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Ultrasound-Guided Minimally Invasive Surgical Resection of Retrocalcaneal Bursitis: A Preliminary Comparison With Traditional Open Surgery

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ABSTRACT

Posterior heel pain is a common complaint that is often caused by overuse injuries. In such cases, the retrocalcaneal bursa is compressed and chafed repeatedly, leading to local inflammation. Sonography is a popular imaging tool used to study the pathology of soft tissues, and it can be used to assist in diagnosing bursitis because of its accuracy. Herein, we report an innovative method to treat retrocalcaneal bursitis under ultrasound guidance. Ten patients with posterior heel pain for >6 months who failed conservative treatment received this ultrasound-guided minimally invasive surgery. An endoscopic puncher and burr were inserted under ultrasound guidance via a stabbing wound, and the swollen retrocalcaneal bursa and bony prominence were resected. The patients were able to ambulate and undergo a rehabilitation program 2 weeks postoperatively. In the patients who underwent this ultrasound-guided minimally invasive surgery, both the average surgical time and average hospital stay were shorter than in those (n = 12) who underwent open surgery. In outcome rating assessment, the American Orthopaedic Foot & Ankle Society (AOFAS) pain score and total AOFAS ankle-hindfoot score were improved in the ultrasound-guided minimally invasive surgery group compared to the open surgery group at 2 months postoperatively. Other advantages included lesser wound pain, shorter hospital stay, faster recovery time, and minimal blood loss. Accordingly, ultrasound-guided surgery appears to be a good option for the treatment of retrocalcaneal bursitis.

Posterior heel pain is a common complaint, in which the pathology may be related to the Achilles tendon and surrounding tissues. The etiology of posterior heel pain includes Achilles tendinopathy, Achilles partial or complete rupture, and retrocalcaneal bursitis (1–3). The retrocalcaneal bursa is a disc-shaped structure that lies between the Achilles tendon and the posterior border of the calcaneal tubercle (4,5). The bursa is mostly made up of hyaluronic acid–rich synovial fluid (6). Overuse and repeated compression can lead to bursitis, which is commonly concomitant with Haglund's deformity (7). Pain is more apparent during an uphill climb, because dorsiflexion of the ankle leads to extreme compression of the bursa (8). In addition, mechanical friction to the bursa under the Achilles tendon causes inflammation and swelling. Conservative treatment of retrocalcaneal bursitis includes physical therapy with stretching exercises, nonsteroidal antiinflammatory medication, shoe modification, and the use of pressure relief insoles (9). Local corticosteroid and anesthetic injections have been reported to have relatively satisfactory results; however, the risk of later Achilles tendon rupture is a major concern (10). Open surgery is an alternative option for patients with recalcitrant symptoms after receiving conservative management (11,12); however, complications related to open surgery include wound infection, skin dehiscence, hematoma, pain owing to the operative scar, and numbness around the posterior heel (13).

To minimize the risk of wound complications, minimally invasive surgery such as endoscopic-assisted procedures have been developed (14–16). Endoscopic calcaneoplasty has been shown to be a safe and effective surgical procedure for the treatment of Haglund's disease. Ultrasound is a popular diagnostic tool for musculoskeletal disorders, and it is has also been shown to be useful in assisting several kinds of surgery because of its comparable diagnostic efficacy with magnetic

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resonance imaging in depicting soft tissue pathology (17–19). Herein, we report an innovative operative technique using ultrasound guidance to treat retrocalcaneal bursitis.

Patients and Methods

Ethical Approval and Patient Profile

All research and surgical procedures performed in this study were in accordance with the ethical standards and approved by the institutional review board of Taipei Tzu Chi Hospital. Informed consent was obtained from all the patients enrolled in the study. There were no conflicts of interest regarding the study. From May 2005 to June 2009, 10 patients (4 males and 6 females) with retrocalcaneal bursitis underwent minimally invasive surgery by the same surgeon. The open group included 12 patients (5 [41.7%] males and 7 [58.5%] females) who refused to receive minimally invasive surgery and underwent open surgical treatment. All patients with retrocalcaneal bursitis received conservative treatment including nonsteroidal antiinflammatory drugs, air-cushioned shoes, and limited activity. Surgical interventions were considered only for recalcitrant cases with persistent painful swelling for >6 months. The exclusion criteria were poor local skin condition associated with cellulitis or folliculitis over the posterior heel area, and patients who had received local steroid injections within the past 2 months. Physical examinations revealed a positive 2-finger squeeze test, local soft tissue bulging, and pain elicited with passive ankle dorsiflexion. Plain roentgenography of the ankle showed a prominent posterosuperior calcaneal bone. Ultrasound examinations with a 10-MHz linear-array transducer (HDI 3000 ATL linear array L10-5, Philips, United Kingdom) revealed distended retrocalcaneal bursa (inflammation with fluid accumulation) in all patients of both groups (20). Two patients in the minimally invasive group also had calcified Achilles tendinopathy (Fig. 1).

Surgical Technique

Under spinal anesthesia, each patient was placed in the prone position. Exsanguination and tourniquets were not used in any case. A #11 scalpel was used to make a stab wound along the lateral aspect of the Achilles tendon at the level of the upper calcaneal border. The stab wound was further distended bluntly with a straight Mosquito hemostat. The ultrasound probe was wrapped in a sterile plastic tube, and ultrasound gel (Aquasonic; Balego and Associates Inc., St. Paul, MN) was used as the transmission medium. An endoscopic puncher (Linvatec Corp., Largo, FL) was inserted under ultrasound guidance until it reached the inflamed retrocalcaneal bursa between the Achilles tendon and upper part of the calcaneal surface (Figs. 2 and 3). The distended retrocalcaneal bursa was removed piece by piece using the puncher or grasper. Caution was taken not to injure the Achilles tendon substance, and the remaining debris was irrigated out. An endoscopic burr (Linvatec Corp.) was then inserted into the superior portion of the posterior calcaneal tuberosity under ultrasound guidance, and the bony prominence that irritated the Achilles tendon was thoroughly removed (Fig. 4). The stab wound was then sutured with one 3-0 nylon stitch.

Two patients with degenerative calcified tendinopathy also underwent ultrasound-guided percutaneous tenotomy (Figs. 3 and 4). The original surgical method used a #11 surgical scalpel blade to make a parallel cut along the long axis of the Achilles tendon under ultrasound guidance (19). The modification of our surgical procedure was to perform ultrasound-guided tenotomy with a Kirschner wire (K-wire). A 1.5-mm K-wire was inserted through the same wound to puncture the degenerative tendinous substance longitudinally under ultrasound guidance. Keeping the K-wire still and holding it perpendicularly to the skin, a full passive ankle dorsiflexion and plantarflexion were performed.

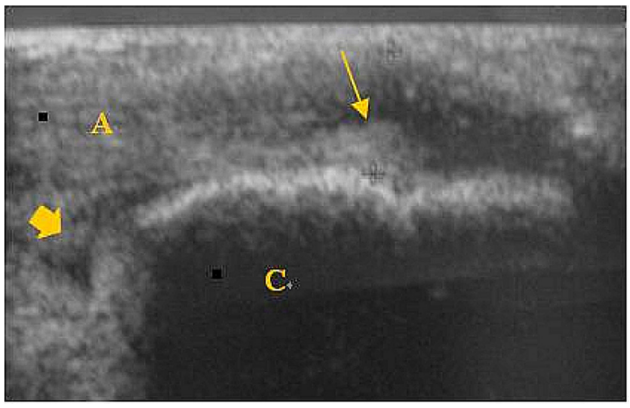

Fig. 1. Preoperative image, retrocalcaneal bursitis (*arrowheads*) and calcified Achilles tendinopathy (*arrows*). A, Achilles tendon; C, calcaneus.

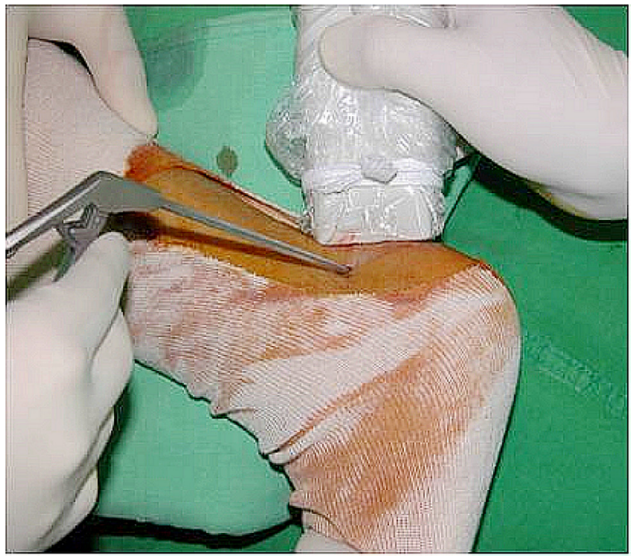

Fig. 2. Intraoperative photo of ultrasound-guided retrocalcaneal bursectomy.

Without moving the K-wire, longitudinal tenotomy was performed during the ankle range of motion. The purpose of using a K-wire was to minimize the puncture wound. Blood loss was calculated by weighing the wet gauze and dry gauze, and the difference between the 2 weights was defined as the estimated blood loss. A bivalve short leg scotch cast was applied for protection for 2 weeks, and the patients started to ambulate with 7.5-mm elevated heel shoes, which they used for 3 months. All patients were referred to our rehabilitation department for training of the range of motion of the ankle, a proprioceptive exercise program, and calf muscle training after the cast had been removed. The patients were taught to perform isometric strength training with their ankle against an immovable object in 4 directions, then progressing to dynamic resistive exercises using resistance bands (12). The patients were able to resume normal walking after 4 weeks.

The control group underwent traditional open surgery. Each patient was placed in the prone position, and a 3-cm skin incision was made over the posterolateral aspect of the posterior heel. The lateral half of the Achilles tendon insertion was elevated, and the superior bony prominence of the calcaneus was resected using an oscillating saw. The osteotomy plane was just proximal to the proximal border of the Achilles insertion (21). The inflammatory tissue was debrided thoroughly under direct visualization, and the elevated Achilles tendon was then reattached to the insertional site using a 3.5-mm suture anchor. The incision wound was closed using a 3-0 nylon suture. The same postoperative protocol was applied as with the minimally invasive group.

Surgical Outcome Evaluations

All patients were evaluated using a pain rating visual analogue scale (VAS) preoperatively and 2 weeks postoperatively. The American Orthopaedic Foot & Ankle Society (AOFAS) hindfoot-ankle scoring system was also applied preoperatively and at 2 months postoperatively (22–24). The final AOFAS score was assessed after >2 years of follow-up time.

Gross and Histologic Examinations

Samples of the tissues removed from retrocalcaneal bursitis were fixed in 10% neutral formalin, dehydrated in a graded series of ethanol, and embedded in paraffin wax. Consecutive sections (5 μm thick) were cut from the paraffin blocks and placed onto slides. The sections were deparaffinized and stained with hematoxylin and eosin (3008-1&3204-2; Muto, Japan) to assess the general construct morphology under an optical microscope.

Statistical Analysis

The Student's *t*-test was used to analyze differences in VAS and AOFAS ankle-hindfoot scores between the 2 groups. A difference was statistically significant if the p value was $\leq$.05.

Results

The age of the patients in the minimally invasive group ranged from 25 to 72 years, with a median of 57 years. In the control group, the age of the patients ranged from 31 to 67 years, with a median of 56 years.

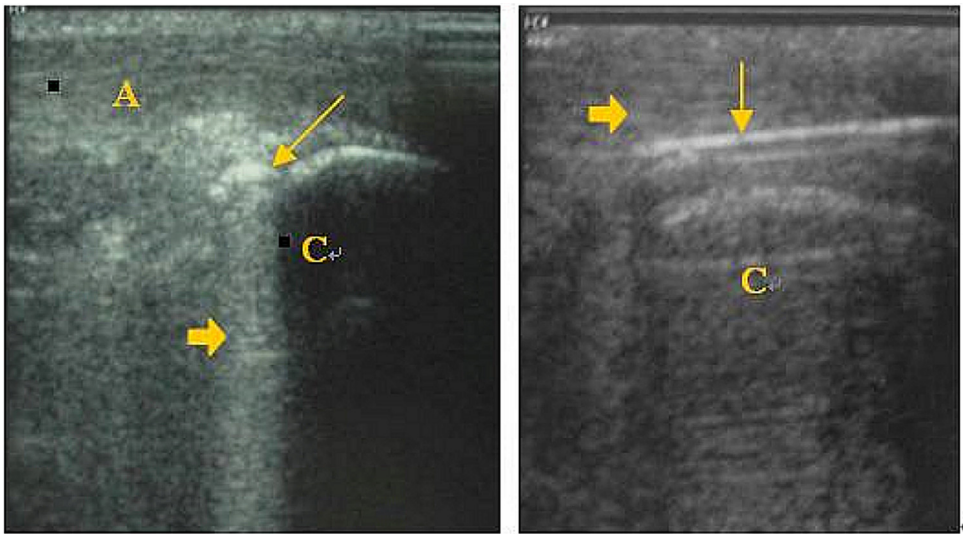

Fig. 3. Left: Intraoperative ultrasonogram of the posterior heel. The micropunch is visible between the Achilles tendon and calcaneus (*arrow*). The comet tail sign (*arrowheads*) beneath the micropunch was an ultrasound artifact caused by the metallic endoscopic tool. Right: Ultrasound-guided multiple puncture and longitudinal tenotomy of the calcified tendinopathy. The K-wire (*arrow*) is visible within the Achilles tendon substance (*arrowheads*). A, Achilles tendon; C, calcaneus.

The average body height was 162.1 ± 7.8 cm in the minimally invasive group and 163.5 ± 7.4 cm in the open surgery group ($p = .334$). The average body weight in the minimally invasive group was 65.2 ± 5.6 kg, compared to 67.1 ± 6.2 kg in the open surgery group ($p = .275$). The body mass index was 24.8 ± 0.8 kg/m^2 in the minimally invasive group and 25.1 ± 0.9 kg/m^2 in the open surgery group ($p = .162$). The median hospital stay in the minimally invasive group was 3 (range 2 to 4) days, and the median surgical time was 26 (range 22 to 29) minutes. The estimated blood loss during surgery was 6 ± 1.2 mL (Supplementary Fig.). Histological examinations revealed inflammatory tissue underneath Kager's fat (Fig. 5). Thickening of synovial lining cells with increased vascularization was also noted, and the absence of fibrin deposition on the surface layer indicated the chronic inflammatory status. The patients returned to our clinic 10 days postoperatively, and no posterior heel pain was noted. All the patients felt better soon after the surgery, and they were all satisfied with the surgery during the 2-month follow-up period, with no recurrent pain. No wound complications such as dehiscence, infection, or fistula were noted. In the open surgery group, the median length of hospital stay was 3.4 (range 3 to 4) days, and the median operative time was 44 (range 39 to 49) minutes. Both the average hospital stay and operation time were longer than the minimally invasive group with a significant difference ($p = .043$ and $p = .027$, respectively). The estimated intraoperative blood loss in the open surgery group was 15 ± 2.7 mL. Eight patients (66.7%) complained of pain around the posterior heel lasting for 2 weeks. The patients were able to ambulate without discomfort at 2.5 ± 0.6 months postoperatively. One patient (8.3%) had a superficial wound infection during the follow-up period and received oral antibiotic treatment for 7 days. The infection was controlled without the need for a further surgical intervention (Table 1). The median follow-up duration was 28 (range 25 to 40) months. There were no statistically significant differences in body weight, body height, or body mass index between the minimally invasive and open surgery groups.

In the minimally invasive group, the preoperative VAS was 6.5 (range 5 to 8), and the VAS 2 weeks postoperatively was 1.2 (range 0 to 2). In the open surgery group, the VAS was 6.4 (range 5 to 8) preoperatively, and 2.9 (range 1 to 4) at 2 weeks postoperatively. There was no statistical significance in preoperative VAS between the 2 groups;

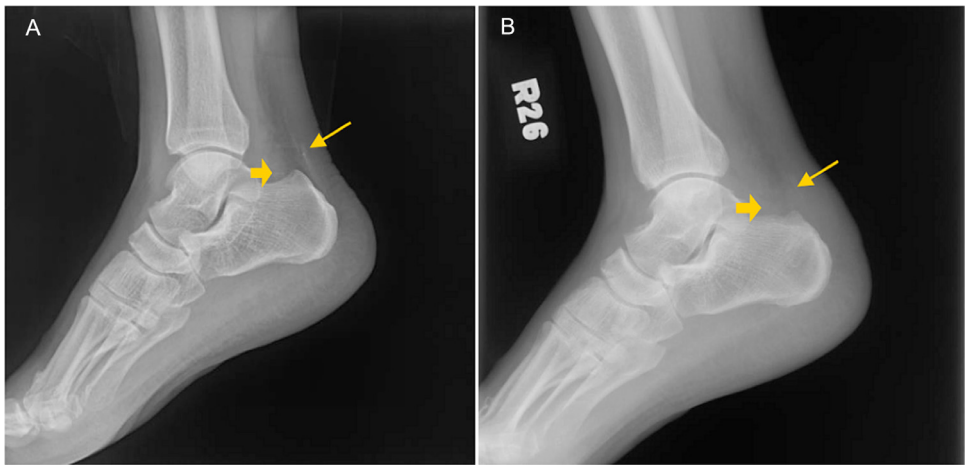

Fig. 4. (*A*) Preoperative x-ray images revealed Haglund's deformity (*arrowhead*) and calcified Achilles tendinopathy (*arrow*). (*B*) Postoperative x-ray images showed the flattened surface of upper calcaneal tuberosity after treatment with ultrasound-guided minimally invasive calcaneoplasty and retrocalcaneal bursectomy (*arrowhead*). The calcified tendinopathy disappeared, which confirmed the good results of percutaneous tenotomy (*arrow*).

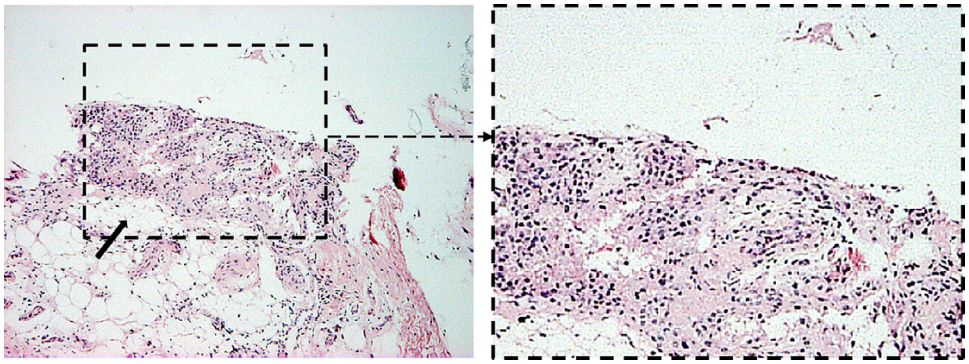

Fig. 5. Light microscopy observation of retrocalcaneal bursitis (magnification × 100; hematoxylin and eosin staining). The tissue underneath the bursitis was Kager's fat (*arrow*). The dashed line box highlights the synovitis (200×).

however, the VAS at 2 weeks postoperatively in the minimally invasive group was significantly better than that in the open surgery group ($p = .042$). The total AOFAS ankle-hindfoot score increased from 42 ± 4.4 preoperatively to 90 ± 12.7 at 2 months postoperatively in the minimally invasive group (Table 2). In addition, the preoperative average pain score of the AOFAS ankle-hindfoot scale was 10 ± 3.4, the function score was 22 ± 4.2, and the alignment score was 10 ± 0. The postoperative average pain score of the AOFAS ankle-hindfoot scale was 38 ± 4.2, with a function score of 42 ± 3.1 and alignment score of 10 ± 0. In the open surgery group, the total AOFAS ankle-hindfoot score increased from 40 ± 2.7 preoperatively to 82 ± 3.5 postoperatively, and the pain score improved from 10 ± 4.2 to 32 ± 6.2. The function score was 20 ± 5.7 preoperatively and 40 ± 1.7 postoperatively, and the alignment score was 10 ± 0 both preoperatively and postoperatively. The AOFAS pain score and total AOFAS ankle-hindfoot score in the minimally invasive group were significantly better than those in the open surgery group ($p = .023$ and $p = .031$, respectively). The final AOFAS scores in the minimally invasive and open surgery groups at 2 years postoperatively were 95 ± 3.4 and 94 ± 2.8, respectively. There were no statistically significant differences in total AOFAS score and all subcategories of AOFAS scores between the 2 groups ($p = .472$, and $p = .265$, respectively). All the patients had a continuous increase in AOFAS hindfoot scores compared to the preoperative scores.

One patient (10%) in the minimally invasive group was hospitalized again because of persistent posterior heel pain 7 months later. This patient was 1 of the 2 patients (50%) who had concomitant calcified Achilles tendinopathy. An ultrasound examination revealed no recurrence of retrocalcaneal bursitis; however, the calcified Achilles tendinopathy had not improved. Therefore, she underwent open partial calcaneal osteotomy and debridement of the Achilles tendon. The symptoms greatly improved after this surgery, and her AOFAS score at 2 years postoperatively was 92. In the open surgery group, 1 patient had an incidental fall owing to limb imbalance while walking that led to Achilles tendon insertional avulsion rupture. This patient received open surgical tendon repair with suture anchor fixation and received 3 months of physical therapy. A return to their previous quality of life was achieved 5 months later, and the AOFAS score at 2 years postoperatively was 90.

Table 1
Postoperative complications in the 2 groups

Complication	Minimally Invasive Group (n = 10)	Open Group (n = 12)
Deep infection	0	0
Superficial infection	0	1 (8.3)
Large hematoma	0	0
Insertional Achilles rupture	0	1 (8.3)
Stiffness of the ankle	0	0
Paresis of the sural nerve	0	0
Deep vein thrombosis	0	0
Recurrent pain	1 (10%)	0
Total	1 (10%)	2 (16.7)

Data are n (%). The superficial infection subsided after oral antibiotic treatment for 7 days.

Discussion

The aim of surgical treatment for retrocalcaneal bursitis is to remove inflamed soft tissues between the calcaneal prominence and Achilles tendon. It is difficult to confirm the etiology of posterior heel pain, and it could be caused by retrocalcaneal bursitis or insertional Achilles tendinopathy. Ultrasound is a useful tool to assist in making a differential diagnosis because of its high resolution in depicting soft tissue pathoanatomy (17,18). Minimally invasive surgery is becoming increasingly popular. In orthopedic surgery, it is most commonly performed with the aid of x-ray images or endoscopy. Ultrasound can also be used to assist surgery intraoperatively, and it has the advantages of not using radiation, avoiding tissue damage, providing real-time images, and having wide availability (19). Ultrasound-assisted surgery was previously limited to tumor biopsies and ultrasound-assisted therapy such as treatment of the shoulder or Achilles tendon calcified tendinopathy (25–27). However, because of the high resolution of sonography, minimally invasive surgery for Achilles tendon rupture can provide better functional outcomes and fewer complications compared to traditional open surgery (28).

Endoscopic calcaneoplasty was first illustrated by van Dijk et al (14), and several modifications have been proposed (15,16). Kaynak et al (29) recently reported the midterm results of endoscopic calcaneoplasty. Their study included 30 feet of 28 patients who underwent endoscopic surgery for Haglund's disease, with an average follow-up period of 58.4 months. The final evaluation revealed significantly improved AOFAS scores, from 52.6 points preoperatively to 98.6 points postoperatively. Moreover, all the patients were satisfied with the results of the endoscopic surgery. Wiegerinck et al (13) compared the outcomes of the open procedure versus endoscopic decompression treatment via a systematic review and found that 91% of the patients expressed good or excellent satisfaction in the endoscopic group compared with 77% of the open surgery group. Furthermore, the complication rate in the endoscopic group was 1.3% compared with 44% in the open treatment group. They concluded that the reason for the better outcomes in the endoscopic group was the lower possibility of damaging soft tissues during the minimally invasive procedure.

Although endoscopic calcaneoplasty has shown optimal results since its introduction, there are several limitations to the technique, including the possibility of injuring the Achilles tendon and a precipitous learning curve (30). In addition, fluoroscopic guidance is required

Table 2
American Orthopaedic Foot and Ankle Society score in the 2 groups at 2 months postoperatively

Variable	Minimally Invasive Group (n = 10)		Open Group (n = 12)		*p* Value
	Mean ± SD	Range	Mean ± SD	Range	
AOFAS pain (range 0 to 40 points)	38 ± 4.2	30 to 40	32 ± 6.2	20 to 40	.023*
AOFAS activity (range 0 to 10 points)	6.7 ± 2.0	4 to 10	5.9 ± 0.6	4 to 10	.056
AOFAS walking ability (range 0 to 18 points)	13.8 ± 1.8	10 to 18	12.5 ± 0.7	11 to 17	.124
AOFAS ROM and stability (range 0 to 22 points)	21.5 ± 1.5	19 to 22	21.6 ± 1.2	18 to 22	.870
AOFAS function (range 0 to 50 points)	42 ± 3.1	33 to 50	40 ± 1.7	33 to 49	.265
AOFAS alignment (range 0 to 10 points)	10 ± 0	10 to 10	10 ± 0	10 to 10	N
AOFAS ankle score (range 0 to 100 points)	90 ± 12.7	73 to 100	82 ± 3.5	82 to 99	.031*

Abbreviations: AOFAS, American Orthopaedic Foot and Ankle Society; ROM, range of motion, SD, standard deviations.
N, cannot be compared because the standard deviations of both groups were 0.
* Significance was set at $p < .05$.

to evaluate adequate resection of Haglund's tuberosity. An advantage of our method is the use of ultrasound to visualize the location and extension of the retrocalcaneal bursitis and bony prominence, and to guide the small surgical instrument to eradicate the target lesion without the need for exposure to radiation. Another advantage is that no partial Achilles tendon detachment was required. Calcaneoplasty was performed carefully without violating the Achilles tendon under ultrasound guidance in the minimally invasive group, thereby decreasing the possibility of insertional Achilles tendon rupture. The use of ultrasound in our surgical procedure resulted in a smaller wound and had advantages similar to an endoscopic procedure. No initial complications were noted in our patients, and there were significantly better AOFAS pain and total AOFAS ankle-hindfoot scores in the minimally invasive group at 2 months postoperatively. At the final evaluation time point (2 years postoperatively), there were no statistically significant differences in total AOFAS ankle-hindfoot score and all subcategories of AOFAS scores between the 2 groups.

Many authors have recommended releasing the adhesive paratendon in the surgical treatment of Achilles tendinopathy, and removing necrotic tissue and the thickened tendon portion or calcified tendon has also been advocated (31,32). Testa et al (19) performed percutaneous tenotomy of the Achilles tendon under ultrasound guidance and obtained good results. We modified their method and used a K-wire instead of a scalpel to puncture the degenerative portion of the tendon substance in our 2 patients with concomitant calcified tendinopathy. This minimized the wound and prevented iatrogenic injury to the surrounding normal tissues. Watson et al (12) compared the clinical outcomes of patients with a diagnosis of retrocalcaneal bursitis or calcific Achilles tendinosis who failed conservative treatment and were treated with retrocalcaneal decompression. The surgical procedure included partial Achilles tendon detachment, excision of the inflamed retrocalcaneal bursa, and calcaneal ostectomy. They found higher satisfaction rates and a shorter time to obtain an improvement in the retrocalcaneal bursitis group (12), which is consistent with our results. We failed in 1 case because Haglund's disease could not be resolved by minimally invasive retrocalcaneal bursectomy with calcaneoplasty, which may have been because of inadequate removal of the bony prominence of the posterior calcaneal tuberosity. Moreover, the peritendinitis and tendinosis were not adequately treated.

There are several limitations to this study. First, the sample size in both groups was small. Second, this was not a randomized controlled trial. Third, the study was not homogeneous, because 2 patients in the minimally invasive group had coexisting calcified Achilles tendinopathy, and this is known to be a confounding factor for functional outcomes.

In conclusion, we report an innovative ultrasound-guided minimally invasive method to treat retrocalcaneal bursitis. We believe that ultrasound can play an important role during retrocalcaneal bursectomy procedures.

Acknowledgments

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Supplementary Materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1053/j.jfas.2018.12.023.

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