

CASE REPORT

Distal Fibula Pro-Tibial Screws in Salvage Fixation of Bimalleolar Ankle Fractures in Osteoporotic Bone – A Novel Technique

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Abstract

Here we present a novel adaptation of the previously described fibula pro-tibial fixation in a case requiring salvage fixation of a bimalleolar ankle fracture in an osteoporotic patient. Unstable osteoporotic ankle fractures are a challenging injury to manage and typically occur in a frail and comorbid subgroup of patients. Various techniques have been described in the evolution of managing these injuries, e.g. hindfoot nailing and anatomical locking plates, however in this uniquely challenging case a novel strategy was required to mitigate bone loss in the distal fibular fracture fragment. There is some evidence to suggest fibular protibial fixation offers a lower complication profile to its alternatives. The novel use of distal fibula pro-tibial screws offers a new alternative to hindfoot nailing of bimalleolar ankle fracture in osteoporotic bone with compromised distal fibular fragment bone purchase. Further research is required to investigate the compatibility of this technique with early weightbearing.

Level of evidence: IV

Keywords: Ankle, Bone failure, Osteoporosis, Revision fixation, Salvage fixation

Introduction

Here we present a case where salvage fixation using a novel extension of the previously described protibial technique was successfully utilised, due to failure of the initial fixation of a displaced bimalleolar ankle fracture in an osteoporotic geriatric patient. This is a useful technique for orthopaedic surgeons to have in their arsenal when dealing with such fractures.

Case Presentation

The patient sustained a bimalleolar ankle fracture which, due to lack of displacement and following discussion around risks versus benefits of potential fixation, was initially treated in a plaster cast. Unfortunately this resulted in a significant loss of reduction at one week post-injury, despite satisfactory initial plain films and a well moulded cast. The patient was then taken to theatre for standard open reduction and internal fixation (ORIF) the following day by a different team. A posterolateral anatomical locking plate for a comminuted distal fibular fracture and cancellous screw for the medial malleolar fracture were utilised. Due to both

physiological factors and technical shortcomings, this fixation also resulted in a loss of reduction post-operatively. The first post-operatively check X-ray revealed that the ankle had collapsed into valgus, with several distal fibular locking screws occupying the majority of the distal fibula fragment and two proximal fibular plate screws missing the fibula entirely.

Failure of conservative management in a moulded cast and ORIF resulted in a 2 week old ankle fracture with severely compromised bone stock in an elderly patient requiring revision fixation [Figure 1 – 5].

This challenging case was discussed between senior traumatologists, and was deemed ill-suited to standard fixation techniques, partly due to the absence distal fibular bone stock available for revision fixation. A novel deviation from the standard fibular pro-tibial fixation technique was therefore considered. As anticipated, poor bone quality with significant bone loss in the distal fibular fragment with “lightbulb” type appearance due to the previous fixation attempts meant difficulty was encountered

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in gaining screw purchase in the distal fragment. Distal fibular pro-tibial screws, which were trans-syndesmotomic and trans-tibial, were used to provide stability to the remaining distal fibula.



Figure 1. Anterior-posterior and lateral plain film Xrays of initial fracture



Figure 2. Anterior-posterior and lateral plain film Xrays of initial fracture in a moulded cast, showing an adequate reduction



Figure 3. Anterior-posterior and lateral plain film Xrays of initial fracture in a moulded cast at 1 week post-injury, showing loss of reduction and valgus collapse



Figure 4. Intra-operative anterior-posterior and lateral plain film Xrays of initial ORIF

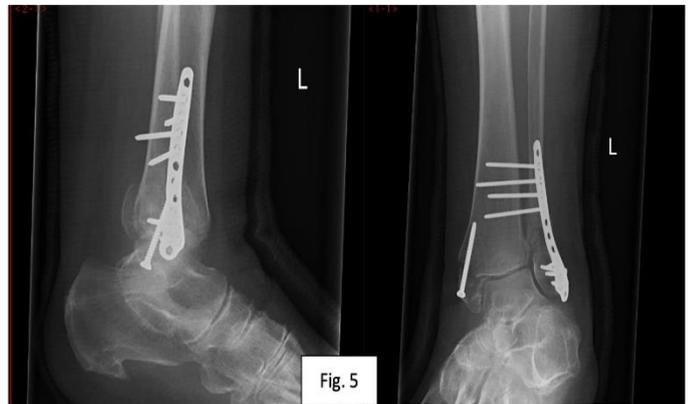


Figure 5. Post-operative anterior-posterior and lateral plain film Xrays of initial ORIF

The medial malleolus fixation was also successfully revised with a combination of partially threaded and cortical screws, as well as a medial buttress plate [Figure 6, Figure 7]. Whilst successful use of fibular pro-tibial screws across the proximal fibula are well described,¹ use of this technique across the distal fragment has not been described previously, to the best of the author's knowledge.



Figure 6. Intra-operative anterior-posterior and lateral plain film Xrays of revision ORIF

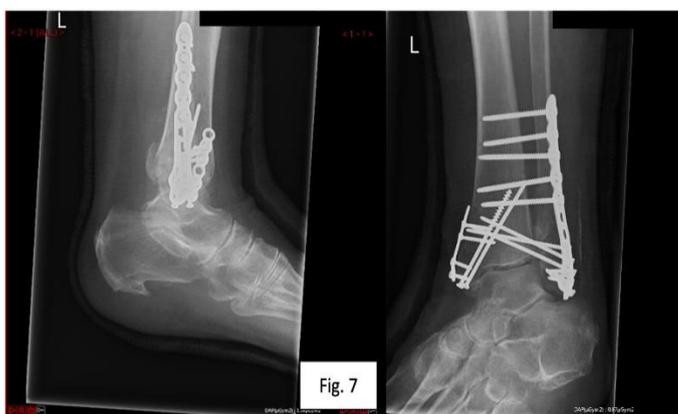


Figure 7. Post-operative anterior-posterior and lateral plain film X-rays of revision ORIF

Post-operatively a below knee cast was reapplied and the operative side was restricted to limited weight bearing for 6 weeks. Successive outpatient follow up showed no loss of reduction, radiological union, and a complete return to baseline mobility (one stick for balance) at the final review 7 months post-operatively [Figure 8c]. On discharge, the patient's recovery can also be appreciated by their high AOFAS Ankle-Hindfoot Score of 94 %, a maximal range of motion of -10 degrees dorsiflexion to 50 degrees plantarflexion – with symmetrical measurements to the contralateral side [Figure 8a, Figure 8b].



Figure 8. (a): Clinical photography of maximal dorsiflexion at discharge (b): Clinical photography of maximal planter-flexion at discharge (c): Anterior-posterior film X-rays of revision ORIF at discharge

Discussion

Ankle fracture fixation in osteoporotic bone can present several challenges due to the reduced bone density and quality associated with osteoporosis. These challenges can affect the stability of fixation constructs and the overall success of the surgical procedure. With an aging population, traumatic ankle fractures requiring fixation in osteoporotic bone will become increasingly common.²

Given the co-morbidities inherent to the geriatric population, high prevalence of osteoporosis and decreased healing potential, unstable ankle fractures in the elderly are sometimes left to heal in a moulded cast. A degree of mal-union can often be accepted in this population from a pragmatic standpoint given the perceived higher risk of operative fixation, and lesser concern around long term development of post-traumatic osteoarthritis. Technical challenges to fixation include decreased screw purchase in osteoporotic bone, Intra-operative fracture propagation, implant failure, non/delayed-union, and associated soft tissue complications (e.g. wound breakdown and infection). These challenges increase the risk of loss of reduction post-operatively and/or construct failure. Patient co-morbidities and advanced age also increase the accompanying risk of anaesthetic or post-operative complications.³

Operative management of bimalleolar ankle fractures commonly utilise fixation with 1/3rd tubular fibular plating and medial malleolar screws described by the AO Foundation.^{4,5} There are concerns regarding this technique in patients with osteoporosis due to inadequate screw/bone purchase resulting in inadequate support for immediate post-operative weight bearing – a primary goal of fixation in this demographic. Additional concerns pertain to bone loss and potential increased risk of soft tissue complications. Alternative fixation techniques have therefore been described, with advent of anatomical locking plates, fibular or hindfoot intramedullary nailing, and fibula pro-tibia fixation. Whilst the fixation modality selection should be based on each individual fracture pattern and case considerations, there is evidence to support the use of fibula pro-tibia fixation over the aforementioned alternative methods.⁶

Fixation modalities such the well published strategy of fibula pro-tibial fixation and fibular nailing were not appropriate in this case due to the inherently poor bone quality and distal fibula volume deficit created by the first attempt of ORIF. Intramedullary Hind-foot Nailing was considered, but also deemed to be carry high risks of construct failure; hind-foot nailing was however the planned 3rd line strategy, if this technique had failed.

Hind-foot nails can offer solid fixation in osteoporotic bone, and can be done through a minimally invasive approach, which is of benefit in patients high-risk for wounds problems. Additionally, hindfoot nails are a load sharing construct so can facilitate early weight-bearing.^{7,8} These benefits are afforded at the expense of tibio-talar and sub-talar joint fusion, which renders the hindfoot stiff.

Fusion of the hindfoot is detrimental to mobility, which may already be impaired in the elderly. Furthermore, neurovascular injury risk is reportedly high.⁹ The evidence is showing that although return to function following hindfoot nailing is good, there is also a significant complication profile; including peri-prosthetic fracture and nail failure.^{10,11}

This therefore presented a uniquely challenging case, requiring a fixation strategy to that would provide a construct which would afford stability to the remnants of the distal fibula in an elderly patient with failed primary ankle fracture fixation. The successful use of pro-tibial screws across the distal fragment in this case provides a new alternative treatment strategy for cases requiring a salvage ankle fixation in osteoporotic bone if hold distally is inadequate to previously described methods.

Conclusion

Osteoporotic ankle fractures are a common and challenging subgroup on injuries to manage, this is due to multiple factors including increased co-morbidities, poor bone quality and limited ability to comply with non-weight bearing rehab protocols in this inherently vulnerable group of patients. Current evidence suggests that surgical goals in treating fractures in this patient subgroup should aim to facilitate early weight-bearing. Given the novelty of

the technique described and the fact it was a revision/salvage procedure, a conservative approach to weight-bearing was taken. Further evaluation of its suitability for early weight-bearing is therefore required, as other surgeons managing similar cases utilise this technique.

This case shows that the use of pro-tibial screws in the distal fibula fragment can provide secure fixation in cases of failed fibular fixation and should therefore be considered during surgical planning of similar difficult cases, where other operative techniques have failed or are felt to be inadequate.

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