

Original Research Article

A prospective study of the surgical management of malleolar fractures around the ankle

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ABSTRACT

Background: Ankle fractures are commonly occurring fractures, especially in the aging population, where they often present as fragility fractures.

Methods: Malleolar (mono, bi and tri malleolar) fracture patients treated at a tertiary healthcare centre located in South Kerala, India were included in this prospective study. The present study comprised of 27 patients over 20 years of age with closed, unstable or displaced ankle malleolar fractures treated surgically attending the study centre over a period of 6 months. After a clinical evaluation, a full survey was done to rule out major damage. After surgical intervention, follow-up occurred every 6 weeks for at least 8 months. The study used Baird and Jackson's subjective, objective and radiographic ankle scoring method to assess functional outcome.

Results: The findings indicated that the predominant injury types according to the lauge hansen classification were supination-external rotation (40.7%) and pronation-external rotation (40.7%). The results indicated that the majority of participants achieved excellent scores (59.25%), followed by good scores (18.5%), fair scores (14.8%) and poor scores (7.4%).

Conclusions: The study of surgical interventions for malleolar fractures at the ankle demonstrates that open reduction and internal fixation (ORIF) is an effective treatment method, leading to improved functional outcomes. The findings underscore the importance of precise anatomical alignment and stable fixation in mitigating issues such as malunion and non-union.

Keywords: Ankle, Fixation, Function, Open reduction, Outcomes

INTRODUCTION

Ankle fractures (AF) are the most common type of lower limb fracture and one of the most common types of fracture worldwide.¹ Such fractures can result in muscular contractures around the ankle joint, reducing ankle mobility and influencing an individual's capacity for daily activities.² AF occur in all ages and both genders, but with a bimodal distribution curve, with the first peak in young men and a second peak in older women.³ The dislocation of ankle fracture is a more severe injury and is characterized by the loss of alignment of tibial and talar articular surfaces.⁴ Patients with ankle fracture-

dislocations typically exhibit inferior functional results.⁵ This may be attributed to the fact that injuries resulting from higher violence intensify the damage to the ligaments encircling the ankle joint.

Consequently, the management of this injury type requires robust evidence to formulate a comprehensive and improved treatment protocol, encompassing emergency care, surgical scheduling and surgical methodology, among other factors.⁶⁻⁸ AFs are common and account for up to 10% of all bone injuries with a rising incidence over the last decades.^{9,10} The incidence of AF is estimated between 101 fractures per 100,000 inhabitants per year in

Europe and 184 fractures per 100,000 inhabitants per year in the United States. In Finland, AFs are very frequent, with a prevalence of 154 fractures per 100,000 inhabitants per year. Of these, approximately 53% are unstable fractures requiring surgical treatment.¹¹

Most AF are complex injuries that are difficult to manage. These injuries gain importance because the whole-body weight is transmitted through the ankle and locomotion depends upon the stability of the ankle joint. They have the potential to produce significant long-term disability and complications in the form of pain, instability and early degenerative arthritis.¹²

The operative method restores the anatomy and contact-loading characteristic of the ankle. Additional advantages include easier rehabilitation without a cast, early mobilization and earlier weight bearing.¹³

Although fractures about the ankle have traditionally been considered non-controversial with respect to the indications for operative intervention, recent advances in the understanding of the biomechanics of the ankle have given rise to areas of clinical uncertainty.

These include the indications for the operative treatment of isolated fractures of the lateral malleolus, the operative techniques for syndesmotic injury and its post-operative management and the reliability of radiographic assessment of fractures about the ankle.¹³

The purpose of this study, on malleolar fractures of ankle is to evaluate the functional outcome and results obtained after surgical management by internal fixation, the treatment options with Open reduction internal fixation (ORIF) technique available for malleolar fractures, to evaluate the need for proper anatomical alignment and stability of ankle joint, which can lead to rewarding outcome for the patient and surgeon.

METHODS

The present study was a prospective study which included patients who suffered from malleolar (mono, bi and trimalleolar) fractures and were treated at Azeezia Institute of Medical Sciences and Research located in South Kerala, India.

The study was conducted for a period of six months between January 2019 and June 2019. The study was conducted after obtaining informed consent from all study participants along with ethical clearance from Institutional Ethics Committee.

Inclusion criteria

The present study included patients aged above 20 years suffering from an unstable and/ or displaced malleolar fracture of the ankle which was closed in nature and treated surgically.

Exclusion criteria

Patients with open fractures, stable malleolar ankle fractures which were treated conservatively and patients treated by non-operative methods were excluded from the study.

A total of 27 patients who fulfilled the selection criteria were treated at the study centre during the study period and were included in the final analysis.

Procedure

On admission of the patient, a careful history was elicited from the patient and/or attendants to reveal the mechanism of injury and the severity of trauma. The patients were then assessed clinically to evaluate their general condition and a complete survey was done to rule out significant injuries. Careful examination was done to rule out fractures at other sites. Local examination of injured ankle and following clinical signs were looked for.

Dorsalis pedis artery and posterior tibial artery pulsations were checked and noted. Distal neural status was also examined and noted. Instability of the syndesmosis was identified based on the mechanism of injury and the fracture pattern. Pain elicited with the squeeze test (manual medial-lateral compression across the syndesmosis) and the external rotation stress test was considered as indicative of clinical syndesmotic instability.

Radiologically, tibiofibular clear space of more than six millimetres and widening of the medial clear space of more than four millimetres were considered as indications of syndesmotic instability. Intraoperatively, the stability was checked by laterally displacing the distal fibula from the tibia, if >3 or 4 mm of lateral shift of talus occurs, it suggests instability (Cotton test).¹⁴

Fractures of the ankle were evaluated using plain radiographs in anteroposterior, lateral and mortise views. The fractures were classified using the Lauge-Hansen, Danis Weber classification systems and anatomical types. Closed reduction and a below knee posterior POP slab were applied. Routine investigations were done. The patients were taken for surgery as early as possible once the general condition is stable and fit for surgery. The routine investigations were as follows: Hb%, Urine for sugar, RBS, Blood urea, Serum creatinine, HIV, HbSAG and ECG.

Under spinal and /epidural anaesthesia, the patient was placed in lateral decubitus position for adequate exposure of lateral malleolus. Pneumatic tourniquet was applied in all cases.

The procedure was performed in a bloodless field, which facilitates good visibility to describe the fracture pattern and thus facilitating anatomical reduction. For medial malleolus fixation, patient was placed in supine position

with affected leg in figure of 4 position. In the case of posterior malleolar fractures, a posterolateral approach was employed.

Postoperative protocol

Parenteral antibiotics were given in the post-op period and ankle immobilized in a below knee U slab. After 10 to 12 days, the sutures were removed. Non-weight bearing gait was started from first or the second postoperative day. Partial weight bearing was started after the removal of the slab (after clinical and radiological signs of union become evident). Active exercises of the ankle was advised.

In patients with syndesmotic screw fixation, weight bearing was delayed till screw removal. Follow up of cases was done at regular intervals of 6 weeks for minimum of 8 months. At each assessment, all patients were questioned with regard to pain, use of analgesics, stiffness, swelling, activities of daily living, use of walking aids and return to work and participation in sports.

At examination, the gait, any thickening, swelling, tenderness of the ankle and the range of motion of the ankle were evaluated. Anteroposterior, lateral and mortise radiographs of ankle were made at the time of examination. Baird and Jackson's ankle scoring system of subjective, objective and radiographic criteria was used for the study. All the patients were evaluated at 6 weeks interval and scores were given.

Statistical analysis

The collected data was then entered into excel sheet and analysed using statistical package for the social sciences (SPSS) v 23.0.

RESULTS

The present study included 27 patients of which most belonged to the age group of 51-65 years (37%) followed by 41-50 years (26%). The gender distribution showed that the study included more female patients (59.3%).

The distribution of side involved showed that the right ankle was involved more commonly (66.6%). The most common mode of injury was fall (44.4%) followed by road traffic accidents (37%) with hypertension being the most reported comorbidity (25.9%).

The results also showed that the most common type of injury based on the Lauge Hansen classification was Supination-external rotation (40.7%) and Pronation-external rotation injury (40.7%) followed by supination adduction (11.1%) and pronation adduction (7%).

Based on the Danis Weber classification, most injuries were typing C (44.44%) followed by type B (37.03%). The time between injury and intervention was calculated and the results showed that most participants received

treatment on the 2nd day (51.8%) followed by the 1st day (44.4%).

Of the fractures observed during the course of the study, bimalleolar fractures were the most common (55.5%) followed by unimalleolar (25.9%) and Trimalleolar/fracture dislocation (18.5%). The treatment of medial malleolar fractures included most of cancellous lag screw (55.5%) followed by malleolar screw (37%).

Lateral malleolar fractures were mostly treated using one third tubular plate (44.4%) followed by dynamic compression plate (33.3%). Posterior malleolar fractures were treated by means of fixation with lag screws or by no fixation (Table 2).

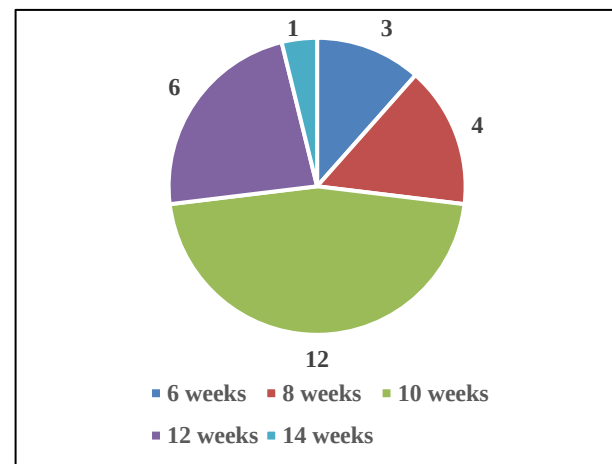


Figure 1: Time taken for union of fractures.

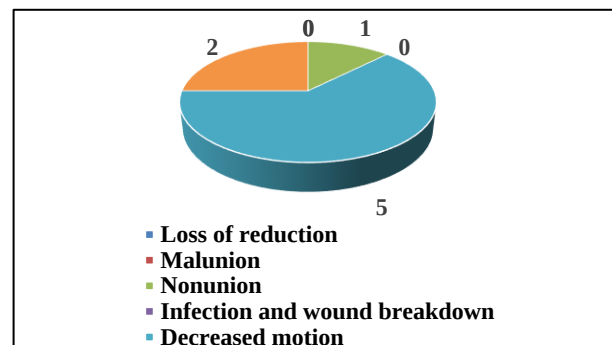


Figure 2: Distribution of complications.

The functional outcome of ankle fractures was assessed using the Baird and Jackson classification and depicted in table 3 and 4, the results showed that most participants presented with excellent scores (59.25%) followed by good scores (18.5%), fair scores (14.8%) and poor scores (7.4%). Based on the results from Figure 1, the time taken for union of fracture among most patients was 10 weeks (12) followed by 12 weeks (6) and 8 weeks (4). The distribution of complication was depicted in figure 2 and the results showed that loss of reduction was the most common complication reported followed by ankle arthrosis and non-union.

Table 1: Demographic and clinical findings of the study participants.

Variable	Categories	%
Age (in years)	21-30	11
	31-40	15
	41-50	26
	51-65	37
	>65	11
Gender	Male	40.7
	Female	59.3
Side involved	Right	66.6
	Left	33.3
Mode of injury	Road traffic accident	37
	Fall	44.4
	Twist Injury	18.5
Associated comorbidities	Diabetes	8.5
	Hypertension	25.9
	Rheumatoid arthritis	3
	Other extremity injuries	8.5
Lauge hansen type	SER	40.7
	SA	11.1
	PA	7
	PER	40.7
Danis weber type	Type B (Trans syndesmotic)	37.03
	Type C (Supra syndesmotic)	44.44
Time interval between injury and intervention	1 day	44.4
	2 days	51.8
	>7 days	3
Malleolar fractures	Unimalleolar	25.9
	Bimalleolar	55.5
	Trimalleolar	18.5
	Syndesmotic disruption (which required fixation)	14.8
	Fracture dislocation	18.5

Table 2: Distribution of treatment of individual fractures.

Fractures		
Medial malleolar fractures		
Implants	Malleolar screw	37%
	Cancellous lag screw	55.5%
	TBW	3%
	K wire	92.5%
Lateral malleolar fractures		
Implants	DCP plate	33.3%
	One third tubular plate	44.4%
	TBW	3%
	Lag screw	3%
Posterior malleolar fractures		
	Fixation with lag screw	60%
	No fixation	40%

Table 3: Distribution of patients based on bird and Jackson scoring system subcategories.

Category	A	B	C	D	E	Total
Pain	19	7	1	0	0	27
Stability	27	0	0	0	0	27
Walking	17	8	2	0	0	27

Continued.

Category	A	B	C	D	E	Total
Running	7	15	5	0	0	27
Work	18	9	0	0	0	27
Motion	21	6	0	0	0	27
Radiographs	22	4	1	0	0	27

Table 4: Distribution of patients based on outcomes of Bird and Jackson scoring system.

Functional scores	No. of cases	%
Excellent	16	59.25
Good	5	18.5
Fair	4	14.8
Poor	2	7.4

DISCUSSION

Ankle fractures are among the most common joint injuries of the lower extremity and have been identified as a significant source of morbidity for both the young and the elderly. Open surgical intervention can restore articular congruence, while it naturally carries the various operative and post-operative risks.⁶ The present study was conducted to assess the functional outcomes of such interventions among patients suffering from ankle fractures. The present study included 27 patients of which most belonged to the age group of 51-65 years followed by 41-50 years while also including more female patients. Prior research indicates that women have a significant rise in ankle fractures between the ages of 30 and 60. The prevalence among females increases markedly due to factors such as osteoporosis and diminished bone mineral density as they near menopause. The largest prevalence of ankle fractures is observed in females over 65, primarily due to osteoporosis and falls. Within this group, women are more predisposed to these injuries than males, contrasting the pattern observed in younger populations.^{15,16} The distribution of the affected side indicated a higher prevalence of involvement in the right ankle. The predominant cause of injury was falls, succeeded by road traffic accidents, with hypertension being the most frequently reported comorbidity.

Research indicates that right-sided ankle fractures may occur more frequently than left-sided fractures. A study revealed a statistically significant propensity for fractures to occur more commonly on the right side, especially among male patients engaged in high-energy activities like motorcycle accidents and sports injuries. This may be ascribed to variables such as the predominance of the right foot in the majority of persons, resulting in heightened utilization and susceptibility to injury.^{17,18} Individuals with orthostatic hypotension are susceptible to abrupt decreases in blood pressure upon standing, potentially resulting in dizziness or syncope. This disease markedly elevates the likelihood of falls, rendering these patients more susceptible to injuries, including ankle fractures. Research demonstrates that individuals hospitalized for unexplained syncope or orthostatic hypotension had an increased risk

of subsequent fractures, notably ankle fractures, attributable to falls arising from these events.^{19,20}

According to the Lauge Hansen classification, the most frequent injury types were supination-external rotation (40.7%) and pronation-external rotation injury (40.7%), which were followed by supination adduction (11.1%) and pronation adduction (7%). The majority of injuries were classified as type C (44.44%) by Weber et al, with type B (37.03%) coming in second. SER injuries account for a significant proportion of ankle fractures, with studies indicating that they represent approximately 40% to 75% of all ankle fractures in various populations, including those in India.^{20,21} This aligns with global findings where SER injuries are consistently reported as the most common type.²⁰

The time elapsed between damage and intervention was assessed, indicating that most subjects received treatment on the second day, followed by the first day. Medical guidelines occasionally recommend delaying surgical intervention briefly to allow for the reduction of swelling or to more accurately assess the stability of the fracture. This method is particularly relevant in cases of soft tissue injury, as it enhances the environment for surgical interventions and clarifies this result.⁷ The management of medial malleolar fractures involved primarily the use of cancellous lag screws, succeeded by malleolar screws. Lateral malleolar fractures were predominantly managed using a one-third tubular plate, then supplemented by a dynamic compression plate. Posterior malleolar fractures were managed with fixation with lag screws or without treatment. Research by Singhal et al, revealed that surgical stabilization of medial malleolar fractures frequently employs cancellous screws, corroborating your findings. Their findings demonstrated that internal fixation markedly enhances functional outcomes, corroborating your fact that 55.5% of patients were treated with cancellous lag screws, which are proficient in attaining anatomical reduction and stability.²² A further study indicated favourable results with malleolar screws for analogous fractures, highlighting the significance of secure fixation in reinstating joint function and mitigating sequelae such as arthritis.²³

The application of one-third tubular plates for lateral malleolar fractures aligns with data from other studies, which indicate that these plates offer sufficient stability while permitting anatomical adaptation to the fibula. A comparative investigation indicated that one-third tubular plates were helpful in treating unstable lateral malleolar fractures, corroborating your finding of 44.4% application of this technique.²⁴ The therapy of posterior malleolar fractures frequently depends on the dimensions and displacement of the fracture fragment.

Certain studies indicate that the fixation of bigger pieces with lag screws is prevalent, whereas smaller or non-displaced fragments may not necessitate fixation, aligning with your observations on diverse treatment methodologies.²⁵ Research suggests that non-fixation may be a feasible approach for specific posterior malleolar fractures, provided they do not jeopardize joint stability, emphasizing the necessity for therapy to be customized according to the unique characteristics of each fracture.²² The functional outcomes of ankle fractures were evaluated using the Baird and Jackson classification, revealing that the majority of individuals achieved outstanding scores (59.25%), followed by good scores (18.5%), fair scores (14.8%) and poor scores (7.4%). In contrast, the findings of a study by Mohapatra A et al, indicated that 20.24% of patients achieved exceptional scores, 55.95% attained good scores, 17.86% received acceptable ratings and 5.95% were classified as having bad scores.²⁶

A study conducted by Saraf et al indicated that all patients undergoing treatment for ankle fractures exhibited suboptimal outcome scores during the initial three months, which subsequently improved to good and exceptional values by 9-12 months.²² This portion can be reinforced by the results of the present study where the time taken for union of fracture among most patients was 10 weeks followed by 12 weeks and 8 weeks. This discrepancy may be attributed to varying treatment methods or differing levels of expertise across healthcare practitioners. The findings of the current study align with earlier research indicating elevated success rates in the management of ankle fractures. A study by Vem KB et al, indicated that around 60-70% of patients with ankle fractures attained outstanding functional outcomes post-surgery, especially with the application of internal fixation procedures utilizing plates or screws.²⁷ This indicates that the therapy procedures utilized in your study correspond effectively with recognized practices that provide positive outcomes. Of the complications reported among patients, loss of reduction was the most common complication reported followed by ankle arthrosis and non-union. Inadequate fixation, soft tissue compromise, patient non-compliance, infection and delayed healing are the common causes of loss of reduction which can further lead to functional impairment and risk of arthritis.²⁷ The drawbacks of the present study included the limited sample size of patients who received surgical intervention for ankle fractures. Secondly, not all patients underwent computed tomography (CT) for diagnostic purposes and measures.

Certain authors have proposed that CT scans may be necessary for precise measurement of the malleolus's size and architecture, as well as their reductions. Thirdly, the results of the surgical management were solely reliant on the Baird Jackson score and the precise management of reductions was not conducted.

The follow-up period may have been insufficient to accurately assess the outcome. This study highlights the efficacy of open reduction and internal fixation (ORIF) in attaining positive functional outcomes, with a significant proportion of patients indicating outstanding results. The results affirm that precise anatomical restoration and stable fixation are essential for reducing problems and improving recovery. This study underscores the necessity for customized surgical strategies according to fracture type to enhance patient outcomes.

CONCLUSION

The examination of malleolar fractures indicates that open reduction and internal fixation (ORIF) is an effective treatment, resulting in enhanced functional outcomes. Critical aspects encompass accurate anatomical alignment and secure fixation, which mitigate problems like as malunion and non-union. By tailoring surgical procedures to particular fracture patterns, surgeons can improve recovery and patient satisfaction. Continued study must concentrate on long-term outcomes and the enhancement of treatment options for ankle fractures.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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