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Editorial

Open reduction and internal fixation of high fibular fractures in ankle injuries: Is it necessary? – A review of the literature

1. Introduction

Normal function of the ankle joint depends on the congruent articulation between the mortise and the talar dome. Bony elements are joined by a complex system of medial, lateral and tibiofibular syndesmotic ligamentous structures.¹ During normal physiologic loading the syndesmotic complex acts in concert with the deltoid and lateral ligaments to maintain stability while allowing for the talus coupled motions of sagittal plane dorsiflexion and plantarflexion and the small amount of axial plane internal and external rotation.^{2–6}

The relative contribution of each of the bony and ligamentous structures to joint stability has been the subject of extensive research in both clinical and laboratory injury simulation settings.^{7,8} The deltoid ligament has been proved to be the primary stabiliser under physiologic loading. From available data it appears that syndesmotic disruption leads to significant diastasis and, consequently, alteration in ankle joint biomechanics only if the medial structures are incompetent.

In cadaveric specimens in which the anterior tibiotalar part of the deltoid ligament was divided and an external rotation torque applied Xenos et al demonstrated that tibiofibular diastasis was proportionate to incremental sectioning of the syndesmosis. Likewise and in similarly created injury patterns Boden et al showed a mean syndesmotic widening of up to 4.5 mm with sequential syndesmotic sectioning. In addition the authors demonstrated that following rigid fixation of lateral and medial malleolar fractures no significant diastasis occurred emphasising the importance of an intact deltoid ligament in maintaining stability even in the face of a significant syndesmotic disruptions. Similar results were shown by Michelson et al in specimens that were axially loaded and, thus, more closely simulating normal physiologic conditions.⁹ Following application of similar experimental protocols further supporting evidence was obtained by Burns et al who proved that in addition to an average syndesmotic diastasis of 0.73 mm there was a 39% reduction in tibiotalar contact areas, and a 42% increase in the peak pressure.¹⁰ Clinical support for this laboratory evidence came from a prospective study by Yamaguchi et al of 21 patients with a Weber type C ankle fracture. Eighteen patients underwent rigid fixation of both

medial and lateral malleolar fractures without syndesmotic fixation. None of them demonstrated syndesmotic widening at final follow-up.¹¹ The authors, however, recommended syndesmotic fixation when a fibular fracture is located 4.5 cm above the joint in the presence of deltoid ligament tear. Several other investigators attempted to formulate guidelines for syndesmotic fixations. However, most agree that the decision must be individualised and based on intra-operative stress testing. This is in keeping with several reports that have shown low predictive values of injury biomechanical and radiographic criteria, and that adequate syndesmotic stability has often been achieved following operative stabilisation of medial and lateral injuries.^{12–15}

Many technical aspects of syndesmotic fixation are still largely controversial. However it is well agreed that the fixation method chosen should maintain accurate syndesmotic reduction while avoiding overtightening until ligamentous healing occurs. This is most often accomplished using one or two 3.5 or 4.5 mm cortical screws engaging three or four cortices positioned parallel to the joint and approximately 3.5 cm proximal to it.^{8,16–18}

The direct influence of malleolar reduction in unstable ankle fractures on final outcome is well documented in several reports.^{19–23} In 150 patients with external rotation (Weber B and C) unstable ankle fractures treated operatively De Souza et al reported satisfactory results in 90%. Failure of accurate lateral malleolar reduction was quoted by the authors as the most frequent reason for the unsatisfactory results when factors such as initial injury severity and infection were excluded.²⁴ The authors however reported twelve cases in this series in which residual fibular displacements in coronal and sagittal planes were accepted. These constituted the Maisonneuve fractures which were treated by syndesmotic screw fixation and had satisfactory outcome except for one case. Although the authors emphasised that fibular length was maintained, a detailed account of the technique used was not discussed. Traditionally middle and proximal third fibular fractures have often been ignored while attention is focused on bringing the distal fibula into tibial incisural notch and thus reducing the syndesmosis. While maintaining reduction, usually by a reduction clamp or K-wires, a percutaneous technique is then used to position the syndesmosis screw.

However the foundation for this approach as opposed to direct fibular reduction is not clear in the literature. Several case series have been reported confirming satisfactory radiological and clinical outcomes following syndesmotic screw fixation without directly addressing the high fibular fracture. Pan-kovich advocated lateral surgical exploration and fibulotibial transfixation if gross fibular motion exists following repair of the medial side in Maisonneuve fractures.²⁵ While Duchesneau et al in their review article stated that Maisonneuve fractures should never be fixed at the fracture level, they advocated indirect means by exposing the distal fibula and syndesmosis and applying traction to correct fibular shortening and rotation prior to transsyndesmotic screw fixation.²⁶ Obeid et al reported good radiological and clinical outcomes in five cases treated by closed syndesmotic reduction and percutaneous supra-syndesmotic screw fixation.²⁷ One case in their series had a middle third fibular shaft fracture. The authors commented that their findings were in keeping with previous results obtained by Merrill et al who had excellent and good functional outcome in six out of nine patients with Maisonneuve fractures treated non-operatively indicating that anatomic fracture reduction was not necessary as long as the syndesmosis is kept reduced.²⁸ Sproule et al reported satisfactory clinical and radiological results in 12 patients (68%) of 14 Maisonneuve fractures. They attributed the unsatisfactory outcomes seen in two patients in their series to the severity of the initial injury and significant co-morbid disease. Although a percutaneous syndesmotic fixation technique was used in all patients the authors advocated restoration of fibular length and rotation and described an indirect technique of internal rotation of ankle and manual distraction and translation of lateral malleolus using pointed clamp or bone hook.²⁹ It is not clear how often this technique was successfully implemented in this small retrospective series.

Fig. 1 – An example of mortise reduction using a percutaneous syndesmosis screw fixation while accepting the fibular fracture alignment.

The aforementioned reports have focused on Maisonneuve injuries in which the fracture occurs at the proximal third of fibula. To our knowledge there are no reports in the English literature specifically discussing treatment recommendations for displaced high fibular fractures occurring in the middle third.

Anatomical and radiological studies have suggested that an apparent posterior displacement and external rotation deformity of the distal fibular fragment is in fact only a visual illusion created by internal rotation and sagittal plane

Fig. 2 – An example of open reduction and plate fixation of a high fibular fracture in addition to syndesmosis screw fixation.

displacement of the proximal fragment and, therefore, bears no consequences on ankle joint biomechanics. Michelson et al in a prospective radiological study found that the proximal fibular fragment was internally rotated on CT scan in 19 out of 26 ankle fractures. The authors however noted that sixteen cases represented isolated lateral malleolar fractures with intact medial structures.³⁰ Similarly Harper et al in a CT study of 18 supination-external rotation stage 2 ankle fractures found that in the majority of cases the fracture displacement was confined to the proximal fibular fragment.³¹ Their conclusions however could not be extrapolated on the unstable patterns with medial malleolar fractures or deltoid ligament injury. In a recent CT study Tang et al demonstrated that in Laugue-Hansen supination-external rotation and pronation-external rotation type IV injuries the distal fragment was externally rotated as compared to both proximal fragment and the normal contra-lateral lateral malleolus.³²

2. Conclusion

It becomes apparent from the above discussion that specific patho-anatomical features as related to the level of injury and degree of displacement of fibular fractures that would constitute operative threshold for direct open reduction and internal fixation are not well defined in the orthopaedic literature (Figs. 1 and 2). Proponents of indirect methods argue that treatment of malleolar fractures is in essence aimed at restoring normal ankle mortise and coronal plane tibiofibular relationship. In addition the significantly deeper surgical dissection that is necessitated by more proximal fibular approaches may be viewed as an additional operative risk. However little is known as to the effects of residual axial plane fibular rotational mal-reductions on ankle biomechanics. These mal-reductions may be difficult to judge or, indeed, to surgically address when indirect methods are employed. Furthermore the literature is lacking in suitably designed long-term clinical studies comparing direct versus indirect approaches. Until such evidence becomes available surgical decisions are likely to continue to be based on individual surgeon's preferences.

Conflicts of interest

The author has none to declare.

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16 October 2012

0972-978X/\$ – see front matter

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<http://dx.doi.org/10.1016/j.jor.2013.01.005>