



The Outcome of Ankle Joint Fusion with Ring External Fixator in Patients with Charcot Arthropathy

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Abstract

Background: Charcot neuroarthropathy is a severe disease involving several joints but most commonly affecting the foot and ankle. Charcot arthropathy is a serious late complication of many pathologies like diabetes mellitus, syphilis, and meningiomyelocoele. It may result in fractures, permanent deformity, and even limb loss. Ankle fusion with internal fixation has high morbidity and complications. External fixation can provide stability to the joint and correction of the deformity with less risk for surgical complications.

Objectives: To assess the clinical and functional outcomes of ankle joint arthrodesis using external fixator in patients with severe Charcot ankle arthropathy.

Materials and Method: This study is descriptive cross-sectional hospital-based study that involved an 18 patients with advanced Charcot arthropathy of the ankle joint. Ankle fusion with Ilizarov external fixation was done for all patients. The patients were followed, and the frame was removed after clinical and radiological evidence of union were obtained. The American Orthopedic Foot and ankle Society scale (AOFAS) was assessed before surgery and one year after surgery. The post-operative complications and patient satisfaction also evaluated. The Data was analyzed using IMP SPSS version26.

Results: Number of patients was 18, 14 males and 4 females. The most frequent age group was more than 50 years (11 patients, 61.1%). Preoperative AOFAS score was poor for all of the patient (100%). The postoperative AOFAS score was improved, 6 patients (33.3%) obtained excellent result, 5 patients (27.8) good, 4 patients (22.2) fair, while 3 patients (16.7) remained poor. 13 patients (72.2%) were satisfied with the outcome while 5 of them (27.8%) were unsatisfied. The most frequent complication rate was for pin track infection which occurred in 6 patients (33.3%).

Conclusion: Fusion of the ankle joint with ring external fixator is useful treatment option for Charcot-arthropathy instability and deformity, particularly in cases where internal fixation methods are ineffective. With an acceptable rate of complications, it can lead to a satisfactory outcome and an improved functional score.

Keywords: Ankle Joint Arthrodesis; Charcot Arthropathy; Ring External Fixator

Introduction

Charcot neuroarthropathy was first described in a group of patients with syphilis. in 1868 by a neurologist named Jean- Martin Charcot, consider common in many neuropathic pathologies but more among patients with diabetes mellitus. incidence in people with diabetes mellitus was estimated to be 0.08-0.13% and up to 7.5%, with foot and ankle deformity and more than 9% in those have bilateral involvement [1]. Charcot neuroarthropathy (CN) is defined as a progressive, non-infectious neuro-osteo-arthropathy that affect the bones and joints in patients with sensory neuropathy and can change the normal anatomy and cause deformity [2]. It is a serious late complication of many pathologies like diabetes mellitus, syphilis, and meningiomyelocele. a patient can present clinically with pain, edema, ulcer and Instability, and may result in fracture, permanent deformity, and even limb loss. There are several modality of management including operative and non-operative, the goal of which is to improve functions and mobility by maintaining a stable planti-grade foot, that minimize the risk of ulceration and infection, thus preventing amputation. Non operative treatment includes Offloading in an irremovable total contact cast (TCC), Anti-resorptive therapy and Bone growth stimulation. Operative treatment involves reconstruction of the deformity by reduction and arthrodesis using either internal fixation devices like pins, screws, nails, and plates, or external fixation devices as Ilizarov and Taylor Special Frames (TSF) and in this study we are want to address the use of Ilizarov external fixation modalities.

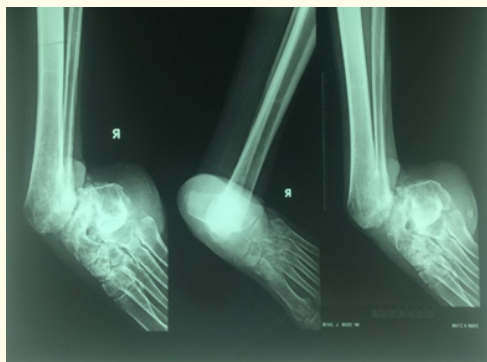


Figure 1: Radiograph AP lateral and Oblique showing Charcot deformity.

Objectives

General objective

To assess the outcome of ankle joint arthrodesis using ring external fixator Charcot-neuro-arthropathy of the ankle.

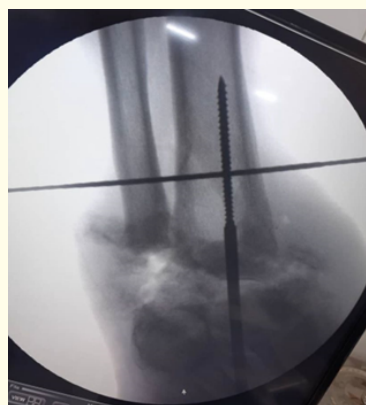


Figure 2: Fluoroscopy Radiograph AP showing postoperative arthrodesis of ankle joint using Ilizarov.



Figure 3: Showing Anterior view of the Ilizarov Ring Fixator.

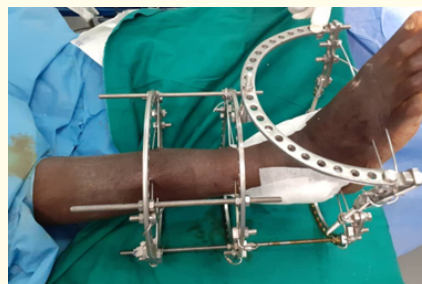


Figure 4: Showing lateral view of Ilizarov Ring Fixator.

Specific objectives

- To assess the functional outcome of ankle joint arthrodesis using external fixator in patients with Charcot neuroarthropathy of the ankle.
- To identify the post-operative complications of the above procedure.
- To evaluate the patient’s satisfaction after the mentioned surgical intervention.

Methodology

- **Study design:** Descriptive Cross-sectional hospital-based study.
- **Study area:** Future hospital (Orthopedic center based in Khartoum, Sudan).
- **Study duration:** From August 2018 to August 2021.

Study Population

- **Inclusion criteria:** Adult patients with Charcot ankle Eichenholtz stage 3 who underwent ankle joint arthrodesis using ring external fixator, both genders.
- **Exclusion criteria:** patient who refused to be included in this study, smokers, patient unfit for surgery.
- **Sample size:** 18 patients.
- **Sampling Technique:** Convenient sample included all patients who underwent ankle arthrodesis at future hospital.
- **Data collection:** Data was collected using questionnaires designed to satisfy the objectives of the study, chick list for AOFAS ankle hind foot scale.
- **Data analysis:** Data was analyzed using IMP SPSS version 26. Stability, movement, the rate of complications, and patient satisfaction were all used to measure clinical outcome. Functional outcome in the form of disability and a shift in activity The AOFAS scales before and after the procedure were evaluated.
- **Ethical considerations:** Written consents were obtained from all patients, for the procedure and for the publication of this this research. The approval of the Research Ethics Review Committee at Future Hospital was secured.

Results

This study included 18 patients with stage 3 Charcot arthropathy of the ankle joint who underwent fusion with Ilizarov external fixators. Among these, 14 (77.8%) were males and 4 (22.2%) were females. The mean age was 54.6 years. 11 patients (61%) were above 50 years of age, 6 patients (33.3%) were between the ages of 30 and 50, and only one patient was younger than 30 years old (5.6 percent). The right side was affected in 10 patients (55.6%) and the left side was involved in the remaining 8 candidates (44%). Regarding the cause of Charcot arthropathy, in 17 participants (94.4 percent) the cause was diabetes mellitus, while in only one patient (5.6 percent) the etiology was meningiomyelocele. The mean hospital stay was 3.2 days. There weren't any notable intra-operative complications reported. Ten patients (55.6%) started partial weight bearing within the first few days of their surgery, while eight patients (44.4%) required more than a week. 7 patients (38.9%) experienced no post-operative complications, while 11 patients (61.1%) experienced variable complications. Pin track infection had occurred in 6 patients (33.3%), followed by pin break in 2 patients (11.1%). Other complications included external fixator

instability, the need for revision surgery, and movement restriction with a similar rate of one patient for each (5.6%). wound dehiscence, requirement for plastic surgery, device intolerance, and fracture all contributed to the device's early removal. Ten patients (55.6%) accepted the device's weight, while eight patients (44.4%) did not. Concerning patient's satisfaction, 13 patients were fully satisfied (72.2%), while 5 candidates (27.5%) were unsatisfied. The pre-operative AOFAS scale was poor for all 18 patients (100 percent), with a mean score of 32.3. One year after surgery, the AOFAS scale became excellent for 6 patients (33.3%), good for 5 patients (27.8%), fair for 4 patients (22.2%), and poor for 3 patients (16.7%). The mean post-operative AOFAS scale was 81.2. The majority of patients showed statistically significant improvement in the postoperative scale compared to the preoperative one, with P value = 0.00.

Age	Frequency	Percent
More than 50 years	11	61.1%
30 - 50	6	33.3%
Below 30 years	1	5.6%
Gender		
Male	14	77.8%
Female	4	22.2%
Involved side		
Right	10	55.6%
Left	8	44.4%

Table 1: The demographic characteristics of the patients.

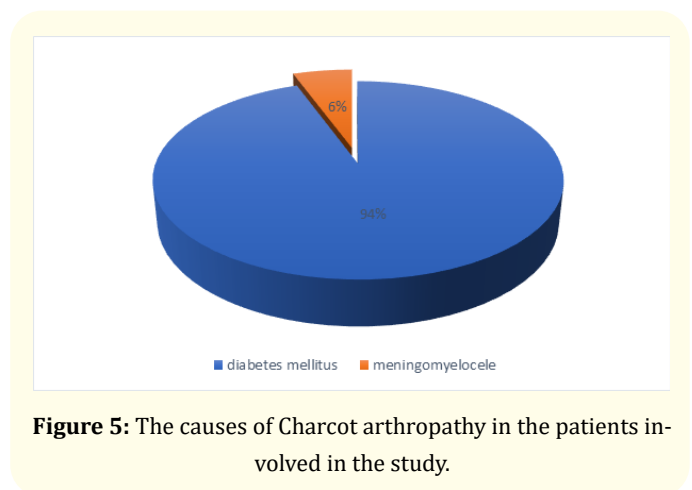


Figure 5: The causes of Charcot arthropathy in the patients involved in the study.

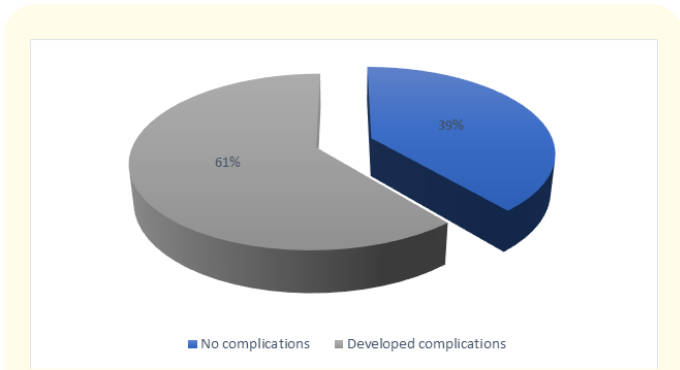


Figure 6: Frequency of post-operative complications.

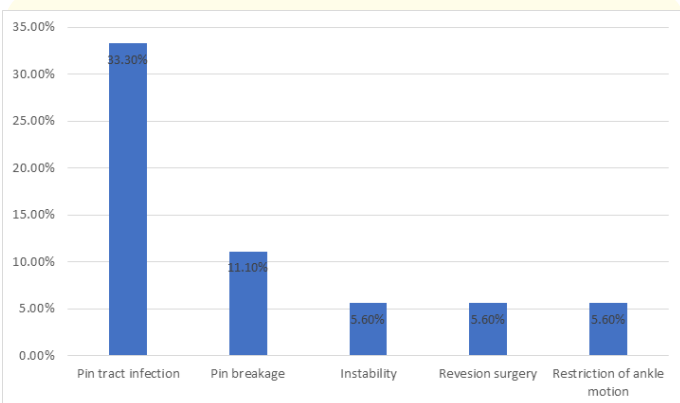


Figure 7: Post-operative complications.

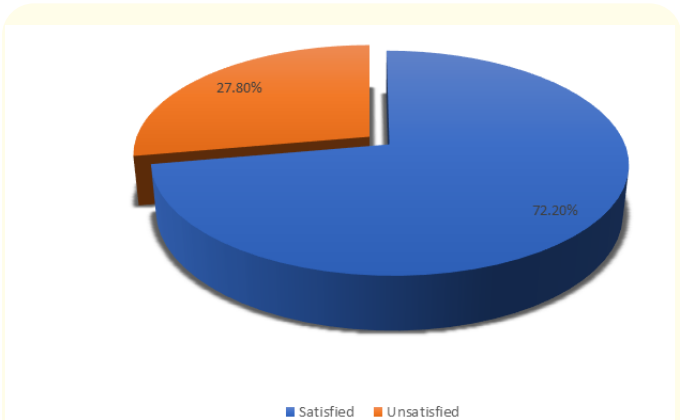


Figure 8: Patients' satisfaction after surgery.

AOFAS	Before arthrodesis	After arthrodesis	P value
Excellent	0 (0%)	6 (33.3%)	0.000*
90-100			
Good	0 (0%)	5 (27.8%)	
80-90			
Fair	0 (0%)	4 (22.2%)	
70-80			
Poor	18 (100%)	3 (16.7%)	
<70			

Table 2: Comparison between AOFAS before and after surgery.

Discussion

In this study, Ilizarov external fixator was used to treat 18 patients with stage 3 Charcot arthropathy of the ankle joint. Four (22.2%) were female and 14 (77.8%) were male. In contrast to the study by Nakul S. Shah and Shamal DasDe [4], which included 11 patients, 6 of whom were males (55%) and 5 of whom were females (45%). The patients aged above 50 years old were 61% and the mean age was 54.6 years. This mean age was slightly greater than Hasan Karina's at 54.6 years [6]. The right side was affected in 10 patients (55.6%), while the left side was affected in 8 patients (44.4%). In Fahad Sheikh, *et al.* study [9], mean age of 51 years. In the other studies, this is not mentioned. Diabetes mellitus was the cause of Charcot arthropathy in 17 patients (94.4%), while meningiomyelocele was the cause in only one patient (5.6%). This is almost the same as in K.A.M. EL-Gafary, *et al.* [10]. study in which diabetes is found in 90% of the patients. The majority of our patients had undergone prior treatment, with Total Contact Cast (4 patients, or 22.2%), internal fixations (3 patients, or 16.7%), and uniplanar external fixators (3 patients, or 16.7%) all showing no improvement. The remaining 8 patients, or 44.4%, had undergone no prior treatment. All the 18 patients had no significant intraoperative complications, and only three (16.7%) spent more than three days in the hospital. The average recovery time was 3.2 days, which is shorter than the 4.6 days in the study by James Richman, *et al.* [3]. Ten patients (55.6%) had started partial weight bearing within the first few days after surgery, while 8 patients (44.4%) required more than a week.

7 Patients (38.9%) experienced no post-operative complications, while 11 patients (61.1%) experienced variable complica-

tions. This was higher than the Coober, *et al.* [5] study, in which only had 5 patients (6%) experience complications. The rate of pin tract infection, which occurred in 6 of the 20 patients (33.3%), was higher than the rate reported by K.A.M. EL-Geary, *et al.* [10]. in only one patient (5%), but none of the patients required removal. The second most common complication was a pin break, which occurred in two patients (11.1%), and one patient (5.6%) developed external fixator instability, necessitating revision surgery. Compared to the James Richman, *et al.* [3] study, in which one of 11 patients (9.1%) required revision surgery, this rate was lower. Restrictions in movement, wound dehiscence, the requirement for plastic surgery, fracture, and intolerance of the device all resulted in early device removal within the first week, with a similar rate of one patient per patient (5.6%). In contrast to the patients in a study by Cooper, *et al.* [5], none of our patients required amputation [5]. According to the study by Fibrin J., *et al.* in which three patients (3.6%) required amputation because of uncontrolled infection or unstable pseudo arthrosis. Ten patients in this study (55.6 percent) accepted the device's weight, while eight (44.4 percent) did not. Despite this, only one patient asked for the device to be removed. 72% of the patients in this study were fully satisfied with the surgical intervention compared to 91% in Fibrin J., *et al.* study [11]. All 18 patients had poor AOFAS scale before surgery with mean score of 32.3. After surgery the mean AOFAS scale improved to 82.1. Six patients (33.3%) scored excellent postoperative AOFAS scale, which is lower than the study by Fahad Sheikh, *et al.* [9], in which 18 of 25 patients (72%) scored excellent and higher than in Hasan Karpinar study, *et al.* [8] where 3 of the 11 patients (27.2%) had excellent scores. A poor score was reported by three of our patients (16.7%), which is more than that in Hasan Karpinar, *et al.* study [8] where (9.1%) had poor outcome.

Despite the high rate of complications, most of it were minor and did not necessitate significant treatment, with the exception of one patient who required revision surgery due to instability.

Conclusion

- An effective treatment for Charcot arthropathy-related instability and deformity is fusion of the ankle joint with ring external fixation.
- When the use of internal fixation methods is constrained, this is an effective approach.
- The majority of complications were minor and did not necessitate a major operation. It can lead to a satisfactory clinical outcome and an improvement in functional score, such as the AOFAS ankle hind foot scale.

Recommendations

When internal fixation is limited by infection or ulcer, consider ring external fixation as an alternative to ankle joint fusion for the treatment of Charcot arthropathy-related instability and deformity. More studies with longer duration of follow up and bigger sample size are needed in the future.

Bibliography

1. Van der Ven A., *et al.* "Charcot neuroarthropathy of the foot and ankle". *Journal of the American Academy of Orthopedic Surgeons* 17.9 (2009): 562-571.
2. Armstrong DG and Peters EJ. "Charcot's arthropathy of the foot". *Journal of the American Podiatric Medical Association* 92.7 (2002): 390-394.
3. Richman J., *et al.* "Intramedullary nailing and external ring fixation for tibiototalcalcaneal arthrodesis in Charcot Arthropathy". *Foot and Ankle International* 38.2 (2016): 149-152.
4. Shah NS and De SD. "Comparative analysis of uniplanar external fixator and retrograde intramedullary nailing for ankle arthrodesis in diabetic Charcot's neuroarthropathy". *Indian Journal of Orthopaedics* 45.4 (2011): 359-364.
5. Cooper PS. "Application of external fixators for management of Charcot deformities of the foot and ankle". *Foot and Ankle Clinics* 7.1 (2002): 207-254.
6. Farber DC., *et al.* "Single Stage Correction with external fixation of the ulcerated foot in individuals with Charcot neuroarthropathy". *Foot and Ankle International* 23.2 (2002): 130-134.
7. Ismavel R., *et al.* "Tibiocalcaneal arthrodesis using a simple external fixator". *The Journal of Foot and Ankle Surgery* 53.4 (2014): 511-514.
8. Karapinar H., *et al.* "Arthrodesis of neuropathic ankle joint by Ilizarov fixator in diabetic patients". *Journal of the American Podiatric Medical Association* 99.1 (2009): 42-48.
9. Sheikh F., *et al.* "Charcots Arthropathy in Diabetics: An Experience in Treatment with Ilizarov External Fixator Technique". *Jornal Medical Thesis* 2.2 (2014): 12-17.
10. El-Gafary KA., *et al.* "The management of Charcot joint disease affecting the ankle and foot by Arthrodesis controlled by an Ilizarov frame". *The Journal of Bone and Joint Surgery. British* 91-B.10 (2009): 1322-1325.

11. Fabrin J, *et al.* "Arthrodesis with external fixation in the unstable or misaligned Charcot ankle in patients with diabetes mellitus". *The International Journal of Lower Extremity Wounds* 6.2 (2007): 102-107.