Original Article

The Union Rate of Ankle Arthrodesis Using Double-column Plating

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Abstract

Background: Ankle arthrodesis is commonly used for the treatment of end-stage ankle osteoarthritis. Many methods have been used for ankle arthrodesis with varying outcomes. A sustained rigid fixation which will enhance healing is the goal of all methods of ankle arthrodesis. The required rigid fixation needed for healing is provided by the method of plating described in this report. The aim of this study is to determine the time to clinical union, time to radiological union and the union rate following the use of double-column plating for arthrodesis of the ankle joint. **Methodology:** This was a prospective study done at Federal Medical Centre, Birnin Kebbi. All adult patients who had double-column plating for severe osteoarthritis of the ankle joint from April 2015 to March 2018 were included in the study after obtaining their consent. **Results:** There were 19 patients in the study, one female and 18 males with the mean age of patients treated as 39.6 ± 8.9 years. All patients had post-traumatic osteoarthritis, and double-column plating was used to achieve arthrodesis in all patients. The average time to clinical union was 8.00 ± 0.89 weeks, while the average time to radiological union was 9.75 ± 1.61 weeks. By 6-month post surgery, the union rate was 100%. The complications noticed were broken screws in one patient and pain in adjacent joints in two patients. **Conclusion:** The use of double-column plating for ankle arthrodesis is a useful method with high union rate and low rate of complications. It is a reliable method for closed, non-infected ankle pathologies that require arthrodesis.

Keywords: Arthrodesis, plating, union

Introduction

The ankle joint is one of the major weights bearing joints in the lower limb. Ankle arthrodesis is the fusion between the distal tibia and the talus after removal of the intervening articular cartilage. It is indicated in patients that have unremitting ankle pain and deformity from severe osteoarthritis of the joint.[1,2] Ankle arthroplasty and arthrodesis are the surgical treatment options for end-stage osteoarthritis. Ankle arthroplasty is not popular in this part of the world, and even worldwide, ankle arthrodesis is still the mainstay for managing end-stage ankle osteoarthritis.[3]

Ankle arthrodesis can be done arthroscopically or by open method.[3] A Charnley's clamp is an external device used for compression between the distal tibia and the talus after joint debridement. It is commonly used fixation device for ankle arthrodesis in this part of the world including this centre.[4,5] An alternative fixation technique is the use of double-column plating which involves the use of 3.5 mm compression plates and screws on the lateral and medial sides of the ankle joint for fixation and compression. Other open methods described for ankle arthrodesis include the use of intramedullary nails, lateral plating alone, anterior plating and screw fixation.[6-8] Although arthroscopic arthrodesis is becoming more popular, open arthrodesis is still the most common technique for arthrodesis.[2] It has been shown that there is no difference in the incidence of revision surgery between the use of arthroscopic and open methods of ankle arthrodesis.[3]

The aim of this study is to determine the time to clinical union, time to radiological union and the union rate following the use of double-column plating for arthrodesis.

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Methodology

The study was a prospective study conducted from April 2015 to March 2018 at the Federal Medical Centre, Birnin Kebbi. Approval was obtained from the ethical committee of the hospital and patients consent was obtained. All adult (18 years and above) patients who presented with severe osteoarthritis of the ankle joint within the study period were included in the study.

Infected ankle joints were excluded from the study as well as open injuries to the ankle joint. Each patient was followed up for a minimum period of 1 year. The bio data, side of lesion the challenges faced in management, the time to clinical and radiological union and complications were recorded in a pro forma which was updated as management of the patient continues.

Surgical procedure

Subarachnoid block or general anaesthesia was administered depending on anaesthetist considerations. Patients were positioned supine and the affected limb was prepared and draped to expose the ankle up to the mid leg. Double incisions were made, one on the medial aspect of the ankle joint and the other one on the lateral aspect of the ankle joint, each about 7–8 cm long centred on the joint. The distal fibula was excised to expose the ankle joint from the lateral side. All articular cartilage was removed from both the distal tibial plafond and the dome of the talus. Any intervening fibrous tissue was also removed. The alignment was made to be in slight valgus (0°–5°), with the foot in the plantigrade position and external rotation of about 5°–10°.The limb length discrepancy was kept at <2.5 cm by minimising removal of the subchondral bone after denuding the articular cartilage from both the talus and the distal tibia.

After joint debridement and proper positioning, K-wires were passed from the distal tibia through the talus for temporary fixation. A 5-hole 3.5 mm narrow dynamic compression plate was placed on the lateral side of the ankle and secured with two screws into the talus and another two screws into the distal tibia. The second 5-hole 3.5 mm plate was placed on the anteromedial aspect of the ankle joint and secured similarly with two screws into the talus and two screws into the distal tibia [Figures 1 and 2].

The wound was irrigated with normal saline and bone graft was laid around the arthrodesis site. The wounds on either side of the ankle were sutured. Dressing was applied in layers. Post-operative antibiotics and analgesics were given parenterally for 72 h after which these drugs were changed to oral for a period of 1 week. Non-weight-bearing ambulation was commenced after 1 week till about 6 weeks post surgery; after 6 weeks, patients were commenced on partial weight-bearing till the time of radiological union. X-ray was done immediately after surgery to assess adequate contact and alignment of the bones. Another X-ray was done 6 weeks after surgery to assess for radiological union. Where radiological union was not evident in 6 weeks, subsequent X-rays were done at 2-week intervals until radiological union was attained. The radiological union was determined when callus was seen to bridge at least three out of the four cortices of bone on anteroposterior and lateral radiographs of the fusion site. Clinical union was determined to be the absence of pain in the patient on full weight-bearing on the limb. Each patient was followed up for at least 1 year.

Figure 1: Anteroposterior view of ankle arthrodesis by double-column plating

The data from the pro forma were analysed with IBM SPSS version 22. The variables were analysed using a descriptive statistical method.

Results

During the study period, a total of 19 ankles in 19 patients were recruited. The mean age of the patients was 39.6 ± 8.9 years. There were 18 males and one female (M: F =18:1). All patients had post-traumatic end-stage ankle osteoarthritis. The range of time between injury and presentation was 1.5–3 years.

The mean duration of surgery was 75 ± 6.45 min. The mean time to clinical union post surgery was 8.00 ± 0.89 weeks, while the time to radiological union was 9.75 ± 1.61 weeks.

By 6 months after surgery, the union rate was 100%. Pain in the arthrodesed ankle was assessed at 6 months post surgery using the Numerical Pain Rating Scale. Sixteen patients had no pain at all and three patients had a score of 1. Two of the patients had a score of 4 at the tarsometatarsal joints. Deformities in all the ankles were all corrected.

The complications noticed during the study were broken screws in one patient and pains in the tarsometatarsal joints in two patients.

Discussion

Arthrodesis of the ankle is an open method of the treatment for painful ankle as a result of arthritis that fails to respond to conservative treatment. The use of plate for ankle arthrodesis

Figure 2: Lateral view of ankle arthrodesis by double-column plating

has been shown to increase the compression force between the tibia and the talus, thereby increases the chance of union in ankle arthrodesis.[9]

The male predominance amongst our patients is to be expected, as the cases were all following severe ankle trauma which is generally more common in males in this environment.

The mean age of patients recruited was 39.6 ± 8.9 years. This is a younger age range for end-stage osteoarthritis than what is typically found in knee or hip osteoarthritis. Again, the fact that the cases were all post-traumatic secondary osteoarthritis is likely responsible for this relatively young age group. Mohamedean *et al*. also reported a young age range of 18–42 years for patients who had arthrodesis in their study.[10] Young men form the bulk of the workforce of any society. This highlights the economic value of arthrodesis as a means to allow return to function for patients with ankle osteoarthritis.

Clinical evidence of union (pain-free full weight-bearing) was present significantly earlier than the radiological evidence of union [Table 1]. The study size was however not large enough to enable a correlation between time of clinical union and time to radiologic union. The reported union rate by Kennedy *et al*. in the literature using screws fixation was 95%.[11] Zwipp *et al*. in their studies reported union rate of 99% using four screws fixation techniques.[7] Furthermore, Ferkel and Hewitt reported a union rate of 97% in their study using transversely crossed screws.[12] The union rate in the method used in this study is 100% which is higher than the method of ankle arthrodesis using screws, this may be due to the fact that the rigidity provides by double-column plating is higher than those of screws. Complications such as the subtalar joint and talonavicular joint arthritis were also higher post arthrodesis with screw method as reported by Zwipp *et al*.[12]

Mendicino *et al*. reported a union rate of 95% following the use of retrograde intramedullary nailing for arthrodesis.[13] Similarly, Moore *et al*. reported a union rate of 73.7% following arthrodesis with intramedullary nailing.[6] These union rates are lower compared to the method used in this article because the

Table 1: Time to union

	Weeks
Time to clinical union	8.00±0.89
Time to radiological union	9.75±1.61

fixation rigidity following the use of retrograde intramedully rod is lower than that of plating methods, occasionally external support with the use of plaster of Paris may be needed following the use of retrograde intramedullary nailing. Such external support is not needed following the use of double-column plating because the fixation is usually rigid. The complications following the use of retrograde intramedullary nailing were higher compared to double-column plating.

Fragomen *et al*. reported a union rate of 83.5% using the Ilizarov technique for ankle arthrodesis; the method has added advantage of ability to lengthen the tibia. This reported that union rate with this method is lower compared to double-column plating. Higher complications than plating method were also reported with the use of Ilizarov.[14] The use of Chanley's clamp in three patients with open ankle fractures was reported by Oboirien M in which two of the three patients had wound break down.[15] These methods involve the use of external device with increased risk of infection and consequent lower union rate compared to double-column plating which involve the use of internal device.

The study by Rowan and Davey using AO tibia T-plate in 33 patients gives a union rate of 94%.[16] Mears *et al*. reported a union rate of 82% following the use of anterior tension plate for ankle arthrodesis.[17] These union rates are lower to the union rate seen with the methods used in this article. Plaass *et al*. described the use of anterior double-column plating for ankle arthrodesis, with 93% of patients having satisfactory outcome.[9] Coughlin *et al*. reported 100% union at 6 month post surgery, with the use of lateral lock compression plate for ankle arthrodesis.[18] The union rate is similar to the rate of union seen in the method used in this article, but the average time to union reported is higher than that seen in double-column plating. Plaass *et al*. and Fragomen *et al*. reported time to union of 13.2 and 25 weeks, respectively, and these are higher than the time to union seen in the method used in this article. This may be due to the fact that double-colomn plating is likely to produce more sustained rigidity than the methods used by Plaass *et al*. and Fragomen *et al*.[9,14]

Sixteen of the 19 patients had a complete resolution of symptoms with no complications. They could all walk without walking aids by 1 year post surgery. Two patients who had mild pain at the adjacent joints had pain relief following the use of analgesics and foot insoles for a few weeks. Despite the tibiotalar joint fusion, the appreciable compensatory movements occur at the subtalar, midtarsal and tarsometatarsal joints which enable patients to cope with walking on rough and sloping surfaces. At 1 year after surgery, all patients were satisfied with the outcome of their surgery.

Conclusion

The use of double-column plating for ankle arthrodesis is a useful method with high union rate and low complication rates. It should be recommended for closed or uninfected ankle arthritis that requires arthrodesis.

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Conflicts of interest

There are no conflicts of interest.

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