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Anatomy, Bony Pelvis and Lower Limb, Medial Thigh Muscles

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Introduction

The thigh has some of the largest muscles in the human body. The medial thigh muscles are important for allowing normal gait and functioning of the lower extremity. The medial thigh muscles mainly allow for adduction of the leg. Weak adductor muscles can create instability at the knee and can increase the risk of an adductor strain.[1] The medial thigh muscles also protect important neurovascular structures as they pass from the proximal hip joint to the knee and lower leg.

Structure and Function

The femoral triangle is a space located at the proximal thigh. Its borders are:

- Superior: inguinal ligament
- Lateral: sartorius
- Medial: adductor longus

The adductor canal is located deep to the sartorius muscle and spans the middle third of the thigh, spanning the femoral triangle proximally to the adductor hiatus distally. The contents of the adductor canal include:

- Saphenous nerve
- The nerve to vastus medialis
- Superficial femoral artery
- Femoral vein

This adductor canal functions to allow the passage of the major thigh neurovascular bundle to travel from the proximal thigh to the distal thigh.[2]

Blood Supply and Lymphatics

The main arterial supply to the lower extremity is provided by the femoral artery. A continuation of the external iliac artery, the common femoral artery enters the thigh passing deep to the inguinal ligament. Once in the thigh, the femoral artery gives off the following branches:[3]

- Medial femoral circumflex artery
- Lateral femoral circumflex artery
- Femoral profunda (deep artery of the thigh) artery

- Medial and Lateral femoral circumflex branches
  - The medial femoral circumflex artery is the predominant blood supply to the head (via the lateral epiphyseal artery)
- First, second, and third perforating branches
  - Supply the medial thigh muscles

- Superficial femoral artery

Nerves

The saphenous nerve enters the adductor canal at the distal apex of the femoral triangle. At this location, it is found adjacent to the femoral artery.[2] Once in the adductor canal, the saphenous nerve courses distally towards the knee joint and, unlike the femoral artery which then enters the adductor hiatus, the saphenous nerve pierces between the gracilis and sartorius and travels superficially eventually providing sensory innervation to the medial distal leg.[2]

The femoral nerve mostly innervates the hip flexor and knee extensor muscles. Of the muscles in the medial thigh, the femoral nerve innervates the sartorius and pectineus muscles via its anterior motor branch.

The obturator nerve comes from the lumbar plexus (second, third, and fourth lumbar levels). The anterior branch of the obturator nerve provides motor innervation to the superficial medial thigh muscles as well as sensation to the hip joint and the medial thigh. The posterior branch of the obturator nerve supplies motor innervation to the deep adductor muscles as well as sensation to the posterior knee.[4]

Muscles

The majority of the adductor muscles originate on the pubic bone and insert at various portions of the femur. The most medial muscle of the medial thigh muscles is the gracilis muscle. Although the sartorius muscle does not originate with the adductors proximally, as it travels distally, it crosses medially across the knee extenders and inserts medially on the proximal tibia. The junction where the gracilis, sartorius, and semitendinosus insert on the anteromedial proximal tibia is known as the pes anserinus. The name of this region derives from its resemblance to a goosefoot.[5] They are arranged semitendinosus, sartorius, and gracilis from deep to superficial respectively. Interestingly, it has been determined that 40% of the adductor longus muscle originates anteriorly near the pubic tubercle via tendon fibers and 60% originates from the posterior pubic symphysis via muscular fibers.[6] Specific origins and insertions are described in detail below.

- Sartorius origin: Anterior superior iliac spine
- Sartorius insertion: Medial proximal tibia at the pes anserinus
- Gracilis origin: Anterior body of the pubis and inferior ramus of the pubis
- Gracilis insertion: Medial proximal tibia at the pes anserinus
- Pectineus origin: Pectineal line
- Pectineus insertion: Posterior femur from lesser trochanter to linea aspera
- Adductor brevis origin: Body of the pubic bone and anteroinferior pubic ramus
- Adductor brevis insertion: Upper third of the femur on the linea aspera and posterior proximal femur
- Adductor longus origin: Body of the pubis and anteroinferior pubic ramus
- Adductor longus insertion: Middle third of the shaft of the femur on the linea aspera
- Adductor magnus origin: Inferior pubic ramus, external obturator membrane, and ischial tuberosity.

- Adductor magnus insertion: Posterior proximal femur and linea aspera

Physiologic Variants

Several anatomic variants of the pes anserinus have been discovered. In cadaveric studies, accessory gracilis and semitendinosus were identified to be inserting together and separately.[5] Another study identified three variations in the arrangement of the pes anserinus tendon. The first variation found that the sartorius tendon did not cover the gracilis tendon. The second variation found that the sartorius tendon covered the gracilis tendon completely, but did not completely cover the semimembranosus tendon. The third variation found that the sartorius tendon completely covered the gracilis and the semimembranosus tendons.[7]

A review of 4880 femoral angiograms revealed that 40% of patients had a high bifurcation in either of their femoral arteries. It was also discovered that in the case of a unilateral high bifurcation, the incidence of a contralateral high bifurcation is increased.[8]

Surgical Considerations

Total knee arthroplasty (TKA)

A femoral nerve block (FNB) and adductor canal block have been used for pain control during and after total knee arthroplasty (TKA). Both techniques provide similar analgesic benefits while mitigating the risks of general anesthesia. However, FNB has fallen out of favor secondary to its associated quadriceps weakness seen in patients postoperatively. Thus, FNB theoretically delays mobilization in this subset of patients [9]. While FNB has been shown to reduce quadriceps strength by 49%, adductor canal blocks result in significantly less (i.e., 8%) quadriceps weakness postoperatively. Adductor canal blocks preserve the ability for patients to ambulate better than a femoral block. Total analgesic consumption was 14.5% less in the adductor canal block, and postoperative pain control was comparable to the femoral canal block.[10]

Surgical approaches to the hip

Chiron et al. describe a minimally invasive medial hip approach that allows for visualization and access to the iliopsoas tendon and the intraarticular region without risking injury to nerve and vascular supply. This medial hip approach is anterior to the adductor longus, adductor brevis, pectinate, and adductor magnus muscles. This surgical approach is in contrast to the traditional trans-abductor approach to the hip which passes anterior to the adductor longus and adductor brevis muscles but is posterior to the pectinate muscle. The trans-abductor approach involves a risk to the obturator nerve which can be avoided in the medial hip approach. It is proposed that the primary indication for this approach is psoas tendon tenotomy.[11]

Hip arthroscopy

Despite the hip joint proving to be challenging to treat arthroscopically, the interest in arthroscopic surgery of the hip joint has increased. Major neurovascular vessels are at risk of injury and care must be taken to preserve these structures. Specifically, medial hip portals are useful when medial hip lesions are present. The obturator nerve, medial femoral circumflex artery, and other femoral neurovascular structures are at risk of injury when medial hip portals are used.

Injury to the obturator nerve was avoided when the portals were placed in two medial locations. The first point was found by drawing a parallel line to the ilioinguinal ligament that was 3 cm distal to the ligament. This line was then crossed perpendicularly by the anterior border of the adductor longus muscle. The intersection created was the first portal location. The second portal was located 2 cm distal to the first portal along the anterior adductor longus muscle border. Injury to the medial neurovascular bundle can be further minimized by flexing the hip to 40-50 degrees prior to inserting the medial portal.[12]

Acetabular fractures

Acetabular fractures commonly require open reduction and internal fixation and are also known to cause impingement of the obturator nerve. The modified Stoppa approach has been popularized, and its use is common in fracture patterns requiring access to the quadrilateral plate. Fracture displacement and medial comminution in this region often occur in both associated column fracture patterns.

Overall the modified Stoppa approach is less invasive compared to the traditional ilioinguinal approach. Moreover, compared to the latter, the modified Stoppa approach provides equivalent access to the quadrilateral plate. A 2017 study compared the ilioinguinal and Stoppa approaches for ORIF treatment for displaced acetabular fractures. Ultimately, both techniques demonstrated the achievement of satisfactory clinical outcomes, the Stoppa approach demonstrated superior outcomes in regard to total operative time and intraoperative blood loss.[13]

Clinical Significance

Obturator nerve entrapment syndrome will present with sensation loss to the medial thigh, thigh adduction weakness, or both. Trauma and iatrogenic injury are the most common causes of this condition. Iatrogenic injury likely results from orthopedic, urologic, spine surgery. Lesser causes being gynecologic complications (e.g., ectopic pregnancy), sports hernias, neurofibromas or lipomas. Magnetic resonance imaging (MRI) can be beneficial in identifying adductor brevis or adductor longus muscle atrophy which would indicate possible obturator nerve entrapment. The gold standard for diagnosis of this condition is electromyography. Treatment is typically conservative at first and can be followed by obturator nerve block or surgical intervention if unsuccessful.[4]

The incidence of groin pain is high, and pain can be challenging to elucidate. Athletic pubalgia has been gaining increased recognition as the cause of chronic groin pain in athletes. The classic presentation is gradually increasing pain located unilaterally in the region of the lower abdomen, deep groin, and proximal origin of the adductors. The differential diagnosis for an injury in this region can be broad.[1] A discussion of the possible diagnosis is beyond the scope of this article, but conditions that apply directly to the medial thigh muscles will follow.

Adductor strains are some of the most common groin injuries in the athletic population. It has been estimated that 10% of all soccer injuries are attributed to this diagnosis. Resisted adduction and palpation to the affected muscle and/or tendon will elicit pain. The diagnosis is almost always made clinically with imaging reserved mainly for chronic conditions that have been recalcitrant to treatment. Initial treatment of this condition is conservative, including nonsteroidal anti-inflammatories and rest. Depending on the specific location of the injury, either light or aggressive physical therapy can be indicated.[1]

Questions

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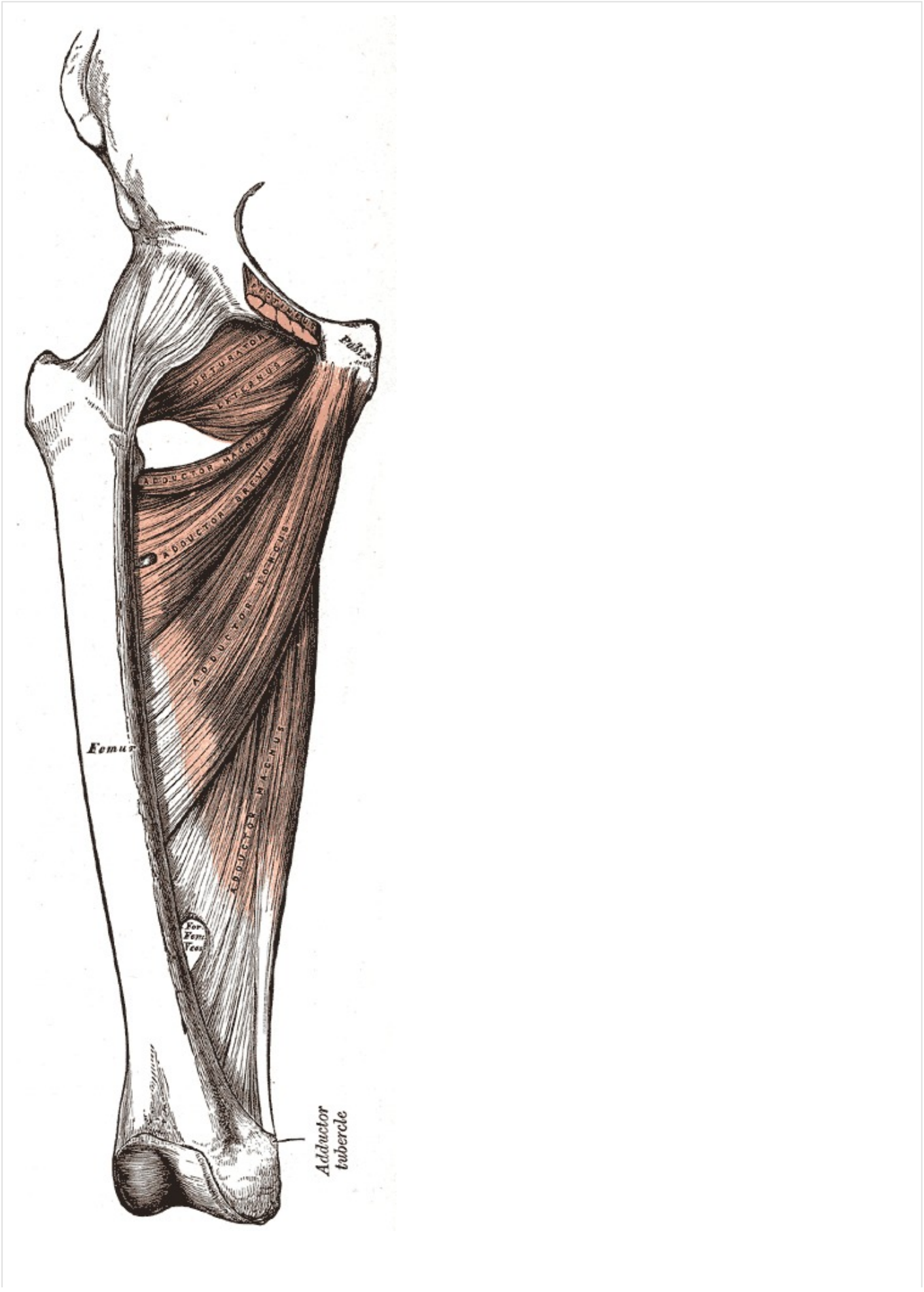
Figures


Pubis
OBTURATOR EXTERNUS
ADDUCTOR MAGNUS
ADDUCTOR BREVIS
ADDUCTOR LONGUS
Femur
ADDUCTOR MAGNUS
For. Fem. Vess.
Adductor tubercle

Medial Compartment of the Thigh, Pubis, Femur, Obturator Externus, Adductor Magnus; Brevis; Longus,. Contributed By Gray's Anatomy Plates

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