of localized tightness, and relax the athlete.

This after-event massage can be really helpful, not only to restore the muscles to be able to train again, but also to alleviate post-event depression which sometimes occurs after an extreme effort has been made. Anecdotal reports by marathon runners indicate that the post-event rubs received by volunteers at the event (which have to be very short due to the huge numbers of runners in line for them) are enough to circumvent the usual depression experienced without the massage after this event.

In *Sports Restoration and Massage, Secrets of the World's Greatest Superstars,*[57] edited by M.C. Siff and M.Yessis, a study by V. Dubrovsky concluded that:

1) When using restorative massage such techniques as stroking, rubbing and kneading should be used.
2) In restorative massage it is not advisable to use techniques (chopping, tapping, etc.) that stimulate the CNS, raise venous pressure, worsen the microcirculation and so on.
3) Restorative massage should be done within thirty minutes to four hours after training or competitions, with regard to physiological changes in the body.
4) Clinical studies of the cardiorespiratory system provide a basis for taking a new view of the methodology of restorative massage, its physiological features, and the changes that occur in the athlete's body.
5) Restorative massage should be sparing, excluding stimulating techniques and lasting no more than 35 minutes (with regard for the athlete's gender, age, weight and functional state).

6) Massage promotes redistribution of blood, its removal from the depot, and increased microcirculation.
7) Massage leads to blood redistribution and to a more uniform blood supply for all lung regions.
8) After massage, muscular blood flow remains accelerated for more than three hours.
9) Special significance should be given to massage of the back and paravertebral region since the region of the back is a vast reflexogenic zone. By influencing this zone a response can be obtained from the internal organs according to the viscero-sensory reflex type.

Another interesting study from the Siff and Yessis text mentioned earlier, titled *Methods of Warm-up Massage for Wrestlers,*[58] authored by Birukov, Kafarov, and Lukyanov, used 32 sambo wrestlers aged 18–21 years as subjects. They concluded that "massage employed after the warm-up markedly increases the wrestlers' special work capacity (the number and quality of throws, the effectiveness of actions in a bout), and betters the neuromuscular system's functional state (muscle tonus). Also, there was a speedier restoration of the muscular system's functional capabilities following a physical work load (a bout) as produced by warm-up and massage."[59]

Dianna headed a massage team for Rickson Gracie and offers this compelling personal account of her experience.

At the First International Rickson Gracie American Jujitsu Association Tournament at UCLA in August, 1997, I headed the team of sports massage therapists which Rickson requested as support for the athletes in competition. We were there for the pre-event, between event massages, stayed and gave some short post-event sessions to the contestants. The association also provided a triage team of chiropractors for the athletes. We used one of the racquet ball courts near the main gym for the massage center and also provided fruit, balance bars, water, ice, and minor first aid supplies.

The athletes came in repeatedly to partake of the support services but also to hang out and talk to each other and to us about their events. The atmosphere there was an inspiring example of camaraderie, friendship, and sportsmanship among competitors. Athletes were graciously deferring to others whose needs were more immediate, for whatever reason. Among the joking around there was an atmosphere of honor, friendly respect, and true support for each other in the efforts made there that day. I saw not one hostile act between competitors.

We stretched some athletes, used acupressure and shiatsu on others, revved some up, calmed some down, helped them recover their enthusiasm and energy after a tough round, and got them back out on the mats ready for another bout. There were surprisingly few injuries to be addressed. Rickson wanted his association members to have that support as part of what their entry fee provided for them in the experience of competition.

It was a long, very rewarding day for the team. The competitors came back again and again for massage between their events and there were no restrictions placed on them as to how best to utilize the services we provided. For many of these athletes, this kind of support provided for them was a novel and highly appreciated experience. Thanks to Rickson's insight, we all learned a lot from the experience.

In a transition from the preceding section's illustrative emphasis on both the preventive and recuperative abilities of massage and it's role in recovery, the following sections now turn to more acute instances of injury management. Several sections have been adapted by permission from the Penn State Sports Medicine Newsletter.

Common Martial Art Injuries

Eye Injuries (Reprinted with permission from the Penn State Sports Medicine Newsletter)

If struck forcefully in the eye while training or competing (whether by a finger, fist, elbow, or foot), seek an immediate examination by an ophthalmologist. "Assume that any trauma severe enough to cause blurred vision or bleeding around the eye is sufficient to cause injury to the eye itself," says Paul Vinger, M.D., associate professor of ophthalmology at Tufts University Medical School and a consultant to the U.S. Olympic Committee.

According to Vinger, immediate medical attention is warranted when an injury to the eye results in blurred vision that doesn't clear, double vision, significant pain or bleeding in and around the eye.

A "blowout"fracture is another eye injury that requires immediate attention. When the thin bone that serves as the floor and wall of the orbit of the eye is fractured by an opponent or an object (such as a weapon or piece of equipment), the eyelid droops as the eye sinks and goes back into it's socket. Experiencing double vision is another common symptom of the injury. "Approximately 10% of all patients with blowout fractures also have significant injury inside the eye," says Vinger.

Immediate Treatment. After suffering a blow to the eye, the only effective self-care is to close the eye and apply an ice pack directly over it. The cold temperature keeps swelling to a minimum. Without ice, a cold soda can soda will do. By immediately combating the swelling, this also reduces the level of subcutaneous bleeding, which causes the black and blue discoloration of the eye. If there is no obvious bleeding in the eye, aspirin may be taken for pain relief. If there is bleeding, however, acetaminophen (not aspirin) should be taken to decrease the chance of further bleeding.

The Eye Exam. A complete eye examination after an injury will include a careful vision test, a check to rule out a blowout fracture, and a complete opthalmologic examination. In addition, the physician will examine the surface and the anterior portion of the eye. The lens of the eye will also be examined to make sure there are no abnormal movements signifying dislocation.

In the opthalmologic examination, the physician will check the back of the eye for any trouble with the retina, the light-sensitive layer that lines that portion of the eye. When a retinal tear is discovered immediately after it occurs, it usually requires minimal treatment, and the procedure has a very high success rate.

Prevention. Eye injuries shouldn't be considered an inevitable part of sports participation, even for fighters. "Protection is virtually assured," says Vinger, "when the athlete wears protective eyewear during practice and competition." (Of course, such eyewear may not be allowed or even feasible during the training and/or competitive phases of some combat sports, but in most cases, protective headwear along with proper gloves and/or boots will go a long way in preventing eye injuries in sports such as boxing and kick-boxing).

Eyeguard lenses should be made of polycarbonate (a plastic that is ten times stronger than glass) or a plastic called CR-39. This material resists shattering and also softens any impact. Make sure the frame is 3mm thick and that it meets the racquet-sports frame standard F803 of the American Society of Testing and Materials (ASTM).

NOSEBLEEDS (REPRINTED WITH PERMISSION FROM THE PENN STATE SPORTS MEDICINE NEWSLETTER)

The cause of nosebleeds is usually an impact to the nose from an opponent's foot or fist, but sometimes the nose bleeds because of a seasonal nasal allergy, a sinus infection, or a winter cold that irritates and weakens the delicate nasal lining.

To stop a common nosebleed that occurs during a workout or competition, Michael J. Lynch, M.D., team physicians at Penn State and a member of the Newsletters Board of Advisors, recommends the following measures:

1) Stuff a soft material such as a piece of tissue or cotton in the affected nostril. Sit or stand upright with the head tilted forward to lower blood pressure to the head. This will also prevent the escaping blood from flowing down into the throat, which can lead to fits of coughing, gagging, and in some instances, vomiting.
2) Apply pressure to the dividing wall between the nostrils by squeezing the nostrils between the thumb and forefinger. Breath through the mouth and continue to apply this pressure for at least one minute, timing this with a watch. Remove the tissue before resuming activity.
3) If the nose continues to bleed, apply pressure for five additional minutes. Again, time this with a watch. To assist in controlling the bleeding, squeeze the bridge of the nose. If the bleeding continues unabated after fifteen minutes of steady pressure, contact a physician so the nosebleed can be evaluated and treated.
4) Once the bleeding has stopped, avoid nose-blowing for several hours or it may bleed again. Apply an antibiotic ointment (Bacitracin) to a cotton-tipped applicator and gently rub it on the inside of the nose. The antibiotic will help kill any bacteria, while the ointment keeps the nasal lining moist. Reapply the ointment for several days, especially before going to bed at night.

CONCUSSIONS (REPRINTED WITH PERMISSION FROM THE PENN STATE SPORTS MEDICINE NEWSLETTER)

During the final playoff game to win a Super Bowl berth, Dallas Cowboy's quarterback Troy Aikman rammed his helmet into the knee of a defensive lineman while attempting to avoid a sack. One play later, he was on the sidelines. When he began talking gibberish to a teammate and failed to answer a series of questions posed by a team physician, it was obvious he had sustained a cerebral concussion. Aikman was kept out of the game and spent that night in a hospital for observation. The next day, Aikman said he was all right, but he remembered very little about the previous day's game.

It has been reported that during the week preceding the Super Bowl, Aikman still had lingering effects from his concussion. Although he led Dallas to their second straight Super Bowl victory, he quickly bowed out of the follow-up Pro Bowl, claiming he was still feeling the effects of his head injury.

"Allowing Aikman to play in the Super Bowl sends a very bad message," says Robert C. Cantu, M.D., a neurologist and medical director of the National Center for Catastrophic Sports Injury Research. "He was allowed to play because of the magnitude of that particular game, but I don't think he understood the risk he was taking."

Many athletes and coaches consider concussions minor injuries that shouldn't preclude further competition. But, as leading neurologists warn, misguided thinking like this can lead to further injury caused by the impaired coordination and judgement that often follow concussions.

In addition (although this is rare), athletes who sustain a second minor head injury

before fully recovering from a concussion may suffer Sudden Impact Syndrome, a catastrophic swelling that may be difficult, if not impossible, to control.

No one is certain of the long-term effects of concussion. While some athletes claim to have had twenty or more concussions in the course of their careers, it's thought that the effect of repeated blows to the head may be cumulative, leading in some cases to the "punch drunk"syndrome.

Therefore, in an effort to protect athletes from either overzealous coaches or from their own drive to continue competing, Hugh H. Greer, M.D., consulting neurologist at the Santa Barbara Medical Foundation Clinic, recommends that athletes who suffer a second concussion during the competitive season not be allowed to practice or compete for the remainder of that season.

What Happens and to Whom. A cerebral concussion is a traumatically induced injury to the head that brings alteration in mental states, sometimes (but not necessarily) with loss of consciousness. A concussion requires a blow that rapidly accelerates the brain inside the cranium in a rotational pattern. This movement torques the brain, exerting shear forces, and it's forces like these that the brain tolerates least. This movement of the brain within the skull may cause microscopic damage. "The brain is fairly soft and malleable and can absorb a fair amount of energy," says Greer. "But if the forces are strong, nerve fibers and cells can be damaged." Confusion, along with amnesia (either instantaneous or delayed several minutes) are classic symptoms after such a head injury.

More severe concussions cause unconsciousness lasting five minutes or longer, with a post-traumatic amnesia that could last for days. "The likelihood is high that you are losing brain cells during this period of time," says Cantu. "Even though you will recover, chances are you will not be 100% as you were before the injury."

The athletes most prone to concussions are those involved in collision sports. "Anybody who may collide with another player, the ground, or an object faces the risk of concussion," says James P. Kelly, M.D., Director of the Brain Injury program at the Rehabilitation Institute of Chicago. It's estimated that 20% of high school football players suffer concussions each year, some more than once.

Kelly notes that, in addition to football, athletes participating in martial arts, wrestling, horseback riding, swimming, diving, ice hockey, basketball, and gymnastics are also at risk. Even a seemingly safe activity such as running is not without danger. Three years ago, a runner in the Twin Cities Marathon in Minneapolis sustained a concussion from a fall and had to be treated.

Leading Symptoms. It's important to note that an athlete can suffer a mild concussion without losing consciousness. Concussion symptoms vary, depending on the degree of severity, which is assessed on a scale of one to three that was developed by Dr. Kelly and members of the Sports Medicine Committee of the Colorado Medical Society. These symptoms may include dizziness and impaired orientation, concentration, and memory. Headache is the most common complaint of concussed athletes, but is not present in all cases.

Often athletes who are concussed, but not rendered unconscious, won't report the concussion and will attempt to finish a workout or competition as if nothing happened. However, there are often physical signs that can tip off alert observers. "There may be a diminished frequency of blinking" says Kelly, "or the athlete may have a glassy-eyed, bewildered look. The athlete may also look worried and concerned and may ask the same questions

over and over. On rare occasions, athletes will cry because they are extremely confused and nothing makes sense to them."

When to Resume. Most authorities agree that when an athlete has sustained a mild concussion during training or competition (typified by mild confusion but with total recall of the incident) the athlete can return to action within 20 to 30 minutes if there are no symptoms whatsoever.

Cantu notes that it goes against most athletes' competitive nature to remain on the sidelines, so they'll often cover up their condition. A short memory test and exertion exercise should clear up any doubts that a physician or coach may have.

"Every five minutes, name a color, someone's name, and two common objects," says Cantu, "and have the athlete repeat this listing a minute later. If they're having trouble processing new information, which is a typical symptom of amnesia, they won't be able to repeat your list and shouldn't be allowed to play."

If the athlete passes the mental exams, he or she should then perform five repetitions each of push-ups, sit-ups, and knee-bends. The athlete should be kept on the sidelines if there is any nausea, dizziness, headache, or blurred or double vision.

Kelly urges all athletes who sustain a concussion and develop amnesia, post-traumatic headache, or have any other lingering symptoms to seek expert advice, either from their team or family physician or neurologist. After symptoms subside, they should be kept from practice or competition for a minimum of seven days. Athletes who require hospitalization can resume practice and competition one month after they have been symptom free for two weeks. In all cases, once the athlete returns to action, the coach and trainer should be on the alert for any gait problems, headache, or other abnormal symptoms.

Strengthening Neck Muscles. Concussions can happen to any athlete, but some people may be more susceptible than others. "In general," says Cantu, "you are at greatest risk for head or neck injury when you don't have sufficient neck musculature to overcome whatever it is that's imparting acceleration forces to your head."

The following exercises, in which athletes contract their neck muscles and push against a fixed resistance, help build overall neck muscle strength. Perform the exercises slowly and steadily throughout the full range of motion.

1) *Forehead Push.* While sitting, place one palm on the forehead. Tense the neck muscles and try to push forward. Resist with the palm so the head moves slowly forward. Repeat five times.
2) *Head Push-Up.* While sitting, tilt the head slightly forward and place one palm on the back of the head. Push against the resistance, gradually tilting the face upward. Repeat five times.
3) *Side-to-Side Push:* While sitting and looking forward, place the right hand to the side of the head and gradually move against the resistance until moving the head to the right as far as possible. Repeat five times and then perform the exercise on the left side.
4) *Side-Bends.* While sitting, place the right hand to the side of the head and gradually tilt the head against the resistance until the hand touches the right shoulder. Repeat five times and then perform the exercise on the left side.

Cuts, Scrapes, and Abrasions (Reprinted with permission from the Penn State Sports Medicine Newsletter)

Cuts, scrapes, and abrasions are the most common type of athletic injury. These injuries, commonly known as open wounds, should be treated promptly and properly to avoid infection.

Before any wound is treated, the individual providing care must protect himself. Attention to proper hygiene and the use of personal protective equipment is essential. Always wash one's hands thoroughly before and after any contact. Disposable gloves should also be worn, and then properly disposed of after any contact with blood or body fluids.

If a wound is bleeding heavily, stopping the flow of blood should be the first priority. Once the bleeding has been brought under control, properly bandage the wound to prevent infection. Following is a simple, step-by-step approach to bandaging the majority of open wounds.

1) Wash hands thoroughly and put on a new pair of disposable gloves.
2) If the wound is bleeding, apply direct pressure with a sterile gauze pad. Small wounds with minimal blood flow can be cleaned while they are still bleeding.
3) Apply a liberal amount of aerosol soap or warm, soapy water. Wash with a new, sterile gauze pad. Start from the inside of the wound and work out. Wash at least two inches around the wound site to kill any germs near the wound.
4) Once the wound is washed, dry the area with a new, sterile gauze pad.
5) Saturate another sterile gauze pad with a small amount of antiseptic germ killer (hydrogen peroxide) and clean the wound.
6) Apply an antiseptic ointment to the wound, being careful not to touch the tube to the wound.
7) Apply a new, sterile gauze pad and secure with a gauze roller bandage and elastic wrap or some form of underwrapping.
8) Apply adhesive tape to keep bandage in place.
9) Do not attempt to remove debris that remains in a wound after washing. Removing debris is a physician's role.

Puncture wounds, which are caused by pointed objects penetrating deep into the skin, should not be washed with soap and water. Puncture wounds are too deep to allow contact with anything not sterile, but they should be disinfected and bandaged.

Proper wound treatment and disposal of blood-contaminated wastes are important elements in an athletic health care program. The procedures outlined above are a good starting place, but seek immediate medical treatment with questions or concerns about an injury.

Joint Problems and Injuries

(The following section was adapted from a series of articles by the author in conjunction with Dr. Sal A. Arria for *Muscle & Fitness* magazine.)

Most athletes are no strangers to joint problems, and martial artists are no exception. The following section deals with the most common joint problems and injuries, and offers a range of preventive suggestions and solutions. Remember that with any medical problem, the most prudent first step is to consult with a competent sports medicine physician, chiropractor, or other health care specialist.

The Elbow

Considering the incredible and constant strain the elbow experiences, it is a very sturdy joint! The elbow is a ginglymus, or hinge-type joint, formed by the humerus bone of the upper arm and the radius and ulna bones of the lower arm. Although only flexion and extension occur around the elbow itself, the joint also permits rotation of the radius around the ulna.

The elbow is encased within an extensive synovial membrane, which synthesizes synovial fluid for the purpose of lubricating the joint. The elbow is quite stable, owing to the numerous tendons and ligaments that contribute to it's integrity. In fact, over a dozen muscles cross the elbow joint, not just the biceps and triceps!

Causes and Pre-conditions for Elbow Problems. Acute traumatic elbow injuries are fortunately rare. Those that do occur are almost always the result of extreme stress in power and explosion events such as judo, wrestling, boxing, and various forms of full contact combat. Traumatic injuries of any type must receive immediate medical attention by a qualified sports medicine physician. Chronic injuries in the elbow are usually a result of overuse. Fighters often suffer from such conditions. Most athletes fail to consider the cumulative impact of all stressful events on the elbow, limiting their attention only to training-related stress. Some of the occupations that present certain risks to the elbow include mechanics (constant work with wrenches, screwdrivers, etc.), secretaries and office workers (constant typing, and writing), and health professionals (massage, physiotherapy, and other forms of physical manipulations).

These types of people are at risk for repetitive overuse syndrome (R.O.S.) to the elbow, due to constant and excessive contracture of the gripping muscles (all of which cross the elbow joint). Most R.O.S. of the elbow is seen in the dominant side, so "handedness" becomes an additional factor to consider in these types of injuries.

In grappling disciplines, clenching the gi repetitively during throws often tightens the flexor tendons of the hand wrist and/or arm, resulting in a possible overuse tendinitis of those flexors at the medial epicondyle and/or restrictions due to myofascial adhesions throughout the forearm.

Intense sparring involving choke holds is highly abusive to the biceps, brachialis, and brachioradialis tendons just above the elbow or at their attachments on and near the lateral epicondyle of the forearm. The tendon of the long head of the biceps at the shoulder could also experience overuse from too many hours spent choking an opponent without considering recovery methods.

The vulnerability of the elbow is apparent in the tiny size of the tendinous attachment sites, of which there are many. These sites can become progressively weakened by both impact and the dynamic forces of leverage. This leverage means that ten pounds in the hand equals approximately 45 pounds at the shoulder joint, for a person with average arm length.

Another way to view this phenomenon is to compare the force achieved by turning a bolt with a long-handled wrench, as opposed to a short-handled wrench. Using this analogy, it's easy to see how a boxer throwing a wide hook can impart high leverages to the elbow, as compared to a tightly thrown hook.

The impact of repetitively hitting an opponent or a heavy bag can result in high levered forces, causing cumulative microtrauma to the tendinous attachment sites at the elbow. Over time, if not treated, these tendons actually begin to fray, much like a nylon rope would if stretched beyond it's tensile strength. Eventually, the tendon can detach from it's attachment site at the elbow, requiring surgical repair.

It's important to note that tendons and musculotendinous areas in muscles fatigue first in sport and are the places most commonly prone to overuse type injuries. One way to prevent this is to ensure that the areas which are highly stressed in one's discipline are strengthened adequately to withstand the loads placed on them.

Stretching the forearms after exercise is helpful to keep the fascia within muscles and tendons flexible and unadhered. An individual who feels the possibility of a trauma or tear to a muscle or tendon should apply ice immediately to induce recovery before the inflammation involves surrounding tissues as well. This will often resolve the problem before it becomes a bigger one. If ice is not readily available, use the nearest soda can. Even five minutes of cold applied immediately is far more effective at eliminating a potential problem than doing nothing at all.

Treatment Options: From Conservative to Radical

1) *Rest.* The most effective yet overlooked aspect of post-injury recovery is simply to become more aware of and markedly limit activities that cause pain and swelling to the affected area! In light of the elbows ubiquitous role in almost all human activity, this is no easy task!
2) *Massage.* Carefully applied massage techniques can be of great assistance in mitigating the adhesions which result from micro- or macro-trauma out of the connective tissue. Find a physical therapist who works with athletes or a sports massage therapist who knows how to effectively apply cross-fiber friction massage, sometimes called Deep Transverse Friction (DTF), developed by an orthopedist, James Cyriax, for these kinds of injuries.

   Active Release Technique (ART) is also very effective at ungluing the adhered and restricted muscles, connective tissue and tendons. Some forms of deep tissue work like Rolfing can be applied effectively to hypertonic or adhered tissues depending on the skill of the practitioner. Look for someone who has background working with sports applications and specific training for athletes. Personal recommendations from other athletes who have experienced the practitioner's skills are often the best referrals.
3) *Forearm Strap.* This is used by tennis players, golfers, and other athletes with elbow problems. The strap acts like a "shunt," absorbing impact and vibrational forces before they reach the tendinous attachment at the elbow. One of the best straps is the Interceptor (ordering information is in the resources section).
4) *Aspirin Therapy.* Aspirin reduces an edema (swelling). Recovery simply does not begin until an edema has subsided.
5) *Diathermy.* This is a high frequency form of heat which can penetrate as deep as two and one-half inches into injured tissues. Administered by a chiropractor or physical therapist, diathermy promotes circulation to the injury site, accelerating the healing process. Diathermy should precede cryo-therapy treatments.
6) *Electrostimulation:* Moderate to intense amounts of intermittent electrostimulation are applied directly to the injured tendinous area or ten to fifteen minutes per session. This form of electrostimulation is most effective when it follows diathermy and is followed up with cryo-therapy.
7) *Cryo-Therapy:* After diathermy or deep massage, construct an ice pack by placing crushed ice in a "zip-lock" bag, or keep a package of frozen peas in the freezer, marked "do not eat," and use them. These frozen packages are cheap and mold well around the joints. Alternatively, "blue ice" is very inexpensive now, retains its soft gel like texture when cold, and sometimes comes with a neoprene wrap which can be Velcroed around a wounded area for icing several times a day without having to stop other activities to do it.

   Cryo-therapy is very beneficial in reducing edema, reducing pain, and pumping muscular tissues free of accumulated training-induced waste products. Spend at least five minutes, but no longer than twenty minutes on the ice.

Upon initial discovery of an injury, ice it as much as five times the first day or two depending on the extent of the trauma, with at least an hour between each icing. After removing the inflammation and edema, ice also causes reflexive dilation of the capillaries, thus ensuring increased blood flow to the area, bringing in the nutrients and proteins required for cellular repair. It is a very simple but possibly most effective tool for quick recovery from the minor glitches which often come with sport training.

8) *Cortico-Steroids.* Administered by injection to the injury site, cortico-steroids help to reduce inflammation and pain. The drawback, however, is that these agents cause a breakdown of collagenous and ligamentous tissue after repeated injections.
9) *Proliferent-Injection Therapy.* This describes an injection directly into the injury site, causing an "artificial injury" which then provokes the collagenous cells to begin restructuring themselves more quickly.
10) *Surgery.* In the most extreme cases, a torn or avulsed tendon or ligament may require surgical reattachment. This is "the final straw" when it comes to solutions for joint problems! Many methods are used, including tendon grafts, and stapling.

Prevention is the key! Fortunately, most serious elbow problems can be completely prevented with good training and work habits, and immediate intervention upon the onset of trouble. Never train through elbow pain. Instead, seek the immediate guidance of a qualified sports medicine physician or chiropractor.

The Shoulder

Any athlete training for more than two or three years has probably experienced shoulder pain. More than any other joint, the shoulder seems particularly prone to injury, both chronic and acute. Once shoulder pain has set in, even routine daily tasks such as putting on a shirt overhead or shampooing in the shower become burdensome. Training seems beyond the bounds of possibilities, since nearly all movements involve the shoulder in varying degrees. Even squatting and calf raises involve and can aggravate shoulder problems.

The shoulder's role as the "black sheep" of joints stems from it's structure. First, the gleno-humeral (G/H) joint (where the head of the humerus attaches to the shoulder complex) is a ball-and-socket type joint, but unlike the hip, the G/H joint is quite shallow. In fact, the bones contribute little to the joint's stability. That role falls onto the surrounding muscles and their tenuous attachments, as well as the capsular ligaments. Always remember that the shoulder's forte is mobility, not stability.

The second structural factor leading to shoulder dysfunction is the enormous leverage that can be applied to the shallow G/H joint by the arm. Remember that for a person of average arm length, a ten-pound dumbbell in the hand equates to over forty-five pounds of force at the shoulder joint when held out at arms' length, such as in a lateral raise.

Causative Factors in Shoulder Injury. Shoulder injuries stemming from both sports and training-related events are summarized below:

Sports-Related Shoulder Injuries.

1) *Falling.* In many combat disciplines, including wrestling, judo, aikido, sambo, and other grappling arts, falling is inevitable. During a fall, the hand instinctively reaches out to break the fall, decelerating the body's downward movement with the arm outstretched. This instinctive reaction creates a long lever which results in tremendous mechanical forces to the G/H joint-fulcrum, often leading to injuries ranging from strains and

sprains of the surrounding muscles and ligaments to subluxation (less than a full dislocation) or in the worst-case scenarios, dislocation of the joint.

2) *Striking/punching.* Any hitting or swinging movement is essentially an attempt to separate the G/H joint, in biomechanical terms. Toward the extreme range of movement in any punching skill, the rotator cuff muscle group is responsible for decelerating the arm. Since many individuals have very weak rotator cuffs and posterior deltoids as compared to the anterior shoulder muscles, the deceleration aspect of the punch often results in strains and sprains of the shoulder's soft tissues, especially those of the rotator cuff.
3) *Impact.* Nearly all combat sports involve direct and often violent impact to the shoulder and arm. Direct blows to the upper arm in particular can "pry" the G/H joint apart, creating injuries ranging from microtraumatic soft tissue injuries to shoulder separations.

Additionally, multiple shoulder injuries stemming from years of athletic participation often result in adhesions, loss of range of motion, calcium deposits, and degenerative changes to the joint itself. With each new injury, the shoulder becomes both more prone to, as well as less capable of withstanding, further injuries.

Training-Related Shoulder Injuries.

1) *Bench Pressing.* Arguably the most popular current-day gym exercise, this great builder of pectorals also results in legions of shoulder wrecks. Besides contributing to the imbalance between the anterior and posterior muscles of the shoulders, the bench press has an almost mystical allure for many trainees, making it more of a demonstration event than a training exercise for many.

The bench is the vehicle for more forced repetitions, heavy negatives, missed attempts, and bad training form than any other exercise. Over 90% of all shoulder injuries from bench pressing occur during the transition or amortization phase between the negative and positive portions of the movement.

Specifically, a rapid lowering of the bar prior to pressing upward results in large linear momentum forces which must then be quickly reversed by the shoulder musculature before the bar can be raised. When these forces exceed the strength of the joint mechanism, the shoulder may not be capable of reversing the accumulated momentum, which means that the lifter will miss the lift, suffer a muscle tear, or both. For this reason, always lower the bar with complete control. This does not mean a full "coffee break" pause, however! With the exception of a competitive powerlifter, a controlled "touch-and-go" movement is best.

2) *Muscle Imbalance.* As noted earlier, most trainees neglect the posterior shoulder musculature in training. Most popular gym exercises such as bench-presses, seated-presses, lat pulldowns, and so on involve internal rotation of the humerus at the shoulder joint. The movements that work the external rotators, infraspinatus, part of the rotator cuff group which reinforce the capsule of the shoulder joint (bent laterals, etc.) have little are no cosmetic value, so few trainees do them. That is, until they suffer a shoulder injury. Eventually, the weaker muscles in the rotator cuff become virtually useless in performing their intended role in stabilizing the shoulder.
3) *Overtraining.* Not in the traditional sense (i.e., performing deltoid exercises too frequently), but in the sense that whenever a bar or dumbbell is in hand, there is stress on the shoulder joint. From this perspective, even exercises for the back, biceps, or triceps can significantly aggravate existing chronic shoulder symptoms. Avoiding this type of overuse demands a purposeful, conscious approach to nearly every movement, both in

and out of the gym! Some of the most common movements, such as getting up off of the floor after doing crunches, opening a car door, or putting on a sweater can add stress to a malfunctioning shoulder.

The Knee

The prevalence of knee problems among martial artists can be attributed in part to the fact that the knee is an anatomical vortex of sorts, where the body's largest and strongest muscle groups converge upon a tiny, though sturdy kneecap (in most cases). When this structure suffers from improper kicking technique, exercise form, and/or unsuitable training gear, the prescription for disaster becomes compounded exponentially.

Common Knee Problems and Solutions.

1) *Chondromalacia.* Defined as an abnormal softening of cartilage which roughens the underside of the patella. Causes may include obesity, improper footwear, inadequate quadriceps flexibility, repetitive overuse, or genu valgum (knock knees). Chondromalacia causes pain when rising out of a seated position or ascending stairs. When chondromalacia is suspected, discuss the problem with a doctor. Prescriptions include cold and/or heat packs, anti-inflammatories or exercises to correct possible underlying causes from muscle strength imbalances between vastus medialis and lateralis.
2) *Instability.* This is indicated by a tendency for the knee to suddenly "give out," usually caused by lax ligaments from old injuries. Any individual who experiences a knee suddenly giving out should immediately see a doctor. If torn structures are ruled out, the doctor may prescribe leg extensions with toes pointed inward to strengthen the medial quadriceps.
3) *Locked Knee.* This is usually caused by a torn meniscus cartilage or a loose body within the joint cavity. A locked knee should receive prompt medical attention. Arthroscopic surgery is often warranted, with good results. If left unattended this could deteriorate into an arthritic knee, a much bigger problem.
4) *Swelling/Tightness.* Almost without exception, this indicates an internal injury. Stop training and seek competent medical assistance immediately. Do not try to force a knee which is swollen and unable to fully straighten or flex into full ROM. Otherwise, this could turn the temporary swelling into a permanently injured or arthritic knee. Not a good plan.
5) *Crepitus.* Defined as "noisy" knees that snap, crackle, and pop. If the crepitus is not painful, don't worry. But if pain and / or swelling accompany the noise, see a doctor.
6) *Arthritis.* Osteoarthritis is the "normal" wear and tear of the joint. It often occurs with age and overuse. Rheumatoid arthritis is the more severe and disabling form of joint inflammation (and sometimes destruction). If a doctor confirms arthritis, avoid high impact leg movements, lose excess weight (if applicable), and perform exercises with the doctor's approval. Arthroscopic surgery may help in some cases.

Weight Training Tips for Healthier Knees.

For squats, hack squats, and leg presses, foot position is an important variable in determining training results and safety of the knees. Although each athlete must determine his or her own best stance for each exercise, (based on the person's distinct anatomical peculiarities such as height and leg length), every athlete should consider the following notes about proper stance.

1) The quadriceps muscles can push more efficiently when the feet are pointing slightly outward as opposed to straight ahead. Athletes who squat with a very wide stance recruit the adductors to assist the quadriceps. This can result in undue stress to the medial collateral ligament, abnormal cartilage loading, and improper patellar tracking.
2) In any leg training movement, make sure the knees are tracking directly over the feet, not to the inside or outside. Many athletes turn their knees inward when rising up from a heavy squat, and they usually aren't aware of it. Get feedback from a coach, training partner, or videotape of a training session to preclude this mistake. Athletes who discover they are turning their knees in should reduce their training load until proper technique is achieved and the legs become strong enough to perform the movement correctly.
3) When rising out of a squat, always push from the heels. This not only keeps the shins more vertical, but also allows the hamstrings to contribute to the movement with maximum efficiency. Balance improves as well, adding an extra margin of safety.
4) Although many athletes use a very close stance (feet together) for the purpose of isolating the quads when squatting, remember that anything that isolates the quads also intensifies the shearing forces to the patellar tendon and ligament. Some have knees that can take this kind of abuse, but others don't.
5) When squatting, try to be efficient in the exit from the rack, and while establishing stance. After lifting the weight from the rack, take just one step backward and assume the squatting stance immediately. This takes time to master, but the reward is to get right into the stance without lots of minute adjustments. Once set in the stance, keep the feet "nailed down" for the duration of the set. Many people fidget with their feet and toes between repetitions which can cause a variety of problems, ranging from a break in concentration to a loss of balance.

Training Shoe Selection and Knee Health.

Athletic footwear is the foundation of leg training. Wearing broken-down fitness shoes (or so-called "kicking shoes" that are recently popular) for heavy squatting or leg pressing is like putting old, worn-out tires on a race car!

Why? Because most general purpose fitness shoes simply lack adequate stability, and have little or no arch support for heavy lifting. During squats, many athletes pronate, or "cave in" their feet. When this happens, the knees are also forced inward, leading to a constant strain on the medial collateral ligament, excessive shear force on the meniscus, and improper patellar tracking, all of which lead to chondromalacia. Those whom pronate anyway, or are knock-kneed, have an even greater need for good training shoes.

Specialized shoes provide a deep and solid heel cup, which prevents the feet from rocking and rolling laterally (to the outside) when they're compressed under heavy loads.

It's also worthwhile to know the difference between a worn-out shoe and one that's broken down. Even if a pair of shoes look fine, they still may offer no arch or heel support at all either because they never had any to start with or because after a handful of heavy leg sessions the supports have compressed to the point where they no longer function as they were intended.

Think about it: A tennis shoe is meant to support a 160-pound tennis player, not a 600-pound leg press! Loads like these cause the shoe to break down without visual signs of wearing out. Choose a heavy duty training shoe for use in weight training only. Use a stable running shoe or cross-trainer for other training activities.

Therapeutic Options.

1) *Cryotherapy.* The "gold standard" of therapy for minor knee pain or swelling, the application of ice reduces edema, promotes circulation, and deadens pain. Crushed ice in a "zip-lock" bag makes the most effective ice pack. The effectiveness of cryotherapy is perhaps doubled when applied with the leg elevated. With the ailing leg in a vertical or nearly vertical position, (lie down on the floor and put a heel on the wall), use an Ace bandage to secure an ice pack to the injured knee. This procedure reverses the hydrostatic or columnar pressure which accumulates during a long day of standing.

When experiencing any trauma to the tendons or ligaments of the knee, employ ice massage immediately to help speed up the healing. Wrap the back one-third of an ice cube with a paper towel to make a handle. Or, freeze a dixie cup of water and peel away the top one-fourth of the paper and use the edge of the ice as a tool. Many athletes prefer the square shape because the corner is a more precise tool to place exactly on the site of the lesion. Rub the ice back and forth across the site of the lesion (the exact spot where the pain is) moving the skin and underlying tissue as one.

Repeat this cross-fiber ice massage for thirty seconds to two minutes for each spot which is painful, then follow it with five to fifteen minutes of regular ice therapy to enhance the chances of removing an adhesion out of a tendon or ligament before it becomes a worse strain or sprain. This treatment protocol should be applied every other day as long as it continues to improve and for as long as there is still some small sign of pain in the area. Tendons and ligaments can be worked effectively this way immediately after injury. Muscle bellies should not be worked deeply immediately after an injury.

2) *Aspirin Therapy.* As noted previously, most athletes simply don't realize the effectiveness of aspirin for relieving pain, reducing edema, and improving circulation. Many individuals find that minimal dosages work as well for them as larger doses. Check with a doctor about any medication, however. Caffeine is thought to be a catalyst for aspirin, improving it's effectiveness. Those who tolerate caffeine well should consider this enhancement.
3) *Diathermy.* A professional therapeutic modality, diathermy is a high-frequency form of heat that penetrates injured tissues deeper than any other available heat modality. Diathermy increases vasodilation (blood supply) needed to carry nutrients to injured tissues. Any form of heat therapy should be followed by cryotherapy for best results.
4) *Electrostimulation.* Typical use involves electrodes that create a contraction of the surrounding musculature, pumping edema out of the affected tissue. An atypical application, pioneered by former Eastern Bloc sports medicine specialists,[72] involves placing electrodes not on the muscles, but directly on the joint. Moderate to intense amounts of intermittent stimulation are applied for ten to fifteen minutes per session. This type of trans-articular electrostimulation is most effective when implemented immediately after diathermy, followed by cryotherapy and elevation.
5) *Extremity Adjusting.* At times, the relationship between the three bony components of the knee can become slightly askew. By using extremity adjusting, a good chiropractor can easily restore normal alignment.

Conclusion

The integrated recuperative strategies just illustrated are not theoretical! Their success is attributed by numerous athletes of the highest caliber from various disciplines in many countries. The cliche, "an ounce of prevention is worth a pound of cure," is especially true when addressing the value of restoration in sport management. It requires a minimum investment of time and money and requires little or no specialized equipment or facilities. For many individuals, integrating a recuperative scheme into their personal training schedule means the start of new progress, even after long periods of stagnation.

CHAPTER 6

TECHNICAL AND TACTICAL PREPARATION

To this point, discussion has focused exclusively on conditioning, or preparing the body for the demands of training and most important, competition. The next emphasis is technique (or skills training), often referred to as biomechanics. Despite the earlier emphasis on strength, flexibility, and endurance, superior conditioning won't help an athlete unless the skills of his or her discipline are mastered. Instructors and students alike are prone to underestimating the importance of efficient technique, feeling that superior conditioning alone will get the job done.

A telling example are the recent mismatches pitting ex-football players against skilled boxers. The football players were in great condition, however, in all cases the boxer was easily able to do away with his hapless opponent, usually setting new records for brevity along the way. Of course, the same lack of sport-specific training that led to the football player's demise would produce similar results were the boxer foolish enough to test his skills on the gridiron under competitive conditions. To the relief and credit of boxers everywhere, this is yet to occur!

Sport technique is dictated by the nature of the event in general (i.e., the duration of rounds, the amount of contact permitted, and the conditions in which the fight is contested), as well as the rules that are in effect for the particular sport or event (in boxing, for example, amateur bouts are governed by different rules than are professional fights. Each format therefore requires different technical applications). In turn, conditioning methods are based largely on the techniques that will be used during the event.

It is not the scope of this book to define and elucidate proper technique for each and every martial art discipline and combat sport. Instead, recommendations are presented for proper technique training, how to best integrate technique work with conditioning, and finally, tips for athletes who seek to maximize their competitive potential.

How The Body Learns New Skills

It's very hard to break old patterns, old habits and old ways of doing things. That's why it's so difficult to learn new skills for a sport, or to adapt old methods to a new set of training circumstances. One of the toughest of all things to do in sports is to successfully master the skills required of a new technique, and then to apply that technique in a realistic situation.

Unless someone is an absolute natural, which few people are, athletes will likely encounter some clumsiness and awkward moments in their efforts to execute the playing skills required in an unfamiliar sport. But there are ways of mitigating this dilemma.

New technology, scientific studies, and experiments have revealed important information

about adaptive learning. Now, coaches and athletes everywhere can put these theories to work. The basis for learning a motor skill (such as lunging, feinting, hitting, kicking or jumping) lies in that complex nerve network called the central nervous system—the brain.

Young children establish a motor pathway from the brain to the muscles. This pathway determines how muscles do the work that the brain instructs them to do. Some people have very clear and open pathways that enable them to learn new skills more quickly. Others must live with an average system of neuromuscular learning and it takes them longer to get a new move or skill committed to "motor" memory.

The brain makes constant adjustments as muscles are trained to execute a new movement. It processes information, makes decisions instantly, and transmits all this back to the muscular system, which enables performing a movement. Some of these movements are natural, conditioned reflexes that require no conscious direction. If someone yells, "Fire!" people jump, without conscious thought. But other, more complicated reflexes take time to learn. And there's only one way to do it: perfect practice.

It takes practice to learn a new skill, and even more practice to perfect it and make it automatic. The old saying, "practice makes perfect," is true only if the practice is also perfect! That's where a good instructor comes in. A miserable mistake in any martial arts career is to practice difficult skills alone, and perform them imperfectly time after time. More and more repetitions of the *perfect* movement is the key to learning a new skill. The more they are done correctly, the more they are learned. And with more correct learning comes increasing enjoyment. Perfect practice is the bottom line, even for professional athletes.

Most athletes don't appreciate that the neuromuscular system actually "learns." It begins to feel what a new movement is like because it's equipped with many different kinds of sensors, called "proprioceptors," which are also found in the joints, tendons and skin. The most important of these is the muscle spindle, which is activated every time the muscles are lengthened or shortened. It relays the messages back to the brain, informing it which movement is taking place. The Pacinian corpuscle, for example, relays the intensity of a contraction to the brain. It's a sensory nerve ending that measures the pressure deep in the muscle. A third proprioceptor, the Golgi tendon complex, responds to how much stretch is occurring in the tendons.

This ongoing network of communication between the brain and the muscles helps develop new skills by adaptation. The whole intricate process is called internal feedback. This is important in developing a conditioned reflex, and conditioned reflexes are what athletes need to develop. The sooner an athlete establishes a conditioned reflex, the quicker he or she is able to execute new and difficult sports skills.

Of course, it's also important that skills eventually occur without thought, as these processes for development are automatic ones after proper training. Athletes who stop and analyze lose the spontaneity needed to do the movement effectively. This is jokingly called "paralysis by analysis." However, some thought must go into variables that exist in any sport, such as movement and speed of the ball (if there is one) as well as reacting to the actions of the competition.

Progressive Overload

Just as in conditioning, progressive overload governs technical training as well. Novices begin with simple technical elements and then gradually progress to more difficult maneuvers. As an example, an athlete may first practice a kick in the air while holding on to a sup-

port for balance. Later, the kick is performed from the fighting stance, perhaps directed toward a partner for visual reference. In time, the athlete will throw the kick against a heavy bag or air shield. Higher targets are introduced when medium height kicks are perfected. Eventually the fighter is able to use the kick against low- to moderately-skilled opponents, and finally, highly-skilled opponents.

During technique training sessions, the coach should eventually introduce artificially difficult conditions to further improve the athlete's skills. A fighter with weak kicking skills, for example, might be instructed to spar using kicks only. A fighter who has difficulty defending against fast jabs can be "tied" to his opponent by a rope attached to each fighter's ankle. The opponent is instructed to throw numerous jabs, while the defender, who has no choice but to stay in jabbing range, defends, working on his confidence to protect himself using parries and head movement.

Additionally, the fighting arena can be modified to provide increased difficulty. For a fighter who over-relies on "running" instead of staying in fighting range, the ring or mat can be reduced in size, which will force the fighter to stay in range and learn to cope with an opponent's attack.

For skilled fighters with no readily apparent weaknesses, the coach can increase the difficulty by dimming the lights, artificially imposing the rules in such a way that the opponent has a decided advantage (i.e., not allowing the fighter to use his "best" technique), or lengthening the rounds (with, or without telling the fighter). Many applications are possible, but an athlete must challenge his skills in order to progress. Care must be taken when applying the progressive overload principle to skills training on two counts.

First, these techniques should not be applied too early, before the skills in question are adequately developed. By way of example, if a novice fighter is unduly anxious about physical contact, it would make little sense to expose him to particularly rugged opponents as a way of "toughening him up." Instead, a more effective approach would be to engage him in matches where the opponent offers half-hearted attacks which can be easily defended. The instructor can assist by keeping the atmosphere lighthearted and fun. As the fighter gains confidence, the conditions can be made gradually more difficult.

Second, progressive overload methods must be enacted with a heightened awareness of safety. When a fighter is exposed to very difficult conditions, he may panic, which creates an increased potential for injury, particularly to his opponent(s). Also, the inherent dangers in sparring in low light, for example, are obvious. Always use appropriate safety precautions (i.e., extra protective gear, closer than usual monitoring of the combatants during the drills, etc.) when applying these drills. A good rule of thumb is to limit the time of the drills to 50% or less of the usual duration of the competitive conditions.

Variability

If a fighter is constantly exposed to the same types of training stimulus, he or she will reach a "plateau" faster than if a variety of stimuli are utilized. Of course, for novices, nearly all training represents a new form of stimulus, and therefore, variability will not be an issue. But for advanced fighters who are already close to their "ceiling" of potential, the introduction of variability in training is a necessity for further improvement.

Physiologically, the need for variability is predicated on the fact that the body's systems will react to a repeated stimuli with less and less "alarm" over time. Eventually, no reaction

can be elicited at all, no matter how severe. The solution is not to make ensuing training sessions more difficult, but instead, more diverse.

Providing diversity in training is limited only by the instructor's imagination. There are innumerable ways to accomplish this task such as training outside instead of indoors, training at an unfamiliar gym, or against unfamiliar opponents, training in encumbering clothing, sparring in water, or in sand, sparring with unusual rules (such as allowing throws for boxers), or even practicing new fighting disciplines. Even the introduction of dance, other sports activities, or training to music can be employed.

Variation and diversity not only helps to ensure continued development. It also provides an occasional bit of fun, keeping things interesting when the athlete may be feeling psychologically drained due to the heavy demands of training. Depending on the facilities, it may be productive as well as refreshing for fighters to swim or play basketball, etc., after a hard training session. This sort of activity is also an effective cool-down and a transition from the high stresses of training, and the lesser stresses of daily life.

Methods of Technique Training and Skill Development

Whenever executing a technique, athletes need some way of knowing how closely that movement conforms to "correct" technique. Otherwise, athletes are relegated to performing the technique incorrectly time after time, which is actually worse than not practicing at all! Why?

By practicing a skill time after time, individuals entrench neural "habits," making each subsequent repetition more "comfortable" and easy to perform. If practicing skills incorrectly, progressively more work means it will be that much harder to change incorrect technique in the future. This fact gives rise to the axiom "practice doesn't make perfect . . . *perfect practice* makes perfect."

This also explains an interesting phenomenon associated with learning motor skills: when doing something incorrectly, the correct movement will feel incorrect at first. This is, of course, because incorrect technique is associated as correct.

Therefore, *feedback* is primary to effective methods of technique training and skill development. Here are some feedback methods available to martial artists.

1) *A Coach or Instructor.* The most common and important feedback comes from an instructor or coach. An instructor can immediately offer suggestions and corrections before athletes become comfortable with mistakes. Many times, what is "felt," or perceived as correct technique, isn't what an athlete is actually doing. Only an instructor can illustrate the difference. Since he or she has been there before, an instructor may provide shortcuts, saving time and frustration.

In selecting an instructor, he or she need not be a world champion although competence to demonstrate proper techniques is inarguably important. Often, an instructor who was a "natural" athlete might never have taken the time or effort to really understand the execution of techniques. It may have come so easy for "naturals" that an understanding of the underlying technical aspects were not necessary. Sometimes, an instructor with only moderate skills is better able to understand student frustrations and offer workable solutions to problems. Look for an instructor who has successful students above and beyond any other factor.

2) *Mirrors.* These are quite helpful to developing martial artists, providing they know what to watch! Mirrors offer immediate and accurate feedback and allow one to see what's going on with his or her own eyes. Two problems can result from the use of mirrors, however.

First, most people will succumb to only practicing their "pretty" techniques, and not practice the skills that really need work. Obviously, this accomplishes nothing.

Second, over-reliance on mirrors tends to draw attention away from how a movement feels. Since that's what really matters in competition, care must be taken to avoid this problem.

3) *Video.* This offers the same type of quality feedback as mirrors but with the additional advantage that a technique can be played back repeatedly for analysis. Slow motion and stop-frame features make this analysis even more productive. The best way to analyze a video of one's performance is with an instructor, who can offer immediate suggestions for further improvement.

4) *The Evaluation Inventory.* Designed by the author in 1992 to obtain quantitative feedback for fighters, the evaluation inventory is a "list" of technical and tactical qualities coupled with a 1–10 scale for assessment (please see Table 6-1). Unlike quantitative sports such as track and field or weightlifting, martial artists lack a measurable criteria for improvement. A shot putter with a best throw of 60'5" who then throws 60'6" knows performance has improved. But a fighter has little objective feedback on which to base progress. Typically, fighters attempt to measure their progress in three ways.

First, by how well they perform at a meet. Second, by how effectively they handle a given classmate or training partner during a training session. And third, by using their own subjective analysis ("Wow. I feel very sharp today!"). Unfortunately, all three methods fall short of reliability. After all, maybe victory at the meet occurred because certain better fighters happened to stay home that day. Or, could it be that the classmate one finally outpoints was just having a bad day? The immense complexity of sparring makes these types of subjective analyses inadequate to say the least.

The evaluation inventory, therefore, is a successful resolution of this problem. Start by constructing a list of pertinent criteria. Table 6-1 provides suggestions, but alter the form to suit individual needs. The number of elements used depends on various factors, including the fighter's experience level (sometimes called "training age"), and how one plans to utilize the inventory. Following each item is an ordinal scale from 1-10 (1 indicates a poor score, 10 a perfect score). Additionally, the form has space to record how many matches are fought, how difficult they were, and so on. Such data helps to accurately document training, which is important when constructing a long-term training plan.

Immediately following each sparring session, fill out the inventory while memory is still fresh. And, be totally honest! Of course, at this point, the form is still little more than a subjective evaluation. The key to making the evaluation an objective one is to cross-reference it with the evaluations of others, which is most often the instructor. After the sparring session, athletes and instructors fill out the inventory simultaneously on separate forms. Now, both the fighter and coach have a valuable tool with which to target technical and tactical shortcomings, which can then be corrected through modification of the training program. This cross-referencing between the athlete's perception and the instructor's assessment creates a relatively objective analysis.

When an instructor and student assign the same or similar scores to a particular skill or attribute, the evaluation can be seen as reliable. However, when a significant disparity results, (i.e., the student rates timing as an "8" when the instructor rates it as a "4"), the fighter probably has less than accurate perceptions regarding his abilities (or at least that particular ability). Through this process, fighters develop a heightened awareness with respect to their skills and tactics.

Name Date Age Training Age*

Opponent(s) Conditions

*Number of years you've been training

Notes:

Attribute	Score									
Speed	1	2	3	4	5	6	7	8	9	10
Lateral Movement	1	2	3	4	5	6	7	8	9	10
Eye Contact	1	2	3	4	5	6	7	8	9	10
Stick to Game Plan	1	2	3	4	5	6	7	8	9	10
Thinking on Feet	1	2	3	4	5	6	7	8	9	10
Courage	1	2	3	4	5	6	7	8	9	10
Head Movement	1	2	3	4	5	6	7	8	9	10
Feinting	1	2	3	4	5	6	7	8	9	10
Combinating	1	2	3	4	5	6	7	8	9	10
Selects Varied Targets	1	2	3	4	5	6	7	8	9	10
Avoids Telegraphing	1	2	3	4	5	6	7	8	9	10
Accuracy	1	2	3	4	5	6	7	8	9	10
Striking Power	1	2	3	4	5	6	7	8	9	10
Defensive Ability	1	2	3	4	5	6	7	8	9	10
Initiates Exchanges	1	2	3	4	5	6	7	8	9	10
Stamina	1	2	3	4	5	6	7	8	9	10
Technical Vocabulary	1	2	3	4	5	6	7	8	9	10
Sees Openings	1	2	3	4	5	6	7	8	9	10

Matches Fought:

TABLE 6-1: The Evaluation Inventory

While the previous discussion outlined the inventory's basic premise, other innumerable applications are available. Here are some further suggestions.

First, after a match, evaluate the opponent, and him or her do the same. This provides valuable insight into one's best and worst skills, as seen through the opponent's eyes. In many ways, an opponent's evaluation may be a better gauge of one's effectiveness than an instructor (in some cases), since opponents are the ones on the receiving end of techniques!

Second, perhaps once a month, have several people simultaneously evaluate one's sparring. There's truth in numbers, so when all the inventories indicate, for example, telegraphed kicks, martial athletes know exactly what to emphasize in training.

Third, for one month, look through all the inventories. Average the scores to form a concise picture of one's tendencies, both good and bad. During the subsequent month, target weaknesses, then evaluate and average all scores again. Note any improvements.

Forth, after identifying the areas needing work, highlight or underline two or three of these skills on a month worth of inventories. This reinforces emphasis on those skills during sparring matches until those skills improve.

Finally, use the inventories to document training. This is critical for success in athletic training, yet very few fighters bother doing it. On the other hand, if athletes are asked how much money they have in the bank, they know the amount to the penny! Yet if asked how many minutes were spent sparring last month, most probably don't know!

One basic premise of improving skills is to spend more time practicing them. If one doesn't know how much time is spent on them now, how can someone plan future training? When possible, fighters should spar for standard time periods, such as two or three minute rounds. In this way the training volume can be adjusted according to the fighter's needs. When using Table 6-1, you can use fractions to notate your matches. The denominator represents the length of the match in minutes. The numerator refers to the intensity of the match according to one's perceived effort. The multiplier shows how many matches were fought. These fractions can be listed under "Matches Fought."

Tips for Instructors and Athletes

The following suggestions will be helpful for both athletes and instructors who seek to maximize the efficiency of their technical sessions.

1) Don't try to learn when under stress. Relaxation is essential, as stress causes athletes to perform erratically or poorly. Too much emotional tension or anxiety has a severe effect on learning new skills. Also, athletes increase the chance of learning the skill incorrectly and doing it that way from then on if "learning" under stress.
2) Be totally motivated. Devotion to learning and concentration on the skill to be mastered are absolutely necessary. If feeling unmotivated, wait until mentally prepared and work up the amount of motivation that will facilitate total concentration. There's no point in a half-hearted attempt. It takes true time, effort and repetition to do the job properly.
3) Work through the learning plateau. Those acquiring a new skill may reach a plateau where they feel they've done all they can do and can't go much further. Initially, new motor pathways are developed fast, but then growth may seem to flatten out. This could be due to nervous system stagnation. The nervous system adapts quickly and, after doing the same movements for a while, it gets settled and then can't go beyond that level. A remedy is to vary the exercises or skills. Variety stimulates the nervous system and challenges it enough

to keep it highly tuned. Athletes who endure this period, the plateau, will see it pass and be ready for more learning.

4) Use short practices and short rests. Don't try to do too much at one time, as this depletes energies and hinders progress. Work for short periods at high intensity, then take short rests. Continue this pattern over a long period of time.
5) Any new skill benefits greatly from positive mental imagery. This truth is apparent when considering that the brain is where learning originates. Therefore, athletes must keep a prepared state of mind while initiating any new activity. Visualization is a very valuable aid in this process and it facilitates perfect practice.
6) Technical skills should be worked on early in the training session, just after the warm-up. Motor learning is best accomplished when the body and mind are fresh. After intensive resistance training or speed work, the nervous system is fatigued and much less responsive to learning new or difficult skills. As a rule, work on fine movements before moving to more gross (whole body) movements. This rule may be occasionally violated, however, as a way of increasing the difficulty of a workout.
7) Ensure the skill taught is within a student's ability to accomplish. In other words, if someone has difficulty executing a spin crescent kick, that athlete has no business trying to develop a *jump*-spin crescent kick! Always stress basics first.
8) Break complicated skills down into their component parts. Once each component part has been learned, combine them into the complete skill sequence. Using the previous example, students learn to perform a crescent kick, then a spin crescent, and finally, a jump-spin crescent kick. This is called the "whole-part" method of learning.
9) Ensure bio-motor abilities are sufficiently developed before attempting to teach demanding technical skills (such as strength, flexibility, agility, balance, coordination, and so on). Advanced kicking, for example, requires high levels of flexibility, dynamic balance, and speed-strength.
10) Reinforce the relationship between proper technique and a successful result. For instance, "Did you see how, as soon as you picked out a focal point, your balance immediately improved?" or "You didn't telegraph that one at all, and you scored!"
11) Beware of "over-coaching." In other words, stick with the most fundamental point at any one time. Trying to correct everything at once leads to "paralysis by analysis" as coaches like to call it. It helps to look for the "core flaw" or the technical mistake that is at the root of the other errors. For instance, a fighter is off-balance while kicking, which is caused by looking down, which is caused by an uncertainty about his stance. Correct the stance problem and other errors take care of themselves. Address the cause, not the symptoms.
12) Quit when ahead. The body "remembers" the last repetitions of a workout the best (using a neurological analogy). If the last repetitions are poorly executed due to fatigue, athletes reinforce incorrect neurological patterns. Always quit on a well-performed repetition of the skill.

Prioritizing Error Correction

Frequently, a coach or instructor will observe an athlete committing several errors simultaneously during the performance of a skill or technique. Since an athlete can only process so much information at one time, it is wise to focus on the correction of one, or, at most, two faults at a time. But how can the coach decide which faults to address first? Several guidelines seem appropriate.

First, correct any dangerous faults first. For example, an athlete who closes his or her eyes when defending against a punch or kick. Such a fault needs to be given top priority, for obvious reasons.

Second, consider the severity of the error. Faults which are particularly severe in terms of the degree to which they compromise the fighters efficiency. The more serious the fault, the more attention it deserves.

Third, consider the point at which the error occurs. Errors earlier in the technique generally lead to errors at later stages. For instance, poor balance or posture while in the fighting stance will usually result in poor punches, kicks, and / or defensive movements. Therefore, all other things being equal, correcting faults that occur earlier in the technique will yield the greatest benefit.

Finally, ease of correction should be considered. If two faults are considered equal in all of the aforementioned respects and one appears to be more easily corrected than another, it is usually a good idea to correct that fault first.

Teaching Sparring So Students Won't Quit: Personal Contact Versus Full Contact

The following section is graciously provided by Mr. John Graden. John is a former elite level competitor and master instructor. His approach to teaching sparring is perhaps the most insightful application of the principles of specificity and progressive overload available to martial artists. John's approach might seem unusual, but the retention rates (and competitive records) of his students are a testament to it's effectiveness. What follows is his personal account.

• • •

"Few areas of training can define martial arts spirit more clearly than sparring. From 1984 until about 1989 I was training three times a week in a dark, nasty boxing gym with American karate legend Joe Lewis. The only reason we would miss the workouts was the scheduling challenges his seminars sometimes presented. The fighting was hard, brutal and as intense as you can imagine climbing into a 12 foot by 12 foot ring with the man named as the greatest fighter in the history of karate could be. He taught me that the fighting should be as real as possible. He also confirmed my opinion that point karate had little value in instilling the tenacity or attitudinal conditioning necessary to go three rounds with anybody, which we agreed should be a minimum standard for a professional black belt.

My motivation has always been as a teacher, not a fighter or champion. Even though at the same time I was traveling to Europe regularly to compete with the United States Karate Team, I've never had a compelling drive to be a world champion or trophy collector. I've always competed for the education and experience. Whenever I'm in a learning environment, such as working with a great teacher or taking a personal development seminar, I am always asking myself, "How can I teach this to my students?"

In the case of fighting with Joe Lewis the question changed to, "How do I teach this to my students without driving them out the door or to the hospital?" In most schools, sparring is one of the leading causes of drop out among students. Even when the school sticks to the relative stop and go safety of point karate students still drop out. How then could I motivate these students to engage in sparring without hurting them or scaring them off?

I learned that the key is in the perspective you keep in working with your students. If your goal is to get your students to black belt, then you must realize that you have three to five years to accomplish that. It's important then that you structure your curriculum to gradually introduce the student to sparring. There's no rush. Some may argue that the sooner a student starts to spar the sooner they can learn how to defend themselves. My feeling is that if a student drops out because of sparring too early in their career then they will never learn to defend themselves anyway. Not to mention missing out on all the life enhancing qualities inherent in the martial arts. A student that drops out of karate because of sparring is a student we have failed.

In our school, our white and gold belts are required to learn simple block and counters with hand and kick pads on. These are executed against the jab and reverse punch but without any contact. In addition we will have them work slipping drills, target drills, defensive footwork drills and set point movement drills to get them moving and firing. Understand that this represents the first six to eight months of their training. Often schools have their students sparring within the first three months. Ours don't even make contact for eight months.

When the students graduate into the orange and green belt class they begin to actually spar following the rules of light contact continuous karate. However, there is still no head contact but body contact is permitted. Of course, they have headgear, hand and foot pads, shin pads, mouthpiece, rib guards and a cup for the guys.

At this point we begin to devote more and more of each class to limited sparring drills. A limited sparring drill is a sparring match with a strategy other than winning as the goal. For instance, one student might be limited to only a jab to the forehead. For these drills we always target the forehead for safety instead of the face. His partner could then be limited to using only position movement (footwork) and head movement as a defense. So the jabber is working on stepping in and snapping his jab to the forehead while the defensive fighter is learning to slip and move against an attack. The following round we may have the defensive fighter add hand traps to his defensive choices. Round three e may slow things down a bit and put the defensive fighter against a wall to prevent them from running. The final round could allow a counter technique to be thrown. So we're preventing the fighters from being overwhelmed by trying to figure out what to do. At the same time they are actively, enjoyably and safely engaged in a sparring like exercise. The end result is the defensive fighter gains confidence in avoiding contact. You can see in this scenario there is no winner or loser. Instead the students are taught to judge the match by how well they stuck to the strategies of the drill.

While the majority of the class time devoted to sparring is spent on limited sparring drills, we will allow them to go a round or two of free sparring under black belt supervision. The matches always begin with the students introducing themselves and shaking hands with their partner and a review of the sparring attitude towards each other which is "I'll make sure you don't get hurt." Also, explain to the students that while control is required and demanded, they are going to get accidentally whacked on occasion just as they are going to whack someone else. Teach them exactly how to inform their partner the contact is too hard. You can even talk to them about the tone in which they make the request to lighten up. An angry demand may elicit a different response than a respectful but firm request. Respect and courtesy are the key attitudes and make sure that the person being requested to lighten up is taught that "Yes ma'am" or "Yes sir" is the only acceptable response. Only the person getting hit can determine the contact level and they cannot be questioned.

After an additional eight months in that class the students graduate into the blue and red

belt level. At this point, they are allowed to make light head contact in addition to moderate body contact to the rib guard. Students are taught to strike the head gear and not the face. You may think that 12 to 16 months is long time to wait to spar with head contact. I think many of your students might disagree with you. I would also argue that your students have a lifetime to spar from that point on. Students must be mentally conditioned and their confidence and tenacity built to prepare them for actual sparring which is part of the Phase One training explained earlier in the book. At that point mentally they are ready to face the challenges sparring will present. But now, after a year of training they're ready to meet it head on with excitement and anticipation instead of anxiety and trepidation. Eight months later they graduate into the brown and black belt class where the intensity and contact level is somewhat more "realistic." But after close to two years of training and preparation these students are ready for the challenge mentally and physically.

Take good care of your students and nurture them along to ensure they are going to be part of your school and part of our martial arts family for a very long time. When they enroll, they are investing a lot of trust in your leadership and guidance. Few areas of the martial arts can be as confusing or intimidating as sparring. Keep a long term black belt oriented perspective on training your students and you will have a much better chance of having them stick around to successfully achieve that goal and more."

PSYCHOLOGICAL PREPARATION: COMPETITION DAY

(The author acknowledges Fred Hatfield, Ph.D., for his contributions to this chapter.)

The day of reckoning. The day that one puts together, in an encapsulating effect, all the preparation. The lifting. The pain and discomfort of sparring. The injuries. The mental visualization. The abandonment of social life. Everything is for the day of reckoning. But unfortunately, all too often, even though all went well beforehand, the martial artist fails to live up to his or her potential. It's easy to forget that the events at the tournament itself are important as well.

This chapter is devoted to methods that ensure everything that happens at the tournament itself leads to a peak performance that day. Nothing must be left to chance. Within the restrictions of the rules of the competition, every advantage must be taken to ensure that the last ounce of potential is recruited. Each individual aspect may seem trivial, but collectively they may well be, and often are, of significant importance.

Listed below are items a martial artist must consider in preparing for and competing in a martial arts tournament:

A. Pre-Competition Preparation
   1) Gradual increase of intensity in the weeks preceding a meet.
   2) Avoid an early peak.
   3) Avoid ego-tripping in practice (an injury can end it all).
   4) Close scrutiny of diet and nutrition, and the pre-competition meal.
   5) Appropriate rest between workouts and before the tournament.
   6) Rational approach to making weight (if applicable).
   7) Avoid pre-start phenomenon.
   8) Travel to the tournament non-disruptively.

B. The Competition
   1) Ensure all necessary equipment and gear is ready and accessible.
   2) Optimal hydration.
   3) Warm-up.
   4) Psyching.
   5) Competition strategy.

Peaking

Peaking is the planned and sequential improvement in sport performance ability over the course of a training cycle. As noted in Chapter Three, the character of training activities becomes more and more specific as the competitive season looms closer. Many students, however, have a poor sense of what specificity actually means, mistaking bagwork and light sparring as sport-specific drills.

The eight weeks immediately prior to a fight should involve plenty of realistic sparring. This includes competition gear and equipment, with competition rules, realistic levels of contact, and against high level opponents. The agreed-upon game plan should be perfected during this period of time, as well. Although care should be taken to prevent injuries, in no way does this mean that the fighter should "take it easy."

To permit this high level of intensity, other training components should be at a relatively low volume during this period. Lifting, bagwork, and all other conditioning drills are still performed, and at high intensity, but the amount of work is reduced. During the last week prior to the fight (called the "taper phase"—see Chapter Two for more information), all training is further reduced to allow athletes to supercompensate and recover. An appropriate reduction in volume means to reduce the volume all training components by one-half, while maintaining previous levels of intensity.

It is common to see fighters training at a furious pace the week before a fight, as if cramming for a high school exam! This type of rigorous training so near to competition day will only wear the athlete down, reducing performance capabilities. Athletes who have correctly periodized their training will not find themselves in such an unfortunate position so close to competition day. For these periodized athletes, the objective is simply to avoid injury and relax. Competing is stressful enough without the additional stress of not planing training properly!

Making Weight

The entire point of dropping weight is to allow the fighter to compete in a lighter weight class. It is a necessary presumption that the fighter will be at an advantage by doing so. It is further assumed that the meet for which the weight is dropped is an important one. For tournaments of less importance, the fighter is advised to compete at his or her current bodyweight.

If, however, it becomes necessary to drop weight, there are some important guidelines to follow that ensure the result of weight reduction will not significantly and adversely affect competition performance.

First, during the latter part of the preparatory period, the martial artist should keep his or her bodyweight to within 3.5% of the class limit. This allows athletes to drop the few pounds of water necessary to make weight without suffering any strength loss.

If this advice is practiced, it will never become necessary to resort to using diuretics to make weight, as a simple steam or sauna will remove the desired amount of weight efficiently. However, before embarking on such a course, be advised that such a practice can be at least psychologically (if not physically) draining. Those who have never used a steam or sauna to lose weight should not wait until an important fight to try it for the first time!

Regardless of the method chosen, it is never advisable to diet down. That should have

been done weeks or months beforehand. Dieting down will cause significant decrements in performance. During a ten day fast, for example, lost weight comprises 65% muscle, and only 35% from fat and water. The loss of this much muscle will cause devastating declines in performance. Remember, discipline is the password here. This applies to training and nutritional practices as well.

Traveling to the Meet

Athletes in every sport have to put up with rapid translocation effects on metabolism and psychological factors. It is a phenomenon often responsible for decrements in performance regardless of the sport. For most martial artists, traveling coast to coast is not a normal occurrence, but when it is necessary, as it may be for national or international competition, it can be devastating if the athlete has not prepared for it. Traveling to Europe or other places in the world removed by six or more time zones will cause even greater debilitating effects than intercontinental travel.

The common term used to describe this state is "jet lag." Research conducted by the U.S. Air Force, as well as by various amateur sport groups involved in international competition, suggests guidelines to overcome jet lag.[60]

1) Excessive alcohol or caffeine consumption during flight will cause dehydration.
2) It takes about one day per time zone change to return the body and mind to normal states, so schedule travel accordingly.
3) There are marked individual differences in response to air travel. Each athlete should learn how they individually respond. Some people are barely affected, others are severely affected.
4) There appears to be little, if any, affect on an athlete's $V0_2$ max from jet lag, but the psychological effects (including anxiety, depression, and all the psychological correlates of these) is often marked. It is predicted that the same holds true for strength and power.
5) The athlete should be aware that traveling east versus west will have quite different effects. Traveling east, the athlete lays awake because of the earlier darkness, and going west, the athlete must retire earlier because of the later darkness.
6) While no guidelines are available on what the athlete can do beforehand to reduce the effects of jet lag, it may be beneficial to change to the time zone schedule that he or she will be traveling to days in advance.
7) There are no noted effects from traveling north or south. If the athlete is traveling by car, bus, or train, and the time spent en route exceeds three hours, measures should be taken to offset the effects of long term inactivity (immobilization). Leave in plenty of time to arrive at the meet site at least one hour per hour of travel ahead of time to ensure that the athlete is fully recovered both physically and psychologically. If the athlete must travel distances greater than six or eight hours, it is advisable to arrive a day ahead of time to obtain a good night's rest.

Another method that may be of benefit in averting jet lag or travel fatigue is frequent stops (ground travel) or walking around (up and down the aisles in air travel) while en route. This will tend to minimize the stiffness and lethargy associated with such travel.

The Pre-Start Phenomenon and Mobilization Readiness

Most martial artists have experienced the increased pulse rate and anxiety in the days immediately preceding a tournament. This is referred to as a "pre-start" condition, and is generally to be avoided, since undue amounts of energy are spent during such activity, detracting from one's performance commensurately.

Mobilization readiness refers to getting "psyched" at the right time—just prior to stepping on the mat. Of course, some stress (or anxiety) is inevitable and perhaps desirable in any sport endeavor. The trick is to control the dysfunctional aspects of stress and attenuate the functional aspects. One must strive to mobilize his or her mental forces at the appropriate point in time.

Long-term tension (weeks or months before the competition), pre-start tension (days before the competition), and start tension (immediately prior to competition) are all important in maximizing performance. Each is dealt with differently. However, the following guidelines help competitors prepare for a meet.

1) Be careful not to peak too soon.
2) Be wary of activation during the pre-start period.
3) Avoid emotional contagion from other athletes during the start period.
4) Be aware of one's emotional state after the meet is over, as this will have an effect on the next tournament performance.

Psyching refers to what is done in the start period, immediately preceding the match. Psyching an hour before, or even 15 minutes before, can be devastating for many martial artists. Tremendous tension builds to the point of escalating fatigue, and should be avoided at all costs. Perhaps the best way to avoid start tension is to remove oneself from the immediate competition site (perhaps go to a locker room, or step outside) and concentrate on visualization and strategies.

Immediately before the match (within the last two to five minutes), the martial artist must psyche him or herself maximally in readiness for the anticipated effort. Again, martial artists have individual approaches for this important matter. It is critically important to maximal performance that the appropriate amount of arousal is accessed.

For beginners who may have technique problems, too much arousal will be detrimental to performance, and "calming down" procedures may be advised during the start period. For advanced martial artists, technique should be well-ingrained, and technical errors should not be a problem. For these martial artists, total blind rage is the state of mind to be achieved! It is only though total abandon, or ultimate aggressiveness, that a maximal performance will be achieved.

Oxendine lists sports according to the amount of arousal necessary in each.[61] He further states that "I have found that, among the truly great martial artists, the psyching technique of choice is almost always exemplified by outward calm. No jumping, face slapping, or growling is displayed. Inside, however, a raging storm is taking place. In the confines of the subconscious, trickles of primordial instinct become raging torrents, escaping into the conscious. So intense are the resulting emotions that there is no room for any other thoughts—surrounding noise, other people, and even pain are but mere shadows of reality, and the single-minded effort of movement prevails."

Before the Meet:

- ☐ 1) Have you followed a rational periodization plan?
- ☐ 2) Have you remained within prescribed bodyweight limits during the past several weeks?
- ☐ 3) Have you used common sense in setting your competitive goals?
- ☐ 4) Have you maintained a sound nutritional regimen?
- ☐ 5) Have you prepared for a trip to the tournament?
- ☐ 6) Have you maintained a reasonably consistent schedule (except for the items listed above) to your normal lifestyle? This is an important thing to do to assist in avoiding pre-competition anxiety).

Travelling to the Meet:

- ☐ 1) Have you packed all your gear? Suggested items are:
  - ☐ a. safety gear, including gloves, boots, shin pads, mouthpiece, groin or breast
  - ☐ protection, tape and headgear (if applicable).
  - ☐ b. competition attire
  - ☐ c. meal replacement bars and plenty of water
  - ☐ d. a first aid kit, including instant ice pack
- ☐ 2) Have you left in sufficient time to offset the effects of travel?
- ☐ 3) Do you have necessary paperwork(association membership card, application forms, etc.)

At the Meet:

- ☐ 1) Recheck all needed gear and equipment before the tournament. You may of lost or forgotten something.
- ☐ 2) Premeet diet should consist of very little sugar (i.e, roughage, fried foods of any kind, milk, eggs, or high protein foods. In short, eat easily digested foods composed primarily of low-glycemic index carbohydrates, within the preceding guidelines. Good examples are pancakes (without excessive syrup or butter), fruits low in fiber, fruit juices, vegetable juices, or potatoes. Avoid eating any foods that you are not familiar with, or foods that produce gas or acid in the stomach.
- ☐ 3) Have an instructor or "second" that you can trust. This person should know beforehand exactly what you intend to do at the meet, and how you want it done. Spend a good period of time going over exact procedures for warming up, order of events, and so on. You are there to compete, period.
- ☐ 4) Stick to your game plan, deviating only under predetermined conditions, should they arise.
- ☐ 5) Stay to yourself, minimizing visits with other competitors.

Table 7-1: The Martial Artist Checklist

Genov's 12 Factors Determining Mobilization Readiness

Renowned Bulgarian sport scientist Filip Genov spoke of mobilization readiness during a compelling speech to the International Congress of Sport Psychology in 1970.[62] In his speech, Genov identified the following factors which determine mobilization readiness.

1) Mobilization readiness is determined by the structure of the impending action. This statement refers to one's readiness to fight a particular opponent. For example, if, during a meet, the martial artist suddenly learns he will fight a less skilled opponent than anticipated, the martial artist is likely to "adjust" his or her state of readiness. Also, the more difficult the skill or task, the more time is needed in mental preparation.
2) Degree of preparation for action. The martial artist can mobilize for execution only those skills prepared for in training. This is precisely why intensity increases throughout the training cycle.

3) The surroundings and conditions of execution influence mobilization readiness. The martial artist should, before the meet, take note of all the details of the venue in which the competition will take place. On the basis of all this processed information, the martial artist is then able to formulate a "plan" for the impending competition. Such factors as the flooring, climactic conditions, referees, audience, etc., all become important in the formulation of such a plan.
4) Personal and social importance for the athlete for attaining a good result in the competition. The more importance given to the meet by the athlete, the easier it is to achieve mobilization readiness.
5) Self-assessment of the athlete concerning his or her preparation and determination to accomplish the goals of the competition. The athlete must assess his or her preparedness, and decide beforehand the adequacy of it. On the basis of this decision, relative to preparedness, emotional response to the competition will vary. Further, only the athlete can generate such a decision. The instructor's thoughts are relatively non-influential.
6) The degree of difficulty of the task to be executed by the athlete in a certain action. For instance, weightlifters give less time for the formation of mobilization readiness when preparing for an "easy" lift. Record attempts require higher levels of psychic and physiological processes.
7) The athlete's personal experience in the formation of a similar state of mobilization readiness. Inexperienced martial artists give less time to the mobilization of their forces than more experienced athletes can. Only training and experience enable this benefit.
8) The athlete's state of health. Sickness, trauma, and fatigue induce high or low spirits that can influence mobilization readiness. By conscious effort, experienced athletes are often able to perform effectively, albeit hazardous to personal safety.
9) Preceding state of the athlete. High or low spirits can influence mobilization readiness. Genov recommends tactics such as humor, song, and so forth to combat low spirits. Negative influences become dominant over effort with such problems as familial stress, personal problems, etc., and should be avoided at all costs. When they do arise, address them appropriately whenever possible.
10) Presence or lack of necessary time for formulation of adequate mobilization readiness. Commonly, stand-by fighters in boxing experience this problem when they are called on to fight with little notice.
11) An athlete's individual peculiarities (principle of individuality). Individual differences exist with respect to such factors as reaction speed, intensity, stability of attention, pulse, muscle tone, etc. Each athlete must understand how these factors affect his or her state of mobilization readiness.
12) The ability of the athlete to regulate the level of mobilization readiness. Often, too much activation (i.e., trying too hard) will cause technical or strategic errors. Appropriately increasing or decreasing mobilization readiness are attributes of experienced athletes, and should be cultivated from day one.

Other Psychological Factors Affecting Maximal Performance

Emotional State

A powerful constraint is met in considering the emotional state of the athlete. All athletes are familiar with the term "psyche" and each has his or her own peculiar method of achieving

this state of arousal. Whether this is induced by thinking of sex, growing angry at the opponent, feeling the impact of the audience, or doing it for "Old Glory" is inconsequential. They all appear to work.

Generally, the mechanisms behind the facilitatory response are the increased secretion of adrenaline, the intensification of nervous discharge of the muscles, and irradiated nervous impulse from surrounding muscles not actively involved in the sport skill or movement.

Extreme depression, over-arousal, and fear are emotional responses which tend to inhibit maximal performance. The astute athlete will find his or her own means to achieve appropriate levels of arousal.

Self Esteem

This is yet another powerful constraint to address. Success begets success. Some forms of sport call it "momentum." Self esteem in such sports is incredibly flexible. One minute, an athlete hates himself, and the next minute, perhaps as a result of scoring a point, his self esteem shoots way up, thereby facilitating his subsequent performance. The increased confidence appears to have "disinhibited" him.

The Athlete's Most Important Virtue: The Open Mind

For all the virtues that the martial arts can instill in people, unfortunately, open-mindedness doesn't seem to be one of them. For example, instructors commonly discourage students from studying other martial art's systems. For the most part, following tradition is encouraged; innovation and creativity are discouraged. Students are encouraged to blindly accept rather than to analyze or to question.

This close-minded approach has benefits, but at a high cost. The security that comes with following time-worn approaches and philosophies allows one to fully commit to their training, knowing that many hundreds of thousands have taken the same path to success. The cost is that this security is often an illusion, however, for at least two reasons.

First, although many succeed with the "traditional" path, athletes rarely see those who don't. In the sport of Olympic weightlifting, the tiny country of Bulgaria has experienced outstanding success in recent years, using training schedules which seem exceptionally brutal such as training at very high intensities, up to six days a week and often using two to three sessions per day.

Although this has lead many lifters to emulate the Bulgarian system, others question the validity of these methods, suggesting that it is used simply as a "weeding out" process. In other words, anyone who can survive the system is likely to end up as a champion lifter. For every champion the Bulgarians produce, there may be many broken bodies along the way. Nevertheless, using this system, Bulgaria manages to find its most genetically gifted lifters without wasting resources on lifters who will never be champions no matter what training system they follow.

Second, athletes rarely venture out to see if there are better methods than the ones in current use. For example, perhaps a martial arts role model performs endless sets of push-ups every day. So, an admiring athlete decides, "If it works for them, it's good enough for me." And for years and years, no one can talk the admiring athlete out of that routine.

The problem is, push-ups are far from an efficient exercise. Most martial artists do them simply because their instructor told them to, or because "that's what everyone does." As men-

tioned in Chapter Three, once an individual can do more than ten repetitions, the exercise can only develop strength-endurance, which is not a quality that most martial artists need or want. For an exercise to be beneficial for a speed-strength endeavor like the martial arts, it must be modifed so that very high intensities (one to five repetitions) can be reached. Only in this way can the proper strength qualities be trained.

Close-mindedness is a survival trait. Thousands of years ago, a Neanderthal man looked under a rock and found some grubs to eat. The technique obviously had value, and it made more sense to look under more rocks than it did to look up in the trees. But for this Neanderthal to go beyond mere survival, he should in fact look up in the trees, for if he did, he might find better food choices.

In many ways, athletes are the same way. At some point in their athletic careers, they are convinced to train in a certain way, and because this way lead to a certain degree of success, they now pronounce this "way" as the "only way."

Readers of this book are encouraged to look beyond their current methods and techniques. Don't simply discard what is used now, but remain open to the possibility that better ways might exist. And for those who happen to stumble upon a better way, resist the temptation to then follow *it* blindly for the rest of an athletic career.

Also, resist the human tendency to classify new information as simply "bad" or "good." Simply listen. Observe. Consider. If the information seems logical and there is no reason to discard it, then conduct an "experiment of one," using oneself as the guinea pig. Carefully integrate the new technique or method into the training plan. Allocate a reasonable period of time to evaluate the effectiveness of the experiment. If it seems like sport-specific fitness has improved, that indicates at least a reasonable assurance that this new element has a place in the training plan.

Finally, although readers are encouraged to cultivate an open mind, it doesn't need to be gaping! When things seem to be too good to be true, or have absolutely no basis in science, time is probably better spent researching more promising options. The hope is that this book has been a source of such options in each reader's own training.

RESOURCES

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