OUTCOME OF ANKLE ARTHRODESIS FOR POST-TRAUMATIC ANKLE ARTHRITIS

H.O. Obiegbu, MBBS, FWACS, FMC Ortho, FAO Spine and **M.O. Ikeotuonye,** MBBS, Department of Orthopaedic Surgery, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria

Correspondence to: Dr. Henry O. Obiegbu, Department of Orthopaedic Surgery, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria. Email: obinnaobiegbu@yahoo.com

ABSTRACT

Background: Post traumatic osteoarthritis of the ankle joint is characterized by debilitating joint pain, dysfunction and instability of the ankle joint, posing a significant morbidity on affected patients. Additional soft tissue loss often further complicates management and also affects prognosis. Arthrodesis is an effective salvage procedure for these patients.
Objective: The aim of this study was to determine outcome of patients who had ankle arthrodesis for post traumatic ankle osteoarthritis
Methods: This was a retrospective study undertaken from April 2018 to May 2022 on all patients who had ankle arthrodesis for post traumatic arthritis of the ankle joint.
Results: A total of 20 patients were recruited into this study, with a mean age of 40.7, with a male: female ratio of 1:1. Although all patients had open arthrodesis of the ankle joint, fourteen patients had trans-articular screw fixation, while two patients had ankle arthrodesis using Charnley's clamp, vertical transtalar Steinman's pin fixation, and a locking plate respectively. Using the AOFAS Ankle-Hind foot scale, 75% of patients had excellent outcomes, 15% had good outcomes while 5% each had fair and poor outcomes respectively.
Conclusion: Arthrodesis of the ankle joint is an effective tool in the management of post traumatic arthritis of the ankle joint.

Key words: Arthrodesis, Transarticular screws, Arthritis, Talectomy, Charnley's clamp

INTRODUCTION

Ankle arthrodesis is a limb salvage procedure for post traumatic ankle arthritis often resulting from an acute ankle injury. These injuries often vary from mild ankle sprain to severe open ankle injuries (including fracture dislocations). Following severe trauma to the ankle joint, the ankle mortise is commonly disrupted, with damage to the overlying articular cartilage, occasionally leading to marked functional disability, pain on weight bearing and gait disturbances (1). The injury process to the ankle joint may occur through either a high or low energy, often depending on the patients' age, bone quality and also ligamentous intergrity (2). In elderly patients with poor bone quality, low energy injury maybe enough to cause a significant damage to the ankle mortise unlike injuries in younger patients, usually resulting from high energy injuries. Post traumatic osteoarthritis of the ankle joint, characterized by debilitating joint pain, dysfunction and instability of the ankle joint develops secondary to trauma to the ankle joint, posing a significant morbidity on affected patients (3). Additional soft tissue loss incurred with an open ankle fracture not only adds to the morbidity of the patient, but also creates a challenge to the managing surgeon especially in a resource constrained environment.

Chronically altered joint mechanics including mal-alignment, instability and incongruity occurring in the post traumatic period, are widely accepted as contributory factors in the development of post traumatic ankle arthritis (4). Although mild post traumatic ankle arthritis is treated conservatively via pharmacologic agents such as analgesics, braces, orthosis and assisted devices; patients with severe ankle arthritis usually benefit from surgical intervention. Arthrodesis of the ankle joint, a salvage procedure refers to surgical fusion of the joint. Though there are several operative techniques for ankle arthrodesis, there is no current consensus on the most optimal approach or fixation method (3).

Although ankle arthrodesis typically entails tibio-talar fusion, tibio-calcaneal fusion with a talectomy can be performed in patients with significant damage to the talus, ankle malformation or avascular necrosis of the talus leading to satisfactory outcomes (5).

The aim of this study was to analyze the early outcome of patients who had arthrodesis of the ankle joint secondary to severe traumatic injury of the ankle joint.

MATERIALS AND METHODS

This was a retrospective study carried out between April, 2019 and May, 2022 on patients who had undergone ankle arthrodesis secondary to traumatic injury to the ankle. A total of 20 patients were recruited. The records of these patients were retrieved, and details such as biodata, mechanism of injury, modality of treatment and treatment outcome were obtained. Radiographs were evaluated for bony union across the ankle joint. Union was defined as bridging trabeculation across the tibio-talar joint, or across the tibio-calcaneal joint (in cases of tibio-calcaneal arthrodesis). Data was analyzed using SPSS version 20, with a p value of 0.05 considered statistically significant.

Operative detail

All 20 patients had developed post traumatic arthritis at the time of presentation, with two patients presenting with avascular necrosis of the talus post trauma (Figure 1). Pre-operative X-rays were obtained (Figure 2) and the patients were thereafter scheduled for surgery. A transfibular approach was used to access the ankle joint in all patients, with resection of the distal 8cm of the fibular. The articular surface of both the tibia and talus was removed, except in patients with avascular necrosis of the talus where a talectomy was done. All patients then underwent reduction and arthrodesis of the ankle joint using either a Charnley's compression clamp (Figure 3), vertical transtalar Steinmann's pin insertion or cross articular ankle screw fixation (Figure 4). The post-operative protocol for all patients were the same. Patients were ambulated non-weight bearing on the affected limb, and after 6 weeks, post-operative X-rays were obtained. The Charnley's compressive device or Steinmann's pin was removed and a below knee walking cast applied if callus was seen bridging atleast two cortices. Follow up was for a minimum of 6 months.

Figure 1
Post traumatic avascular necrosis of the talus

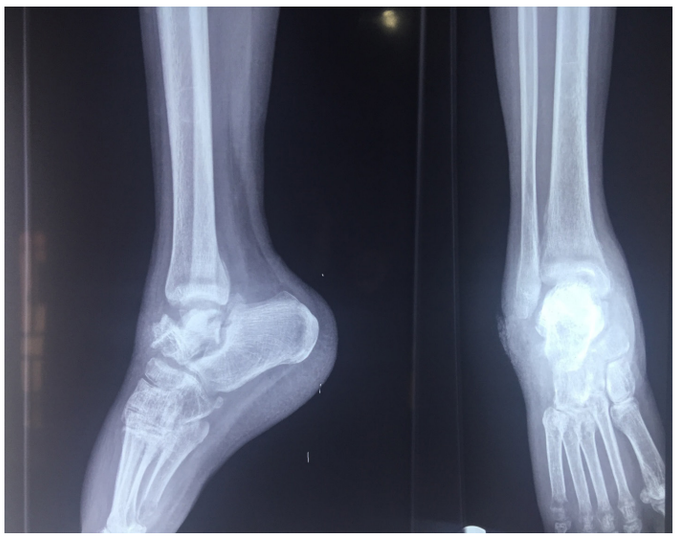


Figure 2
Post traumatic arthritis of the ankle joint arthritis

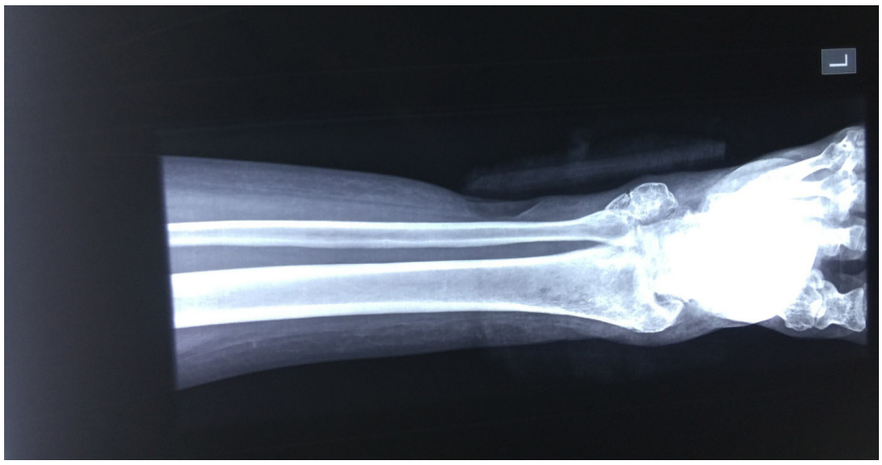


Figure 3
Arthrodesis of the ankle joint using a Charnley's clamp

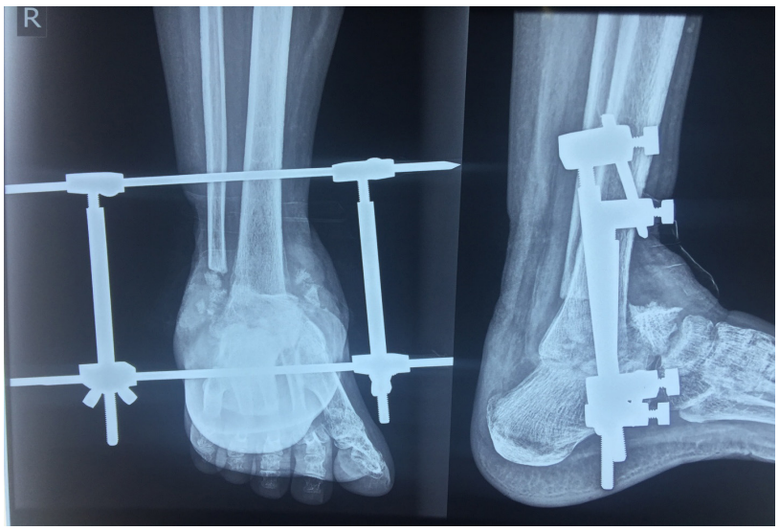
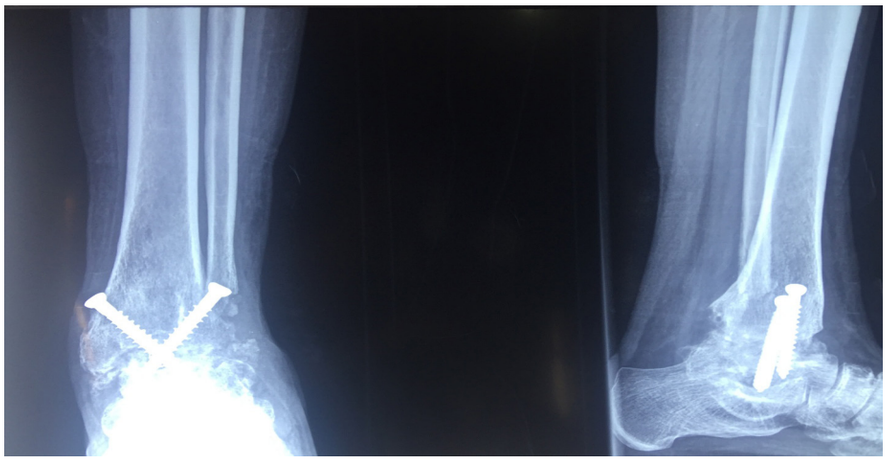


Figure 4
Arthrodesis of the ankle joint using cross articular screw fixation



The outcome of patients were determined by two main parameters: radiological and clinical evaluation using the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot scale (Table 1). X-rays of the ankle were obtained (AP/ lateral views) and bony fusion and position of fusion were ascertained. The AOFAS Ankle-Hindfoot scale was used to assess the results. Although the optimal score in this scale is 100, due to a lack of motion at the ankle joint after fusion, these patients could not earn the 8 points for sagittal motion and thus the scale was adjusted to a maximum obtainable score of 92. A score of 80-92 was considered excellent, 70-79 a good result, 60-69 a fair result, and a score of 60 considered a poor result. This modification was similar to that done by Gowda *et al.* (7). Complications such as pin site infection and non-union were also recorded.

Table 1

AOFAS ankle-hindfoot scale (100 points total)

Pain (40 points)
- None-40
- Mild, occasional-30
- Moderate, daily-20
- Severe, almost always-0

Function (50 points)

Activity limitation, supports requirement
- No limitation, no supportwalker, -10
- No limitation of daily activities, limitation of recreational activities, no support-7
- Limited daily and recreational activities, cane-4
- Severe limitation of daily and recreational activities, crutches, wheelchair, brace-0

Maximum walking distance, blocks
- Greater than 6 (5)
- 4-6 (4)
- 1-3 (2)
- Less than 1 (0)

Walking surfaces
- No difficulty on any surface-5
- Some difficulty on uneven terrain, stairs, inclines, ladders-3
- Severe difficulty on uneven terrain, stairs. Inclines, ladders-0

Gait abnormality
- None, slight-8
- Obvious-4
- Marked-0

Sagittal motion
- Normal or mild restriction (30o or more)-8
- Moderate restriction (15-29o)-4
- - Severe restriction (less than 15o)-0

Hindfoot motion (inversion plus eversion)
- Normal or mild restriction (75-100% normal)-6
- Moderate restriction (25-74% normal)-3
- Marked restriction (less than 25% normal)-0

Ankle- hindfoot stability
- Stable-8
- Definitely unstable-0

Alignment (10 points)
- Good, plantigrade foot, midfoot well aligned-15
- Fair, plantigrade foot, some degree of midfoot malalignment-8
- Poor, non plantigrade foot, severe malalignment-0

RESULTS

Table 2 details the age of the subjects. The mean age was 40.7 years, with an age range of 13 to 58 years. The male to female ratio was 1:1.

Table 2
Age of subjects

Age range (years)	Frequency	(%)
20-30	3	15
31-40	8	40
41-50	4	20
51-60	4	20
61-70	1	5
Total	20	100

Table 3 shows the various mechanism of ankle injury. Eighteen of the patients had high velocity injuries (road traffic accident/ fall from height); the two patients who had a low velocity injury were the oldest in the group (67 and 68 years respectively). However, this was not statistically significant (p=0.313).

Table 4 shows the different modes of treatment received by the patient, with a majority of the patients having had transarticular screw fixation (70%).

Table 3
Mechanism of Injury

Mechanism of injury	Frequency	(%)
Road traffic accident	14	70
Fall on level ground	2	10
Fall from height	4	20
Total	20	100

Table 4
Mode of treatment

Mode of treatment	Frequency	(%)
Transarticular screws	14	70
Charnley's clamp	2	10
Plate fixation	2	10
Trans-talar pin	2	10
Total	20	100

Table 5 shows the different complications encountered during treatment. A majority of patients had no complications in the post-operative period, and this was statistically significant ($p<0.05$).

Table 5
Complication of treatment

Complication	Frequency	(%)
None	16	70
Pin tract Infection	3	10
Malalignment	1	20
Total	20	100

Only two patients who had ankle arthrodesis developed non-union. This was not statistically significant (p>0.05). There was also no statistical correlation between procedure done and outcome (Table 6).

Table 6
Radiological outcome of salvage procedure

Complication	Frequency	(%)	P
Charnley's clamp	2	-	
Trans-talar pin	1	1	0.375
Trans articular Screw	12	1	
Plate fixation	2	-	

Table 7 shows that a statistically significant amount of patients had satisfactory outcomes following ankle arthrodesis.

Table 7
Outcome of salvage procedure using AOFAS Ankle-Hindfoot scale

Grade	Frequency	(%)	P
Excellent	15	75	
Good	3	15	0.002
Fair	1	5	
Poor	1	5	
Total	20	100	

DISCUSSION

Sokolowski in 1958 and Childress in 1965 described the use of vertical transtalar Steinman pin fixation for closed unstable fracture dislocation of the ankle joint, when open reduction was contraindicated due to abrasion or superficial infection (7). However, modifications of this technique has included its use in arthrodesis of the ankle joint, especially in low income countries because of its low cost. Although there are several methods available for the management of post traumatic ankle arthritis including arthroscopic arthrodesis, transarticular screw fixation, total ankle replacement; ankle arthrodesis using either a vertical transtalar Steinmann's pin or a Charnley's clamp remain an effective modality in its management.

In this index study, outcome was determined by both radiological and clinical evaluation (using X-rays and the American Orthopaedic Foot and Ankle Society Ankle- Hindfoot scale respectively). In a study by Hawkins *et al.* (8), they reported a series of five patients who had their ankle joints fused by inserting two Steinman's pins through the calcaneum with good results.

In a similar study by Sitati *et al.* (9), clinical as well as radiological union was achieved in 31 of 33 patients using vertical transtalar Steinman's pin applied via the calcaneus. In a study by Gowda *et al.* (10), 15 patients with post traumatic arthritis of the ankle joint underwent arthrodesis of the ankle joint using a Charnley's clamp re-inforced with a calcaneotibial pin, with satisfactory outcomes obtained. In this index study, 7 out of 8 patients had satisfactory outcomes and achieved union of arthrodesis. Tibiocalcaneal arthrodesis is an effective salvage procedure in both ankle and hindfoot conditions (11) including an avascular necrosis of the talus, and several techniques have been advocated. Techniques include intramedullary nails and transarticular screws. Although biomechanical studies have shown superior strength with the use of intramedullary nail fixation over the conventional cross screw technique (12), contraindication to its use include an intact subtalar joint, active infection of the foot and ankle, and distal tibial deformity malunion greater than 10 degrees in any plane(13). In this index study, cross transarticular screw fixation was used in the patient with avascular necrosis of the talus (afer talectomy was done), and satisfactory outcomes were obtained.

Although numerous complications have been associated with ankle arthrodesis including non-union, delayed wound healing, sepsis, neurovascular injury, chronic oedema and malalignment; complications encountered in this study was mainly pin tract infection which resolved completely with antibiotics/ removal of pin. Non-unions have been reported as the most common complication in ankle arthrodesis, and can be as high as 28% in cases of avascular necrosis of the talus (14). However, only one patient in this index study had avascular necrosis of the talus, however talectomy was done prior to ankle fusion with Charnley's clamp (Figure 3).

Malalignment may serve as a source of dissatisfaction after ankle arthrodesis. Although Buck *et al.* (15) had earlier outlined the preferred position for ankle fusion (including 5 degrees valgus and 5-10 degrees external rotation), the ankle can drift into malalignment even after initial satisfactory alignment as seen in this index study.

The cross transarticular screw fixation for ankle arthrodesis have long been described by Ogilivie-Harris and colleagues (12) with several modifications. In this index study, cross transarticular screw fixation was used for one patient who achieved satisfactory results.

CONCLUSION

Open arthrodesis using Charnely's clamp, transtalar Steinmann's pin and cross articular screw/ plate fixation gave satisfactory clinical and radiological outcomes in this study.

Limitation of the study: The major limitation of this study is its small sample size.

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