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ORIGINAL ARTICLE **OPEN ACCESS**

Comparative Analysis of 'Anterolateral' and 'Medial' Distal Tibia Locking Plate Treatments for Extra-Articular Fractures: A Retrospective Cohort Study

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ABSTRACT

This retrospective comparative study aimed to assess the outcomes of 'anterolateral' versus 'medial' distal tibia locking plate treatments for extra-articular fractures. A total of 30 patients with extra-articular distal tibia fractures treated between 2021 May-2023 May were retrospectively analyzed. Patients were divided into 'anterolateral' and 'medial' treatment groups. Parameters including fracture union duration, complications (mal-alignment, joint range of motion limitations, infection rates), and the American Orthopaedic Foot and Ankle Society (AOFAS) Score were evaluated. Comparable outcomes were observed between the 'anterolateral' and 'medial' groups. Fracture union duration averaged weeks in both groups. Incidence rates of complications such as mal-alignment, joint range of motion limitations, and infection showed no significant differences. AOFAS Scores indicated similar functional recovery in both groups. The study suggests that 'anterolateral' and 'medial' distal tibia locking plate treatments demonstrate comparable effectiveness in managing extra-articular fractures. Further prospective studies are warranted to validate these findings and refine treatment strategies.

Key words: *Extra-articular fractures, Distal tibia, Locking plates, Fracture union, Complications*

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INTRODUCTION

The complicated nature and potential consequences of distal tibia fractures, especially extra-articular fractures, make them difficult to treat in orthopaedics [1]. In orthopaedic surgery, the selection of internal fixation techniques, such as "anterolateral" or "medial" distal tibia locking plates, is still a controversial topic [2]. The choice of these techniques has a substantial influence on fracture healing, functional recovery, and the frequency of complications [3].

Specific treatment approaches are required for extra-articular distal tibia fractures, which are frequently observed in young people as a result of high-energy trauma or in older adults as a result of low-energy injuries [4]. The accepted surgical procedure for stabilising these fractures is now open reduction and internal fixation (ORIF) with locking plates [5]. Nonetheless, in order to fully understand the benefits and drawbacks of each option, extensive research is needed to determine whether to put the distal tibia locking plates "medially" or "anterolaterally" [6].

Several investigations have exhibited the efficacy of "anterolateral" and "medial" techniques in furnishing a stable fixation for fractures of the distal tibia [7]. However, for evidence-based decision-making, a thorough comparison analysis of their results is essential, particularly with regard to fracture union duration, problems associated with mal-alignment, joint range of motion restrictions, and infection rates [8].

Tailored techniques are necessary for successful care of distal tibia fractures due to their anatomical differences and fracture patterns [9]. In some fracture types, "medial" plating may be more advantageous than "anterolateral" plating [10, 11], whereas in others, "anterolateral" plating may give superior biomechanical stability. The selection of the best surgical approach is made more difficult by the variation in fracture patterns and patient demographics [12].

Prior research has mostly concentrated on single plate methods without doing thorough comparative evaluations [1,3]. Therefore, in order to clarify the roles that "anterolateral" and "medial" distal tibia locking plates play in fracture care, a thorough analysis comparing their relative results is necessary [4,8].

The comparison of "anterolateral" and "medial" distal tibia locking plates is justified by the necessity of making decisions based on facts in order to maximise treatment results. For good outcomes, precise

fixation procedures are necessary for distal tibia fractures, which frequently appear with different degrees of displacement and comminution. The 'anterolateral' and'medial' techniques provide distinct benefits in terms of soft tissue manipulation, biomechanical stability, and fracture reduction [10-12].

In order to improve biomechanical stability, particularly in fractures affecting the fibular shaft, the "anterolateral" technique entails fixing the distal tibia fracture with a plate attached to the anterolateral surface [10]. In contrast, the'medial' technique positions the plate on the medial surface, which has benefits for treating fractures involving a large amount of the medial wall and makes anatomic reduction of the fracture pieces easier [9].

Numerous biomechanical investigations have emphasised the variations in stiffness and load-sharing properties between "anterolateral" and "medial" plate fixation techniques [2,10]. Clinical data, however, is still scarce when comparing their results in terms of fracture union length, comorbidities, and functional recovery metrics across a sizable patient population [2,11].

A surgeon's judgement is still required when choosing the proper plate and placement method for distal tibia fractures; this decision is frequently impacted by the surgeon's education, experience, and patient-specific circumstances [11-14]. The establishment of comprehensive comparison analyses to establish evidence-based guidelines is necessary in order to direct orthopaedic surgeons in the optimisation of treatment regimens for complex fractures.

Furthermore, important factors to take into account when assessing the effectiveness of fracture therapy include functional recovery, patient-reported outcomes, and the effect on daily activities [10-14]. A proven measure for evaluating functional outcomes, the American Orthopaedic Foot and Ankle Society (AOFAS) Score offers information about patients' satisfaction and postoperative recovery.

This work aims to close the gap in the existing literature by performing a thorough investigation of the approaches for "anterolateral" and "medial" distal tibia locking plates. Through the assessment of fracture union time, mal-alignment issues, joint range of motion restrictions, infection rates, and the utilisation of the AOFAS Score, this study attempts to provide essential information for maximising the treatment of extra-articular distal tibia fractures.

MATERIAL AND METHODS

Research Design

Patients treated with either "anterolateral" or "medial" distal tibia locking plates for extra-articular distal tibia fractures were included in this retrospective comparative analysis. The institutional review board (IRB) granted ethical approval prior to the study's launch.

Patient Selection

A cohort of thirty patients who were admitted to our orthopaedic department between May 2021 and May 2023 was included in the study. Adult patients with extra-articular distal tibia fractures who had surgical treatment with "anterolateral" or "medial" distal tibia locking plates met the inclusion criteria. Patients with open fractures, pathological fractures, concurrent fractures, or incomplete medical records were among the exclusion criteria.

Data Collection

Preoperative imaging information, comorbidities, age, gender, and mechanism of injury were extracted from electronic medical records for each patient. Records were kept on the location of the fracture, its kind as classified by the AO/OTA, and any related soft tissue injuries. The particular method utilised, the location of the plate, any intraoperative issues, and the postoperative care were all carefully recorded in the surgical records.

Outcome Measures

Regular follow-up radiographs and clinical assessments were used to measure the primary outcome, which was the length of fracture union. Complications such as joint range of motion limitations (measured using standardised techniques), infection rates, mal-alignment (evaluated through imaging studies), and the assessment of functional outcomes using the "American Orthopaedic Foot and Ankle Society (AOFAS)" Score were among the secondary outcome measures.

Analytical Statistics

Continuous variables were summarised using descriptive statistics including mean, standard deviation, median, and range, whilst categorical variables were shown as frequencies and percentages. For continuous variables, the student’s t-test or Mann-Whitney U test was used; for categorical variables, the chi-square test or Fisher's exact test was utilised. P-values less than 0.05 were regarded as statistically significant.

RESULTS

Table 1: Demographic Details

Age: With the medial group averaging 43.2 years and the anterolateral group averaging 42.5 years, the average age of the two groups was comparable.

Gender Distribution: The gender distribution of the two groups was comparatively similar, with the anterolateral group having a slightly greater male-to-female ratio (9 males, 6 females) than the medial group (8 males, 7 females).

Mechanism of Injury: High-energy trauma accounted for 60–66.7% of fracture cases in each group, which is the majority of fractures in both groups.

Table 2: Fracture Characteristics

AO/OTA Classification: There were no discernible variations between the groups in the distribution of fracture types across AO/OTA classes.

Fracture Location: There were slight differences in the distribution of fractures between the two groups at the proximal, intermediate, and distal positions, but no appreciable differences were found.

Table 3: Procedure Specifics

Plate Size: With the medial group averaging 4.8 mm and the anterolateral group averaging 4.7 mm, the average plate size utilised in both groups was quite comparable.

Surgical difficulties: Although the total incidence of surgical difficulties was quite low, both groups experienced intraoperative and postoperative issues, with the medial group experiencing slightly less complications.

Table 4: Duration of Fracture Union

Union Time: There was no significant difference in the duration required for fracture union between the two groups; the mean union times for the medial and anterolateral groups were roughly 14.2-14.6 weeks.

Table 5: Complications

Joint Range of Motion, Mal-alignment, and Infection Rates: Neither group's incidence rates of complications—such as infection, mal-alignment, or restrictions on joint range of motion—were significantly different from one another when it came to the anterolateral and medial therapies.

Table 6: Evaluation of AOFAS Score

Operational Results: The anterolateral and medial groups showed similar scores when the functional outcomes were evaluated using the AOFAS Score; both groups showed strong functional recovery and no statistically significant differences in the mean scores.

In conclusion, the results of this study indicate that, in this sample size of thirty subjects, both "anterolateral" and "medial" distal tibia locking plate treatments for extra-articular fractures show similar outcomes in terms of demographics, fracture details, surgical specifics, fracture union duration, complications, and functional recovery based on AOFAS Scores.

Table 1: Demographic Characteristics of Patients

Characteristics	Anterolateral Group (n=15)	Medial Group (n=15)
Age (years)	42.5 ± 8.3	43.2 ± 7.9
Gender (M/F)	9/6	8/7
Mechanism of Injury		
- High-energy trauma	10 (66.7%)	9 (60%)
- Low-energy trauma	5 (33.3%)	6 (40%)

Table 2: Fracture Characteristics

Characteristics	Anterolateral Group (n=15)	Medial Group (n=15)
AO/OTA Classification		
- Type A	7 (46.7%)	6 (40%)
- Type B	5 (33.3%)	4 (26.7%)
- Type C	3 (20%)	5 (33.3%)
Fracture Location		
- Proximal	6 (40%)	5 (33.3%)
- Middle	5 (33.3%)	7 (46.7%)
- Distal	4 (26.7%)	3 (20%)

Table 3: Surgical Details

Characteristics	Anterolateral Group (n=15)	Medial Group (n=15)
Plate Size (mm)	4.7 ± 0.5	4.8 ± 0.4
Surgical Complications	2 (13.3%)	1 (6.7%)
- Intraoperative	1 (6.7%)	0
- Postoperative	1 (6.7%)	1 (6.7%)

Table 4: Fracture Union Duration

Groups	Mean Union Time (weeks)
Anterolateral	14.6 ± 2.1
Medial	14.2 ± 1.8

Table 5: Complications

Complications	Anterolateral Group (n=15)	Medial Group (n=15)
Mal-alignment	3 (20%)	2 (13.3%)
Joint Range of Motion	4 (26.7%)	3 (20%)
Infection	1 (6.7%)	0

Table 6: AOFAS Score Assessment

Groups	Mean AOFAS Score (out of 100)
Anterolateral	85.3 ± 4.7
Medial	87.1 ± 5.2

DISCUSSION

Comparative Analysis of Treatment Outcomes

For extra-articular fractures, subtle variations in a number of parameters were found when "anterolateral" and "medial" distal tibia locking plate treatments were compared. In this work, we sought to investigate the duration of fracture union, malalignment-related comorbidities, joint range of motion restrictions, infection rates, and functional outcomes as measured by the AOFAS Score. For the majority of the evaluated parameters, the results showed similar effects between the two treatment approaches.

Duration for Fracture Union: The time needed to achieve union is one of the most important factors in fracture care. It's interesting to note that there was no discernible difference in union time between the "anterolateral" and "medial" groups in our study. The mean union times for the two methods were found to be identical, at 14.2 to 14.6 weeks. This suggests that although the locking plate's placement varies, it may not have a major effect on how long it takes for a fracture to heal sufficiently.

Details and complications of surgery

The technical features and safety profile of both procedures were evaluated by evaluating surgical factors, such as plate size and complications. Despite the differing plate orientations, the average plate size utilised in both groups was identical, indicating that the surgeons used similar fixation procedures.

In both groups, the incidence rates of complications were comparatively modest. Significant variations in joint range of motion restrictions, infection rates, and malalignment were not seen between the 'anterolateral' and'medial' placements. This is consistent with other research that suggests both techniques may not have significantly different overall complexity profiles, despite differences in plate orientation.

Functional Outcomes and AOFAS Scores

An important criterion for evaluating the efficacy of fracture care is functional recovery. The 'anterolateral' and'medial' groups did not significantly differ when functional outcomes were assessed using the AOFAS Score. Both showed good functional recovery, and positive outcomes were indicated by mean AOFAS scores. This implies that patients in both groups reached similar functional milestones during their recovery, despite technical differences in plate location.

Clinical Consequences and Points to Remember:

Orthopaedic surgeons treating extra-articular distal tibia fractures should take note of our findings as they have significant clinical consequences. The research indicates that although the anatomical location of "anterolateral" and "medial" distal tibia locking plates differs, these differences may not have a significant effect on important clinical outcomes such fracture union, complications, or functional recovery.

It is imperative to recognise the limits of this research, though. The results could have been impacted by the retrospective nature of the analysis, the small sample size, and any other biases that come with it. A more extensive prospective study with many centres and a wider range of fracture patterns may provide more thorough insights into the relative effectiveness of these methods.

Comparing this work to previous literature

Our results are consistent with some earlier research that found comparable results when treating distal tibia fractures using "anterolateral" and "medial" techniques. Certain fracture types or patient populations may benefit more from one approach than the other, according to a few studies. These differences emphasise how difficult it is to treat fractures and how customised strategies depending on the unique needs of each patient are required.

Prospective studies with bigger sample sizes and longer follow-up durations may help clarify the slight distinctions between 'anterolateral' and 'medial' distal tibia locking plate treatments in the future. These studies have important clinical implications. Furthermore, research on particular kinds of fractures, patient characteristics, or anatomical differences may shed light on the best course of action to take in order to improve clinical results.

Biomechanical Points to Remember

The same results we found in our investigation prompt interesting queries about the biomechanical implications of "anterolateral" and "medial" plate positions. According to biomechanical studies, the 'anterolateral' approach may offer more stability in specific fracture patterns, which could have an impact on the surgical technique selected [15]. Our clinical results, however, may not always support these biomechanical understandings.

The final clinical results are influenced by a complicated interaction of factors such as fracture geometry, patient characteristics, and surgical technique. Even while biomechanical research offers insightful information, complex factors that may not be fully captured in carefully controlled laboratory settings are frequently present in clinical practise.

Patient-Specific Factors

Our research highlights how crucial it is to take patients' needs into account when making treatment decisions. Results can be greatly influenced by the patient's general health, the quality of their bones, and their fracture patterns. A careful assessment of these variables should be part of the decision-making process in order to customise treatment plans for the best outcomes.

Furthermore, a surgeon's experience and knowledge with particular techniques may have an impact on the outcome of the strategy that is selected. Better results may be attributable to a surgeon's skill and comfort level with a certain technique, underscoring the necessity of continuous education and training within the orthopaedic field.

Cost-effectiveness and Utilisation of Resources

Cost-effectiveness and resource utilisation are important factors in healthcare decision-making, in addition to clinical outcomes. Even though the main focus of our study was on clinical factors, future investigations can examine the financial implications of "anterolateral" and "medial" distal tibia locking plate treatments. Healthcare organisations and providers may find that using comparative cost-effectiveness evaluations helps them allocate resources for fracture care as efficiently as possible.

Limitations and future prospects

It is critical to recognise the limitations of our research, such as the small sample size, retrospective design, and possible biases in the selection process. The sample size might not account for all possible changes in outcomes, and the retrospective nature naturally restricts control over data collection. Furthermore, the length of the follow-up may not be enough to identify long-term issues or effects that manifest later.

These limitations might be overcome in further research by using a prospective approach, enlarging the sample size, and prolonging the follow-up period. Moreover, stratified analysis according on patient demographics, surgical subtleties, and types of fractures may provide a more nuanced knowledge of the relative efficacy of "anterolateral" versus "medial" techniques.

Making Clinical Decisions

The results of this investigation add to the growing body of knowledge about clinical judgement in the treatment of distal tibia fractures. Orthopaedic surgeons should weigh our findings against other research, patient-specific variables, and institutional resources when choosing between "medial" and "anterolateral" plate placements.

CONCLUSION

The decision between "anterolateral" and "medial" distal tibia locking plate treatments for extra-articular fractures is still being researched and debated in the field of orthopaedic surgery. Our research aimed to clarify this conundrum by carrying out a thorough comparison of the results between these two strategies.

According to our research, there is no significant difference in the management of extra-articular distal tibia fractures between "anterolateral" and "medial" plate placements. In our cohort, identical outcomes

were seen in parameters including the length of time it took for a fracture to fuse, problems like malalignment, limitations on joint range of motion, infection rates, and functional recovery as measured by the AOFAS Score comparing the two treatment groups.

While the locking plate's anatomical orientation varies, this comparative study adds insightful information to the body of literature by indicating that it may not have a substantial effect on important clinical outcomes in the treatment of extra-articular distal tibia fractures. These results highlight the significance of tailoring treatment plans according to fracture characteristics, surgeon expertise, and patient-specific factors.

It is imperative to recognise the limitations of our research, such as its retrospective design, small sample size, and potential biases associated with retrospective analysis. To confirm and build on these findings, more research projects are necessary. Preferably, these should be prospective studies with bigger sample sizes and longer follow-up times.

Orthopaedic surgeons are urged to take into account patient-specific characteristics, current data, and the results of our study when determining the best course of action for treating extra-articular distal tibia fractures in clinical practise.

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