



Application of MSUS in Ligaments in Sports Injuries

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ABSTRACT

MSUS plays an important role in tendon injury assessment. MRI is able to detect the integrity of the tendon structure, while MSUS helps to image intranasal vein pathologies. Changes in echogenicity, thickness, shape, contour, or blood flow suggest possible tendinopathy. Fluid around the tendon or tendon sheath can also be easily detected on ultrasound. When scanning the musculoskeletal system, especially tendons, it is important to minimize anisotropy by keeping the ultrasound beam from the transducer perpendicular to the desired site for maximum signal reflection. Improper tilting or tipping of the transducer strip may cause more refraction than reflection and thus reduce the echogenicity of target structures. The lesion may be falsely graded as hypoechoic or even anechoic. Such technical problems may lead to misdiagnosis of tendinopathy or normal tendon rupture. By using color or power doppler techniques, the vessels inside or around the bone can be easily identified without additional contrast material. Increased vascularity in the injured tendon is consistent with the post-injury inflammatory process. The degree of muscularization of the muscles may be proportional to the intensity of the inflammatory pain in the hyperemic tendon.

Introduction

For example, the Osgood-Schlatter lesion, a common sports-related lesion in young athletes, may be very painful or completely asymptomatic. The typical sonographic appearance is bony irregularity at the insertion of the distal patellar tendon. Increased vascularity under color Doppler indicates active inflammation of the lesion, which may lead a physician to advise athletes to rest their knees. Excessive muscle building is not mandatory in chronic tendon injuries or tendinosis [1].

At this stage, anti-inflammatory agents may reduce the therapeutic effect. Ultrasound-guided injection of sclerosant or platelet-rich plasma may be useful in treating such tendinopathy. Tendon tears are common in sports injuries [2]. In such cases, experts must determine the location of the tear and measure the amount of the tear [3-5]. Any changes in echogenicity, thickness and continuity of the normal tendon should not be ignored. In a sheathed tendon,

grossly marginal fluid in a healthy sheath may mask a ruptured tendon as severe tendinosis due to its characteristic hypoechoic [6]. Chronic tendon rupture, in which the damaged tendon is replaced by echogenic fibrotic tissue, can also be overlooked. Dynamic views should be part of the standard examination for tendon lesions. A scan of a moving tendon provides information in relation to the surrounding tissues [7-9].

For example, dynamic examination with passive or active abduction of the shoulder may indicate impingement of the rotator cuff or an abnormal bursa by the coracoacromial arch. Another common scenario is "climber's toe". In this situation, the annular pulleys of the flexor tendons in the fingers are torn in sports injuries such as rock climbing. By flexing the finger, one can scan the target flexor tendon along its long axis. Using this maneuver, the tendon may be displaced and flattened from the

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volar surface of the phalanx due to the pulley tear to create a typical bowstring shape [10].

Steroid injections are a common method of controlling sports injuries. Injection into the peritendinous structure is very useful in an acute tenosynovitis or peri tendinitis for sports injuries. Because of the close connection of adjacent structures, fine injection with ultrasound guidance is recommended to potentially avoid intravascular injection. The ultrasound transducer and skin for needle placement must be carefully sterilized before injection. Freehand ultrasound-guided injection into a good structure can be successfully performed by an experienced clinician [11].

Ligament histology is similar to tendon. However, the ultrasound appearance of a ligament is usually hypoechoic due to the anisotropy effect. Proper positioning of ligaments for scanning helps reduce this effect. For superficial ligaments, ultrasound provides good visualization. However, for ligaments that are deep or intra-articular, such as the anterior cruciate ligament (ACL) of the knee, ultrasound does not provide direct information due to physical limitations. MRI is indicated to evaluate deep structures, especially if ultrasound shows indirect evidence of injury to these structures. Overstretched ligaments in an intense athletic activity may twist or tear them, which may lead to instability of the affected joint [12].

Ligament integrity and joint stability can be assessed with ultrasound. For example, the ankle is one of the tense joints that is referred for ultrasound examination. The anterior talofibular ligament, the inferior tibiofibular ligament, and the clavicular ligaments should be routinely evaluated in lateral or superior ankle sprains [13].

When examining the lateral ankle, a passive inversion force on the ankle joint causes the lateral ligaments to flex for better visualization and helps demonstrate joint instability under ultrasound. For medial ankle sprains, the deltoid ligaments should be carefully examined for possible pathology in the same manner [14].

Other superficial ligaments that are frequently examined in sports injuries include the anterior bundle of the ulnar collateral ligament (UCL) of the elbow, the UCL of the metacarpophalangeal (MP) joint of the thumb, and the lateral and collateral ligaments of the knee. Small wrist and hand ligaments such as the scapholunate ligament can be imaged with a high frequency transducer. The anterior bundle is the most important part of the UCL of the elbow joint. It connects the medial epicondyle of the humerus and the coronoid of the fossa and is often injured by repetitive valgus stress to the elbow in major league baseball players or javelin throwers (Figure 1).

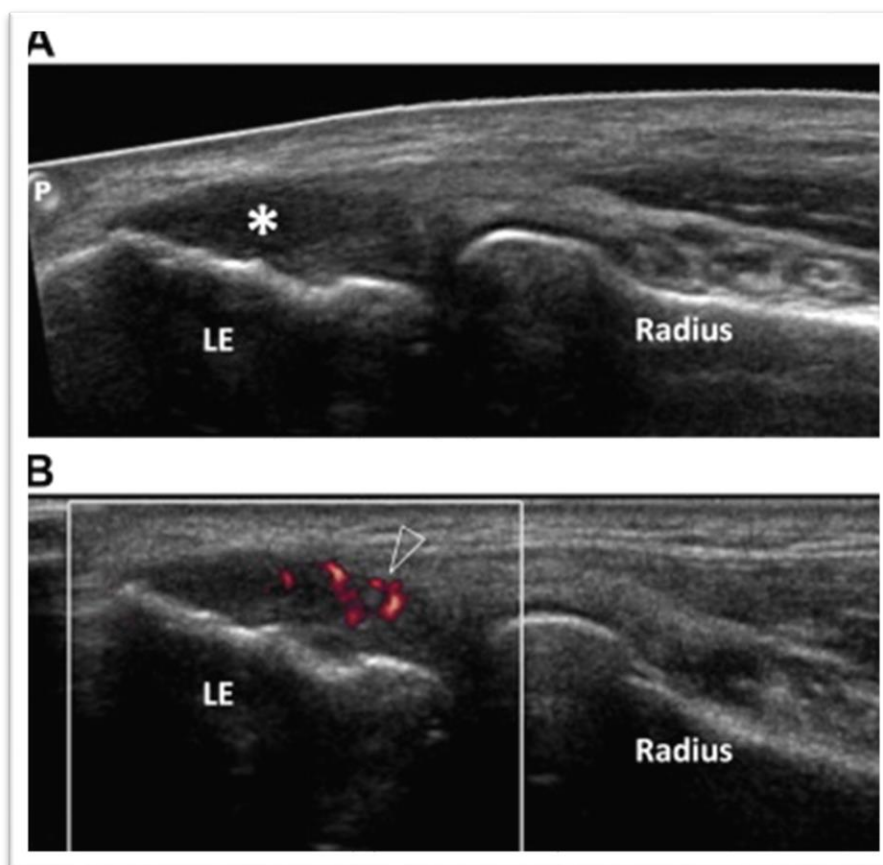


Figure 1. Application of Ultrasound in Sports Injury

A micro tear or a complete tear of this ligament usually occurs with repeated pushing and throwing. Static and dynamic scans show the pathology of this ligament and the stability of the joint. Excessive valgus force on the thumb may cause damage to the UCL at the MP joint. Ligament swelling or rupture can be easily detected by ultrasound. A Stener's lesion is a condition in which a torn UCL inserts into the ligament with the superficial adductor pollicis aponeurosis. Early referral for surgical intervention is necessary for such lesions. Because spontaneous recovery is less possible. A tear of the medial collateral ligament (MCL) of the knee can occur when excessive valgus force is applied to the externally rotated tibia [15-17].

The force can be a non-contact twist or a direct blow to the lateral knee. Ultrasound findings with hypoechoic thickening in the superficial part of the MCL, especially in the thigh, are most suggestive of an abnormal MCL. Fractures of the tibia proximal to the MCL are not uncommon. A sprain or tear of the collateral ligament is less common than the MCL and occurs when injuries to the popliteus tendon or iliotibial band are usually associated [18-20].

Therefore, they should be routinely evaluated under ultrasound examination. For intra-articular ligaments of the knee, such as the ACL, which cannot be directly visualized by ultrasound, MRI is the best imaging tool to examine them. However, in an acute ACL tear, a hematoma can frequently be seen around the insertion site on the medial border of the lateral femoral condyle. Sonographic detection of such a hematoma provides strong indirect evidence for an acute ACL tear [21].

Application of MSUS in the bursa in sports injuries

A normal bursa contains a small amount of fluid that appears as a thin uneven layer on the ultrasound image. A large amount of fluid accumulation in an injured bursa is usually seen as an unbounded mass with or without internal synovial proliferation. Surrounding muscle spasms indicate an acute inflammatory condition that may respond to anti-inflammatory medications.

When scanning the bursa, care should be taken to avoid excessive pressure of the transducer on the body surface. External compression by the converter to a fluid-rich bursa may flatten it and lead to a false negative result. Many bursal lesions occur in sports injuries. Subacromial-subdeltoid bursitis in the shoulder, ulnar bursitis in the elbow, infrapatellar bursitis before the knee or deep in the knee and retrocalcaneal bursitis in the ankle. If intra-articular steroid injection is planned, ultrasound-guided injection is recommended. Because it is more accurate and effective than blind injection [22].

Application of MSUS in bone structure in sports injuries

It is difficult for ultrasound rays to penetrate the bone structure. When performing an ultrasound examination, the information available under the bony cortex is very limited, while the bony surface can be clearly demonstrated. In minimally displaced fractures, a multiplane ultrasound scan may provide a more accurate assessment than plain films. The incidence of fractures in the talus is underestimated by plain film. More attention should be paid to check its internal and lateral processes in suspicion of fracture [23].

If there are abnormalities in the femur on ultrasound, a confirmatory computed tomography of the ankle should be considered. Stress fractures in athletes are often overlooked. Because fine fracture is not always seen in plain film. In such cases, MRI is better than other imaging tools. Because it evaluates not only the bone surface but also the bone marrow. Epiphyseal fractures should be investigated in young athletes. Because it is usually not lost in the traditional roentgenogram. Ultrasound provides good visualization of this lesion [24].

The use of MSUS in subcutaneous tissue in sports injuries

A direct blunt force trauma to the subcutaneous layer may result in an internal hematoma. In a serious condition, tearing of the subcutaneous layers can happen by separating between the layers of fat tissue, it is also called "fracture" of the subcutaneous layer. Sonographic findings of fluid-filled fissures in the cutis with possible internal drops of fat may be depicted, known as Morel-Lavallée lesions. Treatment of this lesion with fluid aspiration is often associated with fluid reaccumulation, and surgical intervention is usually necessary [25].

Limitations of using ultrasound in sports injuries

A major limitation in ultrasound is that the ultrasound beam hardly penetrates the bone cortex, it cannot visualize intra-articular lesions directly, but can only provide indirect evidence. MRI remains the gold standard for diagnosing such lesions. In addition, ultrasound is very operator dependent. A long training course is needed to master the scanning method and related diagnosis. A thorough knowledge of musculoskeletal anatomy is required before a proficient ultrasound scan can be achieved.

The future of ultrasound in sports injuries

There are some questions in ultrasound for sports injuries that need better solutions. Two-dimensional gray-scale ultrasound has sufficient resolution for anatomical diagnosis, but three-dimensional ultrasound imaging still has suboptimal resolution for practical use. Color or power Doppler can detect vasculature, but cannot reliably quantify vasculature, especially for lesional circulation.

Sonolastography is constantly improving and, if applied to post-traumatic tissue in the future, may help clinicians personalize rehabilitation plans for injured athletes [26].

What are the limitations of muscle ultrasound?

Ultrasound cannot show bone tissue well. For this reason, other imaging methods are used to examine bones in adults. Bone tissue in babies is generally soft and cartilage-like. For this reason, there is a possibility of bone ultrasound in babies, but for children and adults, X-ray photography is needed. Ultrasound cannot provide adequate images of very internal organs. For this reason, ultrasound is not recommended in structures that are deep. According to the evidence, ultrasound is not suitable for spinal injuries. If the patient has back pain, MRI imaging or other methods are performed.

Abdomen, or the same part of the body that is popularly called the belly, is the middle part of the

body between the chest and the pelvis. The human stomach includes all digestive organs and organs, including the stomach, small intestine, large intestine, pancreas, liver, and gall bladder. All these organs are able to expand by tissues and are placed next to each other freely [27].

On the other hand, in addition to the organs mentioned above, the kidney and spleen are also part of the abdominal organs. In addition, many important blood vessels travel through the abdomen, including the aorta, the inferior vena cava, and dozens of other branches. Have you ever wondered how the front and back of the abdomen are protected in some way? Well, in the front part of the abdomen, it is protected by a thin and resistant layer called fascia, which is in front of the fascia of the abdominal muscles and skin. On the other hand, from the back side, the muscles of the back and spine protect this middle organ.

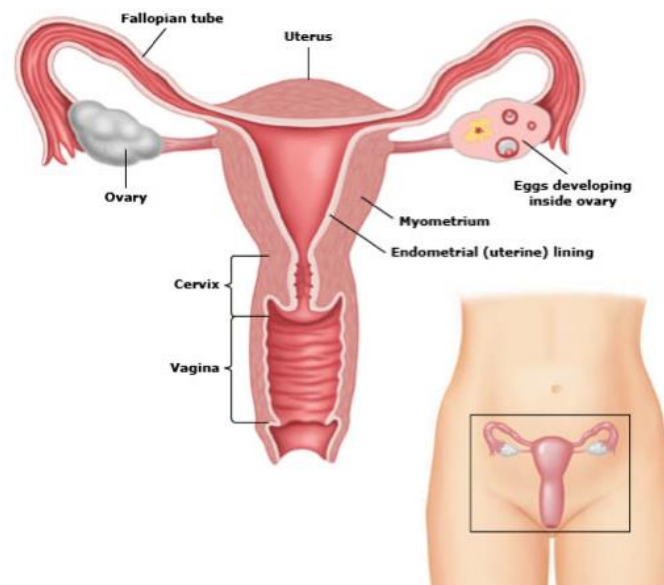


Figure 2. Abdomen & Pelvis

Digestion, nutrient absorption, hormone production and organ protection are some of the most important functions of the abdominal region. Among the main functions of the stomach in the human body, we can mention digestion, absorption of nutrients, removal of waste materials, production of hormones and enzymes, protection of organs, regulation of body temperature and storage of nutrients. In the following, we will talk more about each of these cases:

Digestion

Digestion of food is one of the most important processes performed by an organ called the stomach. The stomach is responsible for breaking down the food consumed into usable particles for the body. In addition to the stomach, small intestine, pancreas and liver also play a role in this process and produce

the enzymes needed to digest food and absorb nutrients [28].

Absorption of nutrients

The small intestine is responsible for absorbing nutrients. The small intestine absorbs these substances and transports them to the liver. These substances are processed in the liver and used by the human body [29].

Removal of waste materials

The meaning of removing waste material is the removal of the remaining materials from the food we consume. The colon is responsible for this process. In fact, it absorbs water and electrolytes from waste materials and stool is formed. Finally, it is excreted through the rectum and anus [30].

Hormone and enzyme production

Hormones and enzymes are more necessary for the internal organs of the stomach than night bread. For example, the pancreas produces a hormone called insulin, which is necessary to regulate blood sugar. In addition, in the meantime, the liver also produces enzymes, hormones and bile. It's good to know that bile helps digest fat [31].

Protection of organs

Another function of the human stomach is to protect internal organs. In addition, abdominal muscles help stabilize the spine [32].

Body temperature regulation

It may be strange, but the liver regulates body temperature by releasing heat through blood vessels to the skin. Interesting, isn't it?

Nutrient storage

The liver stores nutrients broken down through the small intestine. Including glucose, which is released through the bloodstream in the body when needed. Also, the pancreas stores hormones such as insulin, which will enter the bloodstream in emergency situations. The rectus abdominis muscle, external oblique muscle, internal oblique muscle and oblique abdominal muscle are muscles of the anterior external wall of the abdomen [33].

Auxiliary digestive organs

Pancreas, liver and gallbladder are part of the digestive system. To help digest food, these organs are required to produce essential hormones and enzymes. Digestive enzymes and bile are transported to the desired parts through narrow tubes called bile ducts. In addition, the pancreas is one of the endocrine organs that helps break down food by producing enzymes, and this organ is located behind the stomach [34].

"Ankle joint" or talus-heel is one of the capsule joints of the lower limb, which is formed by the bones of the tibia, fibula and talus. The cartilage of this hinge joint is hyaline. This joint facilitates the movement of the sole of the foot up (with the help of the gastrocnemius, soleus, soleus, and tibialis posterior muscles) and down (with the help of the tibialis anterior, extensor hallucis longus, and extensor toes longus). The two general categories of internal (middle) and external (lateral) ligaments that start from the ankles increase the strength of the bones in the joint and reduce the effect of physical blows on the bones.

- **Medial ligaments:** The medial or deltoid ligament of the ankle connects to the medial malleolus. This tissue consists of four ligaments that are connected to the talus, calcaneus, and navicular bones after leaving the ankle. The main function of these ligaments is to limit the return movement of the ankle.

- **External ligaments:** These ligaments start from the external ankle of the tibia and connect the external part of the talus, the back part of the talus and the calcaneus. Three bones, tibia, fibula and talus participate in the formation of the ankle joint [35].

Subtalar joint

The subtalar plate and capsule joint is formed between the bone of the lower part of the talus and the upper part of the calcaneus. The three back, middle and front ligaments between these two bones and outside the joint capsule increase the resistance of joint bones to physical blows. In addition, the tarsal sinus ligament (the hole between the talus and the heel) plays the biggest role in the strength of this joint. The subtalar joint is formed in the diagonal axis of the foot. For this reason, the main joint for inward (inversion) and "Outward" (eversion) movements is the sole of the foot with the external muscles of the leg and the tibial anterior muscle. The subtalar joint is one of the plate joints of the lower limb [36-38].

Metatarsophalangeal joint

"Metatarsophalangeal joints" are formed between the heads of long bones 1 to 5 and the proximal ligament of the big toe. This bite and capsule joint of the lower limb in flexion (with the help of the long muscles of flexor pollicis longus, flexor pollicis brevis, oblique head of the proximal pollicis, flexor digitorum brevis and lambrical), opening (with the help of extensor pollicis longus, extensor digitorum longus and extensor brevis fingers), distance (with the help of thumb abductor muscles, little finger abductor and interdigital longus) and bringing (with the help of thumb and interdigital abductor muscles) the finger to the body axis and the rotation of the fingers. The bones of this joint are put together with three groups of ligaments (lateral, plantar and metatarsal width) outside the capsule [39].

Anatomy of lower limb muscles

The muscles of the lower limb are skeletal muscle tissue connected to the bone, which are examined as front, middle and back groups in the four parts of the hip, thigh, leg and sole of the foot [40].

Thigh muscles

Four articular-muscular sets or "Lliopsoas", "Quadriceps Femoris", "Sartorius" and shoulder or "Pectineus" are located in the front part of the thigh, whose contraction separates the leg from the joint. Straightens the knee.

- **Psoas major muscle:** Psoas major muscle and psoas major muscle and iliacus muscle start from the pelvic ilium and form a common tendon in the front part of the thigh. These muscles do not participate in opening the leg

from the knee. The contraction of these muscles helps to move the thigh in the side joint.

- **Quadriceps femoris muscle:** The quadriceps femoris muscle consists of a set of three broad or vastus muscles (lateral, central and lateral) and the right femoral muscle or rectus femoris. This group accounts for the largest volume of muscle tissue in the front of the thigh. The vastus lateralis muscle starts from the greater trochanter, the vastus medialis muscle from the front and lateral part of the femoral shaft, the vastus medialis muscle from the middle trochanter, and the rectus femoris muscle starts from the lower-back part of the iliac crest. The function of the broad muscles is to open the angle and protect the knee joint. In addition to changing the knee opening, the rectus femoris muscle helps to move the side joint [41].
- **Suture muscle:** Suture muscle is the longest muscle in the body. This long and narrow muscle is located in the lower and middle part of the thigh and is closer to the surface than other muscles in this part. The seam muscle starts from the front-upper part of the ilium bone and connects to the upper-middle part of the tibia. This muscle facilitates bone movement in the hip and knee joints.
- **Shoulder muscle:** This smooth and square muscle starts from the "Pectineal Line" (Pectineal Line) of the Pubis Bone. The contraction of this muscle helps to move the bones in the side joint.

Five band muscles or "Gracilis", obturator externus, short adductor brevis, long adductor longus and the large adductor muscle or "Adductor Magnus" forms the middle or inner part of the thigh. The thigh muscles are located in the front, back and middle parts of this organ.

- **Large abductor muscle:** Starts from the lower part of the protrusion of the pubic bone and the ischium and connects to the lower part of the back of the femur. Contraction of this muscle facilitates movement.
- **Abductor longus muscle:** Covers the abductor brevis and major muscles. This muscle forms the middle part of the femur. This fan-shaped muscle starts from the pubic bone and connects to the middle part of the back of the femur. The contraction of this muscle helps to reduce the movement of the thigh in the direction of the vertical axis of the body.
- **Abductor brevis:** A small muscle below the abductor longus. This muscle starts from the trunk of the pubic bone and the lower ridge of this bone and connects to the upper-back part of the femur ridge. The contraction of this muscle helps to move the thigh in the horizontal axis.
- **Sedadi muscle:** Sedadi muscle is one of the small muscles of the middle part of the thigh, which is located in the highest part of this muscle tissue. This muscle starts from the membrane of the pelvic obturator hole and its side bone and after passing through the neck of the femur, it connects to the back part of the greater trochanter. The contraction of this muscle helps the movement of the thigh in the horizontal axis and the lateral rotation of this part of the lower limb [42].
- **Banded muscle:** Banded muscle is the most superficial muscle of the middle part that passes through the hip and knee joints. This muscle starts from the lower ridge and the trunk of the pubic bone and connects to the middle surface of the shaft of the tibia. The contraction of this muscle helps the horizontal movement of the thigh in the side joint and the backward movement in the knee joint. The muscle tissue of the middle or inner part of the thigh consists of five skeletal muscles. The "Hamstrings" group consists of the "Biceps Femoris", "Semitendinosus" and "Semimembranosus" muscles, which are located behind the thigh and make the appearance of this area of the lower limb.
- **Biceps femoris muscle:** The biceps muscle has two ends or a short and a long head, which are connected to the head of the fibula with a common tendon. This muscle is the outermost muscle of the back of the femur. The long head of this muscle starts from the ischial ridge of the pubic bone and its short head starts from the dorsal ridge of the femur. The main function of this muscle is to bend the leg in the knee joint. But it plays a role in raising the thigh in the side joint and lateral rotation of the knee and side joints.
- **Semitendinosus muscle:** The semitendinosus muscle is located in the inner (middle) part of the back of the thigh and above the semimembranosus muscle. This muscle starts from the ischial ridge of the pubic bone and connects to the middle part of the tibia. The contraction of this muscle helps to move the leg back at the knee joint, and the thigh at the side joint. In addition, it plays a role in the movement of the middle rotation of the thigh in the side joint and the leg in the knee joint.
- **Semimembranosus' muscle:** This smooth and wide muscle is located under the semitendinosus muscle in the inner part of the back of the thigh. The semimembranosus' muscle starts from the ischial prominence of the pubic bone (higher than the semitendinosus muscle and biceps femur) and connects to the middle condyle of the tibia. The contraction of this muscle helps to move the leg back at the knee joint, and the thigh at the side joint. In

addition, it plays a role in the movement of the middle rotation of the thigh in the side joint and the leg in the knee joint. The contraction of the three muscles behind the thigh helps to move the lower body [43].

Leg muscles

The front part of the lower leg consists of the four front muscles of the tibia, "Extensor Digitorum Longus", "Extensor Hallucis Longus" and "Fibularis Tertius".

- **Front tibial muscle:** This muscle, which is located in the lateral (external) part of the tibial bone, starts from the beginning of the lateral surface of the tibial bone and connects to the middle cuneiform bone and the near end of bone number 1 on the foot. The contraction of this muscle helps to move up-down and left-right of the sole of the foot in the wrist joint.
- **Extensor of the big toes:** This muscle is located in the lateral-anterior part of the leg. The toes extensor muscle starts from the lateral condyle of the tibia and the medial surface of the fibula. The end tendon of this muscle turns

into four branches in the leg area and each branch is connected to one of the toes. The contraction of this muscle helps to move the four toes up-down and left-right.

- **Big toe extensor muscle:** This muscle is located under the tibialis anterior muscle and the toe extensor muscle. The tendon of this muscle reaches the big toe after passing between the two muscles of the tibia and the fingers. The big toe extensor muscle starts from the middle (inner) shaft of the fibula and its tendon connects to the bone around the big toe. The contraction of this muscle helps to move the thumb up-down and left-right [44].
- **Lateral fibular muscle:** The lateral fibular muscle starts from the lowest part of the extensor digitorum muscle and is not present in all people. The tendon of this muscle connects to the fifth long bone on the foot (the outermost) in the area around the sole of the foot. The contraction of this muscle helps to move left-right and up-down on the leg.

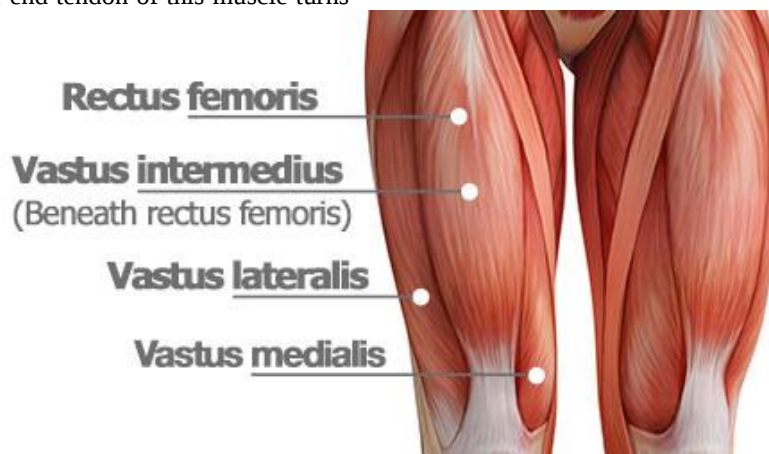


Figure 3. Leg Muscles: Anatomy, Function, and Best Exercises

The muscles of the front part of the leg participate in the movements of the sole of the foot in the ankle joint. The back part of the leg consists of 7 muscles, which are divided into superficial and deep parts. The gastrocnemius, the soleus, and the plantaris make up the superficial part of this complex. The three muscles of this part are connected to the calcaneus bone (heel) by the joint tendon of the heel. Two fluid bags (between the skin and the tendon - between the tendon and the heel bone) along with the heel tendon, reduce the friction of this part of the lower limb in movement.

- **Twin muscle:** The twin muscle is the most superficial muscle on the back of the leg, which reaches the medial (inner) and lateral (outer) parts of the leg. The shape of the back of the leg is created due to the presence of this muscle. The lateral part of this muscle starts from the

lateral condyle and its middle part starts from the medial condyle of the femur. These two heads merge to form the muscle belly. The far end of this muscle forms the heel tendon with the soleus muscle. The contraction of this muscle contributes to bending the leg at the knee joint and lifting the leg at the wrist joint.

- **Soleus muscle:** The soleus muscle is located under the gastrocnemius muscle. This muscle starts from the soleus line of the tibia and the near part of the fibula, and its common tendon is connected to the heel bone with the twin muscle. The contraction of this muscle contributes to bending the leg at the knee joint and lifting the leg at the wrist joint.
- **Plantaris muscle:** This thin muscle is absent in some people and starts from the lateral supracondylar line of the femur (Lateral Supracondylar Line). The tendon of this

muscle, together with the tendon of the soleus muscle and the gastrocnemius muscle, form the heel tendon. The contraction of this muscle contributes to bending the leg at the knee joint and lifting the leg at the wrist joint. Three superficial muscles of the back of the leg make up the heel tendon. The deep part consists of the popliteus, flexor digitorum longus, flexor hallucis longus and tibialis posterior muscles.

- **Muscle behind the knee joint:** This muscle is located behind the knee joint and only helps to move this joint. Between the tendon of this muscle and the back part of the knee joint, there is a fluid bag that prevents the friction of this part of the lower limb in movement. This muscle starts from the lateral condyle of the femur and the lateral meniscus of the knee and is connected to the near part of the tibia above the starting point of the soleus muscle. The contraction of this muscle helps to remove the leg from the knee.
- **Finger flexor muscle:** The narrow finger flexor muscle is located in the middle (inner) part of the back of the leg. This muscle starts from the medial surface of the tibia and connects to the plantar surface of the four toes. Contraction of this muscle helps to flex (downward) the four toes [45].
- **Big toe flexor muscle:** This muscle is located on the lateral (outer) part of the back of the leg. The thumb flexor muscle starts from the back part of the fibula and connects to the plantar surface of the big toe bone. Contraction of this muscle helps to bend the thumb bone.
- **Tibialis Dorsi muscle:** Tibialis Dorsi muscle is the deepest muscle in the back of the leg. This muscle starts from the dorsal surface and the membrane between the tibia and fibula. The tendon of this muscle enters the sole of the foot from the back part of the middle ankle and is connected to the plantar surface of the middle (outer) bones of the ankle. The contraction of this muscle helps to move the sole of the foot in the external direction and bend this part of the lower limb in the downward direction [46].

Conclusion

The liver is located in the upper right quadrant of the abdomen. In addition to producing hormones and regulating the amount of glycogen, the liver also plays a role in blood purification. The liver is constantly communicating with the gallbladder. The gallbladder stores the bile until it is discharged from the liver to the intestine. It is good to know that the gallbladder is located in the abdominal cavity and on the right side of the right lobe of the liver. The spleen is a constantly active purifying organ that destroys dead red blood cells and metabolizes the hemoglobin in them. You can find the spleen in the upper left part of the abdomen. Kidney, ureter and

bladder make up the urinary system. In addition to purifying the blood, this system is responsible for transferring waste materials to the bladder. In some medical articles, this system is considered a part of the pelvis. The kidneys, which are part of this system, filter waste from the blood, manage blood pressure, and regulate blood PH. In the meantime, the urine is discharged from the kidney and through the ureter to the bladder, and the bladder collects the urine for excretion. Note that the bladder, uterus, fallopian tubes and ovaries may be seen as abdominal organs or pelvic organs. If we want to be more precise, we can say that the stomach contains a wide membrane called the peritoneum. The peritoneum has many folds, one fold of which may cover some special organs. While it is likely to cover only one side of the organs that are usually closer to the abdominal wall. This operation is called retro peritoneum in the medical world.

Tibia and fibula joint

There are two joints between the distal and proximal parts of the tibia and fibula. These joints are of a fixed type that do not play a role in the movement of the lower limb, but they increase the strength and weight bearing in the leg. The tibial-fibular plate-capsular joint is formed between the fibular head and the lateral condyle of the fibula. The cartilage between the bones in this joint is hyaline. The superior connections of the anterior and posterior tibia (between the head of the tibia and the lateral condyle of the tibia), the external parallel ligament in the knee joint and the biceps femoral ligament stabilize the position of this joint. The tibiofibular joint increases the strength of this part of the lower limb.

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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