Multi-level Fibular Fractures: Evaluation of a Unique Fracture Pattern in Rotational Ankle Injuries

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Statement of Purpose

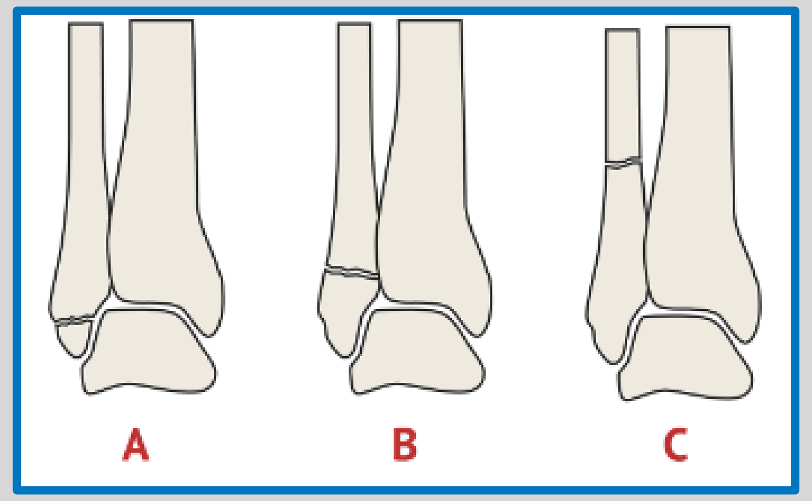
The mechanism of fracture progression and soft tissue damage in rotational ankle injuries has been well described by both the Lauge-Hansen and the Danis-Weber classification systems. While these systems are often adequate to describe a majority of fracture patterns, there exists a subset of fractures that cannot be classified by Lauge-Hansen. We present a case series of two patients with multi-level fibular fractures at both the level of the ankle joint and at the fibular neck that occurred after rotational ankle injuries.

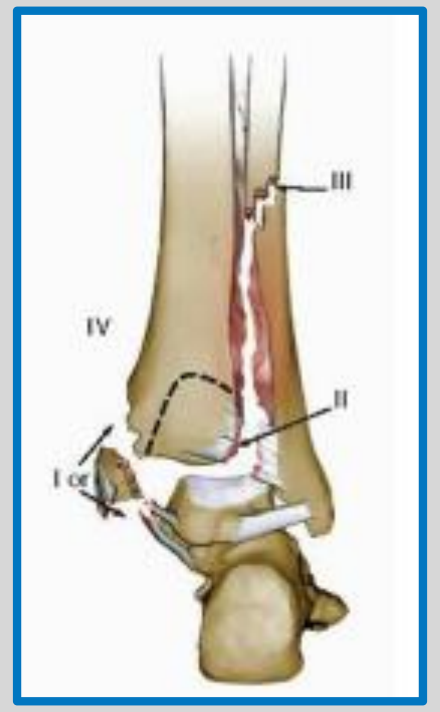
Literature Review

Rotational ankle fractures were initially classified by Lauge-Hansen in 1950 into typical fracture patterns based on foot position at the time of traumatic event[1].This system created four categories and thirteen subgroups to describe ankle fractures. The pronation-external rotation injury pattern includes four stages. The third stage involves a fracture of the fibula proximal to the tibial plafond (Figure 2). This fracture can often occur in the proximal third on the fibula, which has been termed a Maisonneuve fracture[2].

In an effort to create a fracture classification that was not based on mechanism, Danis and Weber classified ankle fractures based on radiographic findings (Figure 1). Type C fractures occur proximal to the tibial plafond and typically include syndesmotic injury[2].

Despite these extensive classification systems, the literature outlines fractures that cannot be defined by these systems[3]. Two studies outlined 1-12% of injuries that cannot be classified, but none of these unclassified injuries involved multi-level fractures[3,4]. To our knowledge, no literature exists on multi-level fibular fractures in rotational ankle fractures.





Figures 1-2: 1. (Above): Danis-Weber Ankle Fracture Classification. **2. (Right):** Pronation-External Rotation Lauge-Hansen Classification

Case Study #1

Patient 1 is a 65 year old male with a past medical history of diabetes with peripheral neuropathy who presented with a closed, right, trimalleolar equivalent ankle fracture after a rotational injury. Radiographs revealed a displaced, comminuted, Weber C fibular fracture, small posterior malleolar fracture, and increased medial clear space. Tibial-fibular radiographs revealed a minimally displaced proximal fibular neck fracture (Figure 3).

A. B. C. D.

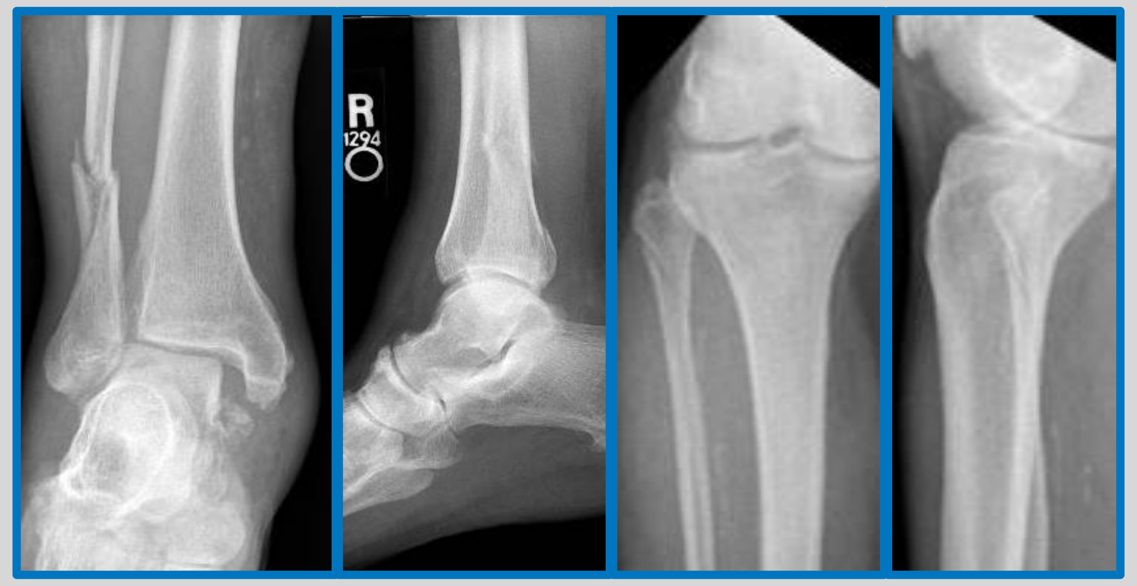


Figure 3:
A. Injury Ankle Mortise
B. Injury Ankle Lateral
C. Injury Leg Lateral
D. Injury Leg AP

Procedure and Results

After reduction and splinting, the patient presented 14 days after the injury for open reduction and internal fixation with a lateral, anatomic, fibular plate and three trans-syndesmotic screws. The proximal fibular fracture and the posterior malleolar fracture were not fixated as reduction and stabilization of the ankle mortise indirectly reduced the fractures. The postoperative course was complicated by partial wound dehiscence that resolved with wound care. Progression to weightbearing at 6 weeks with subsequent radiographs revealed interval healing and a maintained ankle mortise (Figure 4). The patient was ambulating without an assisting device at one year follow up.

A. B. C. D.

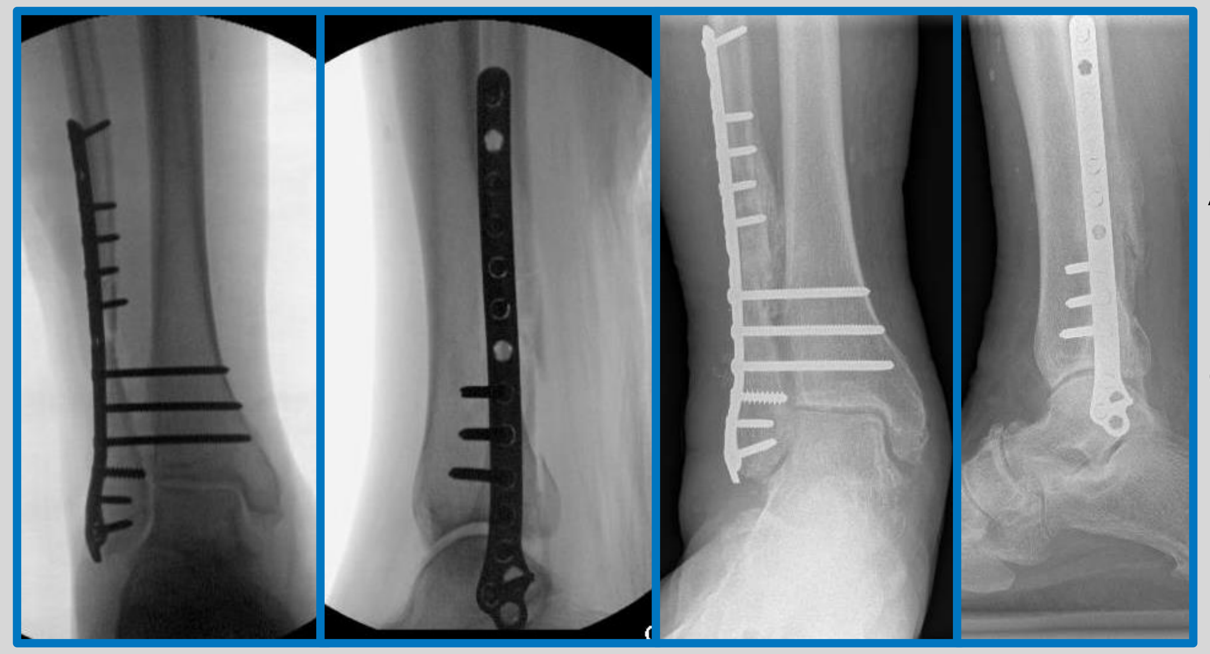


Figure 4:
A. Intra-operative Mortise
B. Intra-operative Lateral
C. Six Month Postoperative Mortise
D. Six Month Postoperative Lateral

Case Study #2

Patient 2 is a 65 year old female without significant past medical history who presented with a closed, left trimalleolar ankle fracture and dislocation after a rotational injury. Radiographs revealed a comminuted, Weber C fibular fracture, a small posterior malleolar fracture, and a medial malleolar fracture. Tibial-fibular radiographs revealed a minimally displaced proximal fibular neck fracture (Figure 5).

A. B. C. D.

Figure 5:
A. Injury Ankle AP
B. Injury Ankle Lateral
C. Injury Leg AP
D. Injury Leg Lateral

Procedure and Results

After reduction and splinting, the patient presented 10 days after the injury for open reduction and internal fixation with a lateral, anatomic, fibular plate, one trans-syndesmotic screw, and two medial malleolar screws. The proximal fibular fracture and the posterior malleolus were addressed by indirect reduction and stabilization of the ankle mortise. The postoperative course was uncomplicated. Progression to weightbearing at 6 weeks with subsequent radiographs revealed interval healing and a maintained ankle mortise (Figure 6). The patient was ambulating without an assistive device at one year follow up.

A. B. C. D. E.

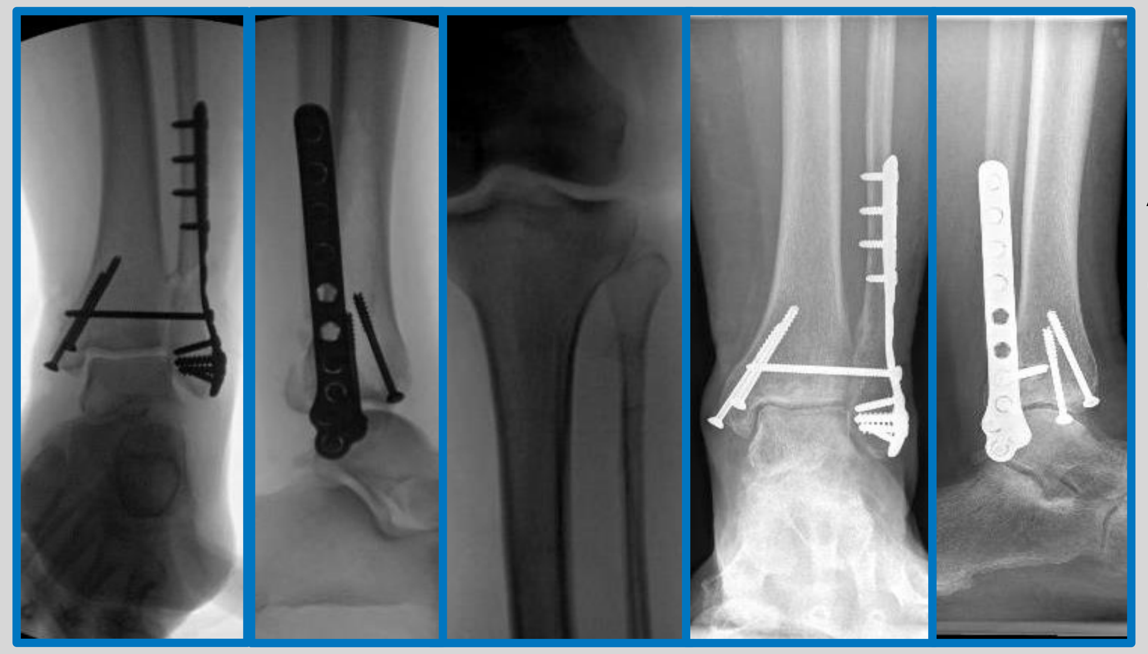


Figure 6:
A. Intra-operative Mortise
B. Intra-operative Lateral
C. Intra-operative Leg
D. Six Month Postoperative Mortise
E. Six Month Postoperative Lateral

Analysis & Discussion

Classification systems such as Lauge-Hansen and Danis-Weber can be helpful in categorizing ankle fractures in terms of mechanisms of injury, radiographic fractures, and predictors of ligamentous injury, but the inclusiveness of these systems has been challenged. This case series illustrates two cases of rotational ankle injuries in which there exists both distal and proximal fractures of the fibula. This fracture pattern has not been described in the current literature.

Treatment of Maisonneuve fractures has historically involved reduction and stabilization of the ankle mortise without direct open reduction and internal fixation of the proximal fracture. Weber C fibular fractures within 10cm of the ankle joint are often directly stabilized with open reduction and internal fixation due to anatomic considerations[5]. Establishing a stable, anatomic ankle mortise after operative fixation of ankle fractures has been shown to play a key role in patient outcomes[6]. It has been conclusively demonstrated that small alterations in mortise alignment leads to altered mechanics and dramatic shifts in contact pressures, and thus increasing the likelihood of post-traumatic pain and arthritis[7]. In our case series, the ankle mortise was re-established with standard open reduction and internal fixation including both syndesmotic fixation and stabilization of the distal Weber C fibular fractures. Both Maisonneuve fractures were found to be indirectly reduced and both patients went on the return to pre-injury activity levels.

It is unclear what mechanism may produce a multi-level fibular fracture pattern. The often vague recollection of mechanism lends suspicion of atypical dislocation patterns. This injury pattern is likely due to additional rotational loads or unclear direct mechanisms. Further biomechanical studies are needed to elucidate the exact mechanism.

This case series illustrates a previously undescribed multi-level fibular fracture pattern in rotational ankle injuries. Both cases went on to successful outcomes with stabilization of the ankle mortise with indirect reduction of the Massioneuve fracture.

References

1. Lauge-Hansen N. Ligamentous ankle fractures; diagnosis and treatment. *Acta Chir Scand.* 1949;97(6):544-550.
2. Tartaglione JP, Rosenbaum AJ, Abousayed M, DiPreta JA. Classifications in Brief: Lauge-Hansen Classification of Ankle Fractures. *Clin Orthop Relat Res.* 2015;473(10):3323-3328.
3. Gardner MJ, Demetrakopoulos D, Briggs SM, Helfet DL, Lorich DG. The ability of the Lauge-Hansen classification to predict ligament injury and mechanism in ankle fractures: an MRI study. *J Orthop Trauma.* 2006;20(4):267-272.
4. Yde J. The Lauge Hansen classification of malleolar fractures. *Acta Orthop Scand.* 1980;51(1):181-192.
5. Stufkens SA, van den Bekerom MP, Doornberg JN, van Dijk CN, Kloen P. Evidence-based treatment of maisonneuve fractures. *J Foot Ankle Surg.* 2011;50(1):62-67.
6. Rukavina A. The role of fibular length and the width of the ankle mortise in post-traumatic osteoarthrosis after malleolar fracture. *Int Orthop.* 1998;22(6):357-360.
7. Ramsey PL, Hamilton W. Changes in tibiotalar area of contact caused by lateral talar shift. *J Bone Joint Surg Am.* 1976;58(3):356-357.

Financial Disclosures

Adam Phillips – None

Steven E. Laxson - None