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# Evaluation of functional and radiological outcomes of using antiglide plates in vertical medial malleolus fractures

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***Abstract*---**Background: Usually, the fracture of the medial malleolus is seen through supination-adduction loading of the talus on the articular surface which is mostly a vertical shear fracture. This fracture is managed with various methods including open reduction and internal fixation and antiglide plating. Aim: The present study was done to evaluate the functional and radiological outcomes following open reduction and internal fixation using antiglde plates in vertical shear medial malleolus fracture. Methods: This present prospective clinical study included 44 subjects with vertical shear medial malleolus fracture managed with the antiglide plates. In all subjects clinical and radiographic evaluation was done, tenderness, and union time were assessed at follow-up at 1, 2, and 6 months. Results: The mean union time was found to be 12.29±1.96 weeks. Tempo loss was reported in 27.2% (n=12) study subjects and work remained similar to the pre-surgery work in 72.7% (n=32) study subjects respectively. Pain while walking on uneven surfaces was

reported by 18.1% (n=8) of the study subjects. Molandar scores were 92.93±3.69 in the study subjects with a range of 10 between 86-96. The median was found to be 95 (91.23-95) in the study participants. On the assessment of the ratings for the surgical protocol by the study participants, it was seen that an Excellent rating was given by 72.7% (n=32) study subjects followed by a good rating given by 27.2% (n=12) study subjects, whereas, in no subject, the rating was found to be fair or poor. Conclusion: The present study concludes that management of vertical shear fracture of medial malleolus by surgical approach using antiglide plate shows excellent outcomes. Early mobilization and optimal ankle function result from rigid fixation by restoring the articular congruity. The fracture fixation using an antiglide plate is easily available and cost-effective compared to the pre-contoured and anatomy-specific fixation type.

***Keywords*---**antiglide plating, functional outcomes, malleolus, malleolus fracture, supination, vertical.

## Introduction

Usually, the fracture of the medial malleolus is seen through supination-adduction loading of the talus on the articular surface which is mostly a vertical shear fracture. Transverse fracture of the medial malleolus is more commonly reported compared to Vertical shear fractures. These fractures are managed by various fixation techniques available including antiglide plates, tension bands, cancellous screws, and/or cortical screws.[1] The fixation for Vertical shear fractures should be adequate to maintain the stable reduction of the articular surface of the ankle joint which reduces the risk for post-traumatic arthritis in the future, maximize the functional outcomes, maintain congruency of the ankle joint, and allow early motion range.[2]

Vertical shear fractures of medial malleolus are usually managed with either buttress or antiglide plates and screws along with the neutralization plates. Previous literature data showed that both antiglide and neutralization plates with screws are a stable method for fixation when placed perpendicular to the fracture line. More rigidity is being offered by neutralization plates compared to the 2 parallel screws placed on the fracture line perpendicularly. However, few other pieces of literature work show contradicting results depicting antiglide plates to be better than neutralization plates.[3,4]

However, various techniques are available for the fixation of Vertical shear fractures of the medial malleolus including antiglide plates, tension bands, cancellous screws, and cortical screws in various configurations. Clinically, to manage these fractures, two partially threaded parallel screws of 4.0mm are used.[5] Strongest construct is shown by divergent unicortical fixation using 2 screws in comparison to convergent and parallel unicortical cancellous screws. One previous literature work reports equal efficacy and biochemical properties of the screw constructs and antiglide plates, whereas, other data depicts that an

antiglide plate having two screws proximal to the fracture site and other 2 at the distal site was found to be stiffer compared to parallel cancellous screw fixation.[6] Owing to the limited literature data assessing the fixation of Vertical shear fractures of the medial malleolus, using antiglide plates with 2 screws proximal and distal to the fracture apex is considered the strongest fixation modality. However, this technique requires significantly higher dissection of the soft tissues compared to using only screws.[7] Scarce literature data is available concerning the comparison of antiglide plate construct, bicortical cortical screws, and divergent and parallel cancellous screws. This present study evaluated the load and stiffness to displacement by 2mm of the joint surface using the 4 different methods of construction in vertical medial malleolus fractures of distal tibia. The study hypothesized that using the antiglide plate construct is the stiffest method adopting most of the load before it gets to the clinical failure, whereas, parallel unicortical screw fixation is hypothesized to be the weakest. The present study aimed to evaluate the functional and radiological outcomes following open reduction and internal fixation using antiglide plates in vertical shear medial malleolus fracture.

**Materials and Methods**

The present study was done at Department of Orthopaedics, Government Medical College, Akola, Maharashtra, after the clearance was given by the concerned Ethical committee. The study population was comprised of subjects from the Department of Orthopedics of the Institute. After explaining the detailed study design, informed consent was taken from all the subjects in both written and verbal format. The study included 44 adult subjects having a vertical shear fracture of the medial malleolus. The inclusion criteria for the study were subjects aged 18 years or more, having a vertical shear fracture of the medial malleolus, (closed) Gustilo Type I, II, managed with internal fixation using Antiglide plates and screws within 1$^{st}$ week of fracture. The exclusion criteria for the study were subjects who have delayed treatment for >1week, were medically not fit for surgery, and subjects who were not willing to participate in the study.

After the final inclusion of the study subjects, detailed history was recorded for all the subjects followed by clinical examination, routine laboratory examination, and radiographic examination including a Plain X-ray of the tibia and ankle joint along with mortise (ankle internally rotated by 20 degrees, lateral, and anteroposterior (AP) view. After the subjects were finally included in the study, the surgery time was different for study subjects as follows: 24 subjects were managed surgically on the same day as admission, and 20 subjects were operated on 5 days following admission after ecchymosis and swelling subsided. The fracture site was assessed locally for pain which was seen in all the subjects, and skin condition which was intact in all subjects, other fractures seen associated were lateral malleolus fracture injuries in 16 subjects and isolated vertical shear fractures of medial malleolus in 28 subjects, edema was seen in all subjects with fracture, and the movement was limited in all the fractured subjects.

All the subjects were given prophylactic antibiotics before the surgery and for 5 days following the surgery. All participants were operated on under spinal anesthesia under strict aseptic and sterile conditions. The medial malleolus was

approached by making an incision 2 cm distal to the medial malleolus tip which was moved to the anterior edge in the middle of the distal tibia direction. Exposing the anterior fracture site and the joint was visualized. The periosteum was moved posteriorly to control the reduction. After cleaning the fracture site, any small loose fragments were removed that might hinder anatomic reduction. Before reducing the fracture, articular surfaces were disimpacted. This was followed by anatomic reduction of the fracture segment and then fixation by placing a 1/3 tubular plate to the center of the medial aspect of the medial malleolus which was secured by the screws on both proximal and distal site of the fracture. Radiographs were taken to confirm the positions of the plates and screws. It was also ascertained that no screw is violating the ankle joint.

After irrigating the surgical site with normal saline, suturing was done and the surgical site was covered with the gauze dressing and standard leg plaster splint for immediate comfort postoperatively. Along with antibiotics, subjects were given anti-inflammatory and analgesic drugs for 5 days. X-rays were taken in mortise, lateral, and anteroposterior views. Subjects were discharged with instructions to crutch walk without bearing any weight for 6 weeks and were recalled at 2 weeks for follow-up.

The follow-up was planned at 2, 4, and 6 weeks postoperatively. At 2$^{nd}$ week follow-up, sutures were removed and the slab was changed. Clinical, as well as radiographic assessment, was done. Clinically, subjects were evaluated for tenderness and ankle movement. Union time was assessed from surgery day to complete bone healing assessed with no gap visible on two radiographs. At 6 weeks, both lateral and AP view of the ankle were radiographically assessed and union signs were noted. Subjects were advised for partial weight bearing for additional six weeks and were advised to keep their legs elevated at night. Follow-up was continued for 1, 2, and 6 months after discharge until complete fracture union was noted. After 3 months, the full-weight bearing was advised. Olerud and Molandar ankle scores[8] were used to assess the results.

**Results**

The study included 44 adult subjects having a vertical shear fracture of the medial malleolus to evaluate the functional and radiological outcomes following open reduction and internal fixation using antiglde plates in vertical shear medial malleolus fracture. On assessing the mechanism of injuries in the study participants, it was seen that injury was secondary to supination and adduction in 100% (n=44) of study subjects, and no other injury mechanism was seen in any study subject. Among 44 subjects, 59.09% (n=26) subjects were managed with antiglide plates for medial malleolus fracture and semitubular plates for lateral malleolus fracture, whereas 40.90% (n=18) subjects were managed with the antiglide plate for the middle malleolus fracture as shown in Table 1.

The mean union time in the study subjects was found to be 12.29±1.96 weeks. After the surgical management of medial malleolus fractures with an antiglide plate, it was seen that concerning daily activities, no subject reported severely impaired work capacity or changed their job to simpler work. Tempo loss was reported in 27.2% (n=12) study subjects and work remained similar to the pre-

surgery work in 72.7% (n=32) study subjects respectively. For the intensity of pain post-surgery, no pain was perceived by 81.8% (n=36) of study subjects, and pain while walking on uneven surfaces was reported by 18.1% (n=8) of study subjects respectively as depicted in Table 2.

On assessing the Olerud and Molandar scores in 44 study subjects after surgical management using the antiglide plates, it was seen that the mean Olerud and Molandar scores were 92.93±3.69 in the study subjects with a range of 10 between 86-96. The median was found to be 95 (91.23-95) in the study participants as shown in Table 3. On the assessment of the ratings for the surgical protocol by the study participants, it was seen that an Excellent rating was given by 72.7% (n=32) study subjects followed by a good rating given by 27.2% (n=12) study subjects, whereas, in no subject, the rating was found to be fair or poor as reported in Table 4.

**Discussion**

The present study aimed to evaluate the functional and radiological outcomes following open reduction and internal fixation using antigilde plates in vertical shear medial malleolus fracture. The study included 44 adult subjects having a vertical shear fracture of the medial malleolus to evaluate the functional and radiological outcomes following open reduction and internal fixation using antiglide plates in vertical shear medial malleolus fracture. On assessing the mechanism of injuries in the study participants, it was seen that injury was secondary to supination and adduction in 100% (n=44) of study subjects, and no other injury mechanism was seen in any study subject. Among 44 subjects, 59.09% (n=26) subjects were managed with antiglide plates for medial malleolus fracture and semitubular plates for lateral malleolus fracture, whereas 40.90% (n=18) subjects were managed with the antiglide plate for the middle malleolus fracture. These were similar to the studies of Blake S et al[9] in 2015 and Kilian M et al[10] in 2017 where authors managed subjects of supination adduction injury with ORIF and antiglide plates.

The study results showed that the mean union time in the study subjects was found to be 12.29±1.96 weeks. After the surgical management of medial malleolus fractures with an antiglide plate, it was seen that concerning daily activities, no subject reported severely impaired work capacity or changed their job to simpler work. Tempo loss was reported in 27.2% (n=12) study subjects and work remained similar to the pre-surgery work in 72.7% (n=32) study subjects respectively. For the intensity of pain post-surgery, no pain was perceived by 81.8% (n=36) of study subjects, and pain while walking on uneven surfaces was reported by 18.1% (n=8) of study subjects respectively. These results were consistent with the studies of Singh R et al[11] in 2014 and Sukur E et al[12] in 2017 where authors reported comparable union time, pain intensity, and daily life activities in their study participants as in the present study.

Concerning the assessment of the Olerud and Molandar scores in 44 study subjects after surgical management using the antiglide plates, it was seen that the mean Olerud and Molandar scores were 92.93±3.69 in the study subjects with a range of 10 between 86-96. The median was found to be 95 (91.23-95) in

the study participants. These results were in agreement with the previous studies of Amanatullah DF et al[13] in 2012 and Ahn J et al[14] in 2016 where authors depicted similar functional scorings after medial malleolus management with the antiglide plate for vertical shear fractures.

Concerning the evaluation of the ratings for the surgical protocol by the study participants in the present study, it was seen that an Excellent rating was given by 72.7% (n=32) study subjects followed by a good rating given by 27.2% (n=12) study subjects, whereas, in no subject, the rating was found to be fair or poor. These results were in line with the studies of El-Alfy A et al[15] in 2021 and Arora KK et al[16] in 2021 where management of the vertical shear fracture of the medial malleolus using antiglide plates was shown to be a highly efficacious management modality.

## Conclusion

Considering its limitations, the present study concludes that management of vertical shear fracture of medial malleolus by surgical approach shows excellent outcomes. Early mobilization and optimal ankle function result from rigid fixation by restoring the articular congruity. The fracture fixation using an antiglide plate is easily available and cost-effective compared to the pre-contoured and anatomy-specific fixation types. The limitations of this study were small sample size, short monitoring time, and biased related to the geographic location warranting further long-term studies planned longitudinally.

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**Tables**

Table 1: Injury mechanism and management strategies in study subjects

| Characteristics | Percentage (%) | Number (n) |
|---|---|---|
| Injury mechanism | | |
| Supination and abduction | 100 | 44 |
| Others | 0 | 0 |
| Management | | |
| Antiglide plate (medial malleolus) | 40.90 | 18 |
| Antiglide plate and semitubular plates for medial and lateral malleolus | 59.09 | 26 |

Table 2: Postoperative parameters in the study participants

| Postoperative parameters | Percentage (%) | Number (n) |
|---|---|---|
| Union Time (Mean ± S.D) weeks | 12.29±1.96 | |
| Daily life activities | | |
| Severely impaired work capacity | 0 | 0 |
| Change to simpler work | 0 | 0 |
| Tempo loss | 27.2 | 12 |
| Same as before the injury | 72.7 | 32 |

| | | |
|---|---|---|
| Pain intensity | | |
| None | 81.8 | 36 |
| On walking on uneven surfaces | 18.1 | 8 |

Table 3: Olerud and Molandar scores in the study participants

| Olerud and Molandar scores | Values |
|---|---|
| Mean ± S. D | 92.93±3.69 |
| Range (min-max) | 10 (86-96) |
| Median (IQR) | 95 (91.23-95) |

Table 4: Surgery rating by the study participants

| Rating | Percentage (%) | Number (n) |
|---|---|---|
| Excellent | 72.7 | 32 |
| Good | 27.2 | 12 |
| Fair | 0 | 0 |
| Poor | 0 | 0 |