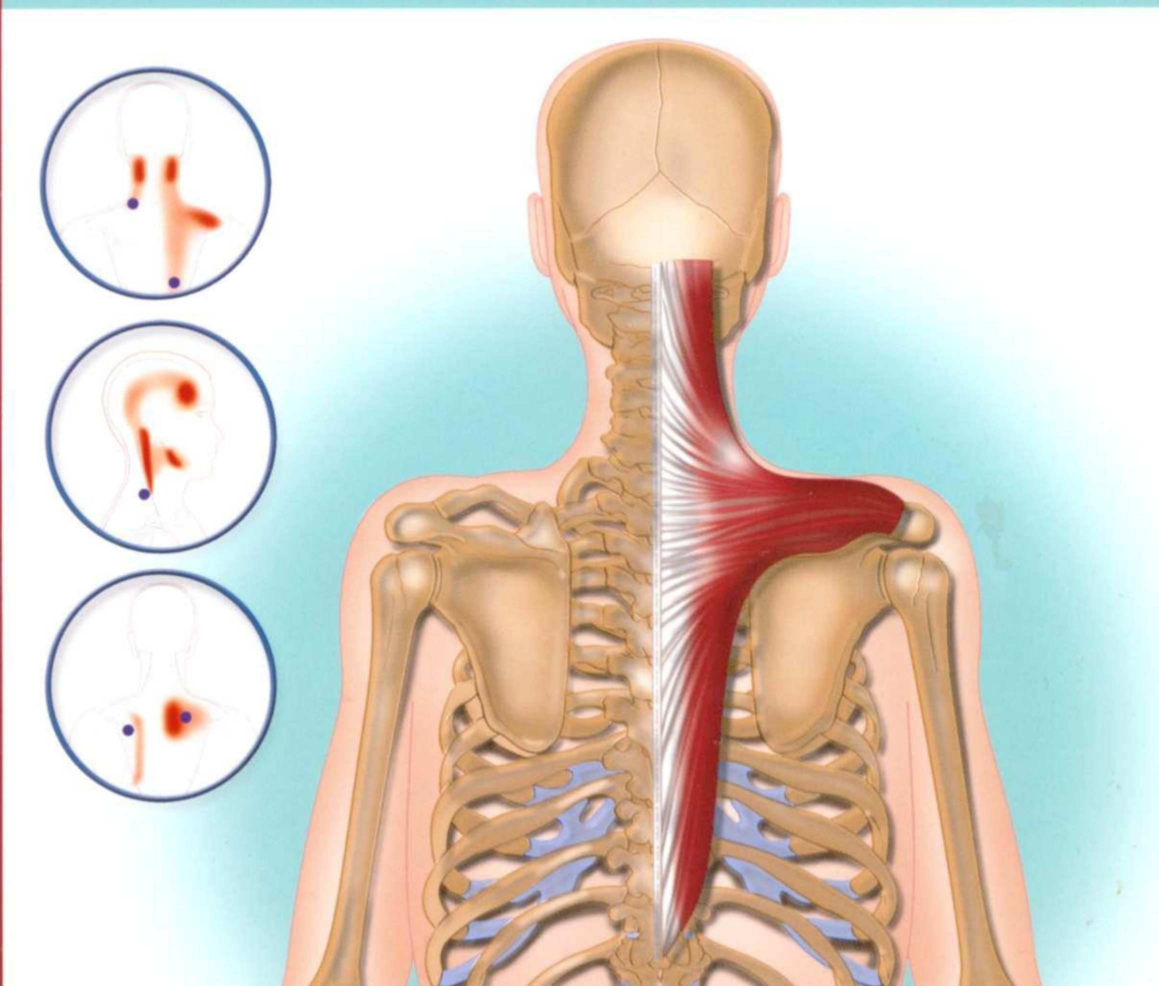
THE CONCISE BOOK OF TRIGGER POINTS

SECOND EDITION



SIMEON NIEL-ASHER

This new edition of the bestselling *The Concise Book of Trigger Points* explains how to treat chronic pain through trigger points – tender, painful nodules that form in muscle fibres and connective tissues. Understanding and treating these points can lead to rapid, effective, and lasting pain relief. A complete and compact reference guide, it is designed for the student and practitioner of massage/bodywork, physical therapy, physiotherapy, osteopathy, sports therapy, and any other health-related field.

The first three chapters provide a sound background to the physiology of trigger points and the general methods of treatment. The following six chapters are organized by muscle groups; each two-page spread features detailed colour illustrations of each major skeletal muscle and referred pain patterns, together with information on each muscle's origin, insertion, action, and function. The physiological implications of the trigger points in each muscle are discussed, along with treatment techniques. This edition contains updated text and an in-depth self-help section addressing common pain complaints, including headache, neck pain, shoulder pain, lower back pain, and TMJ syndrome.

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"Probably the clearest, most concise and comprehensive presentation of the trigger point picture I have ever read. Eminently practical and clinically useful."

–Dr. Richard Bachrach, D.O., F.A.O.A.S.M, president and medical director of the Centre for Sports and Osteopathic Medicine

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Simeon Niel-Asher

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Dedication
To my parents, my wife Galina, for her support, beauty and wisdom, my wonderful patients and my sons Gideon and Benjamin who make every day an adventure.

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Contents

About this Book 5

A Note About Peripheral Nerve Supply 6

Chapter 1
Skeletal Muscle, Muscle Mechanics and Fascia 7
Overview of Skeletal Muscle Structure 8
Muscle Shape 13
Musculoskeletal Mechanics 15
Muscle Attachment 20
Fascia and Myofascia 22
Embryological Development of Fascia 23

Chapter 2
Trigger Points and Trigger Point Formation 25
Trigger Point Definition 26
Acupuncture or Acupressure Points and Trigger Points 27
Fibromyalgia 28
Nutritional and Biochemical Factors 29
Fibre Type and Trigger Point Manifestation 29
Trigger Point Formation and Posture 30
Postural Trigger Points and 'Cross Patternation' 31
Trigger Points Within Sarcomeres 32
Trigger Point Development 32
Trigger Point Classification 36
Trigger Point Symptoms 37
Physical Findings 37

Chapter 3
Therapeutic Technique Protocols 43
Palpation 44
Injections vs Dry Needling 45
Spray and Stretch Technique 46
Hands-on Therapy Trigger Point Release Protocols 48
Modifications: Muscle Energy/ Positional Release Techniques 49
Massage Techniques 50
Manual Lymphatic Drainage Techniques (MLD) 50

Chapter 4
Muscles of the Face, Head and Neck 53
Epicranius (Occipitofrontalis) 54
Orbicularis Oculi 56
Masseter 58
Temporalis 60
Pterygoideus Lateralis 62
Pterygoideus Medialis 64
Digastricus 66
Scalenus Anterior, Medius, Posterior 68
Sternocleidomastoideus 70
Temporomandibular Joint (TMJ) 72

Chapter 5
Muscles of the Trunk and Spine 75
Erector Spinae 76
Posterior Cervical Muscles 78
Multifidis/Rotatores 80
Splenius Cervicis/Splenius Capitis 82
External Oblique 84
Transversus Abdominis 86
Rectus Abdominis 88
Quadratus Lumborum 90
Iliopsoas (Psoas Major/Iliacus) 92
Diaphragm 94

Chapter 6
Muscles of the Shoulder and Upper Arm 97
Trapezius 98
Levator Scapulae 100
Rhomboideus (Minor and Major) 102
Serratus Anterior 104
Pectoralis Major 106
Latissimus Dorsi 108
Deltoideus 110
Supraspinatus 112
Infraspinatus 114
Teres Minor 116
Subscapulars 118
Teres Major 120
Biceps Brachii 122
Triceps Brachii 124

Chapter 7
Muscles of the Forearm and Hand **127**
Pronator Teres 128
Palmaris Longus 130
Wrist Flexors 132
Brachioradialis 134
Wrist Extensors 136
Extensor Digitorum 138
Supinator 140
Opponens Pollicis/Adductor Pollicis 142
Small Hand Muscles 144

Chapter 8
Muscles of the Hip and Thigh **147**
Gluteus Maximus 148
Tensor Fasciae Latae 150
Gluteus Medius 152
Gluteus Minimus 154
Piriformis 156
Hamstrings 158
Adductors 160
Pectineus 162
Sartorius 164
Quadriceps 166

Chapter 9
Muscles of the Leg and Foot 169
Tibialis Anterior 170
Extensor Digitorum Longus/
Extensor Hallucis Longus 172
Fibularis (Peroneus) Longus,
Brevis, Tertius 174
Gastrocnemius 176
Plantaris 178
Soleus 180
Popliteus 182
Flexor Digitorum Longus/
Flexor Hallucis Longus 184
Tibialis Posterior 186
Superficial Muscles of the Foot 188
Deep Muscles of the Foot 190

Chapter 10
Putting It All Together:
Trigger Points and Beyond 193
Holding Patterns 194
Four New 'Laws' 194
Treat Trigger Points in Reverse 203

Manual Therapy and Self-help **205**

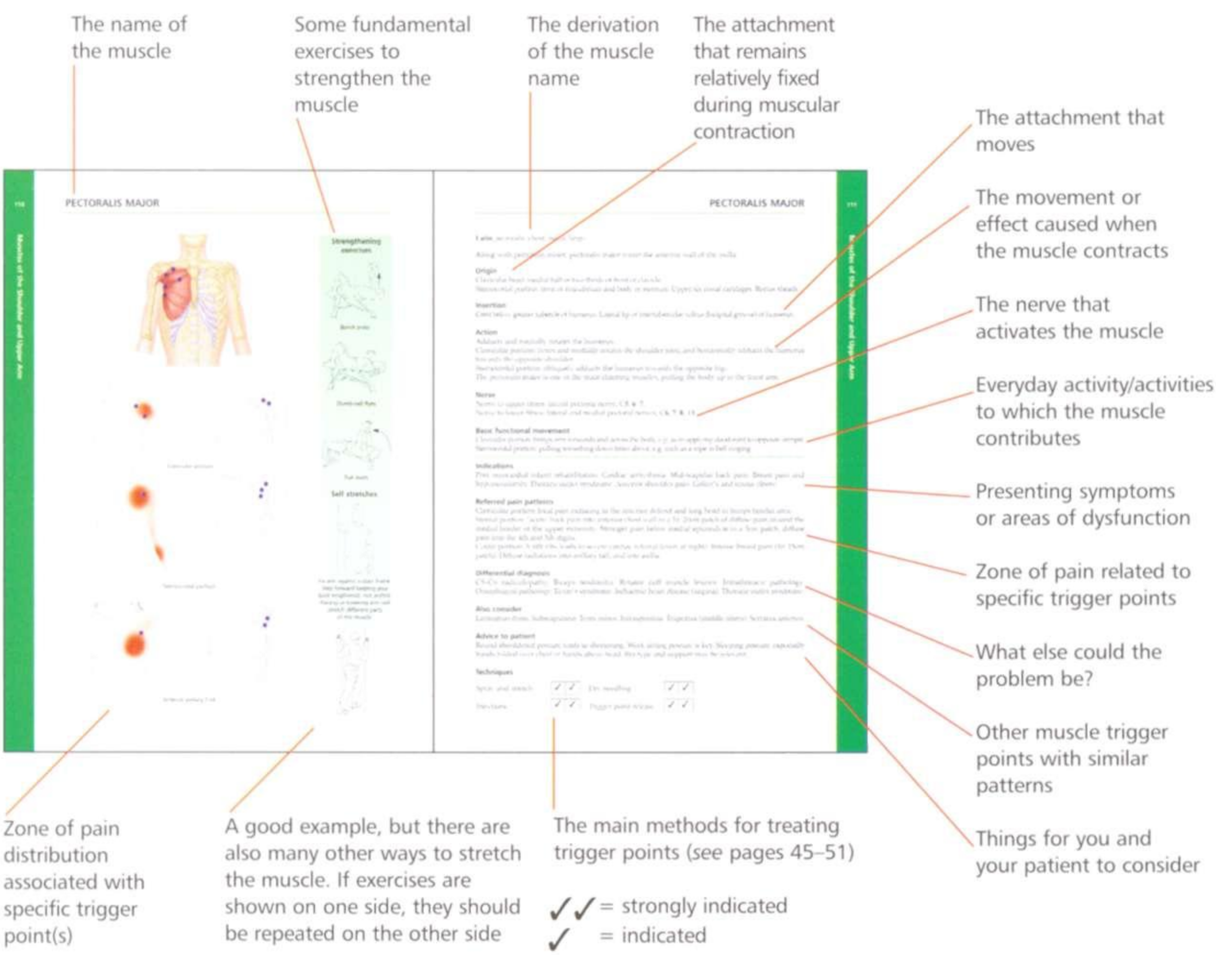
Resources **220**
General Index **222**

About this Book

This book is designed in quick reference format to offer useful information about the trigger points relating to the main skeletal muscles, which are central to massage, bodywork and physical therapy. The information about each muscle is presented in a uniform style throughout. An example is given below, with the meaning of headings explained in bold (some muscles will have abbreviated versions of this).

X Marks the Spot

Whilst I have included dots/markings in the regions of the most common trigger points, please note that these are not exact locations, but are approximations. A number of factors influence the exact location of any given trigger point. Myofascia is a continuum, and minor variations in, for example, anatomy, posture or weight bearing will have an impact on the location and formation of trigger points. In the clinical setting, you may well find the trigger point location varies. Varying the direction, amplitude and applicator force will also have an impact on locating the trigger point.



A Note About Peripheral Nerve Supply

The nervous system comprises:

- The central nervous system (i.e. the brain and spinal cord).
- The peripheral nervous system (including the autonomic nervous system, i.e. all neural structures outside the brain and spinal cord).

The peripheral nervous system consists of 12 pairs of cranial nerves and 31 pairs of spinal nerves (with their subsequent branches). The spinal nerves are numbered according to the level of the spinal cord from which they arise (the level is known as the spinal segment).

The relevant peripheral nerve supply is listed with each muscle presented in this book, for those who need to know. However, information about the spinal segment* from which the nerve fibres emanate often differs between the various sources. This is because it is extremely difficult for anatomists to trace the route of an individual nerve fibre through the intertwining maze of other nerve fibres as it passes through its plexus (plexus = a network of nerves: from the Latin word meaning 'braid')- Therefore, such information has been derived mainly from empirical clinical observation, rather than through dissection of the body.

In order to give the most accurate information possible, I have duplicated the method devised by Florence Peterson Kendall and Elizabeth Kendall McCreary *(see* Resources: Muscles Testing and Function). Kendall & McCreary integrated information from six well-known anatomy reference texts, namely those written by Cunningham, dejong, Foerster & Bumke, Gray, Haymaker & Woodhall and Spalteholz. Following the same procedure, and then cross-matching the results with those of Kendall & McCreary, the following system of emphasising the most important nerve roots for each muscle has been adopted in this book.

Let us take the supinator muscle as our example, which is supplied by the deep radial nerve, C5, **6**, (7). The relevant spinal segment is indicated by the letter [C] and the numbers [5, **6**, (7)]. Bold numbers [e.g. **6**] indicate that most (at least five) of the sources agree. Numbers that are not bold [e.g. 5] reflect agreement by three of four sources. Numbers not in bold and in parentheses [e.g. (7)] reflect agreement by two sources only, or that more than two sources specifically regarded it as a very minimal supply. If a spinal segment was mentioned by only one source, it was disregarded. Hence, bold type indicates the major innervation; not bold indicates the minor innervation; and numbers in parentheses suggest possible or infrequent innervation.

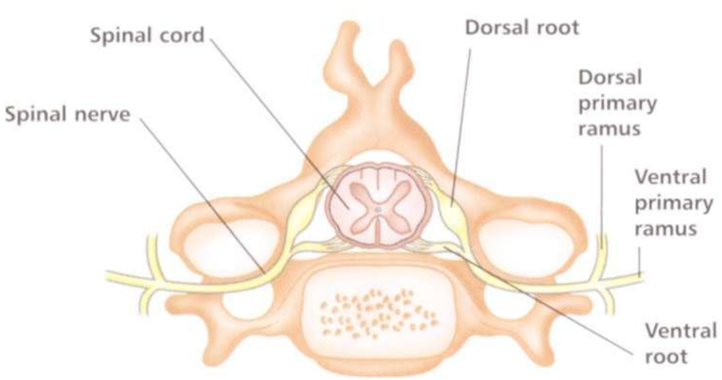


Figure 1: A spinal segment, showing the nerve roots combining to form a spinal nerve, which then divides into ventral and dorsal rami.

** A spinal segment is the part of the spinal cord that gives rise to each pair of spinal nerves (a pair consists of one nerve for the left side and one for the right side of the body). Each spinal nerve contains motor and seasory fibres. Soon after the spinal nerve exits through the foramen (the opening between adjacent vertebrae), it divides into a dorsal primary ramus (directed posteriorly) and a ventral primary ramus (directed laterally or anteriorly). Fibres from the dorsal rami innervate the skin and extensor muscles of the neck and trunk. The ventral rami supply the limbs, plus the sides and front of the trunk.*

Skeletal Muscle, Muscle Mechanics and Fascia

1

Overview of Skeletal Muscle Structure

Muscle Shape

Musculo-skeletal Mechanics

Muscle Attachment

Fascia and Myofascia

Embryological Development of Fascia

Skeletal (somatic or voluntary) muscles make up approximately 40% of body weight. Many theories have been advanced for how trigger points develop within muscles. Chapter 2 will present the most widely accepted hypotheses. However, in order to understand how a trigger point develops, it is important to review the physiological mechanism of muscle contraction.

The primary function of skeletal (somatic or voluntary) muscles is to produce movement through the ability to contract and relax in a coordinated manner. They are attached to bone by tendons. The place where a muscle attaches to a relatively stationary point on a bone, either directly or via a tendon, is called the *origin.* When the muscle contracts, it transmits tension to the bones across one or more joints, and movement occurs. The end of the muscle that attaches to the bone that moves is called the *insertion.*

Overview of Skeletal Muscle Structure

The functional unit of skeletal muscle is known as a *muscle fibre*, which is an elongated, cylindrical cell with multiple nuclei, ranging from 10 to 100 microns in width, and a few millimetres to 30+ centimetres in length. The cytoplasm of the fibre is called the *sarcoplasm,* which is encapsulated inside a cell membrane called the *sarcolemma. A* delicate membrane known as the *endomysium* surrounds each individual fibre.

These fibres are grouped together in bundles covered by the *perimysium.* These bundles are themselves grouped together, and the whole muscle is encased in a sheath called the *epimysium.* These muscle membranes lie through the entire length of the muscle, from the tendon of origin to the tendon of insertion. This whole structure is sometimes referred to as the *musculo-tendinous unit.* The active component of muscle activity occurs at the level of the *myofibril.*

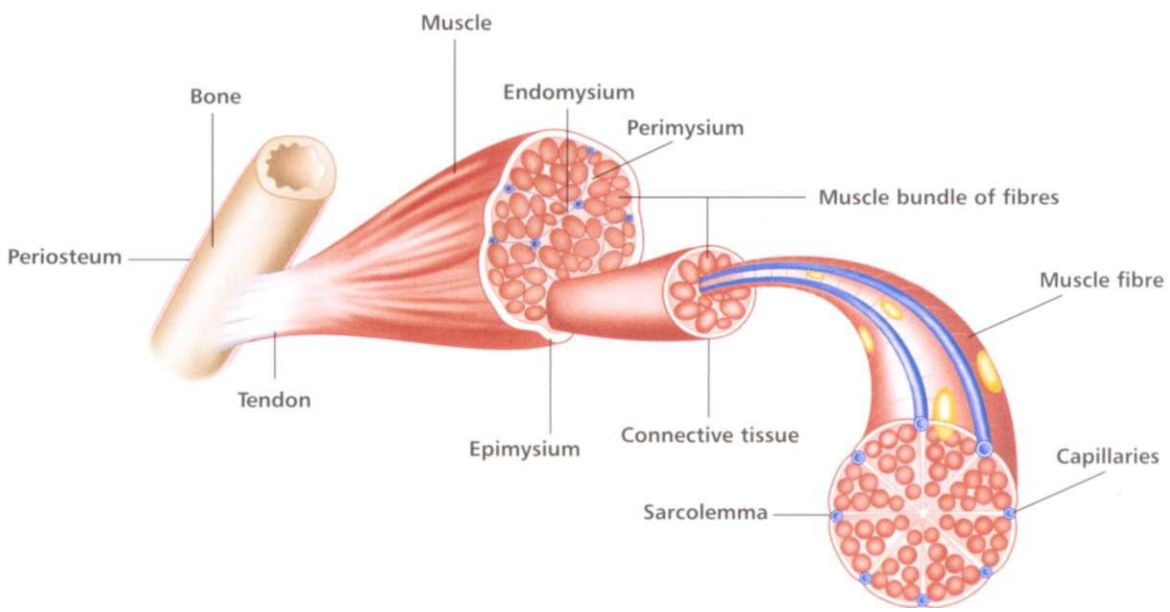


Figure 1.1: Cross-section of muscle tissue.

Myofibrils

Through an electron microscope, one can distinguish the contractile elements of a muscle fibre, known as *myofibrils*, running the whole length of the fibre. Each myofibril reveals alternate light and dark banding, producing the characteristic cross-striation of the muscle fibre. These bands are called *myofilaments.* The light bands (referred to as isotropic (I) bands) consist of thin myofilaments made of the protein *actin.* The dark bands (called anisotropic (A) bands) consist of thicker myofilaments made of the protein *myosin.* (A third connecting filament, made of a protein called *titin*, is now recognized). The myosin filaments have paddle-like extensions that emanate from the filaments rather like the oars of a boat. These extensions latch on to the actin filaments, forming what are described as 'cross-bridges' between the two types of filaments. The cross-bridges, using the energy of ATP, pull the actin strands closer together. Thus, the light and dark sets of filaments increasingly overlap, like the interlocking of fingers, resulting in muscle contraction. One set of actin-myosin filaments is called a *sarcomere.*

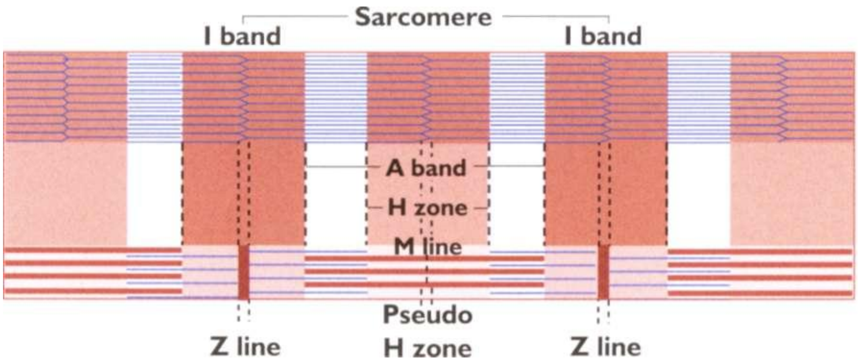


Figure 1.2: The myofilaments in a sarcomere. A sarcomere is bounded at both ends by the Z line.

- The lighter zone is known as the I band, and the darker zone the A band.
- The Z line is a thin dark line at the midpoint of the I band.
- A sarcomere is defined as the section of myofibril between one Z line and the next.
- The centre of the A band contains the H zone.
- The M line bisects the H zone, and delineates the centre of the sarcomere.

If an outside force causes a muscle to stretch beyond its resting level of tonus, the interlinking effect of the actin and myosin filaments that occurs during contraction is reversed. Initially, the actin and myosin filaments accommodate the stretch, but as the stretch continues, the titin filaments increasingly 'pay out' to absorb the displacement. Thus, it is the titin filament that determines the muscle fibre's extensibility and resistance to stretch. Research indicates that a muscle fibre (sarcomere), if properly prepared, can be elongated up to 150% of its normal length at rest.

The outer covering of individual muscle cells, the *sarcolemma,* is designed with special holes and openings. These openings lead to tubes known as *transverse tubules,* or *T tubules,* which cover the myofibrils. T tubules function to conduct impulses originating on the surface of the sarcolemma into the muscle cell, specifically to the *sarcoplasmic reticulum (SR).*

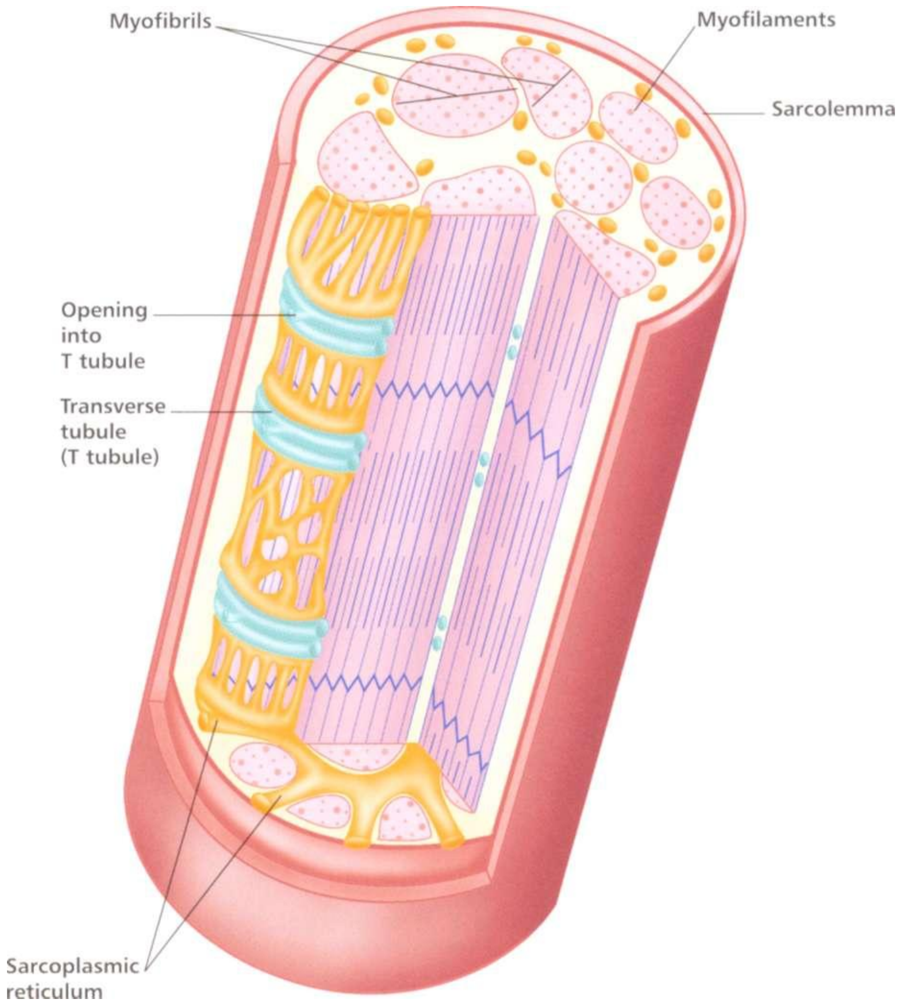


Figure 1.3: Structure of a muscle cell.

Huxley's Sliding Filament Theory

The generally accepted hypothesis to explain muscle function is partly described by Huxley's sliding filament theory (Huxley and Hanson, 1954). Muscle fibres receive a nerve impulse that cause the release of calcium ions stored in the muscle. In the presence of the muscles' fuel, known as *adenosine triphosphate (ATP),* the calcium ions bind with the actin and myosin filaments to form an electrostatic (magnetic) bond. This bond causes the fibres to shorten, resulting in their contraction or increase in tonus. When the nerve impulse ceases, the muscle fibres relax. Their elastic elements recoil the filaments to their non-contracted lengths, i.e. their resting level of tonus.

Red and White Muscle Fibres

There are *three* types of skeletal muscle fibres: red slow-twitch fibres, white fast-twitch fibres, and intermediate fast-twitch fibres.

1. Red Slow-twitch Fibres

These are thin cells that contract slowly. The red colour is due to their content of myoglobin, a substance similar to haemoglobin, which stores oxygen and increases the rate of oxygen diffusion within the muscle fibre. As long as oxygen supply is plentiful, red fibres can contract for sustained periods, and are thus very resistant to fatigue. Successful marathon runners tend to have a high percentage of these red fibres.

2. White Fast-twitch Fibres

These are large cells that contract rapidly. They are pale, due to a lesser content of myoglobin. They fatigue quickly, because they rely on short-lived glycogen reserves in the fibre to contract. However, they are capable of generating much more powerful contractions than red fibres, enabling them to perform rapid, powerful movements for short periods. Successful sprinters have a higher proportion of these white fibres.

3. Intermediate Fast-twitch Fibres

These red or pink fibres are a compromise in size and activity between the red and white fibres.

NOTE: There is always a mixture of these muscle fibres in any given muscle, giving them a range of fatigue resistance and contractile speeds.

Blood Supply

In general, each muscle receives one artery to *bring* nutrients via blood into the muscle, and several veins to *take away* metabolic waste products surrendered by the muscle into the blood. These blood vessels generally enter through the central part of the muscle, but can also enter towards one end. Thereafter, they branch into a capillary plexus, which spreads throughout the intermuscular septa to eventually penetrate the endomysium around each muscle fibre. During exercise the capillaries dilate, increasing the amount of blood flow in the muscle by up to 800 times. The muscle tendon, because it is composed of a relatively inactive tissue, has a much less extensive blood supply.

Nerve Supply

The nerve supply to a muscle usually enters at the same place as the blood supply, and branches through the connective tissue septa into the endomysium in a similar way. Each skeletal muscle fibre is supplied by a single nerve ending. This is in contrast to other muscle tissues, which are able to contract without any nerve stimulation.

The nerve entering the muscle usually contains roughly equal proportions of sensory and motor nerve fibres, although some muscles may receive separate sensory branches. As the nerve fibre approaches the muscle fibre, it divides into a number of terminal branches, collectively called a *motor end plate.*

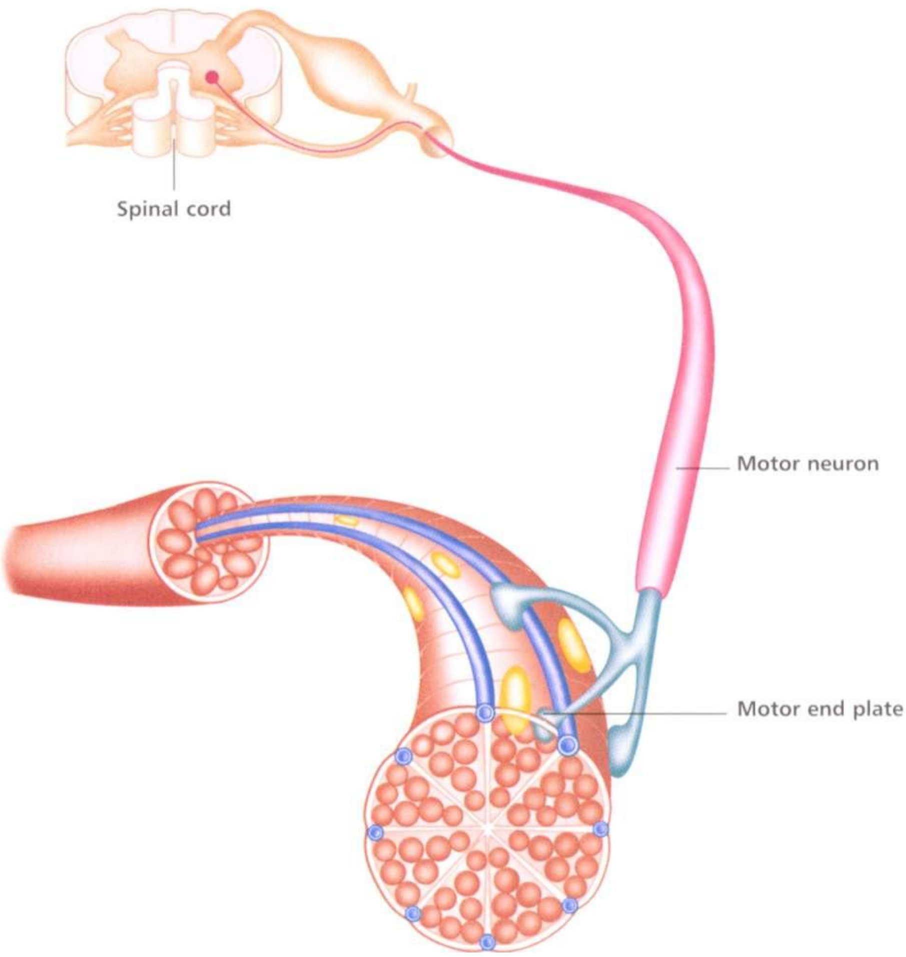


Figure 1.4: A motor unit of a skeletal muscle.

Motor Unit of a Skeletal Muscle

A motor unit consists of a single motor nerve cell and the muscle fibres stimulated by it. The motor units vary in size, ranging from cylinders of muscle 5-7mm in diameter in the upper limb and 7-10mm in diameter in the lower limb. The average number of muscle fibres within a unit is 150 (but this number ranges from less than 10 to several hundred). Where fine gradations of movement are required, as in the muscles of the eyeball or fingers, the number of muscle fibres supplied by a single nerve cell is small. On the other hand, where more gross movements are required, as in the muscles of the lower limb, each nerve cell may supply a motor unit of several hundred fibres.

The muscle fibres in a single motor unit are spread throughout the muscle, rather than being clustered together. This means that stimulation of a single motor unit will cause the entire muscle to exhibit a weak contraction.

Skeletal muscles work on the *'All or Nothing Principle'*. In other words, groups of muscle cells, or *fasciculi*, can either contract or not contract. Depending on the strength of contraction required, a certain number of muscle cells will contract totally, while others will not contract at all. When a great muscular effort is needed, most of the motor units may be stimulated at the same time. However, under normal conditions, the motor units tend to work in relays, so that during prolonged contractions some are resting while others are contracting.

Muscle Shape (Arrangement of Fascicles)

Muscles come in a variety of shapes according to the arrangement of their fascicles. The reason for this variation is to provide optimum mechanical efficiency for a muscle in relation to its position and action. The most common arrangement of fascicles give muscle shapes described as parallel, pennate, convergent and circular. Each of these shapes has further sub-categories.

Parallel

This arrangement has the fascicles running parallel to the long axis of the muscle. If the fascicles extend throughout the length of the muscle, it is known as a *strap muscle:* for example, sartorius. If the muscle also has an expanded belly and tendons at both ends, it is called a *fusiform muscle:* for example, the biceps brachii of the arm. A modification of this type of muscle has a fleshy belly at either end, with a tendon in the middle. Such muscles are referred to as *digastric,* e.g. digastricus.

Pennate

Pennate muscles are so named because their short fasciculi are attached obliquely to the tendon, like the structure of a feather (penna = feather). If the tendon develops on one side of the muscle, it is referred to as *unipennate,* for example, the flexor digitorum longus in the leg. If the tendon is in the middle and fibres are attached obliquely from both sides, it is known as *bipennate,* of which the rectus femoris is a good example. If there are numerous tendinous intrusions into the muscle with fibres attaching obliquely from several directions, thus resembling many feathers side by side, the muscle is referred to as *multipennate.* The best example is the middle part of the deltoid muscle.

Convergent

Muscles that have a broad origin with fascicles converging towards a single tendon, giving the muscle a triangular shape, are called *convergent muscles.* The best example is the pectoralis major.

Circular

When the fascicles of a muscle are arranged in concentric rings, the muscle is referred to as *circular.* All the sphincter skeletal muscles in the body are of this type; they surround openings, which they close by contracting. Examples include the orbicularis oculi and orbicularis oris.

When a muscle contracts, it can shorten by up to 70% of its original length. Hence, the longer the fibres, the greater the range of movement. On the other hand, the strength of a muscle depends on the total number of muscle fibres it contains, rather than their length. Therefore:

1. Muscles with long parallel fibres produce the greatest range of movement, but are not usually very powerful.

2. Muscles with a pennate pattern, especially if multipennate, pack in the most fibres. Such muscles shorten less than long parallel muscles, but tend to be much more powerful.

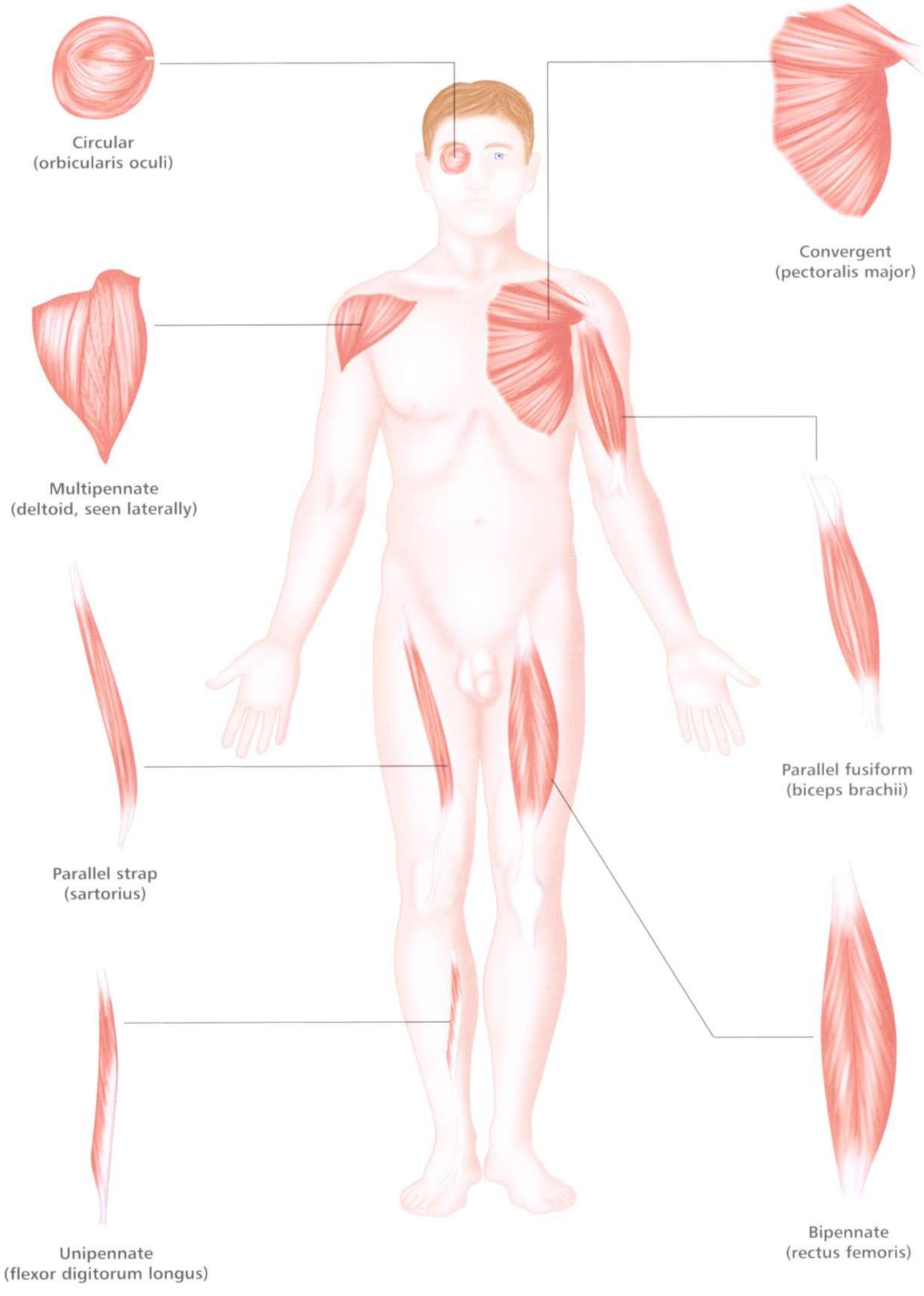


Figure 1.5: Muscle shapes.

Musculo-skeletal Mechanics

Origins and Insertions

In the majority of movements, one attachment of a muscle remains relatively stationary while the attachment at the other end moves. The more stationary attachment is called the *origin* of the muscle, and the other attachment is called the *insertion.* (It is worth noting that some modern authorities now use the term attachments rather than origin and insertion). A spring that closes a gate could be said to have its origin on the gatepost and its insertion on the gate itself. In the body, the arrangement is rarely so clear-cut, because depending on the activity one is engaged in, the fixed and moveable ends of the muscle may be reversed. For example, muscles that attach the upper limb to the chest normally move the arm relative to the trunk, which means their origins are on the trunk and their insertions are on the upper limb. However, in climbing, the arms are fixed, while the trunk is moved as it is pulled up to the fixed limbs. In this type of situation, where the insertion is fixed and the origin moves, the muscle is said to perform a reversed action. Because there are so many situations where muscles are working with a *reversed action,* it is sometimes less confusing to simply speak of 'attachments', without reference to origin and insertion.

In practice, muscle attachments that lie more proximally, i.e. more towards the trunk or on the trunk, are usually referred to as the origin. Attachments that lie more distally, i.e. away from the attached end of a limb, or away from the trunk, are referred to as the insertion.

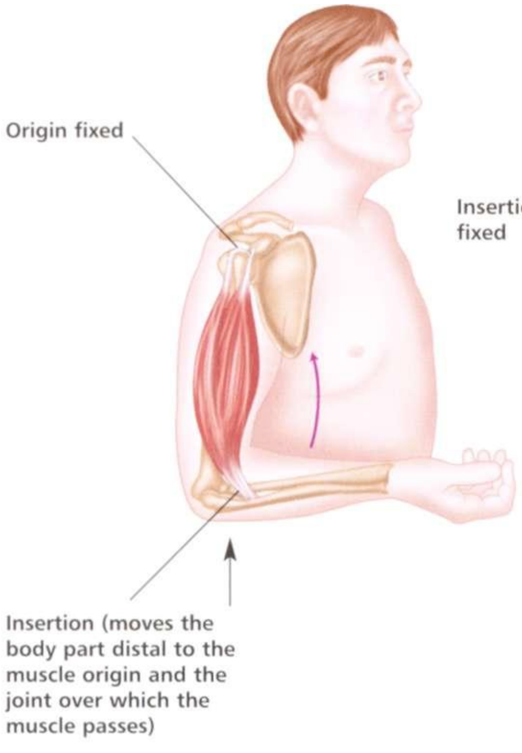


Figure 1.6: Muscle working with origin fixed and insertion moving.

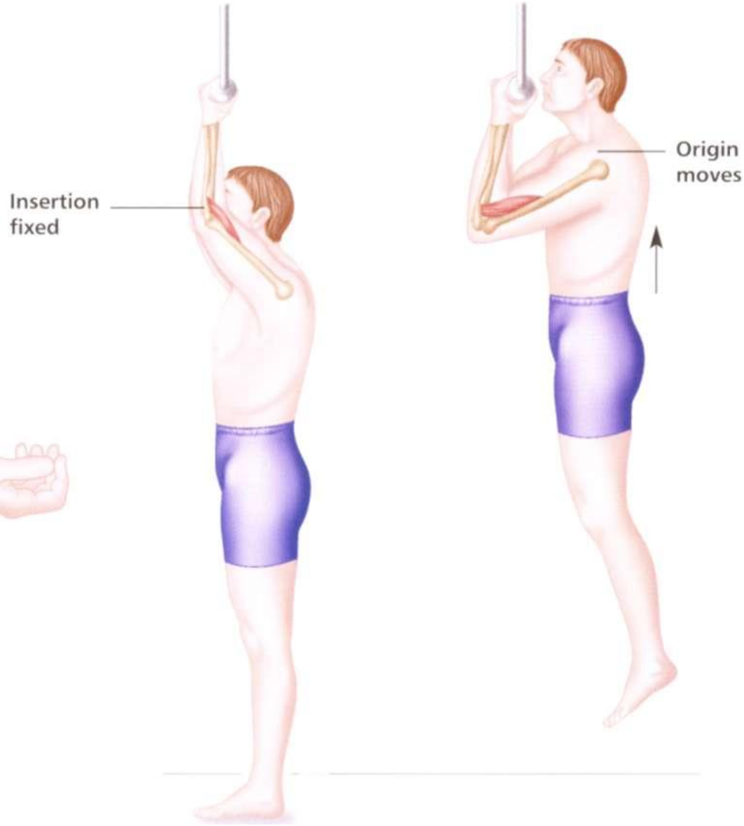


Figure 1.7: Climbing: muscles are working with insertion fixed and origin moving (reversed action).

Group Action of Muscles

Muscles work together or in opposition to achieve a wide variety of movements. Therefore, whatever one muscle can do, there is another muscle that can undo it. Muscles may also be required to provide additional support or stability to enable certain movements to occur elsewhere. Muscles are classified into four functional groups:

- Prime Mover or Agonist
- Antagonist
- Synergist
- Fixator

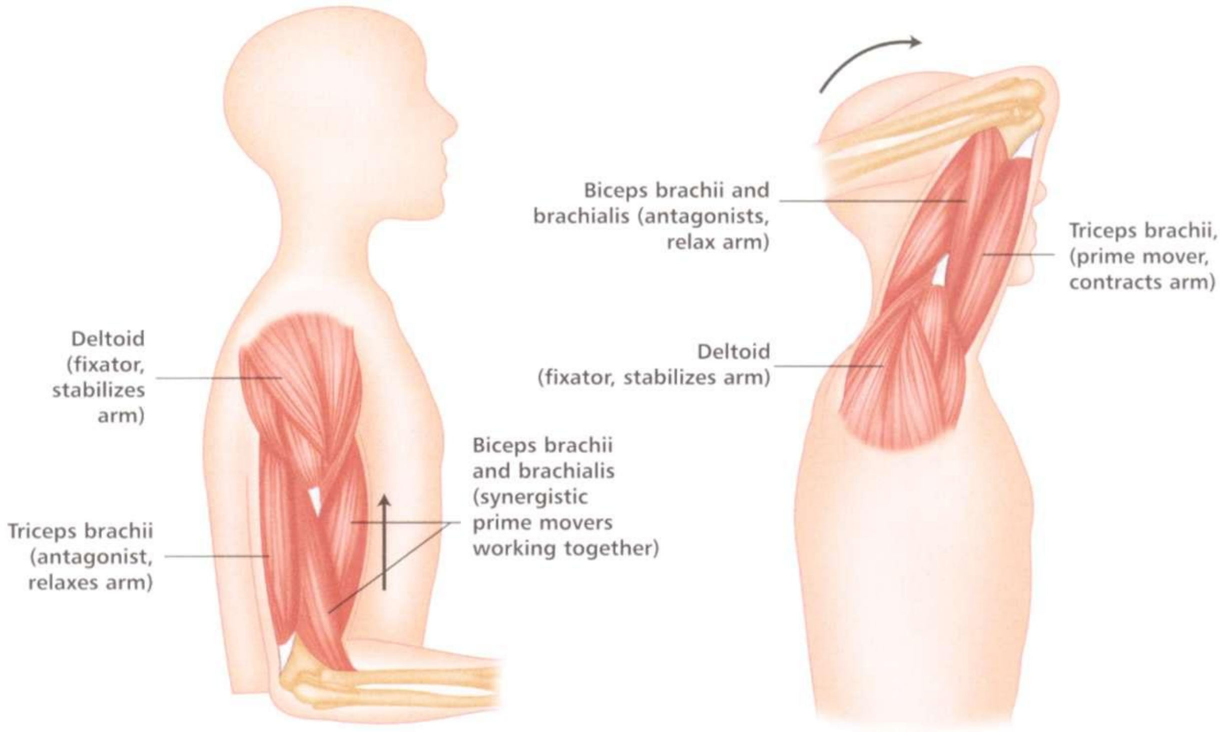


Figure 1.8: Group action of muscles; a) flexing arm at elbow, b) extending arm at elbow (showing reversed roles of prime mover and antagonist).

Prime Mover or Agonist

A *prime mover* (also called an *agonist)* is a muscle that contracts to produce a specified movement. An example is the biceps brachii, which is the prime mover of elbow flexion. Other muscles may assist the prime mover in providing the same movement, albeit with less effect. Such muscles are called *assistant* or *secondary movers.* For example, the brachialis assists the biceps brachii in flexing the elbow, and is therefore a secondary mover.

Antagonist

The muscle on the opposite side of a joint to the prime mover, and which must relax to allow the prime mover to contract, is called an *antagonist.* For example, when the biceps brachii on the front of the arm contracts to flex the elbow, the triceps brachii on the back of the arm must relax to allow this movement to occur. When the movement is reversed, i.e. when the elbow is extended, the triceps brachii becomes the *prime mover* and the biceps brachii assumes the role of *antagonist.*

Synergist

Synergists prevent any unwanted movements that might occur as the prime mover contracts. This is especially important where a prime mover crosses two joints, because when it contracts it will cause movement at both joints, unless other muscles act to stabilize one of the joints. For example, the muscles that flex the fingers cross not only the finger joints but also the wrist joint, potentially causing movement at both joints. However, it is because you have other muscles acting synergistically to stabilize the wrist joint that you are able to flex the fingers into a fist without also flexing the wrist at the same time.

A prime mover may have more than one action, so synergists also act to eliminate the unwanted movements. For example, the biceps brachii will flex the elbow, but its line of pull will also supinate the forearm (twist the forearm, as in tightening a screw). If you want flexion to occur without supination, other muscles must contract to prevent this supination. In this context, such synergists are sometimes called *neutralisers.*

Fixator

A synergist is more specifically referred to as a fixator or stabilizer when it immobilizes the bone of the prime mover's origin, thus providing a stable base for the action of the prime mover. The muscles that stabilize (fix) the scapula during movements of the upper limb are good examples. The sit-up exercise gives another good example: The abdominal muscles attach to both the rib cage and the pelvis. When they contract to enable you to perform a sit-up, the hip flexors will contract synergistically as fixators to prevent the abdominals from tilting the pelvis. This enables the upper body to curl forward as the pelvis remains stationary.

Leverage

The bones, joints and muscles together form a system of levers in the body that optimises the relative strength, range and speed required of any given movement. The joints act as the fulcra (**sing.** fulcrum), while the muscles apply the effort and the bones bear the weight of the body part to be moved.

A muscle attached close to the fulcrum will be relatively weaker than it would be if it were attached further away. However, it is able to produce a greater range and speed of movement; because the length of the lever amplifies the distance travelled by its moveable attachment. Figure 1.9 illustrates this in relation to the adductors of the hip joint. The muscle so positioned to move the greater load (in this case, adductor longus) is said to have a *mechanical advantage.* The muscle attached close to the fulcra is said to operate at a *mechanical disadvantage,* although it can move a load more rapidly through larger distances.

Figure 1.9: The pectineus is attached closer to the axis of movement than the adductor longus. Therefore, the pectineus is the weaker adductor of the hip, but is able to produce a greater movement of the lower limb per centimetre of contraction.

The following illustrations depict the differences in first-, second- and third-class levers, with examples in the human body.

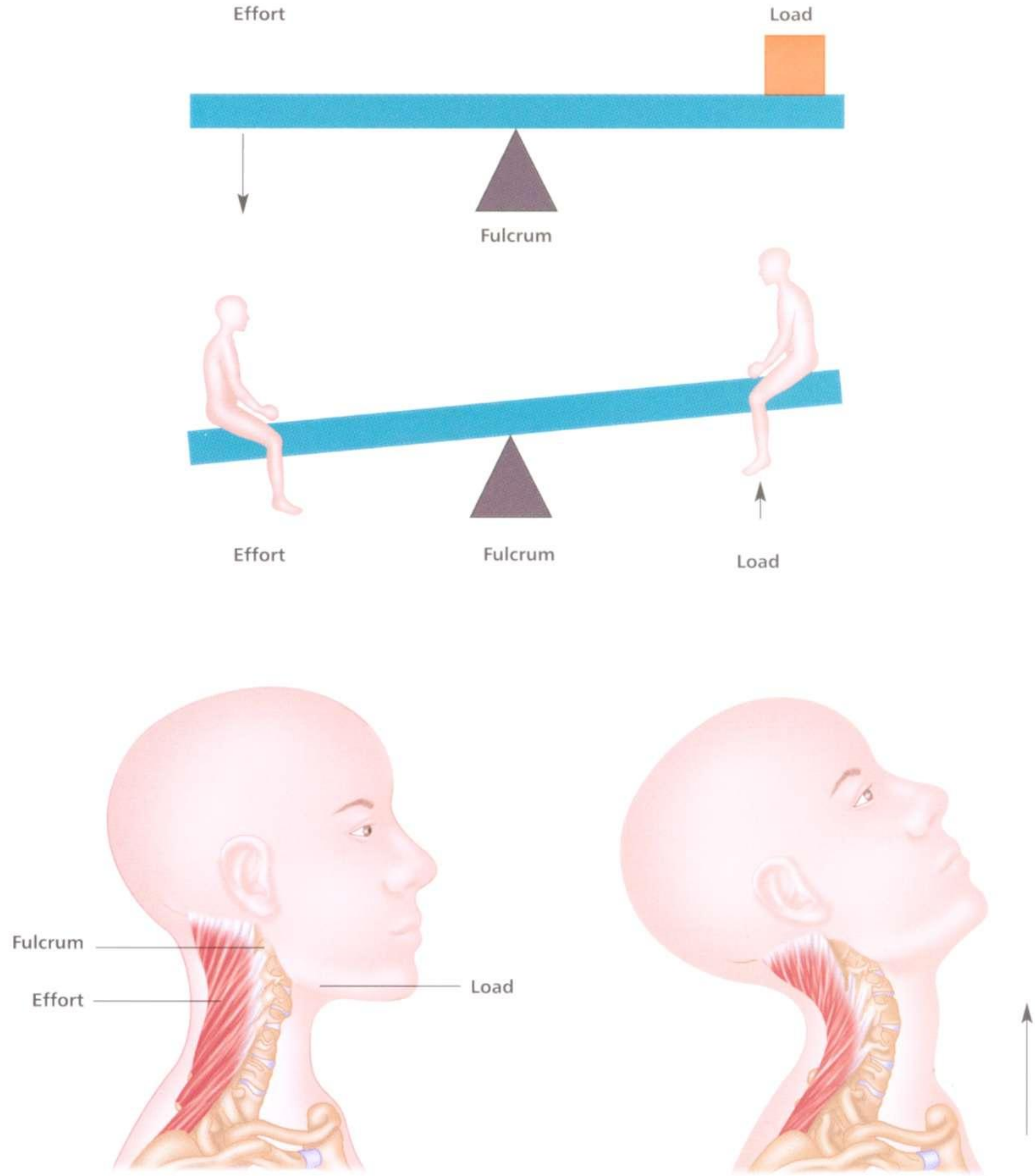


Figure 1.10: First-class lever: The relative position of components is Load-Fulcrum-Effort. Examples include a seesaw and a pair of scissors. In the body, an example is the ability to extend the head and neck, i.e. the facial structures are the load; the atlanto-occipital joint is the fulcrum; the posterior neck muscles provide the effort.

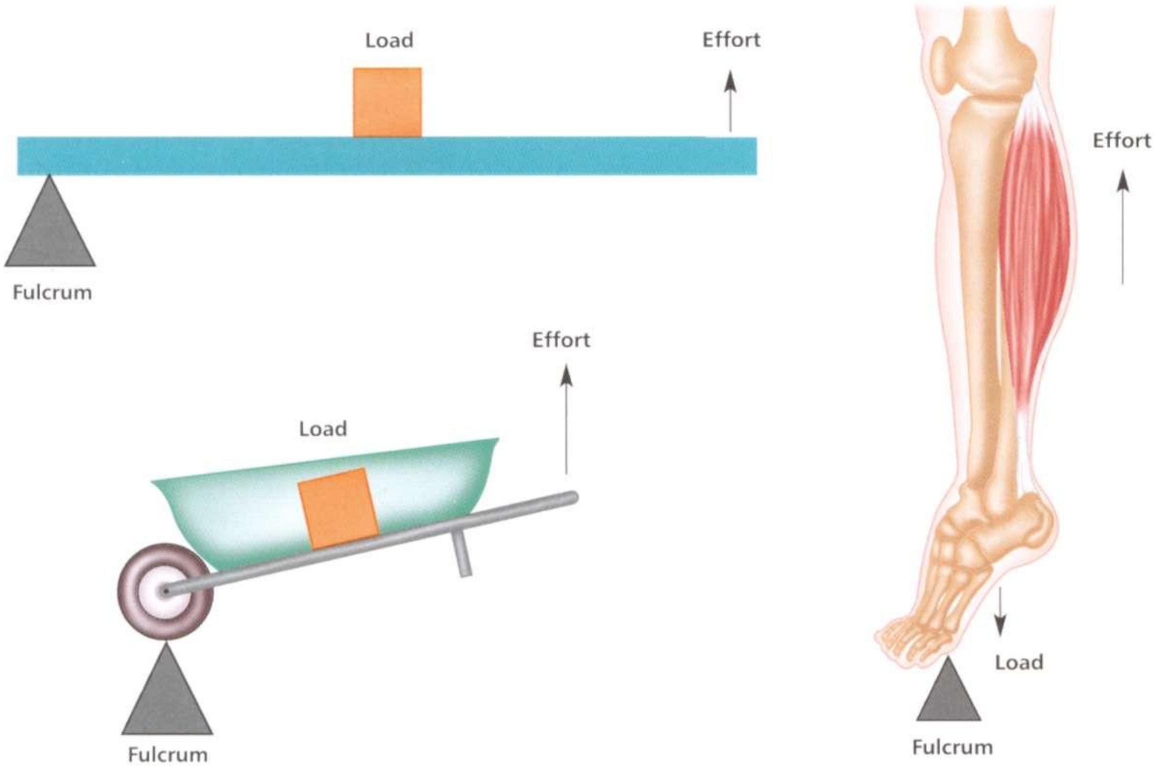


Figure 1.11: Second-class lever: The relative position of components is Fulcrum-Load-Effort. The best example is a wheelbarrow. In the body, an example is the ability to raise the heels off the ground in standing, i.e. the ball of the foot is the fulcrum; the body weight is the load; the calf muscles provide the effort. With second-class levers, speed and range of movement are sacrificed for strength.

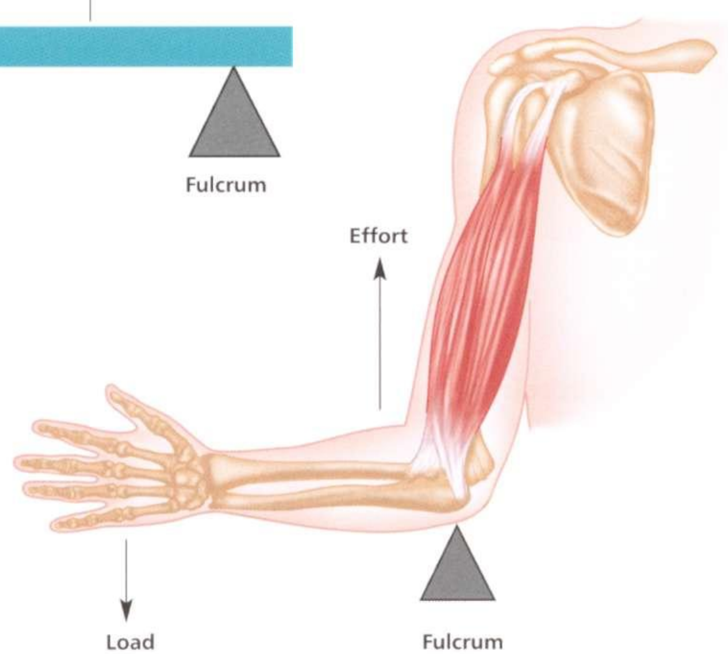


Figure 1.12: Third-class lever: The relative position of components is Load-Effort-Fulcrum. A pair of tweezers is an example of this. In the body, most skeletal muscles act in this way. An example is flexing the forearm, i.e. an object held in the hand is the load; the biceps provide the effort; the elbow joint is the fulcrum. With third-class levers, strength is sacrificed for speed and range of movement.

Muscle Attachment

The way a muscle attaches to bone or other tissues is either through a direct attachment or an indirect attachment. A direct attachment (called *a fleshy attachment)* is where the perimysium and epimysium of the muscle unite and fuse with the periosteum of a bone, perichondrium of a cartilage, a joint capsule or the connective tissue underlying the skin (some muscles of facial expression being good examples of the latter). An indirect attachment is where the connective tissue components of a muscle fuse together into bundles of collagen fibres to form an intervening tendon. Indirect attachments are much more common. The types of tendinous attachments are as follows:

Tendons and Aponeurosis

Muscle fasciae, which are the connective tissue components of a muscle, combine together and extend beyond the end of the muscle as round cords or flat bands, called *tendons,* or as a thin, flat and broad *aponeurosis.* The tendon or aponeurosis secures the muscle to the bone or cartilage, to the fascia of other muscles, or to a seam of fibrous tissue called a *raphe.* Flat patches of tendon may form on the body of a muscle where it is exposed to friction, for example, where it rubs against the spine of the scapula on the deep surface of trapezius.

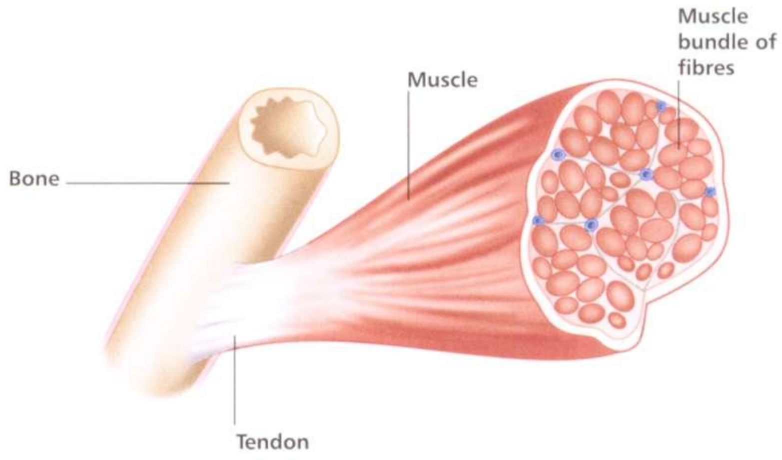


Figure 1.13: A tendon attachment.

Intermuscular Septa

In some cases, flat sheets of dense connective tissue known as *intermuscular septa* penetrate between muscles, providing another medium to which muscle fibres may attach.

Sesamoid Bones

If a tendon is subject to friction, it may, but not necessarily, develop a sesamoid bone within its substance. An example is the peroneus longus tendon in the sole of the foot. However, sesamoid bones may also appear in tendons not subject to friction.

Multiple Attachments

Many muscles have only two attachments, one at each end. However, more complex muscles are often attached to several different structures at its origin and/or its insertion. If these attachments are separated, effectively meaning the muscle gives rise to two or more tendons and/or aponeurosis inserting into different places, the muscle is said to have two heads. For example, the biceps brachii has two heads at its origin: one from the corocoid process of the scapula and the other from the supraglenoid tubercle. The triceps brachii has three heads and the quadriceps has four.

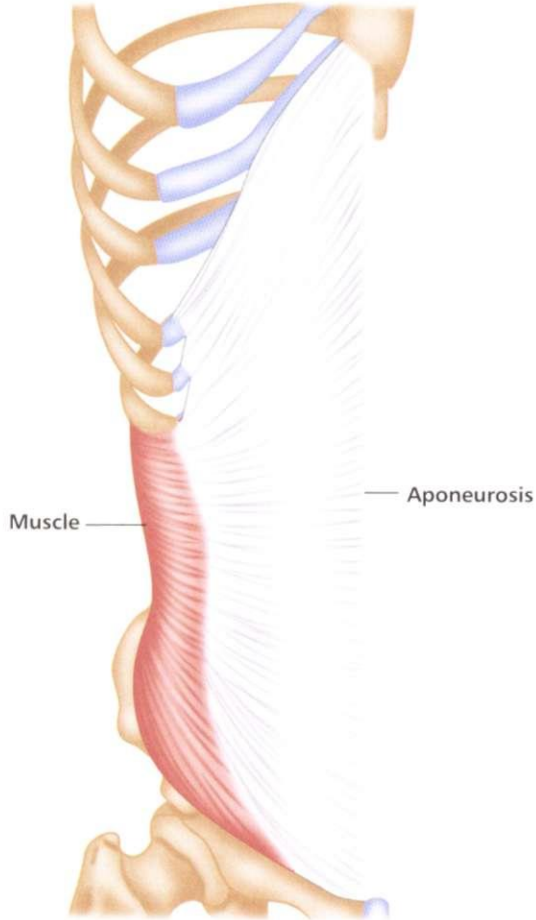


Figure 1.14: An attachment by aponeurosis.

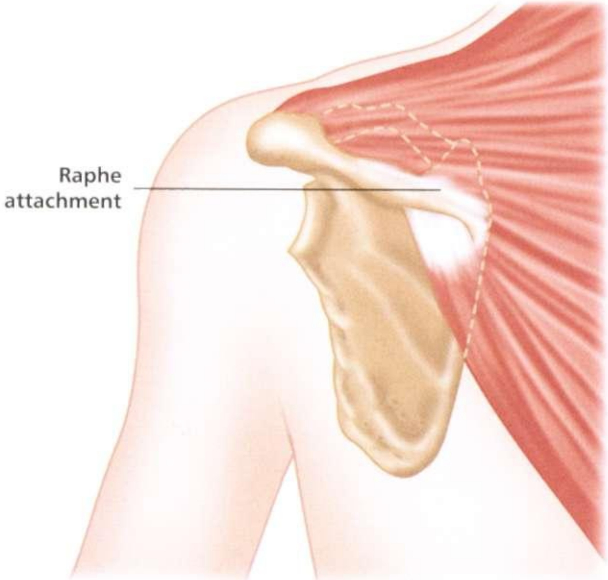


Figure 1.15: Flat patches of tendon on the deep surface of trapezius (raphe attachment).

Fascia and Myofascia

Fascia wraps up the viscera, muscles and even our skeletal system. The body is a system of interconnecting tubes made of connective tissue fascia and possesses an interlocking of fascial planes that connect one muscle group with another. Due to this interconnectedness, restriction in one area will result in reduced range of motion in another local or distal area. So, the fascia covering the anatomical leg merges at the inguinal ligament with the *transversalis fascia* wrapping up the *peritoneal cavity.* The *transversalis fascia* merges with the fascia of the diaphragm and continues up to merge with the *parietal pleura* surrounding the lungs. The parietal fascia merges with the *cervical fascia* and on up to the *galea aponeurotica,* and so on. It is worth spending some time exploring this tissue, since it is directly implicated in the manifestation of trigger points.

Myofascia

The superficial fascia that invests muscle is also known as *connective tissue.* It is a clear, fibrous tissue. The components of the connective tissue are long, thin, flexible filaments of collagen, surrounded by ground substance. The ground substance is made up of glycosaminoglycans (30%) and water (70%), together forming a gel. It is modified according to where it is located in the body *(superficial* or *deep)* but it is somewhat like plastic wrap in nature. For example, if you eat chicken, you may well be aware of the superficial fascia; this lies under the skin and is a tough, transparent, tissue layer. This myofascia invests muscles like an envelope; it is plastic-like, and when it is injured or damaged, it becomes shorter, condensed and tighter. Trigger points mainly manifest in the myofascial tissue; the contracture of this fascia gives rise to nodules underneath the skin. Depending on where it is located, it is classified in many different ways:

Endomysium

A delicate connective tissue called *endomysium* lies outside the sarcolemma of each muscle fibre, separating each fibre from its neighbours, but also connecting them together.

Fasciculi

Muscle fibres are arranged in parallel bundles called *fasciculi.*

Perimysium

A denser collagenic sheath called the *perimysium* binds each fasciculus.

Epimysium

The entire muscle, which is therefore an assembly of fasciculi, is wrapped in a fibrous sheath called the *epimysium.*

Deep Fascia

A coarser sheet of fibrous connective tissue lies outside the epimysium, binding individual muscles into functional groups. This deep fascia extends to wrap around other adjacent structures.

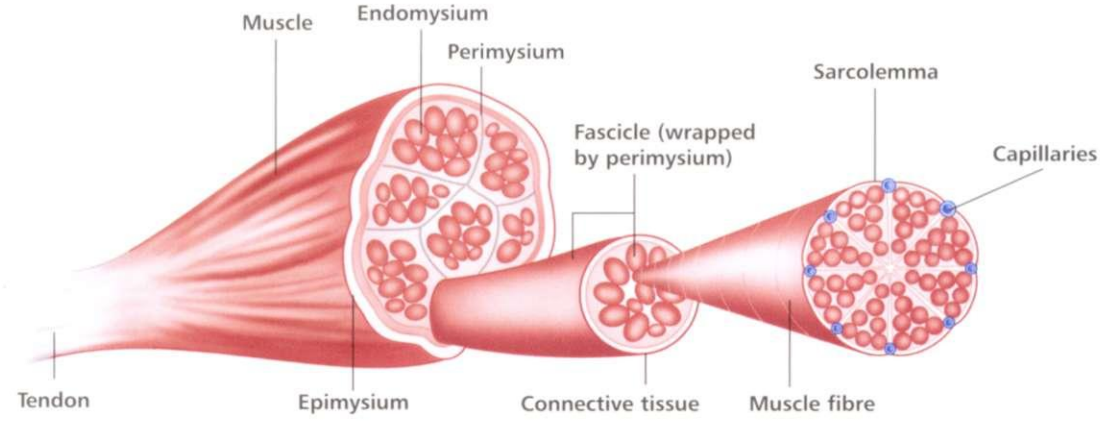


Figure 1.16: The connective tissue sheaths of skeletal muscle.

Embryological Development of Fascia

An overview of the embryological origin of connective tissues may provide some insights into the formation and location of trigger points. Trigger points tend to manifest within the *epimysium* according to myofascial strain patterns. These patterns start to develop very early on in the developing embryo, and may also be related to foetal alignment in the womb. These strain patterns develop as we mature from childhood to adulthood and are influenced by, for example, posture, weight gain and mechanical injury. As stated above, fascia supports organs, wraps around muscles and condenses to form ligaments, aponeuroses and even bones.

By the end of the seventh week of development, the embryo has most of its organs, bones, muscles and neurovascular structures in place. A group of 'filler cells' begins to proliferate around these structures. This filler is derived from *mesodermal tissue*, a primitive fascia that is constructed from cells, fibres and intercellular matrix. This matrix has the consistency of glass wool in a soft, jelly-like substrate. In most body areas, this primitive fascia remains supple until birth. In some areas, however, it condenses and becomes 'directional', in response to internal and external pressures and tensions. Ligaments and tendons begin to form in these areas. Stress and strain lines develop in these tissues, and bone salts are laid down, causing primitive ossification. As the bones grow, they drag some of the connective tissue fibres into 'differentiated' ligaments. An example of this is the pre-vertebral cartilage, which grows and pushes into the mesodermal connective tissue beds. As it does so, it creates lines of stress that help to maintain integrity and provide a scaffold for further directional growth. As the bones start to grow, the complexity of strains and directional pulls results in the differentiated spinal ligaments (flavum, posterior longitudinal, etc.).

Furthermore, it has been reliably demonstrated that primitive organ growth relies on this mesodermal intracellular matrix. The 'potential' pancreas, for example, will only differentiate into a mature organ in the specific presence of this 'primitive' potential fascia. It has been suggested that the primitive or potential fascia creates a 'specific energy field' in which the cells of the 'potential' organ mature and differentiate. (Schultz, 1996). This may make more sense when we consider that the bones, muscles, ligaments and myofascial elements of connective tissue all share a characteristic pattern of growth.

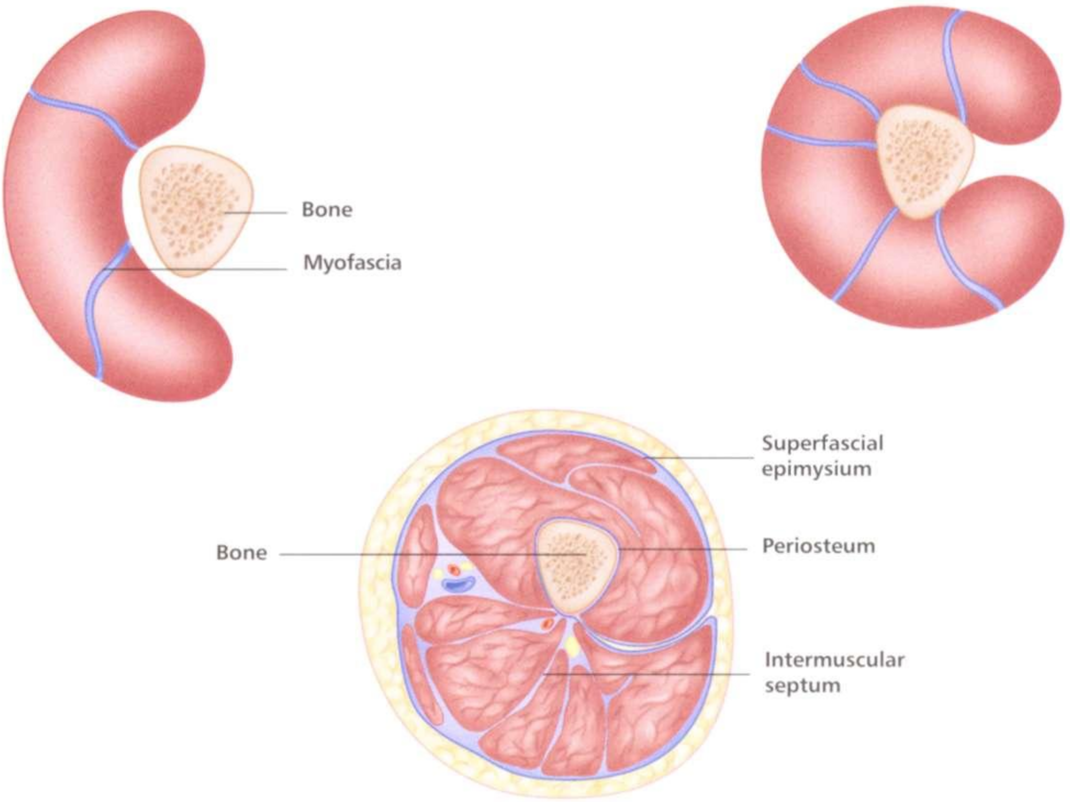


Figure 1.17: Fascial bag: the relationship between myofasciae and bone.

The relationship between a developing muscle and its enveloping connective tissue myofascia is complex. The stress lines may provide a key to understanding this relationship. It has been suggested that during the second month of embryological development, connective tissue is laid down before muscle tissue, and that clumps of 'potential muscle tissue, caught within this directional pull, differentiates into mature muscle oriented along the line of pull'. (Schultz, 1996). These clumps of muscle tissue elongate through directional pressure. At this point they develop, differentiate, mature and grow in size through mitotic cell reproduction to form the muscles as we know them.

In other words, it is the growth of fascia along lines of stress and strain that is the powerhouse of muscle orientation and development. This also explains why muscle action is not singular, but interconnected. For example, a contraction of the biceps brachii muscle will exert a force on the fascia of the whole arm, shoulder and neck. Fascia has neither beginning nor end, and is described by anatomists according to location. On closer inspection the myofascial bags surrounding the muscles are actually part of a continuum. This may also go some way to explaining the referred pain patterns stimulated by pressing on a trigger point.

Trigger Points and Trigger Point Formation

2

Trigger Point Definition

Acupuncture or Acupressure Points and Trigger Points

Nutritional and Biochemical Factors

Fibre Type and Trigger Point Manifestation

Postural Trigger Points and 'Cross Patternation'

Trigger Points Within Sarcomeres

Trigger Point Development

Trigger Point Classification

Trigger Point Symptoms

Trigger Point Definition

Drs. Janet Travell & David Simons (1993) described a trigger point as, *"A highly irritable localized spot of exquisite tenderness in a nodule in a palpable taut band of (skeletal) muscle."*

These hyperirritable localized spots can range in size, and have been described as a 'tiny lump', Tittle peas' and 'large lumps'; they can be felt beneath the surface embedded within the muscle fibres. If they are tender to pressure they may well be 'trigger points'. The size of a trigger point nodule varies according to the size, shape and type of muscle in which it is generated. What is consistent is that they are tender to pressure. So tender, in fact, that when they are pressed, the patient often winces from the pain; this has been called the *'jump sign'.*

Myofascial trigger points may well be implicated in all types of musculo-skeletal and mechanical muscular pain. Their presence has even been demonstrated in children and babies. Pain or symptoms may be directly due to active trigger points, or pain may 'build up' over time from latent or inactive trigger points. Studies and investigations in selected patient populations have been carried out on various regions of the body. These have confirmed a high prevalence of trigger point pain. The following table lists some of these studies. (Travell & Simons, 1999).

Body Region	Research Centre	Population	% With Myofascial Pain
General	Medical	172 (54)	30
General	Pain Medicine Center	96	93
General Center	Comprehensive Pain	283	85
Craniofacial	Head & Neck Pain Clinic	164	55
Lumbogluteal	Orthopaedic Clinic	97	21

Table 1: Prevalence of trigger points in selected patient populations.

So, there is a growing body of research evidence directly linking musculo-skeletal pain to trigger points.

Embryogenesis

There is some evidence that myofascial trigger points may be present in babies and children (Davies, 2004); they have also been demonstrated in muscle tissue after death.

Trigger points develop in the myofascia, mainly in the centre of the muscle belly where the motor end plate enters (primary or central). However, secondary or satellite trigger points often develop in a response to the primary trigger point. These satellite points often develop along fascial lines of stress. These lines of stress may well be 'built in' at the time of embryogenesis. External factors such as ageing, body morphology, posture, weight gain or congenital malformation, etc., also play a crucial part in trigger point manifestation and genesis (see page 32).

Evidence

In 1957, Dr. Janet Travell discovered that trigger points 'generate and receive' minute electrical currents. She determined experimentally that trigger point activity could be accurately quantified by measuring these signals with an electromyogram (EMG). She went on to demonstrate that a trigger point could be accurately and reliably located by the same technique. This is due to the fact that in its resting state, electrical activity in muscles is 'silent'. When a small part of the muscle goes into contracture, as with a trigger point, it causes a small, localized spike in electrical activity.

More easily, trigger points can be palpated beneath the skin in specific locations. They are localized, nodular and discrete and are characteristically painful, producing reproducible patterns of referred pain.

Further Evidence

Shah et al. (2003) performed a micro-dialysis experiment, where two tiny microtubules were inserted (within a hollowed-out acupuncture needle) into the trigger point of the upper trapezius muscle. Saline solution was pumped through one tubule, whilst the other aspirated the local tissue fluid exudate; these microtubules were accurately positioned and manoeuvred, under ultrasound guidance, from the outer zone of the trigger point towards the centre.

Nine subjects were selected for the study; of these, three were said to manifest active trigger points, three latent trigger points, and three no trigger points (control group). To locate the trigger points, the subjects were first manually palpated, and then an algometer (pressure meter) was used to measure the amount of pressure required to elicit symptoms. In each of the nine subjects, the same zone of the upper trapezius was aspirated. The results have thrown some more light on the internal pathophysiology within trigger points. These suggested localized tissue hypoxia, increased acute inflammatory cascade, and lowered pH (acidosis) (see table 2).

Type of Trigger Point	Findings
Active	Lower pain thresholds, increased irritability, highest levels of substance P, bradykinin, norepinephrine and interleukin-1, moderate hypoxia, lower pH
Latent	Moderately increased levels of substance P, bradykinin, norepinephrine and interleukin-1
Control group	Low levels of substance P, bradykinin, norepinephrine and interleukin-1, normal pH

Table **2:** Micro-dialysis findings.

Acupuncture or Acupressure Points and Trigger Points

Whilst there may be some overlap in trigger points and acupuncture points, they are not equivalent. Acupuncture points are said to be localized concentrations of 'energy' that develop along electromagnetic lines (meridians). Trigger points, on the other hand, are discreet nodular tetherings in the myofascial tissues, which cause a specific and reproducible referred pain pattern when stimulated.

Based on the above theory of the 'specific energy field' generated by fascia, it may be that myofascial trigger points develop along lines of altered energetic activity or at the very least altered strain patterns. Some authorities go much further, claiming that there is a 70% correlation between trigger points and acupuncture points. It has been suggested that the *general theory* of acupuncture points may have been put forward by ancient Chinese medicine as an 'explanation' for the demonstrable and palpable presence of trigger points within myofascial tissues. (Travell & Simons, 1999). Furthermore, there is some evidence to demonstrate increased efficacy in pain relief when the trigger point is present at the site of an acupuncture point during treatment.

Fibromyalgia

Fibromyalgia syndrome is characterized by widespread diffuse musculo-skeletal pain and fatigue. It is a disorder for which the cause is still unknown. Fibromyalgia means pain in the fibrous, connective and tendinous tissues of the body. *'Fibromyalgia is a complex syndrome characterized by pain amplification, musculo-skeletal discomfort, and systemic symptoms'.* (Starlanyl, 2000). It has now been 'firmly established' that a central nervous system (CNS) dysfunction is primarily responsible for this amplification in the pain pathway.

Like myofascial trigger points, pain arises from the connective tissues, muscles, tendons and ligaments. Similarly, fibromyalgia does not involve the joints. Both conditions are often mistaken; however, they are discreet conditions. Both conditions may be linked to psychological depression. Unlike trigger point manifestation, fibromyalgia is believed to have a systemic origin.

Unlike trigger points, which cause a specific and reproducible pattern of referral, patients with fibromyalgia describe that they *ache all over* (although some do describe localized tender spots). Patients with fibromyalgia describe their muscles as feeling like they have been pulled or overworked. Sometimes the muscles twitch and at other times they burn. More women than men are affected by fibromyalgia, but there is no age profile. Unlike fibromyalgia points, trigger points have been successfully photographed using electron microscopy. A table listing the basic differences is shown below.

	Pain Location	Type of Pain	Muscular Quality on Palpation
Trigger point	Specific and discrete	Referred in a specific pattern	Tight and stiff, warm
Fibromyalgia	General	Vague, aching, burning, diffuse, widespread	Doughy and soft

Table 3: Some basic differences between fibromyalgia and trigger points (Juhan, 1987).

Add to this list that in fibromyalgia, the pain is mediated centrally (CNS) and for trigger points, pain is mediated locally in the region of the motor end plate from the peripheral nervous system (PNS).

Nutritional and Biochemical Factors

Simons et al. (1999) suggested that changes in biochemical inputs might influence trigger point formation and or perpetuation (see table 3).

Factor	Influence
Allergic/hypersensitivity	May have a potentising effect (Brostoff, 1992)
Hormonal	Oestrogen and thyroid deficiency may impact the endoplasmic environment leading to increased trigger point development and/or perpetuation (Lowe & Honeyman-Lowe, 1998)
Chronic viral, yeast and or parasite infection	May increase the likelihood of trigger point formation (Ferguson & Gerwin, 2004)
Vitamin C	Deficiency may perpetuate trigger point longevity
Iron deficiency	10–15% of people with chronic myofascial pain syndromes may be iron deficient (Simons, 1999)
Vitamin B_{12} deficiency	May increase tiredness, fatigue and increase chronic trigger point formation
Folic acid	May change the internal endoplasmic environment sufficiently to increase trigger point development and/or perpetuation

Table 4: Biomechanical factors after Simons et al. (1999).

Fibre Type and Trigger Point Manifestation

All muscles contain a blend of type 1 and type 2 fibres (Janda, 1986 and Lewit, 1999). This has a direct correlation as to how chronic symptoms might develop if left untreated.

1. Type 1 fibres are postural, and tend to respond to stress or overuse by shortening and becoming hypertonic. A trigger point in a muscle with a high percentage of type 1 fibres may take longer to respond to treatment.

2. Type 2 fibres are built for explosive, short-term activity and tend to become weak, atrophic and hypertonic under chronic or sustained endurance. A trigger point in a muscle with a high percentage of type 2 fibres may respond more rapidly to treatment.

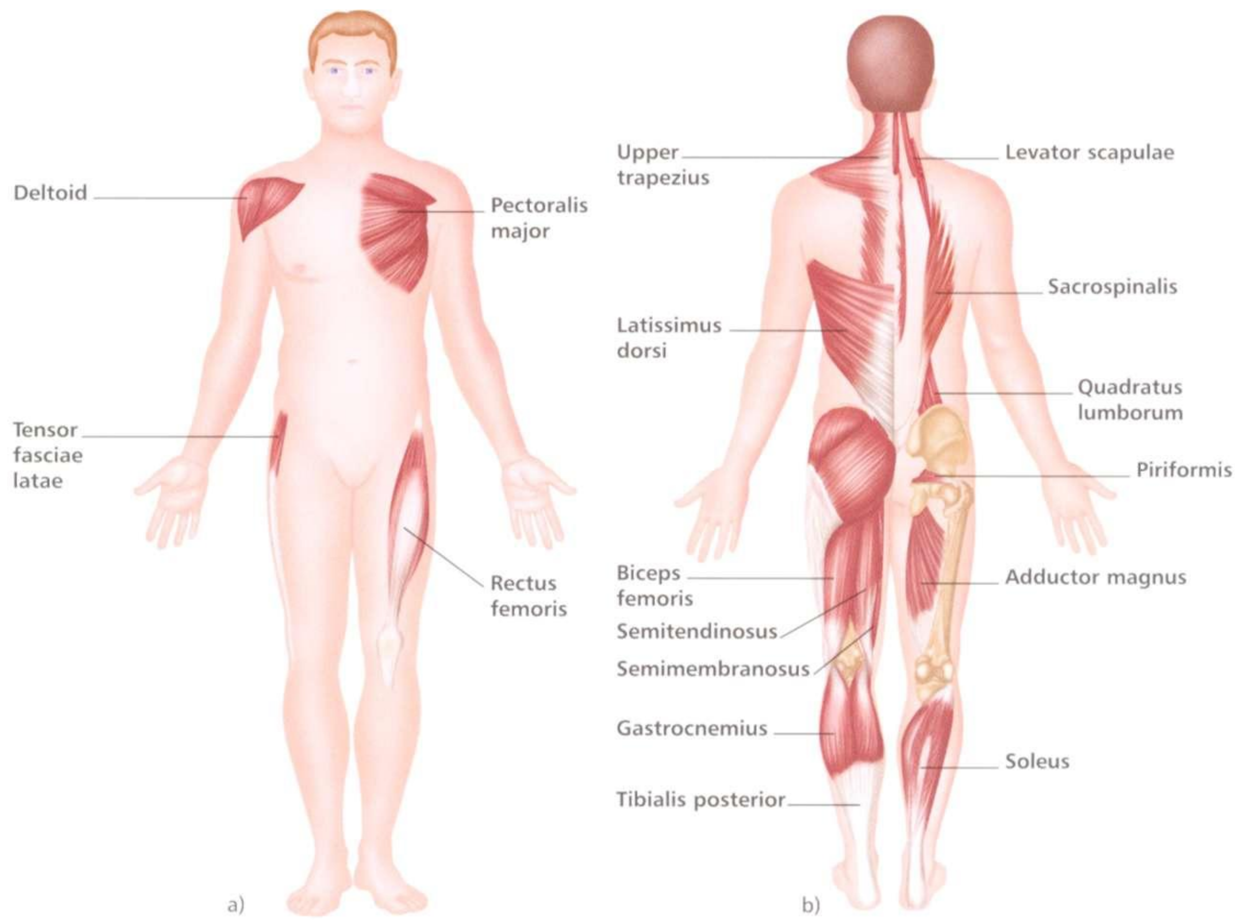


Figure 2.1: Major postural muscles of the body, a) anterior view, b) posterior view.

Trigger Point Formation and Posture

Poor posture is a powerful 'activator and perpetuator' of myofascial trigger points (Simons et al. 1999) and is always worth considering in chronic trigger point syndromes. Postural muscles tend to have a greater percentage of type 1 fibres, which as discussed, may lead to a more resistant type of trigger point. Humans are four-limbed animals and like our cousins, we are designed to move around and hunt for food. I am sure that if one put a gorilla in a chair all day, it would get a bad back!

It is a fact that in the developed world, many occupations involve prolonged sitting, often at a computer screen. Ergonomics is a booming industry, focusing on the interactions between people and their working environments however, not all work places can afford to implement proper ergonomic interventions. For many people, long and monotonous days spent at a computer monitor often lead to chronic and mal-adapted postures. Where possible, it is essential to identify the postural abnormalities and how they impact the patients' symptoms, and offer to remedy it via ergonomic advice, treatment and /or exercise.

Here is a classification of the most common postural mal-adaptations:

- Head forward;
- Round shouldered;
- Head to one side - telephone postures;
- Occupational malpositions;

- Slouched standing;
- Slouched sitting;
- Computer screen/ergonomics;
- Cross-legged sitting;
- Habitual postures;
- Driving position;
- Lifting/carrying;
- Primary short lower extremity (PSLE);
- Scoliosis.

Trigger points are common in the following postural structures: upper trapezius, levator scapulae, sternocleidomastoideus, erector spinae, musculo-ligamentous apparatus of the lumbar spine, gluteus medius, gastrocnemius/soleus complex.

Postural Trigger Points and 'Cross Patternation'

Osteopathic, chiropractic and other physical therapeutic modalities have all observed 'cross patterned' relationships within the body, from upper to lower and left to right. Junda (1996) recorded the two most common crossover postural strain patterns, upper and lower. Myers (2001) has further explored and developed these observations in his seminal book, *Anatomy Trains* (Churchill Livingstone). These myofascial strain patterns have a profound effect on the pathogenesis and chronicity of trigger point development. Trigger points can be found throughout the muscles listed below.

Upper Crossed Pattern Syndrome

This can be observed in the 'round-shouldered, chin-poking, slumped posture', which also compromises normal breathing (see figure 2.2). In such cases, pain is often reported in the neck, shoulder, chest and thoracic spine (these areas are often restricted). An oblique cross can be drawn through the glenohumeral joint, indicating the functional 'crossover' changes in muscular relationships. The main muscles in the upper cross pattern affected are:

Upper trapezius/levator scapulae ⟷ Tight pectoralis major

Deep neck flexors ⟷ Weak rhomboids and serratus anterior

Figure 2.2: Upper crossed pattern syndrome.

Lower Crossed Pattern Syndrome

This can be observed in the 'sway back' posture, with weak abdominals and gluteals muscle and over-tight erector spinae, quadratus lumborum, tensor fasciae latae, piriformis and psoas major.

Weak lower abdominals ⟷ Tight erector spinae

Weak upper abdominals ⟷ Tight quadratus lumborum, tensor fasciae latae, piriformis and psoas major

Figure 2.3: tower crossed pattern syndrome.

Trigger Points Within Sarcomeres

Muscle contraction occurs at the level of the sarcomeres (see Chapter 1). Even the slightest of gross *movements* requires the co-ordinated contraction of millions of sarcomeres. The sliding process requires: a) an initializing stimulation or impulse from a local motor nerve, b) energy and c) calcium ions.

Physiology of Movement

When the brain wants to move a muscle, it fires a message through a motor nerve. The local motor nerve terminals translate this impulse chemically by producing acetylcholine (ACh). ACh triggers an increase in sarcomere activity The energy required for this process is released by the *mitochondria* (energy centres) in the cells. Calcium ions inhabit the sarcoplasmic reticulum, which is found in the sarcoplasm of skeletal muscle.

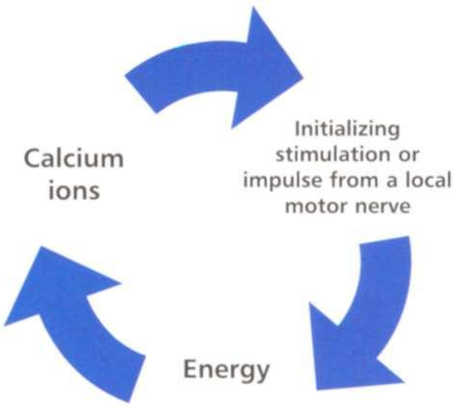


Figure 2.4: Flow chart for nerve impulse to cause muscle contraction.

Trigger Point Development

Trigger points manifest where sarcomeres and extrafusal motor end plates become over-active. We are still not completely sure what causes this to happen. It is probably multifactorial. Hypotheses include:

- Motor end plate theory;
- Energy crisis theory;
- Radiculopathic theory;
- Polymodal theory (PMRs).

For all cases, the following physiological observations have been recorded:

- Increased acetylcholine (ACh) production;
- Changes in calcium metabolism: excess calcium release;
- Hypertension;
- Stress;
- Localized neurological hyper-stimulation.

Motor End Plate Theory

Whatever the stimulus, the actin and myosin myofilaments stop sliding over one another. As a result, the sarcomere becomes turned to the permanently 'switched-on' position, leading to a contraction. Recent electrophysiological investigations of trigger points reveals phenomena which may indicate that the electrical activity of active trigger points arises from dysfunctional extrafusal motor end plates rather than from muscle spindles. This sustained dysfunction and sarcomere contraction leads to local intracellular chemical changes including:

- Localized ischemia;
- Increased metabolism needs;
- Increased energy required to sustain contraction;
- Failed re-uptake of calcium ions into the sarcoplasmic reticulum;
- Localized inflammation (to facilitate repair);
- Compression or watershed effect on local vessels;
- Energy crisis;
- Production of inflammatory agents, which sensitize local autonomic and nociceptive (pain) fibres.

If this situation is allowed to continue over a significant period of time, the above changes lead to a vicious cycle. Calcium is unable to be taken into the actin and myosin myofilaments, leading to sarcomere 'failure'.

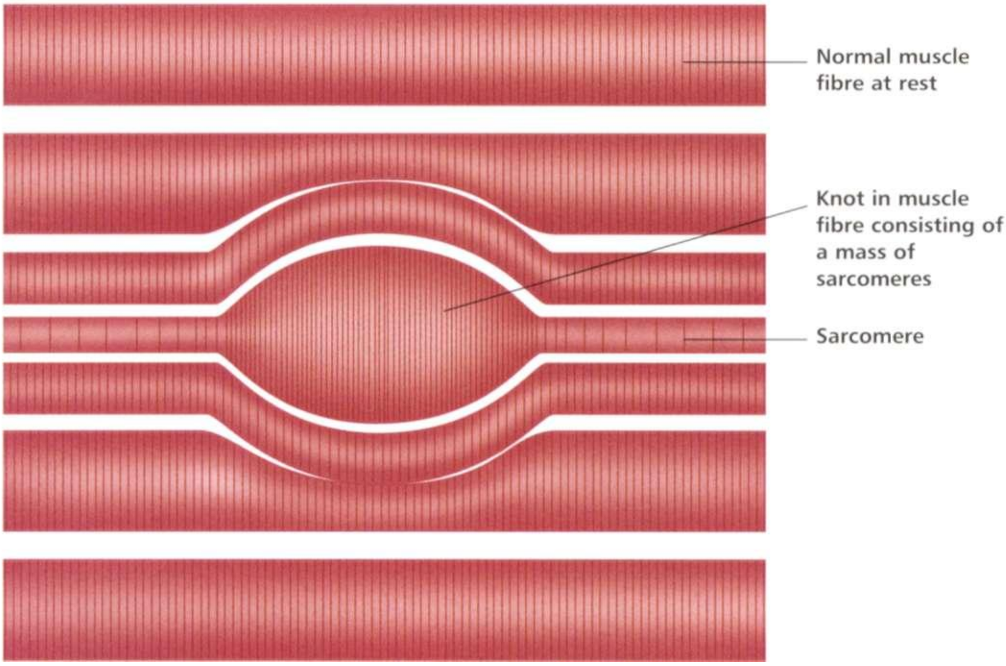


Figure 2.5: A trigger point showing 100 shortened sarcomeres without nerve stimulus and associated taut band.

Energy Crisis Theory

Bengtsson et al. (1986), Hong (1996), Simons et al. (1999) all proposed and developed this theory. They suggested that the body attempts to resolve sarcomere and end plate failure (outlined above) by changing the blood supply to the sarcomere (vasodilation). One further result of this anomalous situation is the migration of localized *acute* and *chronic* inflammatory cells. Inflammation is a cascade; this cascade mechanism starts to occur around the *dysfunctional* sarcomere. Inflammation brings with it sensitizing substances such as substance P, a peptide present in nerve cells, which increases the contractions of gastrointestinal smooth muscle, but also causes vasodilation. This has the effect of stimulating both local (small) pain fibres and local autonomic fibres. This in turn leads to increased acetylcholine production and hence a vicious cycle.

Eventually the brain sends a signal to rest the muscle in which the trigger point manifests. This leads to muscle hypertonia, weakness, shortening, fibrosis (muscle stiffness) and reflex inhibition of other muscle groups. Treatment is thus aimed at interfering and attenuating this vicious cycle.

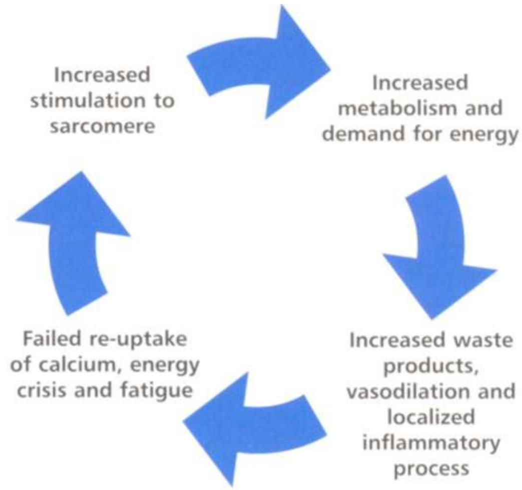


Figure 2.6: Vicious cycle for trigger point physiology.

Radiculopathy Theory

Gunn (1997), Quintner & Cohen (1994) have suggested an alternative mechanism for trigger point construction. This model suggests a causal relationship with intervertebral discopathy, nerve root impingement and paraspinal muscle spasm. It is suggested that the irritation of these nerve roots (radicals) causes a compromise in neurovascular signals, distal muscle spasm and trigger point pathogenesis.

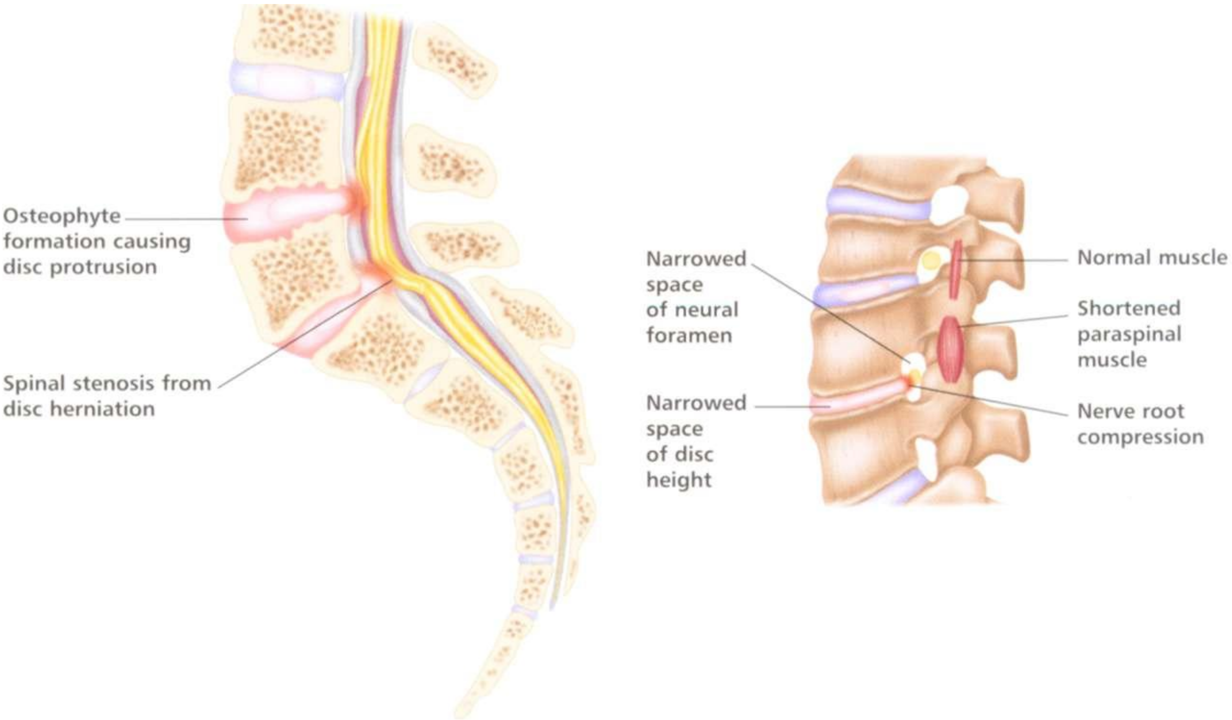


Figure 2.7: Nerve root irritation

Polymodal Theory (PMRs)

Kawakita et al. (2002) put forward this alternative hypothesis to describe trigger points as 'sensitized neural structures', which they called *polymodal receptors (PMRs).* They suggested that these PMRs are a type of nociceptor, which respond to mechanical, thermal and/or chemical stimuli. In potential, these PMR 'sensory terminals' exist in various tissues throughout the body as free nerve endings. The theory is that the latent PMRs are 'switched on' under certain physiological stimuli, becoming tender and morphing into the form we call trigger points. Schleip (2003) refined this theory further and discussed the PMRs as being formed from ubiquitous small fibre interstitial muscle receptors (IMRs) (see Chapter 10). Although somewhat radical, this theory does explain a number of trigger point findings. Kawakita et al. further suggest that these PMRs may explain the link between acupuncture and trigger points.

It may be that trigger points develop as a result of some or all of the above theories.

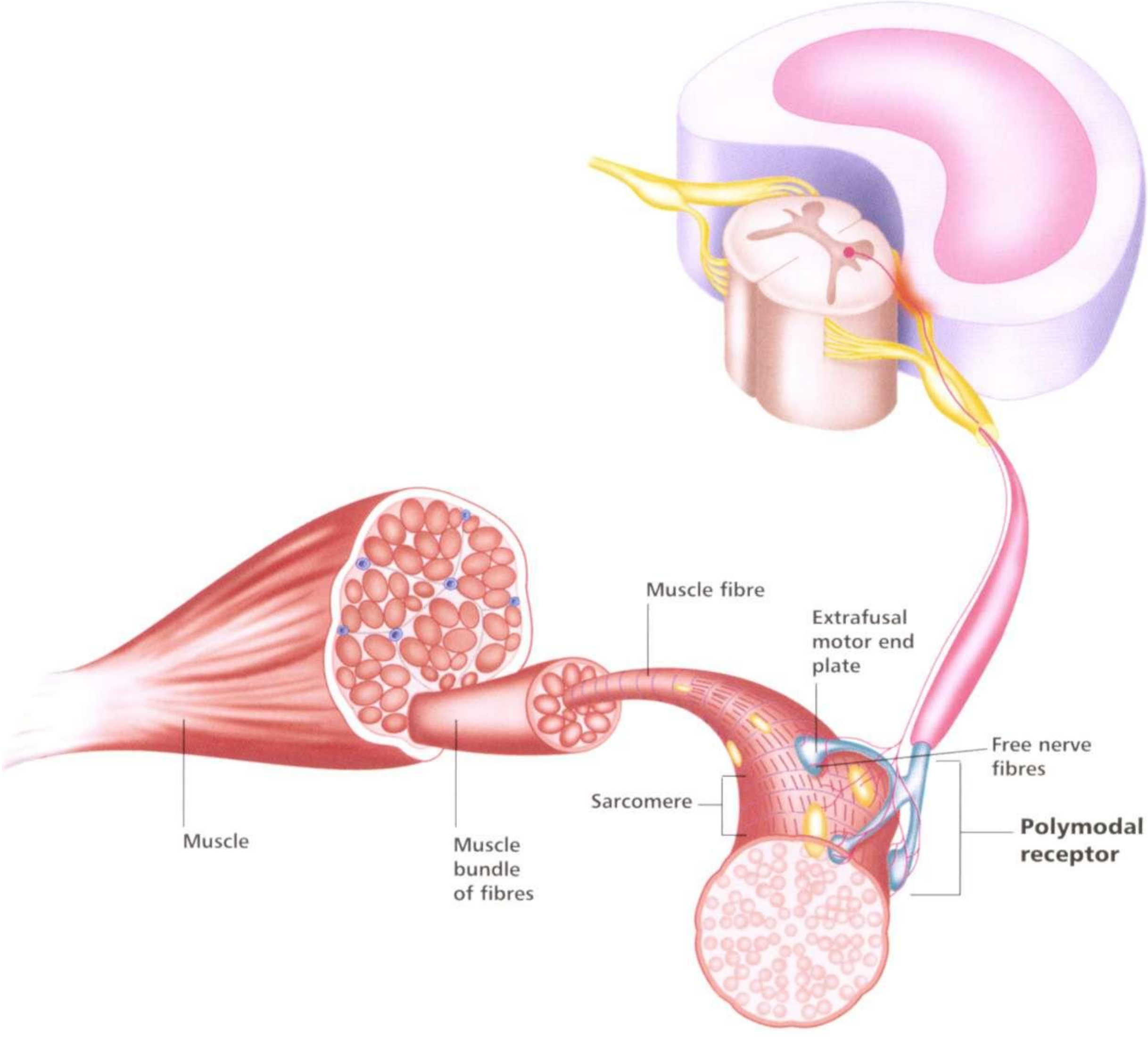


Figure 2.8: Polymodal receptors.

Trigger Point Classification

Trigger points are described in various ways according to location, tenderness and chronicity: central (or primary); satellite (or secondary); attachment; diffuse; inactive (or latent); and active.

Central (or Primary) Trigger Points

These are the most well-established and 'florid' when they are active, and are usually what people refer to when they talk about trigger points. The central trigger points always exist in the centre of the muscle belly, where the motor end plate enters the muscle.

N.B. muscle shape and fibre arrangement is of importance in this regard. For example, in multipennate muscles, there may be *several* central points. Also, if muscle fibres run diagonally, this may lead to variations in trigger point location.

Satellite (or Secondary) Trigger Points

Secondary trigger points may be 'created' as a response to the central trigger point in neighbouring muscles that lie within the *referred pain zone.* In such cases, the primary trigger point is still the key to therapeutic intervention and the satellite trigger points often resolve once the primary point has been effectively rendered *inactive.* The corollary is also true in that satellite points may prove resilient to treatment until the primary *central* focus is weakened; this is often the case in the para-spinal and/or abdominal muscles.

Attachment Trigger Points

As discussed towards the end of Chapter 1, myofascia is a continuum. It has been noted that the area where the tendon inserts into the bone (tendino-osseous) is often 'exquisitely' tender. (Travell & Simons, 1999; Davies, 2004). This may well be the result of the existing forces travelling across these regions. It has been also suggested (ibid) that this may result from an associated chronic, active myofascial trigger point. This is because the tenderness has been demonstrated to reduce once the primary central trigger point has been treated; in such cases, the point is described as an *attachment* trigger point. Furthermore, it has been suggested that if a chronic situation occurs where the primary and attachment trigger points remain untreated, 'degenerative changes' within the joint may be precipitated and accelerated. (Travell & Simons, 1999).

Diffuse Trigger Points

Trigger points can sometimes occur where multiple satellite trigger points exist secondary to multiple central trigger points. This is often the case when there is a severe postural deformity such as a scoliosis, and an entire quadrant of the body is involved. In this scenario, the secondary points are said to be *diffuse.* These diffuse trigger points often develop along lines of altered *stress* and/or strain patterns.

Inactive (or Latent) Trigger Points

This applies to lumps and nodules that feel like trigger points. These can develop anywhere in the body; and are often secondary. However, these trigger points are not painful, and do not elicit a referred pain pathway. The presence of inactive trigger points within muscles may lead to increased muscular *stiffness.* It has been suggested that these points are more common in those who live a sedentary lifestyle. (Starlanyl, 2000). It is worth noting that these points may re-activate if the central or primary trigger point is (re)stimulated, or following trauma and injury.

Active Trigger Points

This can apply to central and satellite trigger points. A variety of stimulants can activate an in-active trigger point such as forcing muscular activity through pain. This situation is common when increasing activity post road traffic accident (RTA), where multiple and diffuse trigger points may have developed. The term denotes that the trigger point is both tender to palpation and elicits a referred pain pattern.

Trigger Point Symptoms

Referred Pain Patterns

Pain is a complex symptom experienced differently and individually. However, referred pain is the *defining symptom* of a myofascial trigger point.

You may be used to the idea of referred pain of a visceral origin; an example of this is heart pain. A myocardial infarct (heart attack) is often not experienced as crushing chest pain, but as pain in the left arm and hand, and in the left jaw. This type of pain is well documented, and known to originate from the embryological dermomyotome; in this case, the heart tissue, jaw tissue and arm tissues all develop from the same dermomyotome.

Referred pain from a myofascial trigger point is somewhat different. It is a distinct and discreet pattern or map of pain. This map is consistent, and stimulating an active trigger point generates either part or all of the entire map of pain.

Patients describe referred pain in this map as having a *deep, aching* quality; movement may sometimes exacerbate symptoms, making the pain *sharper.* An example of this might be a headache. The patient often describes a pattern of pain, or ache, which can sometimes be aggravated and made sharper by moving the head and neck. The intensity of pain will vary according to the following factors (this list is not exhaustive):

- Location (attachment points are more sensitive);
- Degree of trigger point irritability;
- Active or latent trigger points;
- Primary or satellite trigger points;
- Site of trigger point (some areas are more sensitive);
- Associated tissue damage;
- Location/host tissue stiffness or flexibility;
- Ageing;
- Chronicity of trigger point.

Autonomic Effects

The nervous system is divided into central (CNS), peripheral (PNS) and autonomic (ANS). The autonomic nervous system is responsible for regulating many of our *automatic* or *vegetative* functions such as sweating and digestion. From our discussion on the physiology of trigger points, it can be seen that autonomic nerve fibres are implicated in the pathogenesis of a trigger point. Therapeutic treatment of myofascial trigger points has been demonstrated to have an effect on the ANS (see Chapter 10).

Physical Findings

The language for describing sensation is not highly sophisticated; unfortunately we have not yet evolved a suitable language to classify what we feel with our hands. With this in mind I will attempt to classify how trigger points feel.

- Small nodules the size of a pinhead;
- Pea sized nodules;
- Large lumps;
- Several large lumps next to each other;
- Tender spots embedded in taut bands of semi-hard muscle that feels like a cord;
- Rope-like bands lying next to each other like partially cooked spaghetti;
- The skin over a trigger point is often slightly warmer than the surrounding skin due to increased metabolic/autonomic activity.

Known symptoms include:

- Hypersalivation - increased saliva;
- Epiphora - abnormal overflow of tears down the cheek;
- Conjunctivitis - reddening of the eyes;
- Ptosis - drooping of the eyelids;
- Blurring of vision;
- Increased nasal secretion;
- Goose bumps.

Examination

Examination may be conducted by either standing, sitting or lying down. The choice depends on both the area being examined and the type of muscle fibre suspected. You may want to examine a muscle *under load* if you suspect this is an aggravating factor. By way of example, from this point forward, I will describe the examination and stretching of the pectoralis major and its trigger point(s).

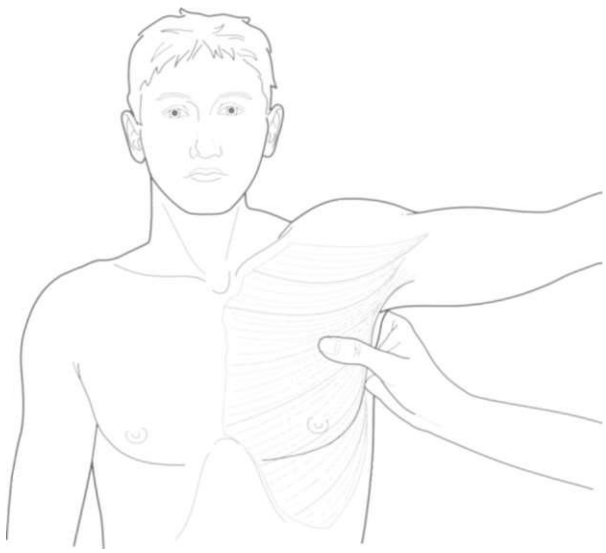


Figure 2.9: Sitting pectoralis major examination.

The main trigger points in the pectoralis major are to be found in the clavicular portion of the muscle. A pincer-like grip is the best way of examining for a trigger point in this region, whilst trigger points in the parasternal region of the muscle are best palpated with a flat-handed contact. Procedure, with the patient sitting or standing:

- Ask patient to abduct the arm 90 degrees to put the muscle into moderate tension;
- Palpate for nodule or tight band;
- Feel for the jump sign or twitch response;
- Pressure should reproduce symptoms experienced by the patient;
- Pressure should elicit a referred pain pattern.

Maintaining Factors

The following are maintaining factors for trigger points. The presence of one or several of these may well present some difficulty in eliminating trigger points over the long-term.

- Ageing;
- Posture (including work);
- Obesity;
- Anorexia;
- Scar tissue (post-surgical);
- Sports, hobbies, habits;
- Stress and strain patterns;
- Metabolic disorders;
- Disease or illness;
- Vitamin deficiency;
- Congenital (bony) anomaly;
- Type of muscle fibre;
- Direction/orientation of muscle fibre;
- Muscle shape/morphology (fusiform, etc.);
- Psychological factors;
- Chronicity of trigger point.

Advice to Patient

Once a therapeutic intervention has been performed, it is advisable to encourage the patient to get involved in managing his or her own symptoms. In this book, I have offered some specific advice under the heading 'advice to patient'. As a more general overview, you might want to include hints, tips, and advice using the following elements or components.

By way of an example, I will use the pectoralis major muscle again.

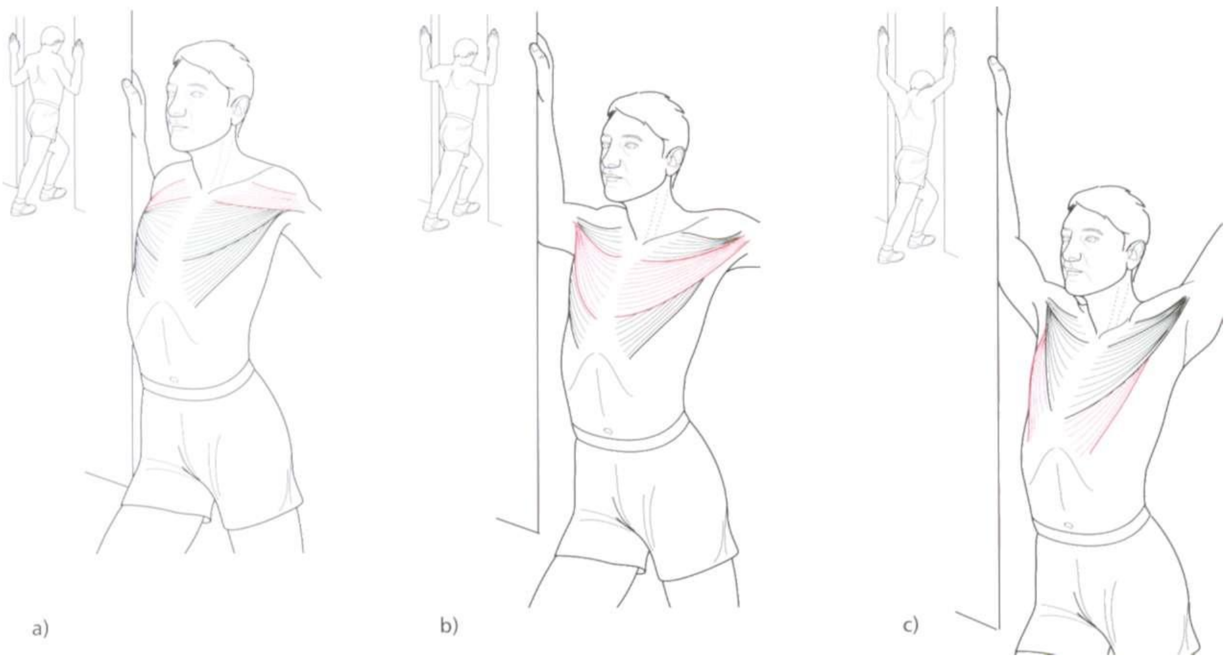


Figure 2.10: Stretching techniques for pectoralis major: a) upper fibres, b) middle fibres; c) lower fibres.

Strengthening

Muscles are more susceptible to damage, fatigue and injury when they are weak. Weakness is often a contributory factor in the pathogenesis of myofascial trigger points. This is because the body overcompensates for the weakness and strains in the muscle; overloading and overstimulating the motor end plate. I have illustrated some simple strengthening diagrams where appropriate.

One muscle should never be strengthened in isolation. If you decide to offer strengthening exercises, it is advisable to put them in context. An overall stretching programme should be advised, perhaps utilizing a yoga-based regime.

Stretching

I have illustrated some simple stretching diagrams where appropriate. Stretching should be performed slowly, and *without* bouncing. Care must be taken to isolate the stretch to the specific muscle as far as possible. As a rule, stretches should be performed three times, slightly deepening the stretch with an out-breath each time. This sequence should be performed several times per day, for a total of approximately 15-20 minutes.

Advice

Most of the advice you can offer is common sense. *"Look at your driving position ", "Look at your every day work set-up".* In the example of the pectoralis major muscle you may ask the patient about their stress or anxiety levels (rib breathing mechanics). If your patient has large, heavy breasts, you may want to advise on a more appropriate bra or support. I have tried to offer some advice for each muscle in this book.

Posture

This may well have a crucial role in maintaining trigger point activity. Faulty sitting and/or standing postures are both a pathogenic and maintaining factor for trigger point activity. Advice and exercises for posture is often the key to unlocking both *central* and *satellite* points. As discussed at the beginning of the paragraph.

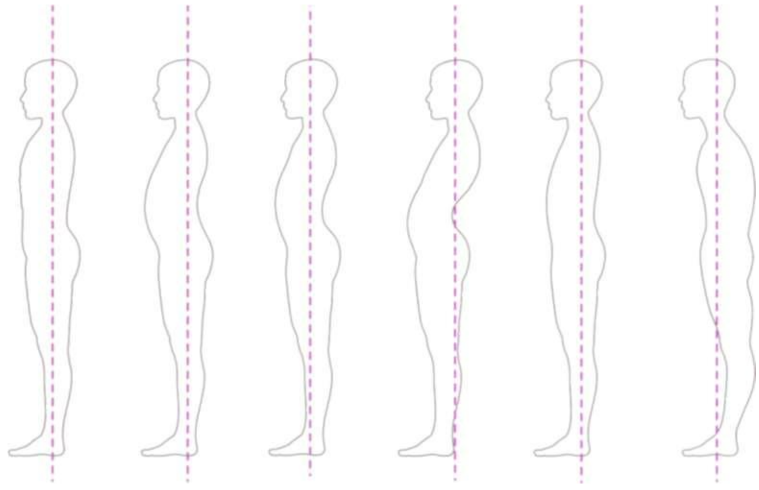


Figure 2.11: Posture.

Sleeping Posture

Patients often assume strange postures at night! This is sometimes to reduce the pain from either active, or stiff latent trigger points; in such cases patients often opt for a sleeping position that shortens the affected muscle. For example, sleeping with either the hands above the head (supraspinatus), or the arms folded over the chest (pectoralis major). In other cases, it may be that the sleeping position is a pathogenic or a maintaining factor.

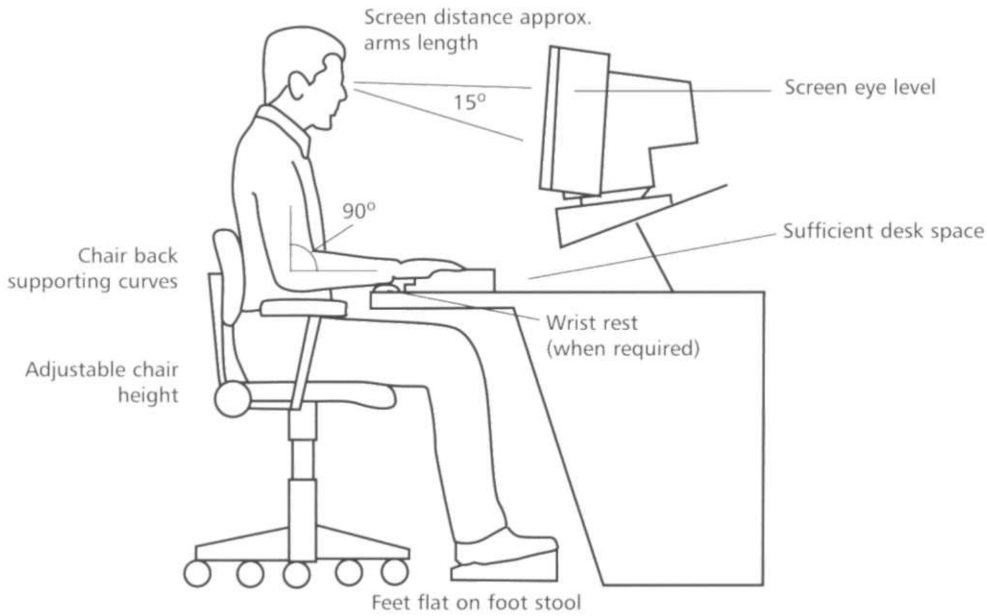


Figure 2.12: Ideal sitting work posture.

Work Posture

Some patients may have manual or repetitive working activities; these may well have a role to play in trigger point pathogenesis or maintenance. Many patients spend their time at work sitting. Above is a diagram illustrating an ideal sitting work posture.

Habitual Activity, Hobbies, and Sports

Similarly it is important to ask the patient if they perform any repetitive or habitual activities. Standing all day on one leg, for example, may well overload the tensor fasciae latae (TFL) muscle. Sitting in a cross-legged position may affect a range of muscles such as the hip flexors (iliopsoas), the buttock muscles (gluteals and piriformis) and the thigh muscles (quadriceps). Heavy smokers may develop trigger points in the shoulder (deltoid) and arm (biceps brachii) muscles.

Similarly, certain hobbies and sports may lead to an increased incidence of trigger point pathogenesis. It is important to ask carefully about such activities. What is the level of competence? Does the patient warm-up and cool-down? How competitive are they? Is their level of activity realistic for their age? Posture? Body type? Physical health? You may want to explore these areas further. It is often useful to run through these activities and set the patient certain *activity goals* to achieve in between treatment sessions.

Therapeutic Technique Protocols

3

Palpation

Injections vs Dry Needling

Spray and Stretch Technique

Hands-on Therapy Trigger Point Protocols

Modifications: Muscle Energy/ Positional Release Techniques

Massage Techniques

Manual Lymphatic Drainage Techniques (MLD)

Palpation

Palpation is as much an art as it is a science. Initially you should seek to relax the patient sufficiently to gain access to vulnerable and potentially painful treatment. A thorough case history with thoughtful and directed questioning is essential, as is an engaging approach with the patient. It is important to talk to the patient; explaining procedures reduces the patient's anxiety levels, and allows participation in the treatment process. Involving the patient is a key step, as you rely on feedback to locate the exact centre of the trigger point.

How do I know it's a trigger point?

You are looking for:

- Stiffness in the affected/host muscle;
- Spot tenderness (exquisite pain);
- A palpable taut nodule or band;
- Presence of referred pain;
- Reproduction of the patient's symptoms (accurate);
- May be hotter (or colder) than the surrounding tissues;
- May be more moist than the surrounding tissues;
- May feel a little like sand paper;
- May be a loss of skin elasticity in the region of the trigger point.

What applicator should I use for palpation?

- Finger pads palpation: remember to cut your finger nails (shorter is better);
- Flat palpation: use the fingertips to slide around the patient's skin across muscle fibres;
- Pincer palpation: pinch the belly of the muscle between the thumb and the other fingers, rolling muscle fibres back and forth;
- Flat hand palpation: useful in the abdominal region (viscera);
- Elbow: allows stronger leverage which can be an advantage.

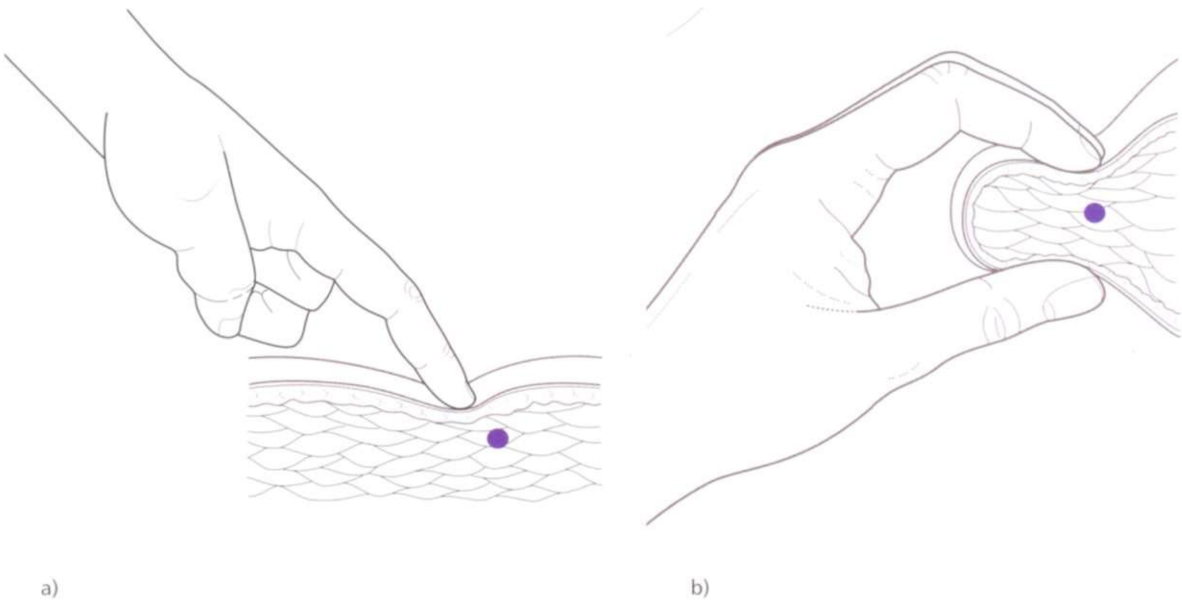


Figure 3.**1**: a) Flat finger palpation, b) pincer palpation.

You will need a *dermometer* to accurately measure reduced skin resistance (needs calibration), and an *algometer* for measuring point tenderness and pain generated by pressure.

The 'Jump and Twitch' Signs

This was first described in 1949 (Good, 1949; Kraft et al., 1968). At first, you should discover that it is easier to locate a *central* trigger point. Firmly pressing it produces *exquisite pain* and often causes the patient to *jump* away. The pain from an active *central* trigger point commonly causes a specific referred pain pattern. This is a distinct pattern away from the point of pressure. In the therapeutic context, this pattern often re-produces the pain felt by the patient.

Using a quick *snapping* pincer palpation or inserting a needle into a trigger point will often elicit a localized *twitch* response within the muscle. (Travell & Simons, 1999). This twitch may be due to the increased irritability of pain fibres. You will find the patterns of referred pain in Chapters 4-9.

Injections vs Dry Needling

Dry needling is as effective as injection when it comes to relief of trigger point symptoms, but may leave a longer period of post injection soreness. The following table offers some ideas as to when to consider injection:

	Injection	Manual Methods
Inexperienced therapist	Not recommended	Not recommended
Invasive	Yes	No
Quick response to treatment	Yes	May require several sessions
Enables self-management	No	Yes
Point always accessible	No	Yes
Patient has low threshold	Yes	No
Patient is needle shy	No	Yes

Table 5: When to inject versus manual methods.

There are three different approaches to needling (Travell & Simons, 1999):

1. Injection of a local anaesthetic (alone);
2. Injection with Botulinum toxin A;
3. Dry needling.

A number of injections may be required although sometimes one is sufficient. Small amounts (<1 ml) of a non-myotoxic anaesthetic are recommended. A local *twitch* response is a reliable indication of the correct position for needling. EMG monitoring allows increased accuracy and specificity.

The following have been advocated for use when injecting:

- Procaine hydrochloride 1% solution;
- Lidocaine hydrochloride (0.5%);
- Long-acting local anaesthetics;
- Isotonic saline;
- Epinephrin;
- Corticosteroid;
- Botulinum toxin A.

Please note: It is not within the remit of this book to offer technical advice for such procedures, (see Travell & Simons, 1999).

In comparative studies, dry needling has been demonstrated to be as effective as injecting an anaesthetic solution (procaine hydrochloride or lidocaine hydrochloride) in de-activating trigger points. In these studies however, dry needling caused localized soreness within 2-8 hours of injection. This soreness may be of a significantly greater intensity and/or duration than treatment with a wet injection. Technique:

• Locate trigger point and insert needle; watch for twitch response;
• Leave for up to 2 minutes, twiddling if necessary;
• Acupuncture needles may be used (8-15cm).

Spray and Stretch Technique

Hans Kraus (1952), who was the first to describe the technique of spray and stretch using *ethyl chloride spray,* used the technique for treating aches and sprains in wrestlers. Since then, techniques have been developed to treat almost all trigger points. These techniques are the *'single most effective non-invasive methods'* for de-activating trigger points. (Travell & Simons, 1999). Ethyl chloride spray is highly flammable and toxic, and is considerably colder than is necessary. It is volatile and has accidentally killed several patients and doctors. Vapocoolents such as *fluori-methane spray* are a safer alternative, although being a fluorocarbon, it may affect the ozone layer. The recommended product is *Gebauer's spray and stretch* as it is non-toxic and non-flammable.

The basic technique is quite straightforward as it *does not* require the same precise localization of trigger points as for an injection; instead you need only locate and identify the affected/host muscle to release its fibres. However, it is advisable to locate the trigger point with palpation as this re-assures the patient as to the efficacy. There are two steps to this technique: 1. **Spray** - performed first; this is a distraction for the more important step of; 2. **Stretch** - is the therapeutic component of the technique.

1. Two to three sweeps of spray are applied to the affected/host muscle whilst extending the muscle gently to its full stretch length;

2. The spray is aimed out of the inverted bottle nozzle at 30 degrees to the skin in a fine jet over a distance of about 30-50cm (do not aim at a single spot).

Situations when to use the spray and stretch techniques include:

• Young children;
• Needle shy patient;
• Immediately after trigger point injection;
• Post-hemiplegic - stroke rehabilitation;
• Immediately following major trauma (e.g. fracture, dislocation);
• After whiplash injury;
• In a patient with myofascial trigger points and hyperuricaemia (excess uric acid);
• Chronic or inhibition resistant trigger points;
• Attachment trigger points;
• After sprains and burns.

Hints and Tips

- Locating the central trigger point which causes a precise referred pain pattern is recommended as it gives the patient a rationale to accept treatment;
- Make sure the patient has recently eaten, as hypoglycaemia aggravates trigger points;
- Have a warm surgery room;
- Use a blanket to cover the body and areas not being cooled, as muscle warmth is more conducive to muscle relaxation;
- Remember to cover the eyes where appropriate;
- Do NOT aim at a single spot as this can burn or cause urticaria;
- Do NOT force a stretch;
- If the patient is apprehensive, ask them to focus on their breathing;
- Test range of motion before and after the spray and stretch technique;
- Make sure that the muscle to be treated is fully relaxed and support it where possible; treatment can be performed sitting, side-lying, prone or supine;
- To get a full stretch, you should anchor one side of the muscle, and move the other (passively).

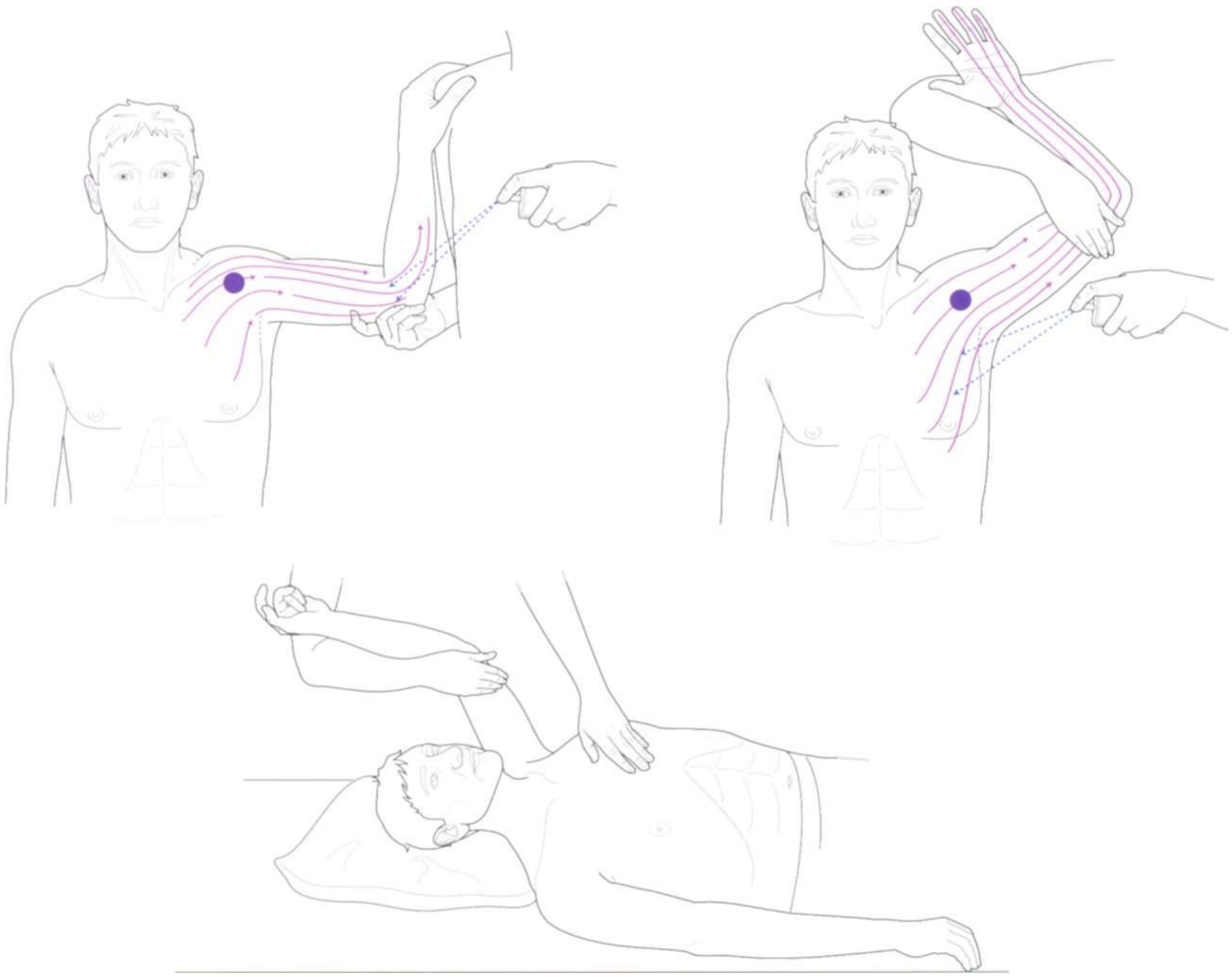


Figure 3.2: Spray and stretch technique for pectoralis major.

Hands-on Therapy Trigger Point Release Protocols

Stretch and Release Techniques

These methods directly involve the patient, asking them to actively contract the affected/host muscle and then to relax it. This sequence forms the basis for several extremely effective inhibitory techniques:

- Post-isometric relaxation;
- Reciprocal inhibition;
- Contract and relax/hold and relax;
- Unloading taping technique;
- Muscle energy techniques/positional release techniques.

These techniques are effective if you consider the concept of an over-stimulated motor end plate; as already discussed in Chapter 2. Utilizing contraction and relaxation whilst fixing through the trigger point may well 'normalize' the sarcomere length. This sets in place a cascade, releasing the affected actin and myosin, and reducing the energy crisis. In this case, taking up the slack whilst inhibiting the trigger point (as in *positional release techniques)* may be particularly useful. Here, I will explore some of these techniques.

Post-isometric Relaxation (PIR) Technique

This technique was introduced by Karel Lewit (1981). The proposed complete technique incorporates the use of co-ordinated eye and respiratory movements (reflex augmentation).

- Identify the trigger point;
- Place the patient in a comfortable position, where the affected /host muscle can undergo full excursion;
- Using 10-25% of their power, ask the patient to contract the affected/host muscle at its maximal pain-free length, whilst applying isometric resistance for 3-10 seconds; stabilize the body part to prevent muscle shortening;
- Ask the patient to relax the muscle or 'let it go';
- During this relaxation phase, gently lengthen the muscle by taking up the slack to the point of resistance (passive) - note any changes in length;
- Repeat several times (usually 3).

Reciprocal Inhibition Technique

This is an indirect technique relying on the agonist-antagonist neurological reflex. It is often used to augment other techniques, adding the 'finishing touch':

- The affected/host muscle is identified and taken into relaxation;
- The antagonist muscle is then contracted against 35-45% isometric resistance.

Contract and Relax/Hold and Relax Techniques

Originally taught by osteopaths Knott and Voss (1968), this technique was devised to increase the passive range of motion of markedly stiff joints. The principles behind the technique have a direct relevance to myofascial trigger point therapy, because as we have discussed, muscle tightness is often a sign of active or *latent* trigger points:

- Identify the trigger point;
- Place the patient in a comfortable position, where the affected/host muscle can undergo full excursion;
- Take the stiff joint to a comfortable near end point, and ask the patient to actively contract the affected / host muscle;
- Gently resist this voluntary contraction;
- Allow relaxation;
- During this phase, passively stretch the joint to a new (increased) end point.

Modifications: Muscle Energy/Positional Release Techniques

These are osteopathic techniques that can be divided into four distinct approaches. (Kuchera, 1994). In all cases, first identify the trigger point.

1. Isometric Contraction Technique

- Hold or fix through the trigger point of the affected/host muscle;
- Ask the patient to actively contract the muscle without any resistance;
- Hold until a softening is palpated in the trigger point;
- Actively and passively stretch the muscle.

2. Isotonic Contraction Technique

- Hold or fix through the trigger point of the affected/host muscle;
- Ask the patient to actively contract the muscle at about 35-45%, whilst you resist/fix against it;
- Hold until a softening is palpated in the trigger point.

Figure 3.3: Isometric contraction technique.

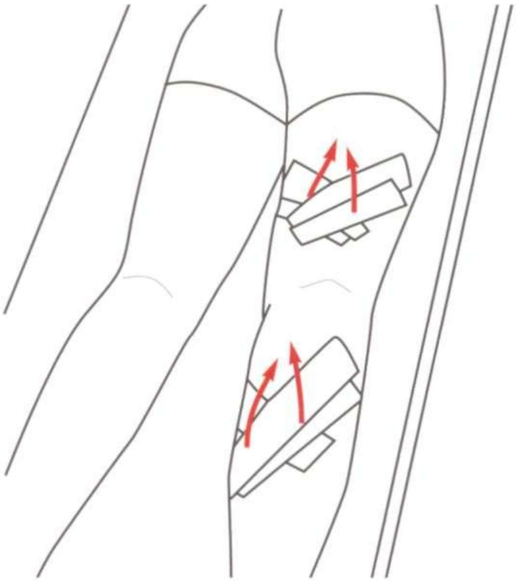


Figure 3.4: Unloading taping technique.

3. Isolytic Contraction Technique

- Hold or fix through the trigger point of the affected/host muscle;
- Ask the patient to actively contract the muscle at about 10-25%, whilst you resist it;
- Overcome this resistance, actively pushing against the muscle into eccentric contraction;
- Hold until a softening is palpated in the trigger point.

4. Unloading Taping Technique

- Tape the affected / host muscle into a position of ease;
- The tape may be left for hours to days;
- This may reduce nociceptor activity;
- This may also improve oxygenation and reduce ischaemia.

Massage Techniques

Inhibition-Ischaemic Compression Technique

This is the best technique to use on an active central trigger point. It involves locating the trigger point that causes a specific referred pain pattern (preferably reproducing the patient's symptoms) and applying a direct inhibitory pressure to the point. Although called ischaemic, it is now commonly accepted that you do not need to compress the trigger point to the point of *ischaemia!* This technique is effective, but is best used in conjunction with other stretch and release techniques. I have included a protocol that incorporates current approach.

Personally, I find it easier to lean on the trigger point, and not to push or press on it. This literally means to find the point, and lean weight through the applicator rather than push. This is much more comfortable for you and the patient.

- Identify the trigger point;
- Place the patient in a comfortable position, where the affected/host muscle can undergo full excursion;
- Apply *gentle, gradually increasing* pressure to the trigger point, whilst lengthening the affected/host muscle until you hit a *palpable* barrier;
- This should be experienced by the patient as discomfort and **NOT** pain;
- Apply sustained pressure until you feel the trigger point soften. This can take from seconds to minutes;
- Repeat, increasing the pressure on the trigger point until you meet the next barrier, and so on;
- To achieve a better result, you can try to change the direction of pressure during these repetitions.

Tip! Don't come away too quickly as this can irritate the trigger point and make the symptoms worse. Feel, don't think!

Deep Stroking Massage Technique

Being more specific as it is more directed than the spray and stretch technique, it is also considered by most authorities to be the safest and most effective hands-on method for treatment. (Travell & Simons, 1999).

- Place the patient in a comfortable position, where the affected/host muscle can undergo full excursion;
- Lubricate the skin if required;
- Identify and locate the trigger point or taut band;
- Position your thumb/applicator just beyond the taut band, and reinforce with your other hand;
- This should be experienced by the patient as discomfort and **NOT** pain;
- Apply sustained pressure until you feel the trigger point soften, and continue stroking in the same direction towards the attachment of the taut band;
- Repeat this stoking in the opposite direction.

TIP! Don't stoke too quickly or deeply as this can irritate the trigger point and rupture the sarcomere, making the symptoms worse.

A modification to deep stroking massage is *strumming,* where the applicator is dragged perpendicularly across the taut band of muscle fibres. This is performed slowly and rhythmically using a light contact and pausing on the trigger point when it is palpated. It is especially useful for treating the *medial pterygoid* and *masseter* muscles.

Manual Lymphatic Drainage Techniques (MLD)

There is mounting anecdotal evidence that MLD techniques are very effective at releasing trigger points. This technique requires a more subtle approach and requires a good knowledge of the morphology of the lymphatic system. Very light pressure is used to encourage lymph flow as opposed to forcing blood through the system. MLD is especially useful for releasing trigger points in the scalenes, anterior cervical musculature and clavipectoral fascia in the acute phase of whiplash injury.

Trigger point activity has been demonstrated to attenuate lymphatic flow in the following ways (Travell & Simons, 1999):

- Scalene trigger points (especially anterior) cause tension that interferes with drainage into the thoracic duct;
- This is compounded by restrictions in the first rib mechanics (often secondary to trigger points in the middle and posterior scalenes);
- The peristaltic movement of lymph is disrupted by trigger points in the scalenes;
- Lymph flow in the arms and breast may be disrupted by trigger points in subscapularis, teres major and latissimus dorsi;
- Lymph flow to the breast may be further disrupted by trigger points in the anterior axillary fold (especially in pectoralis minor). This commonly results from a protracted, chronically round-shouldered posture (Zinc, 1981).

It is suggested that MLD should be employed either before deeper work or after it to help remove excessive toxins and/or waste products from the tissues (Chaitow & DeLany, 2000). The technique involves (after Harris and Piller, 2004):

- Light rhythmic, alternating pressure with each stroke;
- Skin stretching and torque both longitudinally and diagonally;
- Pressure and stretch applied in direction of desired fluid flow (not always in the direction of lymph flow);
- Light pressure over spongy, oedematous areas and slightly firmer over fibrotic tissue;
- Pressure not to exceed 32 mmHg.

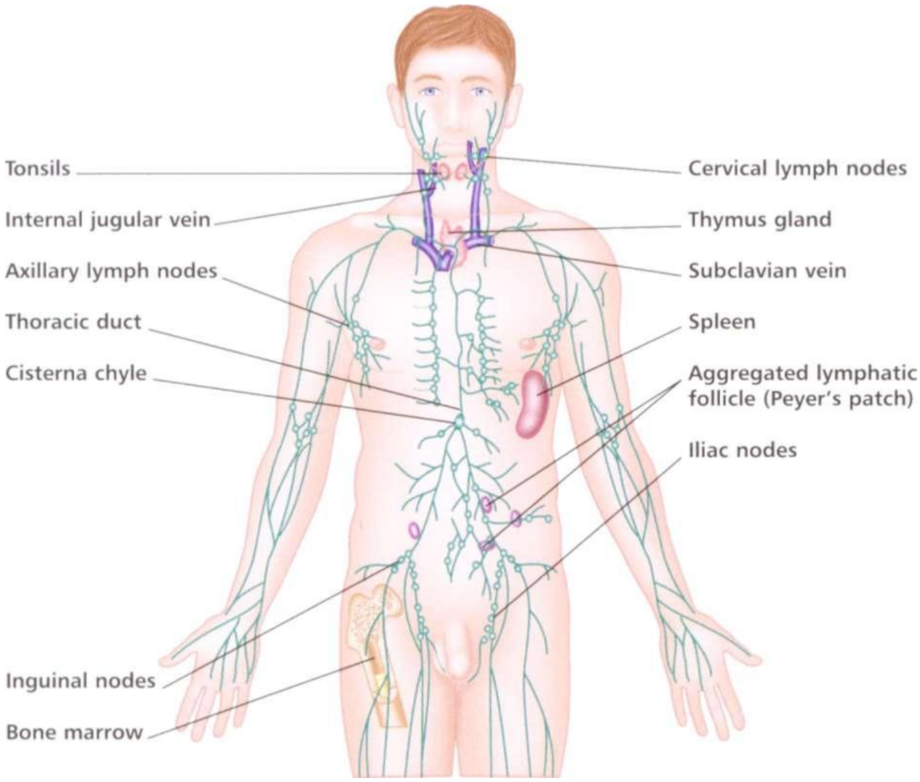


Figure 3.5: The lymphatic system.

Muscles of the Scalp, Face and Neck

4

Epicranius (Occipitofrontalis)

Orbicularis Oculi

Masseter

Temporalis

Pterygoideus Lateralis

Pterygoideus Medialis

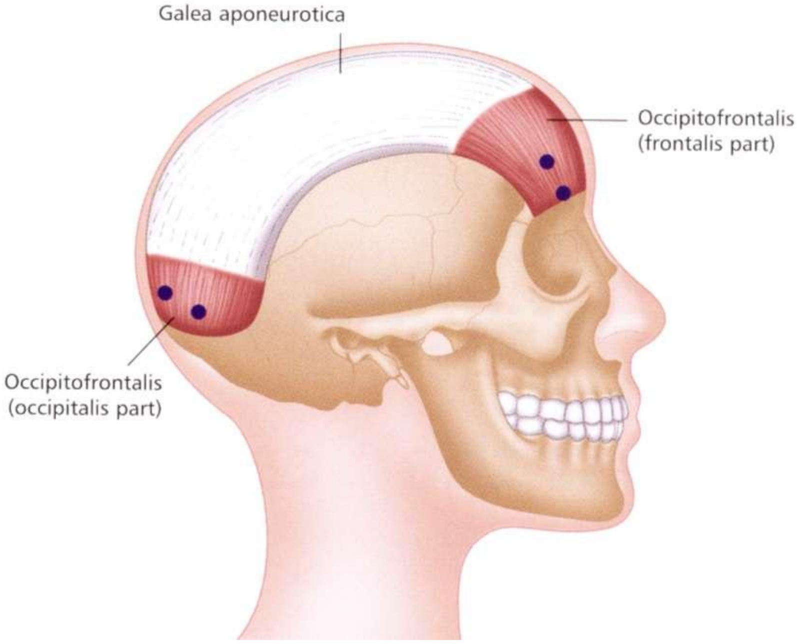
Digastricus

Scalenus Anterior, Medius, Posterior

Sternocleido-mastoideus

Temporomandibular Joint (TMJ)

EPICRANIUS (OCCIPITOFRONTALIS)



Frontalis part

EPICRANIUS (OCCIPITOFRONTALIS)

Greek, *epi-*, upon; **Latin,** *cranium,* skull.

This muscle is effectively two muscles (occipitalis and frontalis), united by an aponeurosis called the *galea aponeurotica,* so named because it forms what resembles a helmet upon the skull.

Origin
Occipitalis: lateral two-thirds of superior nuchal line of occipital bone. Mastoid process of temporal bone.

Frontalis: galea aponeurotica.

Insertion

Occipitalis: galea aponeurotica (a sheet-like tendon leading to frontal belly).
Frontalis: fascia and skin above eyes and nose.

Action
Occipitalis: pulls scalp backward. Assists frontal belly to raise eyebrows and wrinkle forehead.
Frontalis: pulls scalp forwards. Raises eyebrows and wrinkles skin of forehead horizontally.

Nerve
Facial V11 nerve.

Basic functional movement

Example: Raises eyebrows (wrinkles skin of forehead horizontally).

Indications

Headache. Pain (back of head). Cannot sleep on back/pillow. Earache. Pain behind eye, eyebrow, and eyelid. Visual activity.

Referred pain patterns
Occipitalis: pain in the lateral and anterior scalp; diffuse into back of head and into orbit.
Frontalis: localized pain with some referral upwards and over forehead on the same side.

Differential diagnosis

Scalp tingling. Greater occipital nerve entrapment.

Also consider

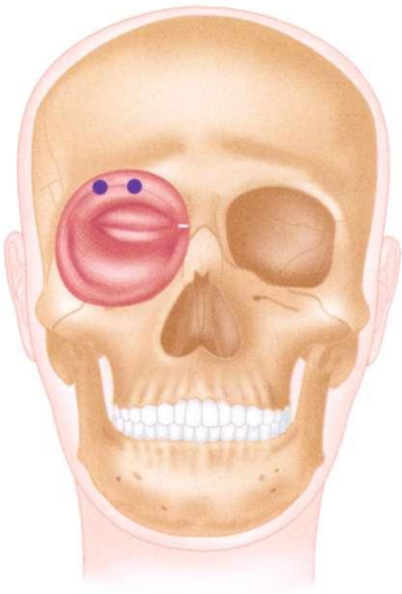
Suboccipital muscles. Clavicular division of sternocleidomastoideus. Semispinalis capitis.

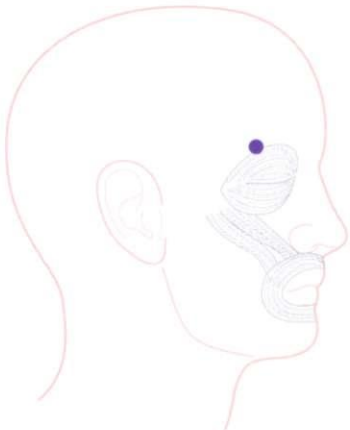
Advice to patient
Avoid frowning and wrinkling of forehead.

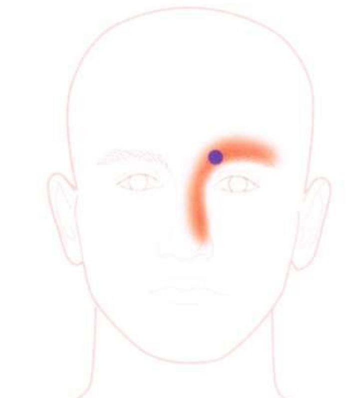
Techniques

Spray and stretch			Dry needling	✓	
Injections	✓		Trigger point release	✓	✓

ORBICULARIS OCULI







ORBICULARIS OCULI

Latin, *orbis,* orb, circle; *oculi,* of the eye.

This complex and extremely important muscle consists of three parts, which together form an important protective mechanism surrounding the eye.

Orbital part	**Palpebral part**	**Lacrimal part**
	(in eyelids)	(behind medial palpebral ligament and lacrimal sac)
	Latin, pertaining to an eyelid.	**Latin,** pertaining to the tears.
Origin Frontal bone. Medial wall of orbit (on maxilla).	**Origin** Medial palpebral ligament.	**Origin** Lacrimal bone.
Insertion Circular path around orbit, returning to origin.	**Insertion** Lateral palpebral ligament into zygomatic bone.	**Insertion** Lateral palpebral raphe.
Action Strongly closes eyelids (firmly 'screws up' the eye).	**Action** Gently closes eyelids (and comes into action involuntarily, as in blinking).	**Action** Dilates lacrimal sac and brings lacrimal canals onto surface of eye.
Nerve Facial **V11** nerve (temporal and zygomatic branches).	**Nerve** Facial **Vll** nerve (temporal and zygomatic branches).	**Nerve** Facial **Vll** nerve (temporal and zygomatic branches).

Indications
Headache. Migraine. Trigeminal neuralgia. Eyestrain. 'Twitching' eyes. Poor eyesight. Drooping eyelid. Sinus pain.

Referred pain patterns
Palpebral: localized 'searing' pain above eye and up to ipsilateral nostril.
Lacrimal: into eye, sinus pain, bridge of nose pain. Ice cream often reproduces eye pain/headache.

Differential diagnosis
Ptosis - Horner's syndrome.

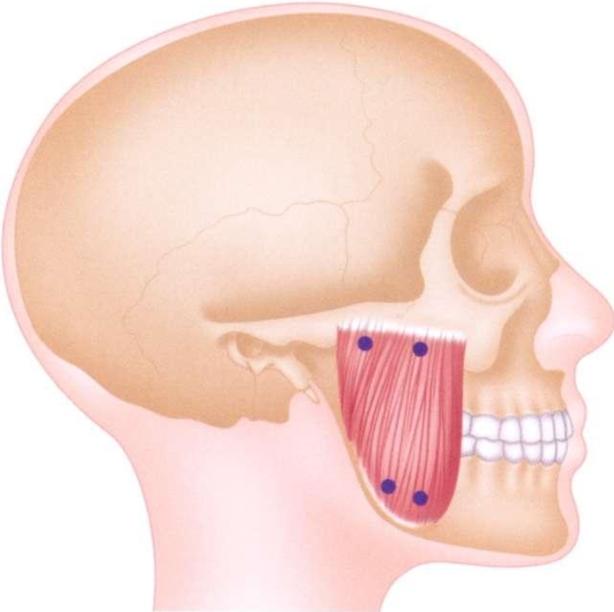
Also consider
Digastric. Temporalis. Trapezius. Spleneii, and post cervical muscles. Often associated with sternocleidomastoideus.

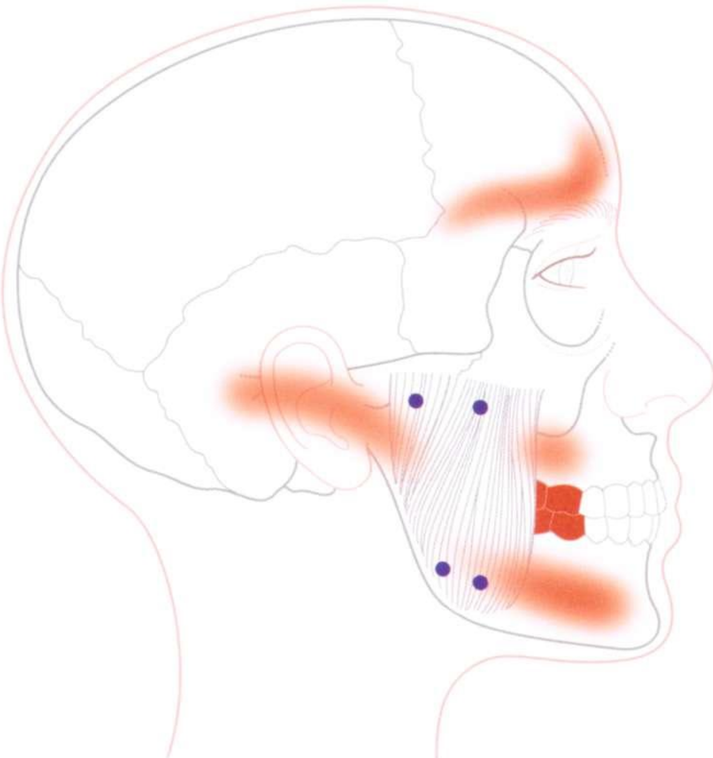
Advice to patient
Check eyesight regularly. Increase sleep/rest. Regular breaks when driving or looking at VDU screen. Are glasses too tight on bridge of nose?

Techniques

Spray and stretch			Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

MASSETER





MASSETER

Greek, *maseter,* chewer.

The masseter is the most superficial muscle of mastication, easily felt when the jaw is clenched.

Origin

Zygomatic process of maxilla. Medial and inferior surfaces of zygomatic arch.

Insertion

Angle of ramus of mandible. Coronoid process of mandible.

Action

Closes jaw. Clenches teeth. Assists in side to side movement of mandible.

Nerve

Trigeminal V nerve (mandibular division).

Basic functional movement

Chewing food.

Indications

Trismus (severely restricted jaw). TMJ pain. Tension/stress headache. Ear pain. Ipsilateral tinnitus. Dental pain.

Referred pain patterns

Superficial: eyebrow, maxilla and mandible (anterior). Upper and lower molar teeth.
Deep: ear and TMJ.

Differential diagnosis

TMJ pain/ syndrome. Tinnitus. Trismus.

Also consider

Ipsilateral temporalis. Medial pterygoid. Contralateral masseter. Sternocleidomastoideus.

Advice to patients

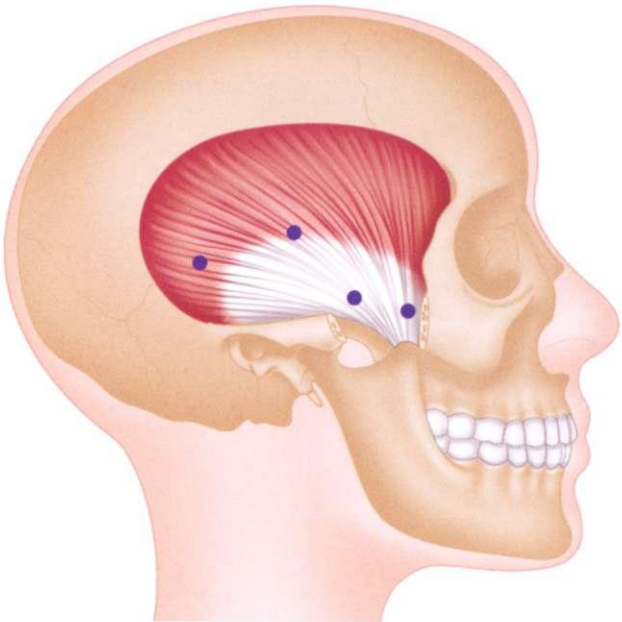
Stop tooth grinding (bite plates). Work posture (telephone). Posture of head-neck-tongue. Stop chewing gum/ice/ nails.

Techniques

Spray and stretch	✓		Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

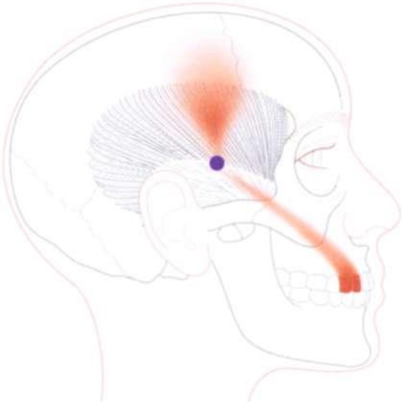
N.B. vapours in asthmatics

TEMPORALIS

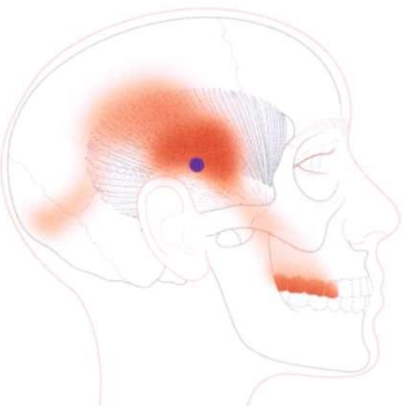


Self stretch

a)



b)



c)

d)

TEMPORALIS

Latin, pertaining to the lateral side of the head, time.

Origin

Temporal fossa, including parietal, temporal and frontal bones. Temporal fascia.

Insertion

Coronoid process of mandible. Anterior border of ramus of mandible.

Action

Closes jaw. Clenches teeth. Assists in side to side movement of mandible.

Nerve

Anterior and posterior deep temporal nerves from the trigeminal V nerve (mandibular division).

Basic functional movement

Chewing food.

Indications

Headache. Toothache. TMJ syndrome. Hypersensitivity of teeth. Prolonged dental work. Eyebrow pain.

Referred pain patterns

Upper incisors and supraorbital ridge. Maxillary teeth and mid temple pain. TMJ and mid temple pain. Localized (backwards and upwards).

Differential diagnosis

Temporalis tendonitis. Polymyalgia rheumatica. Temporal arteritis (GCA).

Also consider

Upper trapezius. Sternocleidomastoideus. Masseter.

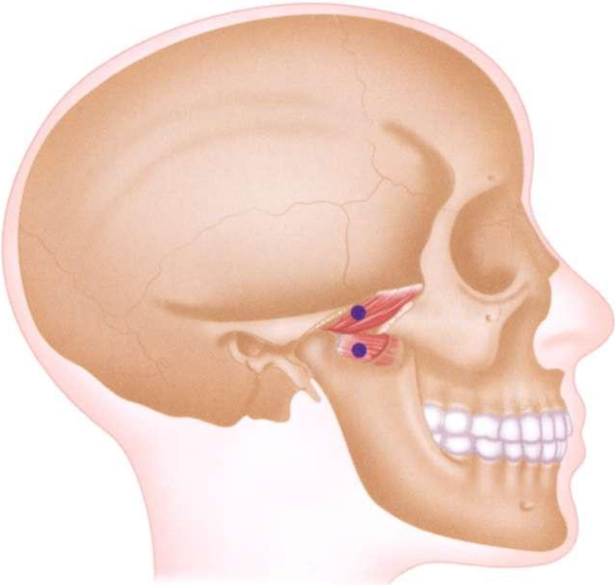
Advice to patients

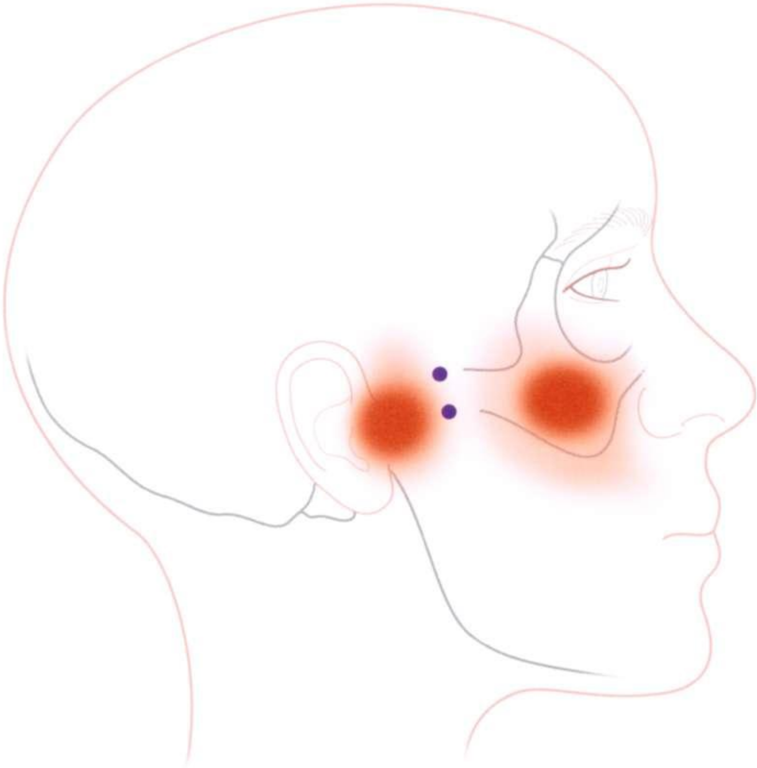
Gum chewing or hard substance chewing. Tongue position. Air conditioning in car/at work. Correcting of the head - forward posture. Stretch.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

PTERYGOIDEUS LATERALIS (Lateral Pterygoid)





PTERYGOIDEUS LATERALIS (Lateral Pterygoid)

Greek, *pterygodes,* like a wing; **Latin,** *lateral,* to the side.

The superior head of this muscle is sometimes called *sphenomeniscus,* because it inserts into the disc of the temporomandibular joint.

Origin
Superior head: lateral surface of greater wing of sphenoid.
Inferior head: lateral surface of lateral pterygoid plate of sphenoid.

Insertion
Superior head: capsule and articular disc of the temporomandibular joint.
Inferior head: neck of mandible.

Action

Protrudes mandible. Opens mouth. Moves mandible from side to side (as in chewing).

Nerve

Trigeminal V nerve (mandibular division).

Basic functional movement
Chewing food.

Indications
TMJ syndrome. Cranio-mandibular pain. Problems chewing/masticating. Tinnitus. Sinusitis. Decreased jaw opening.

Referred pain patterns

Two zones of pain; 1) TMJ in a 1cm localized zone; 2) zygomatic arch in a 3-4cm zone.

Differential diagnosis

Arthritic TMJ. Anatomical variations of TMJ. Tic douloureux (trigeminal neuralgia). Shingles.

Also consider

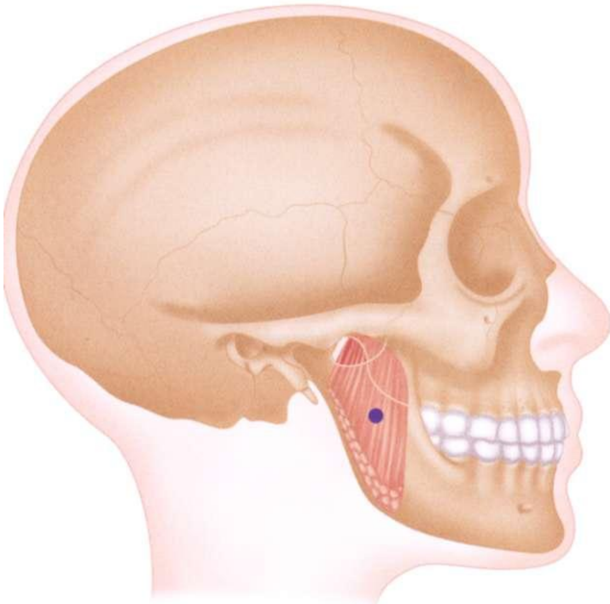
TMJ. Atlanto-occipital joint facets. Neck muscles. Masseter. Medial pterygoid. Temporalis (anterior).

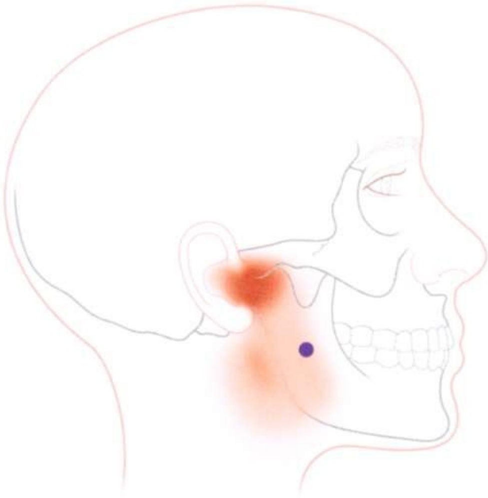
Advice to patient
Chew on both sides of mouth. Avoid gum chewing/nail biting. Bite guard, phone-in-neck postures.

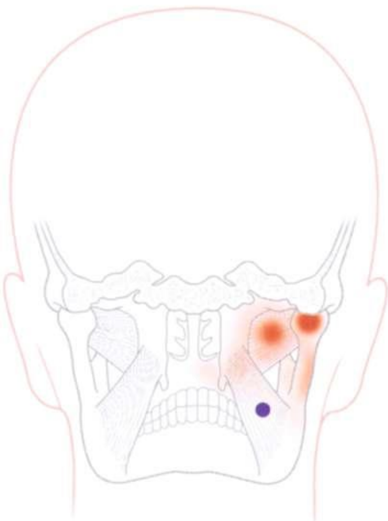
Techniques

Spray and stretch	✓		Dry needling		
Injections	✓	✓	Trigger point release	✓	✓

PTERYGOIDEUS MEDIALIS (Medial Pterygoid)







PTERYGOIDEUS MEDIALIS (Medial Pterygoid)

Greek, *pterygodes,* like a wing; **Latin,** *medius,* middle.

This muscle mirrors the masseter muscle in both its position and action, with the ramus of the mandible positioned between the two muscles.

Origin
Medial surface of lateral pterygoid plate of the sphenoid bone. Pyramidal process of the palatine bone. Tuberosity of maxilla.

Insertion

Medial surface of the ramus and the angle of the mandible.

Action
Elevates and protrudes the mandible. Therefore it closes the jaw and assists in side to side movement of the mandible, as in chewing.

Nerve
Trigeminal V nerve (mandibular division).

Basic functional movement
Chewing food.

Indications
Throat pain. Odynophagia. TM] syndrome. Lock jaw. Inability to fully open jaw. ENT pain. Excessive dental treatment.

Referred pain patterns
Pain in throat, mouth, and pharynx. Localized zone about TMJ radiating broadly down ramus of jaw towards the clavicle.

Differential diagnosis

TMJ syndrome. ENT pathologies. GI referral, e.g. Barrett's syndrome (oesophagus). Bruxism.

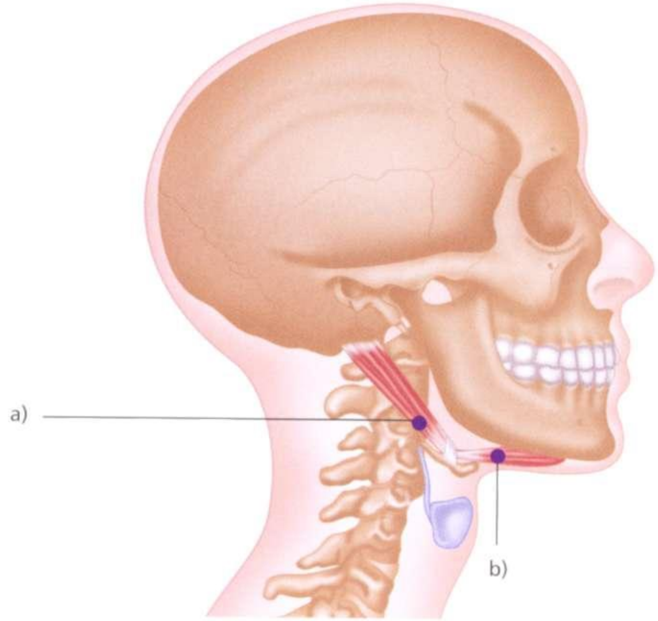
Also consider
Masseter. Temporalis. Lateral pterygoid. Tongue. Sternocleidomastoideus. Digastric. Longus capitis. Longus colli. Platysma. Clavipectoral fascia.

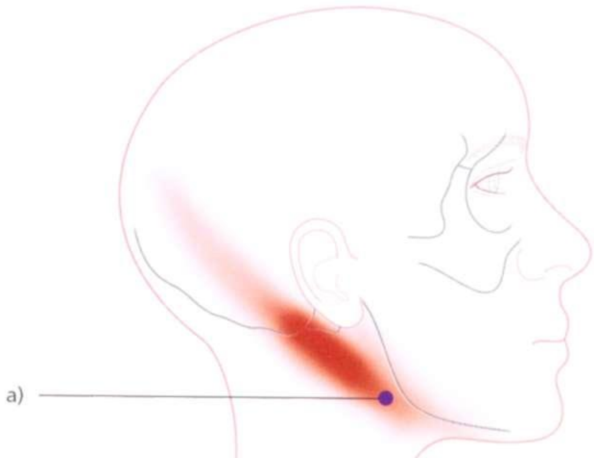
Advice to patient
Head postures. Chew on both sides of mouth. Bite guard (soft). Avoid chewing gum/nails.

Techniques

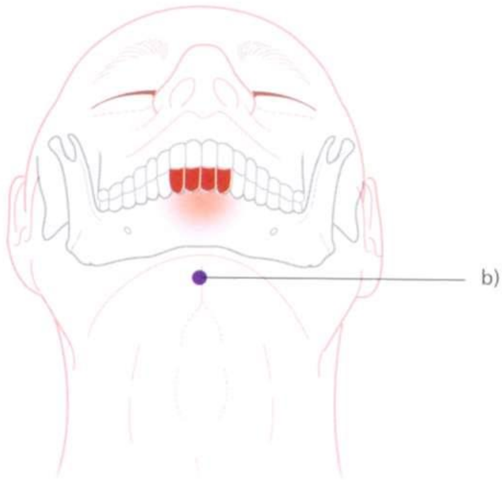
Spray and stretch	✓		Dry needling		
Injections	✓	✓	Trigger point release (internal and external)	✓	✓

DIGASTRICUS





Posterior trigger point



Anterior trigger point

DIGASTRICUS

Latin, having two bellies.

Origin

Anterior belly: digastric fossa on inner side of lower border of mandible, near symphysis.
Posterior belly: mastoid notch of temporal bone.

Insertion

Body of hyoid bone via a fascial sling over an intermediate tendon.

Action

Raises hyoid bone. Depresses and retracts mandible as in opening the mouth.

Nerve

Anterior belly: mylohyoid nerve, from trigeminal V nerve (mandibular division).
Posterior belly: facial (V1l) nerve.

Indications

Throat pain. Dental pain (four lower incisors). Headache. Jaw pain. Renal tubular acidosis. Prolonged/extensive dental work (blurred vision and dizziness). Lower mouth opening.

Referred pain patterns

Anterior: lower four incisor teeth, tongue and lip, occasionally to chin.

Posterior: strong 2cm zone around mastoid and vaguely zone to chin and throat, occasionally to scalp.

Differential diagnosis

Dental problems - malocclusion. Hyoid bone. Thyroid problems. Thymus gland. Sinusitis. Carotid artery.

Also consider

Sternocleidomastoideus. Sternothyroid. Mylohyoid. Stylohyoid. Longus colli. Longus capitis. Geniohyoid. Cervical vertebrae. Temporalis. Masseter.

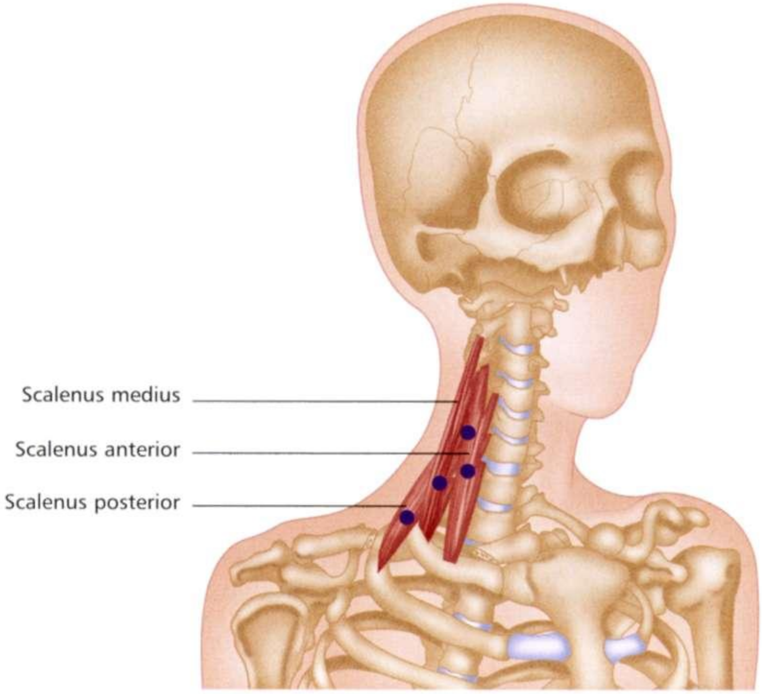
Advice to patient

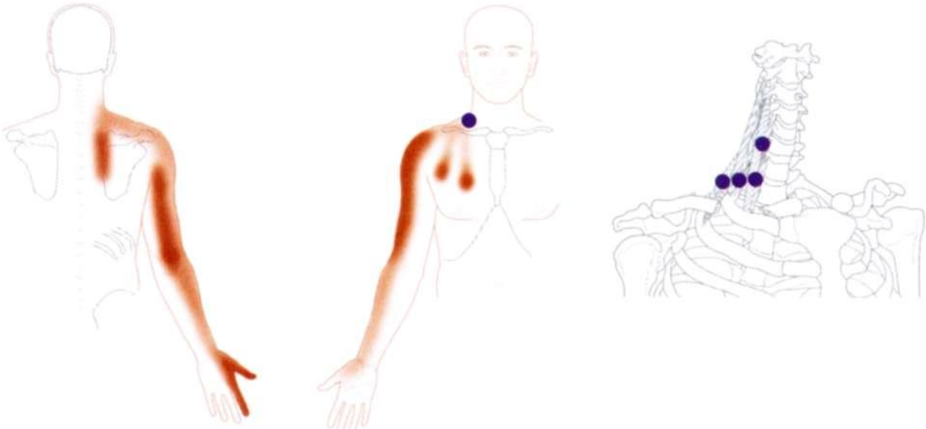
Breathing patterns. Bruxism. Head postures.

Techniques

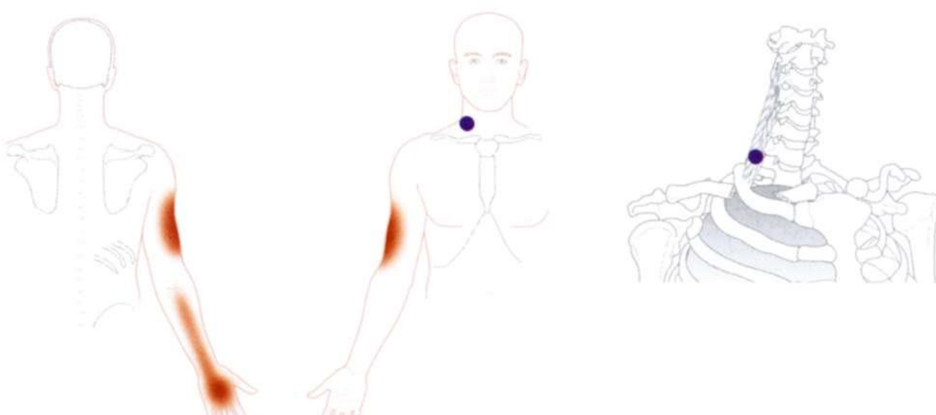
Spray and stretch	✓		Dry needling		
Injections	✓	✓	Trigger point release	✓	✓

SCALENUS ANTERIOR, MEDIUS, POSTERIOR



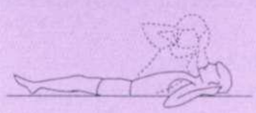


Scalenus medius, anterior, posterior and referred pain patterns



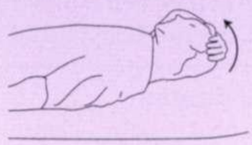
Scalenus medius and referred pain patterns

Strengthening exercise



Twisting sit-ups

Self stretches



Pull left shoulder away from ear. Do not rotate head. Draw right ear towards right shoulder.

SCALENUS ANTERIOR, MEDIUS, POSTERIOR

Greek, *skalenos,* uneven; **Latin,** *anterior,* before; *medius,* middle; *posterior,* behind.

Origin

Transverse processes of cervical vertebrae.

Insertion

Anterior and medius: first rib.
Posterior: second rib.

Action

Acting together: flex neck. Raise first rib during a strong inhalation.
Individually: laterally flex and rotate neck.

Nerve

Ventral rami of cervical nerves, C3-C8.

Basic functional movement

Primarily muscles of inspiration.

Indications

Back, shoulder and arm pain. Thoracic outlet syndrome. Scalene syndrome. Oedema in the hand. Phantom limb pain. Asthma, chronic lung disease. Whiplash. 'Restless neck'. Irritability.

Referred pain patterns

Anterior: persistent aching, pectoralis region to the nipple.
Posterior: upper medial border of scapula.

Lateral: front and back of the arm to the thumb and index finger.

Differential diagnosis

Brachial plexus. Subclavian vessels. Cervical discs (C5-C6). Thoracic outlet syndrome. Angina. Carpal tunnel syndrome. Upper trapezius. Sternocleidomastoideus. Splenius capitis.

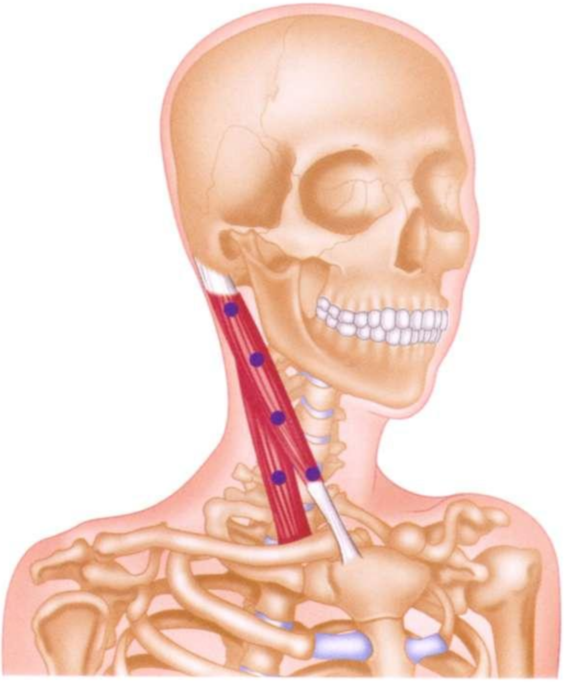
Advice to patient

Use of pillows. Swimming. Backpacks. Heavy breasts. Warm scarfs. Warmth. Moist heat. Pulling and lifting.

Techniques

Spray and stretch	✓	✓	Dry needling		
Injections	✓	✓	Trigger point release	✓	

STERNOCLEIDOMASTOIDEUS

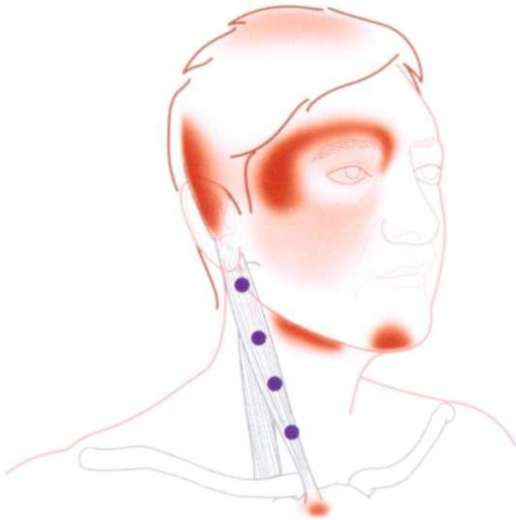


Strengthening exercise

Sit-ups

Self stretch

Turn head to right.
Repeat on opposite side.



STERNOCLEIDOMASTOIDEUS

Greek, *sternon*, sternum; *kleidos*, key, clavicle; *mastoid*, breast-shaped, mastoid process.

This muscle is a long strap muscle with two heads. It is sometimes injured at birth, and may be partly replaced by fibrous tissue that contracts to produce a torticollis (wry neck).

Origin
Sternal head: anterior surface of manubrium of sternum.
Clavicular head: upper surface of medial third of clavicle.

Insertion
Outer surface of mastoid process of temporal bone. Lateral third of superior nuchal line of occipital bone.

Action
Contraction of both sides together: flexes neck and draws head forward, as in raising the head from a pillow. Raises sternum, and consequently the ribs, superiorly during deep inhalation.
Contraction of one side: tilts the head towards the same side. Rotates head to face the opposite side (and also upwards as it does so).

Nerve

Accessory X1 nerve; with sensory supply for proprioception from cervical nerves C2 and C3.

Basic functional movement

Examples: Turning head to look over your shoulder. Raising head from pillow.

Indications
Tension headache. Whiplash. Stiff neck. Atypical facial neuralgia. Hangover headache. Postural dizziness. Altered (hemifacial sympathetics). Lowered spatial awareness. Ptosis.

Referred pain patterns
Sternal: pain in occiput radiating anteriorly to eyebrow, cheek and throat (eye and sinus).
Clavicular: frontal headache, earache, mastoid pain (dizziness and spatial awareness).

Differential diagnosis
Trigeminal neuralgia. Facial neuralgia. Vestibulocochlear problems. Lymphadenopathy. Levator scapulae. Upper trapezius. Splenius capitis.

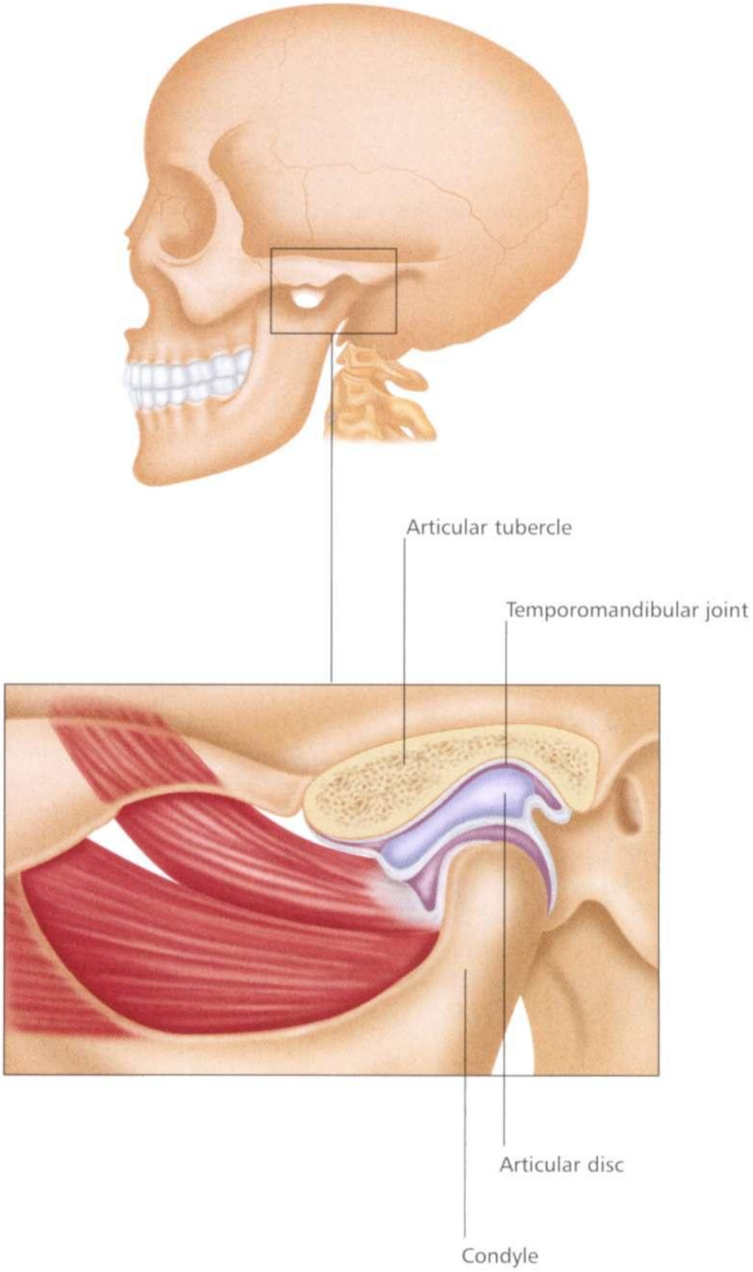
Advice to patient
Breathing efficacy. Number of pillows. Work posture. Head posture. TV posture.

Techniques

Spray and stretch	✓	✓	Dry needling*	✓	
Injections*	✓		Trigger point release	✓	✓

* vascular considerations

TEMPOROMANDIBULAR JOINT (TMJ)



TEMPOROMANDIBULAR JOINT (TMJ)

Trigger points are commonly found in the muscles that move and stabilize the TMJ. People often clench the jaw muscles in response to stress, anxiety and/or tension. TMJ syndrome can be defined as 'chronic pain and or dysfunction of the temporomandibular joint and its muscles'. The most commonly accepted theory is that there is a 'temporary anterior displacement (of the joint) with or without reduction'; this leads to repetitive micro- and macro-trauma of muscles, and chronic inflammation of the joint membranes. Trigger points often develop in the muscles which support and operate the joint. The main symptoms are facial pain, especially around the ear, popping sounds and headaches, but may include nausea and tinnitus. Patients are often driven to distraction by the pain, and have been known to seek exotic and expensive remedies. Trigger point release can be a very useful therapeutic intervention along with identifying and addressing any underlying causes.

TMJ syndrome is multi-factorial, and the following list covers some of the common differential diagnostic criteria:

- 'Under', 'over', lateral bite or malocclusion;
- Dislocation on yawning, popping and or crepitus;
- Ear pain;
- Cervical spine disorders;
- Type/shape of synovial joint; several anatomical variations occur;
- Gum chewing;
- Masticating food unilaterally;
- Chronic dental problems;
- Problems with wisdom teeth;
- Tooth grinding; bruxism;
- Clenching in response to stress/anxiety;
- Depression and bi-polar disorder;
- Arthritis (osteo- and rheumatoid);
- Dentures.

The primary muscles directly associated with the TMJ are: temporalis, masseter, pterygoideus lateralis and medialis. The secondary muscles are the mylohyoid and the anterior digastric. Chronic trigger points in any of these muscles may lead to an increase in muscular stiffness, fatigue and dysfunction. Symptoms may be unilateral and/or bilateral and are rarely seen in the under-20 age group. Further, satellite trigger points may be located in the upper trapezius, upper semispinalis capitis, sub occipitalis and sternocleidomastoideus.

Muscles of the Trunk and Spine

5

Erector Spinae

Posterior Cervical Muscles

Multifidis/Rotatores

Splenius Cervicis/ Splenius Capitis

External Oblique

Transversus Abdominis

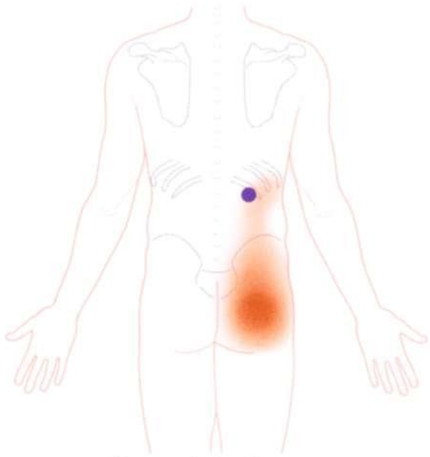
Rectus Abdominis

Quadratus Lumborum

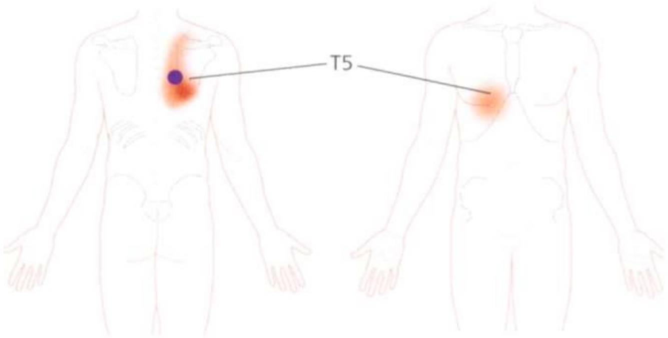
Iliopsoas (Psoas Major/Iliacus)

Diaphragm

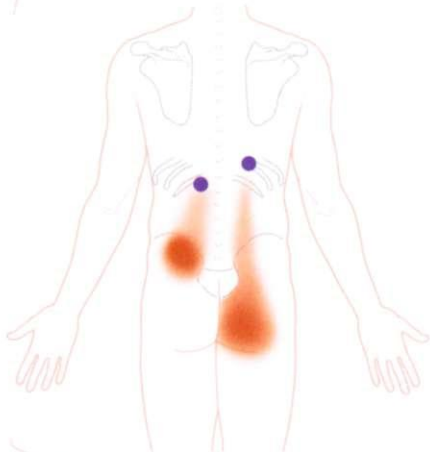
ERECTOR SPINAE (SACROSPINALIS)



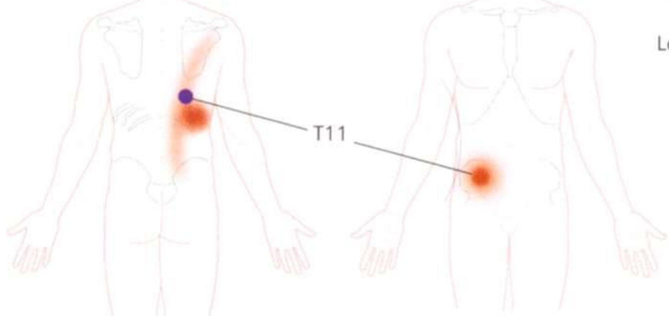
Iliocostalis lumborum



Iliocostalis thoracis

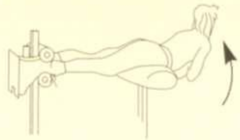


Longissimus thoracis



Iliocostalis thoracis

Strengthening exercises



Back extension (back raise)

Lat. pull downs

Squats

Self stretches

Move towel up back with each set of stretching.

Pull knees into your chest and up towards your shoulders.

ERECTOR SPINAE (SACROSPINALIS)

Latin, *sacrum,* sacred; *spinalis,* spinal.

The erector spinae, also called *sacrospinalis,* comprises three sets of muscles organised in parallel columns. From lateral to medial, they are: iliocostalis, longissimus and spinalis.

Origin

Slips of muscle arising from the sacrum. Iliac crest. Spinous and transverse processes of vertebrae. Ribs.

Insertion

Ribs. Transverse and spinous processes of vertebrae. Occipital bone.

Action

Extends and laterally Ilexes vertebra] column (i.e. bending backwards and sideways).
Helps maintain correct curvature of spine in the erect and sitting positions. Steadies the vertebral column on the pelvis during walking.

Nerve

Dorsal rami of cervical, thoracic and lumbar spinal nerves.

Basic functional movement

Keeps back straight (with correct curvatures), therefore maintains posture.

Indications

Low back pain, especially after lifting. Reduced range of motion in the spine. Low back pain, either from sitting, standing or climbing stairs. Low grade back ache worsening towards the end of the day.

Referred pain patterns

Thoracic spine - iliocostalis: medially towards the spine, and anteriorly towards the abdomen.
Lumbar spine - iliocostalis: mid buttock.
Thoracic spine - iliocostalis: buttock and sacroiliac area.

Differential diagnosis

Angina. Visceral pain. Radiculopathy. Ligamentous, discogenic, sacroiliac. Piriformis.
Pathological: aortic aneurysm. Visceral pathology. Space occupying lesion. Pelvic inflammatory disease.

Advice to patient

Avoid 'sudden overload' when lifting. Do not lift when fatigued. Posture. Heat/hot baths.

Techniques

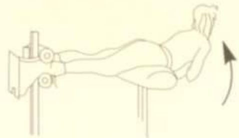
Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

POSTERIOR CERVICAL MUSCLES

Longissimus capitis

Semispinalis capitis/cervicis

Strengthening exercise

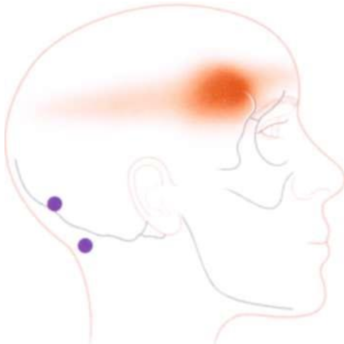


Back extension (back raise)

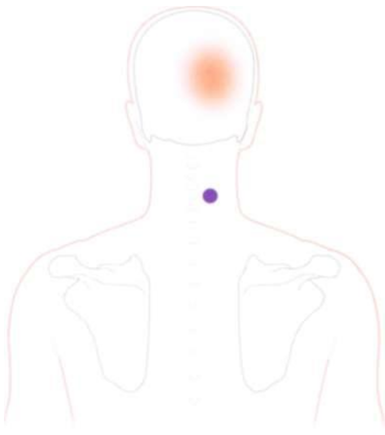
Self stretches

Arch your back as if being drawn up by a piece of string.

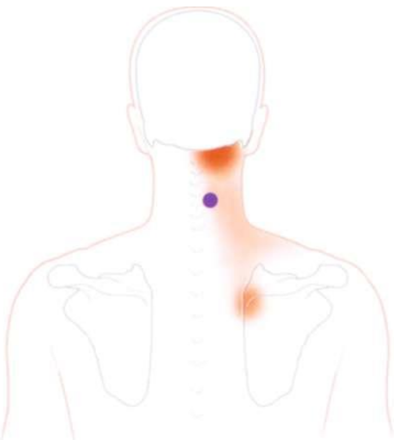
Pull knees into your chest and up towards your shoulders.



Semispinalis capitis (upper)



Semispinalis capitis (middle)



Multifidis (mid cervical)
Even though not mentioned here (*see* also page 86), this muscle runs up the spine as part of the erector spinae, and so is relevant as part of the posterior cervical muscles.

POSTERIOR CERVICAL MUSCLES

Latin, *longissimus,* longest; *capitis,* of the head; *semispinalis,* half spinal; *cervix,* neck.

Comprising longissimus capitis, semispinalis capitis, and semispinalis cervicis.

Origin

Longissimus capitis: transverse processes of upper five thoracic vertebrae (T1-T5). Articular processes of lower three cervical vertebrae (C5-C7).
Semispinalis cervicis: transverse processes of upper five or six thoracic vertebrae (T1-T6).
Semispinalis capitis: transverse processes of lower four cervical and upper six or seven thoracic vertebrae (C4—T7).

Insertion

Longissimus capitis: posterior part of mastoid process of temporal bone.
Semispinalis cervicis: spinous processes second to fifth cervical vertebrae (C2-C5).
Semispinalis capitis: between superior and inferior nuchal lines of occipital bone.

Action

Longissimus capitis: extends and rotates head. Helps maintain correct curvature of thoracic and cervical spine in the erect and sitting positions.
Semispinalis cervicis: extends thoracic and cervical parts of vertebral column. Assists rotation of thoracic and cervical vertebrae.

Semispinalis capitis: most powerful extensor of the head. Assists in rotation of head.

Nerve

Longissimus capitis: dorsal rami of middle and lower cervical nerves.
Semispinalis cervicis: dorsal rami of thoracic and cervical nerves.
Semispinalis capitis: dorsal rami of cervical nerves.

Basic functional movement

Longissimus capitis: keeps upper back straight (with correct curvatures).
Semispinalis cervicis and capitis. Example: Looking up, or turning the head to look behind.

Indications

Headache. Neck pain and stiffness. Decreased cervical flexion. Suboccipital pain. Restricted neck rotation, often related to prolonged occupational positions. Whiplash. Pain on sleeping on certain pillows. 'Burning' in scalp.

Referred pain patterns

Several areas along the fibres, all radiating superiorly into head, skull and towards the frontal region.

Differential diagnosis

Cervical mechanical dysfunction. Spondyloarthropathy of facets. Vertebral artery syndrome. Discopathy (cervical) first rib dysfunction. Polymyalgia rheumatica. Rheumatoid arthritis. Osteoarthritis. Ankylosing spondylitis (seronegative spondyloarthropathy). Paget's disease. Psoriatic arthropathy.

Also consider

Trapezius. Erector spinae. Temporalis. Digastric. Infraspinatus. Levator scapulae. Sternocleidomastoideus. Splenius capitis. Splenitis cervicis. Suboccipital muscles. Occipitalis.

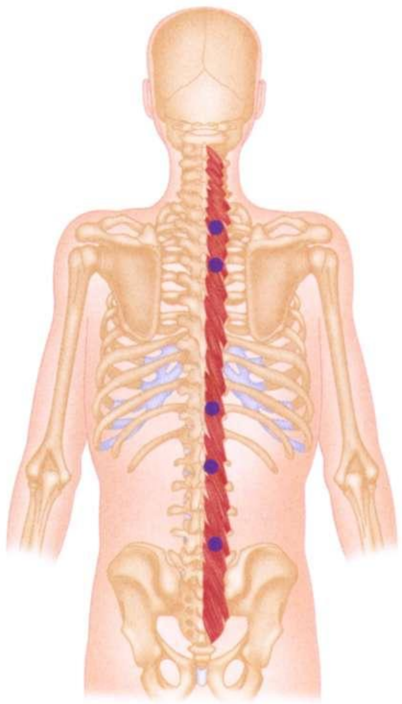
Advice to patient

Occupational ergonomics. Posture. Eyewear. Use of ergonomic pillows. Heat and stretch. Explore bedding/ pillows.

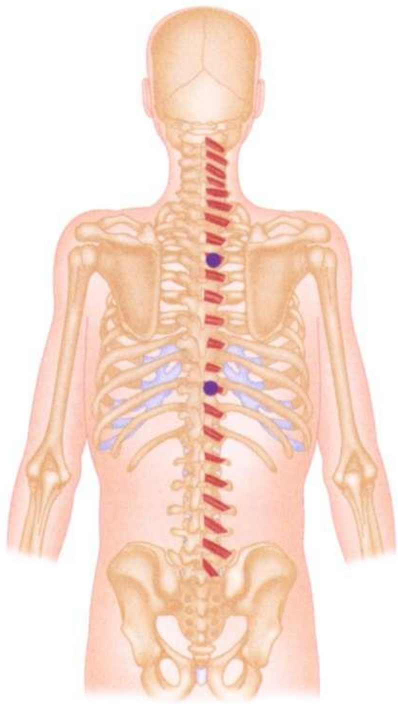
Techniques

Spray and stretch	✓	✓	Dry needling		
Injections	✓		Trigger point release	✓	

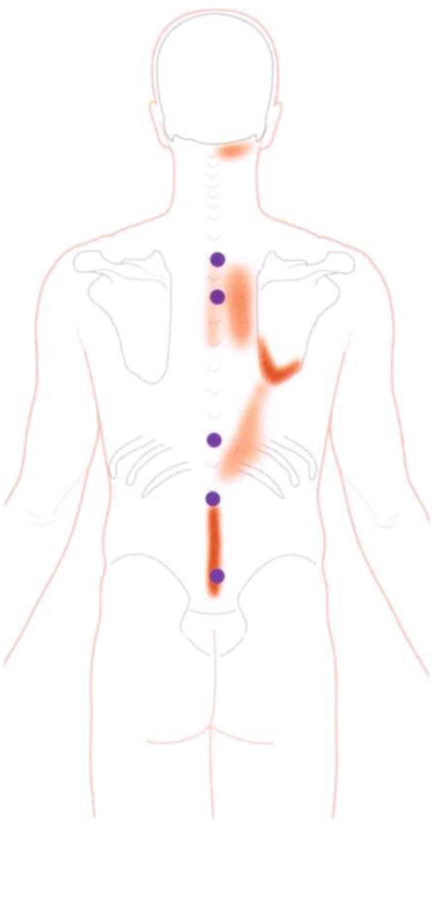
MULTIFIDIS/ROTATORES

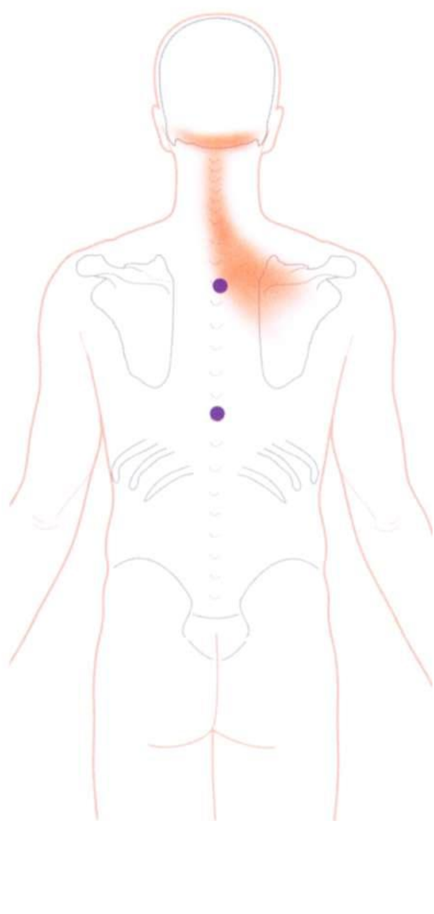


Multifidis



Rotatores





MULTIFIDIS/ROTATORES

Latin, *multi,* many, much; *findere,* to split; *rot,* wheel.

Multifidis is the part of the transversospinalis group that lies in the furrow between the spines of the vertebrae and their transverse processes. It lies deep to semispinalis and erector spinae. Rotatores are the deepest layer of the transverspinalis group.

Origin
Multifidis: posterior surface of sacrum, between the sacral foramina and posterior superior iliac spine. Mamillary processes (posterior borders of superior articular processes) of all lumbar vertebrae. Transverse processes of all thoracic vertebrae. Articular processes of lower four cervical vertebrae.
Rotatores: transverse process of each vertebra.

Insertion
Multifidis: parts insert into spinous process two to four vertebrae superior to origin; overall including spinous processes of all the vertebrae from the fifth lumbar up to the axis (L5-C2).
Rotatores: base of spinous process of adjoining vertebra above.

Action
Multifidis: protects vertebral joints from movements produced by the more powerful superficial prime movers. Extension, lateral flexion and rotation of vertebral column.
Rotatores: rotate and assist in extension of vertebral column.

Nerve
Dorsal rami of spinal nerves.

Basic functional movement

Helps maintain good posture and spinal stability during standing, sitting and all movements.

Indications
Deep/persistant low backache. Vertebral alignment problems. Facilitated segment - localized paraspinal erythema. Coccydynia.

Referred pain patterns
Multifidis: localized and anteriorly to abdomen. S1 leads to coccydynia.
Rotatores: localized to medial pain.

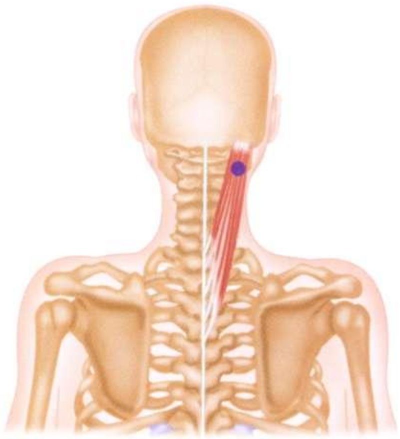
Differential diagnosis
Angina. Visceral pain. Radiculopathy. Ligamentous, discogenic, sacroiliac. Piriformis.
Pathological: aortic aneurysm. Visceral pathology. Space occupying lesion. Pelvic inflammatory disease.

Advice to patient
Posture. Kyphosis from working position. Number and type of pillows. Occupational considerations.

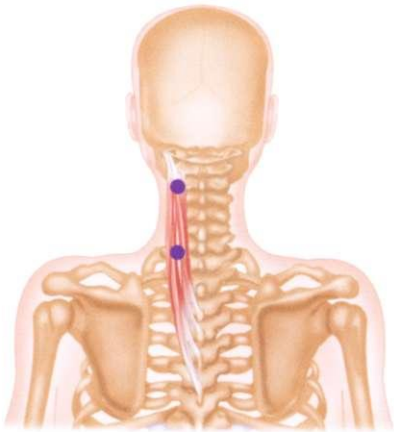
Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

SPLENIUS CAPITIS/SPLENIUS CERVICIS

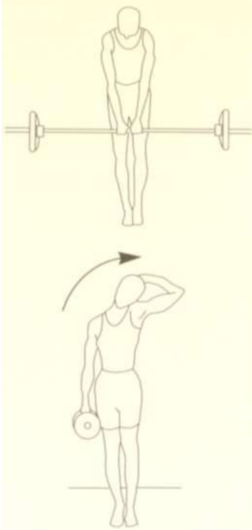


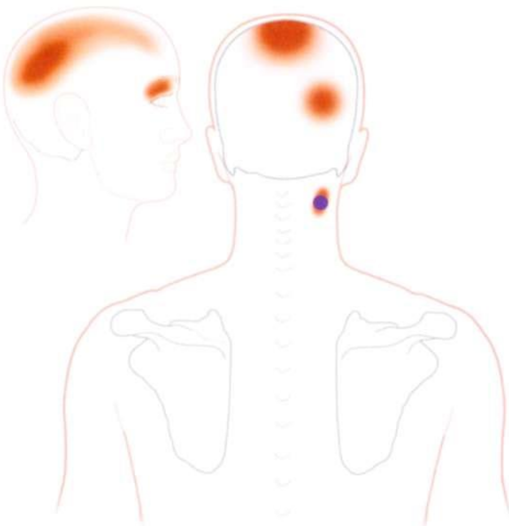
Splenius capitis

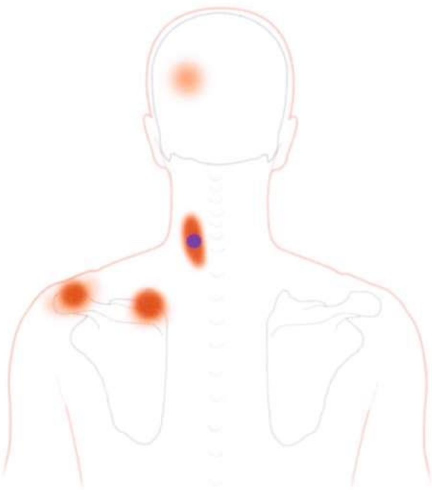


Splenius cervicis

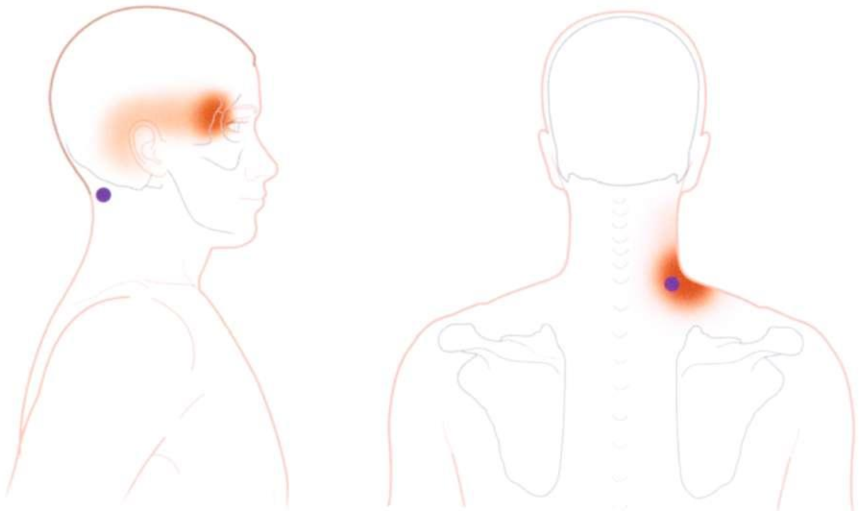
Self stretches







Splenius capitis



SPLENIUS CAPITIS/SPLENIUS CERVICIS

Greek, *splenion,* bandage; **Latin,** *capitis,* of the head; *cervix,* neck.

Origin

Splenius capitis: lower part of ligamentum nuchae. Spinous processes of the seventh cervical vertebra, (C7 and upper three or four thoracic vertebrae, (T1-T4).

Splenius cervicis: spinous processes of the third to sixth thoracic vertebrae, (T3-T6).

Insertion

Splenius capitis: posterior aspect of mastoid process of temporal bone. Lateral part of superior nuchal line, deep to the attachment of the sternocleidomastoideus.
Splenius cervicis: posterior tubercles of transverse processes of the upper two or three cervical vertebrae, (C1-C3).

Action

Acting together: extend the head and neck.
Individually: laterally flexes neck. Rotates the face to the same side as contracting muscle.

Nerve

Dorsal rami of middle and lower cervical nerves.

Basic functional movement

Example: Looking up, or turning the head to look behind.

Indications

Headache. Neck pain. Eye pain. Blurred vision (rare). Whiplash. Pain from draught. Postural neck pain (occupational). 'Internal' skull pain. Neck stiffness. Decreased ipsilateral rotation.

Referred pain patterns

Splenius capitis: 3-5cm zone of pain in the centre of the vertex of the skull.
Splenius cervicis: a) upper: occipital diffuse pain radiating via the temporal region towards the ipsilateral eye; b) lower: ipsilateral pain in the nape of the neck.

Differential diagnosis

Other types of headache. First rib dysfunction. Torticollis. Optical problems (eyestrain). Neurological. Stress.

Also consider

Trapezius. Sternocleidomastoideus. Masseter. Temporalis. Multifidis. Semispinalis capitis. Suboccipital muscles. Occipitofrontalis. Levator scapulae.

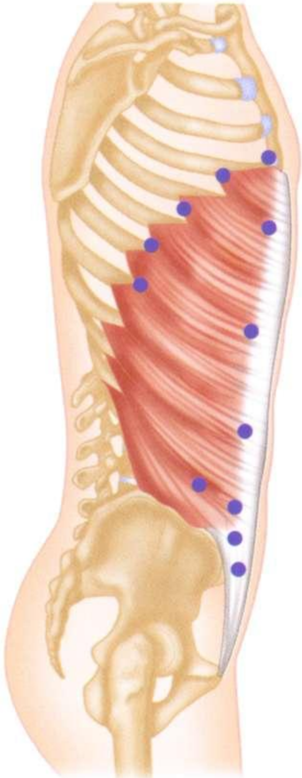
Advice to patient

Avoid postural/maintaining factors, answering the telephone. Work posture. Self stretch programme. Glasses (type, try trifocals).

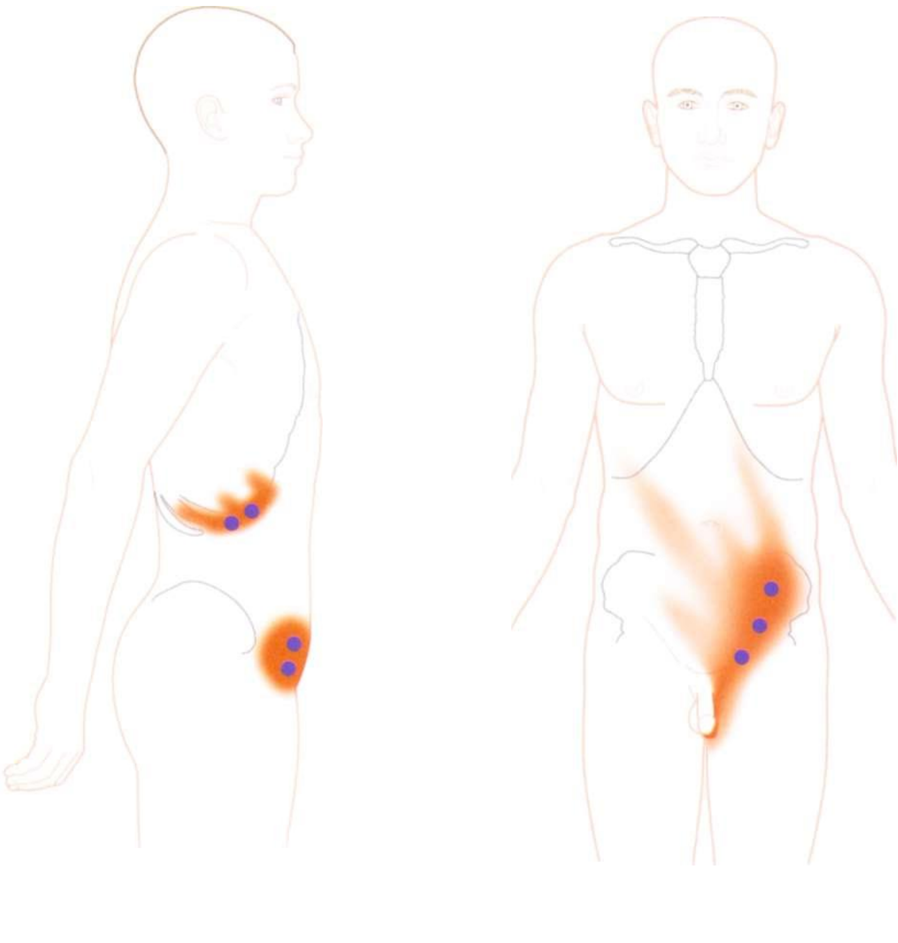
Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓		Trigger point release	✓	✓

EXTERNAL OBLIQUE



Multiple trigger points



Strengthening exercises

Twisting sit-ups

Abdominal machine crunch (for upper fibres)

Hanging leg raise

Self stretches

Try to twist using trunk rather than shoulders or arms

Perform this exercise slowly, thus avoiding the tendency to use momentum

EXTERNAL OBLIQUE

Latin, *obliquus,* inclined, slanting; *externus,* external.

The posterior fibres of the external oblique are usually overlapped by the latissimus dorsi, but in some cases there is a space between the two, known as the *lumbar triangle,* situated just above the iliac crest. The lumbar triangle is a weak point in the abdominal wall.

Origin
Lower eight ribs.

Insertion
Anterior half of iliac crest, and into an abdominal aponeurosis that terminates in the linea alba (a tendinous band extending downwards from the sternum).

Action
Compresses abdomen, helping to support the abdominal viscera against the pull of gravity. Contraction of one side alone bends the trunk laterally to that side and rotates it to the opposite side.

Nerve
Ventral rami of thoracic nerves, T5-T12.

Basic functional movement
Example: Digging with a shovel.

Indications
Abdominal pain and tenderness. Groin pain. Testicular pain. Bladder pain. Nausea. Colic. Dysmenorrhoea. Diarrhoea. Viscerosomatic. Irritable bowel syndrome.

Referred pain patterns
Viscerosomatic.
Costal margin: abdominal pain to chest.
Lower lateral: testicular pain. Local pain.
Pubic rim: bladder pain. Frequency/retention (urine). Groin.

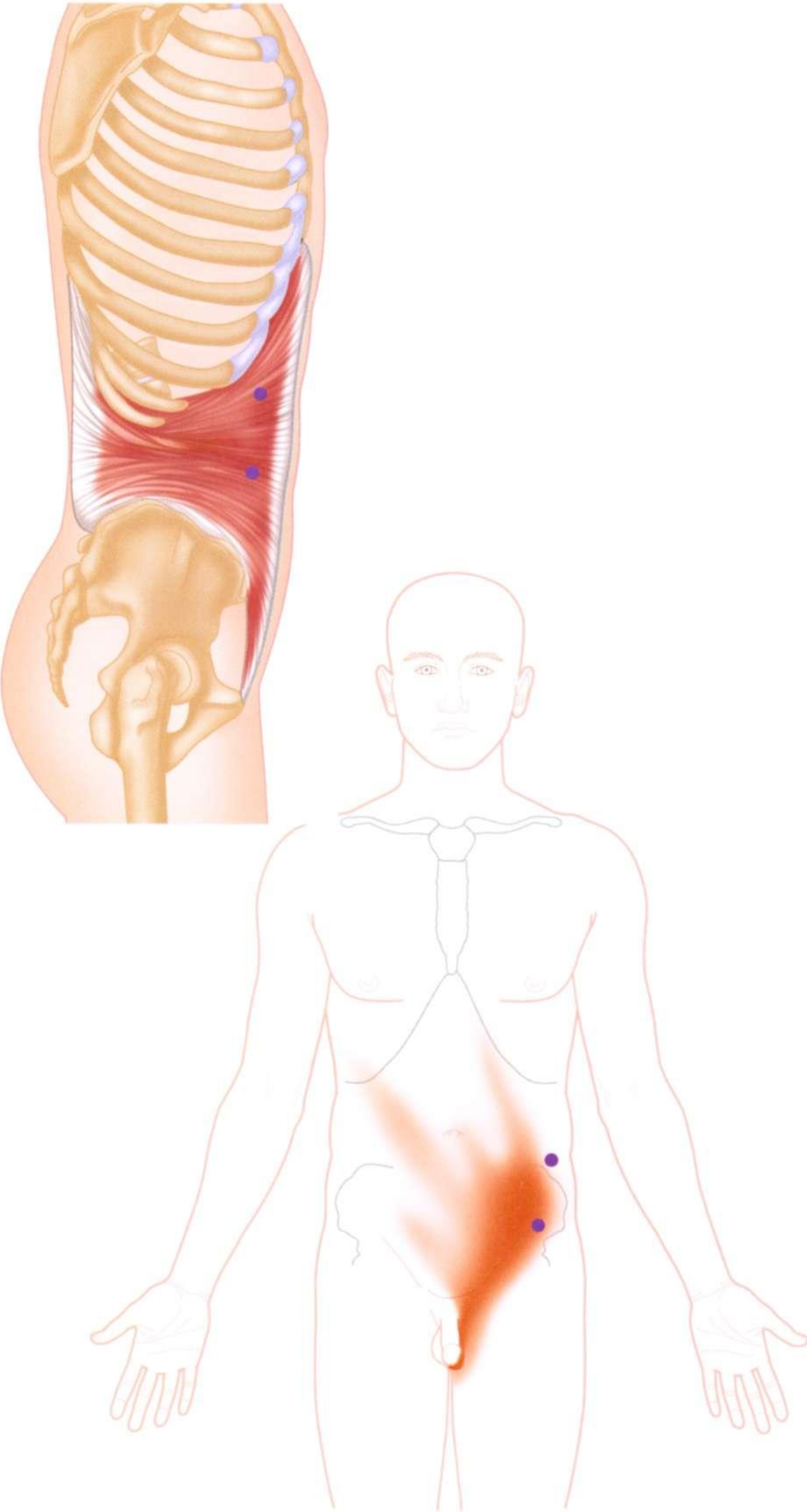
Differential diagnosis
Visceral pathology including: renal, hepatic, pancreatic, diverticular disease, colitis, appendicitis, hiatus hernia, peritoneal disease - pelvic inflammatory disease, ovarian, bladder.

Advice to patient
Occupational. Sports. Diet. Breathing. Pelvic floor and core stability exercises.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓		Trigger point release	✓	✓

TRANSVERSUS ABDOMINIS



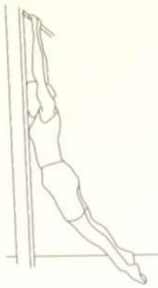
Lateral abdominals

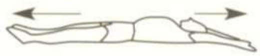
Strengthening exercise

Twisting sit-ups

Self stretches

Avoid or take care if you have back problems, check with your health professional first





TRANSVERSUS ABDOMINIS

Latin, *transversus,* across, crosswise; *abdominis,* belly/stomach.

Origin

Anterior two-thirds of iliac crest. Lateral third of inguinal ligament. Thoracolumbar fascia. Costal cartilages of lower six ribs. Fascia covering iliopsoas.

Insertion

Xiphoid process and linea alba via an abdominal aponeurosis, the lower fibres of which ultimately attach to the pubic crest and pecten pubis via the conjoint tendon.

Action

Compresses abdomen, helping to support the abdominal viscera against the pull of gravity.

Nerve

Ventral rami of thoracic nerves, T7-T12, ilioinguinal and iliohypogastric nerves.

Basic functional movement

Important during forced expiration, sneezing and coughing. Helps maintain good posture.

Indications

Groin pain. Testicular pain. Heartburn. Nausea. Vomiting. Bloating. Diarrhoea. Discogenic pain from the lumbar spine.

Referred pain patterns

Costal margin: local quadrant pain often radiating into anterior abdomen.
Suprapubic: local pain often radiating medially and inferiorly to testes.

Differential diagnosis

Visceral pathology including: renal, hepatic, pancreatic, diverticular disease, colitis, appendicitis, hiatus hernia, peritoneal disease - pelvic inflammatory disease, ovarian, bladder, testicular pathology, e.g. varicocele, non-specific urethritis.

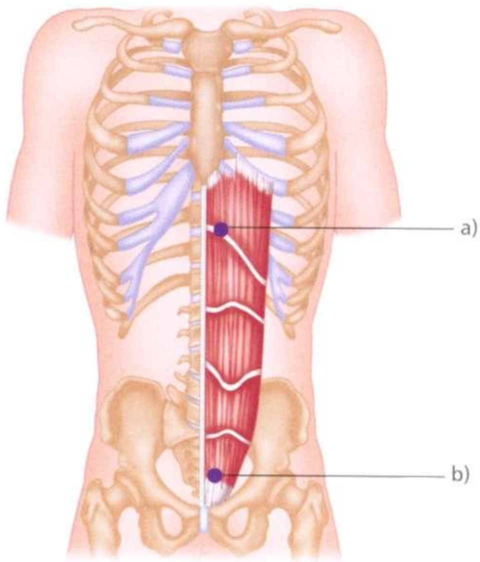
Advice to patient

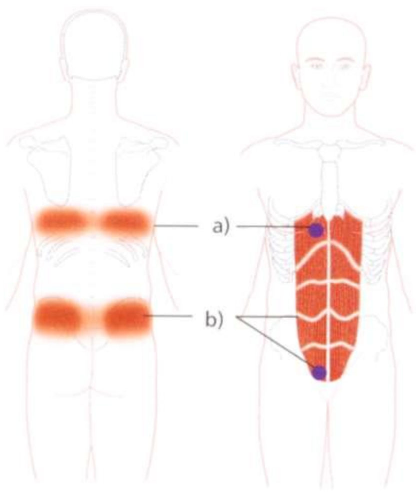
Self stretch and strengthen to stabilise lumbar spine and support vascular activities. Posture and tone.

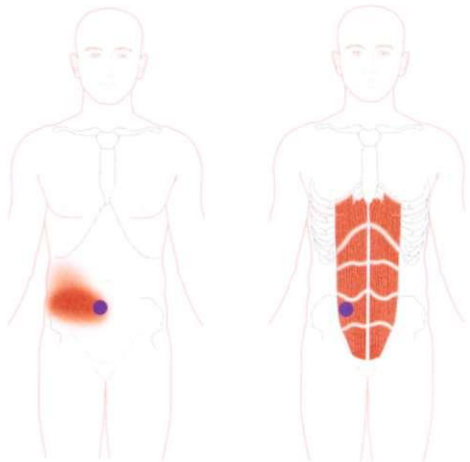
Techniques

Spray and stretch	✓		Dry needling	✓	
Injections	✓		Trigger point release	✓	✓

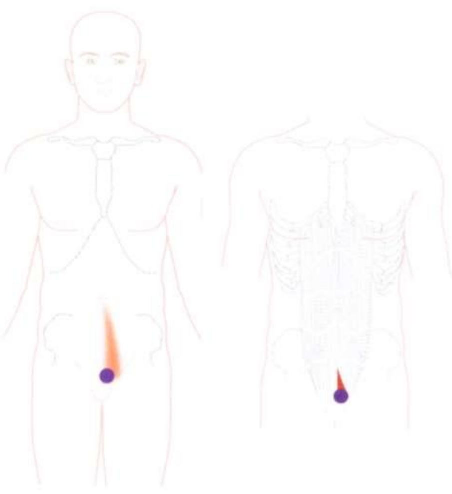
RECTUS ABDOMINIS



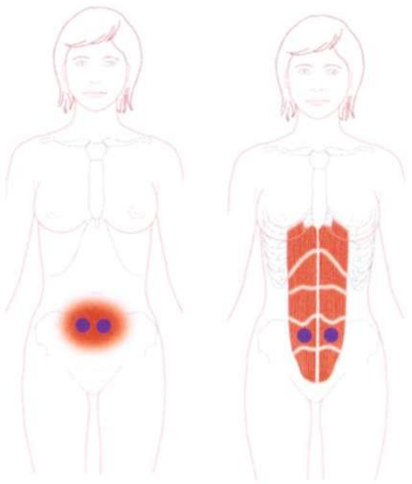




McBurney's point



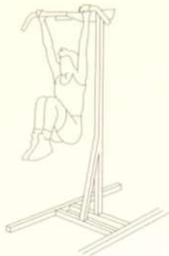
Pyramidalis



Points for dysmenorrhoea

Strengthening exercises

Abdominal machine crunch (for upper fibres)

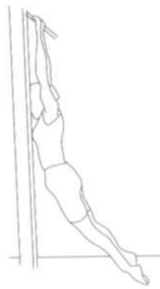


Hanging leg raise

Reverse sit-ups (for lower fibres)

Self stretches

Avoid or take care if you have back problems; check with your health professional first.



RECTUS ABDOMINIS

Latin, *rectum,* straight; *abdominis,* belly/stomach.

The rectus abdominis is divided by tendinous bands into three or four bellies, each sheathed in aponeurotic fibres from the lateral abdominal muscles. These fibres converge centrally to form the linea alba. Situated anterior to the lower part of rectus abdominis is a frequently absent muscle called *pyramidalis*, which arises from the pubic crest and inserts into the linea alba. It tenses the linea alba, for reasons unknown.

Origin

Pubic crest and symphysis pubis (front of pubic bone).

Insertion

Anterior surface of xiphoid process. Fifth, sixth and seventh costal cartilages.

Action

Flexes lumbar spine. Depresses ribcage. Stabilizes the pelvis during walking.

Nerve

Ventral rami of thoracic nerves, T5-12.

Basic functional movement

Example: Initiating getting out of a low chair.

Indications

Heartburn. Colic. Dysmenorrhoea. Nausea. Vomiting. Sense of being full. Horizontal back pain.

Referred pain patterns

Upper fibres: horizontal mid back pain; heartburn and indigestion.
Lower fibres: pain between pubis and umbilicus causing dysmenorrhoea.
Lateral fibres: pseudoappendicitis; McBurney's point.

Differential diagnosis

Visceral pathology including: renal, hepatic, pancreatic, diverticular disease, colitis, appendicitis, hiatus hernia, peritoneal disease - pelvic inflammatory disease, ovarian, bladder. Appendicitis. Gynaecological disease. Umbilical/incisional - hernia. Latissimus dorsi.

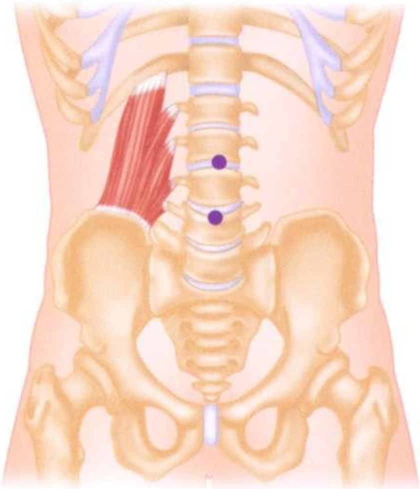
Advice to patient

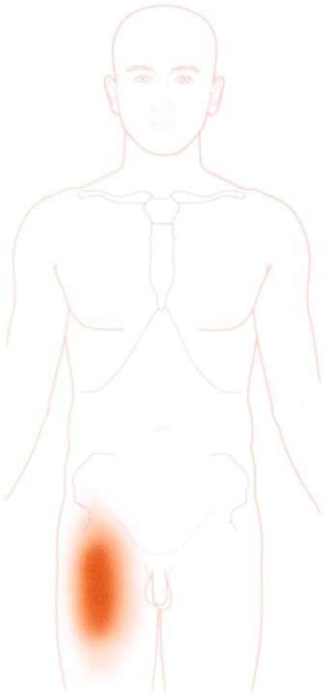
Weight.

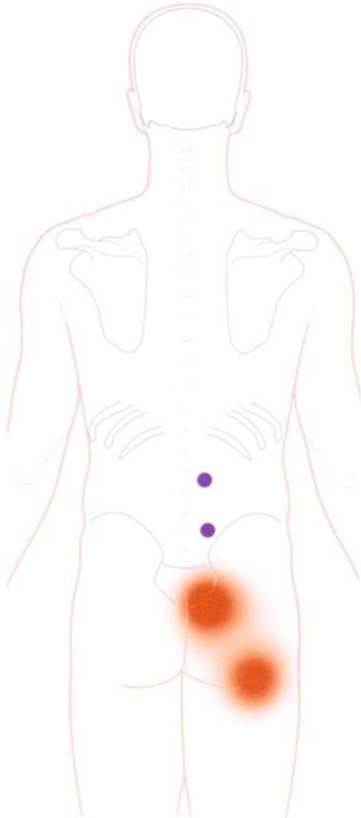
Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

QUADRATUS LUMBORUM







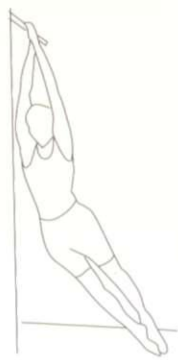
Deep quadratus lumborum

Strengthening exercise

Side bends

Self stretches

Place towel under left foot. Side bend to left, progressively taking up any slack in towel.



QUADRATUS LUMBORUM

Latin, *quadratus,* squared; *lumbar,* loin.

Origin

Posterior part of iliac crest. Iliolumbar ligament.

Insertion

Medial part of lower border of twelfth rib. Transverse processes of upper four lumbar vertebrae (L1-L4).

Action

Laterally flexes vertebral column. Fixes the twelfth rib during deep respiration (e.g. helps stabilize the diaphragm for singers exercising voice control). Helps extend lumbar part of vertebral column, and gives it lateral stability.

Nerve

Ventral rami of the subcostal nerve and upper three or four lumbar nerves, T12, L1, 2, 3.

Basic functional movement

Example: Bending sideways from sitting to pick up an object from the floor.

Indications

Renal tubular acidosis. Discogenic list scoliosis. Mechanical low back pain. Walking stick/cast for fracture. Hip and buttock pain. Greater trochanteric pain (on sleep). Pain turning in bed. Pain standing upright. Persistent deep lower backache at rest. Pain on coughing and sneezing (Valsalva's manoeuvre). Pain on sexual intercourse.

Referred pain patterns

Several 'zones' of pain at: lower abdomen, sacroiliac joint (upper pole), lower buttock, upper hip and greater trochanter.

Differential diagnosis

Sacroiliitis. Bursitis of hip. Radiculopathy (lumbar). Disc pain (lumbar). Ligamentous pain (iliolumbar and lumbosacral). Spondylosis. Spondyloarthropathy. Stenosis (spinal). Spondylolisthesis. Rib dysfunction (lower).

Also consider

Gluteus medius. Gluteus minimus. Gluteus maximus. Tensor fasciae latae. Pyramidalis. Iliopsoas. Pelvic floor. Sciatica. Hernia. Testicular/scrotal.

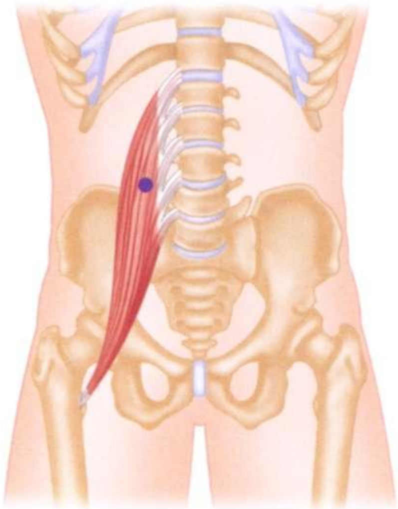
Advice to patient

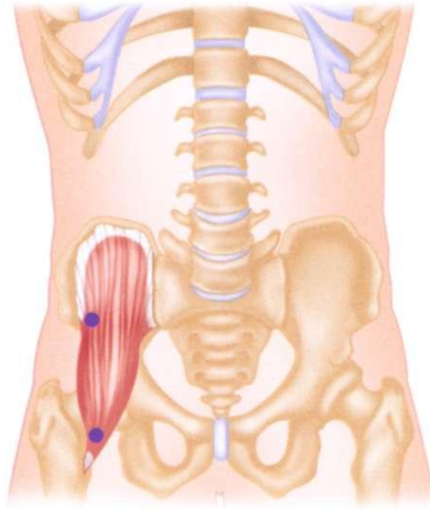
Correct any leg length discrepancy. Change mattress. Occupational advice (mechanical). Hobbies (gardening). Strengthen abdominal (core) stability. Avoid leaning on one leg. Take care when twisting. Emotional component.

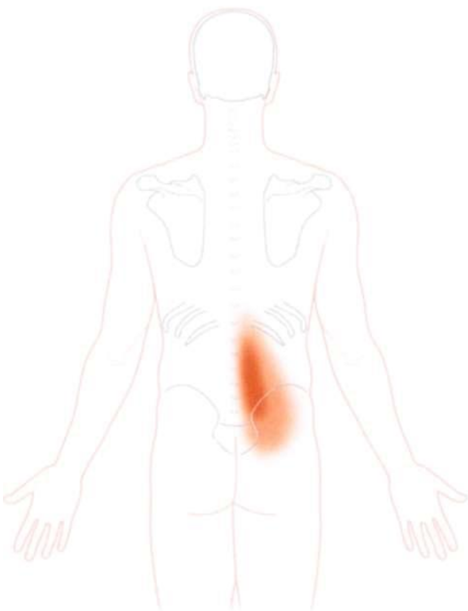
Techniques

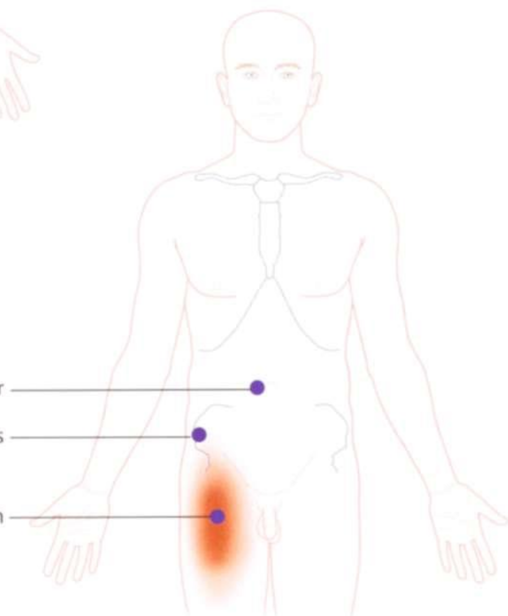
Spray and stretch	✓	✓	Dry needling		
Injections	✓		Trigger point release	✓	✓

ILIOPSOAS (PSOAS MAJOR/ILIACUS)

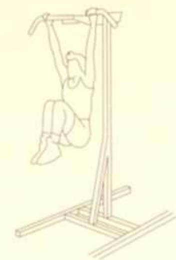

Psoas major


Iliacus


Posterior referred pain distribution



Strengthening exercises


Hanging leg raise


Multi-hip machine (hip joint flexion)

Self stretches


Push right hip forward to stretch right iliopsoas. Keep low back flat and maintain upright posture.

ILIOPSOAS (PSOAS MAJOR/ILIACUS)

Greek, *psoas,* muscle of loin; *major,* large; *iliacus,* pertaining to the loin.

The psoas major and iliacus are considered part of the posterior abdominal wall due to their position and cushioning role for the abdominal viscera. However, based on their action of flexing the hip joint, it would also be relevant to place them with the hip muscles. Note that some upper fibres of psoas major may insert by a long tendon into the iliopubic eminence to form the psoas minor, which has little function and is absent in about 40% of people. Bilateral contracture of this muscle will increase lumbar lordosis.

Origin
Psoas major: bases of transverse processes of all lumbar vertebrae, (L1-L5). Bodies of twelfth thoracic and all lumbar vertebrae, (T12-L5). Intervertebral discs above each lumbar vertebra.
Iliacus: superior two-thirds of iliac fossa. Internal lip of iliac crest. Ala of sacrum and anterior ligaments of the lumbosacral and sacroiliac joints.

Insertion
Psoas major: lesser trochanter of femur.

Iliacus: lateral side of tendon of psoas major, continuing into lesser trochanter of femur.

Action
Main flexor of hip joint (flexes and laterally rotates thigh, as in kicking a football). Acting from its insertion, flexes the trunk, as in sitting up from the supine position.

Nerve
Psoas major: ventral rami of lumbar nerves, L1, **2,3**, 4. (psoas minor innervated from L**1, 2**).
Iliacus: femoral nerve, L1, **2, 3**, 4.

Basic functional movement
Example: Going up a step or walking up an incline.

Indications
Low back pain. Groin pain. Increased (hyper) lordosis of lumbar spine. Anterior thigh pain. Pain prominent in lying to sitting up. Scoliosis. Asymmetry (pelvic).

Referred pain patterns
a) Strong vertical ipsilateral paraspinal pain along lumbar spine, diffusely radiating laterally 3-7cm; b) strong zone of pain 5-8cm top of anterior thigh, within diffuse zone from ASIS to upper half of thigh.

Differential diagnosis
Osteoarthritis of hip. Appendicitis. Femoral neuropathy. Meralgia paresthetica. L4-5 disc. Bursitis. Quadriceps muscle injury. Mechanical back dysfunction. Hernia (inguinal / femoral). Gastrointestinal. Rheumatoid arthritis. Space occupying lesions.

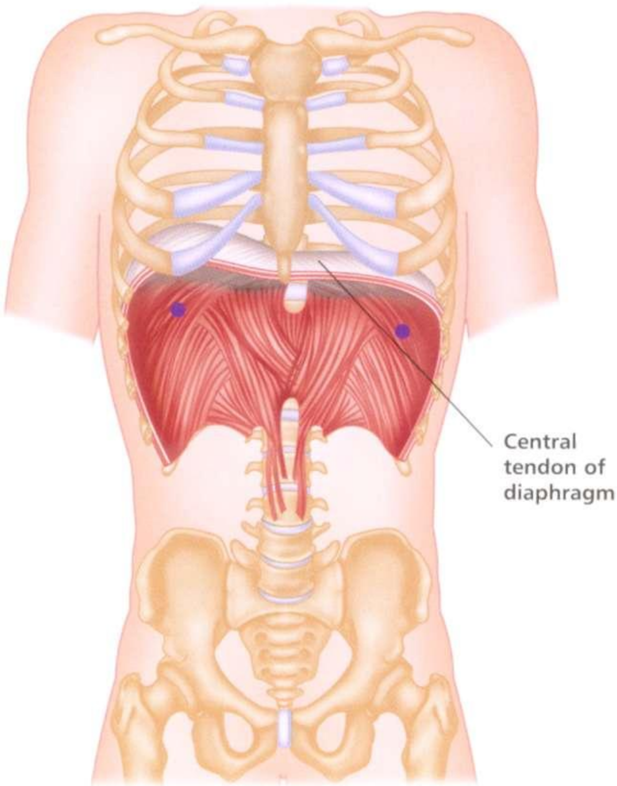
Also consider
Quadratus lumborum. Multifidis. Erector spinae. Quadriceps. Hip rotators. Pectineus. Tensor fasciae latae. Adductors (longus and brevis). Femoropatellar joint. Diaphragm.

Advice to patient
Avoid prolonged sitting. Avoid sleeping in foetal position. Treat low back. Avoid overuse in sit ups. Strengthen transversus abdominis. Stretching exercises.

Techniques

Spray and stretch	✓	✓	Dry needling		
Injections	✓		Trigger point release	✓	✓

DIAPHRAGM



DIAPHRAGM

Greek, *partition,* wall.

Origin
Back of xiphoid process (lower tip of sternum). Lower six ribs and their costal cartilages. Upper two or three lumbar vertebrae (L1-L3).

Insertion

All fibres converge and attach onto a central tendon, i.e. this muscle inserts upon itself.

Action
Forms floor of thoracic cavity. Pulls its central tendon downward during inhalation, thereby increasing volume of thoracic cavity.

Nerve
Phrenic nerve (ventral rami), C3, **4,** 5.

Basic functional movement
Produces about 60% of your breathing capacity.

Diaphragm and Breathing

Nothing in the body happens in isolation, and an exploration of breathing mechanics exemplifies this. Breathing involves many sequences of co-ordinated muscular and visceral co-contractions. Trigger points can often be palpated along the anterior inferior costo-chondral margin. These trigger points should be contextualized with other relationships such as:

- Sub-mandibular inferior margin (often on the opposite side to the diaphragm trigger points);
- Abdominal visceral fascia (greater and lesser omenta);
- Spinal muscles (esp. mid-lumbar);
- Abdominal muscles (especially transversus and rectus abdominis);
- Pelvic floor muscles (pelvic diaphragm);
- Thoracic spine and rib mobility;
- Intercostal muscles;
- Serratus musculature;
- First rib mechanics;
- Scalenes, levator scapulae and upper trapezius.

Breathing patterns are often aberrant; hyperventilation syndrome, panic attacks and postural habit are increasingly diagnosed. If untreated, these syndromes also have ongoing physiological consequences, such as respiratory alkalosis (too much carbon dioxide is exhaled by over-breathing). Paradoxically, this situation is one of the key factors in the development of chronic myofascial trigger points throughout the body. It may be interesting to note here that cranial osteopaths talk about eight diaphragms which all coordinate together in breathing: the diaphragma sellae, under the pituitary gland; sub-mandibular myofascial raphe, bilaterally; thoracic inlet/outlet, bilaterally; abdominal diaphragm; and the pelvic floor, bilaterally.

Aberrant Breathing and Trigger Point Formation
Garland (1994) suggested a sequence of musculo-skeletal changes that may develop over time as a result of chronic upper chest respiration:

- Restriction in thoracic spine mobility (secondary to aberrant rib mechanics);
- Trigger point formation in scalenes group, upper trapezius and levator scapulae;
- Tight and stiff cervical spine;
- Changes in tone of abdominal diaphragm and transversus abdominis (Hodges et al., 2001, McGill et al., 1995);
- Imbalance between weakened abdominal muscles and hypertonic erector spinae;
- Pelvic floor weakness.

Trigger point therapy can be a useful tool in releasing the musculo-skeletal component of respiratory dysfunction and is especially useful when combined with other modalities such as yoga, Feldenkrais, meditation, the Buteyko method and 'breath therapy'.

Muscles of the Shoulder and Upper Arm

6

Trapezius

Levator Scapulae

Rhomboideus (Minor and Major)

Serratus Anterior

Pectoralis Major

Latissimus Dorsi

Deltoideus

Supraspinatus

Infraspinatus

Teres Minor

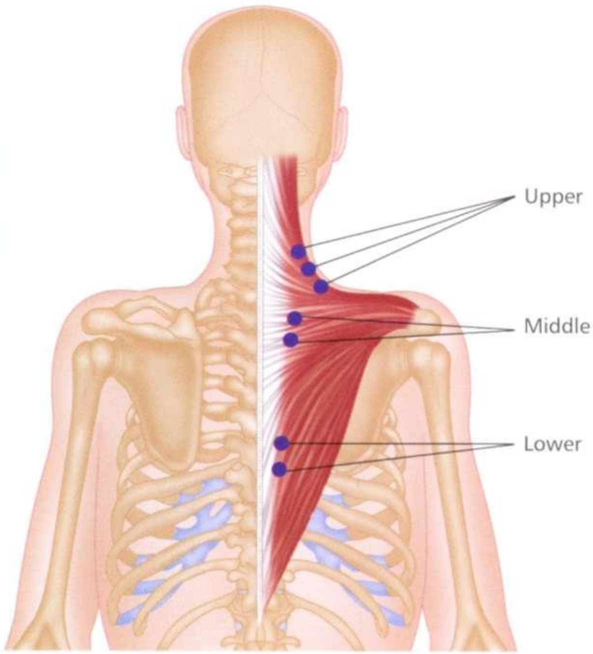
Subscapularis

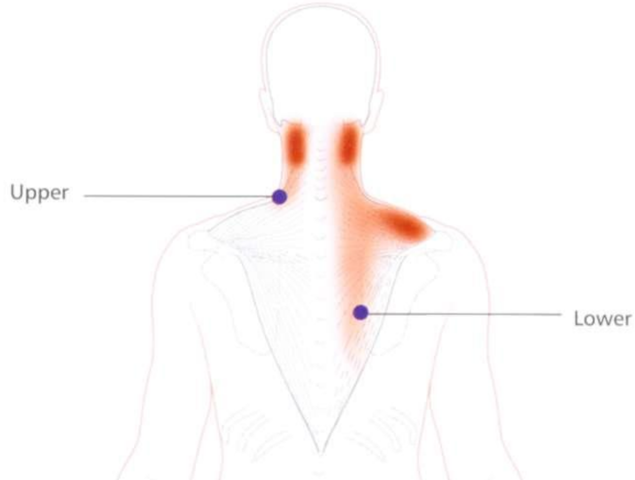
Teres Major

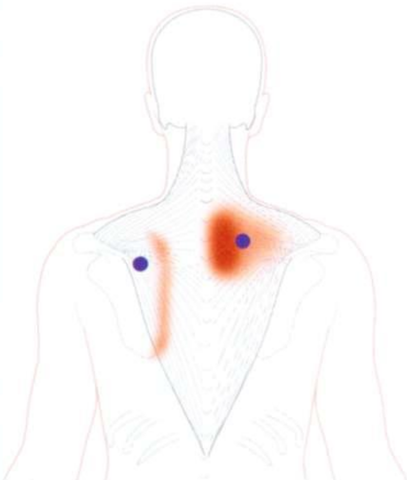
Biceps Brachii

Triceps Brachii

TRAPEZIUS



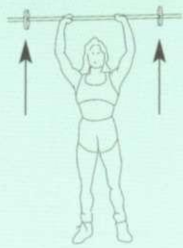




Middle

Upper

Strengthening exercises



Shoulder press
(upper fibres)

Dips
(middle/lower fibres)

Lateral dumb-bell raises

Self stretch

Turn head to right and tuck chin in. Pull left shoulder down. Pull head and left shoulder apart from each other.

Latin, *trapezoides*, table shaped.

The left and right trapezius viewed as a whole create a trapezium in shape, thus giving this muscle its name.

Origin
Medial third of superior nuchal line of occipital bone. External occipital protuberance. Ligamentum nuchae. Spinous processes and supraspinous ligaments of seventh cervical vertebra (C7) and all thoracic vertebrae (T1–T12).

Insertion
Posterior border of lateral third of clavicle. Medial border of acromion. Upper border of the crest of the spine of scapula, and the tubercle on this crest.

Action
Upper fibres: pull the shoulder girdle up (elevation). Helps prevent depression of the shoulder girdle when a weight is carried on the shoulder or in the hand.
Middle fibres: retract (adduct) scapula.
Lower fibres: depress scapula, particularly against resistance, as when using the hands to get up from a chair.
Upper and lower fibres together: rotate scapula, as in elevating the arm above the head.

Nerve
Motor supply: accessory **X1** nerve.
Sensory supply (proprioception): ventral ramus of cervical nerves, C2, **3**, **4**.

Basic functional movement
Example (upper and lower fibres working together): Painting a ceiling.

Indications
Chronic tension and neck ache. Stress headache. Cervical spine pain. Whiplash.

Referred pain patterns
Upper fibres: pain and tenderness, posterior and lateral aspect of upper neck. Temporal region and angle of jaw.
Middle fibres: local pain radiating medially to spine.
Lower fibres: posterior cervical spine, mastoid area, area above spine of scapula.

Differential diagnosis
Capsular-ligamentous apparatus. Articular dysfunction (facet).

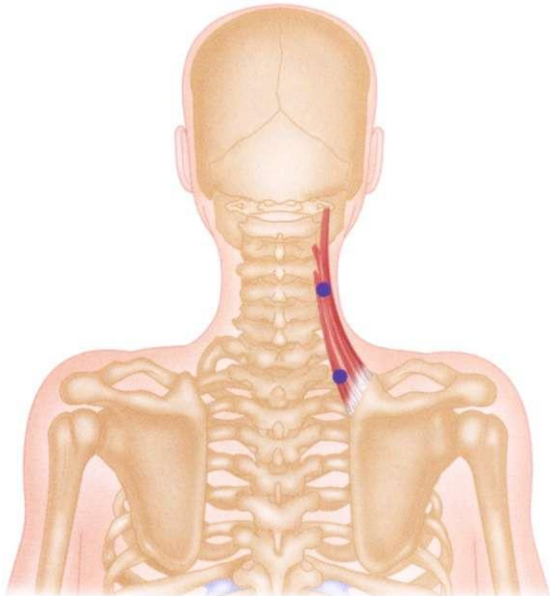
Also consider
Overlap: sternocleidomastoideus. Masseter. Temporalis. Occipitalis. Levator scapulae. Semispinalis. Iliocostalis.

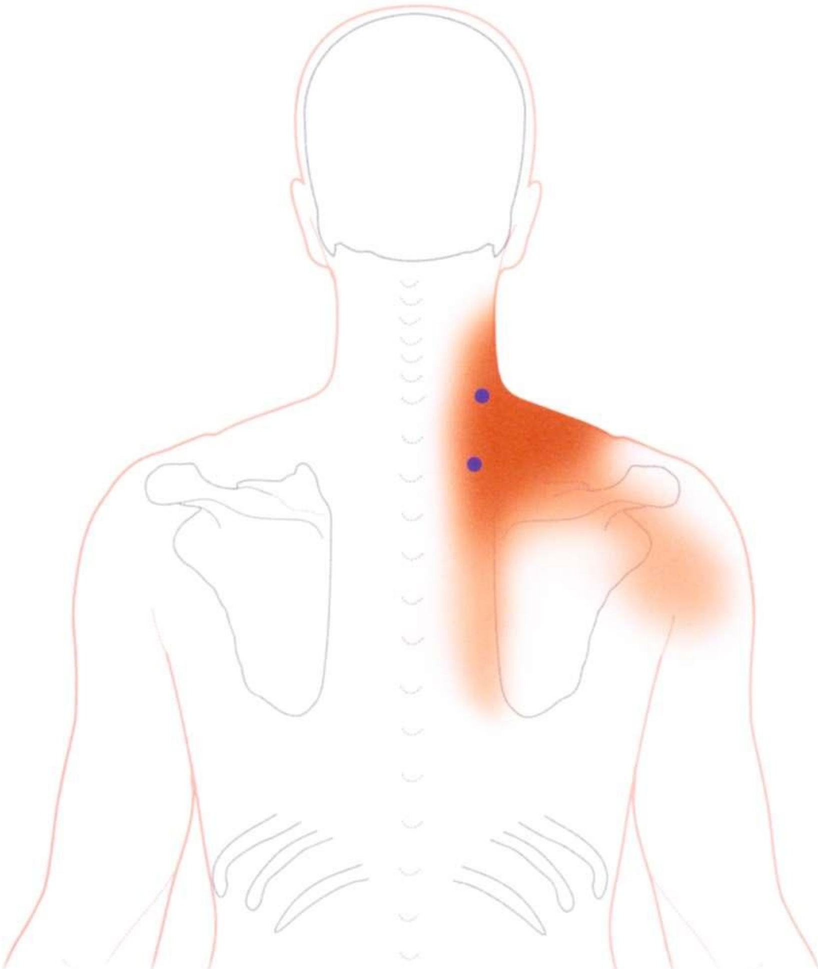
Advice to patient
Posture standing and at work. Stress management. Bra straps. Pectoralis minor tension (round shoulders).

Techniques

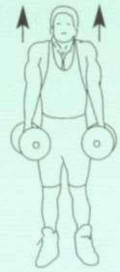
Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

LEVATOR SCAPULAE





Strengthening exercises



Shrugs with dumb-bells or barbell

Upright vertical rowing

Self stretches

Drop chin to chest and turn chin 45°. Keep spine long.

LEVATOR SCAPULAE

Latin, *levare,* to lift; *scapulae,* shoulder, blade(s).

Levator scapulae is deep to sternocleidomastoideus and trapezius. It is named after its action of elevating the scapula.

Origin

Posterior tubercles of the transverse processes of the first three or four cervical vertebrae (C1-C4).

Insertion

Medial (vertebral) border of the scapula between the superior angle and the spine of scapula.

Action

Elevates scapula. Helps retract scapula. Helps bend neck laterally.

Nerve

Dorsal scapular nerve, C4, 5 and cervical nerves, C3, 4.

Basic functional movement

Example: Carrying a heavy bag.

Indications

Stiff and painful neck with limited rotation of cervical spine. Long-term use of walking stick.

Referred pain patterns

Triangular pattern from top of scapula to nape of neck. Slight overspill to medial border of scapula and posterior glenohumeral joint.

Differential diagnosis

Scapulothoracic joint dysfunction; winging of scapula. Apophysitis and capsular ligamentous apparatus. Shoulder impingement syndromes.

Also consider

Trapezius. Rhomboids. Splenius cervicis. Erector spinae.

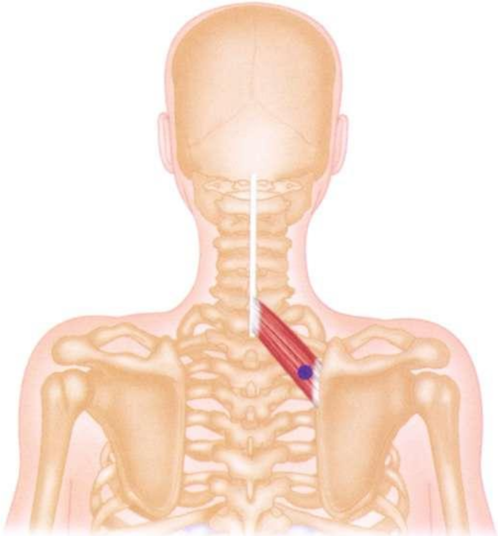
Advice to patient

Holding a telephone shoulder to ear. Stress. Occupation. Air conditioning. Passive stretching. Heat and warmth. Scarf. Change walking stick position.

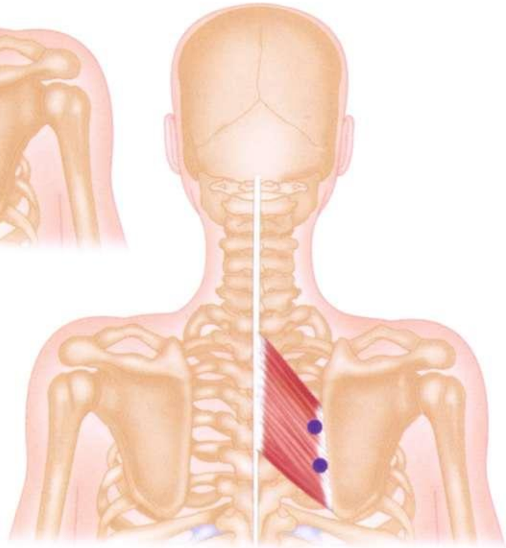
Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

RHOMBOIDEUS (MINOR AND MAJOR)



Rhomboid minor



Rhomboid major

Strengthening exercises

Seated rowing

Upright vertical rowing

Lat. pull downs

Self stretch

RHOMBOIDEUS (MINOR AND MAJOR)

Greek, *rhomb,* a parallelogram with oblique angles and only the opposite sides equal; *minor,* small; *major,* large.

So named because of its shape.

Origin

Spinous processes of the seventh cervical vertebra and upper five thoracic vertebrae (C7-T1).

Insertion

Medial (vertebral) border of scapula.

Action

Retracts (adducts) scapula. Stabilizes scapula. Slightly assists in outer range of adduction of arm (i.e. from arm overhead to arm at shoulder level).

Nerve

Dorsal scapular nerve, C4, 5.

Basic functional movement

Example: Pulling something towards you, such as opening a drawer.

Indications

Localized pain or chronic aching (C7-T5) region - medial or peri-scapular. Scapulothoracic joint grinding/grating or crunching.

Referred pain patterns

Medial border of scapula, wrapping around superior aspect of spine of scapula towards the acromion process.

Differential diagnosis

Scapulocostal syndrome. Fibromyalgia.

Also consider

Levator scapulae. Middle trapezius. Infraspinatus. Scalenes. Latissimus dorsi.

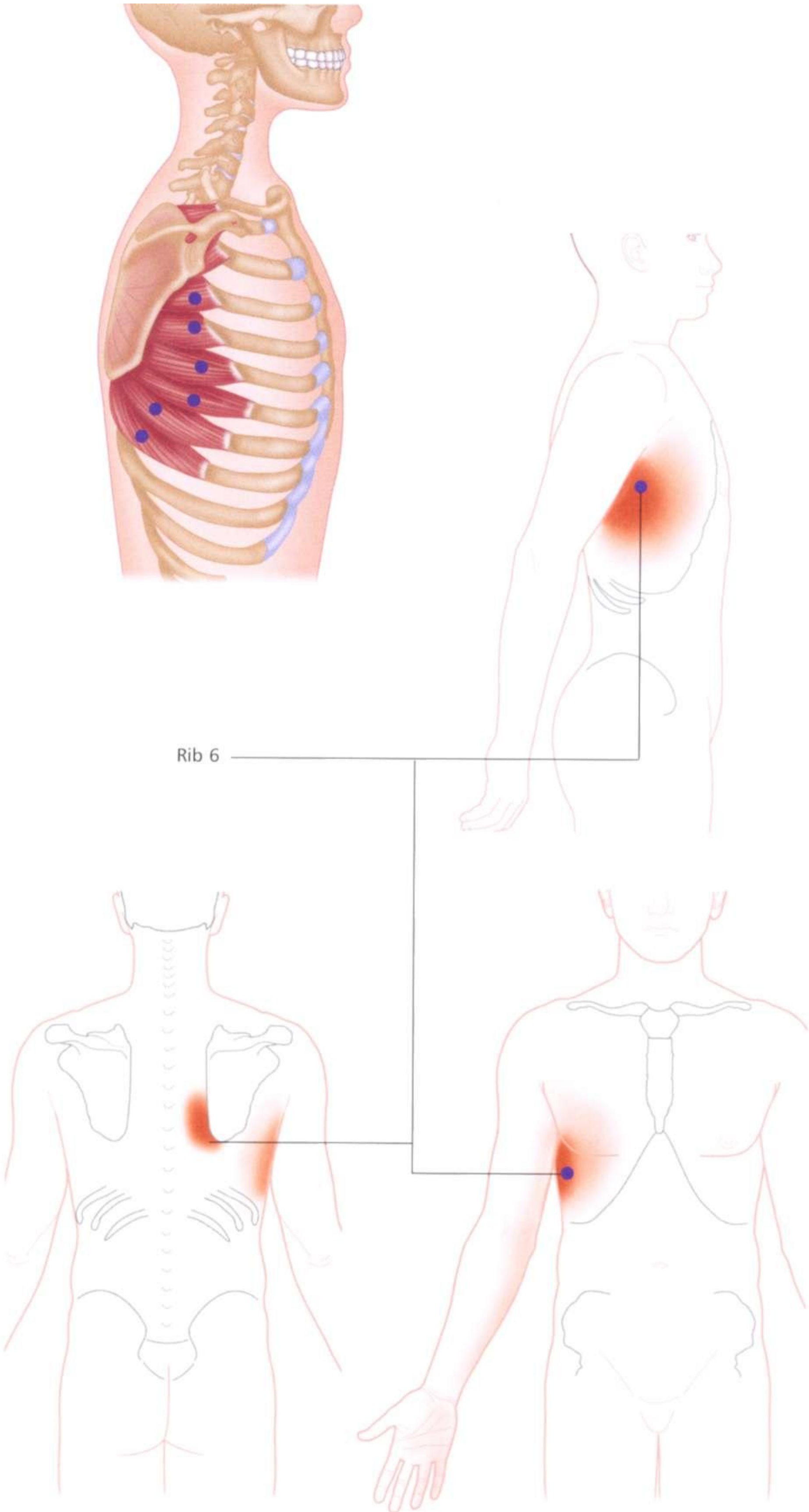
Advice to patient

Posture. Tight pectoralis muscles. 'Round shoulders'. Occupational posture.

Techniques

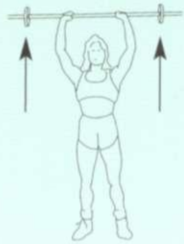
Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓		Trigger point release (N.B. pleural cavity)	✓	✓

SERRATUS ANTERIOR



Strengthening exercises

Bench press (including inclined version)



Shoulder press

Push-ups

Self stretch

SERRATUS ANTERIOR

Latin, *serratus,* serrated; *anterior,* before.

The serratus anterior forms the medial wall of the axilla, along with the upper five ribs. It is a large muscle composed of a series of finger-like slips. The lower slips interdigitate with the origin of the external oblique.

Origin
Outer surfaces and superior borders of upper eight or nine ribs and the fascia covering their intercostal spaces.

Insertion

Anterior (costal) surface of the medial border of scapula and inferior angle of scapula.

Action

Rotates scapula for abduction and flexion of arm. Protracts scapula (pulls it forward on the chest wall and holds it closely to the chest wall), facilitating pushing movements such as push-ups or punching.

Nerve
Long thoracic nerve, C5, 6, 7, 8.

Note: A lesion of the long thoracic nerve will result in the medial border of the scapula falling away from the posterior chest wall, resulting in a 'winged scapula' (looking like an angel's wing). A weak muscle will also produce a winged scapula, especially when holding a weight in front of the body.

Basic functional movement

Example: Reaching forwards for something barely within reach.

Indications

Chest pain which does not abate with rest. Breast pain and sensitivity. Panic attacks. Dyspnoea. Chronic cough. Asthma. Renal tubular acidosis. Scapula winging. Chronic 'stitch' on running. Stress.

Referred pain patterns
Local: where each digitation attaches to rib.
Central: rib (6-8), localized pain radiating anterior and posterior in a 5-10cm patch. Pain inferior angle of scapula. Pain in ulnar aspect of the upper extremity.

Differential diagnosis
T7/T8 intercostal nerve entrapment. Herpes zoster. Local vertebral alignment. Rib lesions. Breast pathologies. Reflex-sympathetic dystrophy.

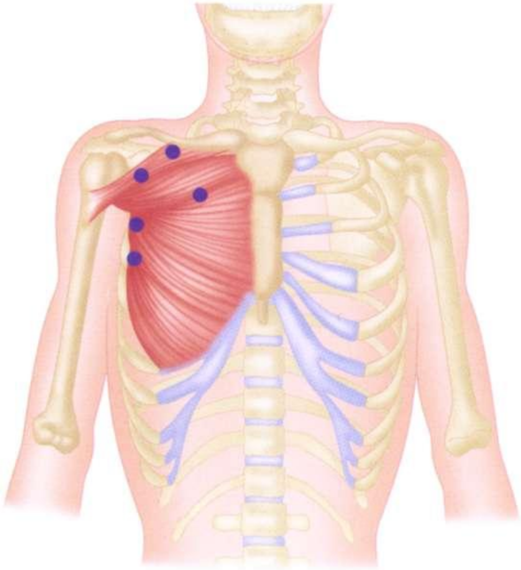
Also consider
Pectoralis major. Sternocleidomastoideus. Scalenus medius. Trapezius. Rhomboideus. Diaphragm. External oblique.

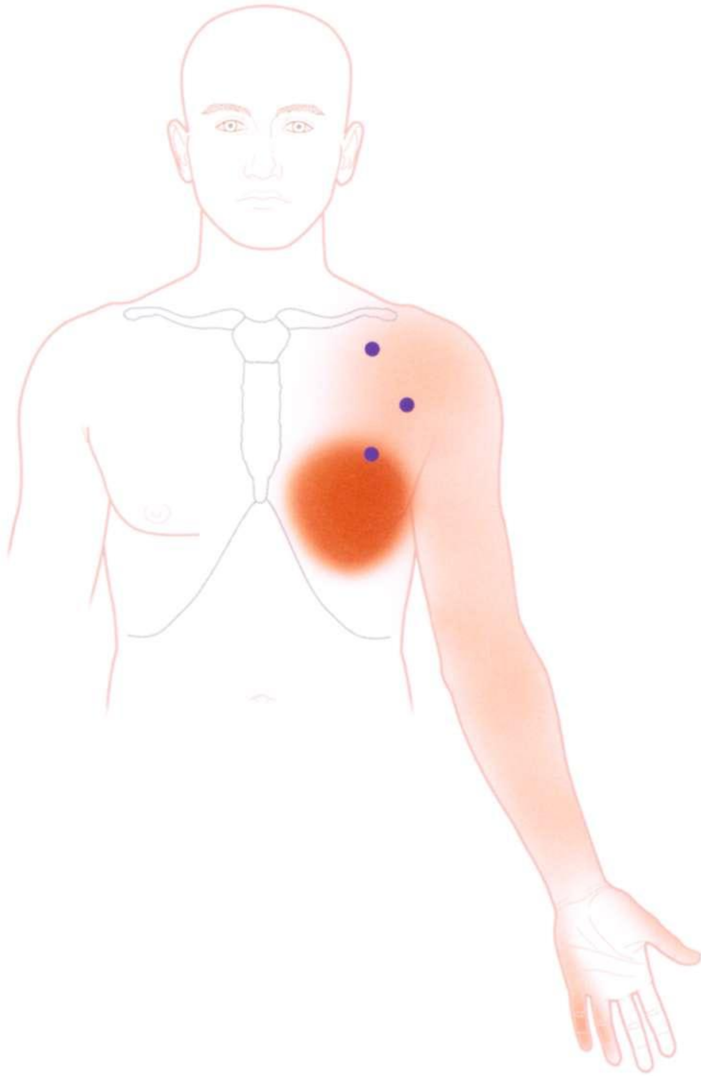
Advice to patient
Avoid cars with heavy steering. Take care with weight-training, especially push-ups and bench press. Avoid stress. Try meditation/relaxation.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

PECTORALIS MAJOR





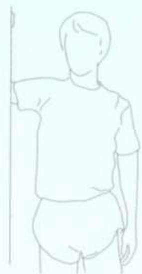
Strengthening exercises

Bench press

Dumb-bell flyes

Pull-overs

Self stretches



Fix arm against a door frame. Step forward keeping your back lengthened, not arched. Raising or lowering arm will stretch different parts of the muscle.

PECTORALIS MAJOR

Latin, *pectoral is,* chest; *major,* large.

Along with pectoralis minor, pectoralis major forms the anterior wall of the axilla.

Origin

Clavicular head: medial half or two thirds of front of clavicle.

Sternocostal portion: front of manubrium and body of sternum. Upper six costal cartilages. Rectus sheath.

Insertion

Crest below greater tubercle of humerus. Lateral lip of intertubercular sulcus (bicipital groove) of humerus.

Action

Adducts and medially rotates the humerus.
Clavicular portion: flexes and medially rotates the shoulder joint, and horizontally adducts the humerus towards the opposite shoulder.
Sternocostal portion: obliquely adducts the humerus towards the opposite hip.
The pectoralis major is one of the main climbing muscles, pulling the body up to the fixed arm.

Nerve

Nerve to upper fibres: lateral pectoral nerve, C5, 6, 7.
Nerve to lower fibres: lateral and medial pectoral nerves, C6, 7, 8, T1.

Basic functional movement

Clavicular portion: brings arm forwards and across the body, e.g. as in applying deodorant to opposite armpit.
Sternocostal portion: pulling something down from above, e.g. such as a rope in bell ringing.

Indications

Post myocardial infarct rehabilitation. Cardiac arrhythmia. Mid-scapular back pain. Breast pain and hypersensitivity. Thoracic outlet syndrome. Anterior shoulder pain. Golfer's and tennis elbow.

Referred pain patterns

Clavicular portion: local pain radiating to the anterior deltoid and long head of biceps brachii area.
Sternal portion: 'acute' back pain into anterior chest wall in a 10-20cm patch of diffuse pain around the medial border of the upper extremity. Stronger pain below medial epicondyle in a 5cm patch, diffuse pain into the 4th and 5th digits.
Costal portion: 5-6th ribs leads to severe cardiac referral (even at night). Intense breast pain (10-15cm patch). Diffuse radiations into axillary tail, and into axilla.

Differential diagnosis

C5-C6 radiculopathy. Biceps tendonitis. Rotator cuff muscle lesions. Intrathoracic pathology. Oesophageal pathology. Tietze's syndrome. Ischaemic heart disease (angina). Thoracic outlet syndrome.

Also consider

Latissimus dorsi. Subscapularis. Teres minor. Infraspinatus. Trapezius (middle fibres). Serratus anterior.

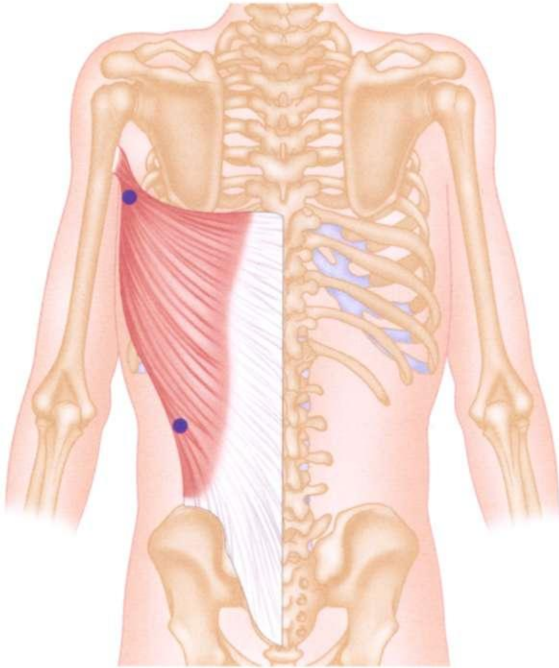
Advice to patient

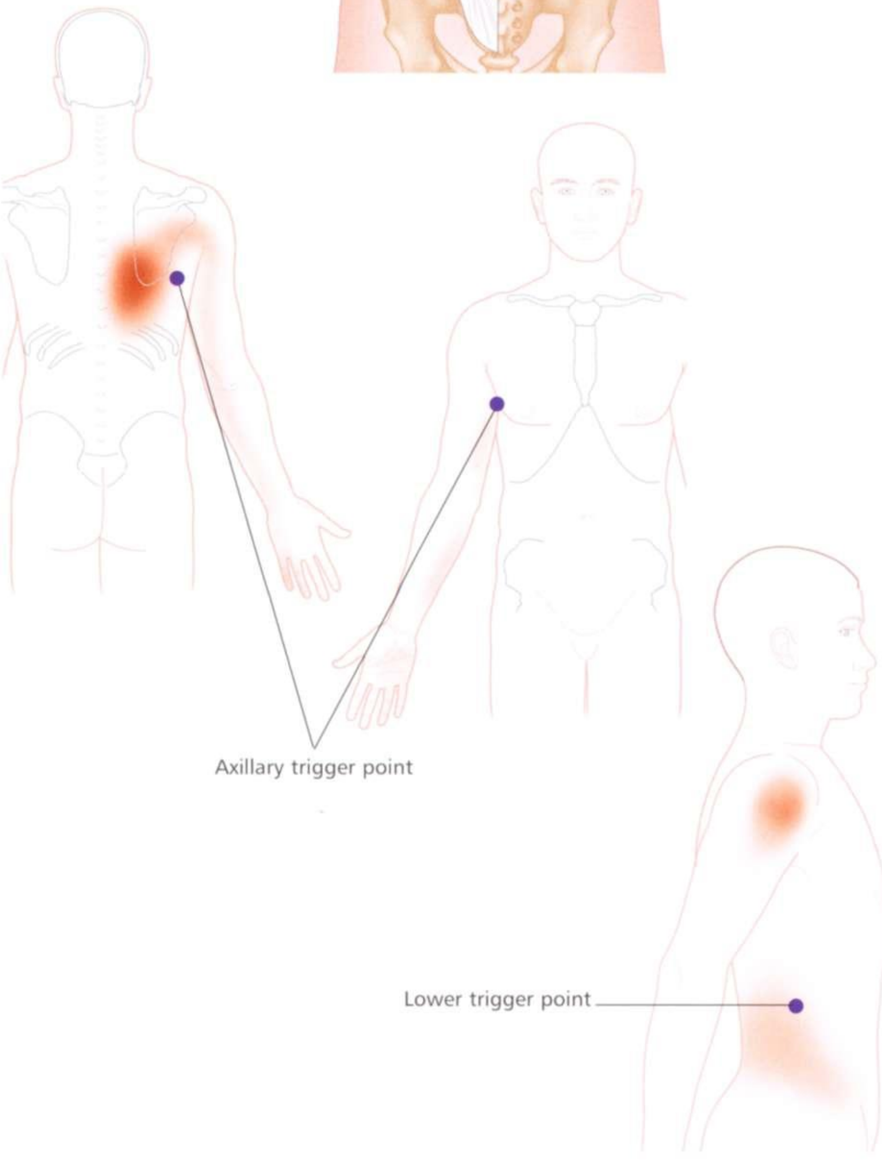
Round shouldered posture leads to shortening. Work sitting posture is key. Sleeping posture, especially hands folded over chest or hands above head. Bra type and support may be relevant.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

LATISSIMUS DORSI





Strengthening exercises

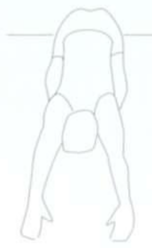
Chin-ups (esp. wide grip)

Lat. pull downs

Pull-overs

Self stretches

Pull right elbow to left with left hand. Side bending to left will increase stretch.



From kneeling on all fours, sit back onto your ankles, keeping your hands fixed. Relax into it and hold for up to two minutes.

Latin, *latissimus,* widest; *dorsi,* of the back.

Along with subscapularis and teres major, the latissimus dorsi forms the posterior wall of the axilla.

Origin

Thoracolumbar fascia, which is attached to the spinous processes of lower six thoracic vertebrae and all the lumbar and sacral vertebrae, (T7-S5) and to the intervening supraspinous ligaments. Posterior part of iliac crest. Lower three or four ribs. Inferior angle of the scapula.

Insertion

Floor of the intertubercular sulcus (bicipital groove) of humerus.

Action

Extends the flexed arm. Adducts and medially rotates the humerus.
It is one of the chief climbing muscles, since it pulls the shoulders downwards and backwards, and pulls the trunk up to the fixed arms (therefore, also active in crawl swimming stroke). Assists in forced inspiration by raising the lower ribs.

Nerve

Thoracodorsal nerve, C6, 7, 8, from the posterior cord of the brachial plexus.

Basic functional movement

Example: Pushing on arms of chair to stand up.

Indications

'Thoracic' back pain; constant in nature and unrelated to activity.

Referred pain patterns

Axillary trigger point: a 5-10cm zone of pain at the inferior angle of scapula with diffuse pain radiating into the medial upper extremity into ulnar aspect of hand.
Lower lateral trigger point: triangular pattern from trigger point into the brim of pelvis and regimental badge area.

Differential diagnosis

C7 neuropathy. Ulnar neuropathy. Subscapular nerve entrapment. Axillary neuropathy. Thoracic outlet syndrome. Cardiopulmonary diseases.

Also consider

Rhomboideus. Trapezius (middle fibres). Teres major. Scalenes. Subscapularis. Iliocostalis. Serratus anterior.

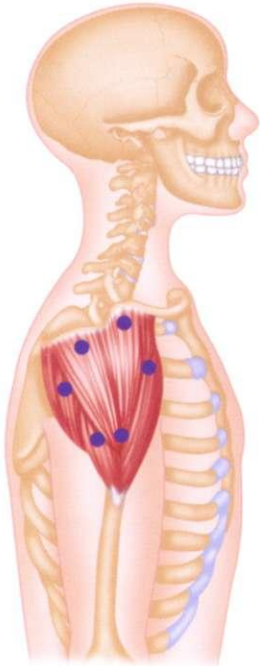
Advice to patient

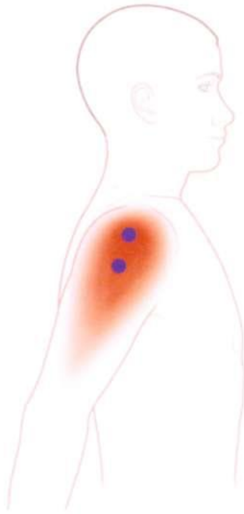
Avoid overloading, e.g. pulling objects down from above head.

Techniques

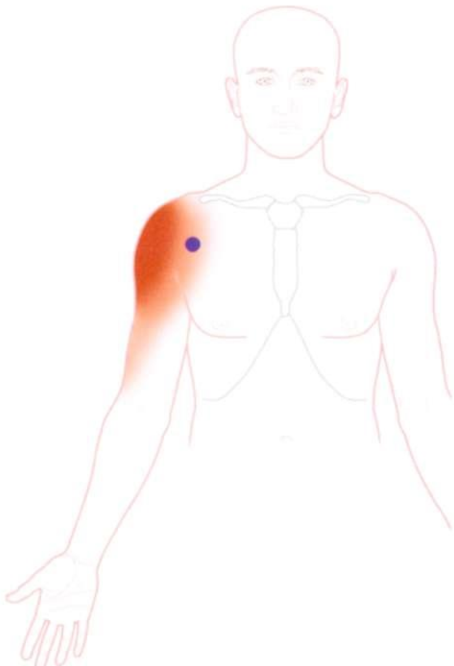
Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

DELTOIDEUS

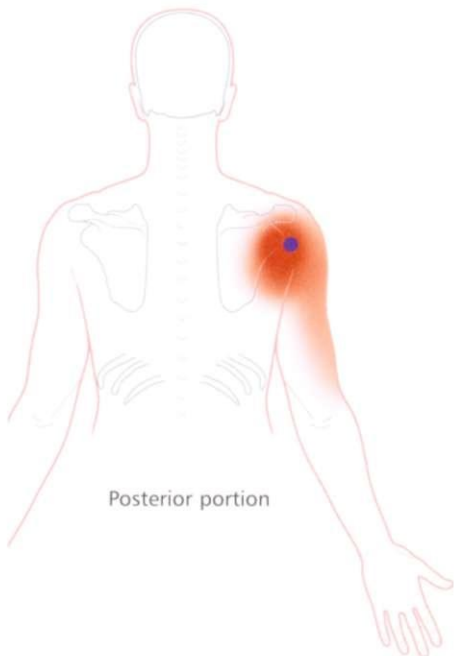




Lateral portion

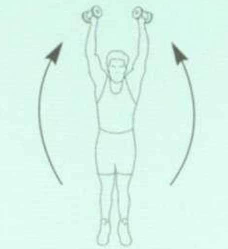


Anterior portion



Posterior portion

Strengthening exercises



Lateral dumb-bell raises

Upright vertical rowing

Bench press

Self stretches

Flex the arm across to the other shoulder. Hold the raised elbow with the opposite hand and pull the elbow backward.

Keep your arms and torso straight and slowly bend your knees.

Greek, *delta*, fourth letter of Greek alphabet (shaped like a triangle).

The deltoid is composed of three parts; anterior, middle and posterior. Only the middle part is multipennate, probably because its mechanical disadvantage of abduction of the shoulder joint requires extra strength.

Origin
Clavicle, acromion process and spine of scapula.

Insertion
Deltoid tuberosity situated half way down the lateral surface of the shaft of the humerus.

Action
Anterior fibres: flex and medially rotate the humerus.
Middle fibres: abduct the humerus at the shoulder joint (only after the movement has been initiated by supraspinatus).
Posterior fibres: extend and laterally rotate the humerus.

Nerve
Axillary nerve, C**5**, **6**, from the posterior cord of the brachial plexus.

Basic functional movement
Examples: Reaching for something out to the side. Raising the arm to wave.

Indications
Post trauma rehabilitation. Shoulder pain. Decreased range of motion, esp. in abduction.

Referred pain patterns
Generally localized to the trigger point and within a 5–10cm zone.

Differential diagnosis
Impingement syndromes. Subacromial bursitis. C5 radiculopathy. Rotator cuff tendinopathy. Osteoarthritis of glenohumeral or acromioclavicular joint.

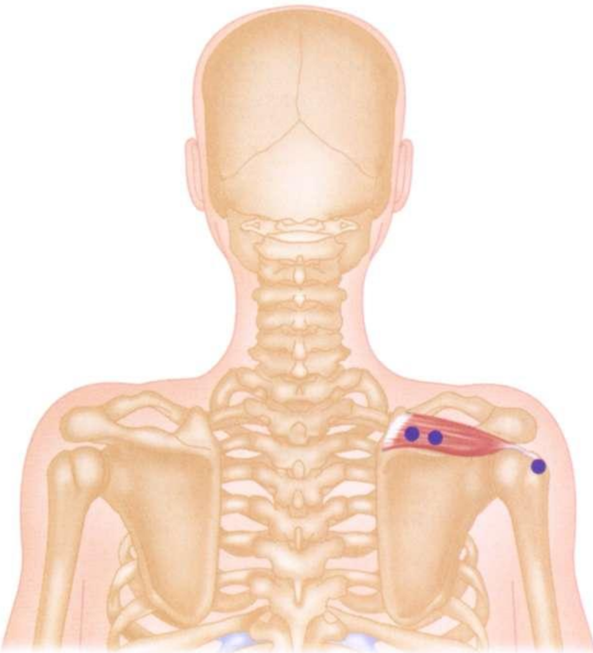
Also consider
Supraspinatus. Infraspinatus. Biceps brachii. Teres minor. Subscapularis. Pectoralis major (clavicular head).

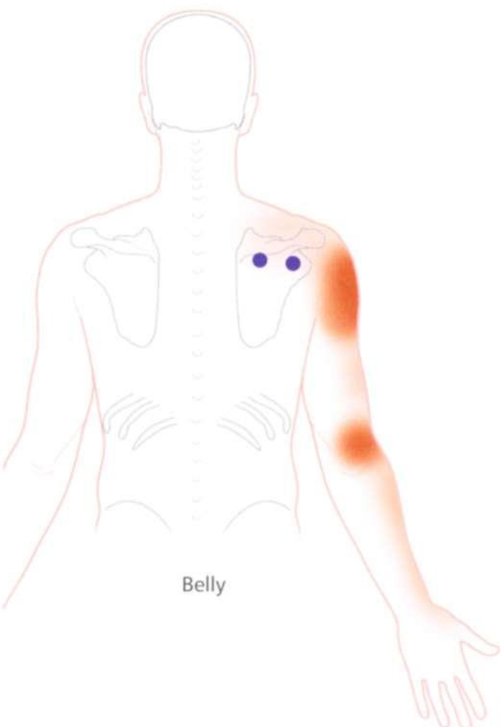
Advice to patient
Stretching (daily). Drive vehicle with two hands. Examine technique with overhead sports such as tennis.

Techniques

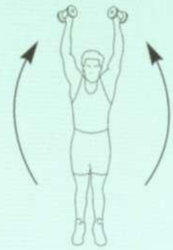
Spray and stretch	✓		Dry needling	✓	✓
Injections	✓		Trigger point release	✓	✓

SUPRASPINATUS





Strengthening exercises



Lateral dumb-bell raises

Seated rowing

Self stretch

Flex the arm across to the other shoulder. Hold the raised elbow with the opposite hand and pull the elbow backward.

Latin, *supra*, above; *spina*, spine.

A member of the *rotator cuff*, which comprise: *supraspinatus, infraspinatus, teres minor* and *subscapularis*. The rotator cuff helps hold the head of the humerus in contact with the glenoid cavity (fossa, socket) of the scapula during movements of the shoulder, thus helping to prevent dislocation of the joint.

Origin
Supraspinous fossa of scapula.

Insertion
Upper aspect of the greater tubercle of the humerus. Capsule of shoulder joint.

Action
Initiates the process of abduction at the shoulder joint, so that the deltoid can take over at the later stages of abduction.

Nerve
Suprascapular nerve, C**4**, **5**, **6**, from the upper trunk of the brachial plexus.

Basic functional movement
Example: Holding shopping bag away from side of body.

Indications
Loss of power in abduction. Painful arc syndrome. Night pain/ache. Subacromial bursitis. Rotator cuff tendinopathy.

Referred pain patterns
Belly: deep ache in regimental badge area (4–6cm). Elipse leads to zone of pain in lateral epicondyle/radial head. Diffuse pain into lateral forearm.
Insertion: localized zone of pain 5–8cm over deltoideus.

Differential diagnosis
Phase 1 capsulitis. C5–C6 radiculopathy. Subacromial bursitis (adhesive). Calcific tendonitis. Calcium boils. Rotator cuff tendinopathy.

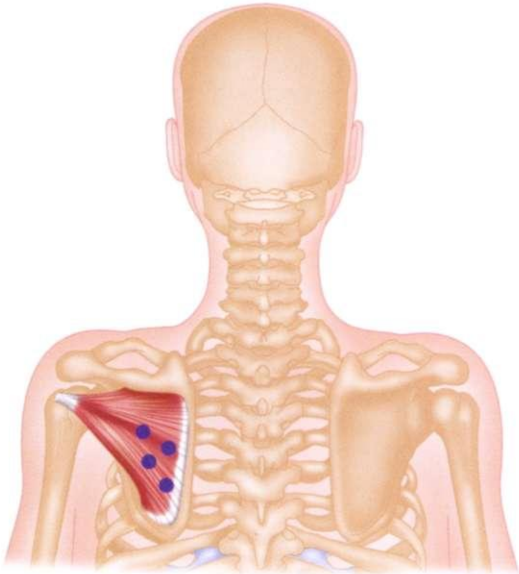
Also consider
Subscapularis. Infraspinatus. Deltoideus. Trapezius. Latissimus dorsi.

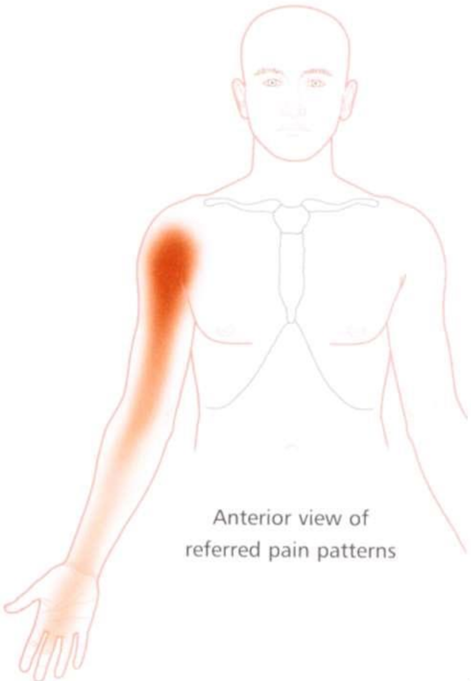
Advice to patient
Avoid heavy carrying. Avoid sleeping with arms above head. Use heat/hot showers.

Techniques

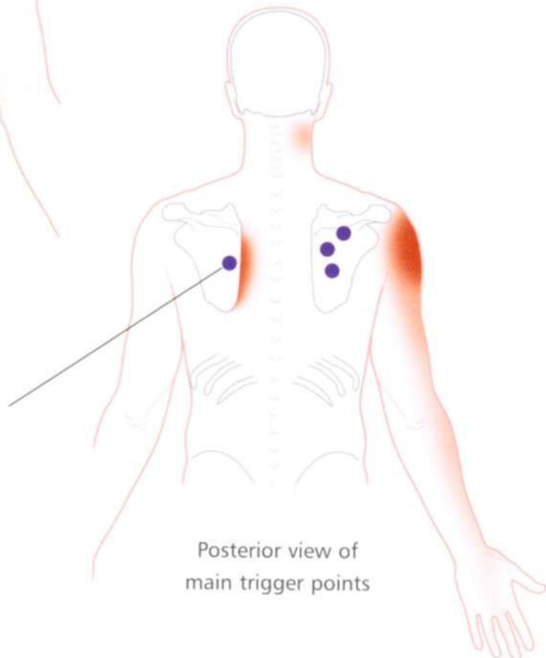
Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

INFRASPINATUS





Anterior view of
referred pain patterns



Posterior view of
main trigger points

Strengthening exercise

Seated rowing
(limited effect)

Self stretches

Hold doorknob and gently step away from the door.

Raise one arm to shoulder height. Flex the arm across to the other shoulder. Hold the raised elbow with the opposite hand and pull the elbow backward.

INFRASPINATUS

Latin, *infra,* below; *spina,* spine.

A member of the *rotator cuff,* which comprise: *supraspinatus, infraspinatus, teres minor* and *subscapularis.* The rotator cuff helps hold the head of the humerus in contact with the glenoid cavity (fossa, socket) of the scapula during movements of the shoulder, thus helping to prevent dislocation of the joint.

Origin

Infraspinous fossa of the scapula.

Insertion

Middle facet on the greater tubercle of humerus. Capsule of shoulder joint.

Action

As a rotator cuff, helps prevent posterior dislocation of the shoulder joint. Laterally rotates humerus.

Nerve

Suprascapular nerve, C(4), 5, 6, from the upper trunk of the brachial plexus.

Basic functional movement

Example: Brushing back of hair.

Indications

Decreased range of motion in the Apley's scratch test (behind back). Hemiplegia. Rotator cuff tendinopathy. Frozen shoulder syndrome.

Referred pain patterns

Middle/upper cervical spine: deep anterior shoulder joint zone of 3-4cm in region of long head of biceps brachii radiating into biceps belly, then into forearm - diffuse symptoms in median nerve distribution.

Medial/scapula: to medial border of scapula.

Differential diagnosis

Biceps tendonitis. C5-C6 neuropathy. Suprascapular nerve dysfunction.

Also consider

Infraspinatus. Subscapularis. Levator scapulae. Pectoralis minor/major. Long head of biceps brachii. Biceps brachii. Anterior deltoideus. Teres major. Latissimus dorsi.

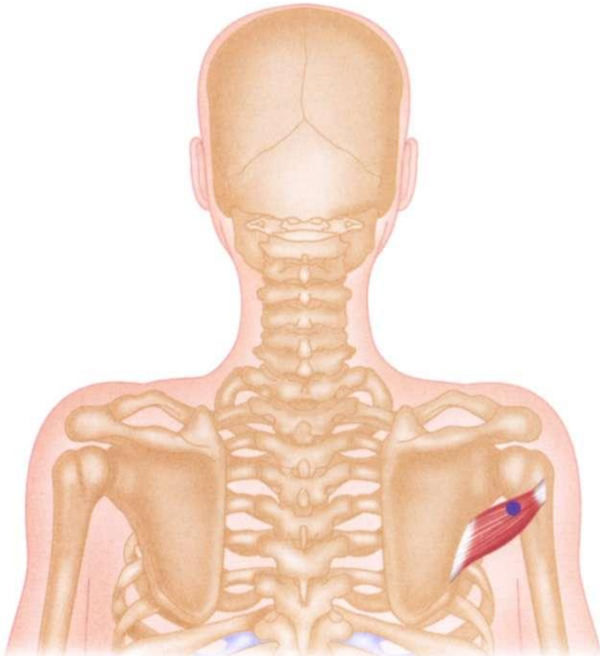
Advice to patient

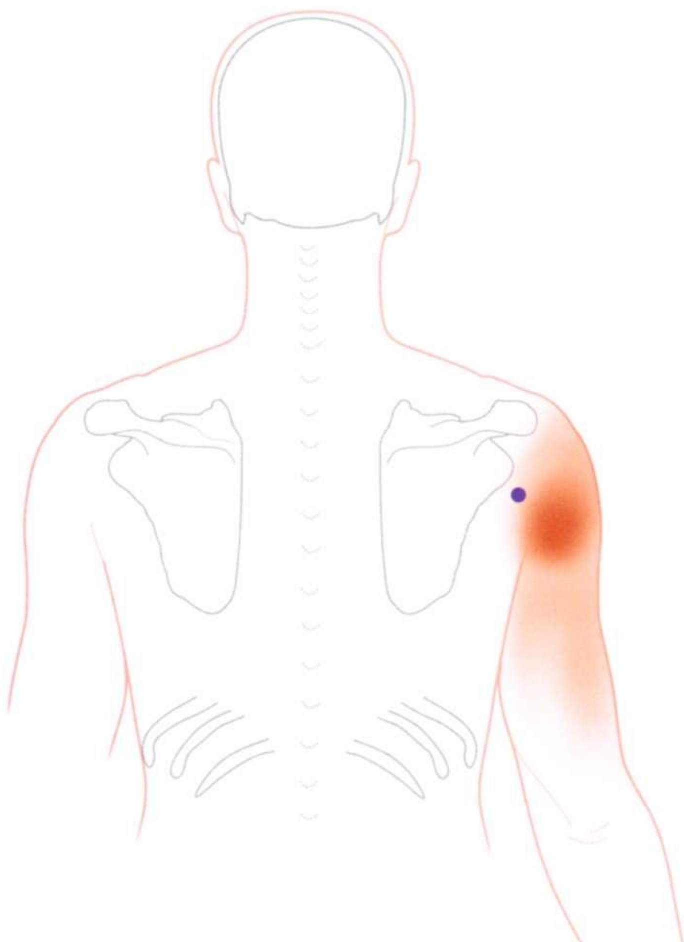
Avoid reaching into back seat of car. Heat can be beneficial. Support arm on pillow for relief.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

TERES MINOR





Strengthening exercise

Seated rowing (limited effect)

Self stretches

Hold doorknob and gently step away from the door.

Flex the arm across to the other shoulder. Hold the raised elbow with the opposite hand and pull the elbow backward.

TERES MINOR

Latin, *teres,* rounded; finely shaped; *minor,* small.

A member of the *rotator cuff,* which comprise: *supraspinatus, infraspinatus, teres minor* and *subscapularis.* The rotator cuff helps hold the head of the humerus in contact with the glenoid cavity (fossa, socket) of the scapula during movements of the shoulder, thus helping to prevent dislocation of the joint.

Origin

Upper two-thirds of the lateral border of the dorsal surface of scapula.

Insertion

Lower facet on the greater tubercle of humerus. Capsule of shoulder joint.

Action

As a rotator cuff, helps prevent upward dislocation of the shoulder joint. Laterally rotates humerus. Weakly adducts humerus.

Nerve

Axillary nerve, C5, 6, from the posterior cord of the brachial plexus.

Basic functional movement

Example: Brushing back of hair.

Indications

Shoulder pain; especially posterior. Frozen shoulder syndrome. Rotator cuff rehabilitation. Subacromial bursitis. Biceps tendonitis.

Referred pain patterns

Localized zone (2-5cm) of intense pain in regimental badge area, with a more diffuse elliptical zone of pain spreading in the postero-lateral upper extremity (above the elbow).

Differential diagnosis

C8-T1 radiculopathy. Rotator cuff tendinopathy. Shoulder-wrist-hand syndrome. Subacromial/deltoid bursitis. Shoulder impingement syndromes (painful arc). Acromioclavicular joint dysfunction.

Also consider

Infraspinatus.

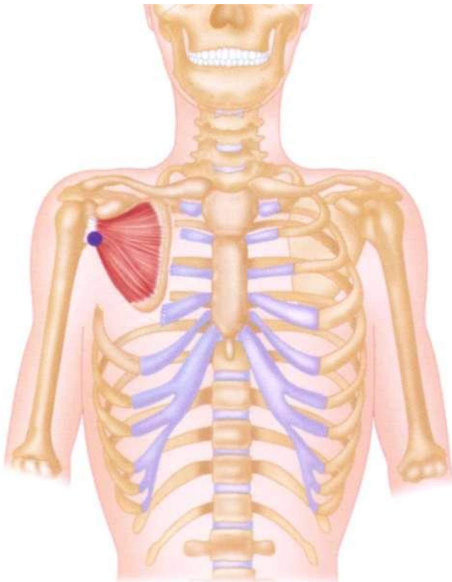
Advice to patient

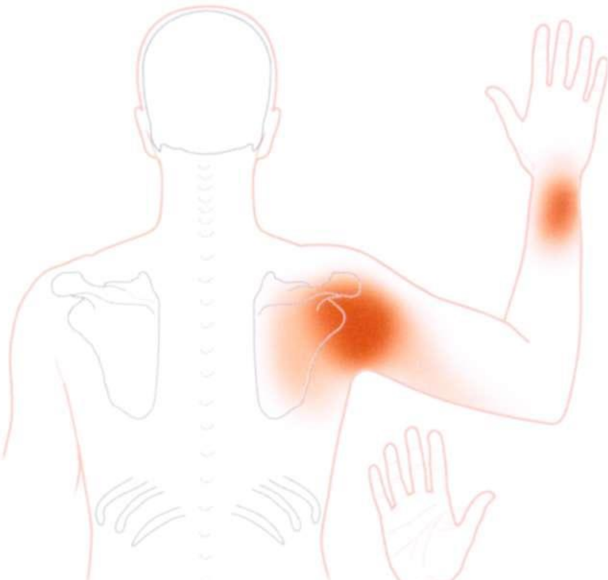
Posture (round shouldered). Arm position during sleep. Avoid overload. Self stretch.

Techniques

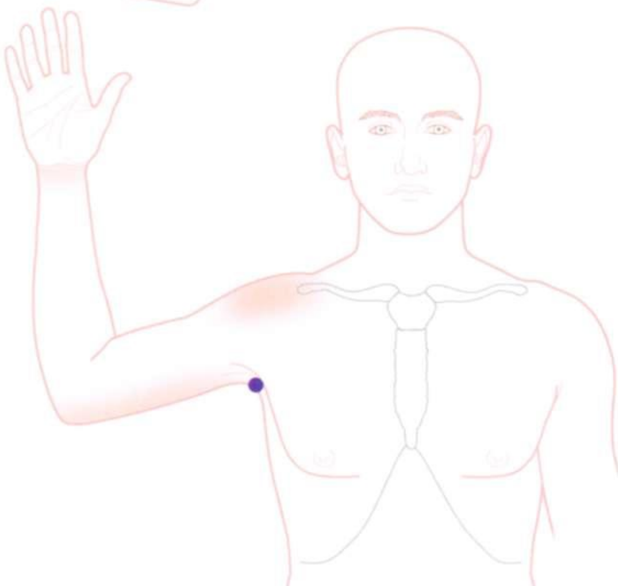
Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

SUBSCAPULARIS





Posterior view of referred pain patterns



Strengthening exercise

Seated rowing (limited effect)

Self stretch

Laterally rotate humerus with elbow bent 90°, and anchor hand against door frame.

SUBSCAPULARIS

Latin, *sub,* under; *scapular,* pertaining to the scapula.

A member of the *rotator cuff,* which comprise: *supraspinatus, infraspinatus, teres minor* and *subscapularis.* The rotator cuff helps hold the head of the humerus in contact with the glenoid cavity (fossa, socket) of the scapula during movements of the shoulder, thus helping to prevent dislocation of the joint. The subscapularis constitutes the greater part of the posterior wall of the axilla.

Origin
Subscapular fossa and the groove along the lateral border of the anterior surface of scapula.

Insertion
Lesser tubercle of humerus. Capsule of shoulder joint.

Action
As a rotator cuff, stabilizes glenohumeral joint, mainly preventing the head of the humerus being pulled upwards by the deltoideus, biceps and long head of triceps. Medially rotates humerus.

Nerve
Upper and lower subscapular nerves, C5, 6, 7, from the posterior cord of the brachial plexus.

Basic functional movement
Example: Reaching into your back pocket.

Indications
Rotator cuff tendinopathy, adhesive capsulitis (frozen shoulder) decreased. Abduction, decreased external rotation.

Referred pain patterns
Axillary trigger point: strong zone (5-8cm) of pain in posterior glenohumeral joint, with a peripheral diffuse zone. Also radiating down posterior aspect of arm and antero-posterior carpals of wrist.

Differential diagnosis
Impingement syndromes. Rotator cuff dysfunctions. Thoracic outlet syndromes. Cervical radiculopathy (C7). Cardiopulmonary pathology.

Also consider

Infraspinatus. Pectoralis minor.

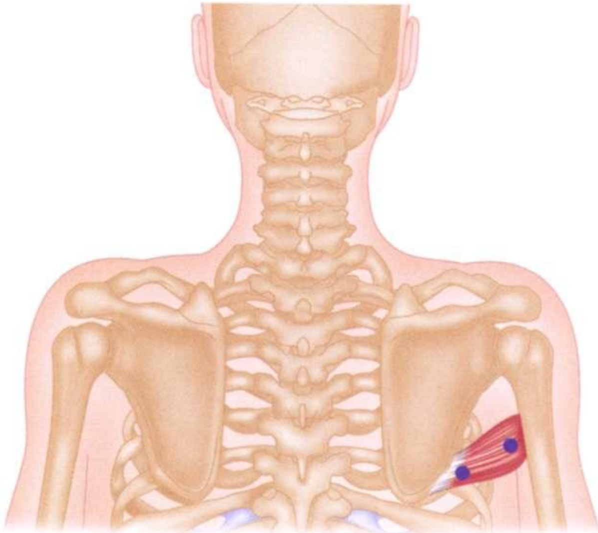
Advice to patient

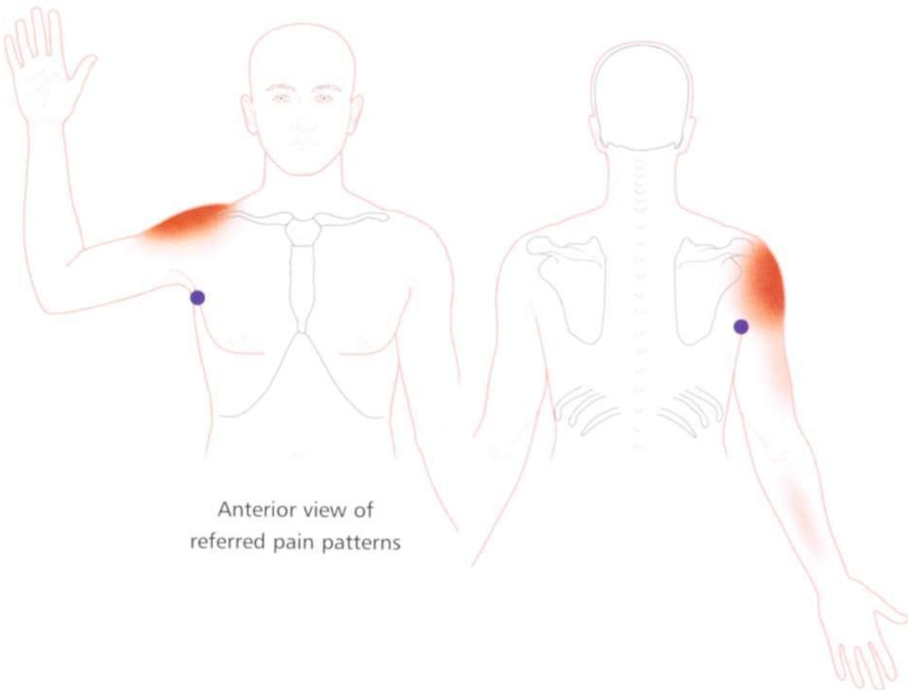
Round shouldered postures. Walking posture.

Techniques

Spray and stretch	✓		Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

TERES MAJOR

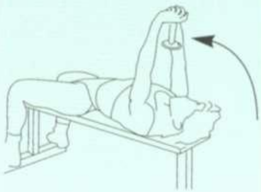




Anterior view of referred pain patterns

Strengthening exercises

Seated rowing



Pull-overs

Pulley shoulder adduction

Self stretches

Flex the arm across to the other shoulder. Hold the raised elbow with the opposite hand and pull the elbow backward.

Keep your arms and torso straight and slowly bend your knees.

TERES MAJOR

Latin, *teres,* rounded, finely shaped; *major,* large.

The teres major, along with the tendon of latissimus dorsi, which passes around it, and the subscapularis, forms the posterior fold of the axilla.

Origin

Oval area on the lower third of the posterior surface of the lateral border of the scapula.

Insertion

Medial lip of the intertubercular sulcus (bicipital groove) of humerus.

Action

Adducts humerus. Medially rotates humerus. Extends humerus from the flexed position.

Nerve

Lower subscapular nerve, C5, 6, 7, from the posterior cord of the brachial plexus.

Basic functional movement

Example: Reaching into your back pocket.

Indications

Frozen shoulder syndrome. Pain on reaching above the head. Slight pain on rest. Pain when driving. Impingement syndromes.

Referred pain patterns

Deep pain into posterior glenohumeral joint and an oval zone (5-10cm) of pain in posterior deltoid area (can radiate strongly to long head of biceps brachii). Diffuse pain into dorsum of forearm.

Differential diagnosis

Impingement syndromes. Rotator cuff tendinopathy. Cervical neuropatterns (C6-C7). Thoracic outlet syndrome. Supraspinatus calcification.

Also consider

Rhomboideus. Long head of triceps brachii. Latissimus dorsi. Teres minor. Pectoralis minor. Posterior deltoideus.

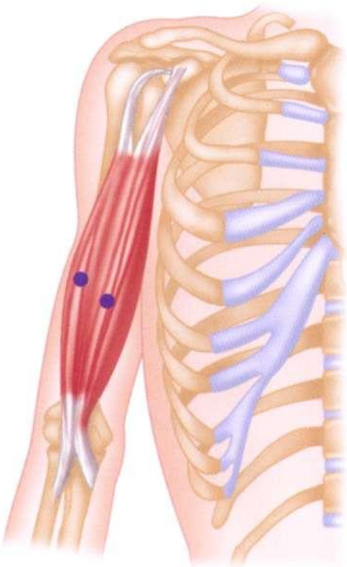
Advice to patient

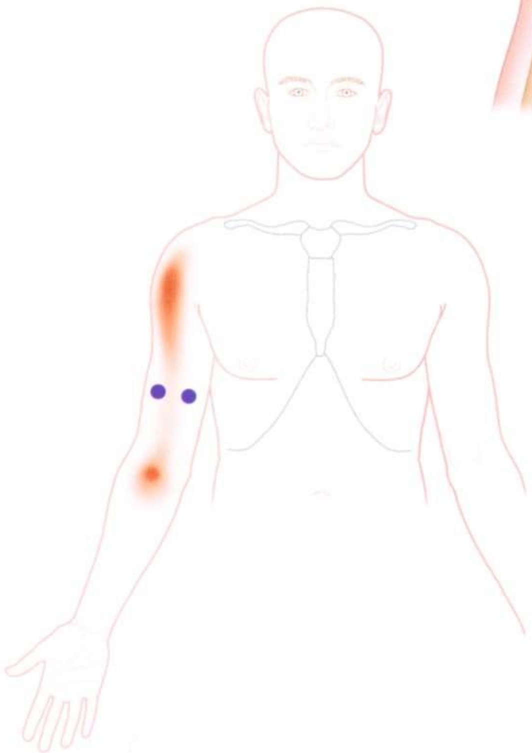
Use heat/warmth, especially hot showers. Avoid heavy steering (wheels). Monitor gym activities. Use a pillow at night (to hug). Plenty of self stretching.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

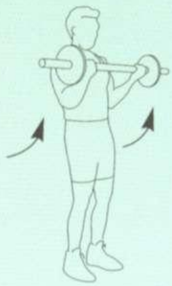
BICEPS BRACHII





Posterior view of referred pain patterns

Strengthening exercises

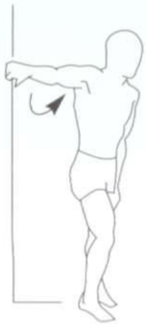


Biceps curl

Chin-ups

Lat. pull downs

Self stretches



BICEPS BRACHII

Latin, *biceps,* two-headed muscle; *brachii,* of the arm.

Biceps brachii operates over three joints. It has two tendinous heads at its origin and two tendinous insertions. Occasionally it has a third head, originating at the insertion of coracobrachialis. The short head forms part of the lateral wall of the axilla, along with coracobrachialis and the humerus.

Origin
Short head: tip of corocoid process of scapula.
Long head: supraglenoid tubercle of scapula.

Insertion
Posterior part of radial tuberosity.
Bicipital aponeurosis, which leads into the deep fascia on medial aspect of forearm.

Action
Flexes elbow joint. Supinates forearm. (It has been described as the muscle that puts in the corkscrew and pulls out the cork.) Weakly flexes arm at the shoulder joint.

Nerve
Musculocutaneous nerve, C5, 6.

Basic functional movement
Examples: Picking up an object. Bringing food to mouth.

Indications
Anterior shoulder pain with decreased arm extension. Biceps tendonitis. Reduced extension of arms. Reduced Apley's scratch test manoeuvre. Frozen shoulder syndrome.

Referred pain patterns
Localized pain with intense ellipse superficially located over the long head tendon. Referred pain into anterior cubital fossa.

Differential diagnosis
Gleno-humeral osteoarthritis. Acromioclavicular osteoarthritis. Supscapularis. Infraspinatus. Subacromial bursitis. Biceps tendonitis. C5 radiculopathy.

Also consider

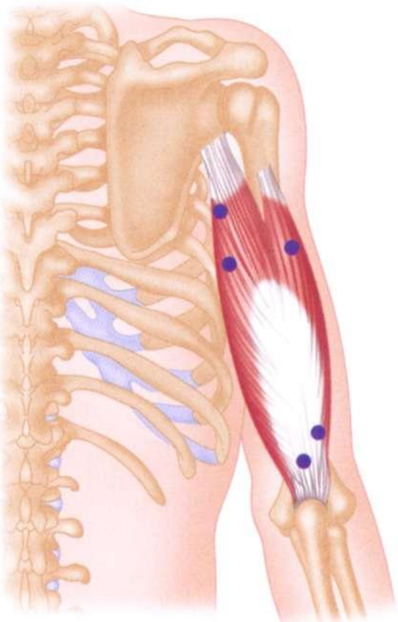
Subscapularis. Infraspinatus. Brachialis. Supinator. Upper trapezius. Coracobrachialis. Triceps brachii.

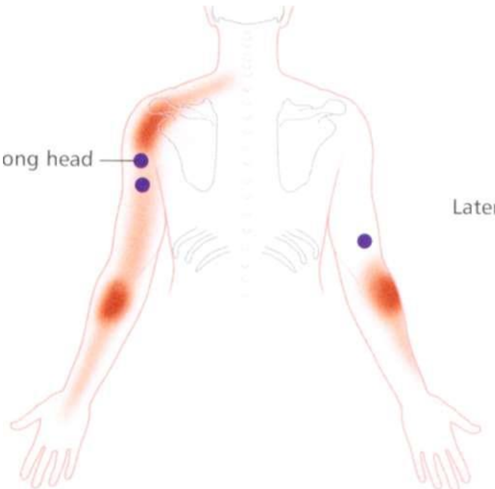
Advice to patient
Exercise antagonists (triceps brachii). Reduce load on biceps brachii when carrying with a bent arm. Sleeping position. Work posture.

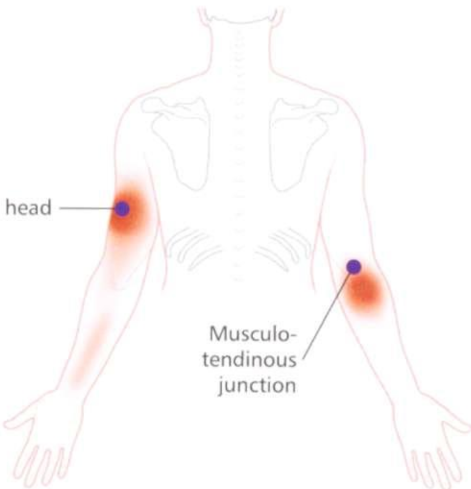
Techniques

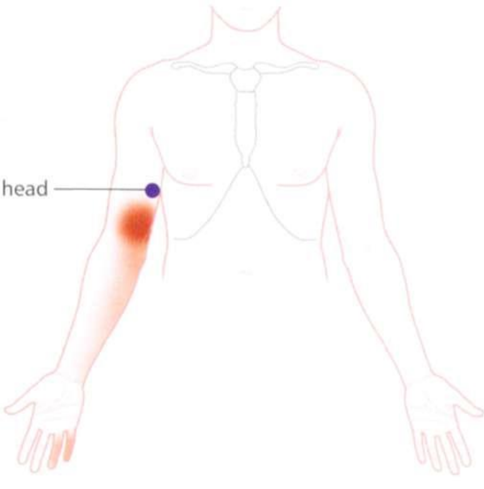
Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

TRICEPS BRACHII



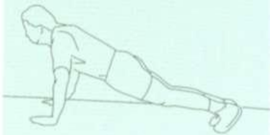




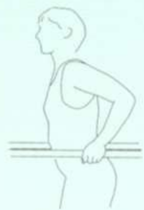


Strengthening exercises

Bench press



Push-ups



Dips

Self stretches

Pull your hands towards each other. Most effective when the raised elbow is against a wall.

Keep your head up and elbow as far back as is comfortable, without hollowing your lower back.

TRICEPS BRACHII

Latin, *triceps,* three-headed muscle; *brachii,* of the arm.

The triceps originates from three heads and is the only muscle on the back of the arm.

Origin

Long head: infraglenoid tubercle of the scapula.
Lateral head: upper half of posterior surface of shaft of humerus (above and lateral to the radial groove).
Medial head: lower half of posterior surface of shaft of humerus (below and medial to the radial groove).

Insertion

Posterior part of the olecranon process of the ulna.

Action

Extends (straightens) elbow joint. Long head can adduct the humerus and extend it from the flexed position. Stabilizes shoulder joint.

Nerve

Radial nerve, C6, 7, 8, T1.

Basic functional movement

Examples: Throwing objects. Pushing a door shut.

Indications

Golfer's elbow. Tennis elbow. Arthritis of elbow and/or shoulder. Chronic use of crutches/walking stick. Repetitive mechanical activities of arms. Raquet sports.

Referred pain patterns

a) Long head: pain at supero-lateral border of shoulder radiating diffusely down posterior upper extremity with a strong zone of pain around olecranon process, and then vaguely into the posterior forearm; b) medial head: 5cm patch of pain in medial epicondyle radiating along medial border of forearm to digits 4 and 5; c) lateral head: strong midline pain into upper extremity radiating vaguely into posterior forearm.

Differential diagnosis

Radial nerve injury. Ulnar neuropathy. C7 neuropathy (cervical disc).

Also consider

Teres minor. Teres major. Latissimus dorsi. Anconeus. Supinator. Brachioradialis. Extensor carpi radialis Iongus.

Advice to patient

Review arm positions on repetitive manual work. Take regular breaks. New tennis raquet or widen grip. Avoid overhead activities.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

Muscles of the Forearm and Hand

7

Pronator Teres

Palmaris Longus

Wrist Flexors

Brachioradialis

Wrist Extensors

Extensor Digitorum

Supinator

Opponens Pollicis/
Adductor Pollicis

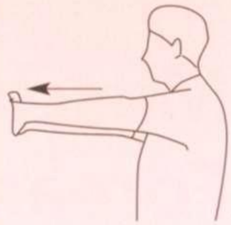
Small Hand Muscles

PRONATOR TERES

Strengthening exercise

Pronation with strength bar

Self stretches



Weight of stick increases supination via gravity

Latin, *pronate*, bent forward; *teres*, rounded, finely shaped.

Origin
Humeral head: lower third of medial supracondylar ridge and the common flexor origin on the anterior aspect of the medial epicondyle of humerus.
Ulnar head: medial border of the coronoid process of the ulna.

Insertion
Mid-lateral surface of radius (pronator tuberosity).

Action
Pronates forearm. Assists flexion of elbow joint.

Nerve
Median nerve, C**6**, 7.

Basic functional movement
Examples: Pouring liquid from a container. Turning a doorknob.

Indications
Pain in wrist (lateral). Pain on supination. Hairdressers (overuse of scissors). Inability to 'cup' hands together, esp. 'cupping' and extension of the wrist. Shoulder pain (compensatory). Wrist pain on driving.

Referred pain patterns
Strong pain 'deep' into palmar region of the wrist (lateral), radiating up the antero-lateral forearm.

Differential diagnosis
De Quervain's tenosynovitis. Carpal tunnel swelling. Osteoarthritis of proximal thumb joint. Distal radio-ulnar discopathy. Epicondylitis.

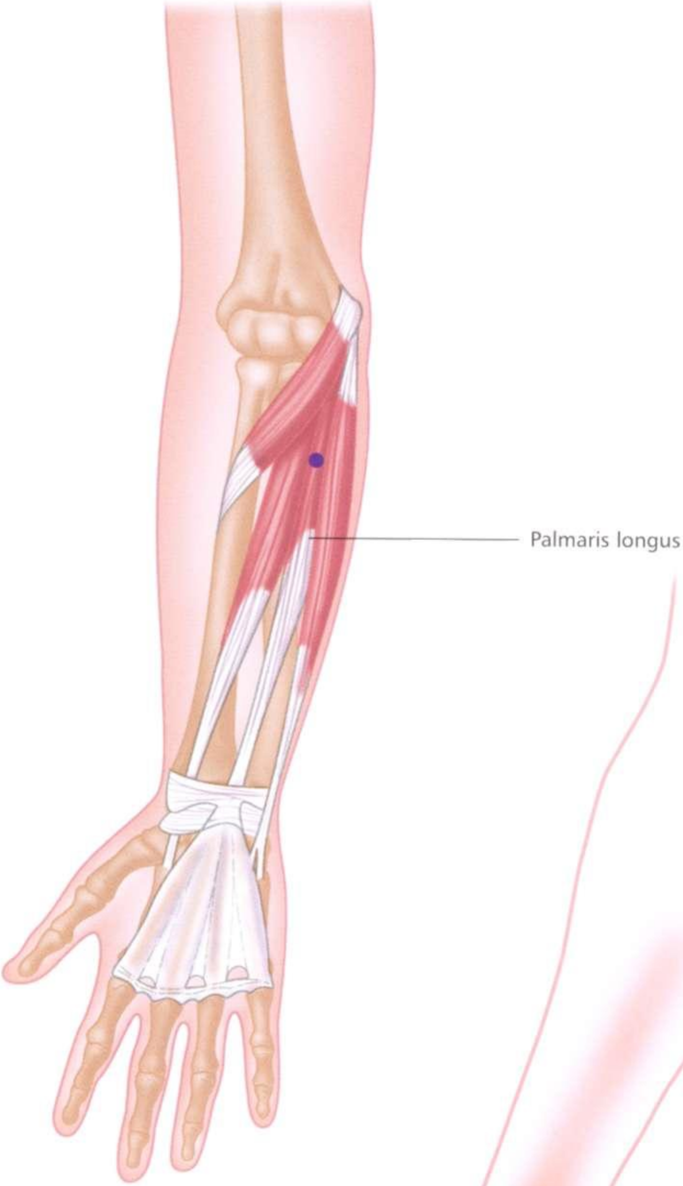
Also consider
Finger flexors. Scalenes. Pectoralis major.

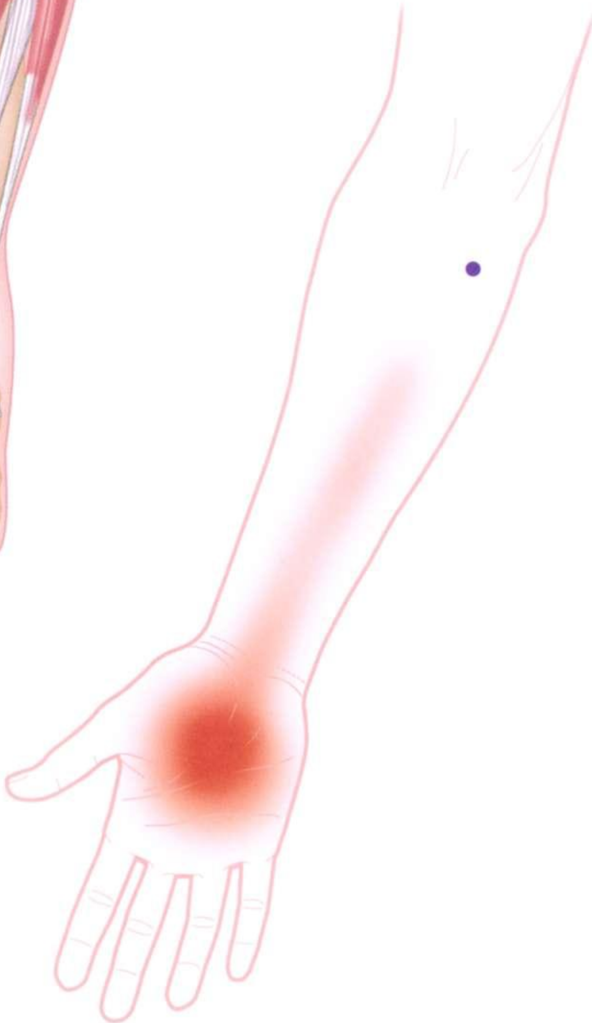
Advice to patient
Stretching techniques. Self massage. Change grip and techniques in tennis/golf. Review driving posture and grip on steering wheel.

Techniques

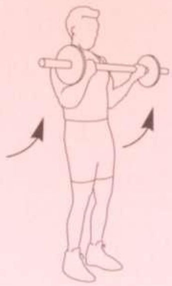
Spray and stretch	✓ ✓	Dry needling	✓ ✓
Injections	✓ ✓	Trigger point release	✓ ✓

PALMARIS LONGUS





Strengthening exercises



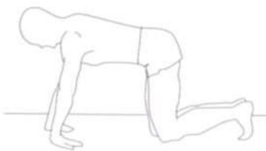
Biceps curl

Wrist rolling (palm up)

Wrist curl

Self stretches

Use one hand to gently lever the other wrist into extension.



Latin, *palmaris*, palma, palm; *longus*, long.

Part of the superficial layer, which also includes: pronator teres, flexor carpi radialis and flexor carpi ulnaris. The palmaris longus muscle is absent in 13% of the population.

Origin
Common flexor origin on the anterior aspect of the medial epicondyle of humerus.

Insertion
Superficial (front) surface of flexor retinaculum and apex of the palmar aponeurosis.

Action
Flexes the wrist. Tenses the palmar fascia.

Nerve
Median nerve, C(6), **7**, **8**, T1.

Basic functional movement
Examples: Grasping a small ball. Cupping the palm to drink from the hand.

Indications
Pain and 'soreness' in palm of hand. Tenderness in hand / palm. Functional loss of power in grip. Tennis elbow.

Referred pain patterns
Diffuse pain in anterior forearm; intense pain zone 2–3cm in palm of hand surrounded by a superficial zone of prickling and needle-like sensations.

Differential diagnosis
Neurogenic pain. Dupuytren's contracture. Carpal tunnel syndrome. Complex regional pain syndrome (reflex sympathetic dystrophy). Scleroderma. Dermatomyositis.

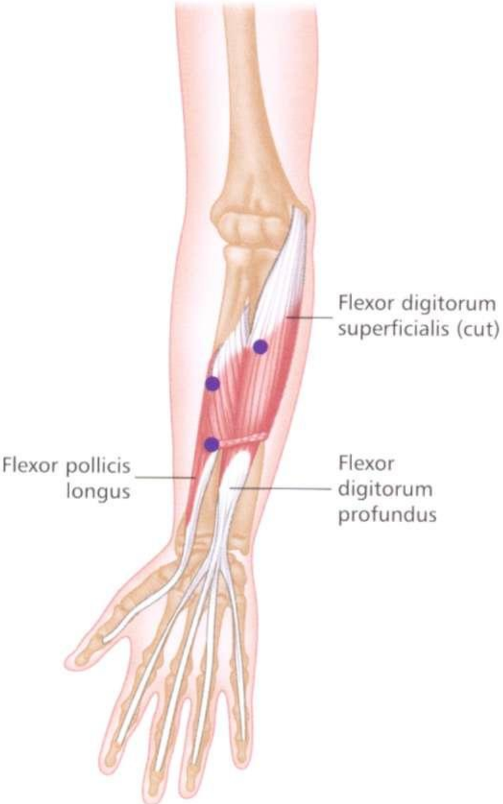
Also consider
Flexor carpi radialis. Brachialis. Pronator teres. Wrist joints (carpals). Triceps brachii.

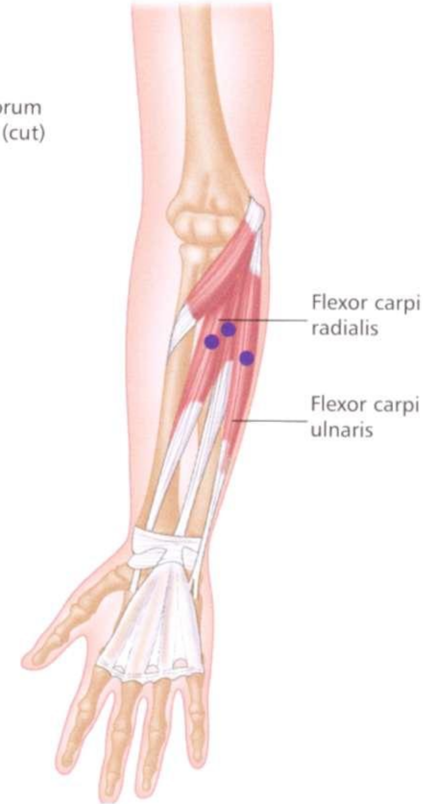
Advice to patient
Avoid prolonged 'gripping', especially of power tools or during massage therapy. Stretching and heat. Regular breaks.

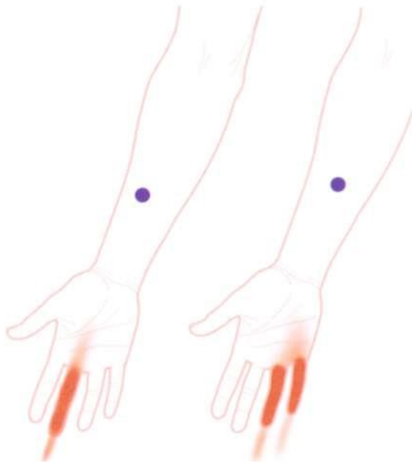
Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

WRIST FLEXORS

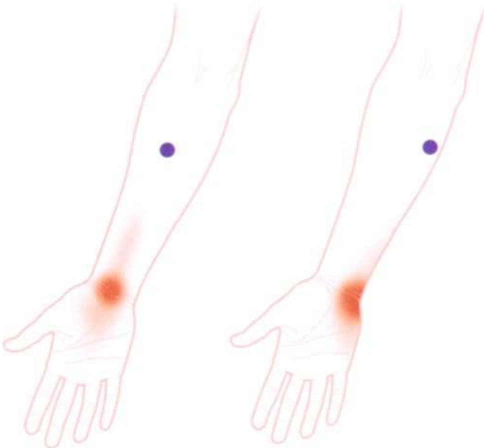






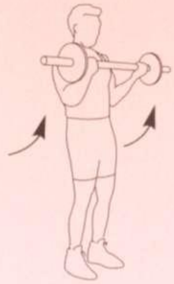
(radial head) (humeral head)

Flexor digitorum superficialis and profundus



Flexor carpi radialis Flexor carpi ulnaris

Strengthening exercises



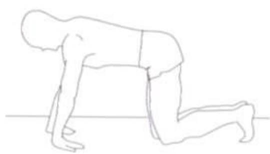
Biceps curl

Wrist rolling (palm up)

Wrist curl

Self stretches

Use one hand to gently lever the other wrist into extension.



WRIST FLEXORS

Latin, *flex*, to bend; *carpi*, of the wrist; *radius*, staff, spoke of wheel; *ulnaris*, of the elbow / arm; *digit*, finger; *superficialis*, on the surface; *profundus*, deep.

Flexor carpi radialis, flexor carpi ulnaris, flexor digitorum superficialis and flexor digitorum profundus.

Origin
Common flexor origin on the anterior aspect of the medial epicondyle of humerus (i.e. lower medial end of humerus).

Insertion
Carpals, metacarpals and phalanges.

Action
Flex the wrist joint. (Flexor carpi radialis also abducts the wrist; flexor carpi ulnaris also adducts the wrist).

Nerve
Median nerve, C6, **7**, **8**, T1.

Basic functional movement
Examples: Pulling rope in towards you. Wielding an axe or hammer. Pouring liquid from bottle. Turning door handle.

Indications
Hand, wrist and finger pain. Trigger finger. Cutting with scissors. Gripping. Golfer's elbow. Repetitive strain injury. Hairdressers. Turning hand to cupping action. Tense finger flexors.

Referred pain patterns
Individual muscles refer to the lower arm, wrist, hand, and fingers (*see* diagrams).

Differential diagnosis
Ulnar neuritis. Cervical neuropathies. Carpal bone dysfunctions. De Quervain's tenosynovitis. Repetitive strain injury. Osteo- and rheumatoid arthritis. Radio-ulnar disc (distal) problems. Carpal tunnel syndrome. Medial epicondylitis.

Also consider
Shoulder muscles. Upper arm muscles. Scalenes. Flexor pollicis longus.

Advice to patient
Avoid prolonged gripping. Avoid repeated twisting (screwdriver). Change golf grip. Take regular breaks. Regular finger stretching.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓		Trigger point release	✓	✓

BRACHIORADIALIS

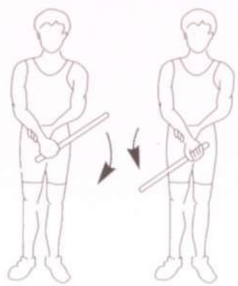
Strengthening exercises

Biceps curl

Chin-ups

Upright rowing

Self stretch



Pronate and supinate forearm.

BRACHIORADIALIS

Latin, *brachial*, relating to the arm; *radius*, staff, spoke of wheel.

Part of the superficial group. The brachioradialis forms the lateral border of the cubital fossa. The muscle belly is prominent when working against resistance.

Origin
Upper two-thirds of the anterior aspect of lateral supracondylar ridge of humerus (i.e. lateral part of shaft of humerus, 5–7.5cm (2–3") above elbow joint).

Insertion
Lower lateral end of radius, just above the styloid process.

Action
Flexes elbow joint. Assists in pronating and supinating forearm when these movements are resisted.

Nerve
Radial nerve, C**5**, **6**.

Basic functional movement
Example: Turning a corkscrew.

Indications
Elbow pain. Pain in thumb (dorsum). Tennis elbow (lateral epicondylitis). Weakness in grip. Repetitive strain injury.

Referred pain patterns
Lateral epicondyle area 3–4cm patch with vague arm pain (radius border), localizing into strong pain dorsum of thumb.

Differential diagnosis
De Quervain's tenosynovitis. Osteoarthritis of thumb (trapezium).

Also consider
Biceps brachiii. Brachialis. Extensor carpi radialis longus, and brevis. Supinator. Extensor digitorum.

Advice to patient
Avoid long standing. Carrying (briefcases). Take regular breaks when typing. Use wrist supports. Change grip on tennis raquet.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

WRIST EXTENSORS

Extensor carpi radialis longus

Extensor carpi radialis brevis

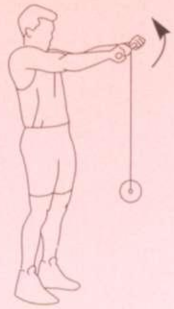
Extensor carpi ulnaris

Extensor carpi radialis longus

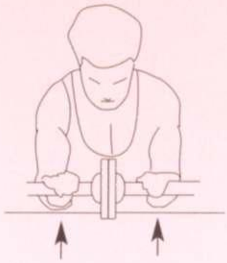
Extensor carpi radialis brevis

Extensor carpi ulnaris

Strengthening exercises



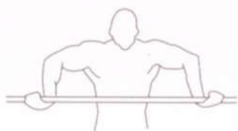
Wrist roller (palms down)



Reverse wrist curl

Self stretches

Use lower hand to gently lever the other wrist into flexion.



WRIST EXTENSORS

Latin, *extensor*, to extend; *carpi*, of the wrist; *radius*, staff, spoke of wheel; *longus*, long; *brevis*, short; *ulnaris*, of the elbow.

Includes extensor carpi radialis longus and brevis, and extensor carpi ulnaris.

Origin
Common extensor tendon from lateral epicondyle of humerus (i.e. lower lateral end of humerus).

Insertion
Dorsal surface of metacarpal bones.

Action
Extends the wrist (extensor carpi radialis and brevis also abduct the wrist; extensor carpi ulnaris also adducts the wrist).

Nerve
Radialis longus and brevis: radial nerve, C5, **6**, **7**, 8.
Extensor carpi ulnaris: deep radial (posterior interosseous) nerve, C5, 6, **7**, **8**.

Basic functional movement
Examples: Kneading dough. Typing. Cleaning windows.

Indications
Forearm, elbow, wrist and hand pain. Finger stiffness. Painful/weak grip. Tennis elbow. Pain on gripping and twisting, seen in musicians/athletes/long distance drivers. Loss of control (fine) on gripping activities.

Referred pain patterns
Extensor carpi radialis longus: strong 2–3cm zone over lateral epicondyle, diffusely radiating to dorsum of hand above thumb.
Extensor carpi radialis brevis: strong zone of pain 3–5cm over dorsum of hand.
Extensor carpi ulnaris: strong, localized, specific referral to dorsal ulnar surface of hand and bulk of wrist.

Differential diagnosis
Epicondylitis. C5–C6 radiculopathy. De Quervain's tenosynovitis. Articular dysfunction of wrist. Osteoarthritis. Carpal tunnel syndrome.

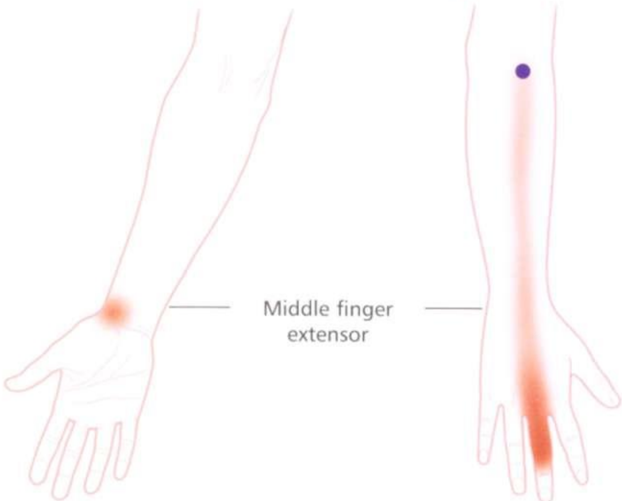
Also consider
Supinator. Brachioradialis. Extensor digitorum. Triceps brachii. Biceps brachii. Anconeus.

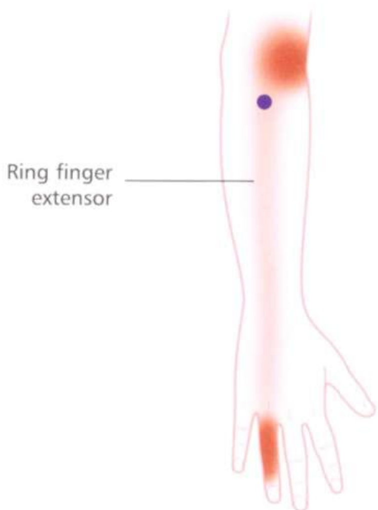
Advice to patient
Avoid 'over' gripping in sports. Take regular breaks/rests when gardening/driving. Explore occupational factors/ergonomics. Home stretch and exercises. Change grip width in golf/tennis. Use of wrist splints.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	

EXTENSOR DIGITORUM



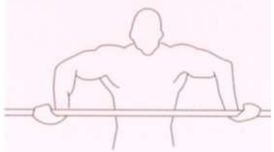


Strengthening exercise

Exer. ring finger extension

Self stretches

Use one hand to gently lever the other wrist and therefore fingers into extension.



EXTENSOR DIGITORUM

Latin, *extensor*, to extend; *digit*, finger.

Part of the superficial group. Each tendon of extensor digitorum, over each metacarpophalangeal joint, forms a triangular membranous sheet called the *extensor hood* or *extensor expansion*, into which insert the lumbricales and interossei of the hand. Extensor digiti minimi and extensor indicis also insert into the extensor expansion.

Origin
Common extensor tendon from lateral epicondyle of humerus (i.e. lower lateral end of humerus).

Insertion
Dorsal surfaces of all the phalanges of the four fingers.

Action
Extends the fingers (metacarpophalangeal and interphalangeal joints). Assists abduction (divergence) of fingers away from the middle finger.

Nerve
Deep radial (posterior interosseous) nerve, C6, **7**, **8**.

Basic functional movement
Example: Letting go of objects held in the hand.

Indications
Finger, hand and wrist pain. Elbow pain. Stiffness and pain in fingers. Weakness in fingers (decreased grip). Tennis elbow. Pain on forceful gripping, often seen in professional musicians (esp. guitarists).

Referred pain patterns
Diffuse pain from forearm becoming more intense in the appropriate finger (proximal metacarpal). Pain in lateral epicondyle.

Differential diagnosis
Radiculopathy (cervical). Epicondylitis (tennis elbow). Osteoarthritis of fingers. De Quervain's tenosynovitis. Mechanical wrist pain (carpals).

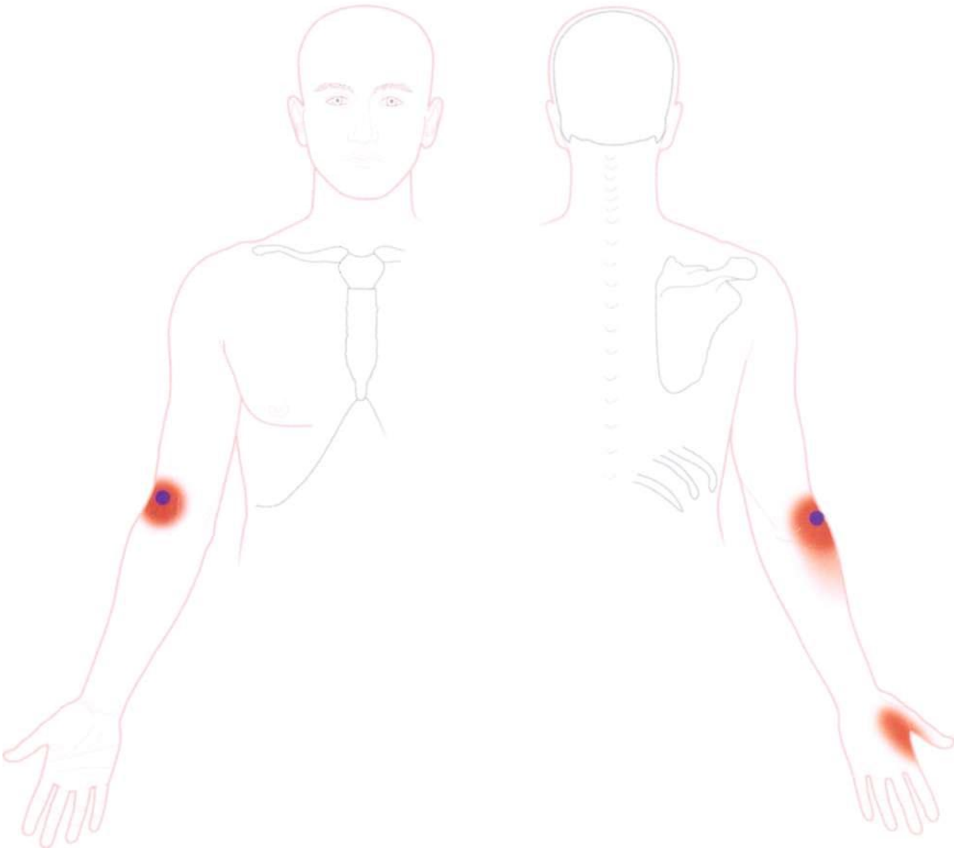
Also consider
Brachioradialis. Supinator. Extensor carpi radialis longus. Extensor indicis.

Advice to patient
Home exercise programme. Self stretch. Avoid sustained gripping. Explore work posture/arrangement with reference to computer keyboards/mouse. Avoid habitual postures such as sleeping with hands folded under head/pillow.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	

SUPINATOR



Strengthening exercise

Dumb-bell biceps curl

Self stretch

Weight of stick increases pronation via gravity.

SUPINATOR

Latin, *supinus*, lying on the back.

Part of the deep group. Supinator is almost entirely concealed by the superficial muscles.

Origin
Lateral epicondyle of humerus. Radial collateral (lateral) ligament of elbow joint. Annular ligament of superior radio-ulnar joint. Supinator crest of ulna.

Insertion
Dorsal and lateral surfaces of upper third of radius.

Action
Supinates forearm (for which it is probably the main prime mover, with biceps brachii being an auxiliary).

Nerve
Deep radial nerve, C5, **6**, (7).

Basic functional movement
Example: Turning a door handle or screwdriver.

Indications
Tennis elbow. Thumb joint pain. Elbow pain (when carrying and at rest). Pain turning door knobs. Localized pain on supination. Chronic use of walking stick. Pain on handshake.

Referred pain patterns
Localized 3–5cm strong zone of pain at lateral epicondyle and at web of thumb (dorsum).

Differential diagnosis
De Quervain's tenosynovitis. Lateral epicondylitis (tendino-osseous, musculo-tendinous, intramuscular). Radial head dysfunction.

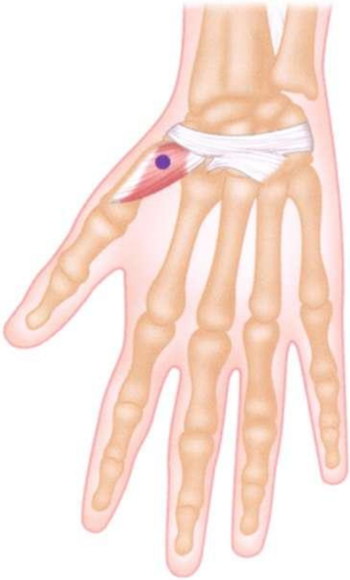
Also consider
Common extensors. Biceps brachii. Triceps brachii (insertion). Anconeus. Brachialis. Palmaris longus. Brachioradialis. Extensor carpi radialis longus.

Advice to patient
Change tennis style (keep wrists dorsiflexed). Change grip size. Avoid prolonged gripping/carrying. Change walking stick side regularly. Use pressure bandage/strap. Use backpack.

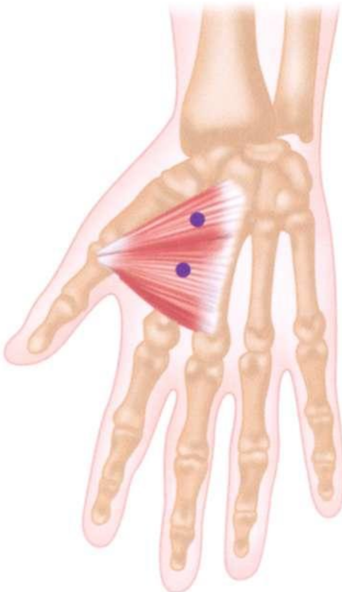
Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

OPPONENS POLLICIS/ADDUCTOR POLLICIS

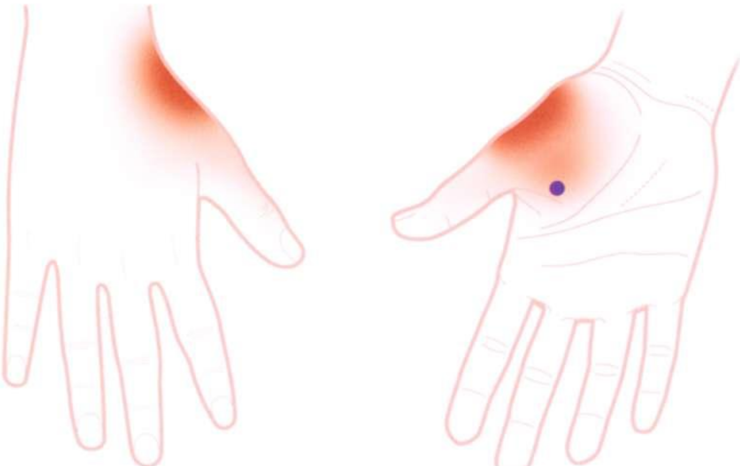


Opponens pollicis



Adductor pollicis

Opponens pollicis



Adductor pollicis

Strengthening exercises

Exer. ring 'pinching' exercise

Self stretches

Gently pull thumb into extension

Latin, *opponens*, opposing; *pollicis*, of the thumb; *adduct*, towards.

Opponens pollicis is part of the thenar eminence, usually partly fused with flexor pollicis brevis and deep to abductor pollicis brevis.

Origin
Opponens pollicis: flexor retinaculum. Tubercle of trapezium.
Adducor pollicis: oblique fibres: anterior surfaces of second and third metacarpals, capitate and trapezoid. Transverse fibres: palmar surface of third metacarpal bone.

Insertion
Opponens pollicis: entire length of radial border of first metacarpal.
Adductor pollicis: ulna (medial) side of base of proximal phalanx of thumb.

Action
Opponens pollicis: opposes (i.e. abducts, then slightly medially rotates, followed by flexion and adduction) the thumb so that the pad of the thumb can be drawn into contact with the pads of the fingers.
Adductor pollicis: adducts the thumb.

Nerve
Opponens pollicis: median nerve (C6, 7, 8, T1).
Adductor pollicis: deep ulnar nerve, C8, T1.

Basic functional movement
Example: Picking up small object between thumb and fingers (opponens pollicis). Gripping a jam jar lid to screw it on (adductor pollicis).

Indications
'Weeder's thumb'. Thumb pain on activity. Difficulty on maintaining pincer movement. 'Texter's', and 'video gamer's' thumb. Pain on sewing, writing and opening jars. Loss of fine motor control in buttoning, sewing, writing and painting, etc.

Referred pain patterns
Opponens pollicis: palmar wrist pain at distal radial head and into palmar aspect of thumb.
Adductor pollicis: dorsal and palmar surfaces of thumb localized around metacarpophalangeal joint and radiating to web of thumb and thenar eminence.

Differential diagnosis
De Quervain's tenosynovitis. Osteoarthritis of thumb (saddle joint). Rheumatoid arthritis. Carpal tunnel syndrome. 'Trigger thumb'. Discopathy of distal radio-ulnar joint. Carpal bones dysfunction. Mechanical dysfunction. Fracture. Subluxation.

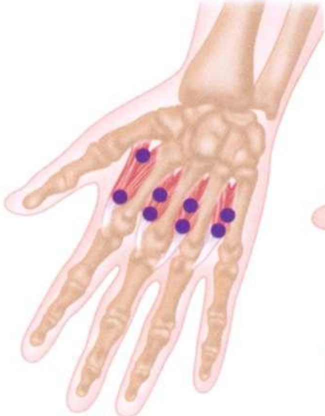
Also consider
Abductor pollicis brevis. Flexor pollicis brevis. Flexor pollicis longus.

Advice to patient
Home stretching exercises. Take regular breaks. Ergonomic pens, etc. Use warmth.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	

SMALL HAND MUSCLES

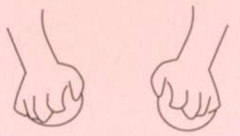


Dorsal interossei

Lumbricales

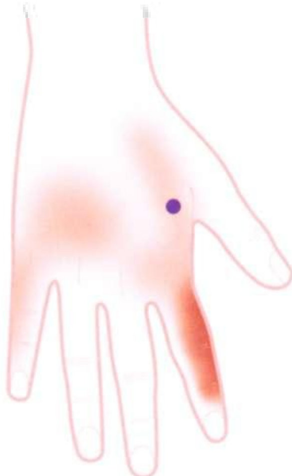
Abductor digiti minimi

Self stretches



Gripping a tennis ball

Palmar view



Dorsal view

First dorsal interosseous

Dorsal view
Second dorsal interosseous

Dorsal view
Abductor digiti minimi

Latin, *dorsal*, back; *interosseus*, between bones; *lumbrical*, earthworm; *abductor*, away from; *digit*, finger; *minimi*, smallest.

Comprising: dorsal interossei, lumbricales and abductor digiti minimi. The four dorsal interossei are about twice the size of the palmar interossei. The lumbricales are composed of small cylindrical muscles, one for each finger. Abductor digiti minimi is the most superficial muscle of the hypothenar eminence.

Origin
Dorsal interossei: by two heads, each from adjacent sides of metacarpals.
Lumbricales: tendons of flexor digitorum profundus in the palm.
Abductor digiti minimi: pisiform bone. Tendon of flexor carpi ulnaris.

Insertion
Dorsal interossei: into the extensor expansion and to base of proximal phalanx.
Lumbricales: lateral (radial) side of corresponding tendon of extensor digitorum, on the dorsum of the respective digits.
Abductor digiti minimi: Ulna (medial) side of base of proximal phalanx of little finger.

Action
Dorsal interossei: abduct fingers away from middle finger. Assist in flexion of fingers at metacarpophalangeal joints.
Lumbricales: extend the interphalangeal joints and simultaneously flex the metacarpophalangeal joints of the fingers.
Abductor digiti minimi: abducts the little finger.

Nerve
Dorsal interossei: ulnar nerve, C**8**, T**1**.
Lumbricales: lateral; median nerve, C(6), 7, **8**, T**1**; medial; ulnar nerve, C(7), **8**, T**1**.
Abductor digiti minimi: ulnar nerve, C(7), **8**, T**1**.

Basic functional movement
Example: Spreading fingers. Cupping your hand. Holding a large ball.

Indications
Finger pain and stiffness. Pain when pinching/gripping, associated with Heberdan's node(s), e.g. in professional musicians (esp. pianists). 'Arthritic' finger pain, also seen in artists/sculptors.

Referred pain patterns
First dorsal interossei: strong finger pain in dorsum of index finger (lateral half), with vague pain on palmar surface and dorsum of hand. Other dorsal interossei: referred pain to the specific associated finger.
Lumbricales: pattern is similar to interossei.
Abductor digiti minimi: pain in dorsum of little finger.

Differential diagnosis
Cervical radiculopathy. Ulnar neuritis. Thoracic outlet syndrome. Digital nerve entrapment. Articular dysfunction.

Also consider
Intrinsic thumb muscles. Scalenes. Latissimus dorsi. Long finger flexors and/or extensors. Pectoralis major. Lateral and/or medial head of triceps brachii.

Advice to patient
Stretching and exercising. Examine work postures/ergonomics. Explore sporting activities (e.g. grip in golf). Use of ergonomic pens/cutlery.

Techniques

Spray and stretch	✓		Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	

Muscles of the Hip and Thigh

8

Gluteus Maximus

Tensor Fasciae Latae

Gluteus Medius

Gluteus Minimus

Piriformis

Hamstrings

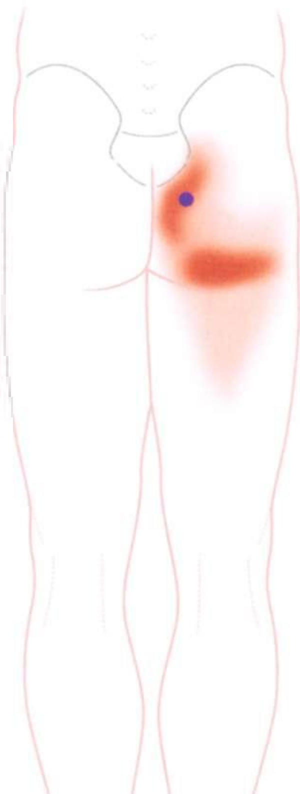
Adductors

Pectineus

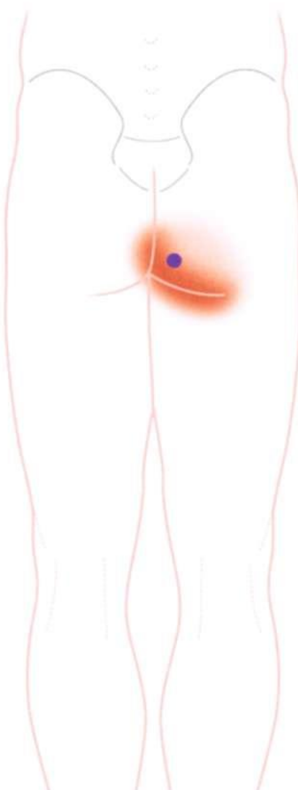
Sartorius

Quadriceps

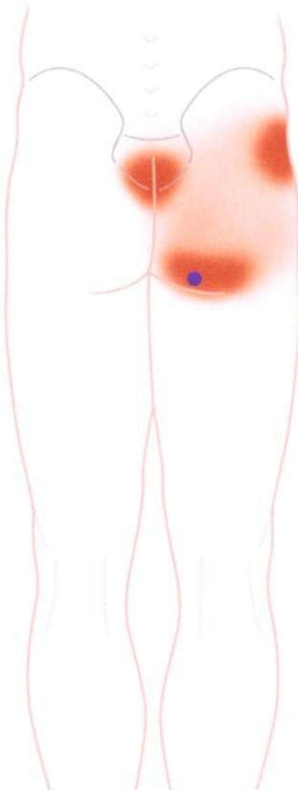
GLUTEUS MAXIMUS



Middle superior



Medial inferior



Middle inferior

Strengthening exercises

Squats

Seated leg press

Self stretches

In lying, pull knee to opposite shoulder. Avoid after pregnancy due to stress on pelvis.

GLUTEUS MAXIMUS

Greek, *gloutos*, buttock; *maximus*, biggest.

The gluteus maximus is the most coarsely fibred and heaviest muscle in the body, forming the bulk of the buttock.

Origin
Outer surface of ilium behind posterior gluteal line and portion of bone superior and posterior to it. Adjacent posterior surface of sacrum and coccyx. Sacrotuberous ligament. Aponeurosis of erector spinae.

Insertion
Deep fibres of distal portion: gluteal tuberosity of femur.
Remaining fibres: iliotibial tract of fascia lata.

Action
Upper fibres: laterally rotate hip joint. May assist in abduction of hip joint.
Lower fibres: extend and laterally rotate hip joint (forceful extension as in running or rising from sitting). Extend trunk. Assists in adduction of hip joint.
Through its insertion into the iliotibial tract, helps to stabilize the knee in extension.

Nerve
Inferior gluteal nerve, L**5**, S**1**, **2**.

Basic functional movement
Examples: Walking upstairs. Rising from sitting.

Indications
Pain on sitting. Pain walking (up hill). Pain on flexion. Buttock pain when swimming. Buttock pain after a fall or trip. Night pain. Restricted hip/thigh flexion. Listing gait. Cramping in cold.

Referred pain patterns
Three to four strong zones of pain in the buttock, with intercommunicating diffuse pain, occasionally just below (5–8cm) gluteal fold.

Differential diagnosis
Coccydynia. Pelvic inflammatory disease. Lower lumbar discopathy. Sacroiliitis. Bursitis (ischial tuberosity/trochanteric). Mechanical low back pain.

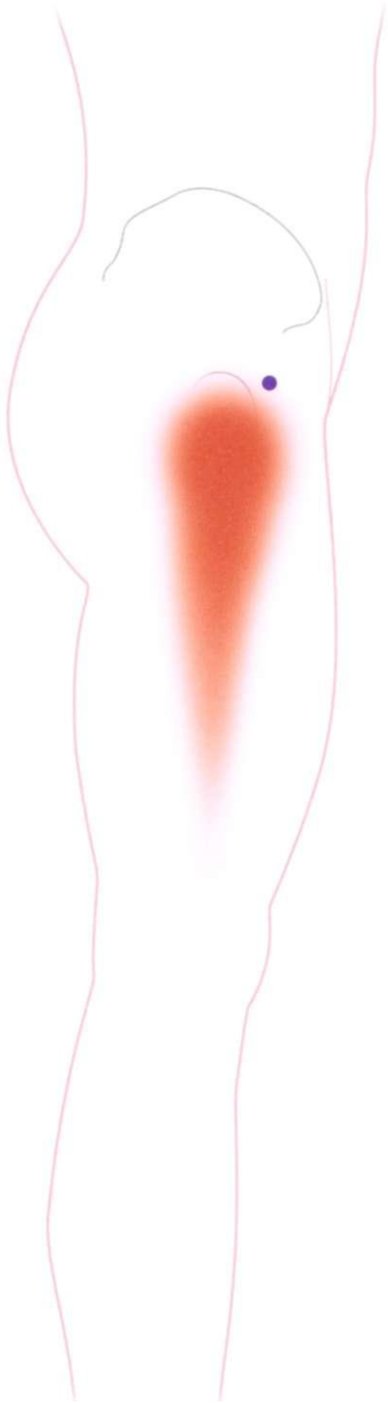
Also consider
Other gluteal muscles. Quadratus lumborum. Pubococcygeus. Hamstring muscles (attachment trigger points).

Advice to patient
Warmth and stretching. Gait and posture analysis. Pillow between knees when sleeping. Stretching programme. Swimming (not crawl).

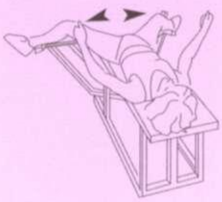
Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

TENSOR FASCIAE LATAE



Strengthening exercises



Abductor machine

Multi-hip machine (cable hip abduction)

Hip abduction

Self stretches

Hand on knee and pull across body.

Push your hips away from the wall.

Latin, *tensor*, stretcher, puller; *fascia(e)*, band(s); *latae*, broad.

This muscle lies anterior to gluteus maximus, on the lateral side of the hip.

Origin
Anterior part of outer lip of iliac crest, and outer surface of anterior superior iliac spine.

Insertion
Joins iliotibial tract just below level of greater trochanter.

Action
Flexes, abducts and medially rotates the hip joint. Tenses the fascia lata, thus stabilizing the knee. Redirects the rotational forces produced by gluteus maximus.

Nerve
Superior gluteal nerve, L**4**, **5**, S**1**.

Basic functional movement
Example: Walking.

Indications
Hip and knee pain (lateral). Pain on side lying. Pain on fast walking. Hip replacement rehabilitation. Fracture of neck of femur rehabilitation.

Referred pain patterns
Strong elliptical zone of pain from greater trochanter inferolaterally towards fibula.

Differential diagnosis
Trochanteric bursitis. Osteoarthritic hip. Sacroiliitis. Lumbar spondylosis.

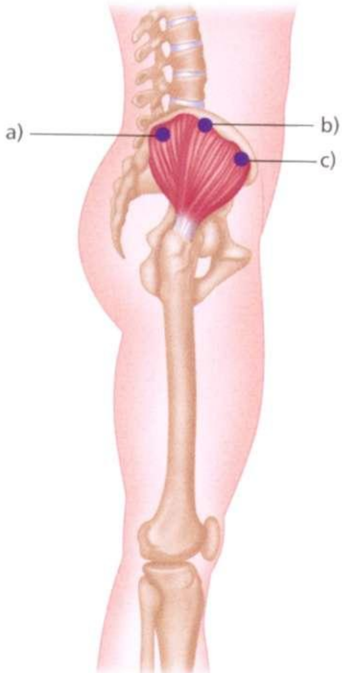
Also consider
Gluteus medius. Gluteus minimus. Vastus lateralis. Rectus femoris. Sartorius. Quadratus lumborum.

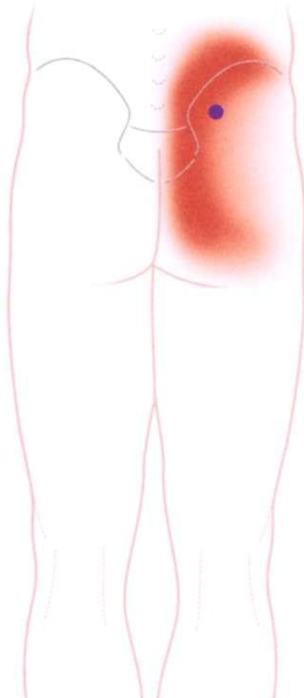
Advice to patient
Avoiding prolonged positions (flexion). Avoid habitual postures (cross-legged, or standing on one leg). Pillow between knees at night. Running style, gait and posture assessment. Warm up. Stretch regularly.

Techniques

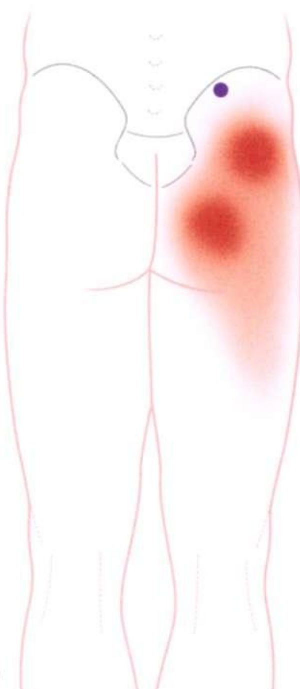
Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓		Trigger point release	✓	✓

GLUTEUS MEDIUS

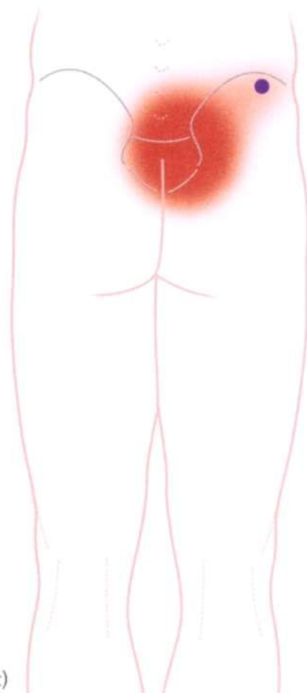




a)

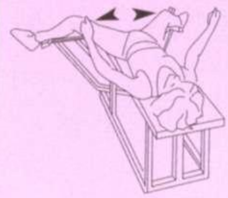


b)



c)

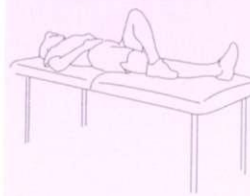
Strengthening exercises



Abductor machine

Multi-hip machine (cable hip abduction)

Self stretches



Hand on knee and pull across body.

Push your hips away from the wall.

Greek, *gloutos*, buttock; *medius*, middle.

This muscle is mostly deep to and therefore obscured by gluteus maximus, but appears on the surface between gluteus maximus and tensor fasciae latae. During walking, this muscle, with gluteus minimus, prevents the pelvis from dropping towards the non weight-bearing leg.

Origin
Outer surface of ilium inferior to iliac crest, between the posterior gluteal line and the anterior gluteal line.

Insertion
Oblique ridge on lateral surface of greater trochanter of femur.

Action
Abducts the hip joint. Anterior fibres medially rotate and may assist in flexion of the hip joint. Posterior fibres slightly laterally rotate the hip joint.

Nerve
Superior gluteal nerve, L**4**, **5**, S**1**.

Basic functional movement
Example: Stepping sideways over an object such as a low fence.

Indications
Pain and tenderness in low back and buttocks. Night pain. Pain side lying. Post hip or spinal surgery. Sitting on wallet.

Referred pain patterns
Low back, medial buttock, sacral and lateral hip radiating somewhat into the upper thigh.

Differential diagnosis
Radiculopathy (lumbosacral). Sacroiliitis. Hip joint dysfunction. Coccydynia. Greater tuberosity bursitis. Mechanical low back pain. Intermittent claudication.

Also consider
Quadratus lumborum. Other gluteal muscles. Pubococcygeus. Tensor fasciae latae. IT band. Piriformis. Lumbar erector spinae.

Advice to patient
Gait and posture analysis. Pillow between knees. Habitual postures. Stretching techniques.

Techniques

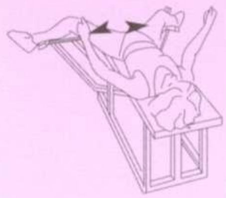
Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

GLUTEUS MINIMUS

Anterior portion

Multiple trigger points

Strengthening exercises



Abductor machine

Multi-hip machine
(cable hip abduction)

Self stretches

Hand on knee and pull across body.

Push your hips away from the wall.

GLUTEUS MINIMUS

Greek, *gloutos*, buttock; *minimus*, smallest.

This muscle is situated anteroinferior and deep to gluteus medius, whose fibres obscure it.

Origin
Outer surface of ilium between anterior and inferior gluteal lines.

Insertion
Anterior border of greater trochanter.

Action
Abducts, medially rotates and may assist in flexion of the hip joint.

Nerve
Superior gluteal nerve, L**4**, **5**, S**1**.

Basic functional movement
Example: Stepping sideways over an object such as a low fence.

Indications
Pain sitting to standing. Pain on walking. Pain at rest. Night pain (may wake). Pain on side lying. Hip replacement.

Referred pain patterns
A multipennate muscle with multiple anterior, middle and posterior trigger points referring strong pain in lower buttock, hip and lateral lower extremity beyond knee to ankle and calf.

Differential diagnosis
Radiculopathy (lumbar). Sacroiliitis. Hip joint dysfunction. Sciatic irritation. Hip bursitis.

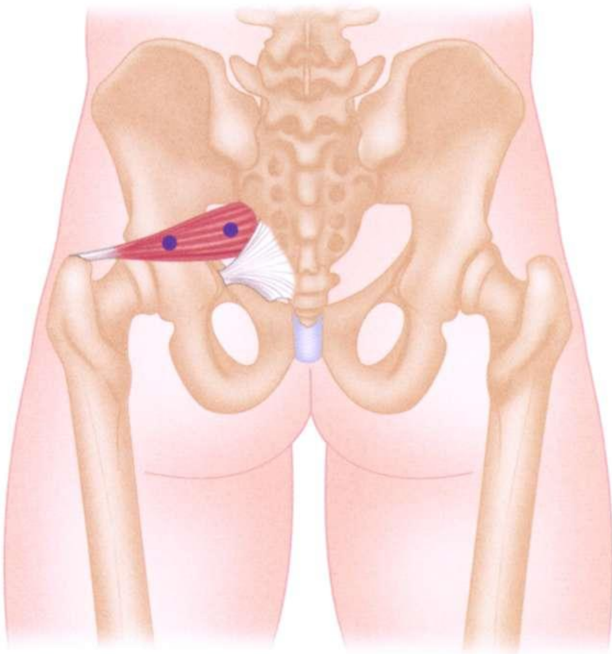
Also consider
Tensor fasciae latae. Other gluteal muscles. Vastus lateralis. IT band. Quadratus lumborum. Peroneal muscles. Piriformis. Pelvic alignment.

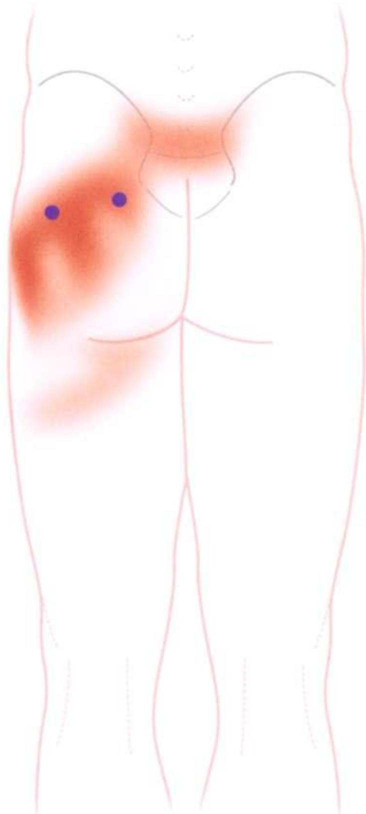
Advice to patient
Self stretch techniques. Gait and posture. Habitual postures. Overload. Allow legs to 'hang' off the bed.

Techniques

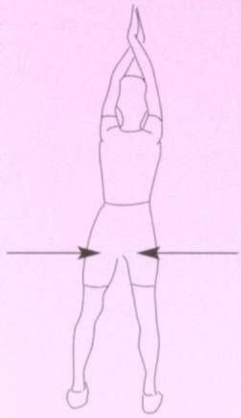
Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

PIRIFORMIS





Strengthening exercise



Isometric contraction of the buttocks in standing with legs apart

Self stretches

Cross right ankle over left knee and bring left knee slowly towards left shoulder, keeping the sacrum in contact with the ground or table. Be careful not to strain your knee joint.

PIRIFORMIS

Latin, *pirum*, a pear, *piriform*, pear-shaped.

Piriformis leaves the pelvis by passing through the greater sciatic foramen.

Origin
Internal surface of sacrum. Sacrotuberous ligament.

Insertion
Superior border of greater trochanter of femur.

Action
Laterally rotates hip joint. Abducts the thigh when hip is flexed. Helps hold head of femur in acetabulum.

Nerve
Ventral rami of lumbar nerve, L(5) and sacral nerves, S**1**, **2**.

Basic functional movement
Example: Taking first leg out of car.

Indications
Constant 'deep' ache in buttock. Sciatica (pseudosciatica). Vascular compression posterior legs. Low back/buttock pain – worse when sitting. Often starts after a fall, or sitting on wallet with driving. Foot pain. Rectal pain. Sexual dysfunction (dyspareunia).

Referred pain patterns
Two strong zones of pain: 1) 3–4cm zone lateral to coccyx; 2) 7–10cm zone posterolateral buttock/hip joint +/- broad spill-over of diffuse pain between 1) and 2) and down thigh to above knee.

Differential diagnosis
Sacroiliitis. Lumbar radiculopathy. Coccydynia. Osteoarthritic hip. HLA (human leukocyte antigen) – B27 condition. Spinal stenosis. Discopathy (lumbar).

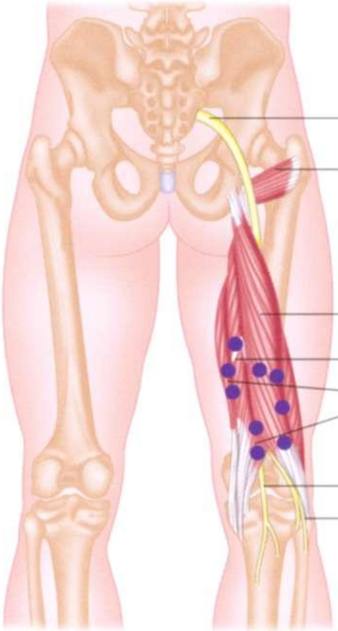
Also consider
Leg length discrepancy. Gluteal muscles. Quadratus lumborum. Attachment trigger point (origin) hamstrings. Gemelli. Obturators. Quadratus femoris. Levator ani. Coccygeus.

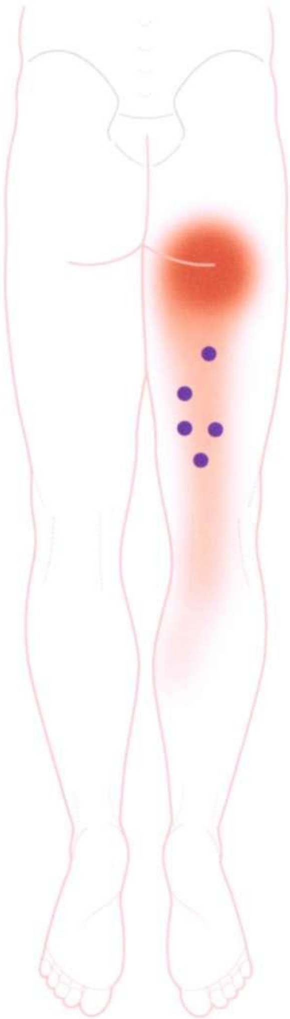
Advice to patient
Avoid habitual postures such as sitting cross-legged. Gait and posture analysis with reference to foot position. Driving position (foot). Self stretch. Use of self massage tools.

Techniques

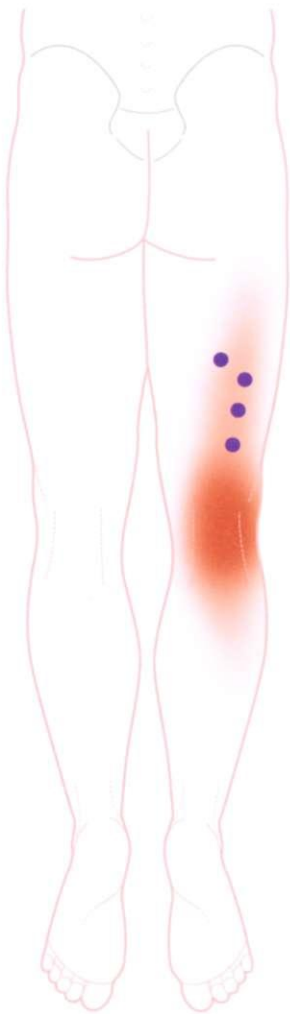
Spray and stretch	✓		Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

HAMSTRINGS





Semimembranosus / Semitendinosus



Biceps femoris (short and long heads)

Strengthening exercises

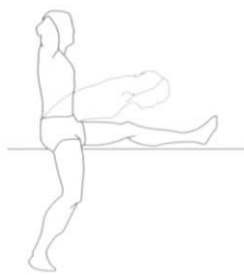
Leg curl (effects lower portion of hamstrings)

Multi-hip machine (cable hip extension/ kick back)

Good morning exercise (effects upper portion of hamstrings)

Self stretches

Actively straighten your leg. For tighter hamstrings, hold onto a towel or strap slung over the sole of the foot.



German, *hamme*, back of leg; **Latin**, *stringere*, draw together.

The hamstrings consist of three muscles. From medial to lateral they are: semimembranosus, semitendinosus and biceps femoris.

Origin
Ischial tuberosity (sitting bone). Biceps femoris also originates from the back of the femur.

Insertion
Semimembranosus: back of medial condyle of tibia (upper side part of tibia).
Semitendinosus: upper medial surface of shaft of tibia.
Biceps femoris: lateral side of head of fibula. Lateral condyle of tibia.

Action
Flex the knee joint. Extend the hip joint.
Semimembranosus and semitendinosus also medially rotate (turn in) the lower leg when knee is flexed.
Biceps femoris laterally rotates (turns out) the lower leg when the knee is flexed.

Nerve
Branches of the sciatic nerve, L4, **5**, S**1**, **2**, 3.

Basic functional movement
During running, the hamstrings slow down the leg at the end of its forward swing and prevent the trunk from flexing at the hip joint.

Indications
Posterior thigh pain in sitting and while walking (worse at night). Tenderness in back of legs may cause limping.

Referred pain patterns
Semimembranosus and semitendinosus: strong 10cm zone of pain, inferior gluteal fold, with diffuse pain posteromedial legs to Achilles tendon area.
Biceps femoris: diffuse pain, posteromedial legs with strong 10cm zone posterior to knee joint.

Differential diagnosis
Sciatica. Radiculopathy. Muscle tears. Osteitis. Bursitic osteoarthritis of knee. Knee joint dysfunction. Tenosynovitis.

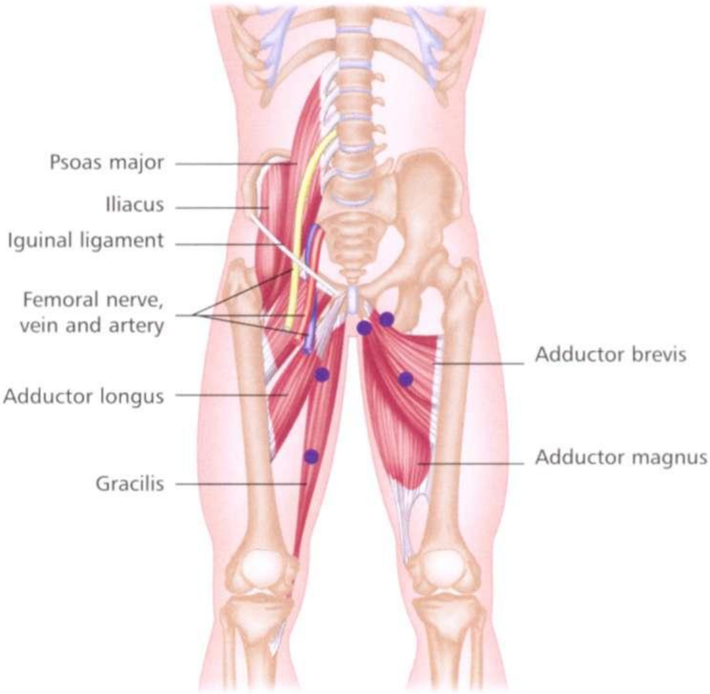
Also consider
Piriformis. Popliteus. Gluteal muscles. Obturator internus. Vastus lateralis. Plantaris. Gastrocnemius.

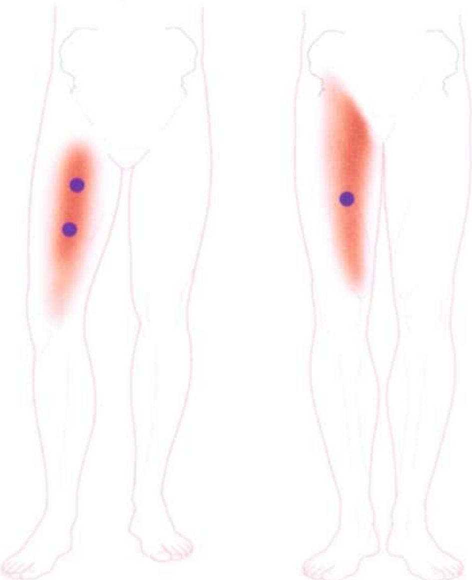
Advice to patient
Regular stretching with hot and/or cold. Warm-up and cool-down before and after exercise. Hot showers/baths. Car seat posture. Work posture. Cycling positions.

Techniques

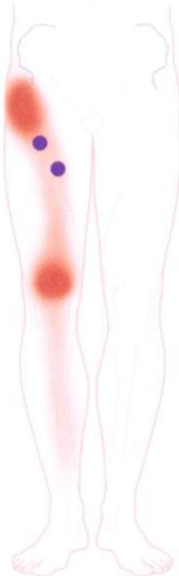
Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

ADDUCTORS

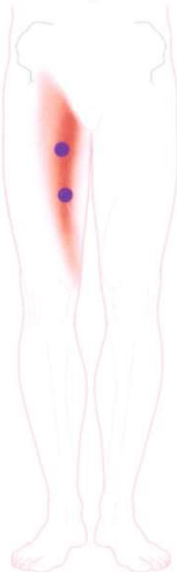




Adductor magnus

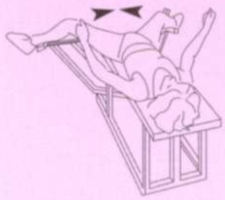


Adductor longus
and brevis



Gracilis

Strengthening exercises

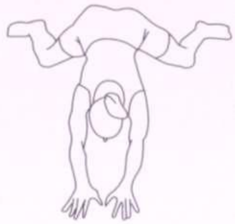


Hip joint adductor machine

Hip adduction

Self stretches

Keep your back straight,
with soles of feet together



Latin, *adductor*, towards; *magnus*, large; *brevis*, short; *longus*, long.

The adductor magnus is the largest of the adductor muscle group, which also includes adductor brevis and adductor longus. Adductor longus is the most anterior of the three. Adductor brevis lies anterior to adductor magnus. The lateral border of the upper fibres of adductor longus form the medial border of the *femoral triangle* (sartorius forms the lateral boundary; the inguinal ligament forms the superior boundary).

Origin
Anterior part of pubic bone (ramus). Adductor magnus also takes origin from the ischial tuberosity.

Insertion
Whole length of medial side of femur, from hip to knee.

Action
Adduct and laterally rotate hip joint.
Adductors longus and brevis also flex the extended femur and extend the flexed femur.

Nerve
Magnus: posterior division of obturator nerve L2, **3**, **4**. Tibial portion of sciatic nerve, L**4**, 5, S1.
Brevis: anterior division of obturator nerve, (L2–L4). Sometimes the posterior division also supplies a branch to it.
Longus: anterior division of obturator nerve, L**2**, **3**, 4.

Basic functional movement
Example: Bringing second leg in or out of car.

Indications
Deep pain and tenderness in medial thigh. Hip/leg stiffness on abduction. Pain on weight-bearing and/or rotating hip. 'Clicky' hip. Hot/stinging pain under thigh. Groin strain. Post hip replacement or fracture rehabilitation. Renal tubular acidosis. Legs swelling.

Referred pain patterns
There are several zones of referred pain: a) 2 zones localized around anterior hip 5–8cm, and above knee 5–8cm; b) whole anteromedial thigh from inguinal ligament to medial knee joint; c) medial thigh from hip to knee.

Differential diagnosis
Avulsion. Pubic symphysis dysfunction. Neuropathy. Lymphadenopathy. Hernia. Knee pain (mechanical). Osteoarthritic hip. Femoral herniation.

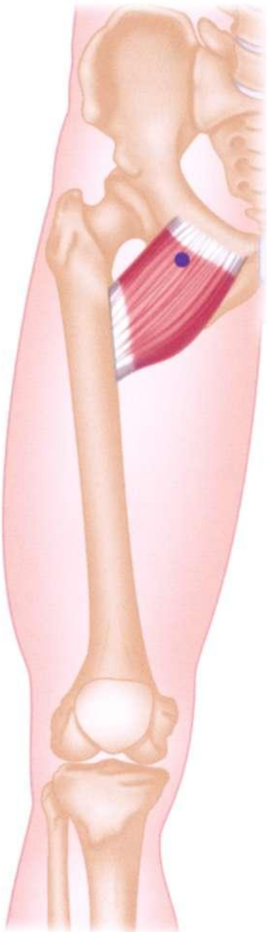
Also consider
Pectineus. Vastus medialis. Iliopsoas. Vastus lateralis. Sartorius (lower end).

Advice to patient
Home stretch programme. Avoid overuse at gym. Explore habitual postures. Skiing/cycling techniques. Vitamin/mineral deficiency.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

PECTINEUS



Strengthening exercises

Hip adduction

Multi-hip machine (cable hip flexion)

Self stretches

Keep your back straight, with soles of feet together.

Latin, *pecten*, comb, *pectenate*, shaped like a comb.

Pectineus is sandwiched between the psoas major and adductor longus.

Origin
Pecten of pubis, between iliopubic (iliopectineal) eminence and pubic tubercle.

Insertion
Pectineal line, from lesser trochanter to linea aspera of femur.

Action
Adducts the hip joint. Flexes the hip joint.

Nerve
Femoral nerve, L**2**, **3**, 4. Occasionally receives an additional branch from the obturator nerve, L3.

Basic functional movement
Example: Walking along a straight line.

Indications
Persistent 'internal' groin pain. Groin strain. Hip pain. Post hip replacement rehabilitation. Post hip fracture. Pregnancy. Postpartum. Pain during sexual intercourse. Pain during hip adduction exercises (gym).

Referred pain patterns
Strong 8–12cm zone of pain in anterior groin with more diffuse radiations in an oval – towards the anteromedial thigh.

Differential diagnosis
Inguinal hernia. Femoral hernia. Lymphadenopathy. Meralgia paresthetica. Lumbar radiculopathy. Vascular.

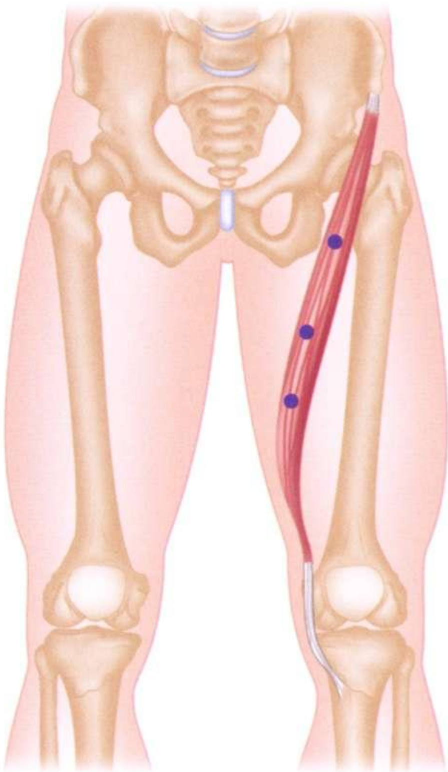
Also consider
Adductor longus and brevis. Iliopsoas. Limb length discrepancy.

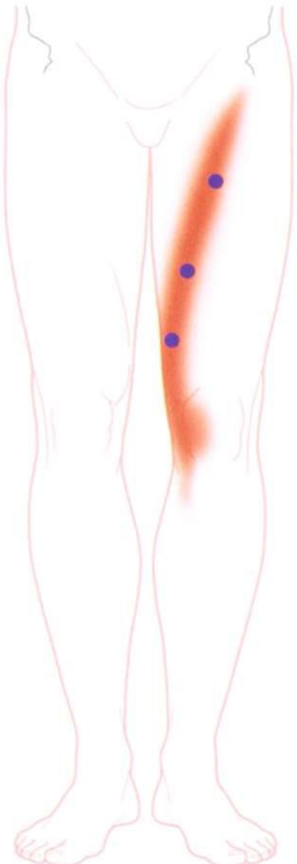
Advice to patient
Avoid repetitive hip adduction and flexion, such as yoga positions (lotus). Avoid sitting cross-legged.

Techniques

Spray and stretch	✓		Dry needling		
Injections	✓	✓	Trigger point release	✓	✓

SARTORIUS



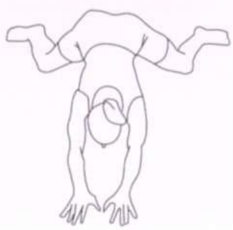


Strengthening exercise

Multi-hip machine (cable hip abduction)

Self stretches

Push your hips away from the wall. Only a slight stretch.



SARTORIUS

Latin, tailor.

Sartorius is the most superficial muscle of the anterior thigh. It is also the longest strap muscle in the body. The medial border of the upper third of this muscle forms the lateral boundary of the femoral triangle (adductor longus forms the medial boundary; the inguinal ligament forms the superior boundary). The action of sartorius is to put the lower limbs in the cross-legged seated position of the tailor (hence its name from the Latin).

Origin
Anterior superior iliac spine and area immediately below it.

Insertion
Upper part of medial surface of tibia, near anterior border.

Action
Flexes hip joint (helping to bring leg forward in walking or running). Laterally rotates and abducts the hip joint. Flexes knee joint. Assists in medial rotation of the tibia on the femur after flexion. These actions may be summarized by saying that it places the heel on the knee of the opposite limb.

Nerve
Two branches from the femoral nerve, L**2**, **3**, (4).

Basic functional movement
Example: Sitting cross-legged.

Indications
Ache in anterior thigh. Sharp and/or tingling pain from hip to medial knee.

Referred pain patterns
Vague tingling from ASIS anteromedial medially across thigh towards medial knee joint.

Differential diagnosis
Meralgia parasthetica. Knee joint pathology. Lumbar radiculopathy. Inguinal lymphadenopathy. Vascular pathology. Inguinal and/or femoral hernia.

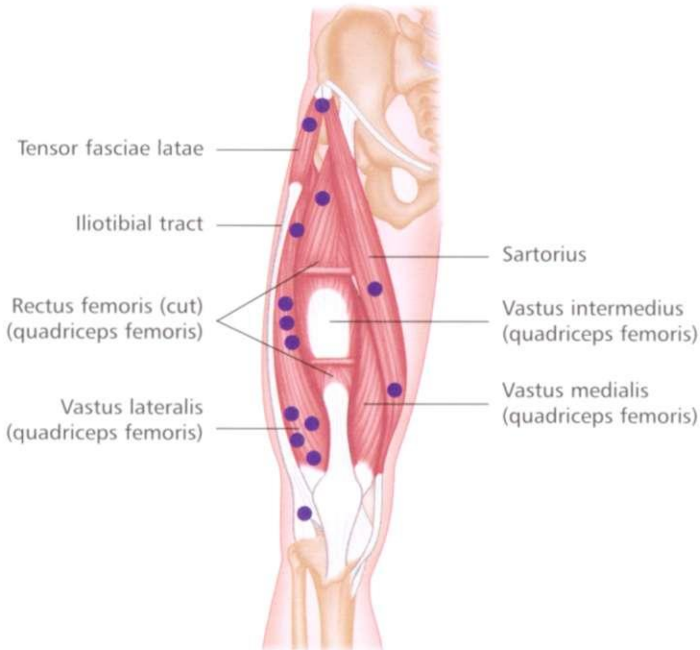
Also consider
Vastus medialis. Biceps femoris. Gracilis. Pectineus. Tensor fasciae latae.

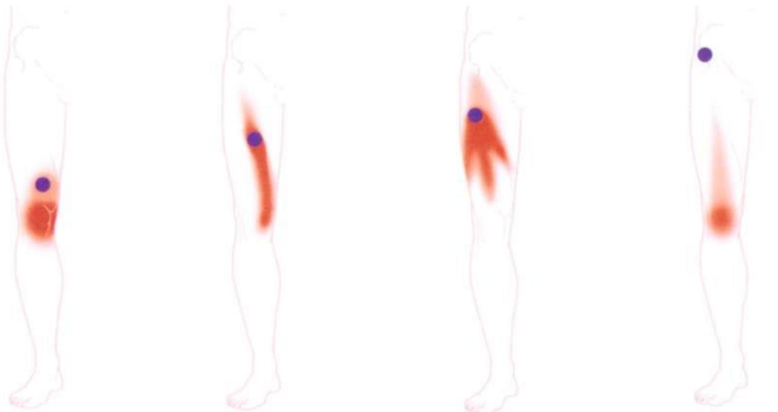
Advice to patient
Gait and posture analysis. Prolonged sitting positions with knees crossed. Habitual postures. Can be overactive secondary to obesity and/or exercise (e.g. running with foot everted). Stretching exercises. Pillow between knees.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

QUADRICEPS

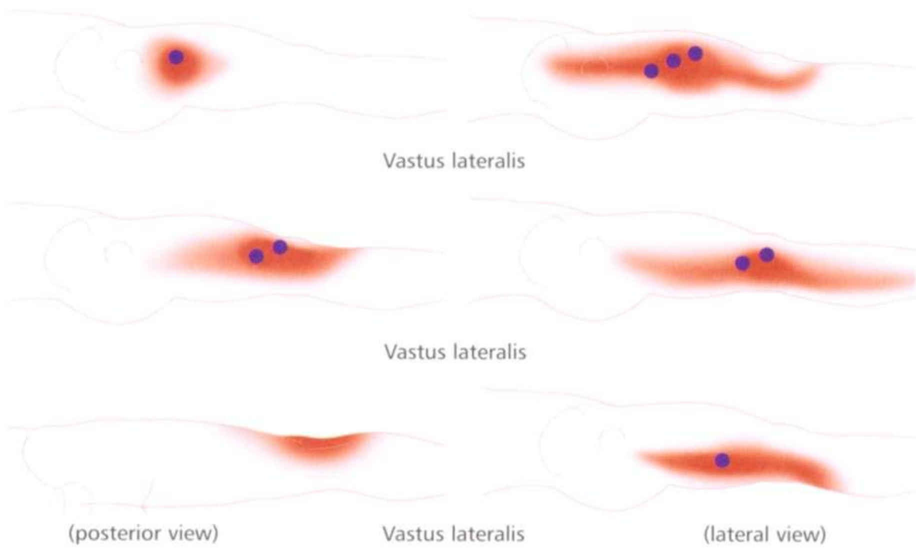




Vastus medialis

Vastus intermedius

Rectus femoris



Strengthening exercises

Quads-knee extension

Leg press

Squats

Self stretches

Use opposite hand to hold your ankle, or wrap a towel around your leg and use both hands.

Latin, *quadriceps*, four-headed; *rectum*, straight; *femoris*, of the thigh; *vastus*, great or vast; *lateral*, to the side; *medial*, middle; *intermedial*, between the middle.

The four quadriceps muscles are: rectus femoris, vastus lateralis, vastus medialis, and vastus intermedius. They all cross the knee joint, but the rectus femoris is the only one with two heads of origin and that also crosses the hip joint. The quadriceps straighten the knee when rising from sitting, during walking, and climbing. The vasti muscles as a group pay out to control the movement of sitting down.

Origin
Vastus group: upper half of shaft of femur.
Rectus femoris: front part of ilium (anterior inferior iliac spine). Area above hip socket.

Insertion
Patella, then via patellar ligament into the upper anterior part of the tibia (tibial tuberosity).

Action
Vastus group: extends the knee joint.
Rectus femoris: extends the knee joint, and flexes the hip joint (particularly in combination, as in kicking a ball).

Nerve
Femoral nerve, L**2**, **3**, **4**.

Basic functional movement
Examples: Walking up stairs. Cycling.

Indications
Pain and weakness in thigh. 'Giving way' of knee. Night pain. Pain on knee extension. Post hip fracture. Post femoral fracture and splinting. Decreased femoropatellar joint 'glide'. Pain on weight-bearing. Unexplained knee pain in young.

Referred pain patterns
Anterior, medial and/or lateral thigh pain. Vastus lateralis has many points of pain referral.

Differential diagnosis
IT band syndrome. Femoropatellar joint dysfunction. Quadriceps expansion injury. Tendonitis. Lumbar radiculopathy. Femoral nerve pathology. Knee problems/dysfunction (multipennate).

Also consider
Iliopsoas. Tensor fasciae latae. Gluteal muscle group. Sartorius.

Advice to patient
Correct lifting techniques. Tubigrip™. Avoid prolonged immobility. Home self stretch. Gait and posture assessment. Avoid heavy 'squats' in gym. Moist heat, cold or hot bath and stretch. Resting periods for cycling. Avoid habitual sitting (i.e. on feet, tucked under). Sleep with pillow between knees.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

Muscles of the Leg and Foot

9

Tibialis Anterior

Extensor Digitorum Longus/Extensor Hallucis Longus

Fibularis (Peroneus) Longus/Brevis/Tertius

Gastrocnemius

Plantaris

Soleus

Popliteus

Flexor Digitorum Longus/Flexor Hallucis Longus

Tibialis Posterior

Superficial Muscles of the Foot

Deep Muscles of the Foot

TIBIALIS ANTERIOR

Strengthening exercises

Toe raise

Quads-knee extension

Self stretches

TIBIALIS ANTERIOR

Latin, *tibia,* pipe or flute/shinbone; *anterior,* before.

Origin

Lateral condyle of tibia. Upper half of lateral surface of tibia. Interosseous membrane.

Insertion

Medial and plantar surface of medial cuneiform bone. Base of first metatarsal.

Action

Dorsiflexes the ankle joint. Inverts the foot.

Nerve

Deep peroneal nerve, L4, 5, S1.

Basic functional movement

Example: Walking and running (helps prevent the foot from slapping onto the ground after the heel strikes. Lifts the foot clear of the ground as the leg swings forward).

Indications

Ankle pain and tenderness. Pain in the big toe. Shin splints (anterior tibial compartment syndrome). Foot dragging. Ankle weakness (children).

Referred pain patterns

Anteromedial vague pain along shin, with zone of pain 3-5cm in ankle joint (anterior) culminating in big toe pain (whole toe).

Differential diagnosis

Lumbar discopathy. Arthritic toes. Anterior tibial compartment syndrome. Shin splints (anterior). Varicose veins.

Also consider

Extensor hallucis longus. Peroneus tertius. Extensor hallucis brevis. Extensor digitorum brevis. Extensor digitorum longus. Flexor hallucis longus. First dorsal interosseous.

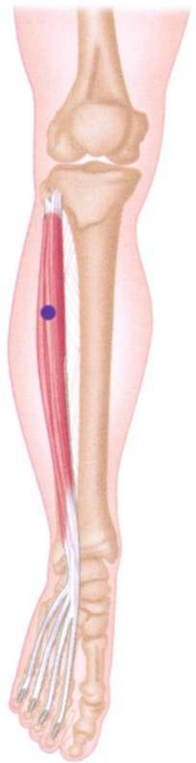
Advice to patient

Avoid prolonged car journeys and use of pedals. Change running surface and running shoes. Avoid walking (prolonged) on sloping surfaces. Have stretch programme (heat/warmth/cold). Adjust car seat. Use wedge under heel of foot for driving pedal.

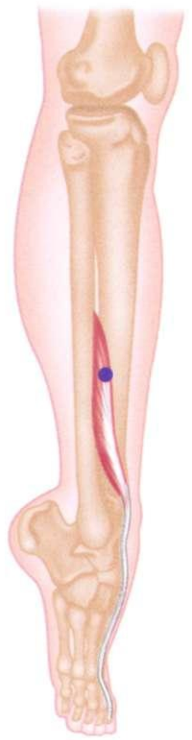
Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

EXTENSOR DIGITORUM LONGUS/EXTENSOR HALLUCIS LONGUS



Extensor digitorum longus



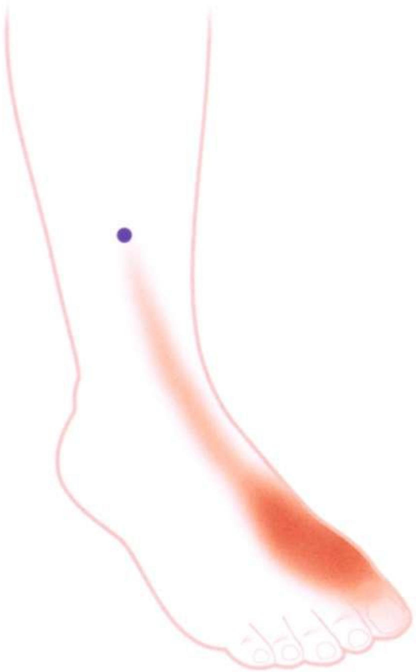
Extensor hallucis longus

Strengthening exercise

Toe raise

Self stretches

Extensor digitorum longus



Extensor hallucis longus

EXTENSOR DIGITORUM LONGUS/EXTENSOR HALLUCIS LONGUS

Latin, *extensor,* to extend; *digit,* toe; *hallux,* big toe; *longus,* long.

Like the corresponding tendons in the hand, the extensor digitorum longus forms extensor hoods on the dorsum of the proximal phalanges of the foot. These hoods are joined by the tendons of the lumbricales and extensor digitorum brevis, but not by the interossei. The extensor hallucis longus lies between and deep to tibialis anterior and extensor digitorum longus.

Origin
Extensor digitorum longus: lateral condyle of tibia. Upper two-thirds of anterior surface of fibula. Upper part of interosseous membrane.
Extensor hallucis longus: middle half of anterior surface of fibula and adjacent interosseous membrane.

Insertion
Extensor digitorum longus: along dorsal surface of the four lateral toes. Each tendon divides to attach to the bases of the middle and distal phalanges.
Extensor hallucis longus: base of distal phalanx of great toe.

Action
Extensor digitorum longus: extends toes at the metatarsophalangeal joints. Assists the extension of the interphalangeal joints. Assists in dorsiflexion of ankle joint and eversion of the foot.
Extensor hallucis longus: extends all the joints of the big toe. Dorsiflexes the ankle joint. Assists in inversion of the foot.

Nerve
Fibular (peroneal) nerve, L4, 5, S1.

Basic functional movement
Example: Walking up the stairs (ensuring the toes clear the steps).

Indications

Dorsal foot pain. Metatarsalgia. Big toe pain (pain is 'persistent'). Night cramps.

Referred pain patterns
Extensor digitorum longus: pain in dorsum of foot extending to middle three toes.
Extensor hallucis longus: pain over big toe dorsum.

Differential diagnosis
Hammer toes. Claw toes. Bunions. Lesions of fibular head. Compartment syndromes. Foot drop (upper motor neurone). Tendonitis. Tendon damage.

Also consider

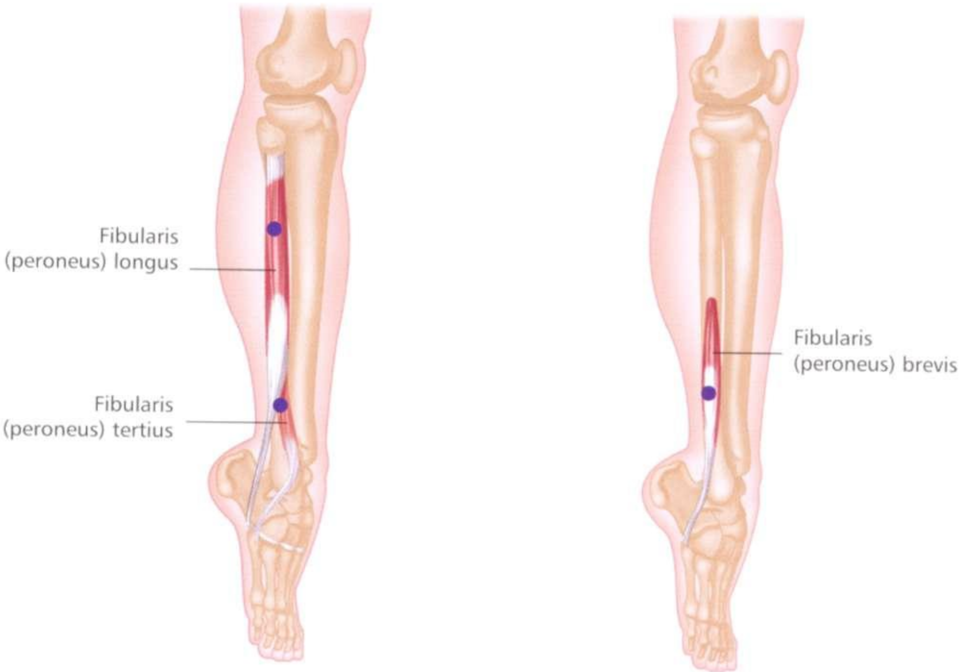
Peroneal muscles. Tibialis anterior.

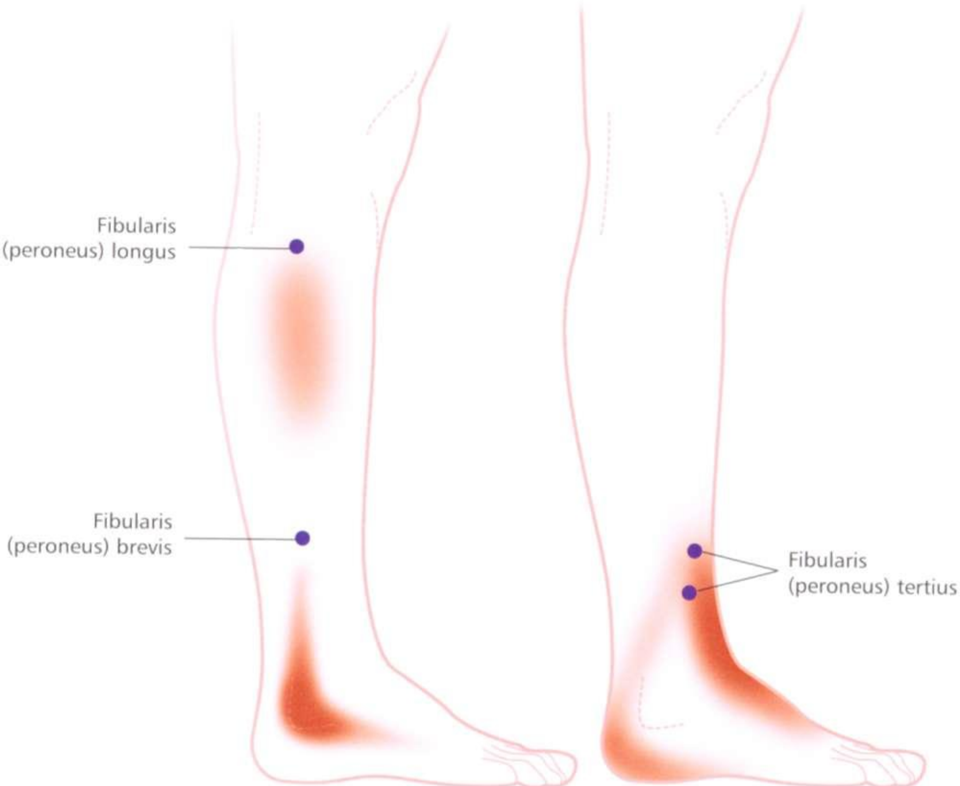
Advice to patient
Footwear. Gait. Foot position during driving/sleeping. Orthotics. Review weight bearing exercises. Occupational postures.

Techniques

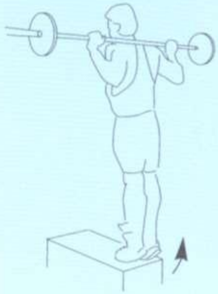
Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

FIBULARIS (PERONEUS) LONGUS, BREVIS, TERTIUS





Strengthening exercises

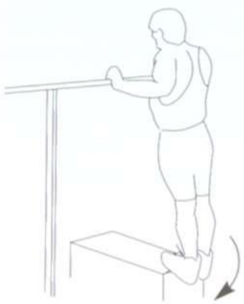


Calf raise
(standing heel raise)

Calf raise
(seated heel raise)

Self stretches

Stretch increases dorsiflexion rather than inversion.



FIBULARIS (PERONEUS) LONGUS, BREVIS, TERTIUS

Latin, *fibula,* pin/buckle; *longus,* long; *brevis,* short; *tertius,* third.

The course of the tendon of insertion of fibularis longus helps maintain the transverse and lateral longitudinal arches of the foot. A slip of muscle from fibularis brevis often joins the long extensor tendon of the little toe, whereupon it is known as *peroneus digiti minimi.* Fibularis tertius is a partially separated lower lateral part of extensor digitorum longus.

Origin
Longus: upper two-thirds of lateral surface of fibula. Lateral condyle of tibia.
Brevis: lower two-thirds of lateral surface of fibula. Adjacent intermuscular septa.
Tertius: lower third of anterior surface of fibula and interosseous membrane.

Insertion
Longus: lateral side of medial cuneiform. Base of first metatarsal.
Brevis: lateral side of base of fifth metatarsal.
Tertius: dorsal surface of base of fifth metatarsal.

Action
Longus: everts foot. Assists plantar flexion of ankle joint.
Brevis: everts ankle joint.
Tertius: dorsiflexes ankle joint. Everts the foot.

Nerve

Fibular (peroneal) nerve, L4, 5, S1.

Basic functional movement
Examples: Walking and running. Walking on uneven surfaces.

Indications
Pronation of feet. Repetitive inversion/eversion injury. Tenderness around malleolus. Ankle weakness. Post fracture (and casting) rehabilitation. Foot problems such as calluses, verrucas, neuromas. Osteoarthritis of the toes. Metatarsalgia.

Referred pain patterns
Mainly over lateral malleolus anteriorly and posteriorly in a linear distribution. Laterally along foot, occasionally vague pain in middle third of lateral aspect of lower leg.

Differential diagnosis
Rupture. Fracture of foot. Fracture of first metatarsal (styloid process). Foot problems. Fibular head dysfunction (common peroneal nerve). Toe problems. Ankle problems (arthritis). Gait dysfunction. Compartment syndromes (lateral). Osteoarthritis of hip.

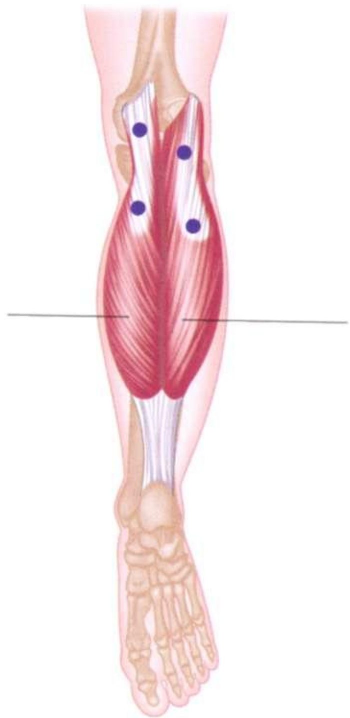
Also consider
Tensor fasciae latae. Gluteus minimus. Extensor digitorum longus. Extensor hallucis brevis. Extensor digitorum brevis.

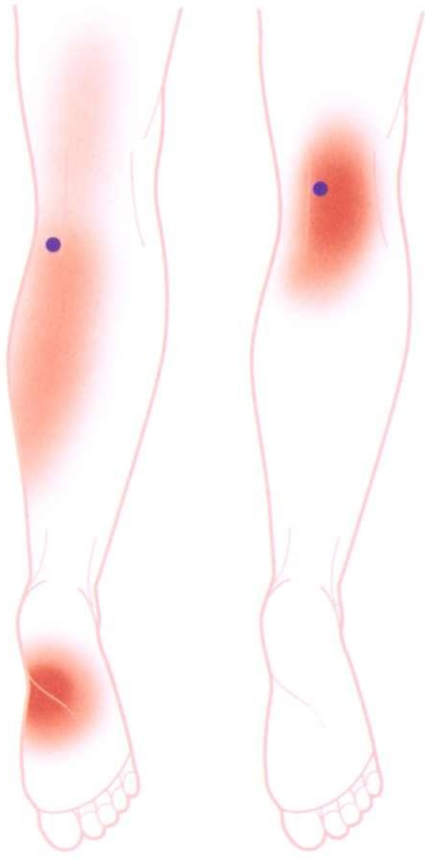
Advice to patient
Avoid high-heeled and flat shoes. Regular stretching with hot and/or cold. Strapping/ ankle support. Use of heel wedges and/or orthotics. Posture and gait advice. Examine shoes.

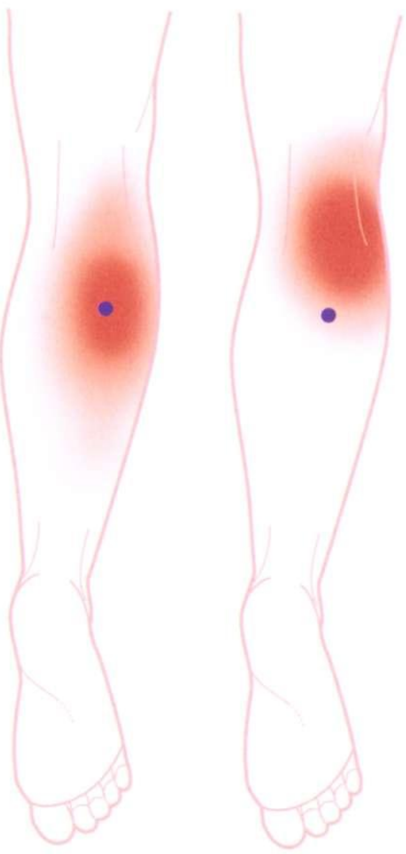
Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

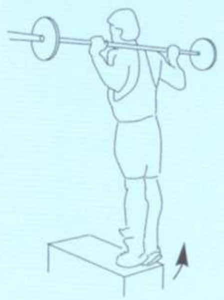
GASTROCNEMIUS



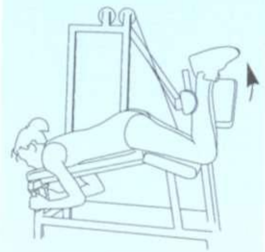




Strengthening exercises



Calf raise
(standing heel raise)



Leg curl

Self stretches

Stretch increases dorsiflexion rather than inversion.

GASTROCNEMIUS

Greek, *gaster,* stomach; *kneme,* leg.

Gastrocnemius is part of the composite muscle known as *triceps surae,* which forms the prominent contour of the calf. The triceps surae comprises: gastrocnemius, soleus and plantaris. The popliteal fossa at the back of the knee is formed inferiorly by the bellies of gastrocnemius and plantaris, laterally by the tendon of biceps femoris, and medially by the tendons of semimembranosus and semitendinosus.

Origin
Medial head: popliteal surface of femur above medial condyle.
Lateral head: lateral condyle and posterior surface of femur.

Insertion
Posterior surface of calcaneus (via the tendo calcaneus; a fusion of the tendons of gastrocnemius and soleus).

Action
Plantar flexes foot at ankle joint. Assists in flexion of knee joint. It is a main propelling force in walking and running.

Nerve
Tibial nerve, S1, **2.**

Basic functional movement
Example: Standing on tip-toes.

Indications

Calf pain and stiffness. Nocturnal cramps. Foot pain (instep). Pain in back of knee on mechanical activity.

Referred pain patterns
Several trigger points in each muscle belly and attachment trigger point at ankle. The four most common points are indicated diagrammatically for medial and lateral heads.

Differential diagnosis
Thrombophlebitis. Deep vein thrombosis (varicose veins, intermittent claudication). S1 radiculopathy. Baker's cyst. Posterior tibial compartment syndrome. Achilles tendonitis. Sever's disease. Bursitis.

Also consider

Soleus. Plantaris. Tibialis posterior. Toe flexors (long). Toe extensors. Tibialis anterior.

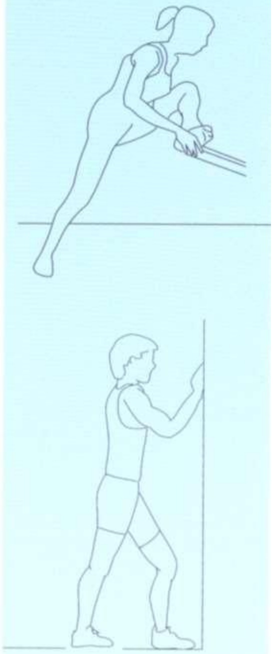
Advice to patient
Avoid high-heeled shoes. Regular stretching. Warm up and warm down with exercise. Use cold and stretch/warmth and stretch. Change running shoes regularly. Posture.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓	✓	Trigger point release	✓	✓

PLANTARIS

Self stretches



Stretch increases dorsiflexion rather than inversion.

PLANTARIS

Latin, *planta,* sole of the foot.

Part of the *triceps surae.* Its long slender tendon is equivalent to the tendon of palmaris longus in the arm.

Origin

Lower part of lateral supracondylar ridge of femur and adjacent part of its popliteal surface. Oblique popliteal ligament of knee joint.

Insertion

Posterior surface of calcaneus (or sometimes into the medial surface of the tendo calcaneus).

Action

Plantar flexes ankle joint. Feebly flexes knee joint.

Nerve

Tibial nerve, L4, 5, S1, (2).

Basic functional movement

Example: Standing on tip-toes.

Indications

Calf pain. Heel pain. Posterior knee pain. Chronic and long-term use of high-heeled shoes.

Referred pain patterns

Popliteal fossa pain in 2-3cm zone radiating 5-10cm interiorly into calf.

Differential diagnosis

Achilles tendonitis. Compartment syndrome. Vascular disease. Heel spur. Fasciitis. Subtalar joint problems. Venous pump mechanisms. Tendon rupture. Baker's cyst. Shin splints. Stress fracture. Leg length discrepancy.

Also consider

Popliteus. Gastrocnemius. Tibialis posterior. Quadratus plantae (of foot). Abductor hallucis (of foot).

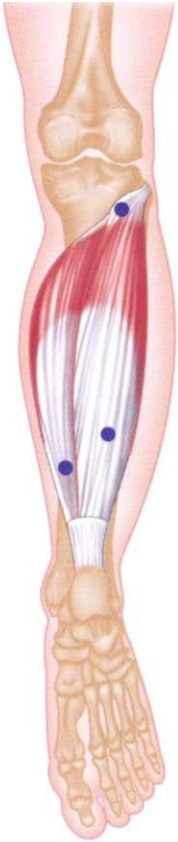
Advice to patient

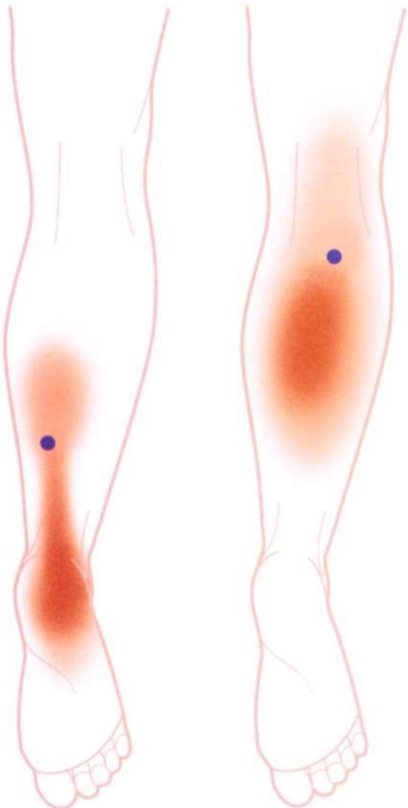
Change footwear. Change and vary running techniques and running surface. Change/avoid high heeled shoes. Regular stretching. Leg rests at home and at work. Use of cold. Massage after sports and warm up and warm down. Posture.

Techniques

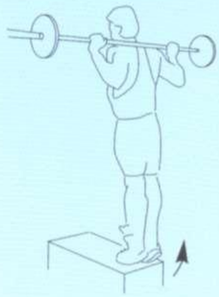
Spray and stretch	✓	✓	Dry needling		
Injections	✓		Trigger point release	✓	✓

SOLEUS





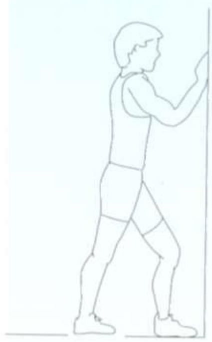
Strengthening exercises



Calf raise
(standing heel raise)

Calf raise
(seated heel raise)

Self stretches



Stretch increases dorsiflexion rather than inversion.

SOLEUS

Latin, sole-shaped (fish).

Part of the *triceps surae.* The soleus is so called because its shape resembles a fish. The calcaneal tendon of the soleus and gastrocnemius is the thickest and strongest tendon in the body.

Origin
Posterior surfaces of head of fibula and upper third of body of fibula. Soleal line and middle third of medial border of tibia. Tendinous arch between tibia and fibula.

Insertion

With tendon of gastrocnemius into posterior surface of calcaneus.

Action
Plantar flexes ankle joint. The soleus is frequently in contraction during standing to prevent the body falling forwards at the ankle joint, i.e. to offset the line of pull through the body's centre of gravity. Thus, it helps to maintain the upright posture.

Nerve
Tibial nerve, L5, S1, **2.**

Basic functional movement
Example: Standing on tip-toes.

Indications

Calf pain. Heel pain. Posterior knee pain. Chronic and long-term use of high-heeled shoes.

Referred pain patterns
Pain in distal Achilles tendon and heel to the posterior half of foot. Calf pain from knee to just above Achilles tendon origin. 4-5cm zone of pain in sacroiliac region ipsilateral (rare).

Differential diagnosis
Achilles tendonitis. Compartment syndrome. Vascular disease. Heel spur. Fasciitis. Subtalar joint problems. Venous pump mechanisms. Tendon rupture. Baker's cyst. Shin splints. Stress fracture. Leg length discrepancy.

Also consider

Popliteus. Gastrocnemius. Tibialis posterior. Quadratus plantae (of foot). Abductor hallucis (of foot).

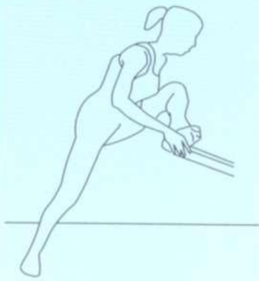
Advice to patient
Change footwear. Change and vary running techniques and running surface. Change/avoid high-heeled shoes. Regular stretching. Leg rests at home and at work. Use of cold. Massage after sports and warm up and warm down. Posture.

Techniques

Spray and stretch	✓	✓	Dry needling		
Injections	✓		Trigger point release	✓	✓

POPLITEUS

Self stretches



POPLITEUS

Latin, *poplcs,* ham.

The tendon from the origin of popliteus lies inside the capsule of the knee joint.

Origin

Lateral surface of lateral condyle of femur. Oblique popliteal ligament of knee joint.

Insertion

Upper part of posterior surface of tibia, superior to soleal line.

Action

Laterally rotates femur on tibia when foot is fixed on the ground. Medially rotates tibia on femur when the leg is non-weight bearing. Assists flexion of knee joint (popliteus 'unlocks' the extended knee joint to initiate flexion of the leg). Helps reinforce posterior ligaments of knee joint.

Nerve

Tibial nerve, L4, 5, S1.

Basic functional movement

Example: Walking.

Indications

Pain in back of knee in squatting, crouching, walking and/or running. Pain behind knee on walking uphill and going downstairs. Stiff knee on passive flexion and extension.

Referred pain patterns

Localized 5-6cm zone of pain (posterior and central knee joint) with some spreading of diffuse pain, radiating in all directions, especially interiorly.

Differential diagnosis

Avulsion. Cruciate ligaments (instability). Baker's cyst. Osteoarthritis. Tendonitis. Cartilage (meniscus) injury. Vascular (deep vein thrombosis, thrombosis). Tenosynovitis.

Also consider

Hamstrings (biceps femoris). Gastrocnemius (ligamentum patellae). Plantaris.

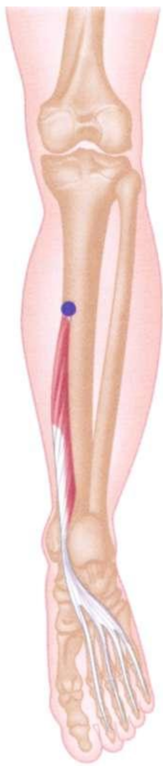
Advice to patient

Avoid 'overload' on weight-bearing activities. Shoe orthotics. Stretching programme. Cycling position.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	✓
Injections	✓		Trigger point release	✓	

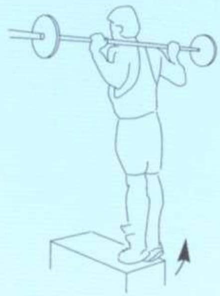
FLEXOR DIGITORUM LONGUS/FLEXOR HALLUCIS LONGUS



Flexor digitorum longus

Flexor hallucis longus

Strengthening exercises

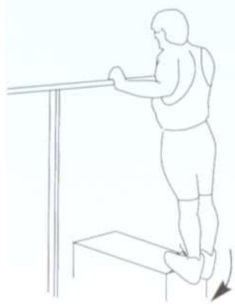


Calf raise
(standing heel raise)

Calf raise
(seated heel raise)

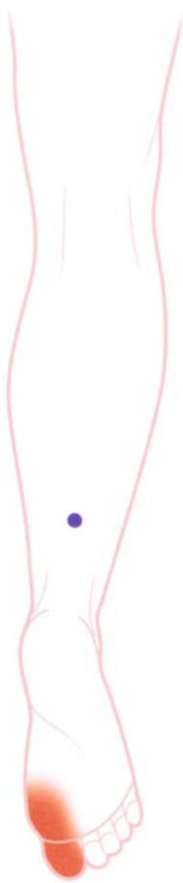
Self stretches

Curl your toes under to extend the toe joints.



Keep your toes extended.

Flexor digitorum longus



Flexor hallucis longus

Latin, *flex*, to bend; *digit*, toe; *longus*, long; *hallux*, great toe.

The insertion of the tendons of flexor digitorum longus into the lateral four toes parallels the insertion of flexor digitorum profundus in the hand. Flexor hallucis longus helps maintain the medial longitudinal arch of the foot.

Origin
Flexor digitorum longus: medial part of posterior surface of tibia, below soleal line.
Flexor hallucis longus: lower two-thirds of posterior surface of fibula. Interosseous membrane. Adjacent intermuscular septum.

Insertion
Flexor digitorum longus: bases of distal phalanges of second through fifth toes.
Flexor hallucis longus: base of distal phalanx of great toe.

Action
Flexor digitorum longus: flexes all the joints of the lateral four toes. Helps to plantar flex the ankle joint and invert the foot.
Flexor hallucis longus: flexes all the joints of the great toe, and is important in the final propulsive thrust of the foot during walking. Helps to plantar flex the ankle joint and invert the foot.

Nerve
Tibial nerve, L5, S1, (2).

Basic functional movement
Walking/pushing off the surface in walking (esp. bare foot on uneven ground). Standing on tip-toes.

Indications
Foot pain on weight-bearing. Foot pain on uneven surfaces. Big toe pain.

Referred pain patterns
Flexor digitorum longus: vague linear pain in medial aspect of calf, with the main symptoms of plantar forefoot pain.
Flexor hallucis longus: strong pain in big toe, both plantar and into first metatarsal head.

Differential diagnosis
Shin splints. Compartment syndromes. Tendon ruptures. Instability of foot/ankle (medial). Stress (march) fracture. Morton's neuroma. Hammer toe/claw toe. Hallux valgus. Metatarsalgia. Osteoarthritis of first metatarsophalangeal joint. Gout. Plantar fasciitis.

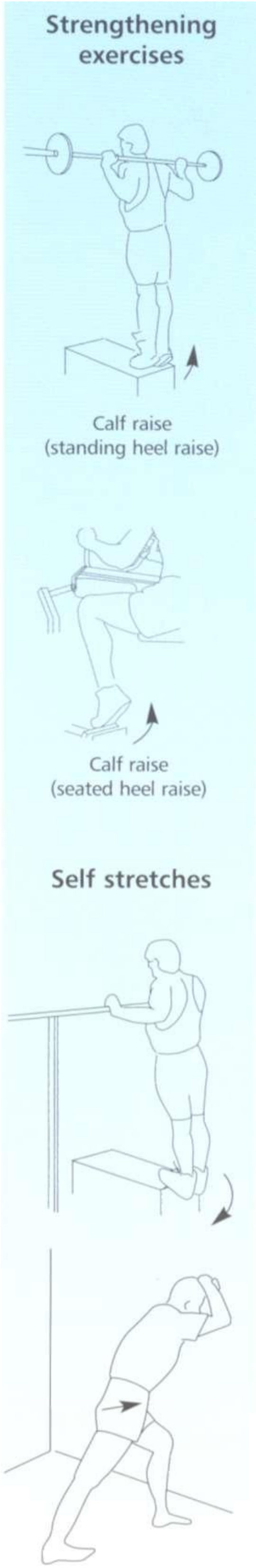
Also consider
Superficial and deep intrinsic foot muscles. Tibialis posterior. Long and short extensors of toes.

Advice to patient
Examine/change in footwear. Gait and posture analysis. Regular stretching. Advice on running technique (e.g. run on flat surface).

Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓		Trigger point release	✓	✓

TIBIALIS POSTERIOR



TIBIALIS POSTERIOR

Latin, *tibia,* pipe or flute/shinbone; *posterior,* behind.

Tibialis posterior is the deepest muscle on the back of the leg. It helps maintain the arches of the foot.

Origin

Lateral part of posterior surface of tibia. Upper two-thirds of posterior surface of fibula. Most of interosseous membrane.

Insertion

Tuberosity of navicular. By fibrous expansions to the sustentaculum tali, three cuneiforms, cuboid and bases of the second, third and fourth metatarsals.

Action

Inverts the foot. Assists in plantar flexion of the ankle joint.

Nerve

Tibial nerve, L(4), **5,** S1.

Basic functional movement

Examples: Standing on tip-toes. Pushing down car pedals.

Indications

Achilles tendonitis. Calf pain. Heel pain. Plantar fasciitis. Pain when running/walking on uneven surface.

Referred pain patterns

Vague calf pain with increased intensity along Achilles tendon to heel/sole of foot.

Differential diagnosis

Shin splints. Posterior tibial compartment syndrome (deep). Tendon rupture. Tenosynovitis. Cardiovascular. Achilles tendonitis. Deep vein thrombosis.

Also consider

Flexor digitorum longus. Peroneal muscles. Flexor hallucis longus. Foot mechanics.

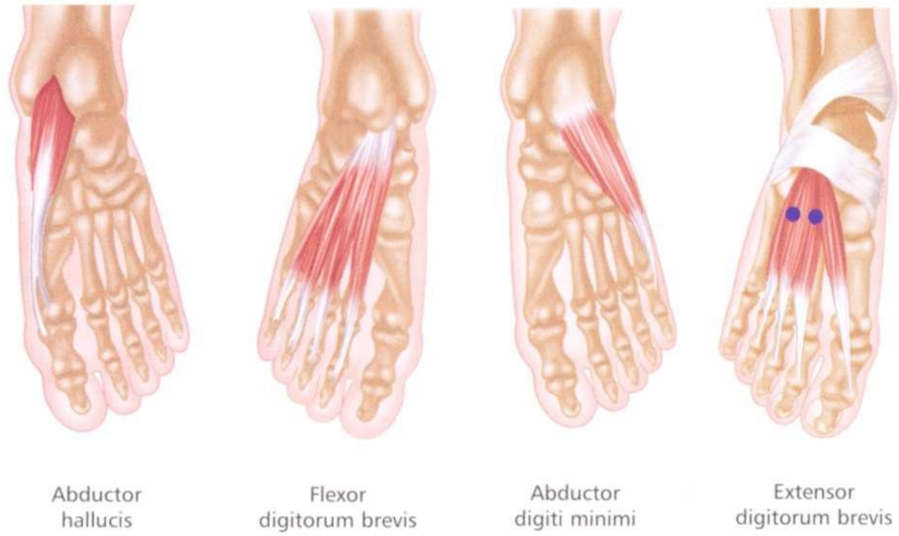
Advice to patient

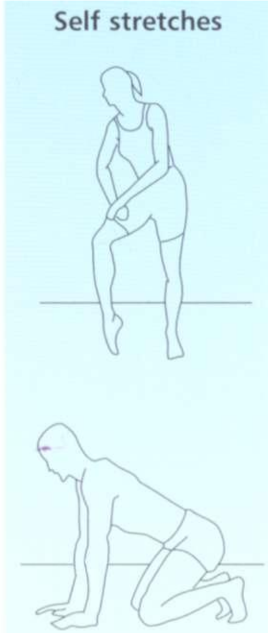
Arch supports/orthotics. Change running shoes. Change running surface. Home stretching programme. Use of cold and stretch.

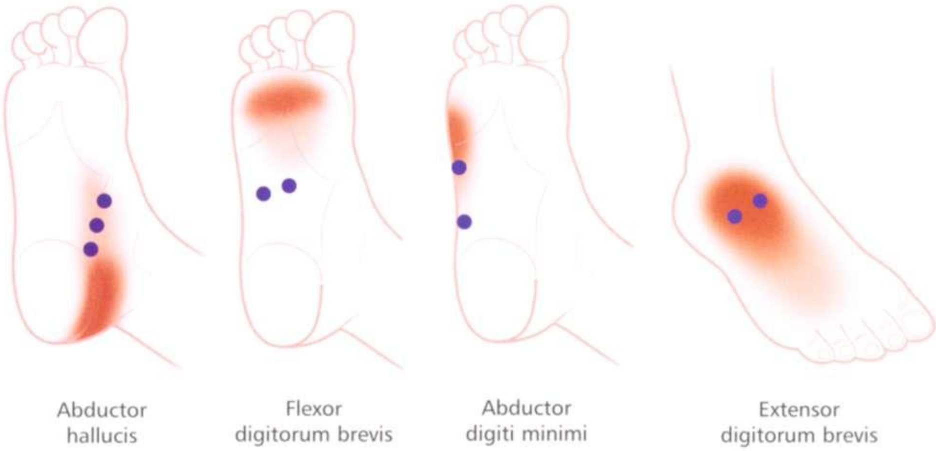
Techniques

Spray and stretch	✓	✓	Dry needling		
Injections			Trigger point release	✓	✓

SUPERFICIAL MUSCLES OF THE FOOT







Latin, *abduct,* away from; *hallux,* great toe; *flex,* to bend; *digit,* toe; *brevis,* short; *minimi,* smallest, *extensor,* to extend.

Comprising: abductor hallucis, flexor digitorum brevis, abductor digiti minimi, extensor digitorum brevis.

Origin

Abductor hallucis: tuberosity of calcaneus. Flexor retinaculum. Plantar aponeurosis.
Flexor digitorum brevis, abductor digiti minimi: tuberosity of calcaneus. Plantar aponeurosis. Adjacent intermuscular septa.
Extensor digitorum brevis: anterior part of superior and lateral surfaces of calaneus. Lateral talocalcaneal ligament. Inferior extensor retinaculum.

Insertion
Abductor hallucis: medial side of base of proximal phalanx of great toe.
Flexor digitorum brevis: middle phalanges of second to fifth toes.
Abductor digiti minimi: lateral side of base of proximal phalanx of fifth toe.
Extensor digitorum brevis: base of proximal phalanx of great toe. Lateral sides of tendons of extensor digitorum longus to second, third and fourth toes.

Action
Abductor hallucis: abducts and helps flex great toe at metatarsophalangeal joint.
Flexor digitorum brevis: flexes all the joints of the lateral four toes except the distal interphalangeal joints.
Abductor digiti minimi: abducts fifth toe.

Extensor digitorum brevis: extends the joints of the medial four toes.

Nerve
Abductor hallucis, flexor digitorum brevis: medial plantar nerve, L4, **5,** S1.
Abductor digiti minimi: lateral plantar nerve, S2, 3.
Extensor digitorum brevis: deep fibular (peroneal) nerve, L4, **5,** S1.

Basic functional movement
Example: Facilitates walking. Helps foot stability and power in walking and running. Helping to gather up material under the foot by involving the big toe.

Indications
Foot pain (dorsal and plantar). 'Soreness' on walking, with 'aching' at rest. Pain on 'tip-toes'. Pain on weight-bearing, on 'initial' standing from sitting. Chronic high-heeled shoe wear.

Referred pain patterns
Abductor hallucis: medial heel pain radiating along the medial border of foot.
Flexor digitorum brevis: pain in plantar aspect of foot beneath (2-4th) metatarsal heads.
Abductor digiti minimi: pain in plantar aspect of foot beneath 5th metatarsal head.
Extensor digitorum brevis: have a strong oval overlapping zone of pain (4—5cm) in the lateral dorsum of foot just below the lateral malleolus.

Differential diagnosis
Avulsion fracture styloid process. Hallux valgus. Flat-footed. Hallux rigidus or hypermobility. Metatarsalgia. Hammer toe/claw toe deformity. Heel spur. Stress (march) fracture. Compartment syndromes. Varus and valgus of foot.

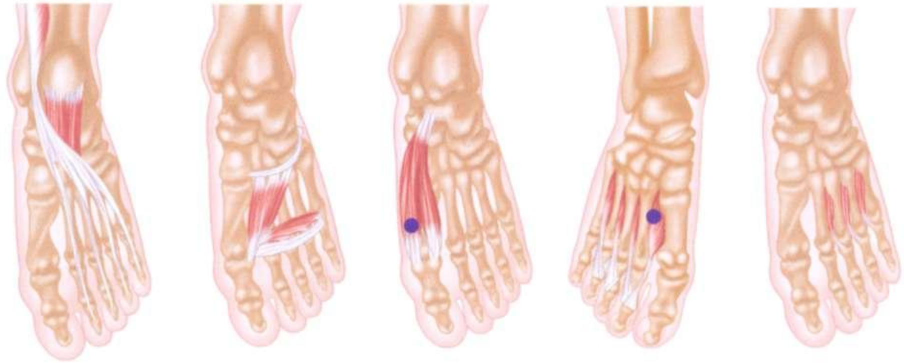
Also consider
Plantar interossei. Quadratus plantae. Adductor hallucis. Extensor digitorum longus. Extensor digitorum brevis. Flexor digitorum brevis. Hip, knee, ankle, and foot mechanics. Extensor hallucis brevis. Abductor hallucis.

Advice to patient
Gait and posture analysis. Footwear. Orthotics. Home stretching using a golf/ tennis ball or rolling pin. Use a small heel. Warmth and stretch.

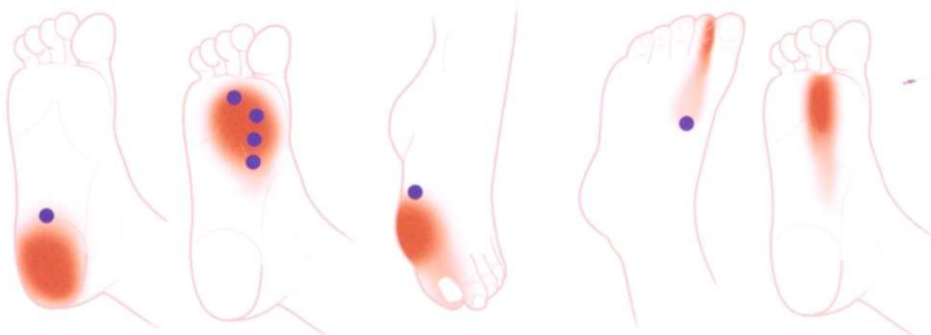
Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

DEEP MUSCLES OF THE FOOT



Quadratus plantae | Adductor hallucis | Flexor hallucis brevis | Dorsal interossei | Plantar interossei



Quadratus plantae | Adductor hallucis | Flexor hallucis brevis | (plantar view) Dorsal interossei

Latin, *quadratus,* squared; *planta,* sole of the foot; *adduct,* towards; *hallux,* great toe; *flex,* to bend; *brevis,* short; *dorsum,* back; *interosseus,* between bones.

Comprising: quadratus plantae, adductor hallucis, flexor hallucis brevis, dorsal interossei, plantar interossei.

Origin

Quadratus plantae: medial head: medial surface of calcaneus; lateral head: lateral border of inferior surface of calcaneus.

Adductor hallucis: oblique head: bases of second, third and fourth metatarsals. Sheath of peroneus longus tendon; transverse head: plantar metatarsophalangeal ligaments of third, fourth and fifth toes. Transverse metatarsal ligaments.

Flexor hallucis brevis: medial part of plantar surface of cuboid bone. Adjacent part of lateral cuneiform bone. Tendon of tibialis posterior.

Dorsal interossei: adjacent sides of metatarsal bones.

Plantar interossei: bases and medial sides of third, fourth and fifth metatarsals.

Insertion
Quadratus plantae: lateral border of tendon of flexor digitorum longus.
Adductor hallucis: lateral side of base of proximal phalanx of great toe.
Flexor hallucis brevis: medial part: medial side of base of proximal phalanx of great toe; lateral part: lateral side of base of proximal phalanx of great toe.
Dorsal interossei: bases of proximal phalanges: first: medial side of proximal phalanx of second toe; second to fourth: lateral sides of proximal phalanges of second to fourth toes.
Plantar interossei: medial sides of bases of proximal phalanges of same toes.

Action
Quadratus plantae: flexes distal phalanges of second through to fifth toes. Modifies the oblique line of pull of the flexor digitorum longus tendons to bring it in line with the long axis of the foot.
Adductor hallucis: adducts and assists in flexing the metatarsophalangeal joint of the great toe.
Flexor hallucis brevis: flexes the metatarsophalangeal joint of the great toe.
Dorsal interossei: abduct (spread) toes. Flex metatarsophalangeal joints.
Plantar interossei: adduct (close together) toes. Flex metatatarsophalangeal joints.

Nerve
Quadratus plantae, adductor hallucis, dorsal interossei, plantar interossei: lateral plantar nerve, S1, **2.**
Flexor hallucis brevis: medial plantar nerve, L4, **5,** S1.

Basic functional movement
Example: Holding a pencil between the toes and the ball of the foot. Helping to gather up material under the foot by involving the big toe. Making a space between the big toe and the adjacent toe. Facilitates walking.

Indications
Foot pain. Heel pain. Pain in first metatarsophalangeal joint. Bunions/hallux valgus. Pain in second toe. Forefoot pain. Stiffness in tissues (inability to use orthotic support). Problems with walking. Numbness in foot. Hip/knee/ankle pain.

Referred pain patterns
Quadratus plantae: heel pain; adductor hallucis: forefoot pain; flexor hallucis brevis: pain around first metatarsophalangeal joint; dorsal/plantar interossei: second digit pain (antero-posterior).

Differential diagnosis
Morton's neuroma. Metatarsalgia. Plantar fasciitis. Heel spur. Stress fracture. Articular (joint) dysfunctions. Injured sesamoid bones. Lumbar radiculopathy (foot drop). Hallux valgus. Calcaneal compartment syndrome. Gout. Arthritis.

Also consider
Hip, knee and ankle problems. Flexor digitorum brevis.

Advice to patient
Stretching with cold (and/or hot). Examine footwear (is it too tight?). Treat any joint dysfunctions. Stretching exercises/home stretch over tennis/golf ball. Proper orthotics. Gait and posture analysis.

Techniques

Spray and stretch	✓	✓	Dry needling	✓	
Injections	✓	✓	Trigger point release	✓	✓

Putting It All Together: Trigger Points and Beyond

10

Holding Patterns

Four New 'Laws'

Treat Trigger Points in Reverse

"The fascia is the place to look for the cause of disease and the place to consult and begin the action of remedies in all diseases."

Andrew Taylor Still, the founder of osteopathy

Identifying and treating trigger points can be very effective therapeutically, but trigger points rarely develop in isolation. As we have seen, longstanding trigger points may lead to secondary (and even tertiary) trigger point formation elsewhere in the body. To obtain the best results from trigger point therapy it is important to release trigger points in context, and often in the reverse order in which they manifest!

Holding Patterns

A few years ago, I was stuck in an airplane for almost an hour, circling around Heathrow Airport, waiting for a landing 'window'. The captain informed us that we were in a holding pattern and should be landing shortly. I have thought a lot about this phrase ever since. For me it neatly encapsulates the way I see a patient when they present in the therapeutic setting. Patients may come with acute or chronic symptoms but whatever the origin, the body's myofascial framework adapts and changes in a 'holding pattern'. Over time, the 'normal' muscle functioning fails, often resulting in trigger point formation. The longer a problem persists, the more rigid these patterns become. Chains of sarcomeres fail and chronic recalcitrant trigger points form.

It is therefore important to see trigger points in context: What is the body trying to achieve? Why has its tolerance/compensation broken down? Where and what is the central or core issue? I encourage my students to think like detectives; find the 'tissues causing symptoms' and then reflect and observe how the body has adapted over time to compensate. This requires a holistic view of the patient's body organs, bones and supporting tissues as well as their posture, occupation and general wellbeing.

Treatment Protocols

In this section, I will present some ideas on the where's and why's of trigger point formation, and then offer advice about how to synthesise an effective trigger point therapy protocol for a range of common conditions.

Four New 'Laws'

The pathophysiology of trigger point genesis is becoming increasingly understood; however, an overall explanation of 'how, where and why' trigger points manifest is still elusive. It is clear that trigger points are more likely to develop under certain physical, psychological and biochemical states, but to be able to predict how and where they manifest can be clinically useful. Based on my own original approach to treating shoulder pain (www.defrosttraining.com) I would like to propose the following 'laws' as considerations for determining the above:

1. Trigger points tend to develop along 'myofascial meridians'.

These meridians are myofascial channels that dissipate and distribute forces from right to left, up to down, and deep to superficial. It is important to remember that muscles do not operate in isolation, but might be considered as the contractile element of the myofascial continuum, which runs throughout the

Putting It All Together: Trigger Points and Beyond

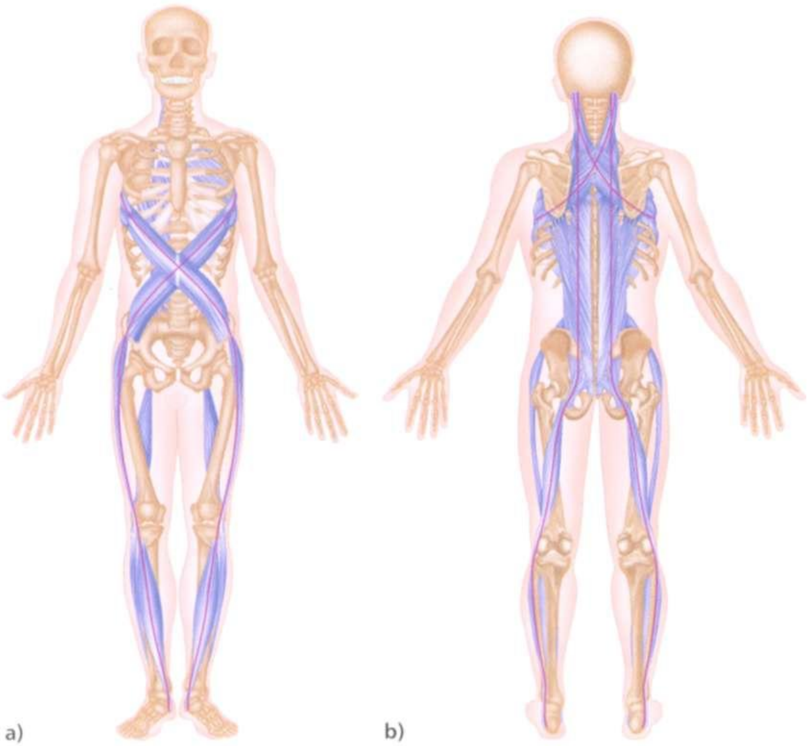


Figure 10.1: The spiral (oblique) chain (S/OC); a) anterior view, b) posterior view.

Figure 10.2: The lateral chain (LC).

body. These meridian maps may help to explain how and why development of primary central trigger points in one area of the body may lead to secondary or satellite trigger points distally. They may also explain the 'crossover' patterns discussed in Chapter 2. The term 'meridian' derives from acupuncture, and Traditional Chinese Medicine (TCM) describes bio-energetic lines or channels that are said to flow throughout the body.

Myokinetic Chains and Sub-links

The brain/body employs a range of neuromuscular strategies to co-ordinate muscular contraction and thus facilitate stability and spatial orientation. All of our body systems and structures work together in interdependent and connected ways. Myers (2001) presented several ideas for the myofascial component of these connections in his seminal work *Anatomy Trains,* labelling them 'myofascial meridians'. Sharkey (2008) developed this concept further; he presented these meridians as a series of 'functional kinetic chains'. Sharkey suggested that the body dissipates kinetic forces (energy) through the *'spiral/oblique chain, lateral chain, posterior sagittal chain and anterior sagittal chain'.* Several other secondary chains and/or connections also co-exist, being both deep and superficial.

The Spiral (Oblique) Chain (S/OC)

The spiral (oblique) chain includes the external oblique, internal oblique (contra-lateral), adductors, iliotibial band, tibialis anterior and peroneus longus/brevis. This chain can also include the following links: serratus anterior, ipsilateral rhomboids and contra-lateral splenius capitis.

The Lateral Chain (LC)

The lateral chain includes the peroneals, iliotibial band, tensor fasciae latae, the gluteals, external and internal obliques, ipsilateral adductors and quadratus lumborum (contra-lateral). The lateral chain may include the following links: intercostals, sternocleidomastoideus and splenius capitis/cervicis, scalenes.

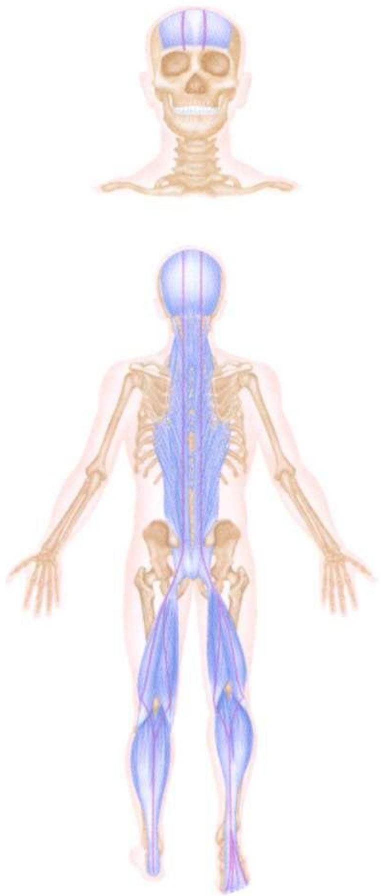


Figure 10.3: The posterior sagittal chain (PSC).

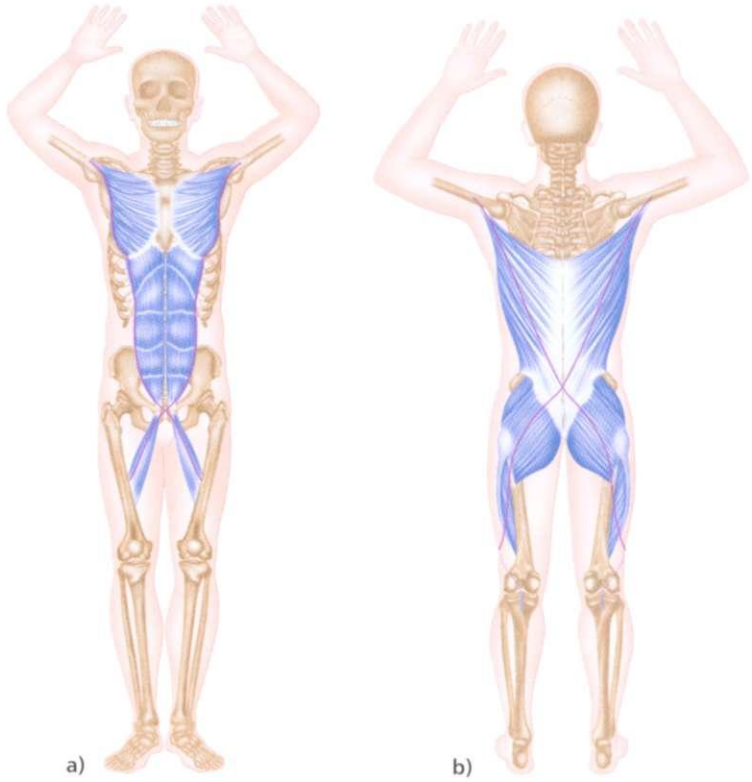


Figure 10.4: The posterior oblique links (POL).

Posterior Sagittal Chain (PSC)

The posterior sagittal chain includes the thoraco-lumbar fascia and muscular links both above and below, offering movement and support to the joints of the periphery as well as to the spinal joints. At the mid-section, sub-links include the transversus abdominis and posterior fibres of the internal obliques. The pelvic floor muscles include pyramidalis, multifidi and lumbar portions of the longissimus, iliocostalis and the diaphragm, more commonly known as the *core muscles.* Of course this joint support system is also present at the glenohumeral and lumbo-pelvic-hip complex.

A deep posterior or sagittal chain involves local, deep, segmentally related muscles providing localized support for motion in segments or joints (Tonic or Type II fibres).

A superficial oblique posterior chain involves prime movers or more global muscles that are, as the name implies, predominantly superficial. These muscles are primarily phasic and are heavily populated with Type I fibres with a high resistance to fatigue.

The posterior sagittal chain includes occipitofrontalis, erector spinae, thoraco-lumbar fascia, multifidus, sacrotuberous ligament, biceps femoris (short head). This link can be continued to include the gastrocnemius and plantar fascia.

The posterior oblique links (POL) includes latissimus dorsi, contra-lateral gluteus maximus and thoracolumbar fascia. This chain can be continued to include the following links: iliotibial band, tibialis anterior and the peroneals.

Putting It All Together: Trigger Points and Beyond

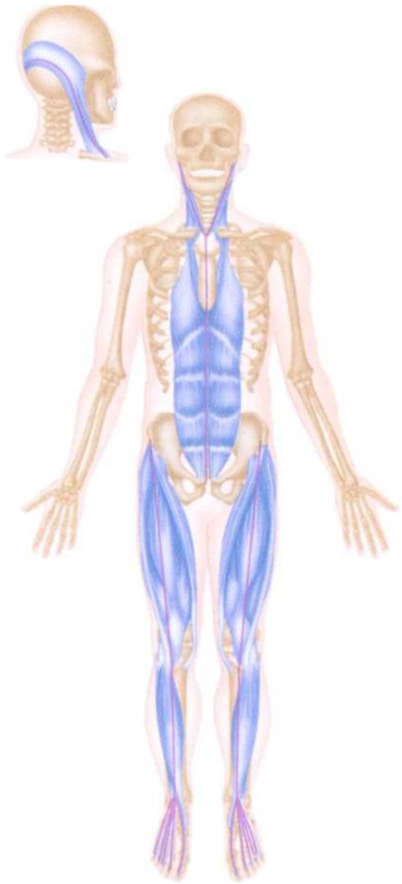


Figure 10.5: The anterior sagittal chain (ASC).

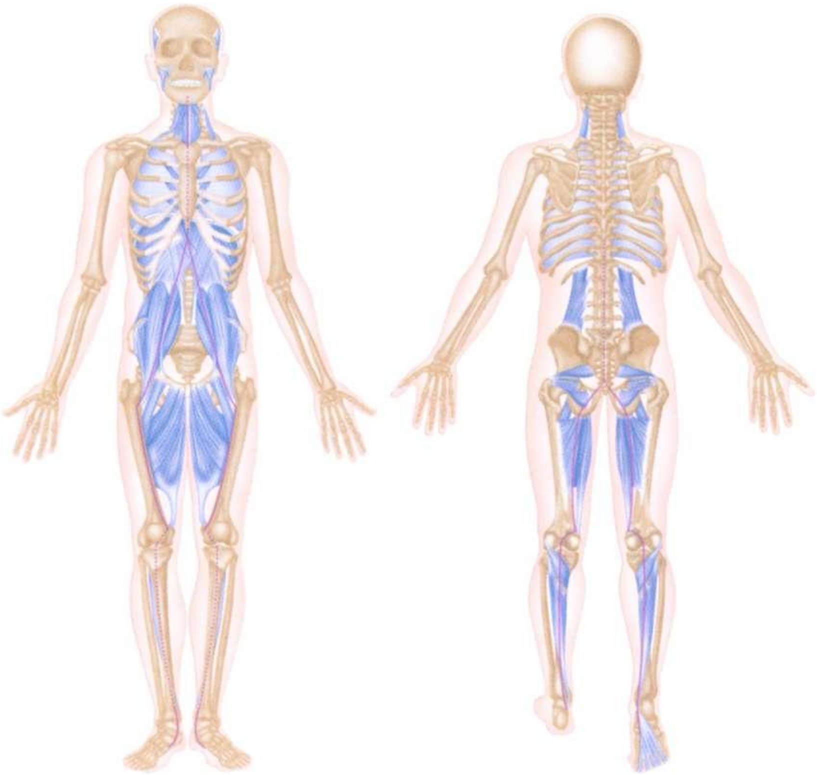


Figure 10.6: The deep anterior chain (DAC).

The Anterior Sagittal Chain (ASC)

The anterior sagittal chain includes the dorsal surface of the foot, tibial periosteum, rectus femoris (including articularis genu), AIIS (anterior inferior iliac spine), pubic tubercle, rectus abdominis, sternal periosteum, sternocleidomastoideus and periosteum of the mastoid process.

The Deep Anterior Chain (DAC)

The deep anterior chain includes the inner arch of the plantar surface (first cuneiform), tibialis posterior, medial tibial periosteum, adductors, linea aspera, ramus of the ischium and pubis, lesser trochanter, iliacus, anterior longitudinal ligament, psoas major, central tendon of diaphragm, mediastinum and pericardium, pleural fascia, prevertebralis fascia, fascia scalenes, longus capitis, hyoid and associated fascia, mandible, occiput and galea aponeurotica.

2. Not all trigger points are equal.

Neuro-receptor Referencing

We perceive and filter the world around us through our senses; we constantly create and re-enforce our internal sensory narrative as a sensory map. These inputs are interpreted by specialized receptors embedded in our tissues (see below) that relay their information via the dorsal column of the spinal cord to the somato-sensory cortex of the brain. It is interesting to note that muscles themselves are a key component for this sensory feedback (pain, joint position and spatial awareness). Bach muscle in the body has a different distribution and composite blend of proprioceptive organs embedded within them. 90% of the golgi tendon organs can be found in the muscles (Burke & Gandeva, 1990), and a further 10% in the enveloping myofascial envelopes. The fascia is also embedded with mechanoreceptors, which may well also respond to deep massage. (Schleip, 2003). Muscles contain approximately 300% more sensory fibres per square centimetre than motor fibres. Of these sensory receptors only 20% or so belong to the golgi tendon organs; the majority of the rest are much smaller in diameter and are now commonly referred to as *interstitial muscle receptors* (these also exist abundantly in fascia).

As discussed, treating trigger points can be painful, and depending on the techniques employed, almost always incorporates the stimulation of localized proprioceptors, deep and superficial sensation receptors, tactile sensation receptors, nociceptors and perhaps more importantly interstitial muscle receptors.

Type of receptor	Function
Mechanoreceptors	Specialized to respond to physical displacement; touch, pressure and movement
Thermoreceptors	Specialized to respond to sense changes in temperature
Nociceptors	Respond to noxious pain stimuli
Proprioceptors	Provide information about body position and movement; located in the joints and muscles
Chemoreceptors	Respond to specific chemical substances
Cutaneous	Embedded in the skin
Deep receptors	Embedded in muscles, tendons, joints and viscera
Superficial sensation	Mediated by cutaneous receptors for touch, superficial pressure, temperature and pain
Tactile sensation	Touch and superficial (light) pressure
Deep sensation	Embedded in joints and muscles including vibration, position and deep pressure
Interstitial muscle receptors	Embedded in muscles and fascia and may make up to 80% of all sensory fibres within muscles.
Visceral sensation	Embedded in the viscera including visceral pain, hunger and nausea (mediated by chemoreceptors)

Table 6: Types of receptor embedded within muscle and fascia.

	Preferred location	Responsive to	Known results of stimulation
Golgi Type Ib 	• Myotendinous junctions • Attachment areas of aponeuroses • Ligaments of peripheral joints • Joint capsules • Muscles	*Golgi tendon organ:* muscular contraction *Other golgi receptors:* strong stretch only, probably	Tonus decrease in related striated motor fibres
Pacini & paciniform Type II 	• Myotendinous junctions • Deep capsular layers • Spinal ligaments • Investing muscular tissues	Rapid pressure changes and vibrations	Used as proprioceptive feedback for movement control
Ruffini Type II 	• Ligaments of peripheral joints • Duramater • Outer capsular layers • Other tissues associated with regular stretching	Rapid pressure changes and vibrations, sustained pressure Lateral stretch, particularly	Inhibition of sympathetic activity
Interstitial Type III & IV 	• Most abundant receptor type • Highest density in periosteum	Rapid as well as sustained pressure changes	Changes in vasodilation

Table 7: Mechanoreceptors in fascia.

Super Trigger Points

It follows that trigger point formation within certain more densely populated sensory muscles may lead to more than just the development of chronic and stubborn trigger points. I have observed that in such muscles, releasing trigger points seems to have even more systemic effects than expected. I call these *physiological* or *super* trigger points (STPs). Stimulating these points seems to have profound physiological effects (such as autonomic changes) well beyond the 'normal' trigger point reactions. I have found that incorporating these points into a treatment protocol acts as a type of short cut rapidly releasing deep seated and chronic pain syndromes. Examples of these *physiological* or *super* trigger points can be found in:

- Scalenes: hand and wrist pain and neuro-vascular problems such as CRPS I;
- Infraspinatus near medial scapula: Anterior (biceps brachii) shoulder pain;
- Gluteus medius: lower back pain;
- Ligamentum patellae (patellar ligament): knee pain;
- Popliteus: knee pain;
- Extensor digitorum longus (at the junction of the talocrural joint): ankle balance (post-fracture rehabilitation) and ankle pain.

I have presented more examples of these STPs in the self-help section.

Figure 10.7: Somato-sensory and somato-motor cortex.

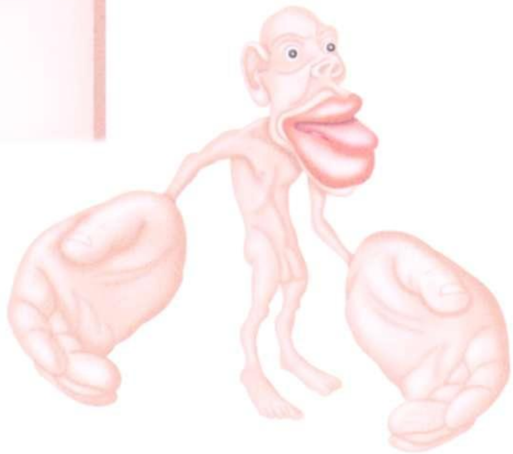


Figure 10.8: Sensory homunculus.

3. Trigger points warp sensory perception.

The way we see each other is not the way the brain sees us! After extensive stimulation of certain areas of the brain, Penfield (1954) suggested that sensory input [which enters the somato-sensory cortex via the thalamus] and somato-motor output [ending at the motor end plate] could be represented as maps in the brain. These maps are similar but slightly different. Penfield developed models which represent these maps and called them *homunculi* or little men. As you can see (figure 10.7), certain areas have a larger representation; this is directly related to the number and types of sensory receptors embedded within these tissues. Our hands, with which we discern and manipulate our environment, have a much greater representation than, for example, our shoulders.

Like other mammals, we have many deep-seated, pre-programmed reflexes to avoid showing others we are in pain, in part to avoid predators. As a response to injury and damaged tissues, the brain switches off 'normal' antagonistic muscular co-ordination patterns via a number of motor responses. In an attempt to compensate for this, the body may demand alternative muscles (synergists) to do different jobs to the ones they are best designed for. This increased demand may lead to altered physiological states within the muscles and to trigger point development. As discussed, trigger points can cause host muscle weakness and generally decreased function. Over time, this may lead to the 'holding patterns' which I discussed at the beginning of this chapter. These patterns can be 'overreactions' (pain is not the same from person to person) due to a number of factors. Once established, they are maintained mainly by the cortex, cerebrospinal tract and rubrospinal tract. (Steward, O., 2000).

Pain is a very complex modality and much has been written about it. It may seem somewhat paradoxical to treat pain with more pain! The pain induced by trigger point stimulation can be intense (remember the jump and twitch signs?). As discussed above, this pain is mediated via the stimulation of various muscle mechanoreceptors, which relay information to the sensory cortex.

Treating discrete trigger points fools the brain and initiates a cascade of neuro-vascular responses at the local tissue level, the spinal cord level (PNS) and in the cortex (CNS). Mitchell & Schmidt (1977) demonstrated that stimulating myofascial mechanoreceptors produced a response in the local autonomic loop, altering the blood pressure in local arterioles and capillaries. Additionally, stimulation of ruffini endings appears to have a similar effect in terms of a lowering of sympathetic activity. (Van den Berg, F. & Cabri, J., 1999). More recently the introduction of functional MRIs has introduced a new and exciting neurological paradigm which challenges our perception of self to its very core. The work of Ramachandran (1999) with phantom limb pain and Melzack (2001) with his neuro-matrix has started to shift our fixed ideas of hard wiring in the cortex into ideas of 'neuroplasticity'.

The Phantom Limb

It has been suggested that far from being hard-wired, our motor homunculus relies on feedback from the sensory homunculus to reinforce and maintain our innate image of self. Phantom limb pain occurs in up to 70% of people who have been born without a limb, or who have lost a limb due to an accident, surgery or illness. The pain is frequently described as 'a constant twisted pain' like the limb has been 'shrunk' and is 'gnarled'. The limb feels as if it is held in a spastic posture. The pain can prevent the sufferer from sleeping, and sufferers can even report feeling phantom rings or wrist watches.

Ramachandran suggested that our sensory homunculus of four limbs is hard-wired into the cortex. This map relies on constant feedback from the sensory receptors embedded within the skin and myofascial complex. When one limb is missing there is a lack of sensory referencing (i.e. the map has four limbs but it only receives input from three). The brain is forced to *invent* feedback as a phantom or ghost memories (Ramachandran and Blakeslee, 1998).

Ramachandran demonstrated that he could recreate the phantom pain by stroking a hand-shaped region on the cheek on the affected side (for the upper limb). This is because the sensory terminals for the hand are located in the cortex next to the cheek. Due to disuse atrophy, the sensory terminals for the hand die away and the area is invaded by neighbouring neurons from the cheek. He then went on to challenge notions of fixed cortical wiring by inventing an elegant yet simple experiment: the mirrored box.

The Mirrored Box

Patients placed their good limb (such as a hand) in a mirrored box (Ramachandran, 1996). Patients were asked to manipulate objects in front of the mirror and concentrate hard on the mirror image. The mirror setup superimposed the visual image of their remaining arm on the cortical map location of their phantom arm. Some patients regained voluntary control over their phantom arm and the pain melted away. The *visual stimulus* from their real arm, superimposed to the location of their phantom arm, was enough to fool their brain into believing that they had regained voluntary control. (Ramachandran and Blakeslee, 1999).

Ramachandran argued that by using the eyes as a primary sensory feedback circuit, the brain can somehow reinforce its sensory and thus motor maps by itself; by substituting visual stimuli for the missing sensory input, the brain thus enables a new circuit to be established.

I would like to suggest that the stimulation of trigger points might in some ways be doing the same thing. In this case we use mechanoreceptor inputs (rather than the visual input) as the primary sensory feedback circuit, affording the cortex a different sense of self. In a sense, the stimulation of trigger points can be used to re-program the cortex much like a new piece of software.

Somatic Input and Treatment Sequencing

Myofascial release techniques stimulate groups of receptors, creating a specific neurological profile within the somato-sensory cortex. By stimulating trigger points in a specific sequence, it is possible to change the somato-motor output. This attenuates the way the brain/body responds to injury. I have named this theory *Cortico Neuro-somatic Programming* (CNSP). Using sequential trigger point techniques in this way may also undo well-established *holding patterns.* (Most notably one can affect the way groups of muscles co-coordinate.)

I liken this theory to an aspect of Neuro-linguistic Programming (NLP). In NLP, the modality of language as an input is manipulated in specific ways. This seems to change the way that the brain interprets, processes and responds to various stimuli. In CNSP, somatic inputs (trigger points, pain responses, joint position and other somatic stimuli) can be blended in specific and co-ordinated sequences (or programs). The brain interprets these somatic inputs at the level of the spinal cord (locally) and somato-sensory cortex (distally); it responds by changing the somato-motor output (changing the reciprocal inhibition and facilitation patterns), resulting in a plethora of changes such as increased strength and power, reduced pain and disability and increased function.*

4. Trigger point release must be three-dimensional.

As we have seen, the brain has 3-D sensory and motor maps soft-wired into the cortex. Our brain (motor cortex) responds to our movement demands by co-ordinating complex sequences of motor units. These motor units can contract singly or collectively, and when more power is demanded, groups of units combine (recruitment). One of the key ways the motor system achieves smooth co-ordinated movement is by utilizing the type of *triangulation* known as *antagonism.* This triangle is formed by agonists, antagonists, (synergists) and fixators (see Chapter 1). When a trigger point develops in one of these three groups, the others are forced to compensate. A number of factors then come into play, which magnify these effects over time. These factors are: reciprocal inhibition (where an antagonist is partially or fully switched off), pure facilitation (where an antagonist is made stronger) and co-facilitation (where increased power is routed to teams of secondary muscles).

Much of the experimental data demonstrating antagonism has been generated on healthy volunteers. I would like to suggest that in the pathological situation, the brain is often forced to compromise this antagonism and, to this end, it exhibits a degree of neuroplasticity (There is some interesting evidence to support this idea in 'soleus reflex changes' in patients with cerebral palsy, Myklebust et al., 2004.) From my many years of work treating frozen shoulder syndrome, I have observed and studied the aberrant and perverted antagonistic functional muscular relationships known as the capsular pattern. The *capsular pattern* is universal, affecting all frozen shoulder sufferers in the same way. It represents a co-ordinated switching off of groups of muscles and a loss or reciprocal antagonism in response to the inflammation in and around the rotator interval (mainly of the long head of biceps brachii [LHB]) and the gleno-humeral capsule. I have observed that instead of the biceps brachii and triceps brachii working against each other as a discrete antagonistic functional pair, the biceps brachii and infraspinatus pair off; similarly the triceps brachii and pectoralis minor seem to change their functional relationship.

** In a randomized placebo controlled research trial for treating the 'frozen shoulder' (Rheumatology Research Unit at Addenbrooke's Hospital, UK), patients treated with The Niel-Asher technique® recorded significantly increased strength and power ($p = 0.047$ measured on a cybex dynamometer) when compared to standard physical therapy (no change) and a placebo treatment (decreased strength and power). Interestingly, I gave my treatment group no exercises whilst the physiotherapy group did undertake exercise. One of the hypotheses for this is that stimulating trigger points in a specific sequence changed the way the brain fires and co-coordinates motor signals to other (agonist, antagonist and fixator) shoulder muscles. For more details, visit www.frozenshoulder.com and/or www.defrosttraining.com.*

Putting It All Together: Trigger Points and Beyond

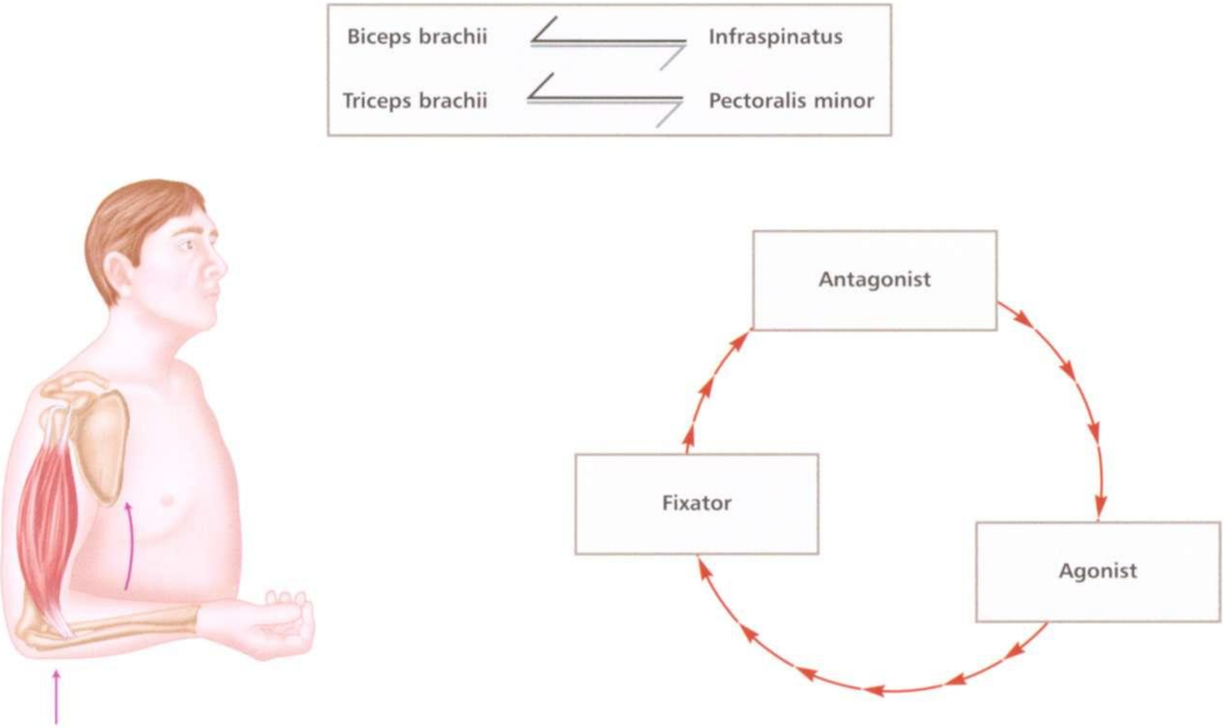


Figure 10.9: Observational functional antagonist reflex patterns for the 'capsular pattern' of the frozen shoulder.

You can observe this for yourself. If you stimulate the trigger point in the infraspinatus somewhere near the lateral scapular border in a supine patient with a frozen shoulder, she or he will almost always tell you that they can feel referred pain in the region of the biceps brachii (long head). In other words, treating a trigger point in the antagonist may reflect pain and reproduce the symptoms in the agonist.

Treat Trigger Points in Reverse

These types of functional relationships become apparent especially in muscles with chronic trigger points. In such cases, it pays to establish the primary tissues causing symptoms and then look at the antagonistic 'holding pattern'. I have found that first treating the *secondary* satellite or latent trigger points and only then the central myofascial trigger points makes treatment more effective and longer lasting. Stimulating a sequence of three points three times (one of these points should be a STP) allows the brain to *triangulate* the sensory input. The motor cortex responds automatically, releasing the holding patterns that have become established in the 3-D map. There is an old osteopathic adage: 'treat the secondary (holding) pattern and the primary problem will sort itself out'.

Manual Therapy and Self-help

Trigger point therapy can be an extremely effective tool in combating acute and chronic muscular pain and fatigue. As you can see from the inner workings of this book, there are a diverse range of techniques that the therapist can employ.

In this section, you will find manipulative sequences to treat a range of common musculo-skeletal problems. These are examples to which you can add or subtract additional points. **1** have included a number of super trigger points (STPs) that I have found effective in each specific case. However, before using the points I have suggested, please check the regional trigger point overview pages and referred pain maps; your pain may well come from another muscle.

Before embarking on the journey of treatment, please remember that the techniques offered in this section are not a substitute for proper therapy from a registered practitioner; although aches and pains from trigger points are common, there can sometimes be an underlying pathology. It is advisable to always seek a proper diagnosis from a qualified medical practitioner. You follow the treatment techniques in this book at your own risk.

Technique

For the purposes of this section, I will focus on the Inhibition-Ischaemic Compression Technique (ICT). This technique is the most straightforward and amongst the most effective, especially when combined with the manipulative sequences I have suggested. Perform the technique as follows:

Step 1
Look carefully at the shape, size and direction of the muscle fibres in which the trigger point is located.

Step 2
Feel the fibres of the muscle, taking note of the nodules beneath the skin. It is worth noting that with a longstanding problem, other areas will have suffered (holding pattern) and you may well find secondary trigger points in other local muscles.

Step 3
Massage the area generally with a deep stroking pressure in one direction only. Only put deep pressure through one of these painful spots when you have located the trigger point. Build up the pressure slowly until you have hit the 'pain zone'. If this is too much to bear, then reduce the pressure, but do not pull away entirely from the painful point. The initial reaction of the patient is to pull away (jump/twitch sign), but you must try to stay with the point until it is no longer painful. This can take anywhere up to two minutes. The pain will diminish, even on very tender areas. Ask the patient to focus on their breathing and visualise the tender point melting away. Be careful not to press too hard; you want to be in the painful zone, but no more than that. Try to get the right spot within this zone, hold it and then move the direction of pressure on this spot in a small circle. You should aim to be on the most painful point. If repeated, this procedure should give a good appreciation of the depth needed.

It is important that you do not come away too soon, as this will cause the tissues to tense against you. This type of sustained deep pressure has many effects, some of which have been discussed earlier.

Step 4
Follow all deep work with a more gentle generalised massage, again in one direction only. The area where you did the deep work may still be tender, but do not avoid it. This will help to dispel lactic acid and pain-inducing toxins from the area, and stimulate the repair of the fascia.

Some effects of pressure on the trigger points are a type of numbing of the treated area; attenuation of the pain feedback pathways; stretching tight structures, which will have an indirect effect on all tissue structures; opening out the plastic fascial bag; stimulating the blood supply to clear away debris and toxins; and the release of powerful pain-killing agents called endorphins.

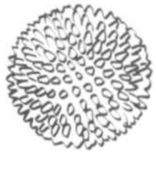
Sequences and Super Trigger Points
The treatment protocols outlined incorporate the three-point sequence discussed above (agonist, antagonist and fixators), one of which is a 'super' trigger point (STP). Please pause and spend a little more time on the spot when you hit an STP. Other trigger points can be added to the suggested sequences.

Other Tools
Whilst fingers, elbows and thumbs still remain the most readily utilized for treatment, a variety of self-help tools have been developed for manipulating trigger points. I have included some of them here for your reference.

Theracane

Backnobber

The Knobble



Balls

Regional Trigger Points for Head and Neck Pain

Temple headache

Trapezius
Semispinalis capitis
Suboccipitalis
Splenius cervicis
Lateral pterygoid
Temporalis

Headache (posterior head)

Suboccipitalis
Sternocleidomastoid
Digastricus
Temporalis
Splenius cervicis
Semispinalis capitis
Trapezius

Sinus area pain

Lateral pterygoid
Orbicularis oculi
Epicranius (frontalis)
Masseter
Temporalis
Sternocleidomastoid

Toothache

Masseter
Digastricus
Temporalis

Headache (top of head)

Splenius capitis
Sternocleidomastoid

Lateral neck pain

Levator scapulae
Digastricus
Medial pterygoid

Eye region pain

Orbicularis oculi
Masseter
Suboccipitalis
Trapezius
Temporalis
Occipitalis
Splenius cervicis

Posterior neck pain

Trapezius
Levator scapulae
Splenius cervicis
Erector spinae group

Headache (front of head)

Epicranius (frontalis)
Semispinalis capitis
Sternocleidomastoid
Orbicularis oculi

TMJ, jaw and ear pain

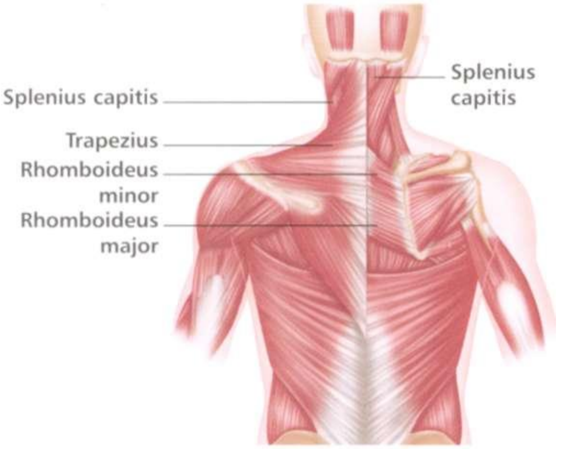
Upper trapezius
Splenius cervicis
Masseter
Temporalis
Both pterygoids
Digastricus
Cervical erector spinae

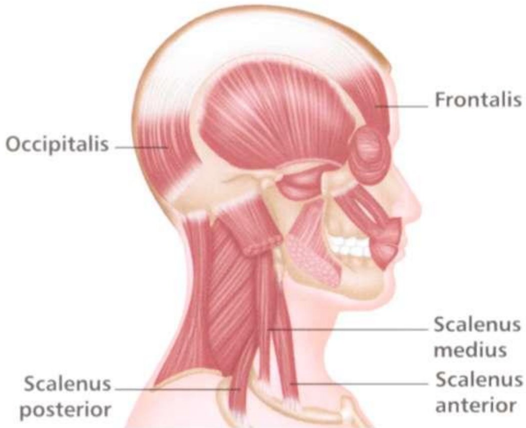
Neck Pain

Indications

Trigger point therapy can be very effective for this region. Indications include chronic tension and neck ache, stress headache, cervical spine pain and whiplash. These muscles often have multiple trigger points, and finding the correct ones is essential.

STEP 1 Study the anatomy and direction of muscle fibres.



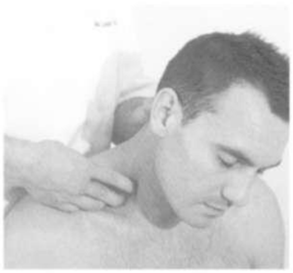


STEP 2

Sitting ICT to upper and middle trapezius (STP).

Slide down the rhomboideus group only pausing on the trigger points, lingering until the pain melts away.

Move up to trigger points within the splenius capitis.



Finally locate and inhibit trigger points in the scalenes group.

STEP 3 Massage the area generously.

STEP 4 With the patient supine, use the dragging massage technique on the cervical erector spinae:

Stand on the opposite side of the patient and place the fingertips under the muscles on the opposite side of the neck. Slowly drag the fingertips towards you, whilst asking the patient to turn their head towards you. Repeat on the other side.

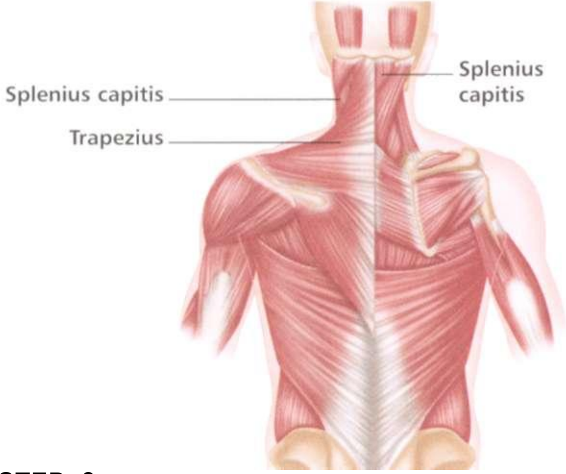
With the patient still supine, finish with ICT to the posterior points for epicranius (occipitofrontalis), asking the patient to drop the weight of the head into your fingers. Ask the patient to breathe and relax on the out-breath.

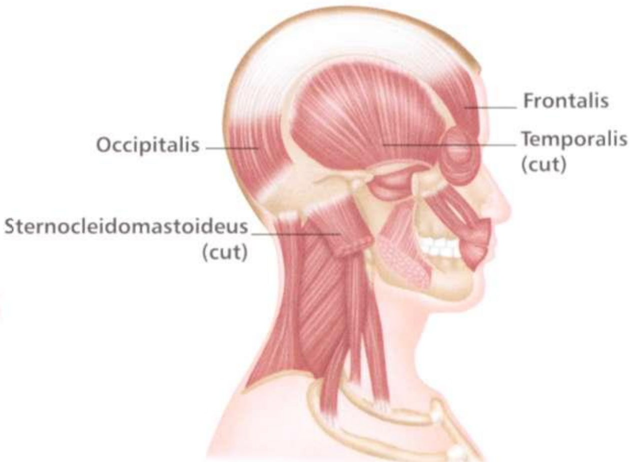
Headache

Indications

Headaches may occur for a variety of reasons, and they manifest in many different ways. If you have a severe or unrelenting headache, it is always worth consulting your doctor. Most headaches, however, have an associated element of muscular tension, which may well benefit from treatment of the trigger points.

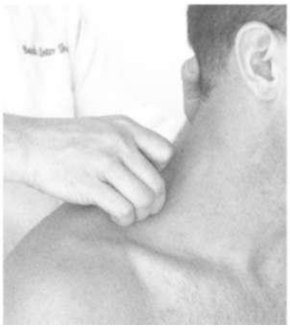
STEP 1 Study the anatomy and direction of muscle fibres.





STEP 2

Sitting ICT to sternocleidomastoid (delicately find and press on the trigger points). The head should be in a nodding forward position, and rotated, initially away and then towards the side of the pressure. Remember that there are a lot of delicate blood vessels and structures in this area of the neck.



Sitting ICT to trigger points within the upper trapezius.

STEP 3 Massage the area generously.

STEP 4

Supine ICT to cervical erector spinae and temporalis.

STEP 5

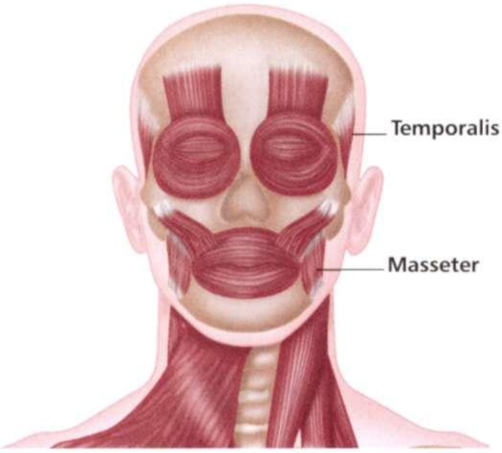
With the patient still supine, finish with ICT on the posterior points for occipitofrontalis asking the patient to drop the weight of their head into your fingers. Ask them to breathe and relax on the out-breath.

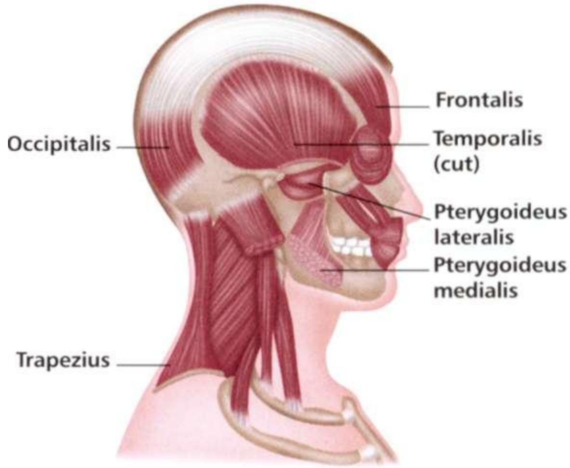
Temporomandibular Joint (TMJ) Syndrome

Indications

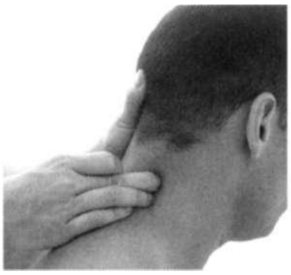
This debilitating condition is characterized by pain, stiffness and aching in the jaw muscles, especially in the region of the ear. It may be primary, as the result of anomalous jaw or bite formation, such as malocclusion or a variation in jaw joint anatomy; or secondary to a variety of conditions such as tooth clenching or grinding. It is always worth getting a proper opinion and diagnosis from a qualified dental practitioner. However, the following treatments may help reduce the severity and chronicity of TMJ pain.

STEP 1 Study the anatomy and direction of muscle fibres.





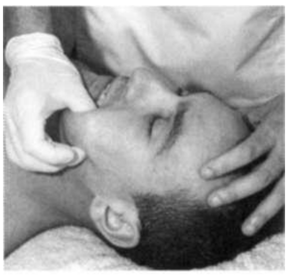
STEP 2

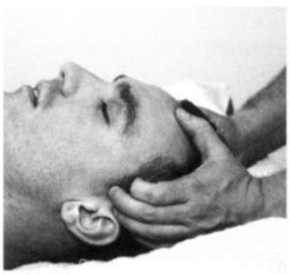


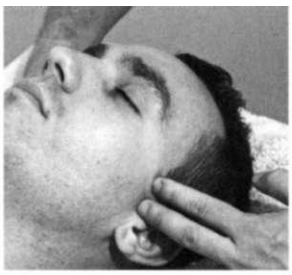
Sitting ICT to the upper trapezius, posterior cervical muscles and splenius cervicis.

STEP 3 Massage the area generously.

STEP 4







Supine ICT to masseter (internally using a glove); temporalis (STP), especially at the muscle/tendon junction; lateral and medial pterygoids; digastricus (being cautious about other local structures); and epicranius (occipitofrontalis).

Regional Trigger Points for Shoulder and Arm Pain

Anterior shoulder and arm

Anterior deltoid
Supraspinatus
Pectoralis major
Pectoral is minor
Infraspinatus
Long head of biceps brachii
Latissimus dorsi

Lateral shoulder

Teres minor
Infraspinatus
Supraspinatus
Lateral deltoid
Scalenes group

Posterior shoulder and arm

Teres minor
Infraspinatus
Supraspinatus
Teres minor and major
Posterior deltoid
Subscapularis
Latissimus dorsi
Triceps brachii
Scalenes group
(Pectoralis minor)

Lateral elbow/forearm pain

Triceps brachii
Extensor group
Supraspinatus
Scalenes group
Infraspinatus
Teres minor
Brachioradialis
Extensor carpi radialis longus
Biceps brachii

Medial elbow/forearm pain

Flexor group
Serratus anterior
Triceps brachii
Pectoralis major and minor
Palmaris longus
Extensor digitorum

Medial wrist pain

Flexor carpi ulnaris
Extensor carpi radialis longus

Lateral wrist pain

Pronator teres
Extensor carpi ulnaris
(Extensor digitorum)
Supinator
Opponens pollicis
Adductor pollicis

Hand and finger pain

Palmaris longus
Flexor carpi radialis brevis
Flexor digitorum
Small hand muscles

Thumb pain

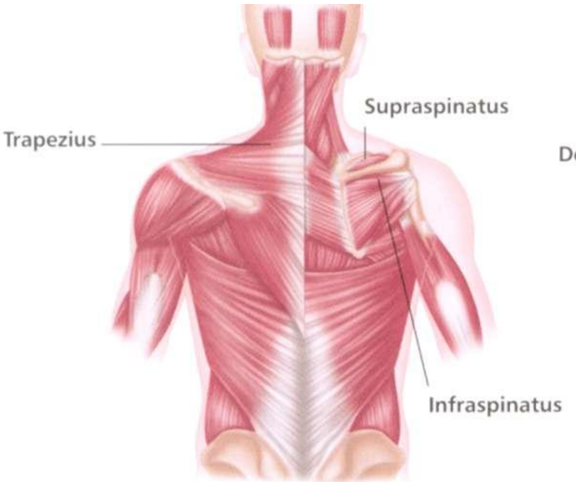
Brachioradialis
Extensor carpi radialis longus
Extensor digitorum
Supinator
Opponens pollicis
Adductor pollicis

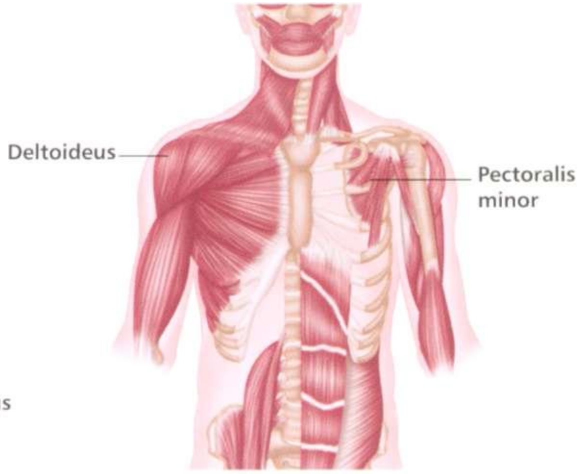
Shoulder Pain

Indications

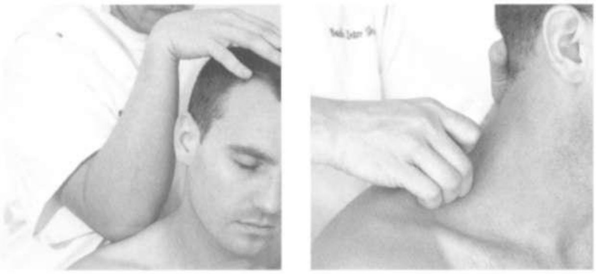
Shoulder problems affect 25% of the population. Trigger point therapy can be very effective for treating a range of shoulder problems including: rotator cuff tendinopathy tendonitis, bursitis and frozen shoulder syndrome. Here I present a basic shoulder protocol, which should yield good results for most problems.

STEP 1 Study the anatomy and direction of muscle fibres.





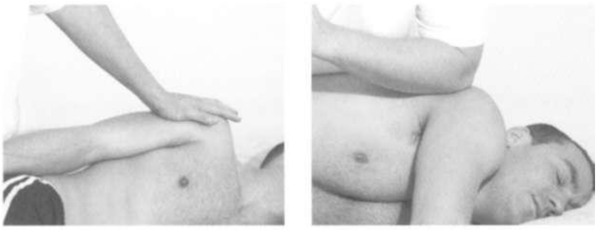
STEP 2



Sitting ICT to supraspinatus and upper trapezius.

STEP 3 Massage the area generously.

STEP 4



Side-lying ICT to deltoid. Stroking upwards only and pause on the trigger points and teres minor, letting the hand fall off the bed.

STEP 5

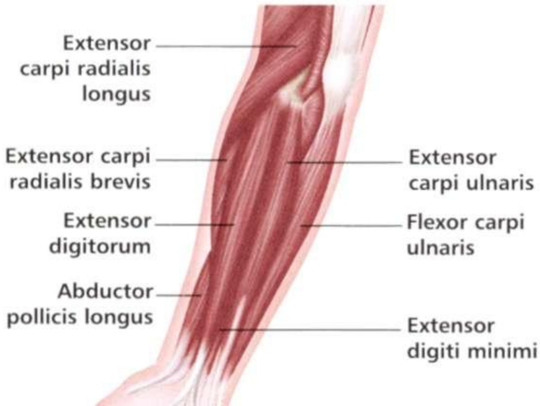
Supine ICT to pectoralis minor and infraspinatus (STP). Initially this can be very painful, but ask the patient to let their shoulder gently fall backwards onto your applicator with deep breathing.

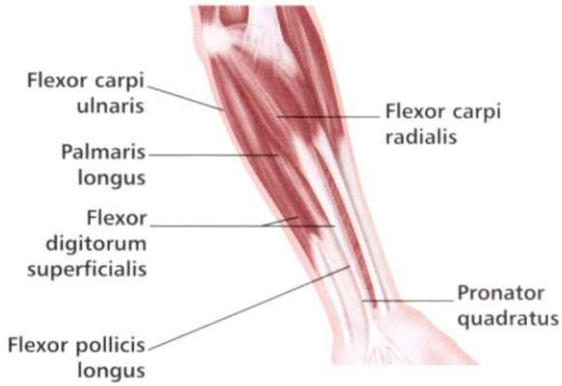
Wrist Pain

Indications

Wrist pain can be a frustrating and debilitating problem for both sufferer and therapist. Symptoms may include recurring pain (myalgia) or soreness in the neck, shoulders, upper back, wrists or hands; tingling; numbness; coldness or loss of sensation; loss of grip strength; lack of endurance and weakness. It is important to view the hand and wrist in context. Chronic poor posture and problems in the head, neck and shoulder should all be taken into account. There are often many trigger points to be found in the wrist flexors and extensors, all of which will need to be documented and addressed.

STEP 1 Study the anatomy and direction of muscle fibres.



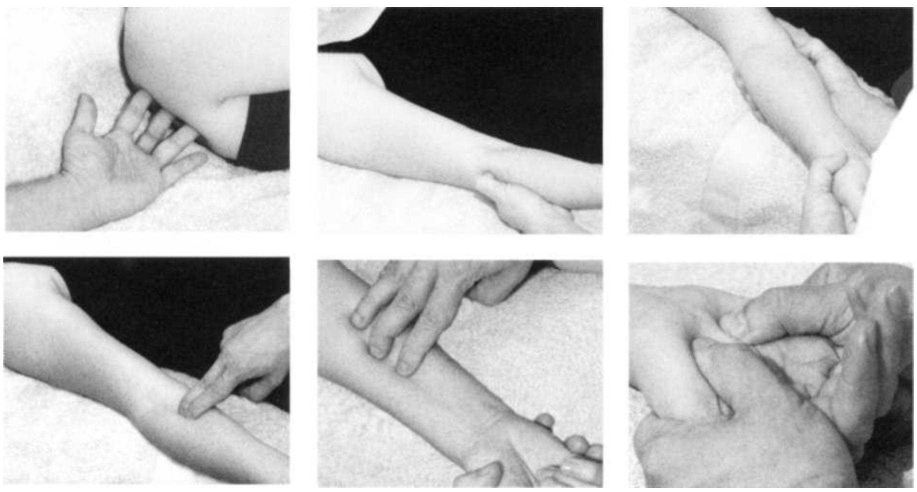


STEP 2

Sitting ICT to scalenes group (STP) and upper trapezius, carefully and thoughtfully. Apply a slow, sliding pressure downwards onto the rhomboids, pausing on the trigger points.

STEP 3 Massage the area generously.

STEP 4



Supine, thorough ICT to infraspinatus, wrist flexors, wrist flexor common origin (sustained), wrist extensors, common wrist extensor origin (sustained), palmaris longus (may be absent), interosseous membrane of the radius and ulna, and the small muscles of the hand.

STEP 5 Apply gentle and thorough massage from the elbows to the hands.

Regional Trigger Points for the Low Back, Hip and Pelvic/Groin

Low back pain

Gluteus maximus
Gluteus medius
Gluteus minimus
(Piriformis)
Quadratus lumborum
Iliopsoas
Longissimus, Iliocostalis, Spinalis } Erector spinae
Multifidus
Rotatores
Rectus abdominis

Buttock and hip pain

Gluteus maximus
Gluteus medius
Gluteus minimus
Piriformis
Soleus
Quadratus lumborum

Middle back pain

Rhomboid major
Latissimus dorsi
Longissiimus, Iliocostalis, Spinalis } Erector spinae
Multifidus
Rotatores
Rectus abdominis

Hip pain

Tensor fascia latae
Gluteus medius
Piriformis
Pectineus
Adductor longus
Adductor brevis
Vastus lateralis
Sartorius tendon (insertion)
(Obturator internus/externus, knee flexed)

Pelvic/groin pain

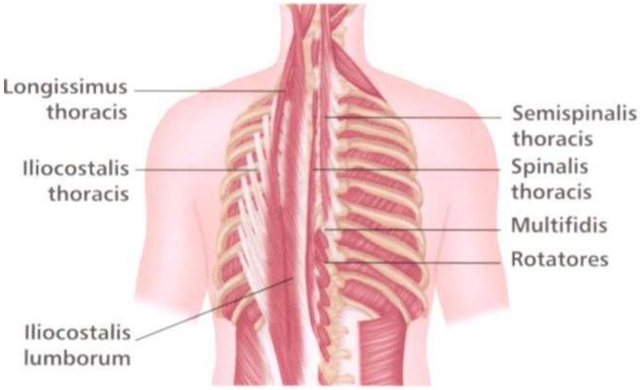
Rectus abdominis
Adductor magnus
Adductor longus
Adductor brevis
Gracilis
Iliopsoas
Pectineus
Sartorius
Iliocostalis thoracis
Lateral abdominals
Flexor digitorum brevis (sole of foot)
Sartorius tendon (insertion)
(Obturator internus/externus, knee flexed)

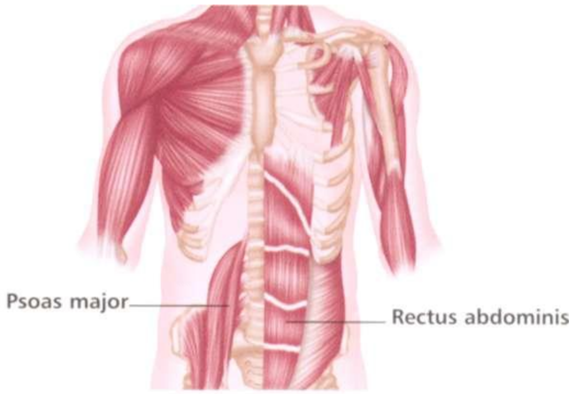
Low Back Pain

Indications

Trigger point release can be an extremely effective component in the treatment and management of the acute and chronic low back. I humbly offer a simple trigger point formula that works for me time after time. Combined with this soft tissue release, I have found the following very helpful: vertebral adjustments, emotio-somatic release and a thorough analysis of gait, posture (including working posture) and sporting activity (or lack of it).

STEP 1 Study the anatomy and direction of muscle fibres.





STEP 2

Apply prone ICT to the gluteus medius (STP).

STEP 3 Massage (cross-fibre) the low back region generously.

STEP 4

Apply prone ICT to multifidus and lumbar erector spinae.

STEP 5 Massage the spinal muscles.

STEP 6

Apply supine ICT to the anterior ramus of the diaphragm (costo-chondral margin) and rectus abdominis (outside edge).

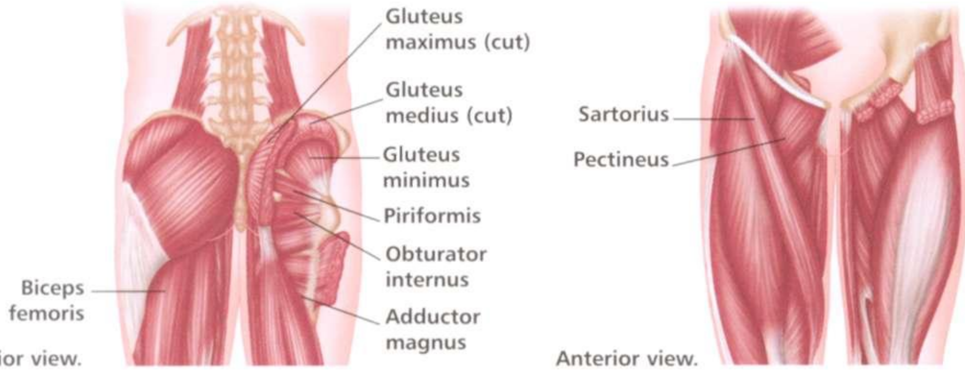
STEP 7 Repeat all these steps three times.

Pelvic Pain

Indications

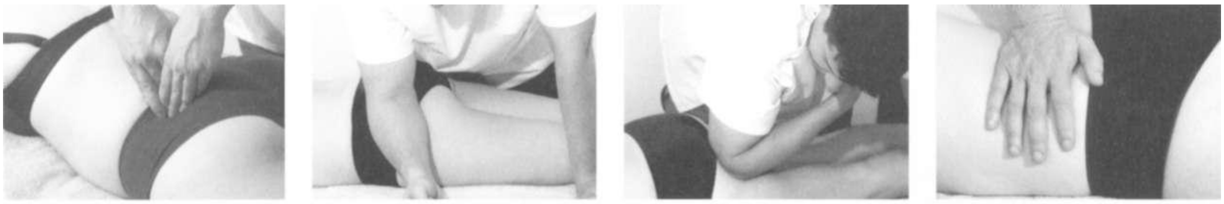
Symptoms include pain during intercourse, cramping or sharp pains, heaviness or a feeling of pressure inside the pelvis, extreme and constant pain, intermittent pain, a dull ache, pain during bowel movements and dysmenorrhoea. Trigger point self-management and treatment can provide a useful and non-invasive intervention.

STEP 1 Study the anatomy and direction of muscle fibres.



Posterior view. Anterior view.

STEP 2



Apply prone ICT to gluteus maximus, medial inferior, middle inferior; piriformis; biceps femoris origin; spinal muscles and pelvic floor muscles.

STEP 3

Side-lying ICT to pectineus (on the affected side), and adductor magnus (origin).

STEP 4

Supine thorough ICT to lower rectus abdominis (STP); psoas major with knee flexed on the same side; flexor digitorum brevis (sole of foot); sartorius tendon (insertion); obturator internus/externus (knee bent).

Regional Trigger Points for the Knee, Ankle and Foot

Medial knee

Gracilis
Vastus medialis
Rectus femoris
Sartorius
Adductor longus
Adductor brevis
Adductor magnus
Semimembranosus
Semitendinosus
Gastrocnemius (medial head)

Lateral knee

Gluteus minimus (anterior portion)
Biceps femoris
Vastus lateralis
Peroneus longus
Gastrocnemius (lateral head)

Posterior knee pain

Popliteus
Soleus
Plantaris
Gastrocnemius (lateral head)
Gastrocnemius (medial head)
Biceps femoris
Semimembranosus
Semitendinosus

Anterior knee pain

Quadriceps expansion
(Ligamentum patellae)
Rectus femoris
Adductor longus
Adductor brevis
Vastus medialis

Anterior ankle pain

Tibialis anterior
Extensor digitorum
Tibialis posterior

Posterior ankle

Tibialis anterior
Soleus

Lateral ankle

Peroneuslongus
Peroneus brevis
Peroneus tertius
Fibularis group
Extensor digitorum brevis

Medial ankle

Flexor digitorum
Adductor hallucis
Tibialis anterior

Foot

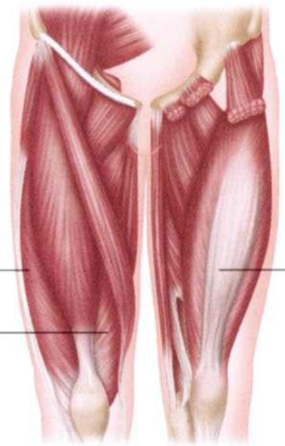
Soleus
Gastrocnemius (medial head)
Flexor digitorum
Extensor hallucis longus
Tibialis posterior
Flexor digitorum brevis
Quadratus plantae
Adductor hallucis
Interossei

Knee Pain

Indications

The signs and symptoms of knee problems can vary widely The knee is an extremely complex joint, involving many bones, articulations and soft tissues. Add to this the amount of use it gets over a lifetime and its vulnerability to a range of injuries and diseases, and it becomes readily evident that the knee can be a common source of pain. Common injuries include: ligament strains, meniscus damage, bursitis and tendon injuries. Careful investigation as to the cause of the pain is essential. However, I have found the following protocol extremely effective for a wide range of problems.

STEP 1 Study the anatomy and direction of muscle fibres,



Anterior view.

STEP 2

Prone ICT to popliteus.

STEP 3

Apply deep stroking massage to the area generously, upwards only.

STEP 4

Supine. Medial and lateral gapping articulation to the knee joint, with the knee in slight flexion.

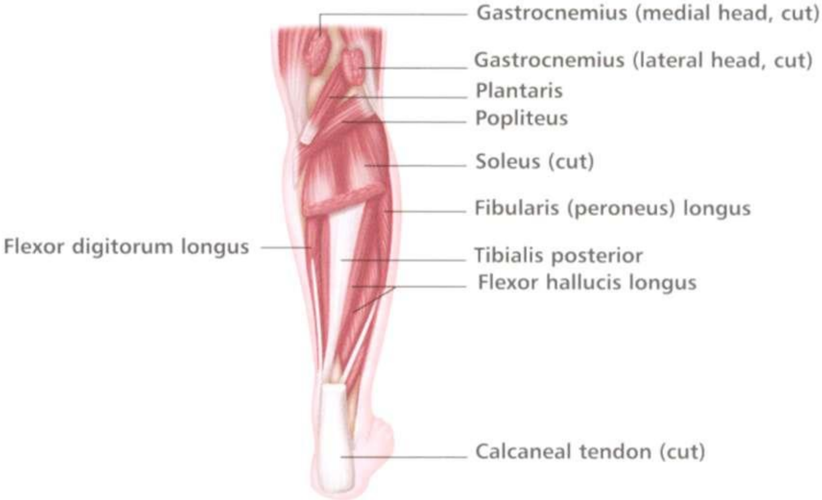
Then ICT to vastus medialis and/or lateralis insertion, quadriceps expansion, just above the patella, and ligamentum patellae, just below the patella (STP).

Ankle Pain

Indications

Recurrent inversion and eversion strains, tendonitis, instability, tarsal tunnel syndrome and arthritis.

STEP 1 Study the anatomy and direction of muscle fibres.



STEP 2


Prone articulation into inversion and eversion to the talo-crural joint.

STEP 3




Apply prone ICT to gastrocnemius, soleus, plantaris and tibialis posterior.

STEP 4

Side-lying deep stroking massage to fibularis (peroneus) group.

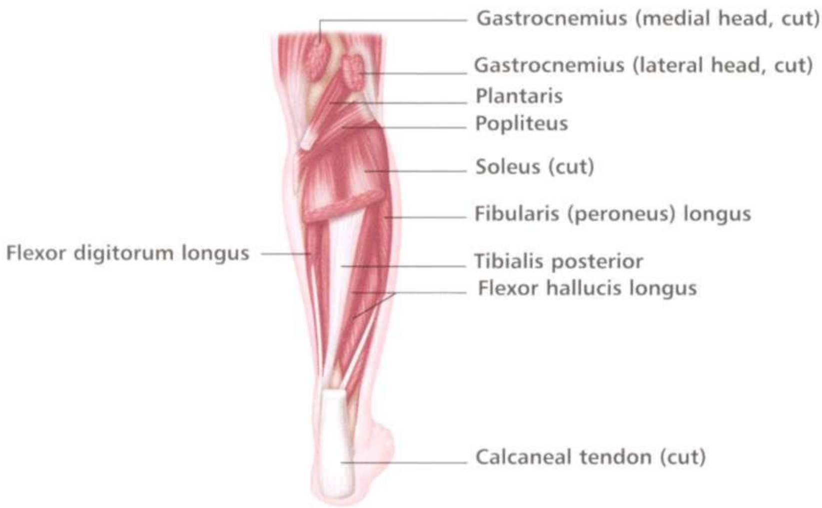

Supine, thorough ICT to extensor digitorum longus tendon (STP) and anterior talo-crural joint.

Foot Pain

Indications

Heel pain, metatarsalgia, plantar fasciitis, myalgia, sesamoiditis, heel spurs, soreness on walking and soreness on rest.

STEP 1 Study the anatomy and direction of muscle fibres.



STEP 2


Prone ICT to gastrocnemius (medial head) and soleus (lower points).

STEP 3 Massage the area generously.

STEP 4


Prone ICT to tibialis posterior and flexor digitorum longus (STP).

STEP 5



Prone, thorough ICT to plantar fascia. Starting at the heel, the small muscles of the foot and the area around the heel spur usually feel gristly and lumpy, so administer ICT to these nodules.

Resources

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Index

Acetylcholine (ACh) 44
Achilles tendonitis 177, 179, 181,187
Actin 9
Acupressure 27
Acupuncture 27
Adenosine triphosphate (ATP) 9, 10
Adhesive capsulitis 117, 119
Agonist 16
Algometer 44
All or Nothing Principle 12
Anaesthetic 45
Angina 68, 77, 79
Anisotropic (A) bands 9
Ankle pain 218
Ankylosing spondylitis 79
Antagonism 201
Antagonist 16
Anterior sagittal chain 197
Anterior tibial compartment syndrome 171
Aortic aneurysm 77
Apley's scratch test 115
Aponeurosis 20
Arthritis 191
Assistant movers 16
Asthma 69, 105
Attachments 15
Autonomic nervous system 37
Avulsion 161, 183

Backnobber 205
Baker's cyst 177, 179, 183
Barrett's syndrome 81
Biomechanical factors 29
Bipennate muscles 13
Bladder pain 85
Bloating 87
Blood supply 11
Botulinum toxin A 45
Brachial plexus 69
Bruxism 65,67
Bunion 173, 191
Bursitis 91, 93, 113, 117, 149,151, 153, 155, 177

Calcific tendonitis 113
Calcium ions 32
Capsular pattern 201
Cardiac arrhythmia 109
Carotid artery 67
Carpal tunnel swelling 129
Carpal tunnel syndrome 69, 131, 133, 137, 143
Central nervous system (CNS) 28
Circular muscles 13
Claw toe 173, 185, 189
Coccydynia 81, 149, 153, 157
Colic 85,89
Conjunctivitis 38
Connective tissue 22
Contract and relax technique 48
Contracture 26
Convergent muscles 13
Core muscles 196
Corticosteroid 45
Cranial nerves 6
Cranio-mandibular pain 63
Cross-bridges 9
Cross patternation 31

Deep anterior chain 197
Deep fascia 22
Deep stroking massage technique 50
Deep vein thrombosis (DVT) 177,183,187
Dental pain 67
De Quervain's tenosynovitis 129,133,135, 137, 139, 141, 143
Dermatomyositis 131
Dermometer 44
Dermomyotome 37
Diarrhoea 85,87
Digital nerve entrapment 145
Direct attachment, see fleshy attachment
Directional pressure 23
Discogenic list scoliosis 91
Discopathy 171
Dorsal primary ramus 6
Dry needling 45
Dupuytren's contracture 131
Dysmenorrhoea 85,89
Dyspareunia 157

Electromagnetic lines, see meridians
Electromyogram (EMG) 26
Electrostatic bond 9
Embryogenesis 26
Embryological development 26
Endomysium 8, 11, 22
Energy crisis theory 33
Epicondylitis 129, 133, 137,139, 141
Epimysium 8, 20, 22, 23
Epinephrin 45
Epiphora 38
Ethyl chloride spray 45
Extensor expansion, see extensor hood
Extensor hood 138
Eyestrain 57

Facial neuralgia 71
Fascia 22
Fasciculi 12,22
Fasciitis 181
Femoral triangle 165
Femoropatellar joint 93,167
Fibromyalgia 28, 103
First-class lever 18
Fixator 16, 17
Fleshy attachment 20
Fluori-methane spray 46
Foot pain 219
Frozen shoulder syndrome, see adhesive capsulitis
Fulcra (sing, fulcrum) 17
Functional antagonist reflex patterns 202
Fusiform muscles 13

Galea aponeurotica 22, 55
Gebauer's spray and stretch 46
Golfer's elbow 107,125,133
Golgi tendon organs 198
Gout 185, 191
Greater occipital nerve entrapment 55
Groin pain 85, 87, 93
Group action of muscles 16

Hallux rigidus 189
Hallux valgus 185, 189, 191
Hammertoe 173,185,189
Hands-on therapy protocols 48
Headache 57, 59, 67, 79, 83, 208
Heartburn 87,89
Heberdan's node 145
Heel spur 179,181,189,191
Hemiplegia 115
Hernia ' 91, 161, 163
Herpes zoster 105
HLA-B27 condition 157
Holding patterns 194
Horner's syndrome 57
Huxley's sliding filament theory 10
Hyoid bone 67
Hypersalivation 38
Hypertonic muscles 45
Hypothenar eminence 145
H zone 9

Impingement syndrome 119, 121
Indirect attachment 20
Inflammation 45
Inguinal ligament 165
Innibition-ischaemic compression technique 50
Injections 45
Insertion 8, 15

Intercellular matrix 26
Intermediate fast-twitch fibres 11
Intermuscular septa 20
Interstitial muscle receptors 198
Irritable bowel syndrome 85
Isolytic contraction technique 49
Isometric contraction technique 49
Isotonic contraction technique 49
Isotonic saline 45
Isotropic (I) bands 9
IT band syndrome 167

Jaw pain 67
Jump (and twitch) sign 26, 45

Knee pain 217
Knobble (the) 205
Kyphosis 81

Lateral chain 195
Lateral epicondylitis, see tennis elbow
Leg length discrepancy 179, 181
Leverage 17
Lidocaine hydrochloride 45
Ligamentum patellae, see patellar ligament
Linea alba 89
Lock jaw 65
Lordosis 93
Low back pain 214
Lower crossed pattern syndrome 31
Lymphadenopathy 71, 161, 163, 165

Maintaining factors 39
Malocclusion 67
Manual lymphatic drainage techniques 50
McBurney's point 88, 89
Mechanical advantage 17
Mechanical disadvantage 17
Mechanical injury 23
Meralgia paresthetica 93, 163, 165
Meridian(s) 27
Mesodermal tissue 23
Metatarsalgia 169,175, 185, 189,191
Migraine 57
Mirrored box 201
Mitochondria 32
M line 9
Morton's neuroma 185,191
Motor end plate 11, 26, 32
Motor end plate theory 32
Motor unit 12
Multipennate muscles 13, 155
Multiple attachments 20
Muscle attachment 20
Muscle cell 10
Muscle energy/positional release techniques 49
Muscle fibre 8, 11, 29
Muscle shape 13
Muscle tone, see tonus
Musculotendinous unit 8
Myofascia 22,26
Myofibrils 9
Myofilaments 9
Myoglobin 11
Myokinetic chains and sub-links 195
Myosin 9

Nausea 85
Neck pain 83, 207
Nerve supply 11
Neuropathy 161
Neuro-receptor referencing 198
Neutralisers, see synergists
Nutritional factors 29

Odynophagia 65
Oedema 69
Origin 8, 15
Osteitis 159
Osteoarthritis 79, 93, 111, 133, 135, 137, 139, 143,151, 157, 159, 175, 183

Paget's disease 79
Palpation 44
Parallel muscles 13
Patellar ligament 183, 199
Pelvic pain 215
Pennate muscles 13
Perimysium 8, 20, 22
Peripheral nervous system 28
Phantom limb 201
Plantar fasciitis 185, 191
Plexus 6
Polymodal theory 35
Polymyalgia rheumatica 61, 79
Posterior sagittal chain 196
Posterior tibial compartment syndrome 177,187
Post-isometric relaxation technique 48
Positional release technique 49
Posture 30,40
Prime mover, see agonist
Procaine hydrochloride 45
Psoriatic arthropathy 79
Ptosis 38, 57, 71

Radiculopathic theory 34
Radiculopathy 77, 81, 91, 159, 163, 165, 167
Raphe 20
Reciprocal inhibition technique 48
Red slow-twitch fibres 11
Referred pain patterns 37, 50
Renal tubular acidosis 67, 91, 105
Repetitive strain injury (RSI) 133
Reversed action 15
Rheumatoid arthritis 79, 87, 133, 143
Rotator cuff tendinopathy 111, 113, 115, 117

Sacroiliitis 91, 149, 151, 153, 155, 157
Sarcolemma 8, 9, 22
Sarcomere 9,32
Sarcoplasm 8,32
Sarcoplasmic reticulum 9, 32
Scalene syndrome 69
Scapulocostal syndrome 103
Sciatica 91,155, 159
Scleroderma 131
Scoliosis 93
Secondary movers, see assistant movers
Second-class lever 19
Sensory homunculus 200
Seronegative spondyloarthropathy 79
Sesamoid bones 20
Sever's disease 177
Shin splints 171,179, 181, 185,187
Shoulder pain 211
Sinusitis 63,67
Sinus pain 57
Sit-up exercise 17
Skeletal muscle 8, 42
Somatic input 201
Somato-sensory cortex 200
Spinal nerves 6
Spinal segment 6
Spiral chain 195
Spondyloarthropathy 79,91
Spondylolisthesis 91
Spondylosis 91, 151
Spray and stretch 46
Stenosis 91, 157
Sternoclavicular joint 101
Strap muscles 13
Strengthening 40
Stress 105
Stress fracture 179,181, 185, 191
Stretch and release 48
Stretching 40
Subclavian vessels 69
Substance P 33
Synergist 16, 17

Temporal arteritis 61
Temporalis tendonitis 61
Temporomandibular joint (TMJ) 72
Temporomandibular joint syndrome 59, 61, 63, 65, 209
Tendonitis 167, 173,183
Tendons 20

Tennis elbow 107,125, 135,137, 139
Tenosynovitis 159, 183, 187
Testicular pain 85, 87
Theracane 205
Third-class lever 19
Thoracic outlet syndrome 69, 107,109, 119, 121, 145
Throat pain 65, 67
Thrombophlebitis 177
Thrombosis 183
Thymus gland 67
Thyroid problems 67
Tic douloureux, see trigeminal neuralgia
Tietze's syndrome 107
Tinnitus 59, 63
Titin 9
Tonus 9, 10
Toothache 61
Torticollis 83
Transverse (T) tubules 9
Treatment protocols 194
Triangulation 201
Trigeminal neuralgia 57, 63, 71
Trigger point(s) 27
  active 36
  attachment 36,46
  central 36, 40, 45
  diffuse 36
  inactive 36
  latent, see inactive
  myofascial 38
  primary, see central
  satellite 26, 36, 40
  secondary, see satellite
  super 199
  symptoms 37
Trismus 59

Unipennate muscles 13
Unloading taping technique 49
Upper crossed pattern syndrome 31

Valgus 189
Valsalva's manoeuvre 91
Varicocele 87
Varus 189
Ventral primary ramus 6
Vertebral artery syndrome 79
Vestibulocochlear 71
Visceral pain 77, 81
Vomiting 87,89

Weight gain 36
Whiplash 46, 69, 71, 79, 83, 99
White fast-twitch fibres 11
Wrist pain 212
Wry neck, see torticollis

Z line 9

Index of Muscles

Abductor digiti minimi (foot) 188
Abductor digiti minimi (hand) 144
Abductor hallucis 188
Adductor brevis, hallucis, longus, magnus 160
Adductor pollicis 142

Biceps brachii 122
Biceps femoris 158
Bracnioradialis 134

Deltoideus 110
Diaphragm 94
Digastricus 66
Dorsal interossei (foot) 190
Dorsal interossei (hand) 144

Epicranius, see occipitofrontalis
Erector spinae 76
Extensor carpi radialis brevis, longus 136
Extensor carpi ulnaris 136
Extensor digitorum 138
Extensor digitorum brevis 188
Extensor digitorum longus 190
Extensor hallucis longus 172

Fibularis (peroneus) brevis, longus, tertius 174
Flexor carpi radialis, ulnaris 132
Flexor digitorum brevis 188
Flexor digitorum longus 184
Flexor digitorum profundus, superficialis 132
Flexor hallucis longus 184

Gastrocnemius 176
Gluteus maximus 148
Gluteus medius 152
Gluteus minimus 154

Iliacus 92
Iliopsoas, see psoas major/iliacus
Infraspinatus 114

Latissimus dorsi 108
Levator scapulae 100
Longissimus capitis 78
Lumbricales (hand) 144

Masseter 58
Multifidis 86

Occipitofrontalis 54
Opponens pollicis 142
Orbicularis oculi 56

Palmaris longus 130
Pectineus 162
Pectoralis major 106
Piriformis 156
Plantar interossei 190
Plantaris 178
Popliteus 182
Pronator teres 128
Psoas major 92
Pterygoideus lateralis 62
Pterygoideus medialis 64
Pyramidalis, see rectus abdominis

Quadratus lumborum 90
Quadratus plantae 190

Rectus abdominis 88
Rectus femoris 166
Rhomboideus major, minor 102
Rotatores 80

Sartorius 164
Scalenus anterior, medius, posterior 68
Semimembranosus 158
Semispinalis capitis, cervicis 78
Semitendinosus 158
Serratus anterior 104
Soleus 180
Splenius capitis, cervicis 82
Sternocleidomastoideus 70
Subscapularis 118
Supinator 140
Supraspinatus 112

Temporalis 60
Tensor fasciae latae 150
Teres major 120
Teres minor 118
Tibialis anterior 168
Tibialis posterior 186
Transversus abdominis 86
Trapezius 98
Triceps brachii 124

Vastus intermedius, lateralis, medialis 166