

# Transfibular ankle arthrodesis: A novel method for ankle fusion – A short term retrospective study

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## ABSTRACT

**Background:** Ankle arthrodesis has long been the traditional operative treatment for posttraumatic arthritis, rheumatoid arthritis, infection, neuromuscular conditions, and salvage of failed ankle arthroplasty. It remains the treatment of choice for patients in whom heavy and prolonged activity is anticipated. We present our short term followup study of functional outcome of patients who underwent transfibular ankle arthrodesis for arthritis of ankle due to various indications.

**Materials and Methods:** 29 transfibular ankle arthrodesis in 29 patients performed between April 2009 and April 2014 were included in this study. The mean age was 50 years (range 22-75 years). The outcome analysis with a minimum of 1-year postoperative followup were included. All the patients were assessed with the American Orthopaedic Foot and Ankle Society (AOFAS) Hindfoot scale.

**Results:** All cases of ankle fusions (100%) progressed to solid union in a mean postoperative duration of 3.8 months (range 3–6 months). All patients had sound arthrodesis. The mean followup period was 32.52 months (standard deviation ± 10.34). The mean AOFAS score was 74 (pain score = 32, functional score = 42). We found that twenty patients (68.96%) out of 29, had excellent results, 7 (24.13%) had good, and 2 (6.89%) showed fair results.

**Conclusion:** Transfibular ankle arthrodesis is a simple and effective procedure for ankle arthritis. It achieves a high rate of union and good functional outcome on midterm followup.

**Key words:** Ankle arthritis, ankle fusion, neglected ankle fractures, tibiotalar compression screw, transfibular ankle arthrodesis

**MeSH terms:** Arthrodesis, ankle joint, arthritis, ankle injuries, rheumatoid arthritis

## INTRODUCTION

Ankle arthrodesis has long been the traditional operative treatment for posttraumatic ankle arthritis, rheumatoid arthritis (RA), infection, neuromuscular conditions, and salvage of failed total ankle arthroplasty.<sup>1-3</sup> Ankle fusion remains the treatment of choice for patients in whom heavy, and prolonged activity is anticipated and ankle replacement can be only recommended for those with more modest requirements.<sup>4</sup>

Ankle fusion provides a painless, plantigrade, and stable foot. Several different methods have been described to achieve the ankle fusion; including external fixators and/or internal fixation, use of fibular strut graft, interposition bone grafting, and intramedullary nailing.<sup>5-10</sup> However, it is a salvage procedure that causes persistent alterations in gait and a potential for deterioration exists due to the risk of developing ipsilateral hindfoot arthritis.<sup>11,12</sup> In our study, the raw surface of the medial side of fibula was compressed using the 4.5 mm cortical screws with lag effect, as a strut graft. We present short term functional outcome of patients who underwent transfibular ankle arthrodesis for ankle arthritis.

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## MATERIALS AND METHODS

29 transfibular ankle arthrodesis in 29 patients performed between April 2009 and April 2014 were included in this study. Of the 29 patients, 16 were male (55%) and 13 were female (44%) (male to female ratio = 1.2:1). The mean age at surgery was 50 years (range 22 - 75 years). The mean followup period was 32.52 months (standard deviation  $\pm$  10.34). Among the 29 patients who underwent transfibular arthrodesis, 22 (76%) patients had post traumatic arthritis (PTA), 5 (17%) patients had tubercular arthritis (TA), and 2 (7%) had rheumatoid arthritis (RA). In our study, 18 procedures were done on right ankles (62.07%) and 11 were on left ankles (37.93%). None of our patients had bilateral transfibular ankle arthrodesis.

Inclusion criteria were a diagnosis of arthritis of the ankle of Grade 3 and above (posttraumatic arthritis [PTA], secondary to tuberculosis, and secondary to RA) with a minimum of 1-year postoperative followup. Patients with septic arthritis, failed ankle arthroplasty, and Charcot's arthritis were excluded from this study.

Data obtained from the case sheets included age, gender, indication for surgery, the side affected, operating surgeon, perioperative antibiotic use, duration of surgery, number of screws used for fixation, source of bone graft, length of stay in hospital, surgical complications, duration of postoperative outpatient followup, comments on postoperative radiographs in the clinic in conjunction with the radiologist reports, and patient satisfaction.

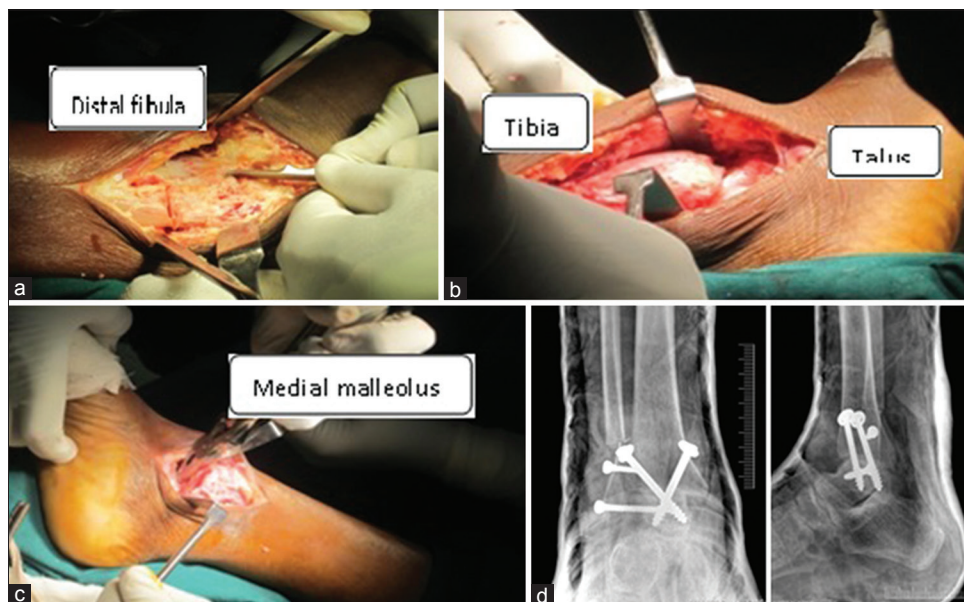
## Operative procedure

Under regional anesthesia and tourniquet control with bump under the ipsilateral hip, the ankle was prepared and draped. Access to the ankle was gained through a lateral approach centered on the fibula. The fibula was osteotomized approximately 2 cm above the syndesmosis level and reflected down and released of all attachment [Figure 1a]. The osteotomized fibula was then prepared by removing soft tissue and articular cartilage. A good exposure of the ankle joint for adequate preparation of the tibial and talar articular surfaces was available. The articular cartilage of the tibial plafond and the talar dome were removed parallel to one another using an osteotome to provide good contact surface [Figure 1b].

In cases where the exposure was not adequate, an additional exposure by osteotomizing the medial malleolus was used and this was done in eight cases [Figure 1c]. The excised bone was used as an inlay graft. Two 6.5 mm  $\times$  16 mm cancellous screws were used to compress the two arthrodesis surface with the ankle in neutral. Two 4.5 mm cortical screws were used to place the onlay distal fibula graft in compression: one as distal tibiofibular and the other as talofibular [Figure 1d]. The distal fibular cortex was over drilled with 4.5 mm drill to achieve good compression.

## Postoperative protocol

Following wound closure, compression dressing and above knee slab were applied. The limb was elevated. Wound inspection was done on second and 4<sup>th</sup> postoperative days. At 12<sup>th</sup> postoperative day, the wound was inspected and



**Figure 1:** (a) Peroperative photograph showing osteotomy of the fibula 2 cms above the ankle joint. (b) Peroperative photograph showing complete removal of the distal fibula after the osteotomy gives good exposure of the joint. (c) Peroperative photograph showing excision of the medial malleolus through a medial incision gives additional exposure when needed. (d) Immediate postoperative radiograph anteroposterior and lateral views showing multiple screws used in arthrodesis

suture removal was done. Slab was converted into below knee walking cast. The initial 6 weeks, patient was mobilized with nonweight bearing. At the end of 6 weeks, we allowed weight bearing in the walking cast and plaster boot. After 3 months, once union was ascertained by radiographs, the walking cast was removed, and patients were free to mobilize to improve the subtalar and midfoot movements with crepe bandage in the day time.

The initial postoperative anteroposterior and lateral radiograph was taken for each patient on the immediate postoperative day, and subsequent radiographs were taken at each followup visit in the outpatient clinic and were assessed by a radiologist and the surgeon. Followup radiographs were examined for bony union and implant position and incorporation of bone graft. Bony union was confirmed by the presence of trabecular lines between the tibia and talus at the point of contact, and disappearance of the radiolucent line that was present in the initial postoperative radiograph. The fibular graft incorporation usually occurred 1 to 2 years after surgery.

All the patients were assessed with the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot scale.<sup>13</sup> This was done at final followup on outpatient basis. The main emphasis of this system was on pain, the functional activities and hind foot deformity. A normal person would score 100 points. Because of lack of ankle motion, the maximum score that the patient with an ankle fusion could have was 92 since they could not earn the 8 points given for the full range of motion. A score of 80–92 was considered as excellent result, 70–79 a good result, 60–69 a fair result, and score less than 60 was considered as a poor result.<sup>11</sup>

## RESULTS

All cases of ankle fusions (100%) progressed to bony union in a mean postoperative duration of 3.8 months (range 3–6 months). All patients had sound ankylosis. All

the patients were assessed clinically and radiologically after a mean followup of 32 months (range 14–52 months).

Four patients had superficial infection. Two patients responded satisfactorily to oral antibiotics, and two patients were treated by intravenous antibiotics (2 PTA, 1 TA, and 1 RA). Two patients had skin maceration and break down that was treated by debridement and secondary suturing (1 TA and 1 RA). None of our patients had deep infection. The incidence of postoperative complications was limited in PTA ( $n = 2/22$ ) when compared to TA ( $n = 2/5$ ) ( $P < 0.01$ ) and RA ( $n = 2/2$ ) ( $P < 0.001$ ).

In our study, the mean AOFAS score was 74 (pain score = 32, functional score = 42). We found that twenty patients (68.96%) of the 29 had excellent results, 7 (24.13%) had good, and 2 (6.89%) showed fair results. All patients returned to their preoperative activities. Of the 22 cases of PTA patients, 18 patients (81.81%) had excellent results and 4 patients (18.18%) had good results [Figures 2 and 3]. The second indication was TA. In five cases of tuberculosis arthritis patients, two patients had excellent results, two patients had good results, and one patient had fair results [Figure 4]. RA was the third indication. Of the two cases of RA patients, one patient had a good result and one patient had fair result. Thus, there were better results among patients whose indication for surgery was PTA ( $n = 22$ ) when compared to TA ( $n = 5$ ) ( $P < 0.05$ ) and to RA ( $n = 2$ ) ( $P < 0.001$ ) [Table 1].

## DISCUSSION

Ankle arthrodesis was first described by Albert.<sup>10</sup> Since then, many surgical approaches have been described in the

**Table 1 : Functional outcome of cases as per the AOFAS scores**

Diagnosis/Outcome	Excellent	Good	Fair	Total
Post-traumatic arthritis	18	4		22
Tuberclular arthritis	2	2	1	5
Rheumatoid arthritis		1	1	2
Total	20	7	2	29



**Figure 2:** X-ray of right ankle joint anteroposterior and lateral views of a 45 years old female showing (a) post traumatic malunited bimalleolar fracture (b) immediate postoperative x-rays with trans fibular ankle arthrodesis (c) Six months followup x-rays



**Figure 3:** X-ray of right ankle joint anteroposterior and lateral views in a 28 years old male showing (a) failed open reduction internal fixation and malunited bimalleolar fracture. (b) Immediate postoperative X-ray with transfibular ankle arthrodesis. (c) Six months followup X-rays showing arthrodesis



**Figure 4:** X-ray ankle joint anteroposterior and lateral views in a 61 years old male showing (a) tubercular arthritis. (b) Immediate postoperative X-rays with transfibular ankle arthrodesis. (c) Six months followup X-ray showing arthrodesis

literature for ankle fusion including the anterior, posterior, and transmalleolar approaches. The transfibular approach to ankle fusion was first described by Horwitz.<sup>14</sup> Adams described transfibular ankle arthrodesis by lateral approach where the distal fibular fragment was removed and prepared for use as an onlay graft.<sup>15</sup> The graft was secured by three screws: Two of which grip the tibia and one the talus. In this approach, clear exposure of the articular surfaces was readily obtained. The fibular graft gives sound stability and provides scaffolding for formation of a stout bone bridge across the joint. Close contact between the tibia and talus was essential, and the packing of cancellous bone chips around the bones was an advantage. Fusion was achieved in 28 out of 30 cases. It is also generally understood that the chances of union are higher when the fixation is rigid. However, in our study, 4.5 cortical screws were used to avoid graft breakage which is common when using 6.5 mm cancellous screws.<sup>16,17</sup>

The factors that are important in achieving maximal healing and ankle fusion include rigid internal fixation, compression of the fusion surfaces, and a good biological environment.<sup>14,18,19</sup> Various strategies have been used to reduce the incidence of nonunion including multiple compression screws and larger diameter screws to improve mechanical stability and compression. Use of multiple

cannulated cancellous screws (about 2–4) provides maximum contact and compression across the viable cancellous bone surfaces. Wang *et al.* used transfibular compression arthrodesis of ankle by lateral approach with resection of distal fibula.<sup>20</sup> They attained compression using a T plate placed across the tibiotalar joint with the aid of an AO compression apparatus. They achieved fusion in 10 out of 11 cases. Flückiger and Weber used multiple lag screws (2 or 3) by trans fibular approach for tibiotalar arthrodesis compression and used the dissected distal fibula as onlay graft to tibia and talus with cortical screws.<sup>21</sup> They achieved solid fusion in all cases with an average AOFAS score being 78.5. Akra *et al.* used transfibular technique with sagittal splitting of fibula with internal compression with multiple cancellous screws and achieved 100% solid union arthrodesis and subjective outcome with very satisfied results in 54% and satisfied results in 46%.<sup>22</sup>

In our study, we used trans fibular approach with osteomized distal fibula being used as an onlay graft over tibia and talus with two cortical screws. Two criss-cross 6.5 mm 16 fillet cancellous screws used for tibiotalar arthrodesis for internal compression. We achieved solid union in all cases. Our results (100% union) were comparable and in some parameters better than results from other series.<sup>11,14,17,21,22</sup>

There were no healing-related problems in our series. This may be attributable to the use of fibula as strut graft and the clearing of cartilage from the distal articular surface of fibula and syndesmosis tissues on the medial side of fibula with decortication. Lee *et al.* in their technique of transfibular arthrodesis using metal burr and curettage and two transarticular screws. They reported union rates similar to our study of 95% ( $P < 0.05$ ). They concluded that use of a metal burr and curettage reduced the surgery time and did not significantly alter the bone surfaces.<sup>23</sup>

The limitation of study is short term followup (mean 32 months). Another limitation of this study is that it was a retrospective analysis. There was no randomization. Finally, the sample size was relatively small but still larger than some previous studies. A long term assessment and larger series of ankle arthrodesis is thus warranted to gain statistically significant results. We excluded Charcot's neuroarthropathy of the ankle as it independently can influence the overall outcome of the procedure and it is best treated by retrograde intramedullary nailing.<sup>24</sup> In more complex trauma around the ankle joint, a humeral locking plate fixation technique described by Zhang *et al.* may be indicated.<sup>25</sup> We do not have experience with this procedure, and it was not indicated in any of our patients as the fibula was used as a lateral stabilizing biological plate.

In our series, of the two patients with RA, one patient had a fair result and the other had a poor result. Patients with RA and involvement of ankle may not meet the criteria for an ankle arthrodesis; this may be because they have involvement not only of the ankle but also of the small joints of the foot so that these joints cannot compensate for the fused ankle.<sup>11,12</sup> However, these patients have a low functional demand. Therefore, these patients with RA may be better candidates for the total ankle arthroplasty.<sup>26</sup> To be considered as a preferable alternative to arthrodesis, a total ankle replacement (TAR) should give better results than those presented here, without other disadvantages. Spirt *et al.* in their study of total ankle had a 5-year survival rate with reoperation as the end point of 54% only. The 5-year survival rate with failure as the end point was 80% for all patients and 89% for patients who were more than 54 years of age.<sup>26,27</sup> Younger age was found to have a negative effect on the rates of reoperation and failure the functional outcome of this procedure is uncertain.

Tibiotalar arthrodesis following failed TAR is an extremely difficult procedure.<sup>4</sup> We did not encounter such patients in our series. Hopgood *et al.* described the problems encountered when trying to restore function using tibiotalar arthrodesis following failed TAR.<sup>3</sup> They found that it could not be achieved in every case despite minimal amount of bone resected at the time of ankle replacement. They

found that severe bone loss develops on the talar side as the component loosens, and this may extend to the subtalar joint. They suggest that if there is sufficient talar bone stock, a tibiotalar arthrodesis be done.<sup>3,28</sup> This is often the case in patients with OA, but rarely for those with RA. If there is a significant loss of bone from the talus or a markedly arthritic subtalar joint, they recommend a tibiotalocalcaneal arthrodesis with an intramedullary nail.<sup>4</sup> An intramedullary nail gives firm fixation both distally and proximally and is the method of choice when tibiotalocalcaneal arthrodesis is indicated. They also found that most serious outcomes occurred, where the lateral malleolus was totally excised in the belief that it would assist in obtaining good, bony apposition and serve as a bone graft. Nonunion occurred in such patients and the absence of a lateral malleolus resulted in the ankle becoming grossly unstable.

## CONCLUSION

Transfibular ankle arthrodesis is a novel procedure for treatment of ankle arthritis. It achieves a high rate of union and good functional outcome on midterm followup. The AOFAS hindfoot score improves satisfactorily following transfibular ankle fusion. This technique is an effective approach for most primary and select revision cases.

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## Conflicts of interest

There are no conflicts of interest.

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