

Review Article

The anatomical, surgical and orthopedic importance of gastrocnemius

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ABSTRACT

Gastrocnemius is one of the most important muscles of lower limb. It belongs to the superficial compartment of calf muscles. They belong to group of superficial flexors. Gastrocnemius, plantaris and soleus form the bulk of the calf. Gastrocnemius forms the belly of the calf. It arises by two distinct heads, connected to the condyles of the femur by strong, flat tendons. It has an immense anatomic, medical, orthopedic and physiological importance and is attributed in a variety of medical and surgical problems. A profound knowledge of this muscle is of great importance to any surgeon or orthopedicians or any clinician.

Keywords: Gastrocnemius, Heads, Sural, Pump, Calf, Plantar, Stance, Orthopedics

INTRODUCTION

Gastrocnemius is one of the most important muscles of lower limb. It belongs to the superficial compartment of calf muscles. They belong to group of superficial flexors. Gastrocnemius, plantaris and soleus form the bulk of the calf. Gastrocnemius forms the belly of the calf. It arises by two distinct heads, connected to the condyles of the femur by strong, flat tendons.

The medial, larger, head is attached to a depression at the upper and posterior part of the medial condyle behind the adductor tubercle, and to a slightly raised area on the popliteal surface of the femur just above the medial condyle.

The lateral smaller head is attached to an area on the lateral surface of the lateral condyle and to the lower part of the corresponding supracondylar line. Both heads also arise from subjacent areas of the capsule of the knee joint. Sural nerve passes between two heads of gastrocnemius.

Two heads of gastrocnemius along with soleus are called triceps surae. Gastrocnemius and soleus are called as the triceps surae and they together constitute a powerful muscular mass whose main function is plantar flexion of the foot.

Their large size is one of the most characteristic features of the musculature of man, being related directly to his upright stance and mode of progression. Gastrocnemius muscle is one of the most important muscles for maintenance of posture.

A special feature about the muscle is that as the muscle descends, the muscle fibres begin to insert into a broad aponeurosis that develops on its anterior surface; up to this point the muscular masses of the two heads remain separate. The aponeurosis gradually contracts and receives the tendon of soleus on its deep surface to form the Achilles tendon.

The Achilles tendon, approximately 10-16 cm long, starts at the musculotendinous junction of the gastrocnemius

and soleus in the middle of the calf and inserts into a rough area on the middle of the lower part of the posterior surface of the calcaneus. Initially flattened at its junction with the gastrocnemius, it subsequently becomes rounded. It flattens approximately 4 cm from its insertion and then expands to become cartilaginous.

On its anterior surface, the tendon receives muscular fibers from the soleus almost to its insertion. Among humans, the gastrocnemius and soleus vary in their orientation, contribution to the Achilles tendon, and the extent of their fusion.

The tendon is enclosed by a paratenon that is continuous proximally with the fascial envelope of muscle and blends distally with the periosteum of the calcaneus. Arteries enter the tendon at either end and course longitudinally along its length.

Kager's triangle is the area between the tendon, the posterior tibia, and the upper part of the posterior surface of the calcaneus, contains blood vessels that supply the tendon.

The superficial surface of the muscle is separated by the deep fascia from the short saphenous vein and the peroneal communicating and sural nerves. The common peroneal nerve crosses the lateral head of the muscle

The tendon of the lateral head frequently contains a fibrocartilaginous or a sesamoid bone the fabella, where it moves over the lateral femoral condyle. A sesamoid may occasionally occur in the tendon of the medial head. These can be seen on radiographs and may be mistaken for loose bodies in the knee joint. Gastrocnemius is innervated by the tibial nerve.

Tennis leg is synonymous with gastrocnemius soleus strain. It is an entity characterized by rupture of medial head of gastrocnemius usually at its distal musculotendinous origin. It is given the name as it is common in sports personnel especially tennis players.¹⁻³

The tendon of the lateral head frequently contains a fibrocartilaginous or bony sesamoid, the fabella, where it moves over the lateral femoral condyle. A sesamoid may occasionally occur in the tendon of the medial head. These can be seen on radiographs and may be mistaken for loose bodies in the knee joint. Fabella is a sesamoid bone developing in lateral head of gastrocnemius. Fabellas have been associated usually with orthopedic complaints of knee pain, inflammation or sesamoiditis of fabella is also a common orthopedic problem.

GASTROCNEMIUS IN WALKING

For effective movement of humans, erect posture, development of arches of foot and the development of muscles of the calf has gained an increased importance. For usual movements of walking, supported by the lower

limb, calf muscles are important. Especially during stance and swing. Muscle used in normal walk during stance and swing is gastrocnemius. It has a profound effect on ankle dorsiflexion and time to heel off during stance phase of walking.

THE DIVORCED TENDON OF GASTROCNEMIUS

Ligamentum plantare longum, the gastrocnemius does not have only a muscular or a tendinous part but a portion of the muscle forms a special ligament. Ligamentum plantare longum or long plantar ligament is divorced tendon of gastrocnemius. In plantar fasciitis or heel pain syndrome inflammation of this ligament can occur.

Inflammation of the tendon of gastrocnemius, Achilles Tendinitis: The tendon of gastrocnemius fuses with tendon of soleus to form Tendo Achillis. It is the largest tendon in the body and one of the most common tendons susceptible to injury due to repeated trauma as well as poor blood supply. It connects the calcaneum to the gastrocnemius and soleus. It is devoid of a synovial sheath but has a paratenon. The most common conditions of the Achilles tendon include tendonitis, peritendonitis, tendinosis, rupture, and retrocalcaneobursitis. Achilles tendinitis is the most common and occurs in gymnasts, tennis players and professional dancers.⁴⁻⁷

GASTROCNEMIUS IN ORTHOPEDICS

Open fractures of the tibia and fibula are usually high-energy injuries. Management skill in orthopedics requires aggressive and thorough debridement of all non vitalized tissue, with provisional or definitive fracture stabilization, depending on the nature of the fracture. All wounds are left open. Staged soft tissue reconstruction is then performed, which may include delayed wound closure, bone and skin grafting, local muscle flaps, or distant free tissue transfer for large defects.^{8,9} Composite tissue transfer, using techniques of microsurgery, is highly effective in the treatment of these injuries. Entire muscles can be transferred for coverage and function. Bone with skin can be transplanted, which provides structural stability as well as coverage.

Principles for coverage of open tibial shaft fractures suggest that the gastrocnemius muscle be used as a rotational flap for proximal-third soft tissue defects, the soleus for middle-third defects, and microsurgical free tissue transfer for distal-third soft tissue defects.¹⁰

GASTROCNEMIUS AS A VENOUS PUMP

The muscles of the calf serve as components of the venous pump. When the skeletal muscles contract, blood forced from the intramuscular and surrounding veins is propelled toward the heart. As a consequence of this pumping action, venous pressures in the dependent portion of the leg are lowered, venous congestion is relieved, edema is reduced, and blood flow through

exercising muscles is facilitated. This venous pump is most highly developed in the calf, where the soleal and gastrocnemius sinusoids compose the major bellows of the muscle pump. Contraction of the calf muscles produces pressures in excess of 205 mm. Hg, which is sufficient to compress the intramuscular veins even in the standing position. With each muscle contraction, blood is, therefore, propelled centrally. Hence the muscles serve as peripheral heart.

POPLITEAL ENTRAPMENT BY GASTROCNEMIUS

Popliteal aneurysms frequently are the most common site of peripheral arterial aneurysms. Atherosclerosis is by far the most common cause, accounting for greater than 95% of aneurysms in most collected series.¹¹⁻¹³ Other causes include popliteal entrapment by the gastrocnemius muscle, bacterial infection, collagen disorders, and trauma.

GASTROCNEMIUS MUSCULOCUTANEOUS FLAPS

Each head of gastrocnemius is supplied by its own sural artery. These arteries are branches of the popliteal artery. They arise variably, usually at the level of the tibiofemoral joint line. The clinical importance of blood supply to gastrocnemius lies in the fact that medial or lateral gastrocnemius musculocutaneous flaps may be raised, each utilizing one of the heads of the muscle based on its own sural artery. Minor accessory sural arteries arise from the popliteal or from the superior genicular vessels.

Brodies bursa is a subtendinous bursae lying deep to gastrocnemius. Occasional bursitis of this tendon can occur and is important to diagnose.

SURAL NERVE AND GASTROCNEMIUS

Nerve transfer techniques borrow other local cranial nerves to innervate the distal facial nerve stump if grafting cannot be done. This requires the availability of distal facial nerve or nerve branch stumps. Typically used

donor nerves include the ipsilateral hypoglossal nerve, spinal accessory nerve, and cross-face sural nerve graft from a contralateral facial nerve branch (redundant buccal or zygomatic branch). For harvesting sural nerve it is to be remembered that the sural nerve is an important structure which passes between the two heads of gastrocnemius.

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