

■ SPECIALTY UPDATE

The plantaris tendon

A NARRATIVE REVIEW FOCUSING ON ANATOMICAL FEATURES AND CLINICAL IMPORTANCE

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In recent years, the plantaris tendon has been implicated in the development of chronic painful mid-portion Achilles tendinopathy. In some cases, a thickened plantaris tendon is closely associated with the Achilles tendon, and surgical excision of the plantaris tendon has been reported to be curative in patients who have not derived benefit following conservative treatment and surgical interventions.

The aim of this review is to outline the basic aspects of, and the recent research findings, related to the plantaris tendon, covering anatomical and clinical studies including those dealing with histology, imaging and treatment.

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For many years, the plantaris tendon, which may be absent in some individuals, was thought to be a vestigial muscle with poor functional abilities.¹⁻⁴ It has traditionally been of most interest to surgeons as a donor site, with its tendon often being used as a graft for the repair of structures including the Achilles tendon,^{5,6} lateral ligaments of the ankle,^{7,8} the peroneal retinaculum⁹ and the long flexors of the finger.¹⁰

In recent years, interest has grown in the plantaris tendon in relation to chronic painful mid-portion Achilles tendinopathy. In patients who respond poorly to conservative and surgical treatments for this condition, a thickened plantaris tendon has frequently been found adjacent to or invaginated within the medial aspect of the Achilles tendon, and surgical removal has been reported to cure the pain.¹¹⁻¹³ This has led authors to suggest that the plantaris tendon somehow interferes with the Achilles tendon in these patients, leading to chronic mid-portion Achilles tendon pain.¹⁴ The aim of this review is to outline the literature relating to the plantaris focusing on the special features of the anatomy of its tendon and associated clinical conditions.

Anatomy and function

The plantaris is a small spindle-shaped muscle, which arises from the postero-superior aspect of the lateral supracondylar ridge of the femur, adjacent to the lateral head of the gastrocnemius.¹⁵ The muscular portion, which has a mean size of 1.5 cm x 10 cm, is located deep and medial to the lateral head of the gastro-

cnemius (Fig. 1) and lateral to the popliteal vessels and the tibial nerve.^{16,17} The elongated tendon passes medially in the avascular area between the soleus and the overlying gastrocnemius (Fig. 1),¹⁶ eventually lying parallel to the Achilles tendon on its medial side, inserting into the calcaneum or the Achilles tendon itself.^{2,18} The plantaris tendon is enveloped in the same peritendinous tissues as the Achilles tendon, and shares the close relation with Kager's fat pad which lies directly anterior to the Achilles tendon.¹⁹ Due to its slender shape the plantaris tendon is sometimes called 'freshmen's nerve' or 'fool's nerve' as it can be mistaken for a nerve.²⁰ The muscle is innervated by the tibial nerve, and it has a dual blood supply, superficially from the lateral sural and popliteal arteries and deeply by the superior lateral genicular artery.¹⁶ The tendon shares its blood supply with the Achilles tendon, particularly via the posterior tibial artery.^{21,22}

The musculotendinous unit of the plantaris crosses both the knee and ankle contributing to plantar flexion of the ankle if the foot is free, or flexion of the knee if the foot is fixed.^{23,24} It is primarily active during plantar flexion when the knee is in full extension. The amplitude of activity decreases with increased flexion of the knee.^{23,24} There is moderate activity in the plantaris during stair climbing and walking on the level, suggesting that it assists the function of the knee in loading situations.²⁴ However, due to its small cross-sectional area, none of these actions can be achieved by the plantaris alone.²⁰ Studies on the relative strength of the plantar flexors in the lower limb have shown



Fig. 1

The course of the plantaris muscle/
tendon unit.

that the plantaris muscle, which contributes a mean of 0.7% of the power of flexion, is much weaker than gastrocnemius (medial head: 13.7%; lateral head: 5.5%) and soleus (29.9%).²⁵

Recently it has been found that, due to its high density of muscle spindles, the plantaris is likely to act as a proprioceptive organ for the larger, more powerful plantarflexors.²⁰ This idea is supported by the fact that most long thin tendons have a role in fine motor function rather than in the production of force.²⁶

Anatomical variations

Muscle anatomy. Large variations in the anatomical features of the plantaris muscle and tendon have been found in cadaveric studies. The muscle may fully or partly arise from the capsule of knee joint, the lateral head of gastrocnemius, the lower part of the linea aspera, the posterior cruciate ligament of the knee in the intercondylar space, the fascial covering of popliteus, the fibula between flexor hallucis longus and peroneus longus or the oblique line of the tibia, under cover of soleus.²⁷⁻²⁹ In some individuals, the plantaris muscle has no contact with neighbouring muscles at its origin, while in others there are inter-digitations with the lateral head of the gastrocnemius or fibrous extensions to the patella.³⁰

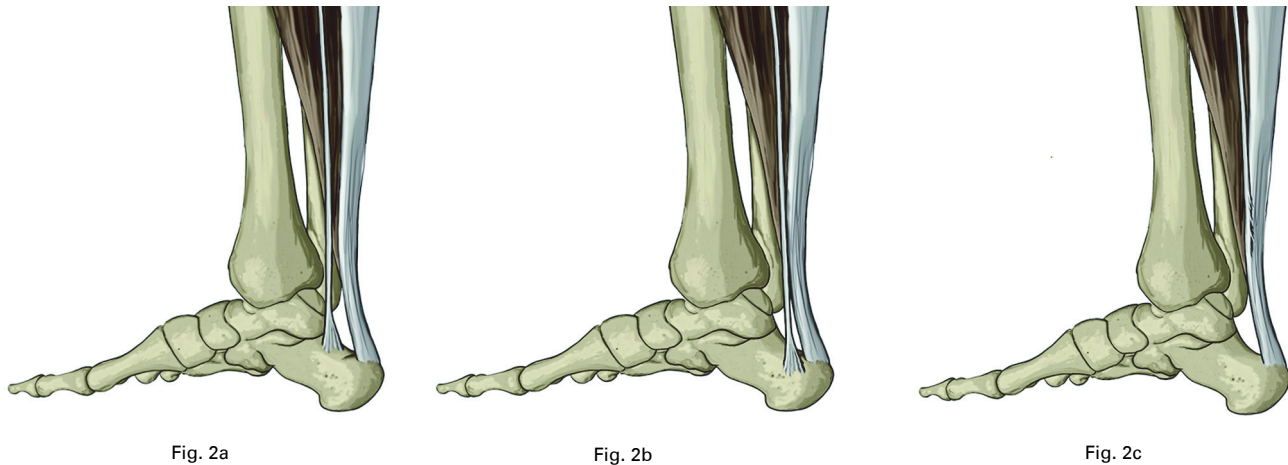
In a MRI study of 1000 legs, Herzog³¹ reported the presence of an accessory plantaris in 6.3% of cases. This observation is supported by case reports describing accessory plantaris muscles with various appearances. They may be bilateral or unilateral^{32,33} and can originate from several structures such as the soleus,³⁴ or the oblique popliteal ligament,³⁵ or may merge with the origin of the normal plantaris muscle.³² The tendons of the two plantaris muscles often fuse distally to form one thick tendon.^{33,35,36} Some authors suggest that differences in the anatomy of the plantaris may have a role in conditions of the knee including patellar mal-tracking and the iliotibial band friction syndrome.^{30,31}

Tendon anatomy and course. The anatomical features of the tendon of plantaris appear to be even more variable than those of the muscle. It can terminate or form attachments in almost any part of its course.^{37,38} In a large cadaveric study of 750 lower limbs,² it was found that 80% of plantaris tendons inserted separately from the Achilles tendon. The authors defined four types of insertion. In type I, which is the most common, the tendon terminates via a short fan-shaped expansion into the medial extremity of the superior tuberosity into which the Achilles tendon inserts. In type II, the tendon inserts into the calcaneum 0.5 cm to 2.5 cm anterior to the adjacent margin of the Achilles tendon. When the tendon is large, it often radiates to the flexor retinaculum and the fascia overlying the medial aspect of the calcaneum. In type III, there is a wide insertion medially at the terminal portion of the Achilles tendon and the adjacent surface of the calcaneum. In type IV, it inserts into the medial aspect of the Achilles clearly proximal to its insertion.^{2,37}

An alternative categorisation was proposed by Dos Santos et al.³⁸ They defined three main variants of insertion: anteromedial, medial to the calcaneum and proximal to the calcaneum into the Achilles tendon (Fig. 2). Nayak et al²⁹ found many cases where plantaris inserted into the flexor retinaculum or the Achilles tendon at various levels, finding that only one third of tendons insert into the calcaneum independently of the Achilles tendon.

More recently, van Sterkenburg et al¹⁸ defined nine different patterns of insertion. As with the study of Daseler and Anson,² they found that most insertions, 96 of 107 (89.7%), were independent of the Achilles tendon. In only 11 of 107 specimens (10.3%) was there a distinct attachment to the Achilles tendon. In some cases the plantaris tendon attached to the mid-portion of the Achilles tendon; in others there was an attachment into the deep fascia or onto the anteromedial or anterior surfaces of the Achilles tendon. In some cases, a retinaculum-like structure was described which held the Achilles and plantaris tendons together. No patients had this appearance bilaterally, suggesting that this variation might have developed during life.

Despite their differences in definitions and findings, most cadaveric studies report that the tendon of plantaris usually inserts independently of the Achilles tendon. However,



Simplified scheme of the main types of insertion of the plantaris tendon: anterior-medially to the Achilles tendon (a), medially to the Achilles tendon (b), and fusing with the Achilles tendon (c). (Adapted from dos Santos et al, 2009³⁸).

Table I. The length and width of the plantaris tendon

Study	Mean length (cm)	Mean width (mm)
Wehbé 1992 ⁴	35	2 - 2.5
Jianmongkol et al 2002 ⁴⁰	33.46 +/- 3.09 right, 31.41 +/- 3.01 left	3.19 +/- 1.02 right, 3.06 +/- 1.06 left
Dos Santos et al 2009 ³⁸	34.7 (30 to 39)	3.4 (1.5 to 5)
Alagoz et al 2008 ⁴¹	29.49 +/- 3.24 (24.2 to 34.50)	3.3 +/- 0.96 (thickness) right, 4.4 +/- 2.2 (width)
Nayak et al 2010 ²⁹	31.7 +/- 4.2 (25.1 to 37.6) right, 31.1 +/- 4.95 (24.4 to 37.3) left	4.0 +/- 1.29 (2 to 6.2) right, 4.1 +/- 1.39 (2 to 6.1) left
Jakubietz et al 2011 ⁴²	25.9 +/- 11.5 right, 24.7 +/- 12.4 left	1.9 +/- 1.0 right, 2.3 +/- 1.1 left

there is great variation in origin, insertion and shape,^{3,38,39} and insertion of the plantaris tendon into the Achilles tendon is common.

Tendon length and width. While several studies describe the course and morphology of the plantaris tendon, only a few have examined its dimensions.^{4,29,38,40-42} These have reported a mean length varying from 24.7 cm to 35 cm and a mean width varying from 1.9 mm to 4.1 mm, with one study reporting a specimens with a width of 6.2 mm (Table I).^{4,29,42} The variation in lengths may be related to differences in the structure of the tendon as outlined above. The degree of variation in width is more surprising, although methods of measurement differ between studies.^{29,42} This variation is interesting in view of the fact that thickened plantaris tendons may be associated with mid-portion Achilles tendinopathy.¹²

Absence of plantaris. A number of authors have reported an absence of the plantaris unilaterally or bilaterally in up to 19% of the population (Table II).^{2-4,16,29,30,36,38-49} However, some authors reported that the plantaris was present in all specimens.^{18,50-53} It was reported by van Sterkenburg et al¹⁸ that the plantaris was present in all 107 cadavers. However, they describe it being difficult to identify in some cases, particularly in the distal region where it may be adherent to the Achilles tendon. They suggested that a more proximal search should be performed after bluntly releasing the fascia between the medial belly of gastrocnemius

and soleus. Furthermore, studies reporting the absence of the plantaris do not always describe the dissecting procedure clearly, suggesting that the percentage of cases in which the plantaris is truly absent may be lower than previously described.¹⁸ As a result, while it is clear that both the muscle and tendon of the plantaris have much anatomical variation, it is difficult to determine the proportion of cases, if any, in which it is truly absent.

Evolution

The plantaris does not have such important functions in humans as it does in other primates, where it is used for grasping objects with the feet.¹⁶ As a result, it is thought that the plantaris may have become vestigial as the foot evolved towards long-distance walking. In Robert Wiederheim's text from 1893 on human anatomy and its relevance to man's evolutionary history,¹ the plantaris was described as one of 886 human organs that had become wholly or partly functionless in the course of evolution. Daseler and Anson² suggested that the plantaris was attached to the plantar aponeurosis of the foot in a distant ancestor, as it is in some quadrupeds like the American bear. As humans evolved and developed an erect posture, the hind-foot dropped to the ground adding increased stability during weight-bearing.² This in turn may have led to a proximal shift of the insertion to where it is seen in humans.¹⁶

Table II. Reported absence of the plantaris tendon

Study	Limbs examined	Technique	% of absence
Daseler and Anson 1943 ²	750	Cadaver	6.7
White 1960 ¹⁶	64	Surgical	9.4
Harvey et al 1983 ³	658	Cadaver	18.2
Moss et al 1988 ⁴³	300	Cadaver	5
Mackay and McCulloch 1990 ⁴⁴	60	US	6.7
Schlicht and Morrison 1992 ³⁹	20	Cadaver	5
Wehbé 1992 ⁴	120	Cadaver	19.2
Wening et al 1996 ⁵⁰	10	CT, MRI, cadaver	0
Vanderhoof 1996 ⁴⁵	372	Cadaver	5.4
Saxena and Bareither 2000 ⁴⁶	86	Surgery	15.1
Saxena and Bareither 2000 ⁴⁶	40	Cadaver	2.5
Jianmongkol et al 2002 ⁴⁰	60	Cadaver	3.3
Delgado 2002 ⁵¹	4	Cadaver	0
LaPrade et al 2007 ⁵²	20	Cadaver	0
Freeman et al 2008 ³⁰	46	Cadaver	13.0
Alagoz et al 2008 ⁴¹	34	Cadaver	5.9
Dos Santos et al 2009 ³⁸	30	Cadaver	3.3
Nayak et al 2010 ²⁹	52	Cadaver	7.7
Aragão et al 2010 ⁵³	20	Cadaver	0
Jakubietz et al 2011 ⁴²	92	Cadaver	13.0
van Sterkenburg et al 2011 ¹⁸	107	Cadaver	0
Sharma et al 2012 ³⁶	60	Cadaver	10.0
Kose et al 2014 ⁴⁷	480	MRI	14.8
Joshi et al 2014 ⁴⁸	84	Cadaver	9.5
Jackson et al 2014 ⁴⁹	35	Cadaver	11.4

Clinical conditions

Ruptures. As the plantaris traverses two joints (the knee and ankle) it is theoretically prone to rupture.⁵⁴ However, for many years it was doubted whether ruptures in the plantaris muscle or tendon actually existed.^{20,55} In 1992, Allard, Bancroft and Porter¹⁷ were among the first to demonstrate rupture on ultrasound, and it is now apparent that injuries to the plantaris are relatively common. A recent study among 214 elite track and field athletes reported that 3.9% to 9.3% sustained an injury to their plantaris each year, although only 24% of these were ruptures with the remainder being acute tendinopathy.⁵⁶

The symptoms of a rupture of the plantaris are less severe than the equivalent injury in other calf muscles; often only minor sensory or motor deficits are found and patients can often go back to full-loading after a short period of rest.^{17,57} This is in contrast to Achilles tendon ruptures, which need a proper rehabilitation program.⁵⁸ Ruptures of the plantaris occur most frequently during running or jumping, as a result of eccentric loads being placed across the ankle with the knee in full extension.²⁰

The mechanism of injury dictates the position of the rupture.⁵¹ Lesions located proximally in the muscle belly can be isolated or occur in association with injuries of the knee, such as a rupture of the anterior cruciate ligament (ACL)^{59,60} Most plantaris tears occur at the myotendinous junction in the upper part of the calf and these are often associated with a rupture of the medial head of gastrocnemius.^{59,60} The clinical condition known as 'tennis leg', which previously was believed to represent a rupture of the

plantaris,⁶¹ is most of the time a rupture of the medial gastrocnemius.⁵¹ Based on an ultrasound study by Delgado et al⁵¹ only 1.4% of patients with tennis leg have plantaris ruptures. Tears in the mid-substance of the tendon are less frequent and are often associated with rupture of the Achilles tendon, although the plantaris often remains intact when the Achilles is ruptured.⁶² Tears of the mid-substance of the tendon are rare in the absence of injuries to the Achilles tendon, and may be mistaken for partial ruptures of the Achilles tendon, deep vein thrombosis (DVT), thrombophlebitis or a ruptured Baker's cyst, all frequently found in lower leg pathologies.^{54,57,62,63} Tears at its insertion into the calcaneum are very rare.^{57,64}

Plantaris tendinopathy and involvement in mid-portion Achilles tendinopathy

Clinical observations. Chronic painful mid-portion Achilles tendinopathy is common in running and jumping athletes, but is also seen in less active middle-aged patients.⁶⁵ Treatment of Achilles tendinopathy is challenging as the pathophysiology of the condition is not fully understood.⁶⁶ Recently, a number of authors have suggested that the plantaris tendon may be implicated in some cases.^{11-13,67} Steenstra and van Dijk¹¹ were the first to report this clinical relationship. In patients with mid-portion Achilles tendinopathy, they observed situations in which the plantaris and Achilles tendons and the paratenon were closely associated and accompanied by an inflammatory process. In a series of 103 patients who were treated with a surgical scraping procedure targeting the ventral peritendinous



Fig. 3

Macroscopic findings during surgery: plantaris tendon lying close to the medial aspect of the Achilles tendon.

tissue, Alfredson^{12,68} observed an enlarged plantaris tendon closely adherent to the medial side of the Achilles tendon in a few patients who did not respond to the scraping treatment (Fig. 3). In some, there was a structural connection between the two, termed an ‘invaginated plantaris’, with a richly vascularised fatty infiltration of the peri-tendinous connective tissue between the two tendons.^{69,70}

Morphology

Macroscopically “abnormal” plantaris tendons have a tendinosis-like appearance with disorganisation of collagen fibres, abnormal morphology and hypercellularity of tenocytes, and infiltration of blood vessels.^{69,71} These tendinopathic changes have led some to suggest that pathology in the plantaris tendon coexists with mid-portion “Achilles tendinosis”.^{69,71} However, recent authors have reported that up to a third of patients have an abnormal plantaris tendon when the Achilles tendon appeared normal on ultrasound.^{13,56}

While pathological plantaris tendons may contain sensory innervation in internal connective tissue zones, most nervous structures, including sensory, sympathetic and glutamatergic nerve fibres, are located in the peritendinous connective tissue between the Achilles and plantaris tendons.⁶⁹ This suggests that the plantaris tendon and surrounding tissues may play a role in the perception of pain in Achilles tendinopathy. The degree of internal innervation of the plantaris tendon is greater than that reported in the Achilles tendon, which supports the theory that the plantaris is an important proprioceptive organ.⁷²

Imaging and diagnostics

Recent studies have compared macroscopic findings during surgery with clinical findings, traditional ultrasound,

colour Doppler (US/CD) and ultrasound tissue characterisation (UTC).⁷⁰ Tenderness and pain in the medial aspect of the Achilles tendon was a common clinical finding in patients in whom there was a close association with a thickened plantaris tendon. In such patients, US/CD revealed hypoechoic regions and localised high blood flow in the medial aspect of the Achilles tendon (Fig. 4a), corresponding to the area where a thickened plantaris tendon was found during surgery (Fig. 3). When using UTC imaging, collagen disorganisation, represented by red and black echopixels, was found primarily in the medial aspect of the Achilles tendon (Fig. 4b). These structural abnormalities have been interpreted as representing compression of the Achilles tendon by a thickened plantaris.^{12,14,70} Unpublished observations indicate that the same features can be seen on MRI (Fig. 4c).

Variations in the anatomy of plantaris can render the direct visualisation of the plantaris tendon difficult. This is particularly true in patients with isolated plantaris tendinopathy without involvement of the Achilles tendon. While it is possible to identify this pathology with US/CD,^{13,70} it requires an experienced examiner.

Possible mechanisms of “plantaris tendon involvement”

There are several theories concerning the role of the plantaris tendon in mid-portion Achilles tendinopathy. In healthy individuals the Achilles and plantaris tendons, being located in the same paratenon, can glide freely without causing pain.⁶⁷ However, in patients with thickening of the plantaris tendon and a close positioning due to anatomical location, the two tendons may interfere with each other due to compressive^{12,14} and/or shearing forces,^{13,56} leading to pain from an inflammatory response within the peritendinous soft-tissues.⁶⁷ This theory is supported by studies demonstrating increased strength and stiffness in the plantaris compared with the Achilles tendon.⁷³ The two tendons convey different forces, in contrast to the bi-articular Achilles tendon that transmits plantarflexion alone, the tri-articular plantaris tendon also contributes to inversion of the ankle and this may lead to tethering.⁶⁷ The consequent shearing and compression leads to traction on the firm and highly neurovascular peritendinous tissue between the two tendons.^{69,71} Some authors have recorded that persistent loading results in shrinkage and adherence in peritendinous connective tissues mediated via myofibroblasts and scar formation.^{18,67} This scarring and adherence restricts gliding and causes pain when load is applied. It was hypothesised by van Sterkenburg et al¹⁸ that the unilateral retinaculum-like structures they observed between the plantaris and Achilles tendons result from this process.

The evidence suggests that the presence of a thickened plantaris tendon adjacent to the medial aspect of the Achilles tendon plays a role in the development of chronic painful mid-portion Achilles tendinopathy. However, there are also patients, who are generally younger, who seem to have

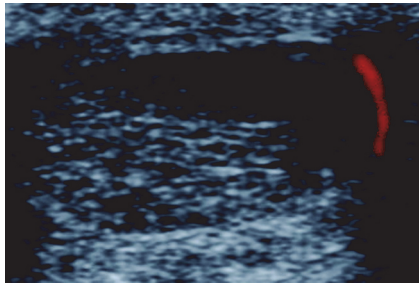


Fig. 4a

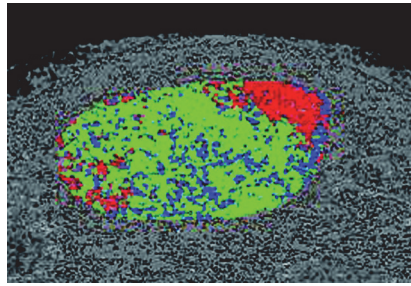


Fig. 4b

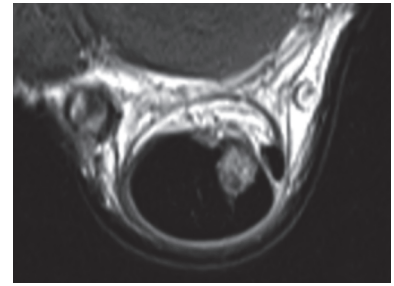


Fig. 4c

Monitoring plantaris tendon involvement: Structural abnormalities are seen in the medial aspect of the Achilles tendon on all common imaging modalities including ultrasound/colour Doppler (US/CD) (a), Ultrasound tissue characterisation (UTC) (b) and MRI (c). On US/CD (a) hypoechoic changes and high blood flow are seen. On UTC (b) imaging an increase of type III and IV pixels (red and black) is present. On MRI (c) increased signal intensity can be observed.

isolated plantaris tendinopathy without any structural abnormalities in the Achilles tendon on US/CD.^{13,56} This suggests that the development of plantaris tendinopathy may later affect the Achilles tendon. However, there are no data yet available to support this hypothesis. An alternative explanation is that the plantaris tendon is anatomically less closely associated with the Achilles tendon in these patients. In situations where the two tendons lie close to each other, histologically verified tendinosis is identified in both tendons in 89% of cases.⁶⁹

It should also be mentioned that the Achilles tendon itself exhibit certain variations in its insertional area that may influence the interference with the plantaris tendon. However, these features are not as diverse as for the plantaris tendon.⁷⁴

The plantaris tendon may also interfere with the Achilles tendon in a more anterior and distant position by snapping, although such a mechanism has only been described in a single case report.⁷⁵ The authors hypothesised that, in this patient, the plantaris tendon had previously been attached to the Achilles tendon but became detached and damaged due to a previous injury, leading to pain.

Treatments

Conservative treatments for mid-portion Achilles tendinopathy such as heavy eccentric loading have been successful.^{76,77} However, conservative measures fail in some patients, necessitating surgery. An alternative procedure, including excision of the plantaris tendon with removal of the ventral peritendinous soft tissue, has been described by several authors with good outcome.^{11-13,68,78} Alfredson¹² excised the plantaris tendon in patients in whom it was located close to the medial aspect of the Achilles tendon, together with ultrasound guided scraping of the ventral aspect of the Achilles tendon. All patients were satisfied with this treatment one year post-operatively.⁷⁹ Our experience, as yet unpublished, suggests that the rate of satisfaction remains high five years after this procedure. Similar outcomes using the same technique have been reported by others.^{13,78} In a small case series, promising short-term results have been achieved with removal of the plantaris tendon using a tendon stripper.⁸⁰ Good results have also been achieved with endoscopic approaches.^{11,81}

The exact mechanism by which these procedures have their affect is not clear. Many patients with mid-portion Achilles tendinopathy have good results with scraping alone,^{68,82} and it may be that the plantaris tendon is not involved in these patients. While sensory nerves have been demonstrated in two thirds of excised plantaris tendons, there are still more sensory nerves in the peritendinous soft tissues between the plantaris and Achilles tendons.^{71,83} Consequently, it is still not known whether excision or release of the plantaris tendon is necessary in all cases, or whether an US/CD-guided local peritendinous debridement alone would be sufficient. Further studies are needed to clarify the role of the plantaris tendon, but because of anatomical considerations, it is very likely that there are subgroups of patients, for instance those with an invaginated plantaris, who will do well following excision of plantaris tendon.

There is evidence that removal of the plantaris tendon may have a positive affect on the structure of the Achilles tendon. Using UTC, the structure of the Achilles tendon was shown to significantly improve following removal of plantaris tendon and scraping of the ventral Achilles tendon.^{78,84} This may be due to the removal of compression and/or shearing forces on the Achilles tendon, but it is not clear whether these changes would have been seen with ventral debridement alone.

There are few guidelines on how to manage Achilles tendinopathy based on the clinical presentation. While a number of exercise-based interventions have been shown to have a good effect on pain, function and return to activity, the literature is sparse.^{14,76,77} The use of load-based interventions should be considered in the light of the improvement in understanding of the role of the plantaris. Compression between the plantaris and Achilles tendons is likely to be at its greatest in full dorsiflexion of the ankle: this may explain why some patients do not respond satisfactorily to these interventions. A robust clinical study is needed to compare load-based interventions to surgical procedures.

In conclusion, the musculotendinous unit of the plantaris has many anatomical variations in insertion, course and structure including the presence of accessory muscles and

tendons. It has been reported to be absent in a small proportion of people. However, based on recent studies it may be that absence of the plantaris does not exist or is at least less frequent than previously reported.

There is increasing understanding of the role of the plantaris in mid-portion Achilles tendinopathy. Such patients characteristically have medial calf pain and tenderness, with structural abnormalities in the medial aspect of the Achilles tendon on imaging. Excision may be useful in these patients and promising clinical results have been reported.^{11-13,78,81} We suggest that the routine assessment of patients suffering from mid-portion Achilles tendon pain should assume involvement of the plantaris tendon and treatment algorithms should be adjusted accordingly.

Author contributions:

C. Spang: Reviewed the literature, Made the concept of the paper, Wrote the first draft of the manuscript, Was involved in creating the figure montages, Analysed the data for the tables.

H. Alfredson: Wrote parts of the paper primarily related to the clinical aspects. L. Masci: Wrote parts of the paper primarily related to the clinical aspects, Provided pictures, Edited the paper concerning the language.

G. Andersson: Wrote parts of the paper primarily related to the anatomical aspects, Drew the figures, Was involved in the conception of the paper.

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