ORIGINAL RESEARCH

THE PES ANSERINUS: THE ANATOMY AND PATHOLOGY OF NATURALLY OCCURRING AND EXTRACTED TENDONS

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ABSTRACT
The goal of this article is to have a comprehensive review of the anatomy of the pes anserinus (PA) and the spectrum of pathologic conditions that can affect this structure. After the insertion site of the PA tendons was fully exposed, careful dissection was performed to determine the exact shape of the PA. Insertions were made into the gracilis and superficial layers of the sartorius and the deep layers of the semitendinosus on the medial side of the tibia. Sixty-six percent of specimens had one semitendinosus tendon at the insertion site, while 31 percent had two, and 3 percent had three. A connection was made between the deep fascia of the leg and the tendons of the gracilis and semitendinosus. The anserine bursa was a somewhat asymmetrical, roughly circular shape. Some of the anserine bursa specimens even extended beyond the proximal line of the tibia. The anserine bursa, as seen from the medial side of the tibia, was situated posteriorly & superiorly from the tibial midline, paralleling the sartorius muscle. Anserine bursa injections should be given at an angle of 20 degrees medially and inferiorly from the vertical line, 15 or 20 millimetres deep, and roughly 20 millimetres medially and 12 millimetres superior from the inferomedial point of the tibial tuberosity.
Keywords: Pes anserinus, Anterior cruciate ligament, Anserine bursa, Reconstruction, Semitendinosus.

INTRODUCTION
The integration of the conjoined distal sartorius, gracilis, & semitendinosus tendons at the anteromedial facet of the tibia gives rise to a deformity known as pes anserinus, or "goose foot" in Latin. These myotendinous structures & their entheses are just a small part of the

anatomical complexity that surrounds the medial aspect of the knee, which also includes ligaments, fascia, nerves, and bursae. Overuse, inflammatory, acute or repetitive trauma, surgical intervention, and tumors or tumorlike lesions can all contribute to abnormalities of these structures [1]. Pes anserinus bursitis and tendon harvesting complications associated with anterior cruciate ligament (ACL) reconstruction make up the bulk of the literature on the pes anserinus, despite the complex anatomy and wide variety of pathological processes that can be encountered in this region [2].

The tendinous inclusions of the sartorius, gracilis, & semitendinosus muscles all come together to form the pes anserinus (PA). These three muscles, which attach to the tibia's medial side, create a shape that is reminiscent of a goose's foot. Clinically, this structure is relevant when dealing with tendon reconstruction or when administering corticosteroid injections to treat anserine bursitis (AB)[3].

Autografts from the patellar tendon (PA) are frequently used in knee ligament reconstruction. The main benefits of this method are the absence of clinical or functional losses associated with harvesting PA tendons and the low morbidity experienced by the donor. However, knowing where the PA tendons are in relation to their insertion site is crucial for minimally invasive surgery.

The anserine bursa is situated on the medial side of the upper tibia, where the tendon of the PA muscles joins. When people complain of knee pain, it's not uncommon for the AB to be at fault [4]. Clinical diagnosis of AB has been made in 46.8% of patients with knee oa. Computed tomography evidence of knee osteoarthritis was reported in 83.3% of patients with AB or tendinitis.

One way to alleviate the pain of bursitis is with a steroid injection into the bursa. When compared to blind injection, the success rate of anserine bursa injections guided by ultrasound is significantly higher. Surgeons are aware that ultrasound-guided injection is preferable, but they are frequently faced with situations in clinical practice that necessitate blind injections. When giving an injection blindly, it helps to have some anatomical background so you can locate the optimal injection site.

While the human bursa has been studied extensively, little was known about its anatomy until now. This article aims to provide a comprehensive review of the normal anatomy of the pes anserinus as well as the spectrum of pathologic conditions can affect this structure.

ANALYZING THE PES ANSERINUS AND SURROUNDING STRUCTURES

According to Warren and Marshall's original description, there are three distinct layers of soft tissue that make up the medial compartment of the knee. The medial patellar retinaculum, the popliteal fascia, and the fascia lata make up the first, superficial layer of the knee. Below this is the thin crural fascia, which forms a circumferential structure around the knee. The superficial medial collateral ligament (MCL) makes up the bulk of the second layer, and its fibers combine with those of the posterior oblique ligament and the third layer [5]. The joint capsule, which includes the deep MCL at the tibia and femur, makes up the third layer. In the case of the pesanserinus, the deeper gracilis& semitendinosus tendons are located between layers 1 and 2, while the distal sartorius muscle & tendon are encased in the crural fascia (layer 1).

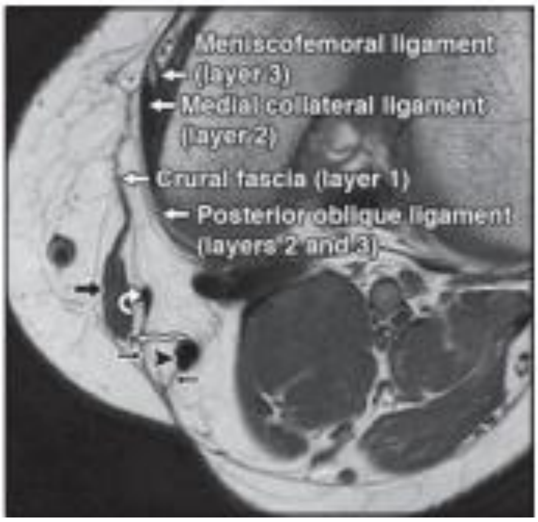
MUSCLES OF THE PES ANSERINUS

The sartorius is a strap muscle supplied by the femoral nerve; its name comes from the Latin word for "tailor," which describes the typical sitting position of tailors. It begins at the anterior superior iliac spine, runs inferiorly across the appendicular skeleton of the thigh from lateral to medial, and inserts at the proximal medial tibia. Although it is the longest muscle in the body, it serves primarily as a synergistic muscle and is therefore relatively weak. This strap muscle, which would be innervated by the obturator nerve, gets its name from the Latin word for "slender," "gracilis." It begins at the ischiopubic ramus and travels down the medial aspect of the thigh to an insertion point behind the sartorius muscle and tendon at the back of the knee [6]. The sciatic nerve provides innervation for the fusiform pennate muscle known as the semitendinosus, which gets its name from the long tendon it forms at the midthigh. It begins as a conjoined tendon with the long head of the biceps quadriceps muscle at the ischial tuberosity, travels down the back of the thigh behind the semimembranosus muscle, and finally inserts behind the gracilis tendon in the back of the knee.

TENDONS OF THE PES ANSERINUS

The pes anserinus has a complex structure. The gracilis& semitendinosus tendons are located on the profound surface of this basal lamina over the medial tibia, and the sartorius tendon maintains its close relationship with the crural fascia (layer 1). The pes anserinus is an important muscle because it inserts proximally and anteriorly to the superficial medial collateral ligament (MCL) (layer 2). The insertion of the pes anserinus tendon complex into the proximal medial tibia is always 42 7 mm below the level of the tibial plateau, and it is always medial to the tibial tuberosity. The sartorius tendon attaches proximally to the pes anserinus bursa, followed by the gracilis tendon and the semitendinosus tendon (ordinary tendon widths of 8.0, 8.4, and 11.3 mm, respectively). These tendons may have separate osseous and soft-tissue insertions, but they are frequently accompanied by accessory tendons and fascial bands. The semitendinosus tendon is the most morphologically variable of the pes anserinus tendons, with as many as three tendinous insertions and a variety of soft-tissue extenders, including a constant band that connects to the gastrocnemius fascia (Fig. 1)

Fig. 1: The three anatomical layers of the knee, as identified by Warren and Marshall, are visible in this axial T1-weighted MR image.



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PES ANSERINUS BURSA

The bursa between both the pes anserinus as well as the distal superficial MCL is lined with synovium and is a constant anatomic structure. The pes anserinus bursa is not connected to the knee's articular cavity like the popliteal bursa on the knee's posterior side. It has an asymmetrical circular shape and follows the path of the sartorius muscle fibers. The pes anserinus bursa is usually found to extend proximally to the joint line (i.e., the proximal articular surfaces of the lateral and medial tibial condyles) in cadaveric dissections; however, in about 24% of specimens, it is found to extend as far as 20 mm above this line [6]. The semimembranosus and medial collateral ligament bursae are additional bursae located on the medial side of the knee. Bursae are located in different areas of the knee; the semimembranosus bursa is located posteriorly and superiorly to the pes anserinus bursa, while the MCL bursa is located between the deep as well as superficial fibers of the MCL in the middle third of the knee. This bursitis can coexist with pes anserinus bursitis, but the bursae are not known to interact with one another.

BRANCHING OF THE SAPHENOUS NERVE

From its origin at the femoral triangle, the saphenous nerve travels distally through the adductor canal, medially across the femoral vessels, proximally toward the knee between both the sartorius&gracilis tendons, and finally inferiorly within the midline subcutaneous fat of the leg, close to the greater saphenous vein. The saphenous nerve divides into the infrapatellar and sartorial branches just above the knee. The infrapatellar artery can run anterior to or posterior to the sartorius muscle. The medial infrapatellar area receives sensory input from this nerve. It is at risk of injury during surgical procedures encompassing the pes anserinus, including such graft harvesting for ACL reconstruction, due to its subcutaneous location as well as horizontal course along the medial knee [7]. It has been proposed that the risk of nerve injury can be reduced by making an oblique incision parallel to this branch instead of a perpendicular vertical incision. The sartorial branch penetrates the crural fascia and becomes subcutaneous about 12 centimeters above the insertion of the pes anserinus, after being intimate with the gracilis tendon for about 5 centimeters. The medial part of the leg receives sensory input from this nerve. The sartorial branch is at risk of injury during tendon harvest because of its close proximity to the gracilis tendon.

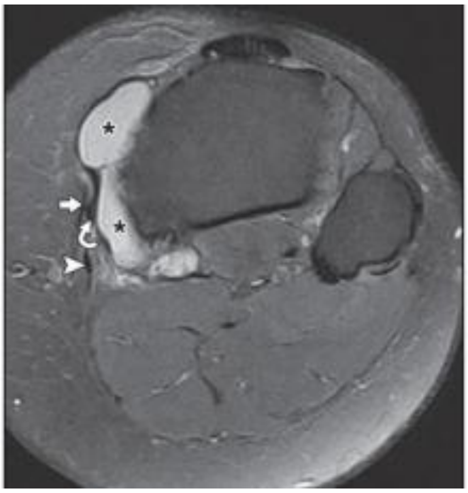
DISTURBANCES OF THE PES ANSERINUS

Overuse, acute trauma, iatrogenic causes, tumors and tumorlike lesions, and benign conditions are the four main types of pes anserinus disorders (Table 1).

OVERUSE

Bursitis of the Pes Anserinus is commonly experienced by runners and other athletes due to repetitive stress. The friction from nearby osteophytes or exostoses, as well as injuries and inflammatory arthritides, have all been linked to this condition. Clinically, pes anserinus bursitis is diagnosed when a patient experiences pain in the proximal medial aspect of the tibia. However, in rare cases, the clinical picture is ambiguous, and further imaging is required. Approximately 67% of asymptomatic volunteers have normal ultrasound visualization of the pes anserinus bursa in its usual position (i.e., between the pes tendons and the tibia), 21% have ultrasound visualization between the pes tendons and MCL, and 8% have ultrasound visualization between the constituents of the pes anserinus. Fluid is detected within the bursa at MRI, which is located depth to the pes anserinus tendons as well as superficial to a superficial MCL. Distal & medial to the tibial tuberosity (Fig. 2), bursal distention is a classic finding, and fluid may version of the image deep to the superficial MCL. It's possible for the pes anserinus bursa to rise above the bony prominence where the two bones meet.

Fig. 2: Pes anserinus bursitis causes medial knee pain and inflammation in adults.



In most cases, rest and over-the-counter pain relievers are all that's needed to treat pes anserinus bursitis. Bursal aspiration and local injection of anesthetics or corticosteroids may be necessary in resistant cases. It is important to note that the infrapatellar branch of the saphenous nerve frequently lies adjoining to the key features of the bursa, and the sartorial branch commonly courses along the bursa posteriorly. A safe access site for such procedures has been proposed as the distal and anterior aspects of the bursa, which are situated about 2 cm medial as well as 1.2 cm superior to the inferomedial point of the tibial tuberosity.

Table 1: Illnesses of the Pes Anserinus and Related Structures

Overuse	Acute Trauma	Iatrogenic Causes	Tumors and Tumorlike Lesions
Pes anserinus bursitis	Musculotendinous injury	Neotendon injury	Tenosynovial giant cell tumor
Posteromedial knee friction syndrome	Complete pes anserinus tear	Failed regeneration	Periosteal ganglion cyst of the tibia
Pes anserinus snapping syndrome	Superficial medial collateral ligament tear with Stener-like lesion	Adjacent nerve injury	Gout

Syndromes of pes anserinus snapping and post-traumatic post-romedial knee friction— Pain in the posteromedial region of the knee has been linked to a condition known as posteromedial knee friction syndrome, which occurs most often in physically active people. Friction between the bone and tendon causes this condition, which manifests in the tight space between both the medial femoral condyle and overlying sartorius or gracilis tendon. MRI scans reveal edema between the sartorius or gracilis tendon and the medial femoral condyle, with poor margination. In order to make this diagnosis, it is necessary to rule out other, more likely reasons of posteromedial edema, such as a medial soft tissue tear, ligament injury, or a leaking popliteal cyst. Knee flexion and extension can cause Pes anserinus snapping syndrome if the tend to be more stable or gracilis tendon snaps so over tibial condyle or semimembranosus tendon at the posteromedial facet of the knee[8]. Pes anserinus snapping syndrome may be caused, in part, by the forward subluxation of the gracilis as well as semitendinosus tendons so over posteromedial corner of the tibia, which is made possible by the diminutive pes anserinus accessory fascial bands. Sonography has been proposed as the imaging method of choice due to its dynamic capability, despite the fact that the imaging findings associated with the this syndrome have received little attention. A tenotomy has been shown to be effective in treating a limited number of patients.

TRAUMA

Musculotendinous injury problems to the pes anserinus are unusual, especially when they occur in isolation. When these kinds of traumas do occur, the sartorius tends to take the brunt of it. The sartorius muscle is the longest in the human body, crosses over two joints, and lies close to the surface, making it vulnerable to strain injuries. Because of its superficial location, it is also susceptible to blunt concussion injury, which can cause intramuscular hematoma or interstitial hemorrhage and damage to the surrounding osseous and soft tissues. Rare but documented cases of semitendinosus distal tendon avulsions and myotendinous strains have been found in elite athletes (Fig. 3). These wounds can be challenging to heal from. Fourty-two percent of patients with incomplete semitendinosus tendon tears who underwent conservative treatment ultimately required surgery, according to a study by Cooper and Conway [9]. However, tenotomy has been successfully used in some cases. Tearing the entire pes anserinus tendon is extremely rare and usually the result of a traumatic event that causes damage to multiple ligaments, such as a knee dislocation. When the MCL complex beneath the knee is torn, the torn pes anserinus tendons tend to retract proximally and may be displaced into a proximal tibial rupture or the medial femorotibial compartment.

Fig. 3: A male baseball player of 18 years old felt immediate pain and heard a pop when he slid into second base after sustaining a rupture to his semitendinosus muscle.

Stener-like lesion and partial separation of the surface level medial collateral ligament Primary valgus stabilizers of the knee include the medial collateral ligament complex (MCL, SCM, and POCL) and are frequently injured. The posterior oblique ligament, the deep medial collateral ligament, and the superficial MCL all give way at 256 N of force. As a secondary valgus stabilizer, the pes anserinus is rarely injured on its own. As a result, it is rarely injured when the primary valgus stabilizer muscles of the knee are compromised. Near the midline femoral epicondyle is where the superficial MCL begins to develop. Proximal tears of the medial collateral ligament are the most common type and are typically treated conservatively. The superficial medial collateral ligament (MCL) attaches distally to the tibia about 60 mm below the joint line and distal to the insertion of the pes anserinus. Despite the rarity of distal superficial MCL tears, they can cause a Stener-like lesion if they retract and are displaced simplistic to the pes anserinus tendons. Because valgus instability testing of the knee can be ambiguous, MRI plays a crucial role in the prognosis of a distal superficial MCL tear with a Stener-like lesion. When healthy, the superficial medial collateral ligament (MCL) is located posterior to the tendons of the pes anserinus. A Stener-like lesion should be described when the superficial MCL is proximally retracted as well as its distal end is simplistic to the pes anserinus tendons. This is because the interposed pes anserinus tendons prevent the superficial MCL from anatomically healing at its tibial attachment.

THE ROLE OF MEDICINE

Bone-patellar tendon-bone or pes anserinus tendon preparations, especially the gracilis and semitendinosus, are the most common autografts used for ACL reconstruction. When compared to a bone-patellar tendon-bone autograft, a pes tendon autograft has fewer adverse effects and appears to be as strong as or stronger after full maturation. It has been reported that the tensile strength of a double-bundle hamstring autograft is greater than twice that of a native ACL, and that of a patellar tendon is greater than 160% of that of a native ACL. Pes anserinus tendons regenerate after being harvested for ACL reconstruction, but with altered anatomic & histologic character traits that are usually not clinically evident. Ultrasound and MR imaging can falsely indicate that a regenerated neotendon is normal, but histological examination reveals focal scar, irregular collagen, increased vascular formation, & fibroblastic proliferation. Although it is not certain, these histologic features of the pesanserinusneotendons may account for their increased susceptibility to injury. It is generally agreed upon that if revision surgery is required, regenerated neotendons must not be reharvested. Furthermore, medial hamstring tendons do not always regenerate after being harvested. Similar to the "Popeye" deformity seen in the upper arm after disturbance of the distal biceps brachii tendon, this condition causes the muscle bellies to lack distal attachments and therefore can retract into the thigh, forming a palpable lump. Intraoperative premature transplant rupture and damage to neighboring buildings, such as the MCL & saphenous nerve, are additional risks associated with pes anserinus tendon harvesting. The pes anserinus is frequently linked to supplementary tendons and fascial bands. To avoid premature amputation of the ACL graft tissue and an inadequate, short graft, these extensions must be released prior to tendon harvesting.

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MALIGNANT GROWTHS OR LESIONS

Tumors and tumor-like lesions of various types frequently develop in the region of the pes anserinus. Originally known as giant cell tumor of the tendon sheath, tenosynovial giant cell tumors are a common benign soft-tissue tumor with synovial origins. Pigmented villonodularsynovitis is the closest histological match. The wrist and hand are common sites of origin for tenosynovial giant cell tumors, but the tumors can develop next to any tendon in the body, including the pes anserinus. It grows slowly in most cases. On T1- and T2-weighted images, MRI has a signature low signal intensity. Frictional pes anserinus bursitis is caused by osteochondromas & tibial spurs, both of which are bone growths that don't have a true cartilage cap. Bone growth like these respond well to surgical excision. There are fibroblasts in the outer layer of tubular bone's periosteum, and progenitor cells in the inner cambium layer. Mucoid degeneration of the fibrous periosteum is hypothesized to give rise to periosteal ganglion cysts. In addition to the medial malleolus and the proximal shafts of the radius, ulna, and femur, these cysts can also occur in the proximal tibia, close to the insertion of the pes anserinus muscle. Malignancy may be suspected when imaging demonstrates a periosteal cystic mass with subsurface cortical scalloping, a percentage of bone sclerosis, and, rarely, spiculated periosteal bone formation. However, the typical location & appearance of this lesion typically lead to the correct diagnosis. Although gout is a common cause of bursitis in other areas, such as the anterior knee as well as olecranon, it is not a common cause of simply a symptom pes anserinus bursitis. It is known as chondrocalcinosis when crystal deposits of calcium pyrophosphate dihydrate (CPPD) are found in either hyaline or fibrocartilage. Crystallization of CPPD occurs in synovial, ligamentous, and tensile tissues, but only rarely in the capsule. Bursitis can develop when there is a CPPD inflammatory response in the bursa.

CONCLUSION

Muscles of the shoulder girdle, gracilis, as well as semitendinosus all have tendons that join together to form the pes anserinus. It contributes to the knee's medial support by inserting into to the proximomedial tibia and acting as a secondary valgus restraint. Overuse, acute trauma, iatrogenic causes, &tumors and tumorlike lesions are the four broad categories that can be used to describe the imaging looks of conditions that affect the pes anserinus. Radiologists will be better able to interpret imaging research results at the medial aspect of the knee if they have a firm grasp on the anatomical features and pathologic procedures of the pes anserinus.

REFERENCES

1. De Maeseneer M, Van Roy F, Lenchik L, Barbaix E, De Ridder F, Osteaux M. Three layers of the medial capsular and supporting structures of the knee: MR imaging-anatomic correlation. RadioGraphics 2000; 20:S83–S89
2. Ivey M, Prud’homme J. Anatomic variations of the pes anserinus: a cadaver study. Orthopedics 1993; 16:601–606
3. Yasin MN, Charalambous CP, Mills SP, Phaltankar PM. Accessory bands of the hamstring tendons: a clinical anatomical study. ClinAnat 2010; 23:862–865

4. Mochizuki T, Akita K, Muneta T, Sato T. Pes anserinus: layered supportive structure on the medial side of the knee. ClinAnat 2004; 17:50–54
5. Hennigan SP, Schneck CD, Mesgarzadeh M, Clancy M. The semimembranosus-tibial collateral ligament bursa: anatomical study and magnetic resonance imaging. J Bone Joint Surg Am 1994; 76:1322–1327
6. Lyu SR, Wu JJ. Snapping syndrome caused by the semitendinosus tendon: a case report. J Bone Joint Surg Am 1989; 71:303–305
7. Karataglis D, Papadopoulos P, Fotiadou A, Christodoulou AG. Snapping knee syndrome in an athlete caused by the semitendinosus and gracilis tendons: a case report. Knee 2008; 15:151–154
8. Forbes JR, Helms CA, Janzen DL. Acute pes anserine bursitis: MR imaging. Radiology 1995; 194:525–527
9. Lempainen L, Sarimo J, Mattila K, Heikkilä J, Orava S, Puddu G. Distal tears of the hamstring muscles: review of the literature and our results of surgical treatment. Br J Sports Med 2007; 41:80– 83; discussion, 83