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Surgical treatment for insertional Achilles tendinopathy and retrocalcaneal bursitis: more than 1 year of follow-up

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Abstract

Objective: To analyse the imaging changes in bone marrow oedema of the calcaneal prominence, retrocalcaneal bursa and degenerative Achilles tendon after the surgical treatment of insertional Achilles tendinopathy (IAT).

Methods: This retrospective study analysed patients with IAT and retrocalcaneal bursitis that were diagnosed based on their symptoms and radiographic and magnetic resonance imaging (MRI) examinations. For patients that had received 3 months of conservative treatment but still presented with symptoms, arthroscopic debridement of the retrocalcaneal bursa and resection of calcaneal prominence were undertaken. Patients with degeneration of the Achilles tendon underwent debridement of Achilles tendon calcification with an open incision. The last follow-up included radiographic and MRI imaging, Visual Analogue Scale (VAS) pain scores and American Orthopedic Foot and Ankle Society (AOFAS)-Ankle and Hindfoot scores.

Results: Thirty patients were included (mean ± SD follow-up, 3.1 ± 0.5 years). The VAS pain and AOFAS-Ankle and Hindfoot scores were significantly improved after surgery. MRI showed that bone marrow oedema of the calcaneal prominence and the retrocalcaneal bursa was significantly reduced compared with preoperative values. There was no significant change in the high signal area of the IAT.

Conclusion: Surgical treatment of IAT and retrocalcaneal bursitis effectively alleviated local pain and restored function.

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Introduction

Heel pain is a difficult disease to treat for surgeons.[1–7] There are many causes of this pain, including: (i) retrocalcaneal bursitis; (ii) posterosuperior calcaneal prominence; (iii) insertional Achilles tendinopathy (IAT); and (iv) inflammatory bursitis between the skin and the Achilles tendon.[8–10] The prominence of the posterosuperior calcaneus was first reported in 1928 and was considered to be an important cause of local heel pain.[11] It was hypothesized that the impingement of the enlarged posterosuperior calcaneal prominence and the fibres at the insertion of the Achilles tendon caused local inflammation, secondary inflammatory bursa and insertional Achilles tendon degeneration.[2,5] At present, the more appropriate clinical diagnosis is IAT and retrocalcaneal bursitis, because the cause of pain may not simply be the deformity of posterosuperior calcaneal prominence. These typical lesions can be easily identified on magnetic resonance imaging (MRI) examinations.

Arthroscopic treatment for foot and ankle disease has made rapid progress in recent years, providing the advantages of minimal trauma and rapid recovery, and becoming more and more popular in the clinic.[12–16] However, there are relatively few reports on the arthroscopic treatment for IAT and retrocalcaneal bursitis,[17–21] especially the postoperative changes in bone marrow oedema of the calcaneus, local bursitis and IAT. If local inflammatory bursa and Achilles tendon degeneration still exist after surgery, this may be an important cause of postoperative pain. Arthroscopic debridement of the retrocalcaneal bursa and resection of calcaneal prominence can be performed; and for some patients with degeneration of the Achilles tendon, debridement of the Achilles tendon calcification was performed with open incision.[22–24] The Fowler-Philip angle (FPA) is generally applied for the diagnosis of IAT and retrocalcaneal bursitis. Patients with an FPA $>$ 75 degrees would have clinical manifestations. Studies have shown that the Fowler-Phillip angle did not take into account impingement caused by the increased inclination of the calcaneus itself (such as talipes cavus).[25,26] It was not highly correlated with the clinical symptoms in this study with false negative rate being 85% to 100%, indicating poor accuracy as a diagnostic and predictive indicator.[23] MRI should show typical lesions of the deformed posterosuperior calcaneal prominence, retrocalcaneal bursitis and IAT, which is helpful for the diagnosis.[27] In contrast, radiographs cannot show the recovery of the Achilles tendon injury caused by the calcaneal impingement, while postoperative MRI can clearly show the recovery of the Achilles tendon injury and bursitis, which could provide valuable reference for the next treatment.[28]

The purpose of this current study was to investigate the value of preoperative MRI for the diagnosis of IAT and retrocalcaneal bursitis, as well as the application value of postoperative MRI in understanding the recovery state of the Achilles tendon

injury and bursitis. This study used MRI in the follow-ups of patients with IAT and retrocalcaneal bursitis to investigate the changes of bone marrow oedema of the calcaneus, local bursitis and IAT, which can provide important evidence for further improving the efficacy of surgical treatment and judging the prognosis of the disease.

Patients and methods

Patient population

This retrospective case analysis study included consecutive patients that were treated for IAT at the Centre for Joint Surgery, Southwest Hospital, Third Military Medical University (Army Medical University), Chongqing, China between April 2010 and February 2017. The inclusion criteria were as follows: (i) primary diagnosis was IAT and retrocalcaneal bursitis; (ii) the course of disease was >3 months; (iii) the posterior calcaneal tuberosity was still painful after conservative treatment; (iv) the patient received surgical treatment at the Centre for Joint Surgery, Southwest Hospital.[29] The exclusion criteria were as follows: (i) combined with ankylosing spondylitis and/or rheumatoid arthritis; (ii) combined with ankle joint gout, tuberculosis, infection, tumour and Charcot joints; (iii) history of ankle joint surgery; (iv) ankle joint malalignment abnormalities; (v) tendon degeneration other than IAT; (vi) abnormal coagulation; (vii) <18 years old. All surgeries were performed by the same senior surgeon (X.D.).

This study was approved by the Ethics Committee of Southwest Hospital, Third Military Medical University (Army Medical University), Chongqing, China (no. KY201924). All patients provided written informed consent and agreed to be enrolled in the study.

Preoperative imaging examination

The anteroposterior and lateral radiographs of the ankle joint in the standing position were taken before surgery. On the radiograph, the FPA refers to the angle between the inferior calcaneus and the posterior surface of the calcaneus.[30] The FPA was measured to determine the degree of deformity of the posterosuperior calcaneal prominence.[16,31] The ankle joint was scanned using an Artoscan-C (0.2T; Esaote, Genoa, Italy) in order to determine the degenerative signals of bone marrow oedema of the posterosuperior calcaneal prominence, retrocalcaneal bursitis and at the insertion of the Achilles tendon, as well as to exclude other causes for posterior hindfoot pain such as subtalar arthritis.

Surgical strategy

For patients with unobvious degeneration at the insertion of the Achilles tendon, calcaneoplasty and bursectomy were performed.[24] For patients combined with IAT, first calcaneoplasty and bursectomy were performed, then thorough debridement of the calcified Achilles tendon was conducted before performing reconstruction of the insertion of the Achilles tendon. If >70% of the Achilles tendon was removed, transposition of the flexor hallucis longus would be required. There were no patients that experienced >70% debridement of the Achilles tendon in the current study.

Surgical techniques

The preferred method of anaesthesia was nerve block anaesthesia. Epidural anaesthesia or general anaesthesia were also acceptable. With regard to position and C-arm fluoroscopy preparation, patients were placed in the conventional prone position, with a tourniquet used at the upper thigh and the pressure was 280–300 mmHg.

Standard sterilization and draping were performed. C-arm fluoroscopy was connected to ensure convenient utilization during surgery.

With regard to the arthroscopic procedure, marker pen was used to mark the lateral and medial ends of the insertion of the Achilles tendon (Figure 1a), in order to avoid the incision being too close to the proximal end, which was not convenient to remove the bony prominence, as well as avoiding the lateral incision being too close to the lateral malleolus and stimulating the sural nerve. When establishing the incision, the ankle joint was in slight plantar flexion and the tension of the Achilles tendon was relaxed. This was conducive to placing the arthroscope in the retrocalcaneal bursa. First, the Achilles tendon was explored according to standard techniques. When injected using a trocar, yellow viscous liquid could sometimes be withdrawn from the bursa. An arthroscope with a diameter of 4.0 mm or 2.7 mm (Smith & Nephew, Andover, MA, USA) was placed and hyperplasia of the synovial membrane in the retrocalcaneal bursa could be observed. Then under the arthroscope, the needle was inserted after confirming that the portal position was satisfactory. The skin was cut and separated using mosquito artery forceps to establish another portal. Next, a bursectomy was conducted with a 4.5 mm arthroscopic blade by removing the entire soft tissue of the bursa; and calcaneoplasty was performed with a 4.5 mm bur by removing the posterosuperior calcaneal prominence (Figure 1b). Attention should be paid to protect the insertion of the Achilles tendon and the calcaneal surface should be smooth. Arthroscopic examination was conducted to check whether the Achilles tendon would impinge the prominence when the ankle joint was placed at a functional position. C-arm fluoroscopy was used to confirmed that the osteotomy surface was flat and the prominence that could cause impingement had been removed. Finally, the insertion of the Achilles tendon was denervated using a radiofrequency therapy device to alleviate the pain of the Achilles tendon (Figure 1c). No joint cavity drainage was needed. All incisions were closed using interrupted nylon sutures and a plaster cast was applied for ankle joint fixation in mild plantar flexion.

With regard the open surgical procedure, a lateral 'L-shaped' incision of the Achilles tendon was established (Figure 1d). After the lesion was exposed, the posterosuperior calcaneal prominence was removed by osteotome; and the inflammatory soft tissue such as the bursa was removed by rongeur.[4,11] If the Achilles tendon was calcified, it was necessary to remove the calcification of the Achilles tendon. The Achilles tendon was detached from the insertion and the calcified and degenerated Achilles

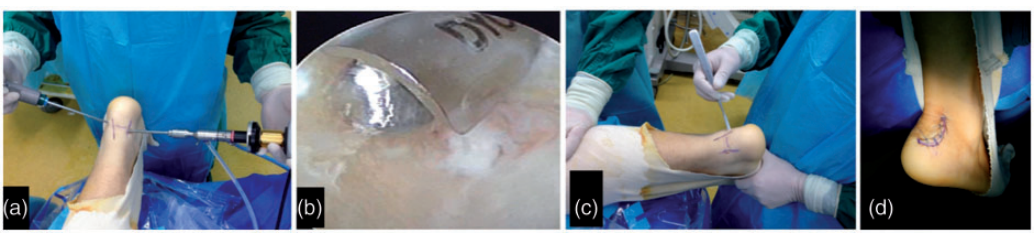

Figure 1. (a) Performing surgery on the lateral and medial side of the Achilles tendon insertion. (b) Removing the posterosuperior calcaneal prominence. (c) Removing the posterosuperior calcaneal prominence. (d) The lateral 'L-shaped' incision of the Achilles tendon. The colour version of this figure is available at: http://imr.sagepub.com.

tendon was removed. Then a suture anchor was used at the insertion of the Achilles tendon. Intraoperative C-arm fluoroscopy was used to confirm that the calcified lesion had been completely removed.

Postoperative treatment

Routine intravenous antibiotics were used for 24 h after surgery. The affected limb was elevated after surgery and non-weight-bearing off-bed exercises could be conducted at an early stage, such as quadriceps static contraction and leg raising exercises to prevent quadriceps amyotrophy and lower extremity thrombosis. The suture was removed 2 weeks postoperatively and the ankle joint was fixed to mild plantar flexion with plaster. If debridement of the retrocalcaneal bursa and resection of calcaneal prominence were conducted by arthroscopy combined with open surgery, the plaster was fixed for 3 weeks postoperatively; and partial weight-bearing walking was undertaken for 3 weeks with the heel being raised under the protection of the walking boots (Aircast; DJO Global, Vista, CA, USA). Within 2 weeks after the reconstruction of the insertion of the Achilles tendon, the ankle joint was wrapped with an elastic bandage. Plaster fixation was applied for 4 weeks. After 6 weeks, the heel was raised and patients could walk with partial weight-bearing under the protection of walking boots (Aircast). If the patient reported no local painful, exercises were gradually conducted as planned until full weight-bearing walking and all activities could be performed.

Follow-up evaluation

A visual analogue scale (VAS) pain score and American Orthopedic Foot and Ankle Society (AOFAS)-Ankle and Hindfoot scores were evaluated before surgery, at 1 year after surgery and at the last follow-up examination. At the last follow-up, radiographic and MRI examinations were performed and compared with the preoperative images. Materialise Mimics software (version 19.0; Materialise, Leuven, Belgium) was used to measure the changes in the bone marrow oedema of the posterosuperior calcaneal prominence, retrocalcaneal bursa and the high-signal area at the insertion of the Achilles tendon. The bone marrow oedema, cyst and Achilles tendon calcification were measured based on different MRI signals. Combined with radiography, calcification of the Achilles tendon and the CT value of inflammation were observed as high signals on MRI. After locating the lesion, the area of the lesion could be directly measured using the Materialise Mimics software (Figure 2). The calcification of the Achilles tendon was also evaluated. The calcification was measured by radiograph combined with MRI. Achilles tendon calcification could be seen on radiographs and the signal expression of calcification on MRI was different from that of normal Achilles tendon. The Materialise Mimics software was applied to locate the different signals and

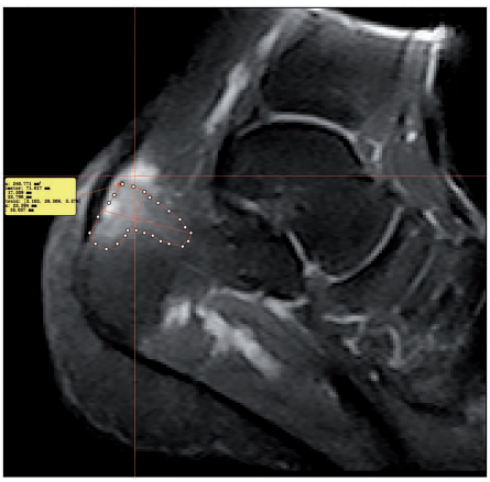

Figure 2. Measurement of the extent of bone marrow oedema of the calcaneal prominence.

directly measure the area of calcification. The measurement method was similar to bone marrow oedema and bursitis. During the follow-ups and re-examinations, the recovery time of activity was evaluated according to the patients' activity level (i.e. the recovery time of specific activities such as walking and running).

Statistical analyses

All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 19.0 (IBM Corp., Armonk, NY, USA). Data are expressed as mean ± SD. Student's *t*-test was used for comparison between groups. A P-value < 0.05 was considered statistically significant.

Results

Thirty patients were included in this retrospective study. Among them, 21 were male and nine were female, with a mean ± SD age of 44 ± 12 years (range, 18–68 years). All patients underwent unilateral surgery, with 10 left ankles and 20 right ankles. The mean ± SD duration of ankle pain was 4.3 ± 1.1 years (range, 0.5–25.2 years). The demographic and clinical characteristics of the patients are shown in Table 1.

Patients were followed for a mean ± SD of 3.1 ± 0.5 years (range, 1–7 years) (Table 1). There were no patients with an FPA > 75 degrees and four patients had an FPA > 65 degrees (Figure 3). There were no complications such as wound infection, persistent pain, rupture of the Achilles tendon and deep vein thrombosis. The preoperative and postoperative VAS pain and AOFAS-Ankle and Hindfoot scores are presented in Table 2. These data indicated that the posterior ankle pain was relieved and the ankle function was improved postoperatively in the medium term. At the last follow-up, the AOFAS scores of all 30 patients were better than before surgery.

Table 1. Preoperative demographic and clinical characteristics and data regarding the return to pre-injury activity levels after surgery in patients with insertional Achilles tendinopathy.

Characteristic	Study cohort $n = 30$
Age, years	44 ± 12
Age range, years	18–68
Sex	
Male	21
Female	9
Side affected	
Left	10
Right	20
Follow-up period, years	3.1 ± 0.5
Follow-up period range, years	1–7
Swelling	30
Calcification at the insertion of the Achilles tendon	3
Heel pain	30
Duration of ankle pain, years	4.3 ± 1.1
Duration of ankle pain range, years	0.5–25.2
Time to return to pre-injury activity levels after surgery, weeks	18.2 ± 2.5
Time to return to pre-injury activity levels after surgery range, weeks	14–24

Data presented as mean ± SD or *n* of patients.

All 30 patients returned to their pre-injury activity levels within a mean of 18 weeks (range, 14–24 weeks) after surgery (Table 1).

Figure 3. Measurement of the Fowler-Philip angle.

At the last follow-up, radiographic and MRI examination showed that bone marrow oedema of the calcaneal prominence was significantly reduced compared with the preoperative levels ($P < 0.001$) and the retrocalcaneal bursitis was significantly decreased compared with the preoperative value ($P < 0.001$) (Table 2). There was no significant change in the high signal area of the IAT. No obvious calcification at the insertion of the Achilles tendon was observed in the radiographs at the last follow-up. Three of the patients had calcification preoperatively and they all improved after surgery.

Discussion

Typical IAT is not difficult to diagnose. The most obvious location of the local pain is at the insertion of the Achilles tendon and local swelling can be observed.[16,23–25,29,30,32–34] If combined with retrocalcaneal bursitis, when in dorsiflexion, the pressure in the bursa between the Achilles tendon and the calcaneus can be increased and lead to aggravated local pain. When the local inflammatory response is obvious, it may be accompanied by an increase in local skin temperature.

Table 2. Comparison of preoperative and postoperative data in patients ($n = 30$) with insertional Achilles tendinopathy (IAT).

	Preoperative value	Postoperative value	t	Statistical significance[a]
AOFAS-Ankle and Hindfoot score	50.60 ± 2.12	94.27 ± 1.563	20.50	$P < 0.001$
VAS pain score	7.23 ± 0.53	0.433 ± 0.124	11.27	$P < 0.001$
Bone marrow oedema of the calcaneal prominence, mm^2	210.07 ± 20.90	25.90 ± 3.212	18.60	$P < 0.001$
Retrocalcaneal bursa, mm^2	76.04 ± 5.04	15.87 ± 1.27	12.33	$P < 0.001$
High signal area of the IAT, mm^2	26.90 ± 2.60	25.54 ± 2.76	1.97	NS

Data presented as mean $\pm$ SD or n of patients.

[a]Preoperative and postoperative values compared using Student's t-test.

AOFAS, American Orthopaedic Foot and Ankle of Society; VAS, visual analogue scale; NS, no significant between-group difference ($P > 0.05$).

IAT is also a common cause of pain in the posterior ankle area. Non-IAT is often located 2–6 cm proximal to the Achilles tendon and is easily differentiated from IAT.[35–38] However, insertional tendinopathy is located within 2 cm of the insertion of the Achilles tendon and often presents in combination with a posterosuperior calcaneal prominence.[16,24] Clinicians usually diagnose the pain caused by the impingement of a posterosuperior calcaneal prominence as retrocalcaneal bursitis and the pain caused by serious degeneration of the Achilles tendon tissue as IAT. IAT and retrocalcaneal bursitis also need to be differentiated from local gout and ankylosing spondylitis.

The treatment of IAT and retrocalcaneal bursitis requires nonsurgical treatment for 3 months,[4,24,38] which can include the following: (i) changing the way the patient exercises, such as encouraging the use of a fixed bicycle to reduce the load on the Achilles tendon; (ii) choosing shoes that avoid direct pressure on the Achilles tendon; (iii) topical application or oral administration of nonsteroidal analgesics; (iv) application of a brace fixation at night to alleviate the pain in the morning and to help improve the flexibility of the Achilles tendon. In the past 10 years, there has been more research on the application of biological agents to improve the repair and healing of the Achilles tendon, and regenerative medicine such as extra-corporeal shock wave therapy and platelet-rich plasma, providing a new direction for the treatment of IAT and retrocalcaneal bursitis.[39] Local injection of steroid hormone drugs is not recommended because it would accelerate the degeneration of the Achilles tendon and even cause Achilles tendon rupture.[40] If the nonsurgical treatment shows little efficacy, surgical treatment can be used.[11,21–23,35] A previous study used a modified technique of dorsally based closing wedge osteotomy of the calcaneus on 28 patients with IAT and conducted follow ups for at least 2 years.[40] The patients were healed within a mean of 5 weeks after the osteotomy.[41] The study found that the modified dorsally based closing wedge osteotomy was a safe surgical method, which could significantly improve the pain and function of IAT patients at 2 years after the surgery.[41] In this previous study, the Victorian Institute of Sports of Australia–Achilles (VISA-A) scale was used for the efficacy evaluation.[41] The VISA-A scale is more effective and specific for assessing the function and activity of the Achilles tendon.[42,43] Arthroscopic treatment for foot and ankle disease has become increasingly popular because it is minimally invasive, provides clear exposure of the lesions, facilitates rapid postoperative recovery and aesthetic incision.[44] In addition to IAT and retrocalcaneal bursitis, the surgical indications of arthroscopy also include osteochondral lesion of talus, ankle joint arthrodesis, chronic ankle instability, ankle joint tuberculosis and even talar bone cyst.[5–7,19,37,45–47]Many studies have demonstrated satisfactory results on the application of the arthroscopic treatment of IAT and retrocalcaneal bursitis and have made recommendations for the promotion of this technique.[1,3,12,14,48] The results of this current follow-up study were consistent with previous studies.[19,49]

Imaging examinations of IAT and retrocalcaneal bursitis have shown characteristic changes.[2,3,20] Initial research was mostly evaluated using radiographs, such as the measurement of FPA at the lateral position; and deformity of posterosuperior calcaneal prominence was considered if the angle was > 75 degrees or the convex shape of the calcaneal prominence was missing.[12,25,26] In this current study, none of the patients had an FPA > 75 degrees, although four patients had an FPA > 65 degrees. Previous research demonstrated the FPA had a poor accuracy as a diagnostic and predictive indicator.[50] Therefore,

this current study did not use the FPA as a diagnostic and observational indicator. Different measurements, such as the Chauveaux-Liet angle (α-β), have been proposed to assess the degree of deformity of the posterosuperior calcaneal prominence and the inclination of the calcaneus.[51] In recent years, it has been suggested that radiographic measurement is less helpful for clinical diagnosis.[12,25,26,51] The diagnosis is mainly based on the medical history and physical examination; and MRI examination is much more instructive than radiographic examination.[52] MRI can clearly show the shape of the posterosuperior calcaneal prominence, whether there is a bone marrow oedema signal, the area of retrocalcaneal bursitis and whether the Achilles tendon has a high signal of degeneration[27,48,53] These abnormal signals, which are important imaging findings of IAT and retrocalcaneal bursitis, are very helpful in confirming the diagnosis. In addition, MRI imaging may be able to measure the prognosis. Studies have found that preoperative calcaneal bone marrow oedema may be an indication of a favourable prognosis.[53,54] MRI is also helpful for achieving a differential diagnosis of subtalar arthritis, calcaneal apophysitis (Sever's Disease) and flexor hallucis longus tenosynovitis.[28,55] Although there have been some follow-up studies on IAT and retrocalcaneal bursitis,[8,27,56]few have focused on the MRI evaluation in the follow-up period.[52,57] Fewer studies have reported on whether or not the degeneration of the Achilles tendon after surgery is reduced.[57–60]This current study made full use of the advantages of MRI, including it being non-invasive and providing a clear image of the lesions, which facilitated the evaluation of the postoperative outcomes. By combining the MRI findings with the VAS and AOFAS-Ankle and Hindfoot scores, it was possible to demonstrate that the surgical treatment of IAT and retrocalcaneal bursitis effectively alleviated local pain. After relieving the pathogenesis of local impingement, there was no significant progression of the Achilles tendon degeneration after surgery. It should be noted that local retrocalcaneal bursa can exist for a long time.[60]

This current study had several limitations. First, the study cohort was small. Secondly, it was only conducted in one research centre. Thirdly, due to the relatively short follow-up period, the long-term postoperative outcomes of IAT and retrocalcaneal bursitis remains to be further studied. In future, multicentred research will need to be conducted to overcome these shortcomings.

In conclusion, this current retrospective study demonstrated that the surgical treatment of IAT and retrocalcaneal bursitis effectively alleviated local pain and restored function.

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The authors declare that there are no conflicts of interest.

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