

Original Research Article

Study of clinical and functional outcome of malleoli fracture

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ABSTRACT

Background: Ankle fractures are a common orthopedic injury, accounting for 9% of all fractures, with an increasing incidence among both young and elderly populations. These fractures often result from road traffic accidents, falls, and sports injuries. Malleolar fractures, involving the bony prominences of the ankle, are particularly prevalent and necessitate accurate reduction and stable internal fixation to prevent complications such as post-traumatic arthritis and restricted motion. This study aims to assess the functional outcomes and results of surgical treatment of malleolar fractures.

Methods: The study utilized Lauge-Hansen's classification to analyze the mechanism of injury in 32 patients with ankle fractures. Surgical techniques included the fixation of syndesmotic injuries with anatomical fibular plates, (AFP) posterior malleolus fractures with percutaneous screws or Ellis plates, and medial malleolus fractures with tension band wiring (TBW). The outcomes were measured in terms of union time, range of motion, and stability.

Results: The most common injury mechanism was supination external rotation (SER) in 14 patients, followed by pronation external rotation (PER) in 7 patients, pronation abduction (PAB) in 6 patients, and supination adduction (SAD) in 5 patients. Syndesmotic injuries were found in 7 patients, all treated surgically except one. Posterior malleolus fractures were present in 3 patients and treated with screws or plates. Fixation of medial malleolus fractures with TBW showed better union rates and improved range of motion compared to screw fixation. Lateral malleolar fractures treated with AFP provided additional stability. The average union time was 6 to 8 weeks.

Conclusions: Anatomical reduction and stable internal fixation are crucial for the successful treatment of malleolar fractures. TBW for medial malleolus fractures and AFP for lateral malleolar fractures provide favorable outcomes. However, a larger sample size and longer follow-up duration are required to further evaluate the outcomes of ankle injuries, particularly in older patients with osteoporosis and comorbidities.

Keywords: Ankle fracture, Lauge-Hansen classification, Malleolar fracture, TBW, ORIF

INTRODUCTION

Ankle fractures are common lower limb injuries, constituting 9% of all fractures with an incidence of up to 174 cases per 100,000 adults annually; about 2% are open fractures. Causes include twisting injuries, falls, and, in India, road traffic accidents or trivial injuries in osteoporotic bones. The prevalence of ankle fractures has risen among both young, active individuals and the elderly in recent decades. Malleolar fractures, involving the

medial, lateral, and posterior malleoli, are prevalent in orthopaedics and require precise reduction and stable internal fixation. Inaccurate reduction can lead to painful restrictions or osteoarthritis.¹⁻³ Stable fractures often benefit from conservative treatment, while unstable, displaced, and open fractures necessitate surgical intervention.^{4,5} Ankle fractures are classified into unimalleolar, bimalleolar, and trimalleolar sub-groups, with studies showing varying functional outcomes across these classifications.^{6,7}

The study aims to evaluate the functional outcomes of surgical treatment for malleolar fractures. Pott's fractures, named after Sir Percival Pott, involve breaks in one or more malleoli due to traumatic stress.⁸ Sir Robert Jones highlighted the ankle's vulnerability and the challenges in treating such injuries.⁹

In France, these are also known as "Dupuytren" and "Maisonneuve" fractures.^{10,11} Most ankle fractures are isolated malleolar, with bimalleolar occurring in about 25% and trimalleolar in 5-10% of cases.¹²⁻¹⁴ Initial evaluation includes physical examination and X-rays, with classifications by AO foundation, Lauge-Hansen, or Denis-Weber systems.¹⁵ Evaluating syndesmosis stability is crucial for joint reconstruction, with a 2% postoperative infection rate and up to 10% of patients developing ankle arthrosis over the long term.^{16,17}

Aim and objectives

Aim

The aim of this study is to study the clinical and functional outcomes of malleolifracture.

Objectives

Objectives were to study the mode of presentation based on the classification, to study the outcomes and results of surgical treatment of malleolar fracture and to study the complications of malleolar fracture and its management.

METHODS

The 30 cases of Malleoli fractures who admitted in department of orthopaedics, Dhiraj hospital at SBKS medical institute and research centre, Vadodara. During period of 15th January 2020 to 31st October 2021.

Inclusion criteria

All closed malleolar fractures and patients above the age of 18 years with skeletal maturation were included.

Exclusion criteria

Pathological fractures, open fractures, patient not willing to participate in study, not fit for surgical intervention and patients in which conservative management is taken were excluded.

Study type

It was prospective observational study.

Statistical method

MS excel was the statistical software used to analyze the data and obtain results.

Examination and treatment

Patients received a thorough initial survey to identify significant injuries upon arrival. Radiographic assessments included anteroposterior, lateral, and mortise views of the ankle. Detailed history was collected, covering age, sex, occupation, mode of injury, and associated medical conditions. Clinical examination focused on heel position, scar marks, bony tenderness, and pulse checks. A below-knee slab was applied with analgesics and anti-inflammatories to manage pain and swelling. If there were open wounds, antibiotics were administered. Fractures were classified according to Lauge-Hansen and Denis-Weber systems. Preoperative investigations were completed, and surgery was planned after swelling reduction and anesthesia clearance.

Preoperative preparation

Informed consent was obtained from patients. The affected area was prepared, and patients were kept NBM (nil by mouth) overnight. Intravenous antibiotics were administered 30 minutes prior to surgery.

Operative technique

Surgical procedures were performed through separate incisions for the medial, lateral, and posterior malleoli. The primary goal was anatomical reduction and restoration of the ankle mortise. Techniques included:

Lateral malleolus: Anterolateral J-shaped incision used for exposure. Fixation methods varied based on fracture configuration, including TBW, cannulated screws, or anatomical plates.

Medial malleolus: Incision over the medial malleolus, exposure of the deltoid ligament, and fracture reduction using clamps or Kirschner wires.

Posterior malleolus: Direct approach with either posterolateral or posteromedial incisions, or indirect through other incisions if necessary. Fixation involved plates or K-wires.

Postoperative management

The ankle was immobilized with a padded dressing and posterior plaster splint to maintain the right angle and prevent plantar flexion. Antibiotics (cefoperazone, sulbactam, and amikacin) were administered initially, transitioning to oral antibiotics if the wound was clean. Analgesics, antacids, and serratiopeptidase were also given. Wounds were inspected on days 2, 5, and 8. Sutures were removed on the 12th day if the fixation was stable and the wound clean. Physiotherapy started once the slab was removed, with weight-bearing restricted for 6 weeks. Partial weight-bearing was allowed after radiological confirmation of union, progressing to full weight-bearing

as tolerated.

Ethical approval taken from the SV institutional ethics committee.

RESULTS

The present study was conducted in Dhiraj general hospital and during this period, 32 patients with Malleoli fractures were operated and followed up from 15th January 2020 to 31st October 2021.

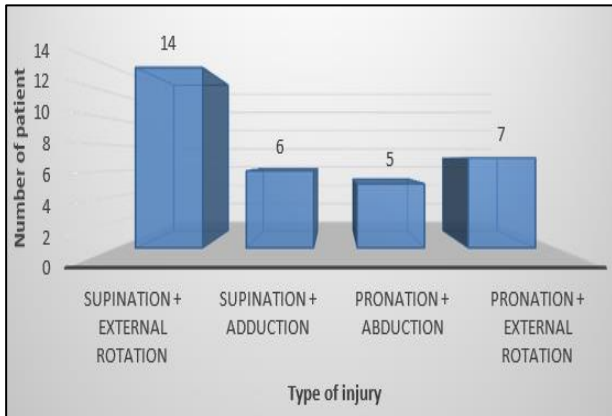


Figure 1: Injury according to Lauge-Hansen classification.

Injury according to Lauge Hansen classification

In this study, based on the Lauge-Hansen classification: supination + external rotation was the most common injury, affecting 14 patients (43.75%). Pronation + external rotation was seen in 7 patients (21.87%). Supination + adduction affected 6 patients (18.75%). The least common type was pronation + abduction, with 5 patients (15.63%).

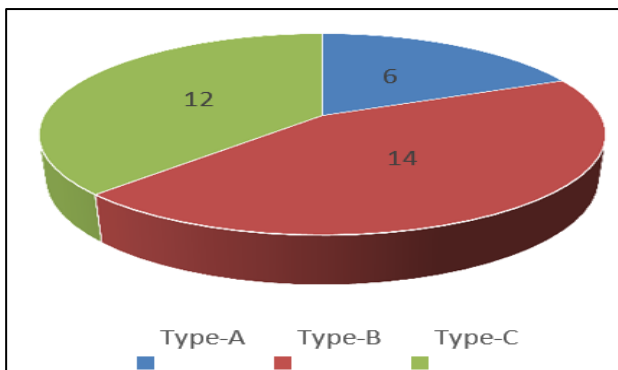


Figure 2: Injury according to Denis-Weber classification.

Injury according to Denis Weber classification

In our study, based on the Denis-Weber classification:

Type-B injury was the most common, affecting 14 patients (43.75%).

Type-C injury was the second most common, seen in 12 patients (37.5%).

Type-A injury was the least common, involving 6 patients (18.75%).

Medial malleolus

SER: 12 of 14 were treated with TBW, 2 with cannulated cancellous screws (CCS). Supination-adduction: All 6 treated with CCS. Pronation-abduction: All 5 treated with TBW. Pronation-external rotation: All 7 treated with TBW.

Overall: 75% treated with TBW, 25% with CCS. TBW was the most common method for medial malleolus fractures.

Lateral malleolus

SER: All 12 treated with AFP. SA and PA: 6 and 5 patients treated with rush pins. PER: 6 treated with AFP, 1 with a rush pin.

Overall: 58.06% treated with AFP, 38.70% with rush pins, and 3.24% with semi-tubular plates. AFP was the preferred method for lateral malleolus fractures.

Posterior malleolus

SER: 2 treated with CCS, 1 with plating. PER: 6 of 7 with syndesmotom injury were treated with syndesmotom screws.

Duration of union (weeks)

In our study, maximum 18 (56.27%) patients achieved union at 8th week followed by 9 (28.12%) patients achieved union at 9th week, 3 (9.37%) patients achieved union at 10th week and one patient each achieved union at 11th and 12th on x-ray.

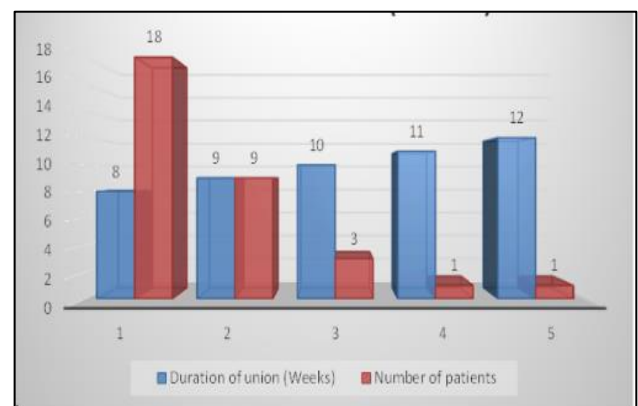


Figure 3: Duration of union (weeks).

Activity limitations at final follow up

In our study, 22 (68.75%) patients had no activity limitation, 6 (18.75%) patients had mild activity limitation and 4 (12.5%) patients had severe activity limitation. In our study, 23 (71.88%) patients had no walking difficulty at final follow up followed by 6 (18.75%) patients had some difficulty in walking and 3 (9.37%) patients had severe difficulty in walking at final follow up.

Sagittal motion (Plantar-flexion + Dorsi-flexion) at final follow up

In our study, 16 (50.00%) patients had 16-29 plantar-flexion and dorsi-flexion movements followed by 7 patients (21.87%) had more than 30 degree movements and 9 patients (28.13%) had less than 15 degree movements.

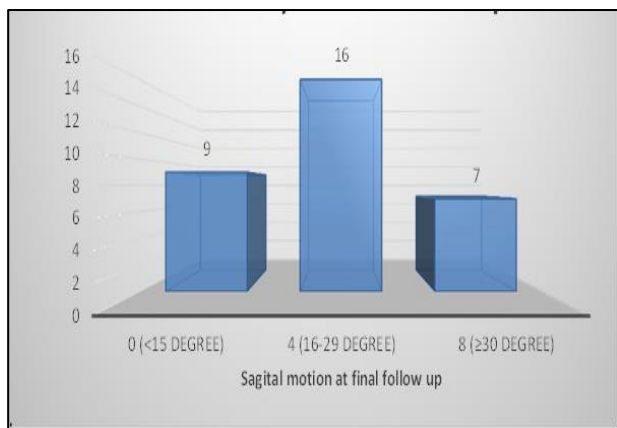


Figure 4: Sagittal motion (Plantar-flexion + dorsi-flexion) at final follow up.

Hind foot (Eversion + inversion) at final follow up

In our study, 22 (68.75%) patients had 16-29 degree eversion + inversion movements followed by 10 (31.25%) patients had less than 15 degree eversion + inversion movements.

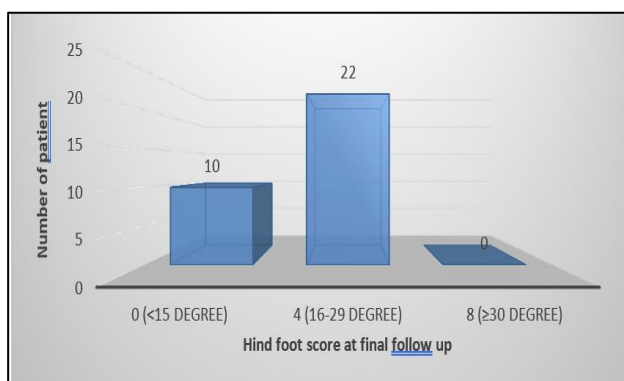


Figure 5: Hind foot (Eversion + inversion) at final follow up.

Result according to Lauge-Hansen classification

In the study of 32 patients: Overall results: 8 (25%) had excellent results, 15 (46.88%) had good results, 5 (15.63%) had fair results, 4 (12.5%) had poor results. Supination + external rotation (14 patients): 4 excellent, 6 good, 3 fair, 1 poor. Pronation + abduction (5 patients): 2 excellent, 2 good, 1 fair. Supination + adduction (6 patients): 1 excellent, 3 good, 1 fair, 1 poor. Pronation + external rotation (7 patients): 1 excellent, 4 good, 2 poor.

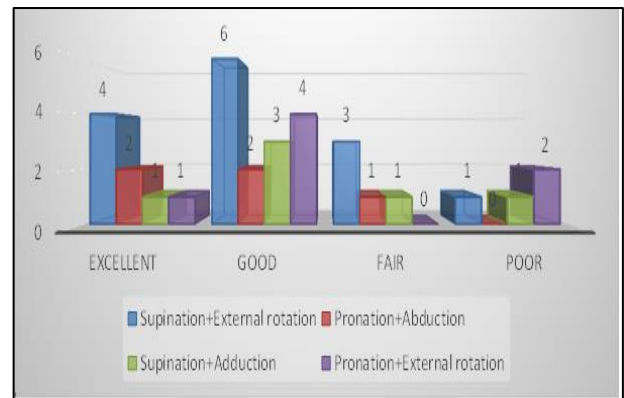


Figure 6: Result according to Lauge-Hansen classification.

Result according to Denis-Weber classification

In this study based on the Denis-Weber classification: Type A injury (6 patients): 1 excellent, 3 good, 1 fair, 1 poor. Type B injury (18 patients): 4 excellent, 9 good, 3 fair, 2 poor. Type C injury (8 patients): 3 excellent, 3 good, 1 fair, 1 poor.

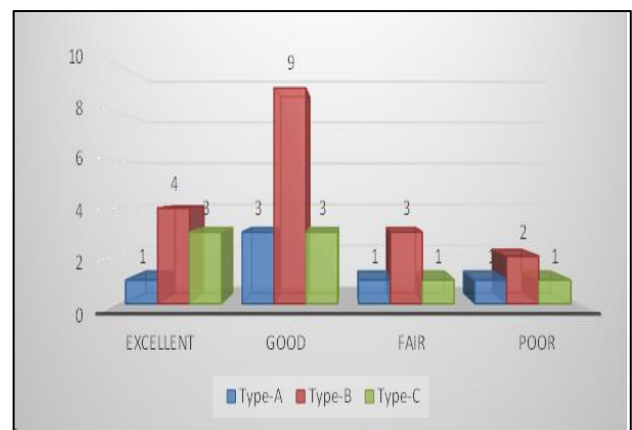


Figure 7: Result according to Denis-Weber classification.

Result according to ankle foot score

In the study: 15 patients (46.87%) had good results, 8 patients (25.00%) had excellent results, 5 patients (15.62%) had fair results and 4 patients (12.05%) had poor

outcomes.

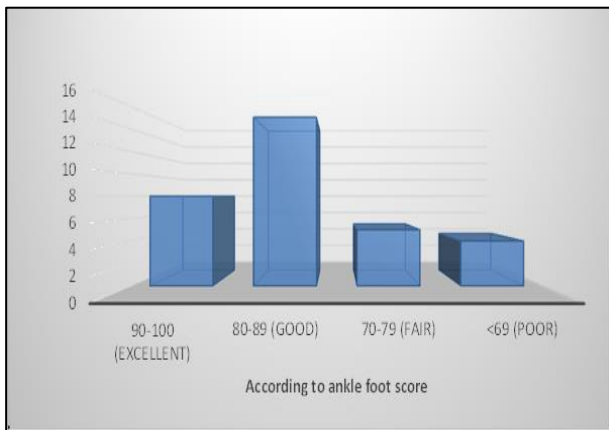


Figure 8: Result according to ankle foot score.

DISCUSSION

Ankle fractures are common, with up to 174 cases per 100,000 adults annually, often caused by road traffic accidents or trivial injuries in osteoporotic bones. Proper reduction and fixation of malleolar fractures are crucial to prevent complications like restricted motion or osteoarthritis.¹⁻³

Recent advancements have improved outcomes, including the use of the AO method for accurate open reduction and the introduction of minimally invasive techniques, such as tight rope fixation for syndesmotic injuries.^{18,19} New AFP offer better results than traditional plates, especially in elderly or osteoporotic patients.^{20,21}

Effective management of malleolar fractures relies on precise reduction and stable fixation. Modern techniques and AFP have enhanced recovery and outcomes, providing superior solutions for complex cases and improving functional results.^{22,23}

Boyer recognized that malleolus fractures or ligament injuries led to joint subluxation. Sir Astley Cooper categorized ankle injuries, including tibial margin fractures. In 1840, Maissonneuve linked external rotation to proximal fibula fractures. Lane was the first to recommend operative treatment for anatomic reduction.

In the 20th century, key developments included Destot who introduced the term "third malleolus," and Ashhurst and Bromer, who classified fractures by mechanism of injury. Coonard and Bugg described tibialis posterior tendon interposition preventing reduction, while Henderson coined the term "trimalleolar fracture."

Muller pioneered open reduction and internal fixation, while Lauge-Hansen created a widely-used classification system based on rotational injury mechanisms. Grath linked the height of fibula fractures to greater ligament

damage. Yablon and Heller emphasized the lateral malleolus's role in bimalleolar fracture reduction.

Beauchamp found operative treatment achieved better fracture positioning, while Pettrone concluded that open reduction was superior for bimalleolar fractures. Lindsoja showed improved outcomes with the Lauge-Hansen classification, and Weber's classification became favored for surgical treatment. Studies through the 1990s, such as those by Limbird and Carragre, highlighted the importance of timely surgical intervention and proper reduction techniques. Recent studies (2012-2014) have further refined surgical approaches and highlighted the role of tension bands and lag screws for specific fracture types.

Table 1: Comparison with Previous studies.

Authors	Good to excellent	Fair	Poor
Burwell et al ²⁸	77.3%	16.7%	6.0%
Colton ²⁹	70.0%	14.6%	15.0%
Beris et al ¹³	74.3%	14.6%	11.1%
DeSouza ⁷	90.0%	6.0%	4.0%
Our study	71.88%	15.62%	12.5%

Fixation techniques: Mohammed and Khalid Ahmed et al found that medial malleolus TBW provides more stable fixation than malleolar screws, reducing the chances of non-union.¹² In posterior malleolar fractures, the posterolateral approach is used for fixation with CCS or Ellis plates.

Patient demographics: In this study, the patients ranged from 20 to 65 years old (mean age 39.56 years), with the majority being young adults (20-30 years). This aligns with previous studies showing that ankle fractures are common in productive age groups. The 62.5% of the patients were male, similar to other studies, highlighting higher fracture incidence among men, possibly due to occupational hazards and greater use of transportation.

Injury distribution: The 62.5% of the ankle fractures were on the right side, which could be related to driving habits and motorbike use. Road traffic accidents were the most common cause (46.87%), followed by domestic falls (34.37%), and twisting injuries (18.75%).

Comorbidities: The 81.25% of patients had no comorbidities. Among the 6 patients with comorbidities, hypertension, diabetes, and hypothyroidism were the most common. Diabetes, in particular, was associated with delayed healing and complications, such as wound infections.

Injury classifications: According to Lauge-Hansen, SER (56.25%) was the most common injury type, while Type B (43.75%) was most frequent in the Weber classification. Medial malleolus fractures were mostly treated with TBW (75%), and lateral malleolus fractures with AFP (58.06%).

Complications and outcomes: Complications were rare, with 90.63% of patients having no issues. Two patients (6.25%) had deep infections. Most patients achieved radiological union by 8 weeks, with a mean union time of 7.04 weeks. Functional outcomes were generally positive, with 71.88% achieving good to excellent results according to the ankle and foot scoring system. SER injuries had the best outcomes, while poor results were associated with syndesmotic injuries and infections in PER fractures.

Limitations

Sample size: The relatively small sample size of 32 patients may not fully represent the diversity of ankle fracture cases, potentially limiting the generalizability of the findings.

Short follow-up period: The follow-up duration may be insufficient to capture long-term outcomes and complications, such as chronic pain or arthritis, which could affect the overall assessment of functional outcomes.

Variability in surgical techniques: Differences in surgical techniques and implant choices among surgeons could introduce variability in outcomes, making it difficult to isolate the effectiveness of specific interventions.

Lack of standardized functional assessment: variations in functional outcome assessments and scoring systems might lead to inconsistencies in evaluating and comparing results across different patients and studies.

Potential confounding factors: The presence of comorbidities and variations in pre-existing health conditions among patients could influence healing and functional outcomes, and these factors may not have been fully controlled or accounted for.

CONCLUSION

This study highlights that ankle fractures, particularly among young adults, significantly impact productivity and quality of life. Fixation techniques such as TBW for medial malleolus and AFP for lateral malleolus are effective in achieving stable fixation and good functional outcomes. SER fractures tend to have better outcomes compared to other types of injuries. Early identification and appropriate management of comorbidities like diabetes are crucial for minimizing complications. Overall, timely surgical intervention with the appropriate fixation method leads to favorable recovery and return to function in most patients.

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Conflict of interest: None declared

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

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