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Minimally Invasive Hind-Foot Fusion in Charcot Patients

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Abstract

Background: Hindfoot fusion, is a fusion of the talonavicular, talocalcaneal, and calcaneocuboid joints and is commonly performed for patients complaining of pain, chronic instability and gross deformity as a result of hindfoot pathology. **Objective:** This study aimed to assess the functional outcomes of the patients underwent hindfoot fusion, the post-operative complications and patient's satisfaction. **Methodology:** This study is a prospective cohort study was conducted in Future hospital, in Khartoum, Sudan. It involved 30 patients from July 2015-July 2022. Data was collected by the primary researcher using data collection sheet, then it was cleaned and entered into Microsoft excel data sheet and was analysed using SPSS version 28 software. **Results:** 33.3% of the patients are aged 51 - 60 years, and >60 years. Male: Female equals 1:1. 56.7% are for the left side, only 23.3% developed complications. 63.3% patients are fully satisfied. There is a significant correlation between the AOFAS score before and after the operation. Also, a significant correlation between the means of AOFAS score after with the complications and the satisfaction of the patients. **Conclusion:** Minimally invasive tibio-talo-calcaneal is an alternative procedure for the treatment of severe Charcot arthropathy of the ankle. The expected functional outcome is impressive and comparable with the open surgery. However, the post-operative complications are prevalent in 23.3% of patients. Most candidates are fully satisfied with the procedure.

Keywords

Ankle, Sudan, Patient Satisfaction, Arthropathy, Neurogenic

1. Introduction

The talonavicular, talocalcaneal, and calcaneocuboid joints are fused together in the hindfoot. It is commonly used to treat patients who have pain, chronic instability, or gross deformity as a result of hindfoot pathology [1] [2]. Severe post-traumatic conditions, osteoarthritis (OA), neuromuscular disorders, extensive contractures, and longstanding posterior tibial tendon dysfunction are among the causes of this disease [3] [4]. The procedure appears to be effective in terms of pain relief and function improvement [2].

Non-union is the most common complication of triple arthrodesis, with rates ranging from 0% to 40% in various studies. [1] Although some of these non-unions are asymptomatic, a significant number of them result in significant disability. Non-unions can be caused by early weight-bearing, insufficient bone apposition, and insufficient internal fixation [1]. Although most surgeons advocate internal fixation to maintain correction and reduce the incidence of non-union, there is no agreement on the best internal fixation technique [1] [3]. Furthermore, concerns remain about the long-term functional outcomes of a triple arthrodesis and whether a painless, plantigrade foot can be maintained indefinitely [5].

In more than half of the cases, degenerative changes in the ankle and midfoot have been reported [6] [7] [8]. Patient satisfaction is an important outcome for determining the procedure's effectiveness.

The Ankle-Hindfoot Score of the American Orthopedic Foot and Ankle Society (AOFAS) is one of the most commonly used instruments for assessing treatment outcomes in patients who have suffered a complex ankle or hindfoot injury. It combines a clinician-reported and a patient-reported component. According to Philip, V. *et al.* [9], the outcome of bilateral AA is independent of the outcome of unilateral AA. They discovered that the Bilateral AA appears to provide patients with a good functional outcome, as well as high patient reported satisfaction in the medium term.

The purpose of this study was to evaluate the functional outcomes of patients who had undergone hindfoot fusion, as well as the complication rate and clinical outcomes.

2. Methodology

2.1. Study Design

This study is a prospective cohort study.

2.2. Study Area

It was conducted in Future Hospital, in Khartoum, Sudan.

2.3. Study Population and Sampling

The study involved adults' patients who underwent surgical fusion of the ankle joint at future hospital during the period from July 2015-July 2022. It involved 30 patients A total coverage for all the cases was done. The missing report was

excluded.

2.4. The Procedure

Patients with severe Charcot arthropathy of the ankle and correctable deformity were included. Optimization of the medical condition is secured before surgery with a multi-disciplinary team. Spinal anaesthesia was utilized except in two patients who asked for general anaesthesia. A tourniquet wasn't used in this series. Closed reduction of the ankle deformity is performed under fluoroscopy. Short retrograde femur nails are used to fuse the ankle and subtalar joint and are introduced from the sole of the foot after adequate reaming. Two distal locking screws and another two proximal locking screws are applied after ensuring adequate compression of the distal tibia and the talus. Walker boot is applied 2 weeks after the procedure and used for three months. The progress of bone healing is followed regularly with serial X-rays. Partial weight bearing is allowed after six weeks and full weight bearing is considered at three to four months depending on the status of healing. The functional status of the ankle is assessed before surgery and one year after surgery. All surgeries were done by the primary researcher and his team.

2.5. Data Collection and Analysis

Data was collected by the primary researcher using data collection sheet, it includes the patients' demographics, satisfaction, and AOFAS score.

American Orthopaedic Foot and Ankle Society Score (AOFAS) Each measure is comprised of nine questions and covers three categories: pain (40 points), function (50 points), and alignment (10 points). These give a total of 100 points. Data was cleaned and entered into a Microsoft Excel data sheet before being analysed with SPSS version 28 software.

2.6. Ethical Considerations

Ethical clearance and approval were obtained from MOF in Sudan and administration of Future Hospital.

2.7. Study Limitations

Small sample size and short follow-up period.

3. Results

This study has involved 30 patients underwent hindfoot fusion at Future Hospital from July 2015-July 2022 to determine the functional outcome, surgical complications and patients' satisfaction. One third of patients (33.3%) are between 51 - 60 years, and another third are more than 60 years of age, 23.3% are between 40 - 50 years, and only 10% are less than 40 years of age. Male: Female ratio equals 1:1. The left side is affected in 56.7% of candidates and the right side is involved in the remaining 43.3%. Only 23.3% developed complications and

only three patients required further surgeries. Wound infection is encountered in one patient, non-union in 4 patients and wound dehiscence in 2 patients (Table 1). Most of the patients are fully satisfied (63.3%) from the procedure, (13.3%) fair satisfaction, and (23.4%) are unsatisfied (Figure 1). The mean AOFAS score was found to be 42.06 ± 3.21 before, and 74.93 ± 9.07 after the operation. The p-value is <0.05 which considered a significant correlation (Table 2). A significant correlation between the means of AOFAS score with the complications and the satisfaction of the patients. There are non-significant correlations with the age group, gender, and the side (Table 3).

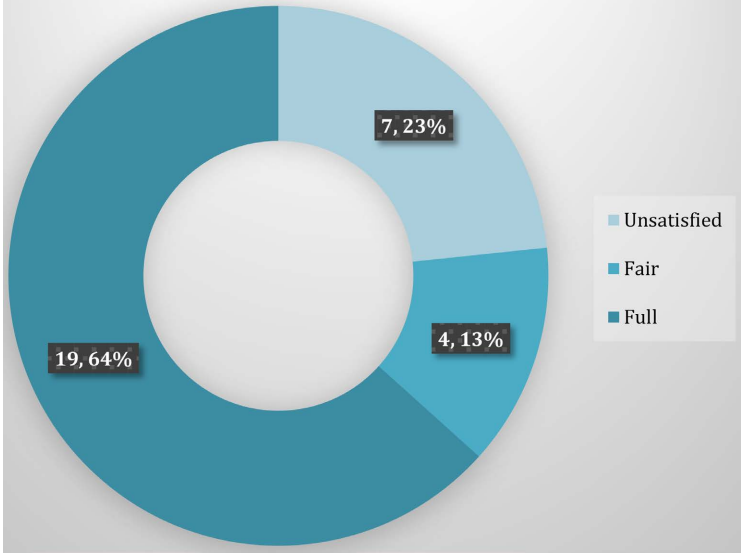

Figure 1. The satisfaction of the patients underwent hindfoot fusion in Future Hospital. (n = 30).

Table 1. Demographic characteristics and presence of complications of patients underwent hindfoot fusion in Future Hospital (n = 30).

		Frequency	Percent
Age group	<40 years	3	10.0
	40 - 50 years	7	23.3
	51 - 60 years	10	33.3
	>60 years	10	33.3
Gender	Female	15	50.0
	Male	15	50.0
Side	Left	17	56.7
	Right	13	43.3
Complications	Infection	1	14.28
	Non-union	4	57.14
	Wound dehiscence	2	28.57

Table 2. The correlation between the AOFAS score before and after the operation among patients underwent hindfoot fusion in Future Hospital (n = 30).

	Pre	Post	p-Value
Mean	42.06	74.93	0.023*
Std. Deviation	3.21	9.07	
Minimum	37.00	51.00	
Maximum	47.00	85.00	

*Significant correlation.

Table 3. The correlation between the AOFAS score POST with the Age, gender, side, complications and satisfaction among patients underwent hindfoot fusion in Future hospital (n = 30).

		Mean	Std. Deviation	p-Value
Age group	<40 years	75.33	7.23	0.012
	40 - 50 years	79.71	3.19	
	51 - 60 years	78.60	6.83	
	>60 years	67.80	10.51	
Gender	Female	74.66	9.26	0.875
	Male	75.20	9.19	
Side	Left	76.35	7.92	0.336
	Right	73.07	10.41	
Complication	Infection	51.00	.	0.000*
	No	79.08	3.90	
	Non-union	62.00	7.78	
	Wound dehiscence	65.00	5.65	
Satisfaction	Fair	73.50	4.43	0.000*
	Full	80.26	2.64	
	Un	61.28	7.63	

*Significant correlation.

4. Discussion

Charcot neuroarthropathy presents an enormous challenge for limb salvage in diabetic neuropathic patients. The risk of ulceration and progression of infection is increased in patients in whom the ankle is involved. The instability of the joint that characterizes the initial phase of the disease progressively worsens with weight-bearing forces on an insensate foot. Stabilization by fusion is the best approach with a low risk of complications and allows the patient to walk again. Open ankle fusion is yet the standard procedure but the post-operative wound

complication represents a real challenge. The purpose of this study was to look into functional outcomes and patient satisfaction with percutaneous fusion of the ankle with the hindfoot nail. The majority of patients who underwent percutaneous hindfoot fusion are over 50 years old, with a male-to-female ratio of 1:1. The rate of complications is approximately 23.3%, which is significantly lower than that found in open fusion like in the study of Philip V *et al.* and N. Vasukutty *et al.* (28%) [9] [10] and also in the study of Chou *et al.* (25.5%). Chou *et al.* also found that in 63.3% of candidates were satisfied in comparison 76.6% in this study [11]. Significant statistical association is found between the post-operative AOFAS scale and the satisfaction, which is similar to the finding of Pell *et al.* [2]. Strong correlation is found between the AOFAS score before and after the procedure indicating significant improvement in the function of the ankle. Before the procedure, the mean AOFAS score was 42.06 ± 3.21, and it has changed to 74.93 ± 9.07 one year after the procedure. In the series of Hani El-Mowafi, *et al.* [12] the AOFAS scale has improved significantly from 34.6 ± 6.8 to 66.4 ± 4.5 at the last follow-up. K. Mader *et al.* elaborated that retrograde locked nailing is a reliable minimally invasive procedure to achieve fusion of the ankle and the subtalar joint after failed fusion. They found an average AOFAS of 73.5 points (range, 61 - 81 points) after surgery [13].

5. Conclusion

Minimally invasive tibio-talo-calcaneal arthrodesis is an alternative surgical technique for severe Charcot arthropathy of the ankle with correctable deformity. The functional outcome is impressive and comparable with the open surgery. However, the post-operative complications are anticipated in less than one fourth of patients. The patient's satisfaction with the procedure is high.

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Thank you very much.

Ethics Approval and Consent to Participate

We declare that we have:

Written permission was obtained from the administrative authority of Future Hospital.

Confidentiality was considered intentionally, data was used anonymously by using code Numbers instead of names to participants' identities and keep secure, and information was used for research purposes only.

Conflicts of Interest

The authors declare that they have no competing interests.

Authors' Contributions

S.N: Orthopaedics surgeon, conceptualization, methodology, resources, project administration, and writing original draft.

M.H: Orthopedic resident, conceptualization, data collection, methodology, and assisting in writing original draft.

A.K: Orthopedic resident, conceptualization, assist in data collection, and writing original draft.

H.A: Orthopedic surgeon, data curation, resources, validation, review and editing.

M.F: Orthopedic surgeon, resources, visualization, validation, and assisting in analysis & editing.

O.G: House officer, data curation, formal analysis, software, and assisting in writing original draft.

The manuscript has been read and approved by all the authors.

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Appendix

Minimally Invasive Hind-Foot Fusion in Charcot Patients Questionnaire

Serial No.: ☐

PR Number: ☐

1. Age (Years): ☐

2. Gender:

Male ☐ Female ☐

3. The Side of Operation:

Right ☐ Left ☐ Bilateral ☐

4. Complication:

Infection ☐ Non-Union ☐ Wound Dehiscence ☐

5. Satisfaction

Fair ☐ Full ☐ Unsatisfied ☐