



ASSESSING THE NECESSITY OF SYNDESMOTIC SCREW FIXATION IN BIMALLEOLAR AND TRIMALLEOLAR FRACTURES POST-ORIF

Orthopaedics

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ABSTRACT

Background And Aims: Ankle fractures, particularly bimalleolar and trimalleolar, frequently result in syndesmotic injuries, contributing to joint instability and poor outcomes if not managed appropriately. The optimal use of syndesmotic screw fixation post-open reduction internal fixation (ORIF) in these fractures remains debated. This study aimed to evaluate the necessity of syndesmotic screw fixation in bimalleolar and trimalleolar fractures, assessing its impact on stability, recovery, and complications. **Methods:** This observational longitudinal study included 30 patients aged ≥ 15 years with bimalleolar or trimalleolar fractures over 18 months. Ethical approval was obtained, and patient consent was secured. Data collection involved X-rays, CT scans, and MRI to assess fractures, with preoperative and postoperative management based on standard protocols. Outcomes were measured using Visual Analog Scale (VAS) and American Orthopaedic Foot & Ankle Society (AOFAS) scores at 3 and 6 months postoperatively. Statistical analysis involved chi-square, Fisher's exact test, and Mann-Whitney U test, with results expressed in mean, SD, and 95% confidence intervals. **Results:** Syndesmotic injuries were present in 76% of patients, with 55.53% of these undergoing syndesmotic screw fixation. The mean VAS score decreased significantly from 2.17 (SD: 0.3790) at 3 months to 1.03 (SD: 0.1826) at 6 months ($p < 0.05$). Mean AOFAS scores improved from 72.57 (SD: 4.6214) at 3 months to 83.90 (SD: 4.5814) at 6 months. The use of syndesmotic screw fixation contributed to better stability and reduced complications. **Conclusion:** Syndesmotic screw fixation plays a critical role in stabilizing syndesmotic injuries in bimalleolar and trimalleolar fractures, improving pain and functional outcomes. Further studies with larger sample sizes are necessary to develop standardized treatment guidelines for these injuries.

KEYWORDS

Syndesmotic screw fixation; bimalleolar fracture; trimalleolar fracture; ORIF; syndesmotic injury.

INTRODUCTION

Ankle fractures, particularly bimalleolar and trimalleolar, are among the most frequently encountered and challenging injuries that often require surgical intervention for optimal recovery.¹ These fractures, involving the medial, lateral, and sometimes posterior malleoli, can lead to significant instability in the ankle joint, resulting in long-term complications like osteoarthritis, chronic pain, and restricted mobility if not properly managed.² One of the key structures affected in these fractures is the syndesmosis, a ligament complex critical to ankle stability.³ Syndesmotic injuries are common in these fractures and can exacerbate joint instability, necessitating meticulous surgical management.³

The role of syndesmotic screw fixation in the treatment of bimalleolar and trimalleolar fractures has been a subject of ongoing debate.⁴ While some surgeons routinely employ syndesmotic screws to restore stability, others advocate for selective use, depending on preoperative imaging or intraoperative findings.⁵ Studies have shown mixed results, with some suggesting that routine syndesmotic screw fixation may not significantly improve outcomes and may even increase the risk of complications such as malreduction, screw breakage, and pain.⁶ On the other hand, selective fixation based on specific factors, such as the degree of syndesmotic disruption, has been associated with better patient outcomes and fewer complications.

This study aims to assess the necessity of syndesmotic screw fixation following open reduction internal fixation (ORIF) in bimalleolar and trimalleolar fractures. It will evaluate key factors influencing the decision to use syndesmotic screws, such as the extent of instability, fracture patterns, and the impact on patient outcomes. By analyzing complication rates and recovery outcomes, this study seeks to provide clarity on the optimal approach for managing syndesmotic injuries in complex ankle fractures, potentially guiding future surgical practices.

MATERIALS AND METHODS

Study Design And Duration: This was an observational longitudinal study conducted over a period of 18 months at a tertiary care hospital. The study included patients presenting with bimalleolar and trimalleolar fractures who met the inclusion criteria.

Study Population And Sampling: A total of 30 patients aged 15 years or older with bimalleolar and trimalleolar fractures were included in the study. Patients were selected using consecutive sampling. The inclusion criteria consisted of individuals with fracture dislocation of the ankle joint. Patients with pathological fractures, compound fractures, and those under 15 years of age were excluded from the study.

Preoperative Assessment: Each patient underwent a detailed radiological evaluation that included X-rays (anteroposterior, lateral, and mortise views), CT scans, and MRI to assess the nature of the fracture and syndesmotic injuries. Fractures were classified based on the Lauge-Hansen classification system, which categorizes injuries based on the initial foot position (supination or pronation) and the direction of deforming forces (abduction, adduction, or external rotation).

Surgical Protocol: Patients were assessed preoperatively, and after stabilizing their condition, surgical procedures were carried out. The surgical approach varied based on the type of fracture. For trimalleolar fractures, the posterolateral approach was used to fix both the posterior and lateral malleoli, whereas for bimalleolar fractures, the lateral malleolus was fixed through a lateral incision. Intraoperative hook tests were performed to assess syndesmotic instability. If the test revealed a tibiofibular clear space greater than 5 mm, indicating syndesmotic injury, a syndesmotic screw (tricortical 3.5 mm) was inserted in the syndesmosis.

Postoperative Management: Postoperatively, patients were managed with a below-knee POP slab, and strict limb elevation was advised. Antibiotics were administered for 5 days, and early mobilization, including ankle dorsiflexion and plantarflexion exercises, was encouraged from day 2. Follow-up evaluations occurred at 2, 6, 12, and 24 weeks, during which AOFAS, VAS, and ROM scores were recorded to assess functional recovery.

Data Management And Statistical Analysis: Data were entered into a Microsoft Excel spreadsheet and analyzed using SPSS version 26. Categorical variables were analyzed using chi-square tests or Fisher's

exact tests, while continuous variables were expressed as mean ± SD and compared using independent samples t-tests or Mann-Whitney U tests. A p-value of ≤0.05 was considered statistically significant.

Ethical Considerations: Institutional ethical approval was obtained prior to the study. Informed written consent was obtained from all patients. Participants were assured that they could withdraw from the study at any point without any loss of benefits.

RESULTS

Table 1 Distribution of Age Groups, Gender, and Fracture Types

CATEGORY	FREQUENCY	PERCENTAGE
AGE GROUP (YEARS)		
≤ 30	6	20.0%
31-40	8	26.7%
41-50	7	23.3%
51-60	8	26.7%
≥ 61	1	3.3%
Total	30	100.0%
GENDER		
Female	5	16.7%
Male	25	83.3%
Total	30	100.0%
FRACTURE TYPE		
Fracture bimalleoli left	4	13.3%
Fracture bimalleoli right	6	20.0%
Fracture bimalleoli (posterior and lateral) right	2	6.7%
Fracture trimalleoli left	6	20.0%
Fracture trimalleoli right	12	39.0%
Total	30	100.0%

This table presents a comprehensive distribution of age, gender, and fracture types among 30 patients. The majority of patients were male (83.3%), and the most frequent fracture type was trimalleolar on the right side, accounting for 39% of the cases.

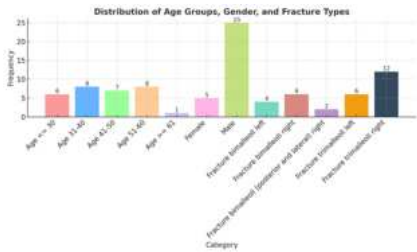


Table 2 Distribution Of Surgical Procedures In Bimalleolar And Trimalleolar Fractures

SURGICAL PROCEDURE	NUMBER	PERCENTAGE
Pm - RP; LM - STP; MM - TBW	2	6.66%
Pm - RP; LM - STP; MM - TBW; SSF	3	10%
Pm - CCS; LM - STP; MM - TBW; SSF	4	13.33%
Pm - CCS; LM - STP; MM - TBW	8	26.6%
LM - STP; MM - TBW	5	16.6%
LM - STP; MM - TBW; SSF	3	10%
Pm - CCS; LM - STP; SSF	1	3.33%
LM - STP; MM - K - CFS	1	3.33%
Pm - RP; LM - STP	1	3.33%
LPM - LCP; MM - TBW; SSF	1	3.33%
Pm - RP; LM - STP; MM - CCS; SSF	1	3.33%
Total	30	100%

This table summarizes the distribution of surgical procedures performed on 30 patients with bimalleolar and trimalleolar fractures. The most common procedure involved the combination of Pm - CCS, LM - STP, and MM - TBW, accounting for 26.6% of the cases.

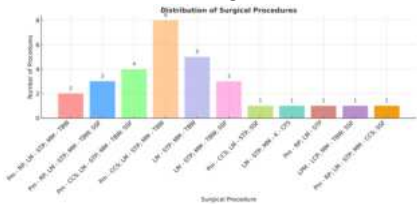


Table 3 Incidence of Syndesmotic Injury, Syndesmotic Screw Fixation, and Clinical Outcome Distribution

CATEGORY	FREQUENCY	PERCENTAGE
INCIDENCE OF SYNDESMOTIC INJURY		
Yes	23	76.0%
No	7	24.0%
SYNDESMOTIC SCREW FIXATION		
Yes	13	55.53%
No	10	44.47%
CLINICAL OUTCOME		
Satisfactory	30	100.0%

This table provides a summary of the incidence of syndesmotic injuries, the use of syndesmotic screw fixation, and the clinical outcomes of the patients. Syndesmotic injuries occurred in 76% of cases, with 55.53% of these patients undergoing screw fixation. All patients reported satisfactory clinical outcomes.

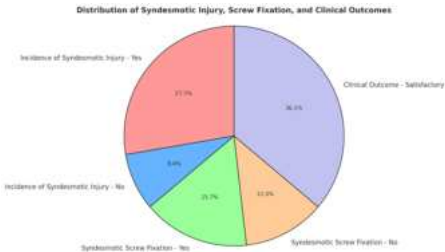


Table 4 Mean VAS and AOFAS Scores at 3 and 6 Months

MEASUREMENT	FREQUENCY	MEAN	SD	MINIMUM	MAXIMUM	MEDIAN
VAS SCORE						
3 months VAS	30	2.1667	0.3790	2.0000	3.0000	2.0000
6 months VAS	30	1.0333	0.1826	1.0000	2.0000	1.0000
AOFAS SCORE						
3 months AOFAS	30	72.5667	4.6214	60.0000	81.0000	73.0000
6 months AOFAS	30	83.9000	4.5814	73.0000	90.0000	85.0000

This table provides a summary of the mean Visual Analog Scale (VAS) and American Orthopaedic Foot & Ankle Society (AOFAS) scores at 3 and 6 months post-surgery. The mean VAS score decreased from 2.17 at 3 months to 1.03 at 6 months, indicating reduced pain. Meanwhile, the mean AOFAS score improved from 72.57 to 83.90, reflecting better functional outcomes over time.

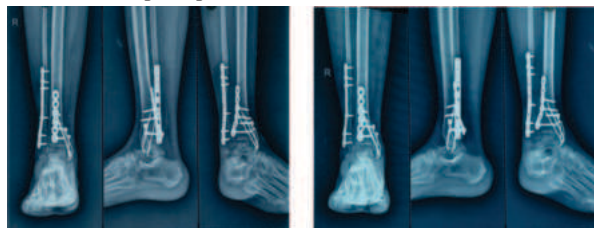


Observed Cases

Case I
35 Years/female
Fracture Trimalleoli Right(PER)



Pre-operative X-ray Rt knee with leg with ankle AP and Lateral view

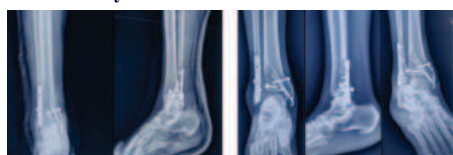
Postoperative X-ray**Pre-operative
X-ray left ankle AP, Lateral and Mortise****Intra operative hook test (A still from the video of intra operative hook test)****Immediate post op****6 weeks****12 weeks****24 weeks****Post-operative X-ray****Case II**

59 Years/Male

Fracture Trimalleoli Right(SER)

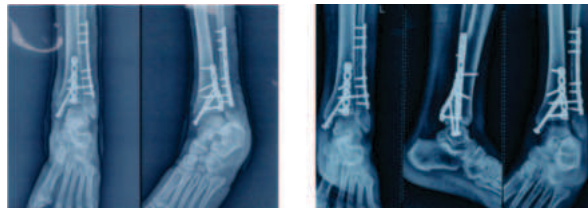
Pre-operative

X-ray Rt knee with leg with ankle AP and lateral view

**Post-operative X-ray****Immediate post op****6 weeks****12 weeks****24 weeks****Case III**

40 Years/ Male

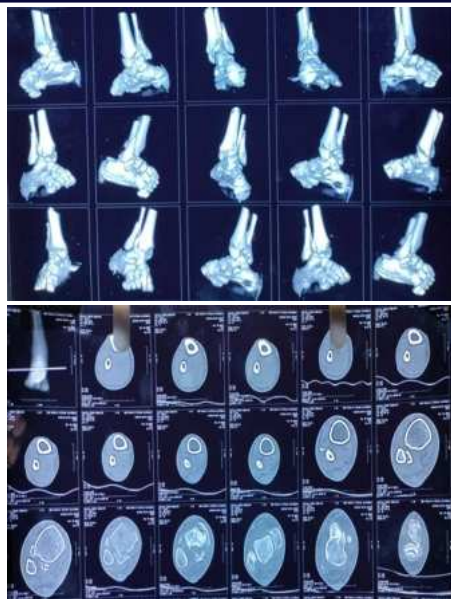
Fracture Trimalleoli Left(PER)

**Immediate Post Op****At-6-weeks****12 weeks****Case III**

50years/male

Fracture trimalleoli Rt(SER)

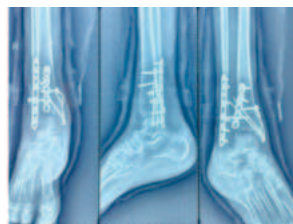
**X-ray Rt ankle AP,Lateral and Mortise**



Pre-operative CT scan Rt ankle



Immediate Post Op



At 6 Weeks



At 12 weeks

DISCUSSION

Our study focused on the incidence of syndesmotom injuries and the need for syndesmotom screw fixation following fracture repair. The findings revealed that 23 out of 30 patients (76.7%) had syndesmotom injuries, with 13 of these patients (55.53%) requiring syndesmotom screw fixation. Shelton ML et al.⁷ (1994) observed that ankle fractures are more common in young men and older women, with men predominating in the under-50 age group and women becoming the majority after this age. In our study, the majority of patients (26.7%) were aged between 31 and 40 years, and 83.3% were male, aligning with Shelton's findings that men predominantly suffer from ankle fractures in younger age groups. This male-to-female ratio of 5:1 was statistically significant ($p < .00001$).

Regarding fracture types, trimalleolar fractures on the right side were the most common (39.0%), a statistically significant finding ($p = .00056$). Additionally, we found that 26.6% of patients had Pm-CCS; LM-STP; MM-TBW as their fracture fixation method. Mutschler M et al.⁸ (2023) reported that syndesmotom screw fixation is commonly employed in 80% of cases, with tricortical fixation in 78% of instances. Our study showed a similar trend, with 55.53% of syndesmotom injuries requiring screw fixation.

In terms of clinical outcomes, all 30 patients reported satisfactory results, as measured by the VAS and AOFAS scores. The mean 3-

month VAS score was 2.17 ± 0.3790 , and the mean AOFAS score was 72.57 ± 4.6214 . At 6 months, the mean VAS improved to 1.03 ± 0.1826 , and the AOFAS increased to 83.90 ± 4.5814 , indicating positive outcomes over time. In contrast to the study of Marques HR et al.⁹ (2020), which suggested that fixing posterior malleolus fragments smaller than 25% improves outcomes, our study fixed posterior malleolus fragments regardless of size. This approach was based on the belief that posterior malleolus fractures are typically avulsion fractures of the PITFL, also known as Volkmann fragments.

The Lauge-Hansen classification provided insights into the injury patterns, particularly in supination-external rotation fractures. Our intraoperative hook test helped assess syndesmotom integrity, leading to additional screw fixation in cases where the test was positive, indicating a potential complete tear of the AITFL. This raises questions about the need for more comprehensive evaluations of syndesmotom complex injuries, as the fixation of the posterior malleolus alone may not fully restore syndesmotom integrity in some cases.

Further research on a larger sample size is recommended to explore the underlying causes of syndesmotom screw fixation in certain patients and to establish a consensus on the optimal management of these fractures.

CONCLUSION

The study of 30 patients, predominantly male (83.3%), revealed that right-sided trimalleolar fractures were the most common (39%). The majority underwent a surgical approach combining Pm-CCS, LM-STP, and MM-TBW (26.6%). Syndesmotom injuries were prevalent in 76% of cases, with 55.53% requiring syndesmotom screw fixation. All patients achieved satisfactory outcomes. Pain levels significantly decreased from 3 to 6 months, as shown by the reduction in the mean VAS score from 2.17 to 1.03, while functional improvement was marked by the rise in the mean AOFAS score from 72.57 to 83.90.

Conflict Of Interest: The authors declare no conflicts of interest.

Funding: No funding was received.

Consent: Written consent from participants has been obtained and preserved.

Ethical Approval: Ethical approval was obtained and documented as per institutional guidelines.

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