Treatment of ankle fracture requires stability to maintain alignment of the talus

Pakarinen Harri, Savola Olli
Department of Orthopedics and Traumatology, Oulu University Hospital

The stability of the fractured ankle is the critical determinant in clinical decision-making. If the injury pattern in a fractured ankle allows external rotation of the talus, the ankle mortise is unstable. Fractures associated with unstable ankle mortise may lead to late instability, pain, and osteoarthritis, and in general operative treatment is indicated. Unimalleolar ankle fractures can be treated non-operatively if the talus in perfectly centered in the mortise and an exact reduction of the talus can be maintained. Treatment of ankle fracture requires stability to restore alignment, which is necessary to achieve a good outcome.

Introduction

Although according to Charnley "the reduction of the displacement is secured by concentrating on the displacement of the talus in relation to the tibia" (1), there is general consensus that the stability of the ankle mortise is the most important factor when choosing between operative and non- operative treatment (2–9).

Anatomical and biomechanical considerations of ankle fractures

If the injury pattern in a fractured ankle allows external rotation (ER) of the talus, the ankle mortise is unstable (7–8,10–12) and appears as a lateral shift of the talus on a two-dimensional plain radiograph (12). Even 1 mm of talar displacement decreases the contact area in the tibiotalar joint by more than 40% (13,14). According to clinical and biomechanical studies, the medial malleolus and deltoid ligament are the primary sources of ankle stability (6,9,12,15–20).

Diagnosis

Plain radiographs do not reveal dynamic incongruity. ER stress or weight-bearing radiographs have been used in an attempt to demonstrate instability associated with lateral malleolar fracture and deltoid ligament injury (21–24). Gravity stress radiographs are considered to be as useful as the manual stress radiograph for determining complete deltoid ligament injury in association with an isolated distal fibular fracture (25). However, it is unclear whether a positive radiograph alone is a sufficient criterion for surgical intervention (26–28). Clinical signs that suggest an unstable fracture pattern include lateral side fracture with medial tenderness, swelling, and ecchymosis; however, these clinical signs did not predict widening of the medial clear space on stress radiographs (26). ER stress examination should be carried out in cases of isolated lateral malleolar fracture with medial tenderness or hematoma and no talar shift on mortise radiograph (8,9).

Decision-making

Treatment of ankle fracture requires stability to restore alignment and to allow bony healing. Stability of the fracture is considered as the most important factor for healing and alignment to achieve a good outcome. Displacement (malleoli) alone is of minor importance, and ankle stability is the key factor in choosing the appropriate treatment (7–9,12).

Fractures associated with unstable ankle mortise may lead to late instability, pain, and osteoarthritis, and in general operative treatment is indicated (3,6–9).

Unimalleolar ankle fractures can be treated non-operatively if the talus in perfectly centered in the mortise and an exact reduction of the talus can be maintained with a short cast or functional brace (27–31). There is no clear evidence presented to support non-operative treatment of bi-and trimalleolar fractures.

Treatment

Stable fractures can be treated with a short cast or functional brace. Weight bearing can be allowed as tolerated, and patients usually start to weight-bear when symptoms ease, good results have been reported with high-top shoes and with use of an elastic bandage (29,30).

Rigid fixation of the lateral and medial malleolus with a small fragment plate and screws is the most common operative method for unstable fractures. Posterior malleolar fractures of more than 30% of the articular surface can lead to instability of the ankle in the posterior direction, and thus fixation is recommended (32–34). Fixation of the posterior malleolus may also stabilize the syndesmosis when injured, especially with high fibular fractures (35).

The goal of the operative treatment should be to stabilize the fractured ankle enough to maintain the reduction of the talus. Early results of our ongoing trials (RCT) show, that also ER stress positive ligamentous, i.e. unimalleolar SE4- type fracture may be able to treat non-operatively (27,28,31) and in most of the bi- and tri malleolar ankle fractures fixation of medial malleolus is enough to maintain the reduction of the talus.

Conclusion

Treatment of ankle fracture requires stability to restore alignment, which is necessary to achieve a good outcome. We have to make "local attack on the one or other of the malleoli" only if the alignment is not restored with a cast, i.e. the fractured ankle is not stable enough for non-operative treatment.

References

1. Charnley J. Pott´s fracture. In: The closed treatment of common fractures, Third edition. Churchill Livingstone, New York, 1974;250-269.

2. Yde J, Kristensen KD. Ankle fractures. Supination-eversion fractures stage II. Primary and late results of operative and non-operative treatment. Acta Orthop Scand. 1980a;51(4):695-702.

3. Yde J, Kristensen KD. Ankle fractures: supination-eversion fractures of stage IV. Primary and late results of operative and non-operative treatment. Acta Orthop Scand. 1980b;51(6):981-990.

4. Bauer M, Jonsson K, Nilsson B. Thirty-year follow-up of ankle fractures. Acta Orthop Scand. 1985b;56(2):103-106.

5. Kristensen K D, Hansen T. Closed treatment of ankle fractures. Stage II supination-eversion fractures followed for 20 years. Acta Orthop Scand. 1985;56(2):107-109.

6. Phillips WA, Schwartz HS, Keller CS, Woodward HR, Rudd WS, Spiegel PG, et al. A prospective, randomized study of the management of severe ankle fractures. J Bone Joint Surg Am. 1985;67-A(1):67-78.

7. Michelson JD. Fractures about the ankle. J Bone Joint Surg Am. 1995;77(1):142-152.

8. Michelson JD, Magid D, McHale K. Clinical utility of a stability-based ankle fracture classification system. J Orthop Trauma. 2007;21(5):307-315.

9. Pakarinen H, Flinkkilä T, Ohtonen P, Ristiniemi J. Stability Criteria for Nonoperative Ankle Fracture Management. Foot Ankle Int. 2011;32(2):141-147.

10. Yablon IG, Heller FG, Shouse L. The key role of the lateral malleolus in displaced fractures of the ankle. J Bone Joint Surg Am. 1977;59-A(2):169-173.

11. Harper MC. An anatomic study of the short oblique fracture of the distal fibula and ankle stability. Foot Ankle. 1983;4(1):23-29.

12. Pakarinen H. Stability-based classification for ankle fracture management and the syndesmosis injury in ankle fractures due to a supination external rotation mechanism of injury. Acta Orthop Suppl. 2012;(347):1-31.

13. Ramsey PL, Hamilton W. Changes in tibiotalar area of contact caused by lateral talar shift. J Bone Joint Surg Am. 1976;58-A(3):356-357.

14. Clarke HJ, Michelson JD, Cox QG, Jinnah RH. Tibio-talar stability in bimalleolar ankle fractures: a dynamic in vitro contact area study. Foot Ankle. 1991;11(4):222-227.

15. Pettrone FA, Gail M, Pee D, Fitzpatrick T, Van Herpe LB. Quantitative criteria for prediction of the results after displaced fracture of the ankle. J Bone Joint Surg Am. 1983;65-A(5):667-677.

16. Michelson JD, Magid D, Ney DR, Fishman EK. Examination of the pathologic anatomy of ankle fractures. J Trauma. 1992;32(1):65-70.

17. Harper MC. The short oblique fracture of the distal fibula without medial injury: an assessment of displacement. Foot Ankle Int. 1995;16(4):181-186.

18. Earll M, Wayne J, Brodrick C, Vokshoor A, Adelaar R. Contribution of the deltoid ligament to ankle joint contact charac-

teristics: a cadaver study. Foot Ankle Int. 1996;17(6):317-324.

19. Sasse M, Nigg BM, Stefanyshyn DJ. Tibiotalar motion--effect of fibular displacement and deltoid ligament transection: in vitro study. Foot Ankle Int. 1999;20(11):733-737.

20. Michelson JD, Hamel AJ, Buczek FL, Sharkey NA. Kinematic behavior of the ankle following malleolar fracture repair in a high-fidelity cadaver model. J Bone Joint Surg Am. 2002;84-A(11):2029-2038.

21. Pankovich AM. Fractures of the fibula at the distal tibiofibular syndesmosis. Clin Orthop Relat Res. 1979;(143):138-147.

22. Pankovich AM, Shivaram MS. Anatomical basis of variability in injuries of the medial malleolus and the deltoid ligament. II. Clinical studies. Acta Orthop Scand. 1979;50(2):225-236.

23. Michelson JD, Varner KE, Checcone M. Diagnosing deltoid injury in ankle fractures: the gravity stress view. Clin Orthop Relat Res. 2001;(387):178-182.

24. Weber M, Burmeister H, Flueckiger G, Krause FG. The use of weightbearing radiographs to assess the stability of supination-external rotation fractures of the ankle. Arch Orthop Trauma Surg. 2010;130(5):693-698.

25. Gill JB, Risko T, Raducan V, Grimes JS, Schutt RC, Jr. Comparison of manual and gravity stress radiographs for the evaluation of supination-external rotation fibular fractures. J Bone Joint Surg Am. 2007;89-A(5):994-999.

26. Egol KA, Amirtharajah M, Tejwani NC, Capla EL, Koval KJ. Ankle stress test for predicting the need for surgical fixation of isolated fibular fractures. J Bone Joint Surg Am. 2004;86-A(11):2393-2398.

27. Tornetta P 3rd, Axelrad TW, Sibai TA, Creevy WR. Treatment of the stress positive ligamentous SE4 ankle fracture: incidence of syndesmotic injury and clinical decision making. J Orthop Trauma. 2012;26(11):659-661.

28. Sanders DW, Tieszer C, Corbett B; Canadian Orthopedic Trauma Society. Operative versus nonoperative treatment of unstable lateral malleolar fractures: a randomized multicenter trial. J Orthop Trauma. 2012;26(3):129-134.

29. Zeegers AV, Van Raay JJ, van der Werken C. Ankle fractures treated with a stabilizing shoe. Acta Orthop Scand. 1989;60(5):597-599.

30. Ryd L, Bengtsson S. Isolated fracture of the lateral malleolus requires no treatment. 49 prospective cases of supination-eversion type II ankle fractures. Acta Orthop Scand. 1992;63(4):443-446.

31. Hoshino CM, Nomoto EK, Norheim EP, Harris TG. Correlation of weightbearing radiographs and stability of stress positive ankle fractures. Foot Ankle Int. 2012;33(2):92-98.

32. Jaskulka RA, Ittner G, Schedl R. Fractures of the posterior tibial margin: their role in the prognosis of malleolar fractures. J Trauma. 1989;29(11):1565-1570.

33. Raasch WG, Larkin JJ, Draganich LF. Assessment of the posterior malleolus as a restraint to posterior subluxation of the ankle. J Bone Joint Surg Am. 1992;74-A(8):1201-1206.

34. Scheidt KB, Stiehl JB, Skrade DA, Barnhardt T. Posterior malleolar ankle fractures: an in vitro biomechanical analysis of stability in the loaded and unloaded states. J Orthop Trauma. 1992;6(1):96-101.

35. Gardner MJ, Brodsky A, Briggs SM, Nielson JH, Lorich DG. Fixation of posterior malleolar fractures provides greater syndesmotic stability. Clin Orthop Relat Res. 2006a;447:165-171.