

Functional and Radiological Outcomes of Closed Ankle Fractures Managed Non-Operatively Among Adults at Mulago National Referral Hospital Six Months Post-Injury: A Cross-Sectional Study

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ABSTRACT

Background: Non-operative management is a common approach for treating closed ankle fractures at Mulago National Referral Hospital (MNRH) due to its potential benefits, including shorter hospital stays and the absence of surgical risks. Evaluating functional and radiological outcomes is essential for determining the success of this treatment. This study aimed to evaluate the functional and radiological outcomes of ankle fractures managed non-operatively and to identify the factors associated with these outcomes.

Methods: This cross-sectional study assessed 93 adults with ankle fractures managed non-operatively at six months post-injury at Mulago National Referral Hospital. Functional outcomes were evaluated using the AOFAS ankle-hindfoot score, while radiological outcomes included fracture union and ankle alignment parameters. Data were analyzed using STATA, and modified Poisson regression was applied to identify factors associated with functional and radiological outcomes.

Results: The mean age and standard deviation were 41+/-12 years. More females, n=49(52.7%), had ankle fractures. The commonest fracture type was Weber B n=65(69.9%)> Weber C n=16(17.2%)> Weber A n=12 (12.9%). The mean AOFAS-AH score was 82.9 ± 14.9. Patients had an AOFAS-AH score categorized as good (54.8%)>excellent (23.7%)>fair (16.1%)>poor (5.4%). Eight-six (92.5%) had radiological union, and 7(7.5%) had nonunion. 97.7% of the patients had a normal MCS, 80.2% normal TFO, 50% normal TCA, and 13.9% normal TFCS. Significant predictors of poor functional outcomes included being HIV-positive, Weber B fractures, and Weber C fractures. Predictors of good functional outcomes included receiving physiotherapy and initiating weight bearing at 4-6 weeks or after 6 weeks

Conclusion: The majority of participants achieved radiological union, though all united fractures resulted in malunion. Worse functional outcomes were associated with Weber classifications B and C, as well as HIV-positive status.

KEYWORDS: Ankle fracture, Weber fracture classification, functional outcome, radiological outcome

INTRODUCTION

Non-operative management is a common approach for treating closed ankle fractures at Mulago National Referral Hospital due to its potential benefits, including shorter hospital stays and the absence of surgical risks. Evaluating functional and radiological outcomes is essential for determining the success of this treatment for ankle fractures. [1] Ankle fractures are common musculoskeletal injuries that can lead to considerable disability and diminished quality of life if not managed effectively. [2] The two main approaches to treating ankle fractures are non-operative and operative management. Non-operative management involves conservative measures such as immobilization in a cast, protected weight-bearing, and physical therapy.

Understanding the functional and radiological outcomes attained through non-operative management is crucial for evaluating the effectiveness of this treatment approach. [3] Additionally, identifying factors associated with treatment outcomes is essential to optimizing patient care and guiding clinical decision-making. [4] Factors such as patient demographics, injury characteristics, treatment protocols, and adherence to post-treatment rehabilitation may all play a role in influencing treatment success. [4]

Six months after sustaining an injury, individuals with non-operatively managed ankle fractures demonstrate both clinical and radiological union, as indicated by [5]. A 2020 systematic review and meta-analysis further support this, revealing that patients undergoing non-operative management for ankle fractures were assessed at the six-month mark and displayed favorable functional outcomes comparable to those in the operative group. The study conducted by [6] emphasizes that patients exhibited positive



radiological and functional outcomes at the six-month post-injury mark, with no statistically significant changes in functional outcomes observed beyond this timeframe.

In a retrospective cohort study conducted by [3], it was observed that, at the six-month follow-up, non-surgically managed ankle fractures had an average AOFAS score of 98. [3] This score was influenced negatively by factors such as age, affected side, fibular displacement, and the length of time the ankle was immobilized in plaster. At MNRH, a significant number of ankle fractures, both stable and unstable, are managed non-operatively due to challenges like resource limitations and a general fear of surgery among the population.

However, there is limited literature on the functional and radiological outcomes of this treatment approach. This study aimed to fill that gap by thoroughly examining these outcomes and the factors influencing them in adult patients at MNRH, Uganda. The insights from this study could improve ankle fracture management practices, enhancing patient care overall.

MATERIALS AND METHODS

Study Design

This was a hospital-based cross-sectional study conducted at MNRH in Kampala, Uganda. MNRH serves as the primary national referral hospital for the country, offering specialized healthcare services, training opportunities, and research activities. The study was conducted from December 2023 to March 2024 and ninety-three adults who had sustained ankle fractures six months earlier and were managed non-operatively were recruited in the study.

Inclusion Criteria

Patients ≥ 18 years of age with a closed ankle fracture which was managed non-operatively in a below-knee cast for a period not less than 8 weeks and had completed a period of 6 months following the injury at MNRH and consented to the study.

Exclusion Criteria

Patients were excluded if they did not have initial radiographs following injury to identify fracture patterns, had concomitant fractures in the ipsilateral limb, changed the treatment course and sought alternative care elsewhere, or had posterior malleolar fractures.

Study variables

The independent variables included age, sex, diabetes mellitus, HIV status, smoking, alcohol consumption, and Weber fracture classification. The moderating variables were the time to definitive management, re-manipulation, type of walking aid used, time to weight bearing, and post-cast removal physiotherapy. The dependent variables included the functional outcome as scored using the AOFAS ankle and hind foot score from 0-100 and radiological outcomes like nonunion and union with the talocrural angle (TCA), medial clear space (MCS), tibiofibular overlap (TFO), and the tibiofibular clear space (TFCS) measured for the union group.

Sample size

We recruited a total of 93 patients in the study.

Study procedure

Administrative clearance was secured from the Department of Orthopedics, Makerere University College of Health Sciences, and ethical approval was obtained from the School of Medicine Research and Ethics Committee (SOMREC). (Mak-SOMREC 2023-767)

Two research assistants who were orthopedic officers by training were recruited and trained by the principal investigator. They were tasked with patient recruitment and consent.

Patient records from the accidents and emergency plaster room, Bossa Orthopedic Outpatient Clinic, Ward 7, and trauma ward plaster room were accessed following permission from the in-charge of the various units, and contacts of eligible patients were retrieved.

Patients were invited by a phone call from the research team to participate in the study. They were required to travel back to MNRH for the study and were enrolled in the outpatient department of Orthopedics. Upon consent, the principal investigator examined the patients and gave a functional score based on the AOFAS-AHS, which has three main blocks of assessment that include pain, function, and ankle alignment. Patients' functional outcome was graded based on the score as excellent (95-100), good (75-94), fair (51-74), and poor (0-50). A block in this study was considered to be 80 meters. Flexion, extension, eversion, and inversion were



measured using a Gem Red 12” digital goniometer. The anterior drawer test, inversion, and eversion stress tests were used to assess ankle joint stability. The patient's initial radiographs were examined for fracture characteristics as an entry into the study, and the fractures were classified as Weber A, B, and C. New radiographs of the affected ankle were then obtained in three views (anteroposterior, lateral, and mortise views) using a Bucky system Phillips digital diagnose 4.1 x-ray machine. The radiographs were examined by a qualified radiologist, and the union or nonunion was noted. The TCA, TFO, TFCS, and MCS were measured by the radiologist and recorded in the data collection tool for all patients with radiological union.

Data analysis

The data from EpiData were imported into STATA version 15 for analysis. Descriptive statistics were used to summarize the study participants. For numerical variables, the mean and standard deviation were used if the data were normally distributed, while the median and interquartile range were used if the data were not normally distributed. Categorical variables such as sex, comorbidities, and fracture characteristics were summarized with frequencies and percentages.

Functional outcomes were computed using the AOFAS score and summarized in proportions. Radiological outcomes were described using frequencies and percentages. Bivariate and multivariate analyses were done using the modified Poisson regression analysis to determine the association between the independent, moderating, and dependent variables.

Ethical considerations

Permission was sought from the Department of Orthopedics, Makerere University, and approval from the School of Medicine Research and Ethics Committee (SOMREC). Participants provided written informed consent, and anonymity was ensured using patient codes. Regular plagiarism checks ensured originality, and participants with complications like malunion and non-union were referred for possible surgical intervention.

RESULTS

Description of study participants

A total of 93 participants were enrolled in the study. The mean and standard deviation of the age was 41±12 years old, and 49 (52.7%) were female. The median time to management was 1 day.

Table 1: Independent and moderating variables for the study population

Characteristic	Frequency (n)	Proportion (%)
Age categories (years)		
18-34	30	32.3
35-54	49	52.7
55+	14	15.0
Sex		
Male	44	47.3
Female	49	52.7
Smoking history		
No	87	93.5
Yes	6	6.5
Alcohol use		
No	55	59.1
Yes	38	40.9
Clinical factors		
HIV status		
Negative	70	75.3
Positive	2	2.2
Unknown	21	22.6
Diabetes history		
unknown	86	92.5

Yes	7	7.5
Fracture characteristics		
Weber classification		
A	12	12.9
B	65	69.9
C	16	17.2
Re-manipulation done		
No	87	93.6
Yes	6	6.4
Walking aid		
Elbow crutches	0	0.0
None	2	2.2
The walking frame	2	2.2
Axillary crutches	89	95.6
Start bearing time		
<4weeks	26	28.0
4-6 weeks	31	33.3
>6 weeks	36	38.7
Physiotherapy done		
No	65	69.9
Yes	28	30.1

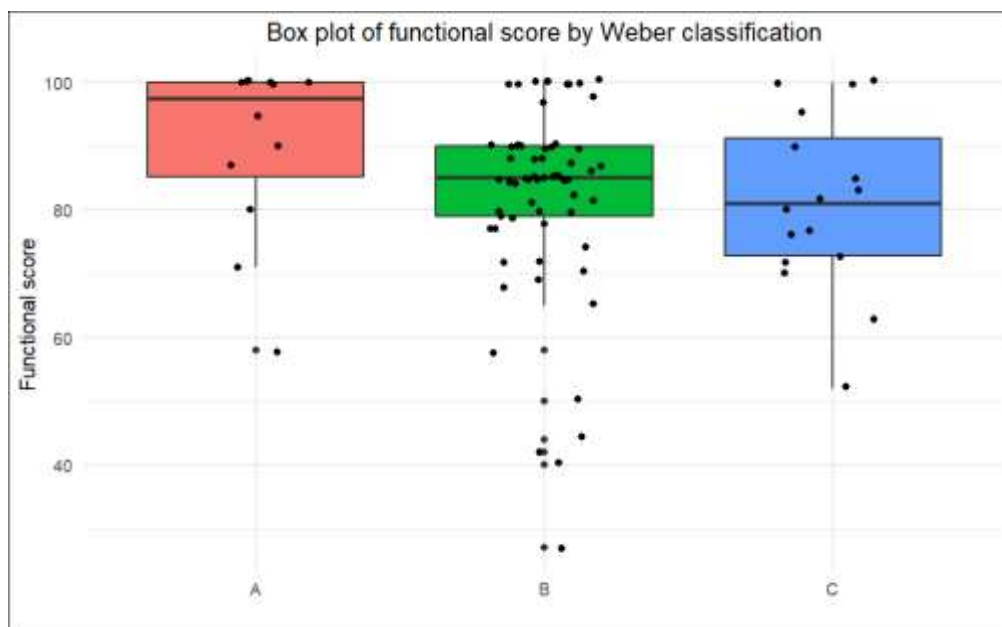


Figure 1. A box plot showing the effect of Weber classification on the functional outcome of the patient

Participants in Weber A had a median functional score of 97.5 (83.5-100) which was the highest compared to participants with Weber B, 85 (79-90) and Weber C, 81 (72.5-92.5)



Table 2: A table showing the radiological outcomes with proportions of participants with union, non-union and ankle joint parameters following union

Parameter	Proportion, n (%)	
UNION	86(92.5)	
NON-UNION	7(7.5)	
Parameters after union	Normal, n (%)	Abnormal, n (%)
MCS	84 (97.7)	2 (2.3)
TFO	69 (80.2)	17 (19.8)
TFCS	12 (13.9)	74 (86.0)
TCA	43 (50%)	43 (50%)

Table 3. Table showing factors that significantly affected the functional outcome at multivariate analysis

Characteristic	Adjusted OR [95%CI]	P-value
HIV status		
Negative	1.00	
Positive	0.02 [0.01-0.21]	0.001
Unknown	1.62 [0.58-4.50]	0.358
Weber classification		
A	1.00	
B	0.19 [0.04-0.77]	0.020
C	0.16 [0.03-0.87]	0.034
Start bearing time		
<4weeks	1.00	
4-6 weeks	5.09 [1.60-16.20]	0.006
>6 weeks	4.20 [1.42-12.43]	0.009
Physiotherapy done		
No	1.00	
Yes	4.45 [1.67-11.90]	0.003

DISCUSSION

The study aimed to assess the functional and radiological outcomes of ankle fractures treated non-operatively at MNRH six months after injury, where 93 patients were enrolled. Functional outcomes were evaluated using the AOFAS-AHS tool, while radiological outcomes were assessed through ankle radiographs in three views (AP, lateral, and mortise view).

The mean and standard deviation of the age were 41+/- 12 years. More females were affected 49(52.7%) compared to males 44(47.3%). Females were more affected than males because they have less muscle bulk compared to males, which leads to less protection of the joints as well as post-menopausal osteoporosis that leads to weaker bones, hence more susceptibility to fractures. Another study done in Sweden also showed that females (58.4%) were more affected. [7] Among the patients, 12.9% had Weber A fractures, 69.9% had Weber B fractures, and 17.2% had Weber C fractures. This is comparable to a study done by Nadeem and colleagues at Rawalpindi Medical University that showed that Weber B fractures were more prevalent at 45.8%, Weber C at 43.1%, and Weber A at 11.1%. [8] A systematic review of clinical outcomes of ankle fractures in sub-Saharan Africa, however, showed different results, with Weber C fractures more prevalent at 45%, Weber B at 38%, and Weber A at 12%. [9]

The mean functional score in our study was 82.9 ± 14.9, with 25% of participants scoring 77. This favorable outcome is likely due to strict adherence to casting instructions, resulting in a high rate of fracture union, improving functional recovery. Additionally, our study focused exclusively on closed ankle fractures, which typically have better prognoses than open fractures. This likely contributed to the higher functional scores observed in our cohort compared to studies that included open injuries. A study by van Schie-van der Weert E reported a mean AOFAS score of 98 for non-surgically managed ankle fractures. [3] The systematic review done in sub-Saharan Africa reported a lower AOFAS mean score of 68.2 at six months follow-up. [9] Most participants (54.8%)



achieved a good functional score (n=51).

Union was observed in 92.5% of cases, while 7.5% experienced nonunion, with a higher nonunion rate in males (9.1%) compared to females (6.1%). Most participants 84(97.7%) had normal MCS, 69(80.2%) had a normal TFO while only 12(13.9%) had a normal TFCS. Most 74(86.0%) abnormalities came from TFCS. The results from our study show that all patients who had union had some degree of malalignment at the ankle joint, as no patient in this group had all four parameters restored to normal; hence, all patients who united had a certain degree of malunion at the ankle joint. The restoration of these parameters is important in the biomechanics of the ankle joint, and this is vital in the distribution of forces across the ankle joint. A study done on the etiology of ankle arthritis showed that malalignment is a big risk factor for the development of ankle arthritis.[10]

The study found that Weber B and C fractures had significantly lower odds of achieving higher functional outcomes compared to Weber A fractures, with 81% and 84% lower odds, respectively. These findings align with [8] where Weber A fractures scored higher in functional outcomes than Weber B and C. The poorer outcomes for Weber B and C are due to their instability compared to the more stable Weber A fractures.

HIV-positive patients had 98% lower odds of achieving higher functional outcomes compared to HIV-negative patients. Despite the low proportion of HIV-positive patients in our study, the association of HIV and poor functional outcomes was significant in both bivariate and multivariate analysis, with narrow confidence intervals signifying that the occurrence is less likely by chance. HIV is known to cause a delay in fracture union through interruption of the blood supply to the bone, and this delay in union leads to poor functional outcomes in patients. [11] found that untreated HIV delays fracture healing, worsening with disease severity.

Similarly, [12] reported no significant difference in fracture union for early-stage HIV patients but higher non-union rates and poorer outcomes for advanced HIV patients.

Patients who started bearing weight 4-6 weeks after intervention were approximately 5 times more likely to achieve higher functional outcomes compared to those who started earlier (<4 weeks), with an odds ratio of 5.09 [95% CI 1.60-16.20]. Similarly, those who began bearing weight later (>6 weeks) had an odds ratio of 4.20, indicating they were 4.2 times more likely to achieve higher functional outcomes compared to those who started earlier. Within the initial 4 weeks, minimal or no callus formation occurs, and the fracture site remains highly unstable. Bearing weight during this period increases the risk of malunion and nonunion, ultimately impacting long-term ankle joint functionality.

Patients receiving physiotherapy were 4.45 times more likely to achieve higher functional outcomes. Physiotherapy serves to improve ankle mobility through regulated mobility exercises, as well as offering strengthening and stability exercises, all of which ultimately impact the functional outcome of the ankle. This explains why the patients who had attended physiotherapy had better functional outcomes compared to those who did not. This differs from a study by [13], which found no impact of supervised exercise on uncomplicated ankle fractures, possibly due to different patient populations. Our study included all ankle fracture types, showing improved function with physiotherapy, aligning with [14], which reported significant improvements with manual physical therapy for stable ankle fractures.

CONCLUSION

The mean AOFAS-AH score was 82.9 ± 14.9 , with Weber A participants having the highest median functional score, indicating that patients with Weber A fractures achieve better functional outcomes when managed non-operatively compared to those with Weber B and C fractures. Most participants, 92.5% (n=86), achieved radiological union, although 7.5% (n=7) experienced nonunion, demonstrating a high union rate among patients managed non-operatively in our setting. However, none of the participants had all four parameters (TFCS, TFO, MCS, TCA) restored, meaning that all participants experienced some degree of malunion following non-operative management of their ankle fractures. Additionally, Weber classifications B and C, as well as positive HIV status, were associated with worse functional outcomes, suggesting that patients with Weber B and C fractures should be treated surgically, while those with HIV should receive special attention and be enrolled in aggressive physiotherapy programs to improve their functional outcomes.

List of abbreviations

AOFAS-AHS	American Orthopedic Foot and Ankle Society ankle and hind foot score
HIV	Human Immunodeficiency Virus
LAT	Lateral



MCS	Medial Clear Space
MNRH	Mulago National Referral Hospital
TCA	Talocrural Angle
TFCS	Tibiofibular Clear Space
TFO	Tibiofibular Overlap

REFERENCES

1. Tunturi T, Kemppainen K, Pätäälä H, Suokas M, Tamminen O, Rokkanen P. Importance of anatomical reduction for subjective recovery after ankle fracture. *Acta Orthop.* 1983;54(4):641–7.
2. Mcphail SM, Dunstan J, Canning J, Haines TP. Life impact of ankle fractures: Qualitative analysis of patient and clinician experiences. 2012 [cited 2023 Jul 27]; Available from: <http://www.biomedcentral.com/1471-2474/13/224>
3. Van Schie-Van Der Weert EM, Van Lieshout • E M M, De Vries • M R, Van Der Elst • M, Schepers • T. Determinants of outcome in operatively and non-operatively treated Weber-B ankle fractures.
4. Alhammoud A, Khamis KM, Mekhaimar MM. Surgical versus non surgical management of Geriatrics ankle fractures. A Systematic Review and Meta-analysis. 2018 [cited 2023 Aug 15]; Available from: <http://www.sagepub.com/journalsPermissions.nav>.
5. Kurar L. Clinical audit of ankle fracture management in the elderly *. 2016 [cited 2023 Aug 21]; Available from: <http://dx.doi.org/10.1016/j.amsu.2015.12.061>
6. Javed OA, Javed QA, Ukoumunne O, Mascio L Di, Javed OA. ORE Open Research Exeter TITLE Surgical versus conservative management of ankle fractures in adults: A systematic review and meta-analysis A NOTE ON VERSIONS Surgical versus conservative management of ankle fractures in adults: a systematic review and meta-analysis. 2020 [cited 2023 Nov 16]; Available from: <http://hdl.handle.net/10871/40219>
7. Juto H, Nilsson H, Morberg P. Epidemiology of Adult Ankle Fractures: 1756 cases identified in Norrbotten County during 2009-2013 and classified according to AO/OTA. *BMC Musculoskelet Disord.* 2018 Dec 13;19(1).
8. Shakir A, Zahid T, Qayyum N, Kashmiri N, Ahmed Shakir I. Pattern of Bimalleolar Ankle Fractures [Internet]. Vol. 21, *Journal of Rawalpindi Medical College (JRMC)*. 2017. Available from: <https://www.researchgate.net/publication/335927456>
9. Samuel Edward Davies P, Pennington R, Singh Dhadwal A, Chokotho L, Nyamulani N, Mpanga C, et al. Clinical outcomes of ankle fractures in sub-Saharan Africa: a systematic review. *European Journal of Orthopaedic Surgery & Traumatology* [Internet]. 2023;33(3):547–57. Available from: <https://doi.org/10.1007/s00590-022-03397-7>
10. Herrera-Pérez M, González-Martín D, Vallejo-Márquez M, Godoy-Santos AL, Valderrabano V, Tejero S. Clinical Medicine Ankle Osteoarthritis Aetiology. *J Clin Med* [Internet]. 2021;10:4489. Available from: <https://doi.org/10.3390/jcm10194489>
11. Libois A, Clumeck N, Kabeya K, Gerard M, De Wit S, Poll B, et al. Risk factors of osteopenia in HIV-infected women: No role of antiretroviral therapy. *Maturitas.* 2010 Jan;65(1):51–4.
12. A.S. Kamat, M. Govender. THE EFFECTS OF HIV/AIDS ON FRACTURE UNION. *orthopaedic proceedings* . 2010 Mar 1;92-BNo.SUPP_1(1):228–228.
13. Moseley AM, Beckenkamp PR, Haas M, Herbert RD, Lin CWC, Evans P, et al. Rehabilitation after immobilization for ankle fracture: The EXACT randomized clinical trial. *JAMA - Journal of the American Medical Association.* 2015 Oct 6;314(13):1376–85.
14. Painter EE, Deyle GD, Allen C, Petersen EJ, Croy T, Rivera KP. Manual physical therapy following immobilization for stable ankle fracture: A case series. *Journal of Orthopaedic and Sports Physical Therapy.* 2015 Sep 1;45(9):665–74.

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