

# Comparison of Adequacy of Reduction of Third Malleolar Fracture in Prone vs. Spine Position in Tri-Malleolar Ankle Fracture a Tertiary Care Experience

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## ABSTRACT

**Background:** Ankle fractures, especially tri-malleolar fractures, are among the most frequent injuries to the lower extremities, affecting about 179 out of 100,000 individuals each year. Because of their complexity, these fractures provide serious complications for orthopedic surgeons. This work therefore analyzes tri-malleolar fractures to know the effect of prone position in relation to supine position while at the same time bearing in mind the characteristics of individual fracture, the surgeon and the patient.

**Methods:** This comparative study was conducted at a tertiary care hospital, involving a cohort of 200 patients with diagnosed tri-malleolar ankle fractures. All participants registered to a tertiary care hospital for management of tri-malleolar ankle fractures were included in the study. Having distinguished patients who stayed in supine position during reduction from those in prone position, the authors proceeded to comparing results. In order to assess effectiveness of each position, radiographic assessment, clinical evaluation and surgical issues were reviewed.

**Results:** Third malleolar fractures were effectively reduced in both supine and prone positions. While the prone position continued to be a dependable way to treat posterior malleolus fractures, the supine position offered improved anterior visibility and maybe decreased neurovascular problems. Positive results were obtained using both methods.

**Conclusion:** For the purpose of reducing tri-malleolar fractures, the decision between prone and supine positions should be made individually. Both approaches can produce acceptable results; however, more investigation is required to improve position selection criteria by taking fracture features and patient-specific factors into account.

**Keywords:** Tri-malleolar fracture, posterior malleolus, prone position, supine position, fracture reduction.

## INTRODUCTION

Ankle fractures are among the most common injuries to the lower extremities. Tri-malleolar fractures in particular pose significant challenges to orthopedic surgeons because of their intricate nature, occurring in around 179 out of 100,000 individuals annually<sup>1,2</sup>. Over the coming decades, it is anticipated that the incidence of ankle fractures will increase as life expectancy increases and adults continue to be physically active<sup>3</sup>. The most often affected area in ankle fractures is the distal fibula (67 percent), which is followed by bimalleolar ankle fractures (25 percent) and trimalleolar ankle fractures (7%)<sup>4</sup>. On the other hand, posterior malleolus involvement might not be as rare as originally thought. The literature indicates that 44% of posterior malleolar fractures occur, which calls for further strategic planning in order to heal misplaced articular fracture patterns<sup>5</sup>. Achieving a suitable reduction of the third malleolar fracture is a crucial step in treating these fractures and is essential for positive results. In the field of orthopedics, the positioning of the patient throughout the reduction process is a contentious issue. Based on observations from a tertiary care setting, this study compares the effectiveness of reduction in prone and supine positions with regard to the sufficiency of reduction in third malleolar fractures. Fractures of the posterior side of the distal tibia<sup>6</sup>, the medial and lateral malleoli, and other structures are included in tri-malleolar ankle fractures. Restoring joint congruity, lowering postoperative issues, and enabling the greatest possible functional recovery all depend on proper reduction. Surgeons have traditionally employed the prone position to minimize the third malleolar fracture; however, there is a growing body of research exploring the benefits of the supine position<sup>6</sup>. A modified posteromedial technique combined with an anterolateral approach was used in a study that compared the supine position to the prone-supine position for pilon fractures, according to the literature review<sup>7</sup>. The results of the study showed that the quality of reduction, bone union time, functional outcomes, and comorbidities were all similarly contributed by both postures. The supine method, however, required a significantly shorter operating time<sup>8</sup>. This work therefore analyzes tri-malleolar fractures to know the effect of prone position in relation to supine position

while at the same time bearing in mind the characteristics of individual fracture, the surgeon and the patient.

## METHODOLOGY

This comparative study was carried out in a tertiary health facility among 200 patients with tri-malleolar ankle fractures. The patients were divided into two groups: A hundred patients for the fracture reduction in the prone posture and another hundred in supine posture. The idea to identify differences was to compare overall effectiveness of each position by changes in radiographic outcomes, clinical assessments, and surgery complications.

**Inclusion and Exclusion Criteria:** Patients of tri-malleolar ankle fractures participated in the study if they were over 18 years, had no history of ankle surgery. Consent was obtained from all the patients they agreed for reduction positioning whether in prone or supine position. In order to establish comparable results for treating this type of injuries, patients with the following characteristics were excluded from the study: those with an open fracture; those with contraindications to the position of prone or supine; and patients with previous surgeries of the ankle joint.

**Surgical Procedure:** In the prone group, patients laid flat on the back and this offered the surgeon ease of visibility of the posterior structure of the ankle joint especially the posterior malleolus. Despite the other benefits of this method, its application is more traditional as it works best dealing with posterior malleolar fractures. Sufficient measures were employed to reduce potential neurovascular compromise and these include use of soft materials in positioning of the limbs during the operation. For the supine group, the patients lay on their back facilitating surgeons to assess the medial and lateral malleoli. However, the positioning of the posterior malleolus was going to be harder to tackle. However, the subgroups are limited by the lack of data on neurovascular complications, the postoperative anterior ankle visibility, and the subgroups are created using supine only due to its preference to reduce neurovascular complications during surgeries. Standing radiographs were taken both intraoperatively and at the end of fixation to ensure satisfactory fracture reduction. Endpoints were assessed during physical examination: neurovascular

complication, requirement for secondary interventions and patient satisfaction. In addition, the time taken for fracture reduction was measured.

**Statistical Analysis:** Statistical analysis was done using standard statistical descriptive and comparator method. The continuous data were described by mean values while the categorical data were presented by percentages. Reduction adequacy, complications and surgical time of the two groups was compared with a calculation of the p-value for significance.

**Ethical Considerations:** The study was first and foremost reviewed and received permission from the institutional ethics committee of the tertiary care hospital. All patients gave their informed written consent before the study was done. To these ends, this study respected the provisions of the Declaration of Helsinki with the identification of patient confidentiality, their capacity to self-determine as well as their safety in mind. There was no use of patient identifying information in the analysis or the use of findings in our study.

**Follow-up:** Patients were afterwards followed up to 6 months' follow-up with clinical and radiographic evaluation of fracture healing, complication, functional outcomes, etc.

**RESULTS**

This paper presents a quantitative comparison between prone and supine positions for the management of tri-malleolar ankle fractures with regards to their effectiveness, rate of complications and general results. Both positions were effective though slight differences were demonstrated in surgical time, adequacy of reduction, and the overall rate of complications encountered.

In the prone position group (n=100), we obtained the fractures in 82% of the patients in a sufficient manner, according to the x-ray findings. Their mean time for reduction in the prone position was 31 minutes with a SD of 20 – 45. One would be prone position that offers direct access to the posterior malleolus and a scood what makes it easier to exert force and manipulate fractures. There are however a few complications with the position. Postoperative neurovascular complications were detected in 2% of patients due to the increased operative time and position-related complications. Moreover, 5% patients met inadequate fracture reduction and required further surgical intervention in 2% of patients. Follow-up complications, such as delayed healing or infection, were observed in 5% of patients. However, despite these challenges, patient satisfaction was high due to favorable radiographic outcomes and overall functional recovery as shown in table 1.

Table 1: Outcomes for the Prone Position Group (n=100)

Prone Position Group (n=100)	Outcome
Complications (e.g., Neurovascular)	2 (2%)
Adequate Reduction Achieved	82 (82%)
Inadequate Reduction	5 (5%)
Follow-up Complications	5 (5%)
Secondary Interventions	2 (2%)
Time Required for Reduction (minutes)	Mean: 31, Range: 20-45
Radiographic Evidence	Favorable
Patient Satisfaction	High

Table 2: Outcomes for the Supine Position Group (n=100)

Supine Position Group (n=100)	Outcome
Complications (e.g., Neurovascular)	2 (2%)
Adequate Reduction Achieved	89 (89%)
Inadequate Reduction	4 (4%)
Follow-up Complications	3 (3%)
Secondary Interventions	2 (2%)
Time Required for Reduction (minutes)	Mean: 29, Range: 19-45
Radiographic Evidence	Favorable
Patient Satisfaction	High

In contrast, the supine position group (n=100) demonstrated slightly better outcomes in terms of reduction adequacy and surgical time. Adequate reduction was achieved in 89% of patients,

with a mean reduction time of 29 minutes (range: 19 to 45 minutes), slightly faster than in the prone group. The supine position offers superior visibility of the anterior ankle structures, which may contribute to its effectiveness in reducing the medial and lateral malleoli. Neurovascular complications were also reported in 2% of the supine group, similar to the prone group, but follow-up complications were slightly lower at 3%. Inadequate reduction occurred in 4% of cases, and secondary interventions were required in 2%. Like the prone group, radiographic evidence of fracture healing was favorable, and patient satisfaction remained high, underscoring the effectiveness of the supine approach (Table 2).

The data highlights that both prone and supine positions are viable options for the reduction of tri-malleolar fractures, but the supine position may offer slight advantages in terms of faster reduction times and lower rates of follow-up complications. This paper presents a quantitative comparison between prone and supine positions for the management of tri-malleolar ankle fractures with regards to their effectiveness, rate of complications and general results. Both positions were effective though slight differences were demonstrated in surgical time, adequacy of reduction, and the overall rate of complications encountered.

In the prone position group (n=100), we obtained the fractures in 82% of the patients in a sufficient manner, according to the x-ray findings. Their mean time for reduction in the prone position was 31 minutes with a SD of 20 – 45. One would be prone position that offers direct access to the posterior malleolus and a scood what makes it easier to exert force and manipulate fractures. There are however a few complications with the position. Postoperative neurovascular complications were detected in 2% of patients due to the increased operative time and position-related complications. Moreover, 5% patients met inadequate fracture reduction and required further surgical intervention in 2% of patients.

**DISCUSSION**

Based on the findings of this study, it is found that the prone position as well as the supine position are valuable approaches in the minimization of fractures due to tri-malleolar ankle fractures. When fractures of the medial and lateral malleoli were studied, the supine position was also reported to be advantageous in this position with a higher frequency of appropriate positioning (89% vs. 82%) and less postoperative complications (3% vs. 5%)<sup>8</sup>. A less approximate reduction of these malleoli is achieved due to the better visualization of the anterior aspect of the ankle in the supine position necessary for analyzing total ankle stability. This result is consistent with other studies on the supine position because the position provides faster and more immediate access to the anterior ankle structures, hence reducing surgical time and intra-operative challenges<sup>9,10</sup>.

Although, the prone position has a slightly less incidence of adequate reduction, the method is used to treat posterior malleolar fractures. A lot of advantage of prone posture is that there is direct approach to the plantar aspects of the ankle. Because of poor view and exposure, the traditional technique of minimum resection of posterior malleolus is often a problem during surgical intervention on the supine-positioned patient<sup>11</sup>. This is particularly important bearing in mind that improper positioning of the posterior malleolus increases the likelihood of developing post traumatic arthritis and results in permanent functional limitation. As seen in this study, the prone position was associated with good radiography outcomes and high patient satisfaction; this means that with proper application the prone position is still useful for treating complex fractures<sup>12</sup>. The neurovascular complication rate that was noted in the two groups at 2 % puts into perspective the risks involved with these regions of the surgery<sup>5</sup>. It is well known that a position of lying prone has been over years often accompanied by higher propensity to the appearance of neurovascular complications, however, in this investigation, the incidences of the complications were nevertheless similar in both groups. It would also seem that

through advancements in positioning and surgery, these risks have been minimized especially so for qualified surgeons<sup>14</sup>. Moreover, the mean time for fracture reduction in a supine position was slightly lesser than that in the prone position; 31 minutes. This small variation in operating time suggests that while the supine posture may afford some efficiency benefits, the selection of posture has little impact on the overall time required for surgery. As for radiographic data, both groups showed positive outcomes which conveys the idea that both ways are effective if appropriate. Although there was a slightly higher percentage of inadequate reductions (5%) in prone position, it can mean that this method requires more time and skill to achieve. This desired level of reduction can be challenging for the surgeons with low familiarity using the prone approach in dealing with diverse fracture patterns<sup>15</sup>. It is clear from comparing these findings to earlier research that the surgical position should be selected based on the particulars of the fracture as well as the surgeon's experience<sup>16</sup>. The results of this study are consistent with previous research, which has demonstrated that the supine posture is linked to quicker surgical recovery times and a lower risk of neurovascular problems. For posterior malleolar fractures, the prone position is still a crucial alternative, especially if direct access to the posterior ankle is required<sup>17</sup>.

**Limitations and Future Suggestions:** Notwithstanding the study's merits, it is important to acknowledge some constraints. While the sample size was enough for preliminary comparisons, it might be increased in further research to enhance the findings' generalizability. Furthermore, the follow-up time was brief and concentrated mostly on results that occurred soon after surgery. Evaluation of the emergence of problems such as post-traumatic arthritis, functional recovery, and long-term patient satisfaction requires longer-term follow-up. Larger, multi-center studies should be the goal of future research in order to confirm the results. A wider variety of outcome measures, such as patient-reported outcomes, quality of life evaluations, and long-term functional assessments, should also be included in these research. Other valuable insights that would be revealed if the effectiveness of different surgical positions was analyzed in relation to the training and experience of surgeons are also present. Further, exploring these relatively recent techniques and technologies, including navigational systems as well as intra-operational imaging could improve the efficiency of the fracture reduction and conceivably, reduce complication rates in both prone and supine position.

## CONCLUSION

The choice between prone and supine postures in the reduction of third malleolar fractures in tri-malleolar ankle fractures is a difficult one that should be tailored to each patient. The experiences with regards to the present work has revealed that both positions can yield satisfactory outcome if rightly applied in the tertiary care center. Further investigation in more cases and in greater sample sizes are required to establish sturdier guidelines for the management of these aspects choosing the site and further methods of the reduction of these complex ankle fractures.

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