

A Novel Approach to Medial Malleolus Fracture of Ankle using Adjustable Loop Suspensory Fixation

Sandeep Deore¹, Sachin Kale¹, Sunil Shetty¹, Ajit Chalak², Rohan Jayaram¹, Roonam Patir¹

Abstract

Medial malleolar fractures are traditionally treated by orthopaedic surgeons using cancellous screws, plates, and tension banding with stainless steel wires. However, a considerable proportion of these patients eventually require revision surgery or implant removal due to complications such as wire migration, impingement, breakage, and infection. Revision surgeries for previously operated malleolar fractures pose challenges due to dilated bone tracks and osteopenia which complicate securing the mechanical hold of the implant. A potential solution to mitigating these factors could be the use of high-strength polyethylene suture material such as fiber-wire to fix the fracture fragments which are held in place by a cortical button on either side. This study aims to evaluate the clinical and radiological outcomes in a patient with medial malleolus fracture fixed by fiber-wire fixation as an alternative modality of treatment.

Keywords: Medial malleolar fractures, tension band principle, stainless steel wire, implant breakage, revision surgery, suspensory fixation using fiber-wire, magnetic resonance imaging compatible construct.

Introduction

Bimalleolar ankle fractures are routinely encountered by orthopaedic surgeons in everyday clinical practice, with the majority having indications for surgical intervention. Traditional methods include cancellous screw fixation, buttress plating, and tension banding with stainless steel wires depending on the classification of the fracture. However, these conventional methods are known to come with many disadvantages, vis-à-vis wire migration or breakage in 20% of all operated patients, infection, and prominent metalwork leading to skin irritation and as a result require revision procedures or implant removal [1]. Plate fixations demand good soft-tissue conditions due to larger exposure. A report by Skie et al. [2] illustrates the hurdles of operating over the medial malleolus and highlights the difficulties in obtaining intraoperative stable fixation. Unicortical screw fixation and tension banding threaten the risk of fragmentation in small osseous fragments [3] that rarely respond to stabilization using

standard partially threaded cannulated screws. In cases of revision procedures, crushing of fragments due to dilated bone tracks or the osteoporotic nature of the bone must be considered with proper caution. Painful non-union encountered post-operatively poses another hurdle in deciding fixation modality. As a result, new techniques are constantly being developed, such as bio-absorbable or headless screws, in an effort to reduce post-operative morbidity and eliminate the need for implant removal. However, deficits in adequate qualitative literature prove it difficult to justify their routine implementation [4]. Recent practices have shown that adjustable loops of high-strength polyethylene paired with cortical buttons gaining popularity in various applications, such as anterior cruciate ligament reconstruction in the knee, acromioclavicular joint stabilization in the shoulder, and syndesmotic stabilization in the ankle. We hypothesize that high-strength polyethylene suture material with cortical button could be used as an alternative to fixation by traditional metal wires of medial malleolar fractures, yielding similar outcomes whilst simultaneously reducing complication rates.

Case Report

A 59-year-old male patient presented to the outpatient department with pain and swelling over his right ankle following a fall from his motor vehicle. On eliciting history, the

¹Department of Orthopaedics, Dr. D.Y. Patil Medical College and Hospital, Navi Mumbai, Maharashtra, India,

²Department of Orthopaedics, MGM Medical College, Navi Mumbai, Maharashtra, India.

Address of Correspondence

Dr. Rohan Jayaram,
Department of Orthopaedics, Dr. D.Y. Patil Medical College and Hospital, Navi Mumbai, Maharashtra, India.

E-mail: drrohanjayaram@gmail.com

Submitted Date: 29 Jul 2024, Review Date: 15 Aug 2024, Accepted Date: 18 Sep 2024 & Published Date: 10 Dec 2024

Journal of Clinical Orthopaedics | Available on www.jcorth.com | DOI: <https://doi.org/10.13107/jcorth.2024.v09i02.698>

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License (<https://creativecommons.org/licenses/by-nc-sa/4.0/>), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.



Figure 1: Radiographs of the ankle following trauma.

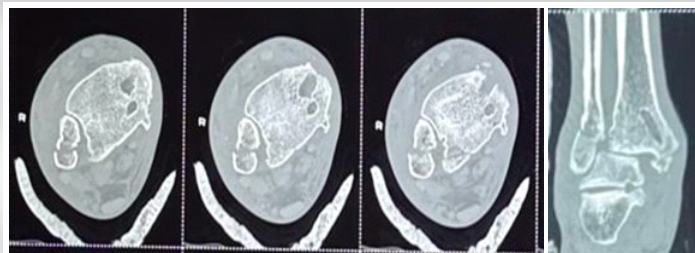


Figure 2: Computed tomography of ankle revealed dilated bone track in the tibia.



Figure 3: Lateral malleolar plating and temporary reduction of medial malleolus fracture.



Figure 4: Open reduction of medial malleolus.

Surgical procedure

Following skin preparation and draping, open reduction with internal fixation by plating was done for the lateral malleolus (Fig. 3). The medial malleolus was exposed following incision and dissection over the previous surgical scar (Fig. 4). Freshening of the fracture edges was performed and the fracture was reduced using reduction clamps. A 2.8 mm guide wire was passed across the fracture site followed by 4.5 mm cannulated drill to make the tunnel and pass relay sutures for the endobutton with adjustable loop onto the lateral tibial cortex. The guide wire track was made with reference to the safe corridors of the distal tibia [5] (Fig. 5) and avoid neurovascular injury. The adjustable loop was lengthened by 10 cm to flip the endobutton onto the lateral tibial cortex. Through its maneuvering, the loop end coming out of the medial malleolus was mounted onto the suture disc (Arthrex attachable button system [ABS]) (Fig. 6). Following satisfactory placement, the threads were pulled laterally to achieve and controlled compression across the fracture site and

patient had previously suffered from a medial malleolar fracture, around a year prior, and was surgically managed by cannulated cancellous screw fixation. He subsequently underwent another procedure for implant removal due to symptoms of impingement over medial aspect of the ankle. On physical examination, the patient was found to have tenderness and effusion around both malleoli. A healed surgical scar was present over the medial aspect. Radiographs showed a bimalleolar fracture (Fig. 1) and computed tomography (CT) scan (Fig. 2) revealed dilated screw tracks in both proximal and distal fragments at the previously operated site.

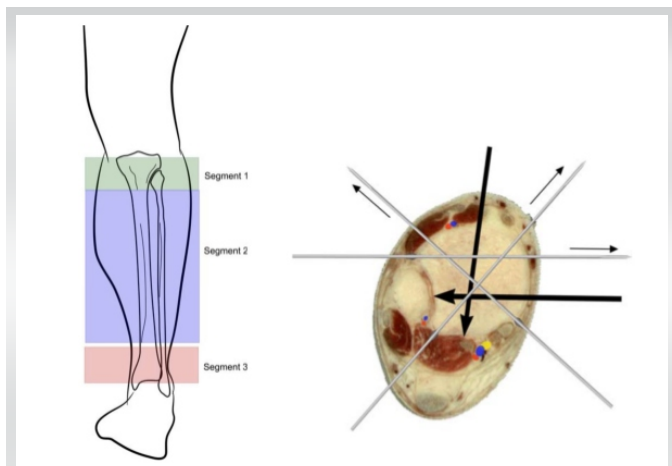


Figure 5: Safe corridors of distal tibia for wire passage.

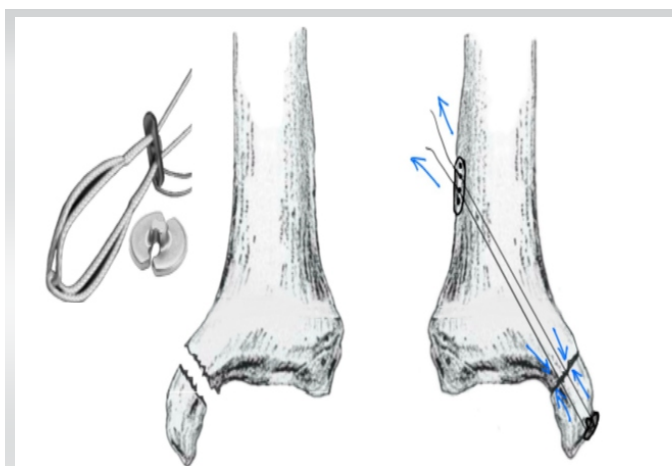


Figure 6: Adjustable loop with button system across the fracture site.



Figure 7: Post-operative X-rays.



Figure 8: Follow up radiograph showed good union.

maintained between the two buttons as checked under C-arm. Imaging further confirmed positioning of the ABS being flush with the medial malleolus (Fig. 7). Thorough wash was given preceding closure. The patient shifted to recovery with uneventful intra-operative period. Ankle range of motion started after 1 week. Sutures were removed at the 2-week interval and the patient was discharged with no complications. The patient started non-weight-bearing walk post-operatively after 3 weeks. Regular follow-ups taken through outpatient visitations. Assessment was performed through clinical examination and serial radiographs (Fig. 8) to determine the outcome.

Discussion

Ankle fractures have become an increasingly common entity in everyday practice with conservative estimates attributing 10% of all bony injuries with rising incidence in recent years [6]. The most routinely encountered cause is falls from heights with ankle distortion, but it is not uncommon to see varied mechanisms ranging across low to high-energy trauma [7]. Fractures in elderly patients also have added challenges of comorbidities such as diabetes, osteoporosis, and fragile skin over the ankle.

There are multiple modalities of fixation available in today's practice such as tension band wiring with stainless steel wires, malleolar screws, bio-absorbable screws, and buttress plates. However, each of these methods is governed by their own set of complications. A retrospective review by Johnson et al. examined 22 displaced medial malleolar ankle fractures treated with modified tension band wiring. They reported problems with the technique including medial ankle pain and asymptomatic wire migration [8] suggesting that hardware impingement is a complication of tension band wiring in ankle fractures. Fowler et al. compared different fixation techniques in a study for medial malleolar fractures which noted that a well-documented complication of tension-band fixation is

prominent symptomatic implants and secondary surgery for implant removal [9]. A comparison between traditional stainless steel wire tension band with a knotless tension band technique for medial malleolus fractures in a retrospective clinical study by Cottom et al. reported that both sets of patients experienced hardware irritation at the tension band site followed by subsequent hardware removal, although wire tension band had rates of higher incidences [10]. A comparative study by Mehdi et al. examined three fixation techniques for isolated medial malleolus fractures: Tension-band wire fixation, partially threaded cannulated screws, and fully threaded cannulated headless compression screws, which found that tension band wiring and cannulated compression screws can cause irritation of soft tissues and pain over the hardware implantation site [11].

The biomechanical properties of fiber-wire allow it to augment the primary benefits of controlled compression at the fracture site with lesser metallic hardware whilst retaining tensile strength comparable to stainless steel wires, leading to the lower incidence of skin irritation in amagnetic resonance imaging compatible construct. It is similar relative strength comparable to metallic wires and loop integrity help in achieving sturdy fixation and negate the post-operative need for secondary

procedures to remove implant due to skin impingement or prominent hardware. Metallic wires are susceptible to breakage with time owing to fatigue, which is avoided by fiber-wire fixation due to its resilient nature [12, 13, 14]. The implications of these properties make employing fiber-wire as the modality of fixation highly desirable. In addition, unlike in fixation with metallic wires, fiber-wire can be employed not only just in transverse medial malleolar fractures but also effectively in avulsion fractures, revision procedures with dilated screw tracks, and fractures with osteoporotic distal fragments. A limitation of this fixation is that it cannot be employed in vertical shear fractures of the medial malleolus.

Conclusion

The biomechanical properties of fibre-wire augment primary benefits of controlled compression at the fracture site with lesser metallic hardware whilst retaining comparable tensile strength in an MRI compatible construct. Sturdy fixation even with poor bone quality, and elimination of need for secondary procedure to remove implant make fixation using fibre-wire a highly desirable alternative in similar fractures.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

References

- Ostrum RF, Litsky AS. Tension band fixation of medial malleolus fractures. *J Orthop Trauma* 1992;6:464-8.
- Skie MC, Ebraheim NA, Woldenberg L, Randall K. Fracture of the anterior colliculus. *J Trauma* 1995;38:642-7.
- Mast JW, Teipner WA. A reproducible approach to the internal fixation of adult ankle fractures: Rationale, technique, and early results. *Orthop Clin North Am* 1980;11:661-79.
- Carter TH, Duckworth AD, White TO. Medial malleolar fractures: Current treatment concepts. *J Bone Joint Surg* 2019;101:512-21.
- Nayagam S. Safe corridors in external fixation: The lower leg (tibia, fibula, hindfoot and forefoot). *Strategies Trauma Limb Reconstr* 2007;2:105-10.
- Elsoe R, Ostgaard SE, Larsen P. Population-based epidemiology of 9767 ankle fractures. *Foot Ankle Surg* 2018;24:34-9.
- Thur CK, Edgren G, Jansson KÅ, Wretenberg P. Epidemiology of adult ankle fractures in between 1987 and 2004. *Acta Orthop* 2012;83:276-81.
- Georgiadis GM, White DB. Modified tension band wiring of medial malleolar ankle fractures. *Foot Ankle Int* 1995;16:64-8.
- Fowler TT, Pugh KJ, Litsky AS, Taylor BC, French BG. Medial malleolar fractures: A biomechanical study of fixation techniques. *Orthopedics* 2011;34:e349-55.
- Downey MW, Duncan K, Kosmopoulos V, Motley TA, Carpenter BB, Ogunyankin F, et al. Comparing the knotless tension band and the traditional stainless steel wire tension band fixation for medial malleolus fractures: A retrospective clinical study. *Scientifica (Cairo)* 2016;2016:3201678.
- Kochai A, Türker M, Çiçekli Ö, Özdemir U, Bayam L, Erkorkmaz Ü, et al. A comparative study of three commonly used fixation techniques for isolated medial malleolus fracture. *Eklemler Hastalık Cerrahisi* 2018;29:104-9.
- Dy CJ, Little MT, Berkes MB, Ma Y, Roberts TR, Helfet DL, et al. Meta-analysis of re-operation, nonunion, and infection after open reduction and internal fixation of patella fractures. *J Trauma Acute Care Surg* 2012;73:928-32.
- Jirangkul P, Kosiyatrakul A. Abstaining from symptomatic implants of modified tension band wiring by nonabsorbable suture fixation for transverse patella fractures. *J Orthop Surg Res* 2021;16:367.
- Weber MJ, Janecki CJ, McLeod P, Nelson CL, Thompson JA. Efficacy of various forms of fixation of transverse fractures of the patella. *J Bone Joint Surg Am* 1980;62:21520.

Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Deore S, Kale S, Shetty S, Chalak A, Jayaram R, Patir R. A Novel Approach to Medial Malleolus Fracture of Ankle using Adjustable Loop Suspensory Fixation. *Journal of Clinical Orthopaedics* July-December 2024;9(2):132-136.