The Medial Malleolar Approach for Arthrodesis of the Ankle: A Report of 13 Cases

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A series of thirteen patients that had primary fusion of the ankle joint through an isolated medial approach is presented. The technique involves transection of the medial malleolus for access to the articular surfaces, rather than the traditional transfibular approach. The medial malleolus was replaced in all cases, preserving the deltoid ligament. Union was achieved in 12 of 13 patients. The technique is described in detail and the advantages of this approach are discussed with respect to preservation of the blood supply to the talus and tibia. (The Journal of Foot & Ankle Surgery 44(2):125-132, 2005)

Key words: ankle, arthrodesis, fusion, medial approach, tibiotalar

Various surgical approaches have been described for fusion of the tibiotalar joint. Although the arthroscopic technique is rather contemporary, its utility is limited to a reasonably well-aligned ankle joint. It is not possible to correct large planar deviations with the arthroscopic surgical approach (1). To achieve optimal realignment in some patients, a more extensive open surgical approach is required. The modern approach to open ankle arthrodesis has been credited to Sir John Charnley, who used a transverse anterior incision at the level of the ankle joint (2). The incision was carried directly to bone and afforded excellent visualization of the respective articular tissues. The principles of joint arthrodesis were executed but a high nonunion rate of 21% was observed. Although that technique is now considered primitive, surgeons have evolved to the lateral transfibular approach for ankle arthrodesis, which was popularized by Adams in 1948 (3). This technique involves resection of the distal portion of the fibula to gain access to the tibiotalar joint (3–14). After preparation of the joint surfaces and delivery of fixation, the fibula can be discarded or used as an onlay graft. This exposure is rather extensile and can compromise several major structures including the superficial peroneal or sural nerves, and the perforating peroneal artery (15). In addition the union rate has been reported to be as low as 64% (6, 16). In a study of 60 patients comparing the different approaches to ankle fusions, Morrey and Wiedeman (13) concluded that the lateral approach had the highest rate complications at 92%. This approach also yielded the most infections and nonunions in their study.

Of the previous studies that reported union rate, most implicated the type of fixation as the primary culprit for a high failure rate (7, 11, 17–21). An additional group of surgeons also implicated less than optimal fixation for failure of fusion, and as a consequence tailored the surgical approach to accommodate the internal or external fixation (22–27). Dohm et al compared several ankle fusion techniques using a variety of fixation devices (transfibular, Charnley, T-plate, crossed screws, interposition and miscellaneous) and showed that the transfibular approach had the lowest success rate (29%) and the longest time to obtain a fusion (20 weeks) (28). Only one of these investigations suggested the role of these rather extensile surgical exposures, as a primary cause of nonunion (13).

The visualization afforded by the transfibular approach is good when the foot is well aligned in the frontal plane. However, with the valgus ankle, the exposure to the joint surfaces is compromised as the talus is pushed laterally or embedded into the lateral distal tibial bone. Medialization of the talus and entire foot, to attain coaxial alignment of the foot and leg, requires even more surface preparation and increased surgical exposure. In some instances, removal of the medial malleolus must be performed to properly align the foot under the leg. In addition, correction of any transverse plane or rotational mal-

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FIGURE 1 Intraoperative photograph of the medial approach. This is a right foot with the toes positioned to the left side of the photograph. Note the complete visualization of the medial malleolus and protection of the posterior neurovascular bundle.

alignments requires either careful sculpting of the medial gutter and talus through a separate incision, or removal of the medial malleolus altogether (29).

Because of the inherent problems of visualization, extensile exposures, medialization and potential disruption of lateral neurovascular structures, we began doing realignment ankle fusions through a primary medial approach. In particular, because many of these patients presented with valgus deformities, it seemed axiomatic that the medial approach would afford a subcutaneous location of the distal tibia and avoid the large lateral exposure. The purpose of this article is to report our early experience with a primary medial incisional approach for ankle arthrodesis.

Methods

The inclusion criteria for this study were all patients having a tibiotalar arthrodesis through a medial malleolar approach. Patients were from the practices of the authors during the period of January 2002 through April 2004. Minimum follow-up was 9 months.

In a few instances, a small accessory incision was made over the distal fibular malleolus to remove the distal tip of the fibula or to remove a small cylinder for shortening. However, in no case was the fibula taken down for exposure. Thirteen patients met the inclusion criteria. Nine patients were personally operated by 1 author (J.M.S.), and the other 4 patients were operated by the other authors (S.M.R., 2 patients; N.B., 1 patient; B.R., 1 patient).

The type of fixation, the use of accessory fibular incisions, use of osteogenic supplements and past medical histories were recorded from the medical record. A successful fusion was defined as unequivocal bony bridging across the arthrodesis site as determined by the operating surgeon. Clinically, patients were determined to be fused by absence of pain at the fusion mass and a lack of clinical motion with ankle stress and weightbearing.

Operative Technique

A 10-cm medial incision was created over the midline of medial distal tibia and malleolus. The saphenous neurovascular bundle was mobilized and retracted anteriorly. Subperiosteal dissection was performed to expose the medial distal tibia, medial gutter and anterior articular surface. The posterior tibial tendon, flexor digitorum longus, neurovascular bundle, and flexor hallucis longus were retracted posteriorly using a large blade-type retractor inside the periosteal envelope (Fig 1). The retractor was placed completely across the posterior aspect of the distal tibia to protect the vital structures during articular resection.

Using an osteotome or oscillating saw, a transverse medial malleolar osteotomy was created at the level of the distal tibial articular surface. The medial malleolus was reflected distally on the deltoid hinge, exposing the ankle joint. A power saw was used to resect the tibial plafond perpendicular to long axis of the tibia (Fig 2). The foot was then placed in the desired position of fusion. All planar deviations or deformities were reduced by careful manual positioning of the talus. In some cases temporary Steinmann pin fixation was utilized to maintain the plantigrade position. The talar articular surface was resected parallel to the cut made on the tibial plafond. The resection of the respective articular surfaces was performed down to viable bleeding bone.

Fibular osteotomies were necessary in several cases to permit correction of varus or valgus ankle deformity. This was easily accomplished through the medial incision with an osteotome. Occasionally, a small section of the fibular malleolus was resected either through the medial incision or an accessory incision made directly over the lateral malleolus (Fig 3). If harvested, this section of fibula was morselized and used as autograft.

Attempts were made to obtain a neutral plantigrade foot

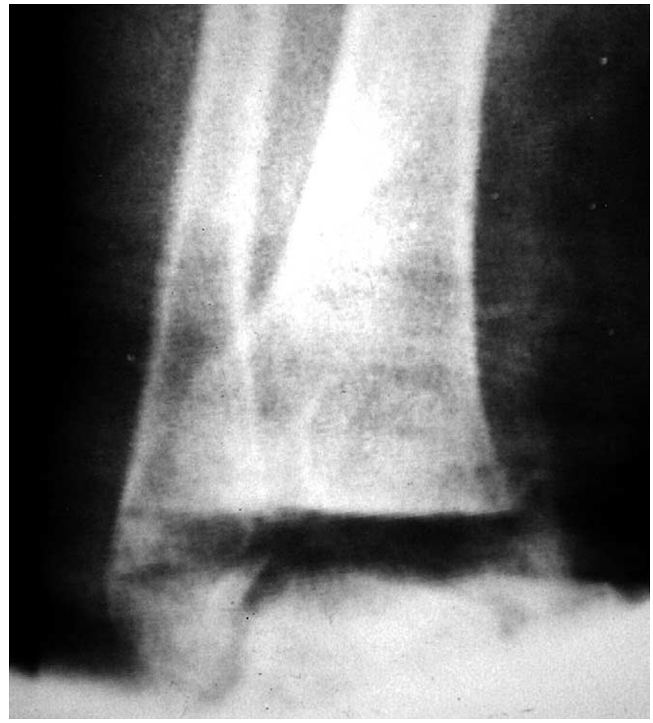

FIGURE 3 Intraoperative fluoroscopic view showing the technique for fibular shortening, if necessary for apposition and medialization of the talus. The cut is carried across the fibula in a line parallel to both the tibial and talar resection.

in 0° to 5° of valgus and slight external rotation. The talus was typically translated medial and posterior relative to the tibia in an attempt to attain coaxial alignment. The lateral process of the talus was positioned in line with the long axis of the tibia on the lateral perspective. When screw fixation was used, two or three 7.3 cannulated or 6.5 fully threaded screws were used. The placement of temporary guide wires or Steinmann pins was performed under fluoroscopic control. The first screw was placed from posterior proximal medial to the central head and neck of the talus (Fig 4). The second screw was placed through a stab incision from the anterior lateral tibial metaphysis and directed toward the posterior medial body of the talus. In some situations, a third screw was placed from the lateral tibia to the central talar body to create a tripod construct. When external fixation was used, the pins or wires were placed in the talus and tibia in standard fashion. After delivery of the fixation, the medial malleolus was shortened by resecting a 3- to 4-mm thick cylindrical portion of bone. The lateral aspect of the medial malleolus and medial aspect of the talus were deco-

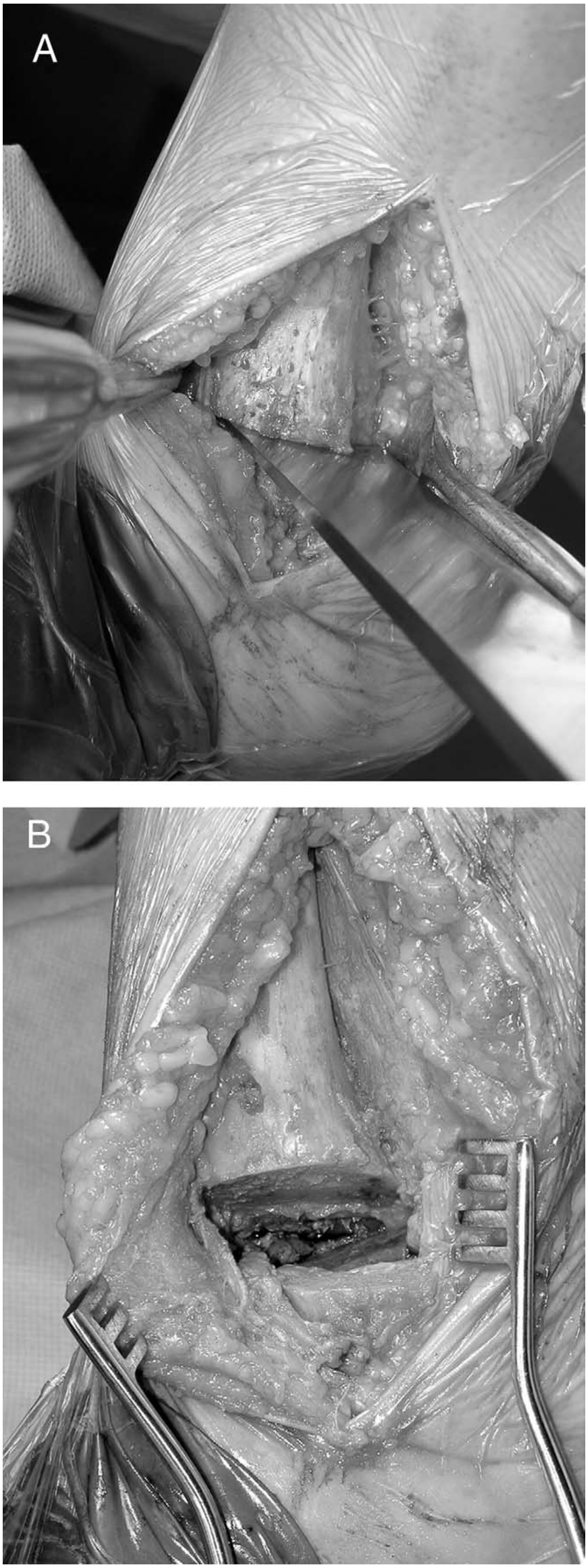

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FIGURE 2 (*A*) Photograph of medial side of the ankle after the osteotomy was performed. (*B*) The medial malleolus is flipped inferiorly using the deltoid as the hinge. The medial surface of the talus is visible.

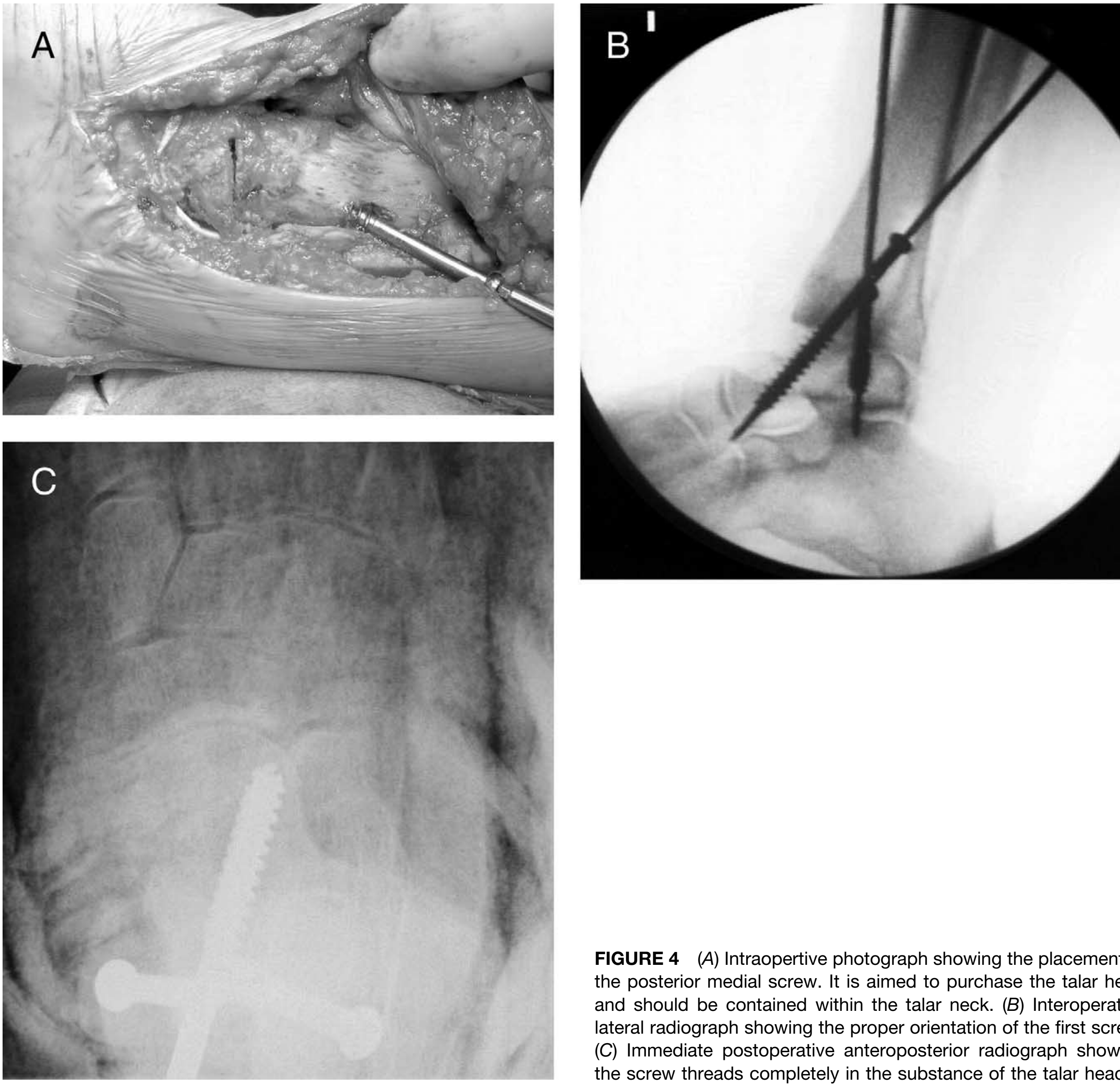

FIGURE 4 (*A*) Intraopertive photograph showing the placement of the posterior medial screw. It is aimed to purchase the talar head and should be contained within the talar neck. (*B*) Interoperative lateral radiograph showing the proper orientation of the first screw. (*C*) Immediate postoperative anteroposterior radiograph showing the screw threads completely in the substance of the talar head.

rticated. The medial malleolus was repositioned to the distal tibia and fixated with 1 or 2 fully threaded 4.5-mm cortical screws (Fig 5).

Those patients with screw fixation were placed in a plaster posterior splint with a sugar tong. The limb was then immobilized in a nonweightbearing short-leg cast for 8 to 10 weeks or until radiographic fusion was seen. Patients were then progressed to a weightbearing cast and then to a removable boot over the course of several weeks. External fixator removal occurred after bony consolidation.

Results

The summary of the thirteen patients is contained in Table 1. The median age of the patients was 49, with 6 women and 7 men. Ten of the 13 patients had insignificant past medical histories. The remaining 3 patients had disease processes such as juvenile rheumatoid arthritis (1 patient), steroid dependent asthma (1 patient), and coronary artery disease and diabetes (1 patient). Four high-risk patients with a greater chance of nonunion were identified. Two of the patients had a documented history

FIGURE 5 Two-year follow-up radiograph showing the optimal position of the screws. Note that the medial malleolus has completely healed as part of the fusion mass.

of prior alcoholism and current tobacco usage. One other patient stopped smoking 2 weeks prior to the surgery and did not smoke throughout the convalescent period. The other patient had avascular necrosis of the talus secondary to trauma. The primary indication for tibiotalar joint fusion in these patients was posttraumatic osteoarthritis. Most patients received cortisone injections and 1 patient received a series of sodium hyaluronate injections prior to surgical intervention. The latency period from cortisone injections to surgery was greater than 6 months in all patients.

Three patients received fibular osteotomies through a small accessory lateral incision and an additional patient had a small cylinder of bone removed from the fibula from the medial exposure. Twelve of the 13 patients went on to complete radiographic and clinical fusion. One patient developed a stable fibrous union but was currently satisfied with the surgical outcome because his preoperative malposition had been corrected (Fig 6). No risk factors were identified in this patient. One female patient on birth control pills developed a pulmonary embolus postoperatively despite prophylactic anticoagulation. One patient complained of varus posture with ambulation. A previously unrecognized subtalar varus deformity became unmasked after postoperative ambulation. There were no infections or soft tissue compromise. All surgical wounds healed primarily. No neuriitis, tendonitis, or persistent pain issues were identified.

Discussion

Utilizing the medial approach, the patients in this series demonstrated a 92% fusion rate. This compares favorably with the published reports on the open approach for ankle arthrodesis (3, 5–8, 10, 11, 13, 14, 16–18, 20, 24, 28–32) Although our sample size is too small to draw any meaningful conclusions regarding the union rate of primary open ankle arthrodesis with this surgical approach, there are some other observed advantages of the medial approach. The visualization of the tibiotalar articulation afforded by this technique is excellent. In particular, when the medial malleolus is transected and reflected inferiorly on a deltoid ligament hinge, the articular surfaces of the tibia and talus are actually closer to the skin incision than that attained from the lateral transfibular approach. The surgical exposure is more subcutaneous and provides better access for articular surface preparation.

To prepare the articular surfaces down to bleeding cancellous bone, it is most expedient to use a power saw. This is often difficult from the transfibular approach because the excursion of the saw can injure the vital structures and other soft tissues. However, when executed from the medial side of the ankle, the posterior neurovascular bundle and posterior tendons can be protected rather easily by the placement of the bladed retractor on the posterior surface of the tibia, from the medial corridor. In addition, the profile and contour of the anterior ankle joint is more easily visualized from the medial side.

We believe that the single medial incisional approach allows for less soft tissue compromise. Although it is difficult to stratify the importance of the perforating peroneal artery in achieving fusion of the ankle, this vessel is at greater peril during the takedown of the fibula or the resection of the articular surfaces from the lateral side (33, 34). We believe that nonunion may be potentiated by damage to the blood supply on the lateral side of the ankle and in particular, the perimalleolar vascular ring when the ankle is accessed from the transfibular corridor (35, 36).

Secondly, the complete preservation of the deltoid ligament with the medial approach may also enhance bony union. Often with the transfibular approach, an accessory incision is made over the medial gutter to sculpt the medial corner and fashion a mortise configuration, or to allow for

TABLE 1 Summary of clinical data

Patient #	# of Screws	Placement	Time to WB (weeks)	Bone Enhancers	Complications	Union	Notes
1	2	7.3 cannulated screw from medial tibia into neck of lateral body/neck of talus and from anterior lateral tibial to medial talar body/neck	7			Yes	Smoker; ETOH
2	3	3 crossed screws	6		Slight equinus by heel lift, Subtalar varus	Yes	Fibula cut med to lateral for translation
3	4	6.5 mm screw from proximal medial to distal lateral, 7.3 part thread from lateral fibula into tibia and talus, two 4.5 fully threaded screws for medial malleolus	7			Yes	Fibula transected and removed from small lateral incision
4	3	7.3 cannulated screw from medial posterior tibia to body and neck of talus, 7.3 cannulated screw from anterolateral of distal tibia to posteromedial talus, 4.5 fully threaded screw from lateral mall into talar body	8	ICBG, platelet gel		Yes	Talar AVN
5	3	7.3 cannulated screws from post medial tibia to head neck of talus, 7.3 cannulated screw from distal lateral tibia to medial posterior body of talus, 4.5 fully threaded screw across medial malleolus	11		Pulmonary embolism	Yes	Birth control pills
6	2	6.5 full thread across AJ	5			Yes	JRA; Fibula cut with lateral incision
7	4	7.3 cannulated screw from medial tibial to lateral process of talus, 7.3 cannulated screw from posteromedial tibial to lateral talus, 7.3 screw from fibula to head/neck of talus	9		Non painful fibrous non-union in residual valgus	No	Calcaneal osteotomy
8	5	2–6.5 full threaded cancellous screws from posterior heel through subtalar and ankle, 2–6.5 screws from medial to lateral from tibia into talus, 4.0 cancellous screw across medial malleolus	6			Yes	AJ and STJ fusion; Steroid dependent asthma
9		K-wires; external fix	4	Platelet gel	Delayed union at 5 months. Solid union at 6 months	Yes	Smoker; ETOH; coronary artery disease; DM
10	3	3 crossed screws posteromedial, medial, and lateral 6.5 mm	6		None	Yes	Midfoot arthrosis; Fib cut through small lateral incision
11	3	1 posterior medial; 1 anterolateral; 1 medial	6			Yes	
12	3	1 anterolateral; 1 posterior medial; 1 medial	8		Walked before allowed	Yes	
13	3	6.5 mm screws 1 medial, 1 anterolateral, 1 posterior medial	8	Platelet gel		Yes	History of smoking; quit before surgery

Abbreviations: AJ, ankle joint; AVN, avascular necrosis; DM, diabetes mellitus; ETOH, alcohol abuse; Fib, fibula; ICBG, iliac crest bone graft; JRA, juvenile rheumatoid arthritis; STJ, subtalar joint; WB, weightbearing.

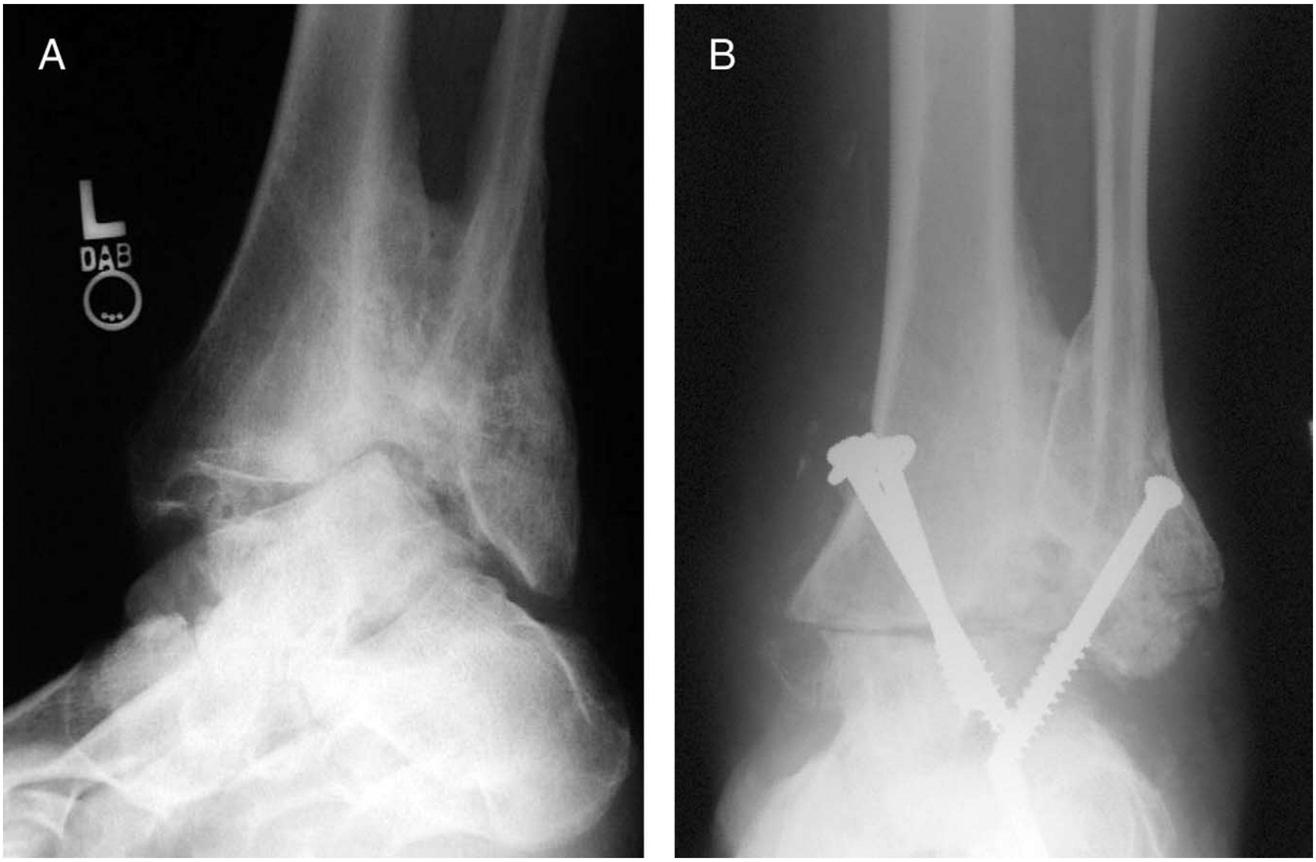

FIGURE 6 (*A*) Preoperative mortise radiograph of the patient with the single nonunion in our series. (*B*) Fifteen-month postoperative radiograph with good correction of position, but a persistent nonunion.

medial translation of the talus. Either of these maneuvers may necessitate severance of the deltoid and thus compromise of at least part of the blood supply to the talus from the rest of the vasculature.

The attainment of hindfoot alignment or coaxial position of the talus and tibia in any ankle fusion is critical for consistent surgical results. Often the talus has migrated into valgus from an asymmetric collapse of the cancellous substance of the tibia plafond. In order to restore good bony contact, the talus is usually mobilized medially. In addition, this maneuver is technically easier from the medial side.

The medial approach also offers some advantages in fixation constructs. Given the exposure of the posterior medial aspect of the distal tibia, a large caliber screw can be directed in a coaxial arrangement with the talar head and neck. In the transfibular approach, the posterior screw is placed blindly from the posterior lateral portion of the tibia. The cortical bone density is often compromised in this area and accurate placement is difficult. In addition, the screw is oriented more obliquely to the axis of compression and that may compromise stability. Should revision surgery be necessary, access and retrieval of the posteromedial screw is relatively easy as compared to removing a screw placed posterolaterally. Although we have yet to perform takedown of a fusion for insertion of an ankle implant, preservation of the distal fibula does not preclude this possibility.

We did not specifically question the patients with regard to cosmesis. However the maintenance of the anatomic contours of the respective malleoli allow for a more normal appearing ankle joint. Impingement of the fibular malleolus on the lateral structures of the foot can occur when the fibula has been replaced (14). Yet, none of the patients in this series reported any such problem. This may have been due to medialization of the foot away from the point of potential fibular impingement, shortening of the fibula in a few instances, or the minimal shortening that occurred in our series. Although we did not measure limb length, in those patients with valgus collapse of the ankle, it can be expected that the overall limb length would remain the same or even lengthen by transposition of the foot over the medial column of intact tibial metaphyseal bone. Simple mobilization from the depressed lateral tibial plafond bone would minimize or negate any shortening caused by joint preparation.

Although we did not include them in our analysis, 4 additional patients with nonunions after an arthroscopic ankle fusion attempt had revision fusions through the medial approach. All four patients had favorable postoperative outcomes with respect to fusion. Exposure was excellent and allowed for immediate identification of the non-union interface.

Summary

Although the sample size is small thus far, we believe that the medial approach for ankle fusion allows excellent visualization with certain advantages over more traditional approaches. A union rate comparable to the most successful published studies was observed.

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