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Miniarthrotomy assisted percutaneous screw fixation for displaced medial malleolus fractures – A novel technique

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ABSTRACT

Aim: To describe here a technique of miniarthrotomy assisted percutaneous screw insertion for displaced Herscovici type B and C medial malleolar fractures.

Method: Incision was made centred over the superomedial angle of the ankle mortise, about half a cm medial to tibialis anterior. Arthrotomy was done and reduction obtained. Percutaneously, two 4 mm cancellous cannulated screws were inserted through medial malleolus.

Results and conclusion: This approach allows direct visualization of reduction, removal of entrapped soft tissue and preservation of saphenous vein and nerve.

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1. Introduction

Medial malleolus can fracture in isolation or in association with lateral malleolus or tibial plafond. Displaced fractures need reduction and fixation to restore ankle mortise. Open reduction and internal fixation is considered as the standard treatment of these fractures.¹ Depending on the fracture configuration and comminution, this can be achieved with 4 mm partially threaded cancellous screws, a combination of screw and K wire or tension band wiring.²

Medial malleolar fractures have been classified by Herscovici et al based on the location of fracture into four types.³

Avulsions of the tip of the malleolus are classified as type-A. Fractures occurring between the tip and the level of the plafond are grouped as type B. Type-C fractures occur at the level of the plafond and type-D are vertical fractures. Type B and C fractures are amenable to fixation by screws.

Traditionally, medial malleolus fractures are approached through an anteromedial approach, a direct longitudinal incision centred over malleolus or a J shaped incision.^{4,5} A major limitation of these approaches is impaired visualization of the articular reduction and any articular injury, for which an anterior arthrotomy and retraction of soft tissues is needed. These approaches carry risk of damage to saphenous vein and nerve. Furthermore, the skin over medial malleolus

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Fig. 1 – Preoperative radiograph AP view.

has precarious blood supply resulting in instances of skin breakdown, exposed hardware and infection especially in high energy fractures with compromised soft tissue envelope and in diabetics.^{6,7} To prevent soft tissue complications, it has been recommended to limit soft tissue stripping and use limited approaches directly over the fracture site.^{7,8}

The standard anteromedial malleolar approach is through a 10 cm long incision centred anterior to tip of medial malleolus, starting 5 cm proximally and curving to end 5 cm distal and anterior to medial malleolus tip.⁴ Excessive, distal, anterior angulation in this approach makes screw insertion difficult due to steep angle and these cases require screw to be put through separate stab incisions in the skin.⁹

To circumvent the above mentioned problems and difficulties, we devised a technique of miniarthrotomy assisted percutaneous screw fixation for displaced Herscovici type B and C medial malleolus fractures. This method has been successfully used in three of our patient. We present one of the cases for illustration of the surgical technique. Based on our experience we recommend this technique in all cases of displaced medial malleolus fractures with fragment large enough to allow screw placement.

2. Case presentation

An 18 yr old female had a twisting injury to her ankle while working in farmyard resulting in supination external rotation injury and bimalleolar fracture with grade 2 compounding of fibula (Figs. 1 and 2). The patient was taken to operating theatre 6 h after injury for debridement and fracture fixation. Fibular fracture was first debrided and fixed with two 1.8 mm K-wires. For medial side, initial attempts were made to close reduce the fracture, but anatomical reduction could not be

achieved. Therefore, we did a miniarthrotomy at superomedial angle of ankle mortise and performed direct reduction of fracture. Anatomical reduction was achieved and fixation was done with two 4 mm partially threaded cannulated cancellous screws, thereby avoiding the complications of open reduction.

3. Surgical technique

Surgery was performed in supine position on a radiolucent table with a small bump under ipsilateral hip. A tourniquet was applied in mid thigh and inflated to provide a bloodless surgical field. A 3 cm incision, slightly curved was made centred over the superomedial angle of the ankle mortise, about half a cm medial to tibialis anterior (Fig. 3). Skin and subcutaneous tissue were cut in straight line. Blunt dissection was done for identification of joint capsule. Capsule was cut along its insertion over superomedial angle of joint and over medial malleolus (Fig. 4). Reflection of the capsule distally exposed the joint and intrarticular extent of the fracture (Fig. 5). Subperiosteal placement of a homan retractor on the medial side provided a clear unobstructed view of extraarticular surface of fracture (Fig. 6). Fracture site was cleaned of haematoma and entrapped periosteum. Joint was inspected for marginal impaction and lavaged to remove any intraarticular fragment. Fracture reduction was done under direct vision with help of K-wires in distal fragments as joy sticks and was maintained with a percutaneously applied reduction clamp. Reduction was confirmed fluoroscopically. Guide wires were placed from tip of medial malleolus into opposite cortex for provisional fixation. Definitive fixation was done with two partially threaded 4 mm cannulated cancellous screws placed over guide wires through stab incisions (Fig. 7). Wound closure was done in layers and compression bandage was applied. Pt was allowed. Ankle exercises and non weight bearing mobilization

Fig. 2 – Preoperative radiograph lateral view.

Fig. 3 – Location of skin incision in relation to anteromedial approach.

for first 6 weeks and then partial wt bearing for next 6 weeks. Fracture united at three months (Fig. 8).

4. Discussion

Anteromedial approach, conventionally used for ORIF of medial malleolus fracture is associated with risk to saphenous vein and nerve at the proximal half of incision and posterior tibial tendon at the distal extent. Damage to saphenous nerve results in painful neuroma or numbness in its distribution. Injuring saphenous vein may result in venous insufficiency in foot. It is also an important site for cutdown in shock and venous grafts and therefore should be protected. Secondly, in this approach direct visualization of intraarticular fracture line is not possible and retraction or undermining of skin flap is needed for performing anterior arthrotomy which can cause marginal necrosis; given the precarious blood supply of skin in

Fig. 4 – Blunt dissection exposes capsule which is cut along its tibial attachment.

Fig. 5 – Joint is inspected for loose bodies, osteochondral injury and marginal impaction.

this area. Furthermore, making an incision directly over the fracture can lead to potentially catastrophic wound problems.¹⁰

Injury to saphenous nerve has been reported following ankle arthroscopy, fasciotomy and release for tarsal tunnel syndrome.^{11–13} A Cadaveric study showed that the nerve runs posterior to saphenous vein dividing into anterior and posterior branches at a distance of $3 \text{ cm} \pm 4 \text{ mm}$ proximal to tip of medial malleolus.¹⁴ Another cadaveric study found that the nerve and vein intersected anterior cortex of the tibia at an average of 2.88 cm (range, 1.9–6.8 cm) and 2.39 cm (range, 1.9–3.2 cm) from the tip of the medial malleolus.¹⁵

Fig. 6 – Hohman retractor placed on the medial side.

Fig. 7 – Direct visualisation of reduction and provisional fixation.

The incision for miniarthrotomy approach described here is situated just medial to tibialis anterior and away from saphenous nerve and vein, thus avoiding them. Tibialis posterior, sometimes found entrapped at fracture site, can be retracted away by subperiosteal placement of a human retractor. The miniarthrotomy, done directly over the shoulder of malleolus, allows visualization of fracture site as well as superomedial articular surface of talus and tibia. Hence, with this approach, direct inspection of fracture site and removal of entrapped periosteum is possible. Reduction is done under vision. Joint is easily explored and lavaged. Articular surface of tibia and talus can be inspected for marginal impaction and osteochondral injuries. It also allows inspecting superomedial corner of the joint to ensure that screw is not intraarticular.

The incision is very small; soft tissue stripping is minimal, therefore this approach is ideal for fractures with soft tissue damage as early fixation has been proven to be advantageous in these cases over delayed surgery, both in terms of wound healing and hospital cost.^{16,17} Additionally, a small scar is cosmetically appealing and less painful than a formal open

reduction. This approach leads to reduction in operative time, fluoroscopy exposure and rapid recovery of patient. However, ligament injury cannot be identified and repaired with this approach. Another limitation is difficulty in visualizing posterior articular margin. A similar technique of limited open reduction and percutaneous screw insertion has been described by Lintecum and Blasier for treatment of distal tibial physeal injuries. Their incision was situated anteriorly between tibialis anterior and extensor hallucis longus.¹⁸

Treatment of vertical fractures, in which a horizontal screw perpendicular to fracture line is passed, can also be fixed by this method, but no such case has been treated by the authors. Marginal impaction commonly seen with this fracture can be managed with proximal extension of the incision, but this can put saphenous nerve and vein at risk.¹⁴

5. Conclusion

Miniarthrotomy assisted percutaneous screw fixation for medial malleolus fracture allows direct reduction of fracture and preserves great saphenous vein and nerve. It has a small scar, minimal soft tissue stripping and therefore, allows rapid recovery and is recommended for displaced Herscovici type B and C medial malleolar fractures.

Consent statement

Written informed consent was obtained from patient for publication of this report and accompanying images.

Conflicts of interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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Fig. 8 – Follow up radiograph.

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