10 Important Muscles of the Human Musculoskeletal System

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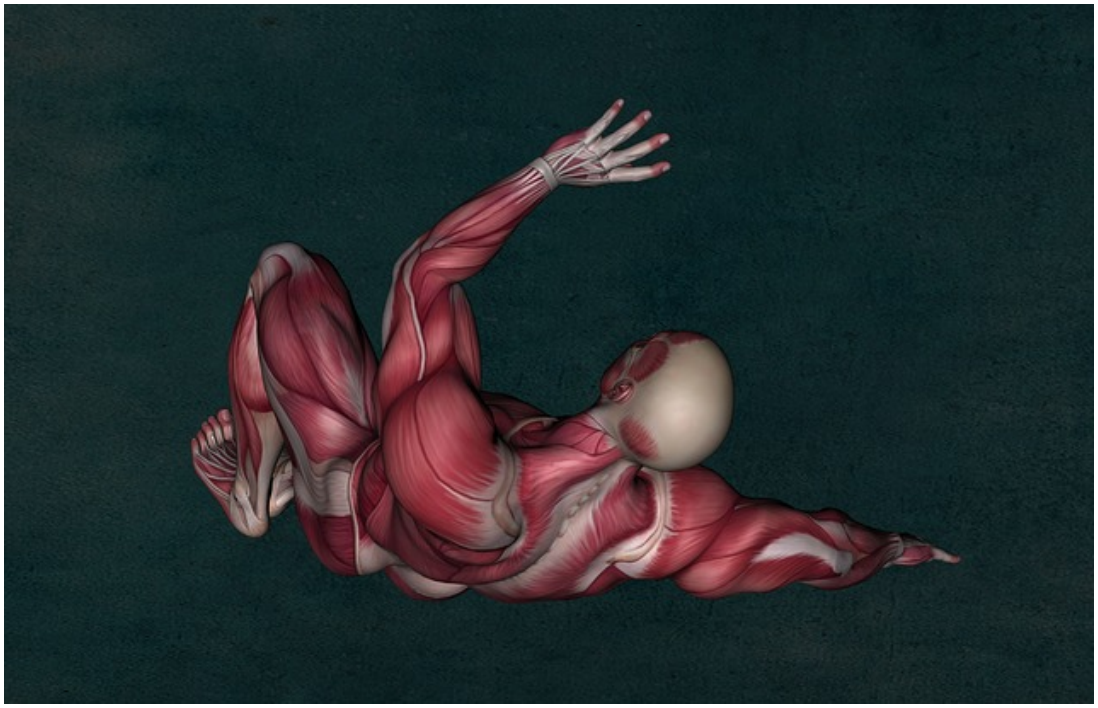
Our musculoskeletal system is a complex machinery of bones, joints, muscles, and their auxiliaries, which support the body structurally and facilitate movement. Our skeletal muscles generate varying levels of muscle tone and provide the strength for movement. The course of skeletal muscles differs from origin to insertion. Muscles also differ in their function. The following article presents a brief overview of 10 important muscles of our musculoskeletal system.



Deltoid Muscle

The deltoid muscle was named after the Greek letter ‘delta’ because of the similar triangular shape.

Location:

The deltoid muscle is located on the outer aspect of the shoulder and gives the shoulder its rounded contour. The outside and center of the upper arm are located at the top of the muscle triangle, whereas the base is on the spine of the scapula and the acromion is fixed to the clavicle.

Origin:

The muscle consists of 3 heads:

- Pars clavicularis (collarbone), which is the anterior muscle portion that originates from the lateral 3rd of the clavicle
- Pars acromialis (acromial segment), which is the middle muscle portion
- Pars spinalis (spinal part), which is the posterior muscle segment arising from the scapula

Insertion:

- The 3 heads insert laterally on the humeral shaft on the deltoid tuberosity.

Function:

- The deltoid muscle is the strongest abductor (moving away from an extremity from the midline of the body) in the shoulder joint.

Nerve supply:

- The muscle is supplied by the brachial plexus via the axillary nerve.

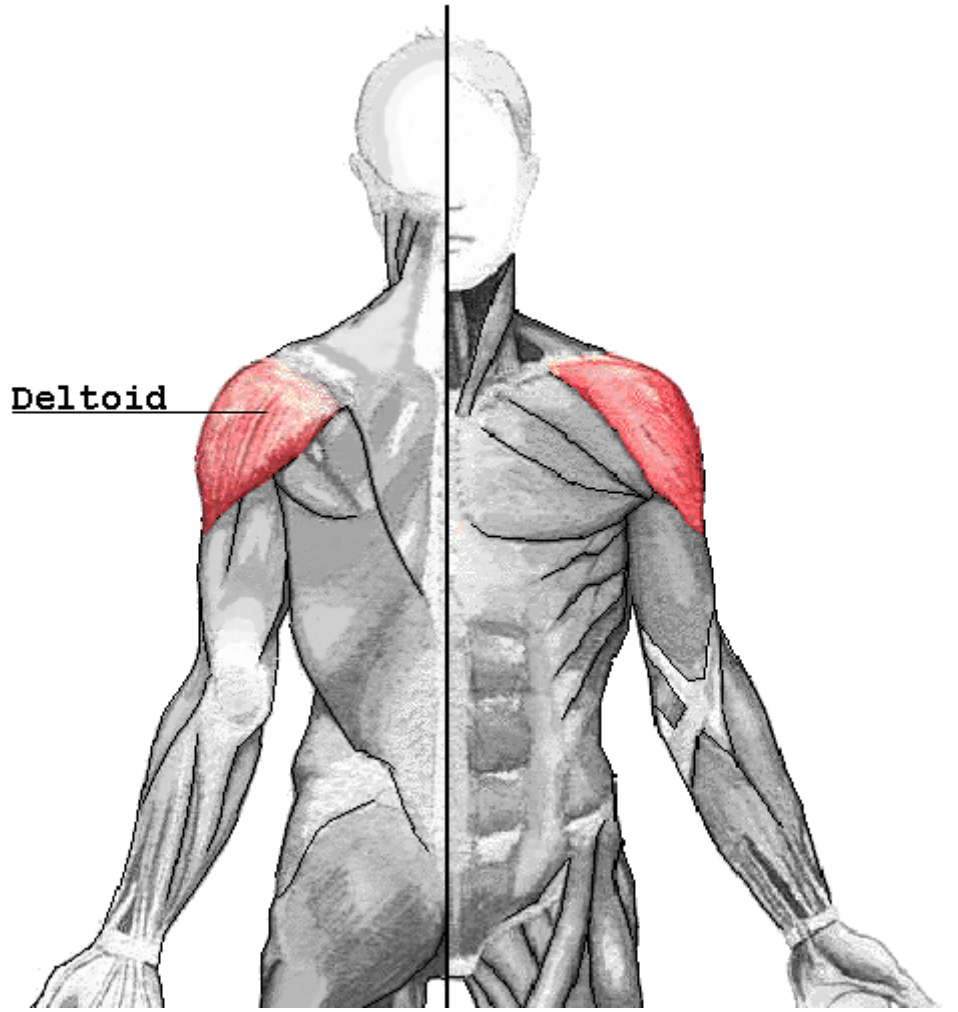


Image: Deltoideus. By Nikai, License: CC BY-SA 3.0

Muscle Performance Test of the Deltoid Muscle

Pars clavicularis:

The patient lies on his back with 90° abduction of the arm at the shoulder joint as well as flexure at the elbow (lateral flexion = bend). The examiner immobilizes the shoulder and applies resistance on the distal upper arm towards the table.

Pars acromialis:

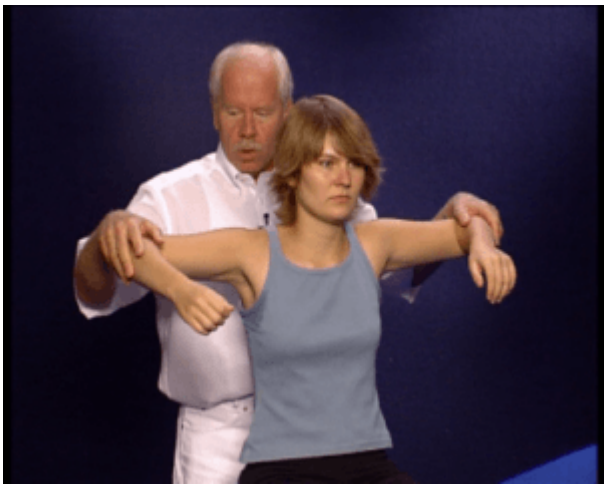


Image: Position of the examiner for isometric testing of m. deltoideus. By Openi, License: CC BY 2.0

The patient is seated and the arm is flexed to 90° at the elbow joint. To test the muscle segment, the examiner applies pressure on the distal upper arm in the direction of adduction. The test can be performed simultaneously with both arms.

Pars spinalis:

In the prone position, the patient abducts his arm at the shoulder joint to 90° and lays his upper arm on the examination table. The forearm is allowed to hang vertically over the edge of the table. The examiner immobilizes the scapula with one hand and with the other arm, the pressure is applied on the elbow in the direction of the table in order to test this part of the deltoid muscle.

Function and Innervation of the Deltoid Muscle

With its 3 different components, the deltoid muscle is involved in all acromioclavicular movements. It is the most important abductor due to the highly complex pinnation and large physiological cross-section in a relatively small volume.

In the event of isolated tension, the pars clavicularis causes anteversion (lat. ante = before; vertere = turn) and internal rotation of the humerus in the shoulder joint.

However, the pars spinalis of the deltoid muscle causes retroversion (lat. retro = back) during isolated tension (lat. retro = back) and outward rotation of the humerus in the shoulder joint. In conjunction with the pars spinalis, they can, therefore, act antagonistically (Greek antagonistés = opponents, adversaries) in an adducted arm (move an extremity towards the midline of the body) to the pars acromialis, and therefore, act as strong adductors. When the pars acromialis is inadequate as an abductor, the abduction of the arm is prolonged.

The supraspinatus muscle performs the abduction of the arm and is facilitated by the pars acromialis. The supraspinatus muscle centralizes the head of the humerus in the joint socket.

The functions of the deltoid muscle are summarized as follows:

Pars clavicularis

- Anteversion
- Internal rotation
- Adduction

Pars spinalis

- Retroversion
- External rotation
- Adduction

Pars acromialis

- Abduction

The axillary nerve is responsible for the innervation of the deltoid muscle.

Note: The deltoid muscle is an indicator of the spinal segment C5, i.e. in the event of failure, the location of a nerve lesion can be established.

Infraspinatus Muscle

Location

Image: A picture of both shoulders from the back showing muscle atrophy on the left side (arrow) obtained at the patient's 6-month follow-up examination. By Openi, License: CC BY 2.0

The infraspinatus muscle is 1 of the 4 muscles constituting the **rotator cuff.** It covers the larger segment of the infraspinous fossa in the scapula where it originates and inserts dorsally over the shoulder joint capsule into the greater tubercle of the humerus. Only a small ventral portion surfaces in the triangle formed by the trapezius, deltoid and teres minor muscles. Frequently, the infraspinatus is fused with the teres minor, which extends along its bottom rim.

Muscle Performance Test of the Infraspinatus Muscle

The muscle performance test of the infraspinatus muscle can be performed in sitting, standing, prone and supine positions. The patient moves the arm at approx. 90° of abduction and the elbow at a flexion of 90°, with maximum external rotation of the humerus. The examiner then applies pressure with a soft touch dorsally on the patient's forearm towards the internal rotation and stabilizes the elbow with the other hand.

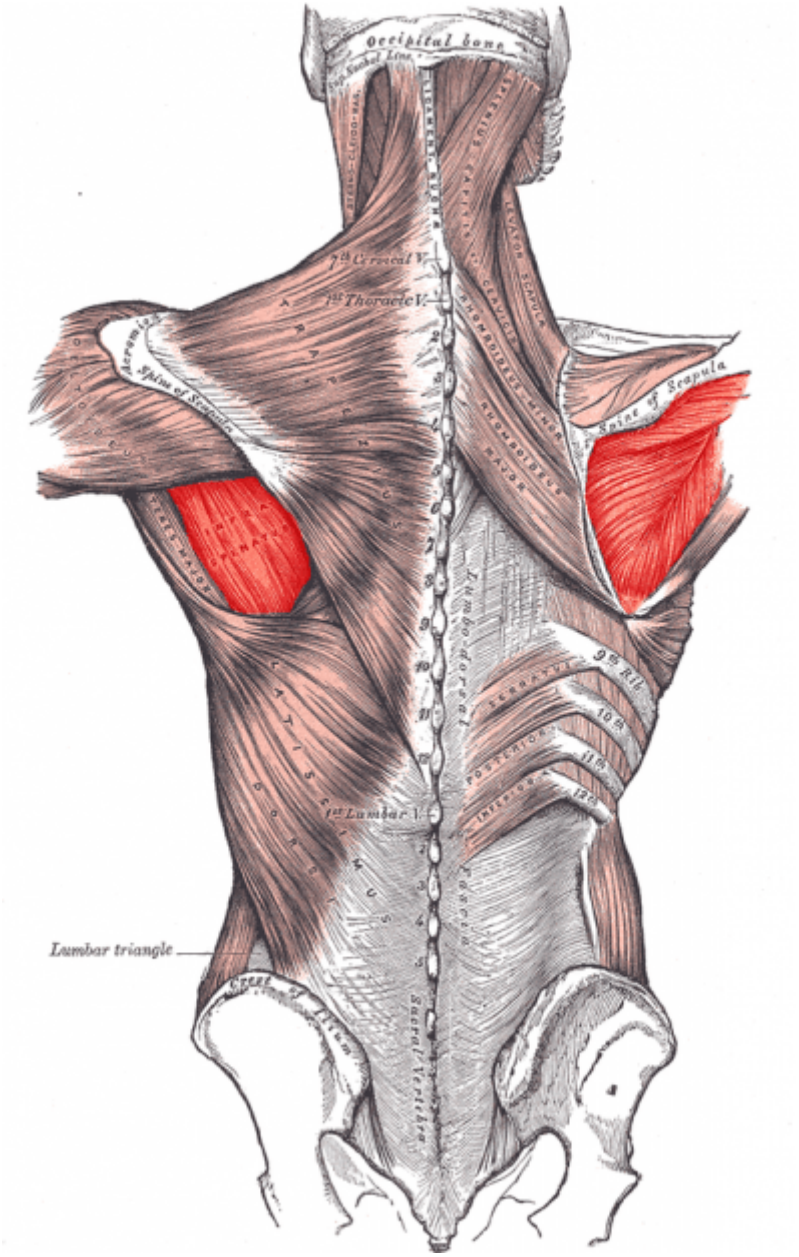


Image: Infraspinatus. By Mikael Häggström, License: Public Domain

Function and Innervation of the Infraspinatus Muscle

The infraspinatus muscle is used for external rotation. It can be used to perform strong external rotation, especially in the last stage of the abduction when the muscle insertion is outwards such that it does not hamper the continued abduction by touching the coracoacromial arch (fornix humeri). With its cranial portion, it abducts the upper arm and adducts with its caudal fibers.

The suprascapular nerve is responsible for the innervation of the infraspinatus muscle.

The infraspinatus tendon is located close to the shoulder joint, from which it is separated by a bursa.

Pectoralis Major Muscle

Location

The pectoralis major is the large chest muscle in the musculoskeletal system. It is located in the anterior chest wall, between the front axillary folds and the breastbone (sternum) and between the rectus sheath and the collarbone (clavicle).The outline of the muscle is very easily recognized in men and children due to its superficial location, whereas in women it is hidden under the breast.

According to the origin, the 3 parts of the pectoralis major include:

- Pars clavicularis (clavicular — collarbone part)
- Pars sternocostalis (sternocostal — breastbone-rib part)
- Pars abdominalis (abdominal part)

The clavicular head originates from the anterior surface of the medial head of the clavicle.

The sternal head originates from the lateral aspect of the manubrium sterni, upper 6 costal cartilages and the aponeurosis of the abdominal oblique muscle, which constitutes the main segment of this muscle.

The abdominal segment is the smallest of the 3 parts and originates in the extension of the anterior axillary fold from the cranial end of the rectus sheath.

On the crest of the greater tubercle (crista tuberculi majoris humeri), all the muscle segments arise with a common aponeurosis.

Pectoralis clavicularis

The pars clavicularis originates from the anterior surface of the medial half of the clavicle. The main portion of the muscle that originates from the sternal border and from the adjacent costal cartilages forms the pectoralis sternalis. The abdominal part is the smallest and originates in the extension of the anterior axillary fold from the cranial end of the rectus sheath.

On the crest of greater tubercle (crista tuberculi majoris humeri), all parts of the muscle arise with a common aponeurosis.

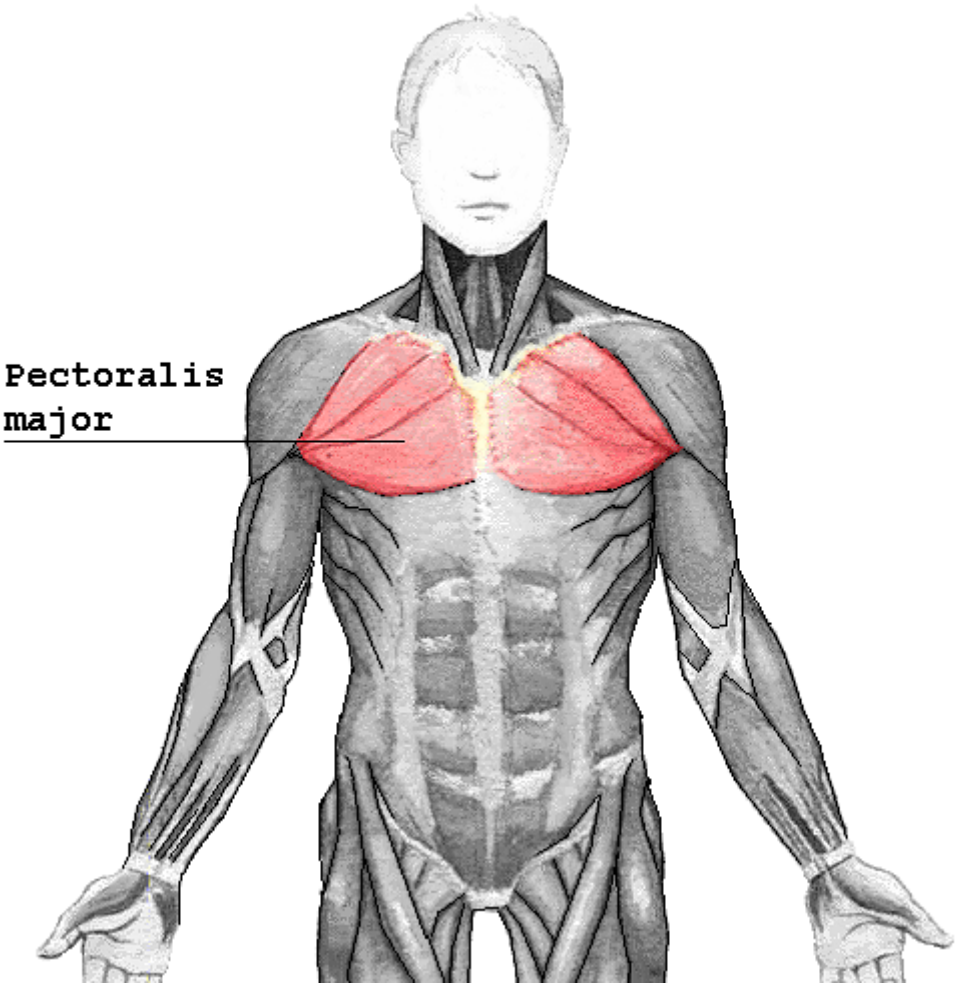


Image: Pectoralis Major. By Nikai, License: CC BY-SA 3.0

Muscle Performance Test of the Pectoralis Major Muscle

Pectoralis Clavicularis:

To test the muscle performance, the supine position is the most appropriate but also standing, sitting or the prone position are considered adequate.

1. The patient begins the test with anteflexion of the shoulder joint until 90°, with a maximum elbow extension. The patient stretches out the arms with a maximum internal rotation so that the thumbs point to the toes. Testing of the arms can also be done unilaterally.
2. To perform the test, the patient is asked to press the arm towards the contralateral shoulder. The examiner makes a soft contact on the distal forearm and pushes towards abduction with minimal extension of the shoulder.

Note: If the patient tries to flex the arm at the elbow in order to activate the long biceps tendon, it indicates a sign of weakness.

Pectoralis Sternalis (PMS):

Image: Pectoralis major muscle (sternal division), proper hand contact. By openi, License: CC BY 2.0

The supine position can be used to test the pars sternocostalis. Again, the patient begins the test with anteflexion in the shoulder joint until 90° is reached, with a maximum elbow extension and extension of the arm with a maximum internal rotation so that the thumb points to the toes. To test this muscle segment, the patient presses the straight arm towards the contralateral hip and the examiner exerts soft pressure on the distal forearm towards abduction and flexion.

Pectoralis Abdominalis:

The patient is in a supine position and abducts the arm at the shoulder joint about 120°. The examiner holds the shoulder with one hand and applies pressure on the distal upper arm towards the examination table with the other. To test the muscle, the patient pulls the arm to resist the examiner on his abdomen and holds the end position.

Function and Innervation of the Pectoralis Major Muscle

For clarity, we assume that the pectoral girdle stiffens and the muscles act from this ‘punctum fixum’ of the shoulder joint.

The pectoralis major’s primary functions include:

- Adduction
- Anteversion
- Retroversion
- Internal rotation

From any joint position, the pectoralis major is the strongest adductor of the arm. Without its participation, we would not be able to cross our arms in front of our chest or to place a hand on the contralateral shoulder. The breaststroke during swimming is unthinkable without the pectoralis major.

During anteversion, all muscle segments (pars clavicularis, pars sternocostalis, and pars abdominalis) pull the arm from the most extreme retroversion into the zero position. The arm is lifted further to the 90° mark, starting with the lowest (pars abdominalis) to the higher levels and maintains the extended position. The clavicular segment manages to approach the 90°.

In retroversion, the pars abdominalis and the pars sternocostalis can be used for retroversion of the arm against resistance to anteversion to a neutral position. Further, due to its insertion on the humerus, the abdominal portion can indirectly lower the

scapula and, with fixed arms, it can be used as a respiratory muscle.

Internal rotation is possible in all parts of the muscle and in all joint positions.

The medial pectoral nerve innervates the abdominal and the sternocostal segments. Additionally, the sternocostal and clavicular portions are stimulated by the lateral pectoral nerve.

Note: The pectoralis major is also the so-called ‘hugging muscle’ as all of its possible actions are carried out in an embrace. Anteversion is followed by transition to retroversion, adduction and internal rotation.

Latissimus Dorsi Muscle

Location

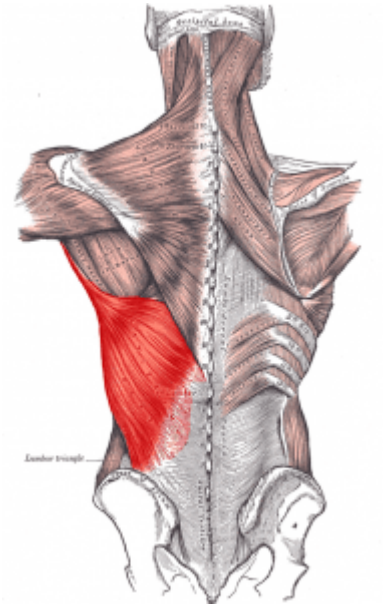


Image: Latissimus Dorsi. By Mikael Häggström, License: Public Domain

The latissimus dorsi muscle originates in a broad aponeurosis (flat structure of connective tissue that serves as a tendon to attach 1 or more muscles), which extends from the spinous processes of the lower 6 thoracic vertebrae over the lumbar vertebrae to the posterior rim of the os ilium. In addition, the muscle also originates from the lower 3 to 4 ribs and the inferior angle of the scapula.

The crest of the lesser tubercle of the humerus represents the insertion point of the latissimus dorsi. The muscle approaches this point as it turns spirally around the teres major as part of the rear axillary fold, travels between the trunk and the humerus, thereby twisting around itself.

Muscle Performance Test of the Latissimus Dorsi Muscle

The muscle function test can be performed while standing, sitting, as well as in supine and prone positions. The patient extends his arm to a maximum and rotates it internally with thumbs pointing to the body and arm approx. 20° away from the body. The patient now moves towards abduction and the examiner with light contact against the distal

forearm in the direction of abduction. No pain should be triggered by the examiner.

Function and Innervation of the Latissimus Dorsi Muscle

The latissimus dorsi muscle is an important muscle used as a walking aid in any activity in which the body is pulled in the direction of the arms, for example, climbing.

The latissimus dorsi muscle has 3 essential functions:

- Retroversion
- Adduction
- Internal rotation

Internal rotation occurs as this muscle pulls the humerus towards the trunk. It thus supports the internal rotation and adduction of the humerus. Further, the muscle facilitates retroversion by lowering the elevated arm forcefully, for example, when chopping wood.

The muscle is also needed for forced expiration (coughing and sneezing) as well as deep inspiration (inhalation).

The latissimus dorsi muscle is innervated by the thoracodorsal nerve.

Iliopsoas Muscle

Location

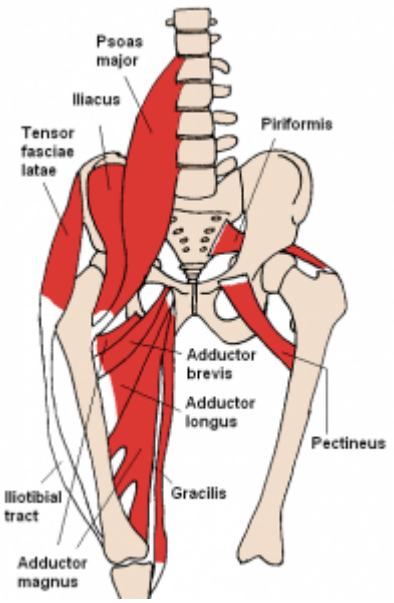


Image: Anterior hip muscles. By Beth Ohara, License: CC BY-SA 3.0

The iliopsoas muscle is actually made up of 2 muscles, each with a different origin but a common insertion point immediately distal to the lesser trochanter and with similar function.

The iliopsoas comprises 2 heads arising from the iliacus muscle and the psoas major muscle. The iliacus covers the entire inner side of the iliac bone with one head like a thick muscle plate. The psoas major, which is the other head, is located adjacent to the inside

of the posterior wall of the abdominal cavity next to the spine. The psoas major originates in this area in the angle between the vertebral body and the transverse processes. The iliacus arises from the upper 2/3 of the iliac fossa inside the upper pelvic rim, the ala of the sacrum, as well as the sacroiliac, lumbosacral and iliolumbar ligaments.

The already merged iliopsoas traverses from the anterior iliac spine between the upper pelvic rim and the inguinal ligament leaves the inner body to extend across the arch of the hip joint, and finally reaches its point of insertion on the lesser trochanter.

Muscle Performance Test of the Iliopsoas Muscle

The supine position is perfect for the iliopsoas muscle performance test.

The patient lies down on the table and extends the fully rotated leg externally at about 45° of flexion and abduction. The examiner places a stabilizing hand softly but firmly on the contralateral side of the pelvis in order to prevent the patient from rolling across to the side of the tested muscle.

With the other hand, the examiner contacts the distal femur, the medial knee joint or the medial condyle of the tibia. A larger lever can be used, especially with strong patients, by contacting the lower leg distally.

The test is conducted towards extension and light abduction, whereby the patient presses in the direction of flexion and adduction.

Alternatively, with appropriate stabilization, the muscle can also be examined while standing or sitting.

Function and Innervation of the Iliopsoas Muscle

The iliopsoas muscle is the strongest flexor of the hip joint and therefore, indispensable for walking. In the absence of iliopsoas, it is impossible to lift a leg (anteflexion in the hip). Altogether, the failure of this muscle cannot be compensated by any other muscle. Consequently, it is one of the most important muscles.

Additionally, the iliopsoas muscle can be used to abduct the leg from the abducted position to the neutral position. Normally, its rotation is directed inwards; however, a minimum external rotation is also possible in other joint positions.

The femoral nerve is responsible for the innervation of the iliac muscle. The psoas major, however, is supplied by ventral rami.

Note: The iliopsoas muscle is the most important hip flexor. Failure of this muscle cannot be compensated by any other muscle

Tensor Fasciae Latae Muscle (TFL)

Location

Image: Tensor fasciae latae. By Gray's Anatomy, License: Public Domain

The tensor fasciae latae muscle, also called the sprinter muscle, is located laterally to the gluteus maximus muscle in the upper layer of the gluteal muscles. It is separated from the gluteus maximus by the iliotibial tract, which is the insertion point of the muscle. The muscle originates laterally in the anterior superior iliac spine, on the upper rim of the iliac bone. During its course from the anterior superior iliac spine to the anterolateral surface of the femur, the muscle is characterized by an elongated flat muscle ventrally, which is clearly visible through the skin in many people.

Muscle Performance Test of the Tensor Fasciae Latae Muscle

The supine position is ideal for testing the tensor fasciae latae performance.

The patient extends his knee maximally and is aided by the examiner to perform abduction, internal rotation, and flexion of approx. 30° at the hip joint.

Subsequently, the patient extends his leg outward and upward, in the direction of further abduction and flexion. The examiner contacts the distal lower leg with one hand and the table with the other hand for stabilization. A test pressure may be applied in the direction of adduction and extension in the direction of the other leg.

The contact to the ankle joint should be avoided.

Function and Innervation of the Tensor Fasciae Latae

The tensor fasciae latae muscle supports the flexion and abduction of the leg at the hip joint. However, the gluteus medius or gluteus minimus are much stronger and readily available for abduction.

The tensor fasciae latae is a strong internal rotator on the hip and also balances the external rotation of the gluteus maximus in the iliotibial tract.

If necessary, the muscle can replace a paralyzed quadriceps femoris, at least partially, as the knee joint extension, which is mediated through the tract, is strong enough.

The tensor fasciae latae muscle is innervated by the superior gluteal nerve.

Rectus Femoris Muscle

Location

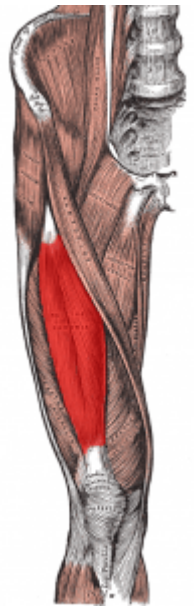


Image: Rectus Femoris. By Uwe Gille, License: Public Domain

The rectus femoris muscle represents 1 of the 4 parts of the quadriceps femoris muscle, the strongest muscle in the body.

As the only head of the quadriceps that has 2 articulations, it originates on the anterior superior iliac spine. A small transverse portion also extends to the upper edge of the acetabulum and to the hip joint capsule.

The muscle is inserted together with other parts of the quadriceps femoris on the patella. The muscle is located on the upper border of the patella in the patellar ligament and reaches the tibial tuberosity.

In spite of its large overall length, the muscle contains short fibers measuring only a few centimeters in length. Due to the physiology of the fibers, the muscle may exhibit specific configurations, suggesting active or passive insufficiency.

Active insufficiency occurs when the rectus extends the knee so that its residual capacity for shortening is no longer sufficient to flex the hip joint as well. A passive insufficiency occurs when the hip and knee joint, subject to an extension of the rectus, move beyond a certain degree. The rectus' fibers are too short and may tear if extended until the end of both joints. Anatomically, it is not possible to extend the hip to a maximum and flex the knee completely at the same time.

Muscle Performance Test of the Rectus Femoris Muscle

It is best to test the rectus femoris in the supine position, but it can also be tested while sitting or standing. In the supine position, the patient performs a 90° knee flexion and 90° hip joint flexion. The examiner contacts the distal femur and presses the thigh in the direction of straight extension during the examination.

Note: Any rotation must be avoided. Also, the angle of the knee should not be changed. With extremely muscular patients, the examiner can also support himself on the table or use both hands for support via a locking mechanism.

Function and Innervation of the Rectus Femoris Muscle

The rectus femoris muscle exhibits three essential functions:

- Extension
- Flexion
- Abduction

As already mentioned, the rectus femoris strongly flexes at the hip and extends in the knee, both of which are needed for the forward swinging of the free leg. During slow walking, the muscle is the main hip flexor, whereas it is barely tensed when standing on both feet. The rectus femoris is a weak adductor in the hip.

The rectus femoris muscle is innervated by the femoral nerve.

Sartorius Muscle (the Tailor’s Muscle)

Location

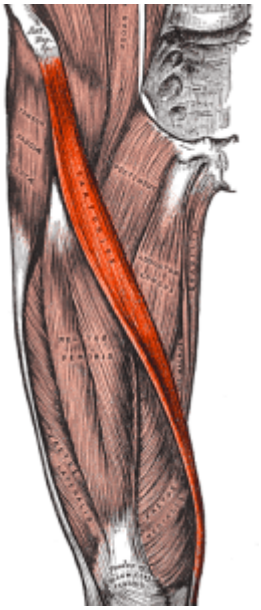


Image: Sartorius Muscle. By Uwe Gille, License: Public Domain

The sartorius muscle originates anteriorly in the superior iliac spine, running along a slight S-shaped curve similar to a long belt across the front and inner segments of the thigh and traveling in a dorsomedial direction (= to the back and middle of the body) over

the knee towards the lower leg.

Down the knee, the sartorius merges into a fan-shaped aponeurosis, from the tibial tuberosity to the middle of the lower leg on the free tibial surface. Together with the gracilis and semitendinosus muscles, it forms part of a common tendon. The 3 thick main strands are connected by an aponeurotic membrane and form the pes anserinus, the insertion point of the sartorius on the medial side of the tibia.

Muscle Performance Test of the Sartorius Muscle

The supine position is ideal to test the performance of the sartorius muscle.

Taking the example of the right leg, the examiner holds the knee from the outer side with his left hand and, with his right hand, the distal lower leg from the medial side just above the malleolus (partly on the upper ankle joint).

Subsequently, the patient's leg is brought into approx. 30°–45° abduction with maximum external rotation, slight flexion in the hip joint and simultaneous flexion in the knee joint. Accordingly, the patient's right foot is now at approx. the same level as the opposite left knee.

The examiner starts with the test pressure, and the patient pushes against him with maximum resistance.

Note: If the patient tries to only flex in the knee over the hamstring group or use the other abductors in the hip joint for abduction, it suggests weakness of the sartorius muscle.

Function and Innervation of the Sartorius Muscle

The sartorius muscle stabilizes the medial side of the knee, as well as the iliac bone anteriorly.

The sartorius muscle facilitates flexion, outward rotation, and abduction of the hip joint. At the knee joint, the sartorius muscle aids inward flexion and rotation.

Simultaneous movements facilitated by the sartorius are necessary for the cross-legged sitting position adopted by tailors at work. Therefore, the sartorius is also known as the tailor's muscle.

Similar to the rectus femoris, the sartorius is also innervated by the femoral nerve.

Note: The sartorius muscle is the only muscle that flexes the hip and knee at the same time.

Popliteus Muscle

The popliteus muscle is located below the lateral gastrocnemius, which is buried deep inside the popliteal fossa.

It originates laterally in the femoral condyle and the posterior horn of the lateral meniscus, from where it travels between the fibular lateral ligament and the lateral meniscus diagonally to the side opposite to the posterior tibial surface. Therefore, the lateral meniscus, unlike its medial counterpart, cannot coalesce with its collateral ligament.

It is inserted at the medial rear of the tibia, above the soleal line.

The flat triangular muscle belly develops below the knee joint cavity on the lower leg.

It arises from the tibial nerve with spinal roots L5-S2.

Muscle Performance Test of the Popliteus Muscle

The muscle performance test of the popliteus muscle can be done either in a sitting, prone or supine position. The patient lies on an examination table and has his knee and ankle flexed at 90°. Stabilizing with one hand, the examiner holds the calcaneus from the back and outside. With the other hand, the examiner makes a broad contact on the inner foot.

The examiner applies test pressure in the direction of the external rotation of the tibia over the lever of the foot. Although it is not important to rotate the foot, the tubercle of the tibia is held immobile.

Any instability or pain in the ankle area can complicate the popliteus muscle test.

Function and Innervation of the Popliteus Muscle

The popliteus muscle is considered a weak medial rotator and flexor of the knee but plays an important role as a stabilizer of the dorsal knee joint.

The 2 essential functions of popliteus muscle include:

- Contraction in a tightly expanded knee joint (e.g., in a supporting leg) to prevent hyperextension or snapping of the knee joint, and thereby facilitates shock absorption under heavy loads
- External rotation of the femur on the tibia with a simultaneous reduction of the extensor tonus

For this reason, it is possible that the cruciate ligaments loosen and allow flexion of the knee joint. During flexion, the popliteus muscle pulls the lateral meniscus dorsally to the tibia, to prevent its entrapment. Therefore, the lateral meniscus exhibits higher passive flexion than the medial muscle and is also active dorsally during flexion.

The tibial nerve is responsible for the innervation of the popliteus muscle.

Note: An important task is shock absorption of the knee joint and the posterior cruciate ligament.

Tibialis Anterior Muscle

Location

Image: Tibialis Anterior 2. By Uwe Gille, License: Public Domain

The tibialis anterior muscle is the anterior shin muscle in our musculoskeletal system.

It originates in the lateral condyle of the tibia and the upper 2/3 of the lateral surface of the tibia. In addition, fibers arise from the interosseous membrane and the intermuscular septum.

The long spindle-shaped skeletal muscle traverses under the superior and inferior extensor retinaculum on the medial side of the ankle to the foot and inserts on the plantar surface of the medial cuneiform and the base of the 1st metatarsal.

Muscle Performance Test of the Tibialis Anterior Muscle

The patient lies on the examination table looking at the examiner. The examiner flexes the knee at 90° and the forefoot is placed in the maximum supination position with plantar flexion of the big toe.

The peroneus muscles are excluded from the test to the maximum extent possible by bringing them into supination position.

The examiner contacts the foot dorsally with the test hand directly distal to the talus and stabilizes the calcaneus with the other hand. The patient pushes against the resistance of the examiner in the direction of the extension. The patient should keep his toes loose during the test to prevent the involvement of extensor digitorum longus muscle and the extensor hallucis muscle.

Note: No punctual bone should contact the metatarsal bones in order to prevent pain-related diminution. Moreover, a contraction inhibition exists in shortened calf musculature. The strength of the knee joint should be tested with the flexed leg.

Function and Innervation of the Tibialis Anterior Muscle

The ankle joint extension is caused by the tibialis muscle to lift the medial foot border. The muscle is particularly active during walking when the foot is lifted off the ground and

the heel is later replaced on the ground. Together with the antagonistic soleus, tibialis anterior muscle balances the lower leg on the talar dome while standing.

The innervation is provided by the deep peroneal nerve.

Note: The tibialis anterior muscle is the most important dorsal flexor but only a weak supinator and adductor of the foot in the Chopart's joint.

Key characteristic: Together with the peroneus longus muscle, the tibialis anterior muscle forms an antagonistic muscle sling, the so-called 'stirrup'.

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Notes