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Review

COMPREHENSIVE REVIEW OF PES ANSERINUS SYNDROME: ETIOLOGY, DIAGNOSIS, AND MANAGEMENT

R. Aicale[1], R. Pellegrino[2,3*], D.I. Angelo[4], R. Mottola[5], R. Saggini[6], C. Ruosi[5] and D. Tarantino[7]

[1] Department of Orthopaedic and Trauma Surgery, Casa di Cura di Bernardini, Taranto, Italy;
[2] Department of Medicine, LUM University, Italy;
[3] Santa Chiara Institute, Lecce, Italy;
[4] Department of Innovative Technologies in Medicine & Dentistry, University "G. d'Annunzio" of Chieti-Pescara, Italy;
[5] Department of Public Health, University of Naples Federico II, Naples, Italy;
[6] Faculty of Psychology, eCampus University, Novedrate, Italy;
[7] Department of Orthopaedic Rehabilitation, Campolongo Hospital, 84025 Marina di Eboli, Salerno, Italy.

**Correspondence to*:
Raffaello Pellegrino, MD,
Department of Medicine,
LUM University, Italy.
e-mail: r.pellegrino@lum.it

ABSTRACT

Pes anserinus is an anatomical structure located on the medial aspect of the knee, where the tendons of the sartorius, gracilis, and semitendinosus muscles conjoin and insert onto the anteromedial surface of the proximal tibia, approximately 5 cm distally to the medial knee joint space. Pathological conditions associated with pes anserinus, most notably pes anserinus bursitis, are common sources of medial knee pain, particularly among athletes, individuals with osteoarthritis (OA), and obese patients. Since this peculiar structure is made by the insertion of three tendons, a true difference between bursitis and tendinopathy is hard to identify in the context of pes anserinus. Diagnosis of pes anserinus syndrome (PAS) is primarily clinical, supported by imaging techniques like ultrasound or magnetic resonance imaging to rule out other causes of medial knee pain. Treatment often involves conservative measures such as rest, cryotherapy, nonsteroidal anti-inflammatory drugs (NSAIDs), physical therapy, and injections. In refractory cases, surgical intervention may be considered. Understanding the anatomy and pathology of pes anserinus is essential for clinicians to accurately diagnose and manage conditions affecting this structure. Comprehensive knowledge of its clinical implications can lead to more effective treatment strategies and improved patient outcomes. This article provides a concise overview of the anatomical features, common pathologies, diagnostic approaches, and treatment modalities related to PAS, highlighting its significance in musculoskeletal health and disease.

KEYWORDS: *tendinopathy, pes anserinus, pes anserine; pes anserinus syndrome; anserine syndrome; pes anserinus tendinopathy; pes anserinus bursitis*

INTRODUCTION

Sartorius, gracilis and semitendinous tendons insertion forms a peculiar anatomical structure that refers to the natatory goose membrane, and is named commonly from latin, *pes anserinus* (PA), also known as the "goose's foot"(1,2). Tendons

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of these muscles, originating from different parts of the pelvis and femur, extend into the crural fascia and attach approximately 5 cm distally to the knee joint space medial portion (3,4) (Fig.1).

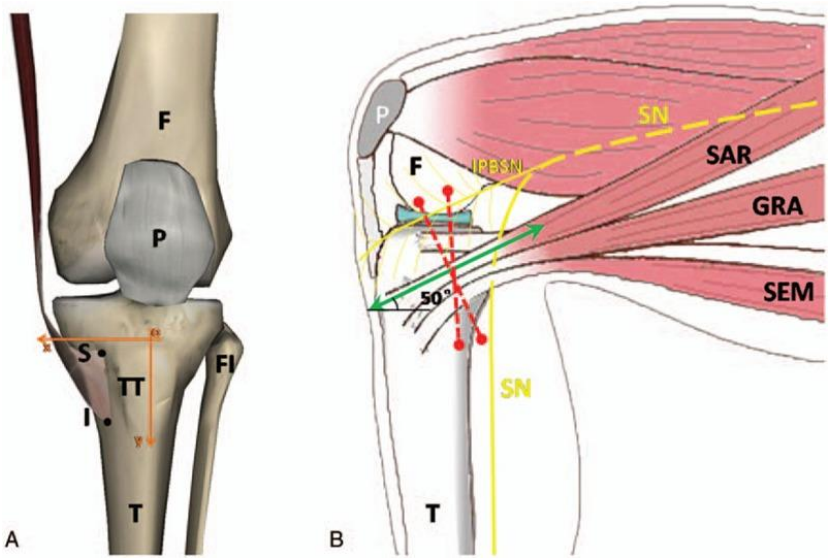

Fig. 1. *PA tendons and their insertion. Retrieved from: Zhong S, Wu B, Wang M, Wang X, Yan Q, Fan X, Hu Y, Han Y, Li Y. The anatomical and imaging study of pes anserinus and its clinical application. Medicine (Baltimore). 2018 Apr;97(15):e0352.*

The configuration resembles a goose's foot, giving the structure its distinctive name. These tendons and their muscles are knee flexors with a secondary action on the tibia internal rotation, protecting against rotation and valgus stress (5). Furthermore, PA is essential for various physical activities, from walking and running to complex athletic maneuvers. The integrity and functionality of the PA are paramount for maintaining knee health and preventing injury.

Pathological conditions affecting the PA, most notably pes anserinus bursitis (PAB), are common sources of medial knee pain. PAB involves inflammation of the bursa located between the PA tendons and the medial collateral ligament (6).

The first report mentioning this disease came from Moschcowitz in 1937, which reported knee pain almost exclusively in women (7).

The term “tendinopathy” instead includes all the situations in which there are chronic clinical conditions characterized by pain, swelling and functional limitations of tendons and nearby structures (8–12). Both intrinsic and extrinsic factors play a key role in the pathogenesis of tendinopathy; age, gender and gender are the most prominent non-modifiable factors, while excessive and/or improper loading, disuse, drugs and smoking habit are the most influent modifiable factors (8,9,13–17). Although the term "tendinitis" is often associated with the concept of tendinopathy, in recent years it has been shown that the inflammatory process only affects the initial stages of the disease, while degenerative and apoptotic phenomena prevail afterwards because of long-lasting overuse condition related to work and/or sports (10,18–23). Tendinopathy can be viewed as a failure of the cell matrix to adapt to a variety of stresses as a result of an imbalance between matrix degeneration and synthesis (19,24–28).

A true distinction between PAB and PA tendinopathy (PAT) is hard and the management proposed by the studies in the current literature is the same for both conditions. Moreover, the exact structures responsible of the symptoms related to pain in PA area is still under debate, and several articles report doubts regarding the validity of the identification of the PA disease as an inflammatory or degenerative condition of the bursa and/or tendon (29). For this reason, the term “pes anserinus syndrome” (PAS), instead of only PAB or PAT, seems to be more appropriate.

PAS seems to be more common in overweight females with knee OA who have a wider pelvis, resulting in greater knee angulation, which leads to more pressure in the insertion area of the PA (3,5,29,30). However, this condition is also frequent in athletes (such as long-distance runners) and in the elderly (31,32).

Pain in the PA area is usually the main symptom which can significantly impair daily activities and athletic performance. The diagnosis of PAS is mainly based on physical examination, looking for tenderness over the PA insertion site, or performing tests such as the pes anserinus stress test, which involves resisting knee flexion while the leg is externally rotated, to reproduce pain.

US can provide clinically useful information in the differentiation between intraarticular versus periarticular or extraarticular disorders and should be used as a first-line imaging modality as it may reveal bursal swelling, fluid accumulation, and thickening of the PA tendons (33,34) (Fig.2).

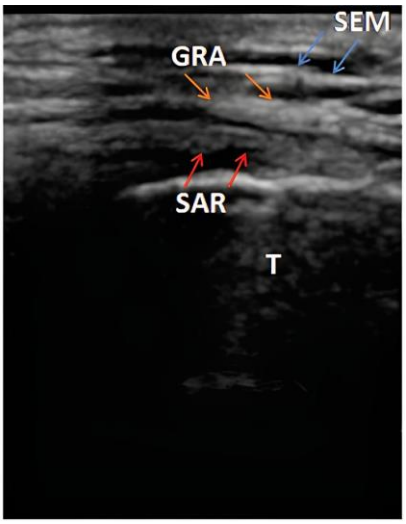

Fig. 2. *PA tendons revealed at the US examination. Retrieved from: Zhong S, Wu B, Wang M, Wang X, Yan Q, Fan X, Hu Y, Han Y, Li Y. The anatomical and imaging study of pes anserinus and its clinical application. Medicine (Baltimore). 2018 Apr;97(15):e0352.*

Authors suggest that structural changes, i.e. meniscal lesions commonly in OA, may play a role in pain generation in the medial aspect of the knee (33), so it is important to differentiate from other pathology that may mimic PAS through an accurate differential diagnosis.

Given the paucity of comprehensive information on PAS, the aim of the present review is to report the actual evidence on this pathology especially regarding risk factors, diagnosis, and treatment, highlighting the limits in the understanding on the underlying process and the involved structures.

METHODS

A comprehensive search of scientific databases, including PubMed, Scopus, and Web of Science, was performed by two independent authors (R.A. and D.T.) to collect relevant articles on the topic. All kinds of articles in English language were included, with no limitation of time. Two independent reviewers (R.P. and R.M.) extracted and evaluated the data. The included articles reported on the risk factors, diagnosis and treatment of PAS. The authors also evaluated the reference lists of the included articles but eventually found no extra articles to be included.

Specific keywords including “pes anserinus”, “pes anserine”, “pes anserinus AND bursitis”, and “pes anserinus AND tendinopathy”, “pes anserinus AND tendinitis” were used during the search. To facilitate the understanding of the results, we categorized the results into the following sections: risk factors, clinical presentation and diagnosis, conservative and surgical treatment.

DISCUSSION

Risk factors

Recently, various studies have examined the mechanical and metabolic factors that may influence the development of PAS, such as valgus knee deformity, alone or in combination with knee collateral instability. The aetiology is not well understood and may include trauma, posterior thigh muscle retraction, bone exostosis, suprapatellar plica irritation, medial meniscus injury, pes planus, genu valgum, and infection (35,36).

Metabolic and degenerative conditions such as diabetes mellitus (DM), obesity, and knee OA, classically described as risk factors for PAS in uncontrolled reports (37), do not seem to be significantly associated with it (38–40). In other cross-sectional studies, type-II DM was strongly associated with PAS compared with a non-diabetic population (37,41).

Biomechanical alterations of the lower limbs (i.e., knee deformity, instability, collateral instability, and hindfoot malalignment) were also not found to be associated with PAS development (40).

Medial knee pain has been studied in search of a correlation with PAS, but different articles have failed in this scope, finding no correlation between PA bursa swelling, as observed via magnetic resonance imaging (MRI), and the presence of medial knee pain (42). Similar results were found using US imaging, showing no correlation between any PA bursa or PA tendon degeneration and clinically defined PAS (41,43).

More recently, the medial knee collateral complex, particularly its superficial layer, has been investigated for its close anatomical relationship with the PA complex, as a structural element that may play an important role in the clinical presentation of PAS (44).

The medial collateral complex is significantly stressed during valgus loading of the knee, for example in mature women, in whom a valgus knee deformity, alone or in combination with knee collateral instability, has been identified as a risk factor for PAS development (40,45).

Clinical presentation and diagnosis

The clinical presentation of PAS is commonly characterized by pain in the medial aspect of the knee and edema at the anatomical site of PA insertion, which may be exacerbated by going up or down stairs. Despite this, several patients report posteromedial or medial knee pain without edema. The first criteria for diagnosing PAS were proposed in 1985: pain in the anteromedial region of the knee (particularly when going up or down stairs), morning pain and rigidity, pain at rest during the night, difficulty in rising from a chair or getting out of a car, frequently associated with local edema (46).

Diagnosis is primarily clinical and confirmed by imaging exams. Generally, pain is located in the proximal medial region of the knee, approximately 5 cm below the medial joint line, more frequently in overweight individuals with signs of degenerative joint disease and OA. Radiographs of the knee are normal in most patients, occasionally showing bony exostosis or signs of OA in the medial compartment. Although clinical evaluation seems straightforward, diagnosis using imaging tools such as US or MRI can be used as an adjunct (47) (Fig.3,4).

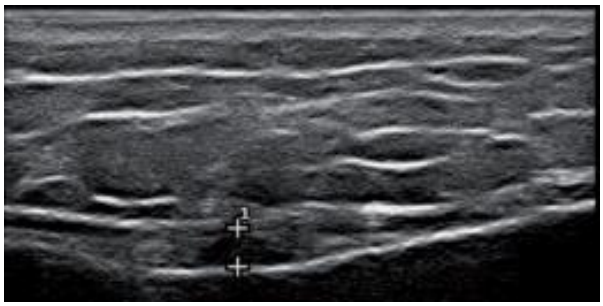

Fig. 3. *PAB with fluid accumulation as showed by the marked hypoechoic area. Retrived from: Toktas H, Dundar U, Adar S, Solak O, Ulasli AM. Ultrasonographic assessment of pes anserinus tendon and pes anserinus tendinitis bursitis syndrome in patients with knee osteoarthritis. Mod Rheumatol. 2015 Jan;25(1):128-33.*

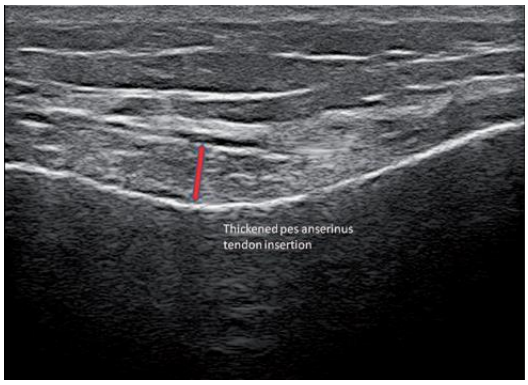

Fig. 4. *PAT: The PA tendon insertion is thickened. Retrived from: Toktas H, Dundar U, Adar S, Solak O, Ulasli AM. Ultrasonographic assessment of pes anserinus tendon and pes anserinus tendinitis bursitis syndrome in patients with knee osteoarthritis. Mod Rheumatol. 2015 Jan;25(1):128-33.*

A relatively recent study (43) evaluated 37 female patients using US analysis with a clinical diagnosis of PAS (bursitis or tendinopathy), considering the thickness of PA insertion, intratendinous morphological characteristics, the presence of a bursa greater than 2 mm, and changes in the subcutaneous fat of the medial aspect of the knee. Only one patient had PAT on imaging. Bursitis was found in one asymptomatic knee, one symptomatic unilateral knee, and one with bilateral pain. The authors concluded that most patients diagnosed with PAB or PAT did not present morphological changes on US, and that the pain etiology may result from an interaction between structural changes secondary to OA and/or altered peripheral and central pain processing mechanisms.

In another study, the prevalence of 4 out of 48 patients with type-II DM showed evidence of PAT on US imaging, suspected after clinical evaluation. The authors highlighted that none of these patients had bursal inflammation (41).

The use of US to detect PA syndrome was recently investigated in a sample of 314 knees with OA (47), classified according to the Kellgren and Lawrence (K-L) scale. The study evaluated the thickness of PA tendon insertion, intratendinous tissue characteristics, and pes anserinus bursitis. The researchers found that the mean thickness of the PA in knees with OA, both with and without PAS, was significantly greater compared to controls. For K-L grades 3 and 4,

the mean thickness was greater compared to knees with OA graded K-L 1 and 2, independent of the presence of PAS. Fibrillar echotexture was altered in all cases, but these modifications were more evident in knees with OA and PAS compared to those without it, which also presented a relatively lower VAS score.

The reported discrepancy between clinical and radiological results may be explained by three mechanisms: (1) US imaging may not be adequate for asserting the presence of PAT and/or bursitis, with MRI potentially being a better alternative; (2) the pain-generating tissue may be deeper or not well visualized by US; (3) the pain point on the medial aspect of the knee may be a tender point with an atypical pain threshold (1).

Based on the reported evidence, there is no doubt that US can be useful in evaluating soft tissues, tendon structure changes, and small quantities of fluid (48). However, the terms “tendinopathy” or “bursitis” may not be used correctly, and caution must be exercised when using the expression “PA tendino-bursitis” (43).

Regarding the use of MRI, different studies support its use, although the results are not very promising. One study found a prevalence of only 2.5% (13 knees) of PAB in about 488 patients (49). The authors emphasized the importance of the axial view to differentiate the bursa from other medial fluid collections. Similar results were shown in another study, where the presence of effusion in the PA bursa was reported in 3.7% of 451 symptomatic patients. Although 59 patients demonstrated changes in imaging, no correlation between clinical symptoms and imaging was found. Therefore, the authors concluded that clinical findings of PAB or PAT rarely show changes on MRI (42). Another article investigated the use of computed tomography (CT) and concluded that distension of the PA bursa is not synonymous with bursitis if patients do not have any symptoms, and that the syndrome could be due to tendinopathy or fasciitis affecting the PA insertion (50).

For differential diagnosis, many conditions need to be considered, such as medial meniscus tears, OA of the knee's medial compartment, L3-L4 radiculopathy, and medial collateral ligament complex injuries. Pain located inferomedial to the medial joint line in PAS differs from that in OA or meniscus tears. Moreover, clinical tests help diagnose lesions of various structures. In the case of L3-L4 radiculopathy, knee pain is associated with lumbar pain. Pathological cysts and other soft tissue masses that may mimic cysts can result in symptom overlapping with PAS. Bursae inflammation should always be included in the differential diagnosis, particularly suprapatellar bursitis and pre-patellar bursitis, which are better visualized in the sagittal MRI view.

Furthermore, cases of PAB induced by polyethylene after knee arthroplasty have been reported, with an incidence of 5.6% (51). This condition was initially considered an infectious complication after surgery, but it is now regarded as an inflammatory consequence in patients who receive joint replacements (35).

Other conditions that may be considered include muscle pain, patellofemoral syndrome, patellar chondromalacia, recurring patellar subluxation, Osgood-Schlatter disease, osteochondritis dissecans, patellar tendinopathy, synovial plica, lesion of the infra-patellar fat pad, patellar dysplasia, patellar fracture, para-articular chondroma or osteochondroma, synovitis and synovial haemangioma, and fibromyalgia syndrome (1,52–54).

Conservative and surgical treatment

Conservative management of PAS typically includes rest for the affected knee, cryotherapy for acute cases, rehabilitation, and anti-inflammatory drugs (corticosteroids and/or non-steroidal anti-inflammatory drugs) (31,55,56). For obese patients, weight loss is mandatory, as well as the treatment of associated conditions such as deviated knee, pes planus, and diabetes control. In elderly patients, avoiding muscular atrophy secondary to disuse is a primary goal, and isometric exercises can be used (31).

Recent literature includes case reports of giant bursae or ruptured bursae due to severe OA of the knee (6,57,58), and a condition defined as a “snapping” PA tendon evaluated using dynamic US (59).

Local anesthetic injections associated with corticosteroids (CS), such as 20 to 40 mg of methylprednisolone or triamcinolone in the bursa, no more than three times a year, are safe and effective (60,61).

The injections should be performed under ultrasound guidance to avoid injecting the substance into the PA tendons (Fig.5,6).

Fig. 5. *US-guided injection, the transducer was positioned in a longitudinal orientation relative to the anterior fibers of the medial collateral ligament, with an oblique transverse orientation relative to the PA. Retrieved from: Lee JH, Lee JU, Yoo SW. Accuracy and efficacy of ultrasound-guided pes anserinus bursa injection. J Clin Ultrasound. 2019 Feb;47(2):77-82.*

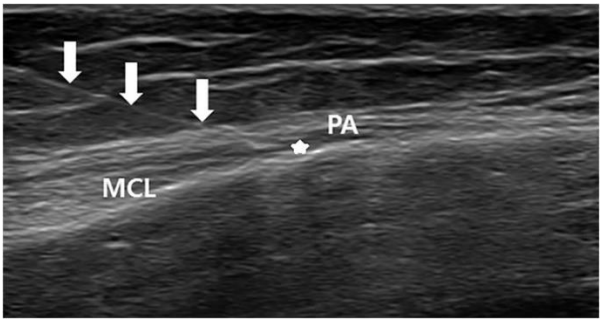

Fig. 6. *US-guided injection, longitudinal ultrasound image of a needle (white arrow) in the PA bursa (asterisk) between the medial collateral ligament (MCL) and the PA tendon. Retrieved from: Lee JH, Lee JU, Yoo SW. Accuracy and efficacy of ultrasound-guided pes anserinus bursa injection. J Clin Ultrasound. 2019 Feb;47(2):77-82.*

The interval between injections should be greater than one month, and if there is no response to treatment, one injection into the knee joint can be beneficial in refractory cases (1).

A significant improvement was noted in a cohort study of 44 patients with PAS managed with naproxen every 12 hours or corticosteroid injections. After one month, resolution was reported in 5% of patients in the naproxen group, while in the CS group, resolution was reported in 30% of patients (62).

In another study, clinical remission was observed in 11 of 12 patients treated with CS injections, compared to 7 of 17 who did not receive any injections; however, these patients were affected by clinical PAS and OA of the knee (39).

Yoon and Kim (38) reported good results in 17 out of 26 patients with knee OA and PAS, confirmed by US, treated with injections of triamcinolone acetonide. Only two patients (8.7%) demonstrated US evidence of PAS. All scores improved significantly after the injections, concluding that only the two patients who reported excellent outcomes had US evidence of PAS.

A proper rehabilitation program should be characterized by stretching and strengthening exercises for the adductors and quadriceps, especially focusing on the last 30° of knee extension using the vastus medialis muscle. This includes stretching the tendons that comprise the PA. Stretching promotes a reduction in tension in the PA tendon complex, particularly in cases secondary to restricted flexibility and muscle and/or tendon retraction.

A recent article reported the effects on 27 patients treated with kinesiotaping compared to 19 patients managed with naproxen and physical therapy. The study, which used US diagnosis of PAS, found a significant decrease in pain and swelling in the kinesiotaping group compared to the naproxen/physical therapy group, with only one case of mild local skin irritation in the kinesiotaping group (56).

In recent years, new technologies have been developed to treat tendon and muscle conditions (63), such as injections of platelet-rich plasma (PRP), which have shown overall good results (21,64). PRP injections used for PAS are safe and effective, demonstrating excellent results in pain reduction (evaluated using the VAS scale) at 6 months follow-up (55). More recently, a randomized controlled trial compared single versus double injections of PRP, reporting no difference in terms of VAS score, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), 6-minute walking test (6MWT), and Likert Scale at one- and three-months follow-up. However, intra-group evaluation showed significant improvement. (65).

In cases of failure of conservative management (rehabilitation and injections), surgery can be indicated, although there is no clear evidence regarding the optimal timing for changing management modalities. Typically, an open procedure is preferred, with simple incisions followed by drainage of the distended bursa providing symptom improvement (46,60,66,67). This approach is recommended when there is a definitive diagnosis made clinically and using imaging. If necessary, due to the large size of the lesion or in the case of bone exostosis, the bursa can be removed (35).

CONCLUSIONS

In conclusion, PAS represents a significant source of discomfort and functional limitation for individuals, particularly those engaged in activities involving repetitive knee flexion. The actual structures located in the PA responsible for the symptoms related to PAS are still under debate, as well as its risk factors.

Effective management of this condition involves a multifaceted approach encompassing rest, activity modification, physical therapy, and possibly adjunctive interventions such as bursal injections.

Understanding contributing factors such as metabolic disorders, biomechanical abnormalities or overuse is crucial for targeted treatment and prevention of recurrence.

While PAS can pose challenges, timely intervention and adherence to a comprehensive rehabilitation plan can yield favorable outcomes, facilitating a return to pain-free movement and improved quality of life. Ongoing research and clinical advancements continue to refine our understanding and treatment strategies for this condition, underscoring the importance of a collaborative and individualized approach in optimizing patient care.

Conflict of interest

The authors declare that they have no conflict of interest.

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