Calcific spurs at the insertion of the Achilles tendon: a clinical and histological study

Kristian Jarl Johan Johansson,
Janne Julius Sarimo,
Lasse Lennart Lempainen,
Tiina Laitala-Leinonen,
Sakari Yrjö Orava

Department Paavo Nurmi Center, Hospital NEO,
Turun Yliopisto, Turku, Finland

Corresponding author:
Kristian Jarl Johan Johansson
Department Paavo Nurmi Center
Hospital NEO, Turun Yliopisto
Savikkakatu 1 A 2, Turku, Finland
e-mail: kristian.johansson@utu.fi

Summary

In active people, insertional calcific tendinopathy (CT) of the Achilles tendon is rare. We evaluated the results of surgical treatment for Achilles tendon CT and analyzed post-surgery Achilles tendon histological features. The study included 36 operations in 34 patients. Twenty-eight (78%) cases had a resection of a Haglund's deformity performed. The mean age of the patients was 42 years (range=23 to 68). Thirteen of the patients were professional athletes and 20 recreational athletes. In twenty-five (69%) cases, the result of surgery was rated good, in nine cases (25%) moderate and in two (6%) cases poor. The mean age of those with a good result was 10 years lower (40 versus 50 years) than those with a moderate result (p=0.0239). Higher athletic activity was also related to a better outcome (p=0.0205). Histology samples showed fast remodellation and stem-cell activation. Surgery seemed to result in a good outcome in patients with or without a Haglund's deformity which failed conservative treatment.

Key words: Achilles tendon, achillodynia, calcific tendinopathy, enthesophyte, Haglund's deformity, surgery.

Introduction

Achilles tendinopathy is common in athletes and physically active people[1,2]. Approximately one-third of all Achilles tendinopathies are distal with retrocalcaneal bursitis and Haglund's heel deformity being the most common type of disorders along with partial Achilles tendon tear and tendinosis[3].

Calcific spurs occasionally grow to the calcaneal insertion of the Achilles tendon. They are seen in various rheumatic and articular diseases but also in physically active individuals[4,5]. A symptomatic tendon with a confirmed insertional spur may be referred to as an insertional calcific tendinopathy (CT), and may be present with or without calcific deposits of the main body of the tendon, referred to as CT of the main body[6].

Surgery for distal tendinopathy of the Achilles tendon may sometimes become necessary to eliminate the disturbing symptoms[7,8]. Due to the rare nature of insertional CT, a good understanding of effective surgical treatments and the presence of the possible outcome related factors is lacking. Also, the cellular distribution in the spurs, which can be assessed by histological staining, found in the insertional CT of the Achilles tendon is unclear.

We present a series of 36 cases treated surgically due to insertional CT of the Achilles tendon, most of which is in conjunction with a Haglund's deformity.

Materials and methods

Study design

The study consists of material gathered retrospectively from 36 operations conducted on 34 patients in Turku, Finland and Rome, Italy during the years 1999 to 2007. In two of the patients the finding was bilateral. The 36 cases of Achilles tendon insertional CT were selected from materials of a total of 1425 operations done for Achilles tendon over-use injuries by the senior author (SO). The incidence of insertional CT of the Achilles tendon was thus 2.5% in our material. All patients were evaluated at the senior authors' office.

Inclusion criteria

Clinical symptoms of CT included exercise related pain and swelling and warmth in the back of the foot. Clinical findings included tenderness during palpation, with bursitis specifically at the upper posterior calcaneus, swelling in the heel and also a thickened distal Achilles tendon.

The diagnosis of CT at the Achilles insertion was confirmed radiologically on average of 10 months after the appearance of the first symptoms and the patients were treated conservatively for an average of 8 months after the diagnosis. In addition to radiography, ultrasound and MRI were used to either confirm the diagnosis or rule out other causes for the symptoms.

Preoperative treatment

The preoperative conservative treatment used in these patients included anti-inflammatory pain medication, corticosteroid injections, rest, physiotherapy with eccentric exercise, heel elevation and modified shoes.

Surgical technique and post-operative treatment

The surgery was performed in spinal anaesthesia, isolating the leg from the circulation by tourniquet and with the patient lying in prone position. An incision was made laterally, vertically, and continued in L-form medially distal to the Achilles tendon. After exposure of the retrocalcaneal space the hypertrophic retrocalcaneal bursa was resected. When a Haglund's deformity had been diagnosed, the prominent part of the superior corner of calcaneus was excised with a chisel. The calcific spur was palpated at the insertion of the Achilles tendon and a longitudinal incision was made in the tendon insertion parallel to the tendon fibres. The calcification was then carefully prepared, free from the surrounding tendon, with a small scalpel and removed from its base with a chisel. The tendon defect was closed using 3-0 PDS suture. If the defect in the tendon was over 1-cm in width or almost through the tendon in depth, reinforcing sutures were applied by drilling holes through the calcaneus. In cases of CT of the main body of the tendon, the calcified fragments were also carefully freed and excised.
All patients had the same postoperative course. At first, an elastic bandage was used for 2 weeks. Partial weight bearing was allowed immediately and crutches were used usually for 2 to 3 days. Heel-elevation of approximately 3-cm was used for 3 weeks. During the first postoperative month activity was limited to walking, cycling and swimming. Physical activity was then gradually increased, but heavy strain such as running was not allowed until 2 to 3 months from the operation. Postoperative evaluation was made by the operating surgeon. Follow-up evaluation was done at the office until patients were free from symptoms. Those patients unable to attend the office were contacted by phone for evaluation of the result approximately 1 year after the surgery. Painful patients were seen at the office more frequently and for an extended period of time. A postoperative radiograph was only done for symptomatic patients.
The grading of the results of surgery was made at the final follow-up. If the patient was free of symptoms and had returned to same level of activity, prior to the onset of the symptoms, the result was rated good. When there were symptoms in athletic activities which prevented the return to the same level of activity as prior to the onset of the symptoms, but there were no symptoms in activities of daily living, the result was rated moderate. The result was rated poor when the patient had disturbing symptoms, even in activities of daily living.

Histology

The histological material consisted of 7 specimen of calcaneal spurs resected from patients between 1999 and 2006. Two of the specimens were contained in 50% EtOH and the rest in 10% fosfatic buffered formalin. All of the specimens were transferred to 70% EtOH at the beginning of this study. The spurs were cut into two equal parts. One piece was stored in the 70% EtOH and the other decalcified for 16 days in a 14% solution of EDTA. The decalcified spurs were washed in tap water for 4 hours and dehydrated in graded alcohols, cleared in xylene, then embedded in paraffin and cut with microtome. Samples were stained with hematoxyline-eosine, Weigert-van Gieson and TRACP for immunohistochemistry and analysed under light microscopy.

Statistical analysis

The patients were tabled in the statistical program SAS Enterprise Guide 4 by 8 variables: sex, age, athletic activity, spur size, duration of conservative treatment, duration of symptoms before operative treatment, surgical procedure (spur resection with or without resection of a Haglund's deformity), and outcome. In the processing of the material, we used one-way ANOVA and table analysis with p-values calculated with the Pearson chi-square-test. Significant differences were rated as $p\text{-value} < 0.05$.

Results

Twenty of the patients were Finnish, twelve Italian and two from other countries. Eight of the patients were women and 26 were men. Twelve of the patients were professional athletes and 21 recreational athletes. One patient was not engaged in any sports activities, however, the occupation of this patient was farming and required intense physical activity. The sports activities of the patients are listed in Table 1. In Figures 1 and 2, different types of insertional calcifications are shown.
The mean age of the patients, at surgery, was 42 years (range=23 to 68). In the operation, the calcific spur at the calcaneal insertion of the Achilles tendon was resected in all cases. In 29 of the 36 cases (81%) a concomitant Haglund's deformity of the calcaneus was simultaneously resected. Four patients had also in addition to insertional calcific tendinopathy, CT of the main body of the tendon, and excisions of separate calcific deposits of the Achilles tendon was performed. One patient had three separate calcific insertional spurs in the same heel that were all resected at the same operation.
The outcome of surgery was rated good in 25 (69%) cases, moderate in 9 (25%) and poor in 2 (6%) cases with an average follow-up of 35 months (range=6-108 months). The patients with poor outcome were re-operated, 1 and 4 years respectively, after the primary operation, because of a regrowth of a spur in the same location, and this resulted in a successful outcome. All athletes did eventually resume their training successfully. Those patients who had a moderate outcome had minor symptoms in sports activities, usually in strenuous exercise such as fast running.

Table 1. Sports activities of the 34 patients with a calcific spur at the distal Achilles tendn insertion.

Sports	n (professional athlete)	%
Running	16 (4)	47.1
Football	5 (5)	14.7
Jogging	6	17.6
Floorball	1 (1)	2.9
Orienteering	2 (2)	5.8
Aerobics	1 (1)	2.9
Walking	1	2.9
Hiking	1	2.9
No specific sport	1	2.9
Total	**34 (13)**	**100 (38.2)**

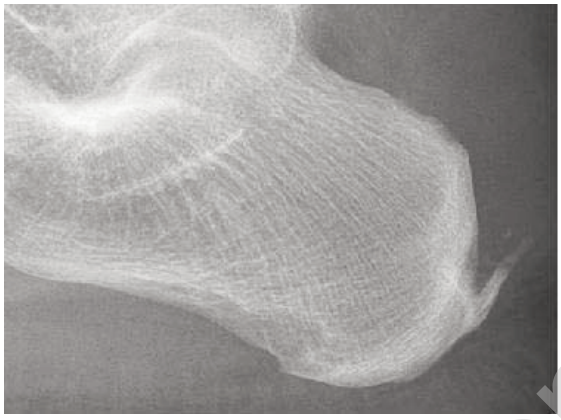

Figure 1. Radiograph of a pointy calcaneal spur at the Achilles tendon insertion.

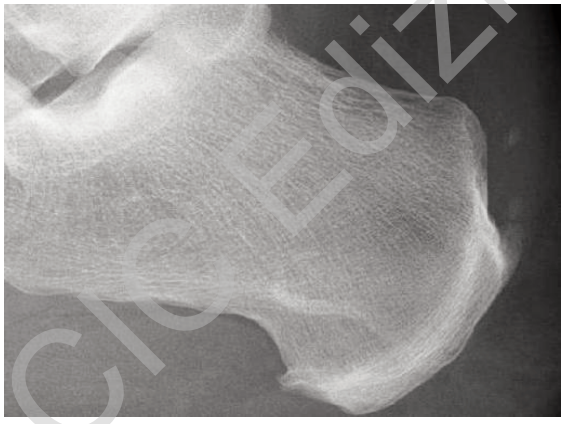

Figure 2. Radiograph of a round calcaneal spur at the Achilles tendon insertion.

The results from statistical analysis are summarised in Table 2. The average duration of conservative treatment was 8 months, 8.1 months and 5 months in the group with good, moderate and poor outcome, respectively after the patients had come to the observation of the treating surgeon. The patients with good outcome were operated on average 6.8 months earlier after the onset of symptoms than those with moderate outcome (14.5 vs. 21.3 months of symptoms prior to surgery), but

Table 2.

Dependent variables for outcome	p-value
Duration of symptoms	0.2604
Age	0.0239
Athletic activity	0.0205
Sex	0.2009
Spur size	0.9543
Haglund's deformity	0.0613

this difference was not statistically significant (p=0.2604). In the group with a good outcome the mean age was 10.2 years lower (39.6 years, standard deviation (SD)=10.7) than of those in the moderate group (49.8 years, SD=11.8) and this difference was statistically significant (p=0.0239). A correlation between the outcome and athletic activity existed -higher activity was related with a better outcome (p=0.0205). Gender differences occurred in the mean size of the calcific spur. The mean size in women was 19.8-mm and 25.2-mm in men, however, no significant difference in the outcome between men and women (p=0.2009) occurred. The size of spurs varied from 1.5- to 4-cm. No correlation was seen between spur size and outcome (p=0.9543). Good outcome associated with a concomitant resection of a Haglund's deformity but our study was too limited to bring forth significant differences (p=0.0613).

All histological samples showed trabecular bone and medullary cavities. In comparison to ordinary tendon-bone junctions, the samples showed a relatively large amount of fibrocartilage and occasional, diffusely organized chondrocytes in collagen- rich medium. In some of the samples, a large number of bone-absorbing osteoclasts and osteoblast-like cells were observed at the surface of the bone.

The cell population in the medullary cavity looked abnormal, resembling mostly fetal mesenchymal tissue. Histologically, all of the 7 samples resembled rapid remodellation in the bone tissue. Because of decalcification, an estimate of the amount of osteoids could not be done. Presentation of cartilage cells was atypical. They were located anatomically in an unusual way, further the matrix did not fit to either hyaline-, elastic- or fibrocartilage. The presence of the mesenchy-

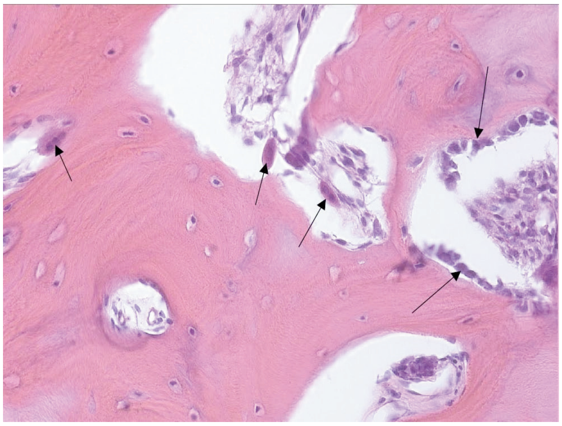

Figure 3. Light microscopy of resected spur in haematoxylin and eosin staining with 400x magnification, showing osteoclasts (three leftside arrows) and osteoblasts (two rightmost arrows) lining the bone cavities.

mal-like tissue in the bone cavities gave the impression that the stem-cells would have activated, proliferating cartilage cells and osteoblasts (Fig. 3). The source of the osteoclasts remains unknown but vascularisation was observed.

Discussion

Surgical treatment for insertional CT of the Achilles tendon with or without a concomitant Haglund's deformity resulted in good outcomes in most patients with our procedure. Occasionally, regrowth of the insertional calcification occured. In these cases, re-operation lead to a successful outcome. In the histological examination, the general appearance of the spur showed active remodellation and some sections featured signs of stem-cell activity.

Within the power of our study, there was not a significant association of sex, spur size, Haglund's deformity or duration of symptoms before surgery to the clinical outcome. When we compare the groups with good and moderate outcome, we find that younger patients and higher athletic activity is related to better outcome with statistical significance. Because of limited observations with poor outcomes, we cannot show the same significant difference when a calculation is done for all three levels of outcome.

This study included only one surgical procedure with a relatively large number of subjects and an encouraging follow-up time, therefore it should add confidence in the understanding of the surgical treatment of insertional CT of the Achilles tendon. We also distinguish shortcomings of this study that challenge our conclusions. This is merely a retrospective study and the procedure of assessing the outcome does not include written pre- and postoperative assessment, independent of the surgeon. The lack of rating of symptoms before surgery is due to the retrospective nature of this study. There are only a few small sized, population-based studies on the subject, but the results are optimistic, most recently by Johnson et al.[9] and Maffulli et al.[10]. Previous studies do not show the relation of simultaneous resection of the upper posterior calcaneal corner to success rates. While a statistically significant connection was not shown, partly due to the limits of the study, between the outcome and the resection of a concomitant Haglund's heel, it is still interesting to speculate whether the vaguely perceived beneficial connection could be due to the mere elimination of a prominent upper corner of the calcaneal bone or, to the exposure to growth factors within the cancellous bone. Conservative treatments for main body or insertional calcifying Achilles tendinopathy are largely derived from studies for non-calcific tendinopathy, although a different degree of malady is suspected. The best evidence-based conservative treatments for tendinopathy include eccentric exercises and extracorporeal shock wave therapy (ESWT)[11], although our patients did not receive ESWT due to limited availability.

The etiology of insertional CT of the Achilles tendon remains disputed and the incidence is unknown. The prevalence of calcific spurs was, however, surprisingly high in a cadaver study. In an investigation of Achilles tendons from 50 elderly corpses, 16 small insertional enthesophytes were found12. In these subjects, this does not indicate that clinical tendinopathy would be present. In radiological studies, approximately 25% of population is estimated to develop a spur, either in the plantar fascia or Achilles tendon[5]. The majority of the present patients had a simultaneous Haglund's heel, which is a typical deformity in exercise related tendinopathy[3]. It is possible that part of the population may have an undiagnosed spur which, if not aggravated by simultaneous Haglund's deformity and physical exercise, remains asymptomatic.

Trauma is widely believed to have a primary role in the development of CT in the main body of the tendon[12,13]. However in our study, no distinct trauma preceded the onset of the disabilitating symptoms associated with insertional CT. The correlation between insertional CT and the main body CT of the Achilles is not known. In our study, these two were concomitant in 4 cases of 36 (11%).

Studies have confirmed a correlation between athletic activity and incidence of calcific spurs[14,15]. This indicates that repeated tensional stress and/or microtrauma are predisposing factors. This theory is in line with our study as well, as all the patients but one were engaged with some sports activity, mostly running. Speculation has also extended to physiological mechanics, suggesting that an increased tendon-bone junction area might be an adaptational process in response to the increased mechanical stress, because spurs can develop without inflammatory or microtraumatic conditions[16]. Distal insertional Achilles enthesopathy develops in similar circumstances, usually without calcification.

More detailed studies as to when the insertional CT is mature for surgery would be valuable, as some spurs tend to regrow. The true impact of posterior calcaneoplasty to surgical outcome needs investigation in a larger study. Also, further histological investigations are necessary to evaluate our microscopical findings, while the reason for disarranged cartilage cells and atypical matrix and confirmation of the presence of osteoblasts would be of special interest.

This investigation shows that a good clinical outcome to in-

sertional CT may be attributed to younger age and professional athleticism when compared to factors related to moderate outcomes. Also, the resection of a prominent Haglund's heel is possibly a positive outcome factor. This investigation may guide future treatments to insertional CT.

Acknowledgments

We wish to acknowledge Hans Helenius, Biostatistics, University of Turku and TBDP. We also wish to thank Robert M. Badeau for linguistic checking of this manuscript.

References

1. Williams JPG. Achilles tendon lesions in sport. Review. Sports Med 1986;3:114-135.
2. Orava S, Leppilahti J, Karpakka J. Operative treatment of typical overuse injuries in sport. Annales Chirurgiae et Gynaecologiae 1991;80:208-211.
3. Leppilahti J, Karpakka J, Gorra A, Puranen J, Orava S. Surgical treatment of overuse injuries to the achilles tendon. Clinical J of Sport Med 1994; 4:100-107.
4. Bassiouni M. Incidence of calcaneal spurs in osteoarthrosis and rheumatoid arthritis, and in control patients. Ann Rheum Dis 1965: 24:490-493.
5. Resnick D, Feingold ML, Curd J, Niwayama G, Georgen TG. Calcaneal abnormalities in articular disorders: rheumatoid arthritis, ankylosing spondylitis, psoriatic arthritis, and Reiter's syndrome. Radiology 1977; 125: 355-366.
6. Oliva F, Via AG, Maffulli N. Physiopathology of intratendinous calcific deposition. BMC Med. 2012; 10: 95.
7. Krahe MA, Berlet GC. Achilles tendon ruptures, re rupture with revision surgery, tendinosis, and insertional disease. Foot Ankle Clin 2009; 14: 247-275.
8. Oshri Y, Palmanovich E, Brin YS. Chronic insertional Achilles tendinopathy: surgical outcomes. MLTJ 2012; 2: 91-95.
9. Johnson KW, Zalavras C, Thordarson DB. Surgical management of insertional calcific achilles tendinosis with a central tendon splitting approach. Foot Ankle Int 2006; 27: 245-250.
10. Maffulli N, Testa V, Capasso G, Sullo A. Calcific insertional Achilles tendinopathy: reattachment with bone anchors. Am J Sports Med 2004; 32: 174-182.
11. Loppini M, Maffulli N. Conservative management of tendinopathy: an evidence-based approach. MLTJ 2011; 1: 133-136.
12. Rufai A, Benjamin M, Ralphs JR. Structure and histopathology of the insertional region of the human achilles tendon. J Orthop Res 1995; 13: 585-593.
13. Jozsa L, Balint BJ, Reffy A. Calcifying tendinopathy. Arch Orthop Trauma Surg 1980; 97: 305-307.
14. Krahl H, Pieper HG, Quack G. Die Knochenhypertrophie als Trainingseffekt. Orthopade 1995; 24: 441-445.
15. Tyrdal S, Finnanger AM. Osseous manifestations in handball goalie´s elbow. Scand J Med Sci 1999; 9: 92-97.
16. Benjamin M, Rufai A, Ralphs JR. The mechanism of formation of bony spurs (enthesophytes) in the achilles tendon. Arthritis & Rheumatism 2000; 43: 576-583.