Treatment of Insertional Achilles Pathology With Dorsal Wedge Calcaneal Osteotomy in Athletes

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Abstract

Background: Insertional Achilles tendinopathy and retrocalcaneal bursitis is difficult to treat, and several operative techniques have been used after failure of conservative management. Dorsal wedge calcaneal osteotomy has been described for the treatment of insertional Achilles pathology. It was hypothesized that dorsal wedge calcaneal osteotomy would be an effective and safe method for the treatment of athletes with insertional Achilles pathology unrelieved by nonoperative measures.

Methods: Fifty-two athletes (64 feet) who had painful Achilles tendon syndrome unrelieved by 6 months of nonoperative measures were treated surgically. Dorsally based wedge calcaneal osteotomy was performed through a lateral approach, and 2 staples were used for fixation. Patients were scored pre- and postoperatively with the American Orthopaedic Foot & Ankle Society (AOFAS) ankle-hindfoot and Victorian Institute of Sports of Australia-Achilles (VISA-A) scores.

Results: At a minimum follow-up of 3 years, the patients’ AOFAS and VISA-A scores improved from 59.5 ± 15.0 and 65.9 ± 11.1 preoperatively to 95.7 ± 6.2 and 90.2 ± 8.4 postoperatively, respectively. Clinical results were considered excellent in 38 patients, good in 12 patients, and fair in 2 patients. Return to previous sports activity time was 21 (SD, 8.0) weeks. One patient necessitated a revision operation.

Conclusion: Operative treatment of insertional Achilles pathology in athletes with dorsal closing wedge calcaneal osteotomy was a safe and effective method that allowed for a quicker return to previous level of sports activities compared with other techniques.

Level of evidence: Level IV, retrospective case series

Keywords: insertional Achilles tendinopathy, retrocalcaneal bursitis, dorsal wedge calcaneal osteotomy, Zadek osteotomy, operative treatment

Insertional Achilles tendinopathy (IAT) is a relatively common entity among ankle and hindfoot disorders.\textsuperscript{2} It may coexist with retrocalcaneal bursitis (RB) and Haglund deformity and causes tenderness at the insertion of the Achilles tendon (AT) onto the posterior calcaneal tuberosity.\textsuperscript{24} Although any of these 3 entities can present as an isolated condition, it is more common for them to present simultaneously.\textsuperscript{2,24} Together, the 3 conditions comprise what is referred to as Haglund syndrome or Haglund triad.\textsuperscript{3}

The current management of IAT varies substantially, with several conservative and operative treatments.\textsuperscript{25} Operative intervention is only indicated in patients unresponsive to conservative therapy.\textsuperscript{2} However, there is no consensus in the literature regarding the most appropriate operative treatment.\textsuperscript{25} Although dorsal closing wedge calcaneal osteotomy (DCWCO) is a technique, first described by Zadek\textsuperscript{27} in 1939, there are only few reports in the literature regarding this technique for the treatment of IAT and RB.\textsuperscript{7,13,16}

The aim of this study was to prospectively evaluate the effectiveness of DCWCO in athletes with chronic IAT and RB after failure of conservative treatment. To our knowledge, there are no reports in the literature specifically dealing...
Methods

Institutional review board approval was obtained prior to beginning the study by the Hospital Ethic Committee. Between 2007 and 2010, a DCWCO was performed in 52 patients with 64 painful heels diagnosed with IAT and RB. Inclusion criteria in this prospectively designed observational study were an age between 18 and 50 years, professional or recreational involvement in sporting activities, clinical signs of IAT and/or RB for at least 6 months unresponsive to conservative treatment, radiological evidence of prominent posterior calcaneal tuberosity (Haglund prominence), and degenerative tendinopathy affecting less than 50% of the insertion of the AT into the calcaneus on preoperative magnetic resonance imaging (MRI) scan. Patients with excessive calcific deposits at the insertion of the AT or clinical signs of coexistent mid-portion AT pathology were excluded from the study. The average age was 32.5 ± 10 years. The sex ratio between male and female was 1:1.4 (22 male, 30 female). Twenty-three of the patients were professional athletes and 29 were involved in recreational sport activities. Nineteen were runners, 13 were volleyball players, 12 were tennis players, and 8 were basketball players. The average duration of conservative management was 5 months (range, 4-7 months).

All patients had undergone conservative management for at least 6 months that failed to provide adequate relief. Complete or modified rest from their sports, nonsteroidal anti-inflammatory medication, physiotherapy, ultrasound therapy, intrabursal or peritendinous injection with local anesthetic, and/or steroids were used but did not allow the patients to return to their previous sports activities. All patients were followed up at 2 weeks for wound check, at 6 and 12 weeks with radiographs, and at 6 months for clinical assessment. Routine follow-up was at 1 and 3 years.

The systematic diagnostic imaging included a lateral radiograph of the involved calcaneus and ankle, which confirmed the presence of a Haglund prominence in all cases, and an MRI scan, which confirmed the diagnosis of insertional Achilles pathology. Also, some of the patients had an ultrasound scan that showed loss of the normal intratendinous texture and microcalcification at the AT within 2 cm of the insertion and chronic inflammation of the retrocalcaneal bursa.

All patients were clinically examined and graded by the American Orthopaedic Foot & Ankle Society (AOFAS) hindfoot score (primary outcome measure range 0-100 points) and the Victorian Institute of Sports of Australia-Achilles (VISA-A) score (pain score validated for Achilles tendon pathology, ranging 0-100 points) preoperatively and at 1 year postoperatively. The outcome of operative management was subjectively evaluated according to Testa’s rating system (using the 4-point functional scale validated for evaluation of long-term results following surgery for tendinopathy) as shown in Table 1.

Cross-bridging between the osteotomized surfaces on 2 orthogonal radiographs was considered a radiological union. Calcaneal length was measured on the lateral radiographs from the most posterior point of the calcaneus to the most distal aspect of the anterior process.

Operative Technique

All cases were performed under general anesthesia and ankle block with thigh tourniquet after administration of 1.5 g cefuroxime. Patients were positioned in the lateral decubitus position. A short L-shaped lateral incision was used and a full-thickness flap was elevated proximally. The Haglund prominence was removed first using a sagittal saw (Figure 1). The osteotomy was begun just superior to the insertion of the Achilles fibers on the calcaneus and carried out at approximately a 45-degree angle to the long axis of the tendon up to the posterior-superior surface of the calcaneus. A dorsal wedge calcaneal osteotomy was then performed. The goal of the wedge osteotomy was to rotate the superior aspect of the posterior fragment anteriorly as opposed to dorsally, which was achieved if the anterior cut was vertical. The first cut of the osteotomy was performed immediately posterior to the posterior subtalar joint facet and perpendicular to the weight-bearing surface. The second cut was performed anterior to the Achilles tendon and angled to meet the first cut to form an apex plantarly. The dorsal base of the wedge was about 1 cm. Care was taken to preserve a bone hinge at the apex of the wedge at the plantar surface of the calcaneus. The wedge was removed, and the osteotomy was closed and fixed with 2 staples (Figure 2) or a 6.5-mm cannulated screw (Figure 3).

Postoperative Management

Postoperatively, the patients were placed in a removable below-knee splint with the ankle plantarf lexed and mobilized non–weight bearing for 3 weeks. Partial weight

Table 1. Testa’s Rating System Using the 4-Point Functional Scale Validated for Evaluation of Long-Term Results Following Surgery for Tendinopathy.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Symptoms—Ability to Return to Sports</th>
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<tr>
<td>Excellent</td>
<td>Pain completely relieved, with full return to sporting level without significant symptoms</td>
</tr>
<tr>
<td>Good</td>
<td>Full return to sports at the desired mileage, speed, and jump with intermittent or mild discomfort</td>
</tr>
<tr>
<td>Fair</td>
<td>Discomfort that did not allow full return to preinjury level resulting in cessation of competitive sporting activity</td>
</tr>
<tr>
<td>Poor</td>
<td>Patients gave up sports with discomfort in activities of daily living</td>
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bearing was initiated at 3 weeks in a walking boot. The patients were encouraged to continue to full weight bearing after the sixth week and start mobilization exercises of the ankle, isometric contraction of the gastrosoleus complex,
stationary cycling, and swimming. Gradual progression to sports activities at 3 months was planned according to the patient’s progress. Patients were reviewed at 6 weeks, 3 months, and 6 months postoperatively with radiographs. Routine follow-up was arranged at 1 and 3 years.

**Statistical Analysis**

Analysis of variance was performed with the Wilcoxon signed-rank test, and statistical significance was defined at the $P < .05$ level.

**Results**

The preoperative AOFAS score was $59.5 \pm 15$ (range, 39-77) and the postoperative score was $95.7 \pm 6.2$ (range, 87-100) ($P < .001$). The median VISA-A score was $65.9 \pm 11.1$ (range, 53-76) preoperatively and $90.2 \pm 8.4$ (range, 86-98) postoperatively ($P < .001$). Clinical results were considered excellent in 38 patients (73%), good in 12 patients (23%), and fair in 2 patients (3.8%).

Return to previous sport activities ranged from 3 months to over 7 months. Average time was $21 \pm 8.0$ weeks. All professional athletes returned to the same professional level of competition at a mean time of $15 \pm 3$ weeks. Twenty-two of 29 recreational athletes returned to the same level of sport activities (mean time $18 \pm 5$ weeks), while for 7 of 29 athletes, although they returned slowly to the same sport activities (mean $24 \pm 7$ weeks), the frequency of participation was reduced by 30%. Radiographic examination revealed healing of the calcaneal osteotomy at a mean time of 7 weeks (range, 6-12 weeks). The calcaneal length prior to the osteotomy was on average 87 mm (range, 77-99 mm) and postoperatively 82 mm (range, 75-94 mm). The average anatomic change in calcaneal length was 5 mm (range, 3-8 mm).

The overall complication rate was 10.9%. Four cases (6.25%) of superficial wound infection were treated uneventfully with oral antibiotics. One case with paresthesia in the sural nerve distribution resolved with time. Two cases (3.1%) with deep vein thrombosis were treated conservatively. One major complication was encountered (1.6%). A 45-year old runner underwent a reoperation due to proximal displacement of the posterior calcaneal process and failure of hardware. The patient was reoperated on at 7 weeks with removal of broken staples, debridement of the osteotomy surfaces, and compressive fixation with a 6.5-mm cannulated screw. The calcaneal osteotomy healed at 12 weeks without any subsequent complication.

**Figure 3.** Preoperative (a) and postoperative (b, c) lateral radiographs of the calcaneus. Twelve-month lateral view reveals good position and healing of the osteotomy site (c). A 6.5-mm cannulated screw was used.
A minimum follow-up of 3 years was obtained for all the patients (range, 3-5 years).

Discussion

The most important finding of the present study was that the DCWCO could be used for treatment of insertional Achilles pathology in athletes after failure of conservative management. This technique was safe, with good clinical results, a low complication rate, and a quick return to previous sport activities, and it demonstrated excellent postoperative scores, including improvement of pain and function.

Insertional Achilles tendinopathy can be particularly disabling for athletes in sports that require repetitive dorsiflexion and plantarflexion at the ankle, forceful push-off, or bursts of acceleration, including not only running but also numerous other activities such as tennis, volleyball, basketball, and cross-skiiing. Among the competitive and recreational athletes with AT pathology, 66% had noninsertional tendinopathy and 23% had either RB or IAT. Signs of IAT were found in 29% in runners compared with only 4% in the global population in a matched-control study.

The management of AT aims to return the athlete to the required level of physical activity in the shortest possible time without significant residual pain. The operative treatment of IAT and RB is wide ranging and includes tendon procedures, bony procedures, or a combination of procedures with a variety of approaches, including debridement of the degenerative tendon, detachment of the AT and reattachment with bone anchors or augmentation with the flexor hallucis longus (FHL) tendon, open or endoscopic calcaneoplasty, and excision of retrocalcaneal bursa.

Dorsal closing wedge calcaneal osteotomy—first used by Zadek and popularized by Keck and Kelly—tilts the heel prominence anteriorly to reduce the posterior prominence of the heel, lowers the Fowler-Philip angle, slightly elevates the insertion of the Achilles tendon, and reduces the length of the calcaneus. The orientation of the AT fibers at the calcaneal insertion is also effectively altered, thereby reducing stress, which provides relief from pain associated with related IAT and RB. All the anatomical changes of the osteotomy cause improvement to both the biological and mechanical disorders that are believed to be the cause of the insertional Achilles pathology: degeneration of the AT, friction and compression of the retrocalcaneal bursa, mechanical irritation of the tendon by the calcaneal prominence, increased mechanical load at the calcaneal insertion of the AT, and a tight gastrocnemius muscle. Sharon commented in the article by Miller and Vogel that by tilting the posterior aspect of the calcaneus forward when performing the DCWCO, the lever arm about which the Achilles tendon functions is effectively shortened, which may lead to a weakened muscle-tendon complex and a longer postoperative period of rehabilitation. However, that statement was not consistent with the results of this study.

The overall improvement was 34 points for the AOFAS score and 25 points for the VISA-A score. The Wilcoxon signed-rank test revealed significant differences between the preoperative and postoperative values in both scores ($P < .001$). This was in agreement with other studies where AT debridement and reattachment with anchors or augmentation with the FHL were used, where the overall improvement of the AOFAS score was 36 to 39 points and the VISA-A score was 23 points. Our results were also in agreement with the results of the only study in the literature that included an exclusively athletic population (runners), although a different operative technique was used (debridement of the AT and/or autograft augmentation and calcaneal exostectomy). We are aware of only 3 studies where the Keck-Kelly osteotomy was used for treatment of IAT, but none reported on any scores for clinical evaluation of this technique.

The time to return to previous sports activity varied according to the operative technique used, from 5 months up to 13.5 months for studies that included a general population and 25 weeks for the only study that included an exclusively sports population (runners). Our results showed quicker return to activities compared with these studies. Saxena reported that the time to return to competition for the elite athletes was 25 weeks (range, 6 weeks to 12 months) and for nonelite athletes was 27 ± 11 weeks after Achilles tendon debridement. Rousseau et al reported the average elapsed time to running practice for middle- and long-distance runners was 8.1 ± 3.3 months after calcaneal exostectomy and 10.5 ± 4.6 months after Achilles tendon debridement and autograft augmentation. The advantage of calcaneal osteotomy was the fact that healing of the calcaneal body was more predictable and consistent compared with tendon healing, given the vascular nature of the calcaneus. Athletes who stand to lose more with complications associated with Achilles detachment/reattachment may benefit from wedge osteotomy vs AT debridement and reattachment or augmentation.

The most frequent complication was superficial wound infection (6.3%). Our results were consistent with the results of a systematic review that showed a wound infection rate up to 13%. Paavola et al reviewed 432 patients and found that 4.7% of the insertional group had wound-related complications, including significant local necrosis. We encountered only 1 major complication (1.6%) compared with a 3.1% rate of major complications reported in a systematic review. The posterior calcaneal process was displaced proximally and the hardware failed. We believe that this occurred due to intraoperative violation and breakage of the bone hinge at the apex of the
wedge osteotomy at the plantar surface of the calcaneus. The Achilles tendon then retracted the posterior calcaneal process proximally, causing failure of the staples. We revised the fixation with a 6.5-mm cannulated screw after debridement of the osteotomy site. Extra care should be taken to preserve the plantar bone hinge at the apex of the osteotomy. We did not encounter any AT rupture or avulsion, skin breakdown, stiffness, hematoma, or tenderness around the operative scar—complications associated with operative procedures.13,14

There are several limitations present in the study. There was no control group, but its strength was increased as it was a prospectively organized study. Follow-up was longer than other studies, but long-term follow-up will be necessary to determine whether the results deteriorate with time. Randomized clinical trials are required to compare DCWCO with other operative techniques for the treatment of IAT. The advantage of this series is its homogeneity. The observed population was exclusively athletes, and all were treated under the same operative approach with the same protocol of postoperative care.

**Conclusion**

Chronic IAT can necessitate operative intervention after failure of conservative treatment. Management aims to return the athlete to the required level of physical activity in the shortest possible time without significant residual pain. The midterm results suggest that DCWCO can provide consistent symptomatic relief from insertional Achilles pathology in athletes by altering the biomechanics of the tendon. It demonstrated excellent postoperative scores, including improvement of pain and function. It was a safe, effective, and reproducible technique that offered a relatively quick return to previous level of sports activities.

**Declaration of Conflicting Interests**

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