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Ossicle resection and anatomic reconstruction of lateral ligaments for chronic ankle instability with large accessory malleolar ossicles

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Abstract

Background

Accessory malleolar ossicles are often found in patients with chronic ankle instability. For the large ossicles more than 10mm, there are still uncertainties about the suitable surgical option.This study was aimed at evaluating the clinical efficacy of ossicle resection and anatomic reconstruction of the lateral ligaments for chronic ankle instability with large accessory malleolar ossicles.

Methods

Sixteen chronic ankle instability patients with large accessory malleolar ossicles were treated with ossicle resection and anatomic reconstruction of lateral ligaments between December 2014 and February 2018. The clinical effects were evaluated with Visual Analogue Scale, Karlsson-Peterson ankle scoring system, and subjective satisfaction of patients. The varus talar tilt angle and anterior talar displacement between bony surfaces of the tibia and talus were included as radiographic parameters.

Results

There were 11 males and 5 females in this study group. The average age at the time of surgery was 28.9 years old. The average final follow-up time was 26.9 months (range, 12 to 47). The average size of the ossicles was 11.7mm. The VAS score declined from 3.5 ± 1.6 preoperatively to 1.4 ± 1.0 at the final follow up ($p < 0.01$). The Karlsson-Peterson score was significantly improved from 52.7 ± 15.1 before surgery to 86.4 ± 8.2 at the last follow up ($p < 0.01$). Radiologically, the average varus talar tilt angle was decreased from 15.4 ± 2.0 degrees preoperatively to 6.2 ± 1.6 degrees at the final follow up ($p < 0.01$), and the average anterior talar displacement was decreased from 14.3 ± 2.1 mm preoperatively to 6.3 ± 1.4 mm at final follow up ($p < 0.01$). Fourteen patients (87.5%) were satisfied (‘excellent’ or ’good’) with treatment outcome.

Conclusions

Ossicle resection and anatomic reconstruction of the lateral ligaments provided good clinical outcomes for chronic ankle instability with large accessory malleolar ossicles. This method appears to be one of the reliable and effective procedures for the treatment of chronic ankle instability with large accessory malleolar ossicles.

Introduction

Accessory malleolar ossicles are often found in patients with chronic lateral ankle instability. These ossicles are generally embedded within the lateral ligament fibers. There are several operational options for accessory malleolar ossicles including ossicle fixation, simple ossicle resection, ossicle resection with ligament repair. For the small ossicles less than 10mm in size with chronic ankle instability (CAI), ossicle resection and modified Brostrom procedure are widely adopted. For the large ones, there are still some uncertainties about the suitable surgical option. Ossicle fixation with screws or K-wire tension band after the pseudarthrosis ectomy has been implemented [1, 2], but nonunion and persistent pain occur frequently [3]. Chun et al [4] reported that postoperative outcomes after ossicle resection with ligament repair were equal to the same surgery without an ossicle, even if the size of ossicle is considerable. Mancuso et al [5], Ahn et al [6], and Hasegawa et al [3] also recommended ossicle resection and lateral ligaments repair. However, Kim et al [7] reported poor improvement in anteroposterior stability in the large ossicle group after ossicle resection and modified Brostrom procedure. They found that resection of a large ossicle can result in an unrepairable gap between ligament remnant tissue, leading to poor anteroposterior stability. We also found that in the absence of enough available remnant tissue, ossicle resection and the modified Brostrom procedure is not enough to attain mechanical stability. Therefore, this study aimed to evaluate the clinical efficacy of ossicle resection and anatomic reconstruction of the lateral ligaments for CAI with large accessory malleolar ossicles.

Methods

After our institutional ethics committee approval, we retrospectively analyzed 16 CAI patients with large accessory malleolar ossicles between December 2014 and February 2018. These patients were treated with ossicle resection and anatomic lateral ligaments reconstruction. The ossicle size was measured by the largest diameter in three-dimensional computerized tomography (CT) scans and the greatest dimension was elected (Fig. 1). Large ossicle refers to one's diameter equal to or larger than 10 mm.

Arthroscopic examination was executed with the patient in the supine position. We routinely adopted standard antero-medial and antero-lateral arthroscopy portals to evaluate any accompanying intraarticular lesions, such as bony impingement, osteochondral lesions, synovial hypertrophy and loose body. A curvilinear incision was centered on the top of distal fibula and extended on both sides. Ossicles at the lateral malleolus were identified and excised. The quality of ligament remnant tissue was evaluated. In all cases, at least one of the anterior talofibular ligament (ATFL) and calcaneofibular ligament (CFL) remnants was too short to be sufficient for isolated Brostrom procedure. Anatomic reconstruction of lateral ankle ligaments with tendon graft was performed to achieve mechanical stability. The allograft tendon (Osteorad Ltd, Shanxi, China) or semitendinosus autograft was used for anatomic reconstruction of the lateral ligaments. A cannulated reamer was applied to make tunnels in the talus, lateral malleolus and calcaneus. The trimmed tendon graft was passed through the tunnels and tensioned with the ankle joint in the neutral position. Tendon graft fixation was performed with inference screws (Fig. 2). The operation technique was fully described in our previous article [8, 9].

A U-shaped short leg plaster was applied after surgery with the ankle joint in a neutral position. The plaster was changed to an orthosis (VACO cast, Company OPED, Germany) with partial weightbearing to tolerance at 2 weeks postoperatively. Full weight bearing was allowed at 6 weeks after surgery. The orthosis was taken away at 10 weeks after operation, and the patients transitioned to an ordinary shoe with a soft ankle protector.

The clinical effects were evaluated with Visual Analogue Scale (VAS) for pain, Karlsson-Peterson ankle scoring system for functional evaluation, and subjective satisfaction of patients. The VAS and Karlsson-Peterson ankle score questionnaires were completed preoperation and at final follow-up. The subjective satisfaction level of patients was divided into excellent, good, fair and poor.

Excellent refers to full activity with no swelling, pain, or giving way of the ankle joint. Good refers to occasional pain or swelling but only after strenuous activity without giving way of the ankle. Fair refers to remaining apprehension and residual ankle instability with an improvement compared with that before operation. Poor refers to recurrent giving way and ankle instability, no change or worse during normal activities, often accompanied by pain and swelling. We also measured and recorded the preoperative and postoperative stress radiographs. The varus talar tilt angle and anterior talar displacement between bony surfaces of the tibia and talus were included as radiographic parameters.

Statistical analysis was performed by SPSS software (Version 18.0, SPSS Inc, Chicago). Differences of the VAS, Karlsson-Peterson score, and radiographic parameters preoperation and postoperation were analyzed by Wilcoxon test. The differences were considered statistically significant when the P value was less than 0.05.

Results

There were 11 males and 5 females in this study group. The average age at the time of surgery was 28.9 years old (range, 16 to 65). The average final follow-up time was 26.9 months (range, 12 to 47). The mean size of the ossicles was 11.7mm (range,10–15mm). In all cases, after ossicle resection, the ligament remnants were too short to be sufficient for isolated Brostrom procedure. Anatomic reconstruction of lateral ligaments with tendon graft was performed to achieve mechanical stability. The VAS score declined from 3.5 ± 1.6 preoperatively to 1.4 ± 1.0 at the final follow up ($p < 0.01$). The Karlsson-Peterson score was significantly improved from 52.7 ± 15.1 before surgery to 86.4 ± 8.2 at the last follow up ($p < 0.01$). Radiologically, the average varus talar tilt angle was decreased from 15.4 ± 2.0 degrees preoperatively to 6.2 ± 1.6 degrees at the final follow up ($p < 0.01$), and the average anterior talar displacement was decreased from 14.3 ± 2.1 mm preoperatively to 6.3 ± 1.4 mm at final follow up ($p < 0.01$). Fourteen patients (87.5%) were satisfied (‘excellent’ or ‘good’) with treatment outcome. The satisfaction in one patient was fair, because of soft tissue irritation from the cortex button. After removal of implants, the patient’s symptoms were relieved. The other one patient complained intermittent intra-articular pain, while his ankle joint was stable on physical examination. This was probably because of complicated osteochondral lesion of the talus.

Discussion

Separate ossicles around the distal tip of the fibula actually may be accessory ossicles that result from abnormal center of ossification or they may arise from the nonunion of an avulsion fracture of the lateral ligament complex. It is sometimes difficult to determine the exact etiology of an accessory malleolar ossicle [10]. In cases of symptomatic CAI combined with an accessory ossicle, the ossicle could be actually formed by non-union avulsion fracture fragments at the lateral ligaments. For such patients, the ligaments should be reattached to the fibular tip after the ossicle resection [11, 12]. As opposed to what exists in non-union avulsion fractures, no ligamentous structures or capsular are attached to a true ossicle. There is no ankle instability after excision of a true ossicle [13]. It is noteworthy that a developmental accessory ossicle of the lateral malleolus is rare of the human population. The incidence of development accessory ossicles in the general population ranges from 1% to 5.2%, and they are ordinarily asymptomatic [14]. Ossicles findings in this vicinity in CAI patients are unlikely to be developmental and are most likely to be associated with trauma whether it was acute or chronic [4, 15, 16].

Usually we use the anteroposterior, lateral, and mortise ankle plain radiography to evaluate bony injuries after ankle sprain. But a portion of avulsion fractures was overlooked on initial radiographic check-up and subsequently found intraoperatively. Vahvanen V et al found 11 of 19 acute osteochondral fracture children were not visible on the initial standard ankle views [17]. It is mainly because avulsion fragments, especially of the ATFL, are frequently hardly visible on standard plain radiographs. Haraguchi et al [18] suggested a new radiographic projection method with more clear vision of avulsion fragments compared with standard ankle views. However, it is reported that this method is not always reliable [19]. CT will be helpful for a more accurate assessment of the avulsion fracture. For patients with suspected avulsion fractures, CT should be used to confirm the diagnosis.

Several studies have reported that the incidence of accessory malleolar ossicles in patients with CAI as it ranges from 34% to 66% [7, 11, 20, 21]. Some studies have shown that an accessory lateral malleolus ossicle associated with the ankle's recurrent instability [22, 23]. In patients with this condition, most scholars recommended that ossicle resection should be consolidated with repair or reconstruction of the lateral ligament complex [4, 6, 7]. Hasegawa et al reported that fibrous and ligaments union state was more important for CAI than the ossicle's size [3]. Resection of the ossicle could reduce surrounding inflammation and abnormal impingement. Chun et al reported that the size of ossicle did not affect the postoperative outcome [4].

Ossicle fixation with screws or K-wire tension band after the pseudarthrosis ectomy has been implemented [1, 2], but nonunion and persistent pain occur frequently because the tension on the lateral ligaments attached to the ossicle causes a separation of the fragment from the bone or they are intraarticular and bathed in synovial fluid. [3].

Brostrom and modified techniques have yielded a number of reports with good or excellent effects. But, if the ligament is incompetent or nonexistent, most researchers suggested that a modified Brostrom procedure should not be implemented [24–26]. For CAI patients with ossicle, ossicle removement means gap between ligament remnant and bone attachment point of lateral malleolus. Resection of a small ossicle did not significantly interfere with achievement of Brostrom procedure by means of ligament stretch. But for large ossicles which embedded in ligament, it may be too tight to repair and the suture point is vulnerable even if repair can be done, especially with thin and feeble available ligament remnant for repair.

In patients with this condition, some researchers have suggested that periosteal flap can be used to enhance poor quality ligamentous remnant found during the Brostrom procedure. Kim et al reported that enhancement with the periosteal flap did not supply sufficient strength to get ankle stability if there was lack of enough healthy ligament fibers or ligamentous continuity was not provided after a large ossicle's removal [7].

In clinical practice, we also found that in the absence of enough available remnant tissue, ossicle resection and the modified Brostrom procedure is not enough to attain mechanical stability. Therefore, we proposed that ossicle resection and anatomic reconstruction of the lateral ligaments for CAI with large accessory malleolar ossicles. The research results demonstrate the clinical feasibility and effectiveness of these procedures.

Conclusion

Ossicle resection and anatomic reconstruction of the lateral ligaments provided good clinical outcomes for CAI with large accessory malleolar ossicles. This method appears to be one of the reliable and effective procedures for the treatment of CAI with large accessory malleolar ossicles.

Abbreviations

ATFL, anterior talofibular ligament; CAI, chronic ankle instability; CFL, calcaneofibular ligament; CT, computerized tomography.

Declarations

Ethics approval and consent to participate

This study was approved by the Ruijin Hospital North ethics committee, School of Medicine, Shanghai Jiao Tong University.

Consent for publication

Not applicable.

Availability of data and materials

All related information is freely available to any scientist that wishes to apply them for non-commercial intents, without going against patient confidentiality.

Competing interests

The authors declare no conflicts of interest.

Authors' contributions

YC participated in the interpretation of the results and drafted the manuscript. YX and QH made contributions to patient recruitment and the collection of original information. YH supervised clinical parameter measurement. XX projected the study's proposal and checked the manuscript critically. All authors read and agreed the final manuscript.

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Figures

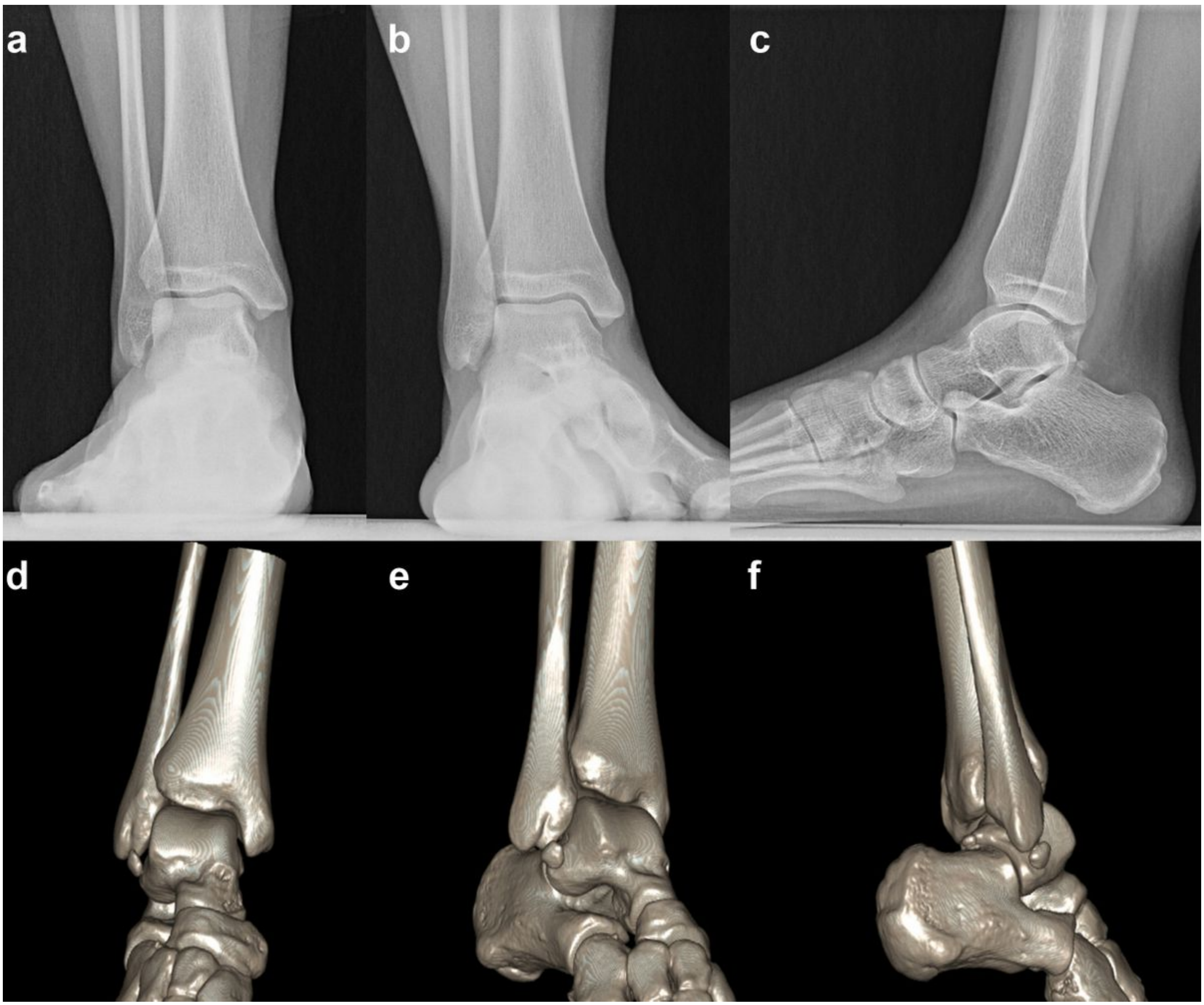

Figure 1

a-c: Ossicle was often barely visible on the ankle anteroposterior, mortise, and lateral plain radiography. d-e: CT is useful for a more accurate assessment of the avulsion fracture.

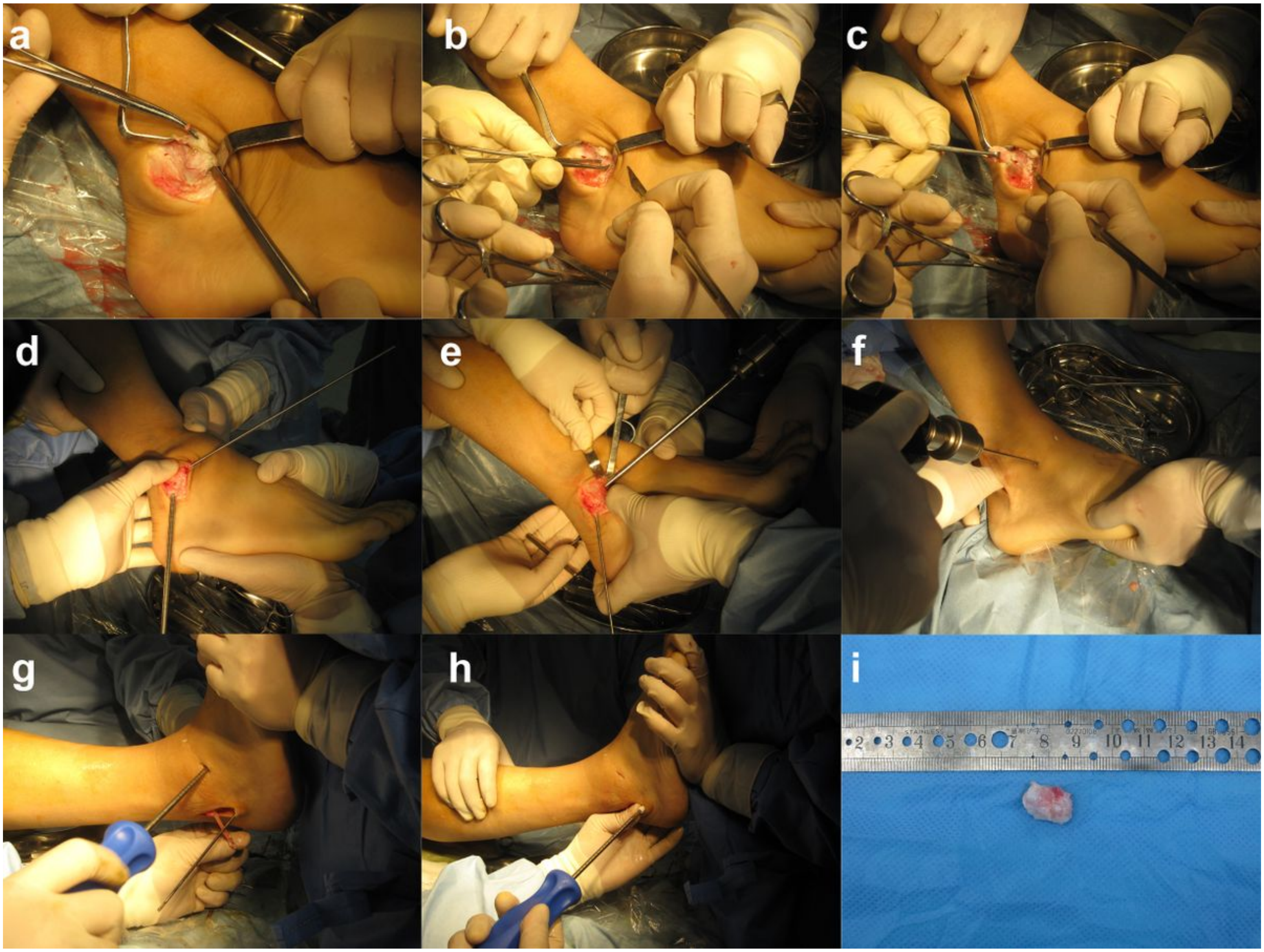

Figure 2

Ossicle resection and anatomic reconstruction of the lateral ligaments of the ankle. a-c: Ossicle at the tip of the lateral malleolus was identified and excised. The ligament remnants were too short to be sufficient for isolated Brostrom repair. d-f: Creating the talar, calcaneal and fibular tunnels. g, h. Fixation the graft terminates to the calcaneal and talar tunnels. i. Resected accessory malleolar ossicle.