

Staged vs Early Definitive Fixation of High Energy Tibial Plateau and Plafond Fractures: What is best for the soft tissues and the patient?

Summary

Bicondylar tibial plateau fractures and pilon fractures commonly result from a high energy injury mechanism, and are frequently associated with significant insult to the soft tissue envelope surrounding these fractures. Although excellent outcome and low complication rates were reported in early case series¹ where low energy pilon fractures were managed with ORIF, application of this management to high energy pilon (and plateau) fractures resulted in significantly worse outcomes and alarmingly high complication rates.^{2,3,5,6}

Implementation of a staged management protocol^{2,3,5} for these injuries has resulted in significantly improved outcomes and reduced complication rates. For this reason, staged management of high energy tibial plateau and pilon fractures has become widely adopted and is in most cases the “standard of care” for these injuries.

Early definitive fixation of high energy tibial plateau and plafond fractures continues to have a role in the management of some patients with this type of injury. The results of several recent retrospective cohort studies^{7,8,9} show that early definitive fixation can be performed safely with outcomes and complication rates comparable to results achievable with staged management protocols. These studies point to several factors which seem to be the key to obtaining improved results with early definitive fixation: careful selection of patients appropriate for early care based on assessment of the soft tissue envelope, injury to surgery time typically less than 48h, avoidance of traditional single-incision approaches, and use of minimally invasive plate osteosynthesis techniques. Early definitive fixation also has several advantages over use of a staged management protocol: greater ease in obtaining a surgical reduction and perhaps less complexity when performing the definitive fixation procedure, avoidance of complications related to pin site infection, and significant cost savings (due to reduced length of hospitalization and lower implant costs from not having to make use of external fixator components¹⁰).

Annotated Bibliography

1. Ruedi T. Fractures of the lower end of the tibia into the ankle joint. *Injury* 1969; 1:92-99

Among the first reported case series of pilon fractures managed with definitive single-stage open reduction internal fixation. In this group of 84 pilon fractures a “good functional result” was found in 74% of cases, and less than 5% had a significant wound healing issue or deep infection. These results were significantly better than those reported previously following non-operative management of this injury. Most patients in this series sustained their injury as a result of a low energy injury mechanism, nevertheless the results of this study subsequently encouraged surgeons to consider surgical management for all pilon fractures.

2. Sirkin M, et al. A Staged Protocol for Soft Tissue Management in the Treatment of Complex Pilon Fractures. J Orthop Trauma Vol 13, No 2, Feb 1999 78-84
3. Patterson, M et al. Two-Stage Delayed Open Reduction and Internal Fixation of Severe Pilon Fractures. J Orthop Trauma Vol 13, No 2. Feb 1999 85-91

These conclusion of these two studies were among the first to promote use of a staged treatment protocol for management of pilon fractures. Compared with historically high rates of complications associated with early definitive management of pilon fractures (44% good or fair results and 70% complication rates in Type III fractures), patients in the case series described in these articles had significantly better outcomes and lower complication rates.

4. Barei D et al. Complications Associated With Internal Fixation of High-Energy Bicondylar Tibial Plateau Fractures Utilizing a Two-Incision Technique. J Orthop Trauma Vol 18 No 10 Nov/Dec 2004 649-657

A retrospective case series of 83 patients with AO/OTA 41-C3 fractures where definitive surgical management was performed using a two-incision technique. Temporary spanning fixation was used in 50% of patients. Overall the major complication rate (deep wound infection or need for unanticipated operation) was 19% - substantially lower than historically reported rates. Although a two-stage protocol was chosen more frequently as the study progressed, the deep septic complication rates remained relatively stable over the duration of the study period. The results of this study suggest that with use of dual (rather than single) incision surgical approaches, careful soft tissue handling, and improved implants for fracture fixation all have important roles in achieving low complications rates – additional to the advantages associated with use of a staged management protocol.

5. Egol K et al. Staged Management of High-Energy Proximal Tibia Fractures (OTA Types 41): The Results of a Prospective, Standardized Protocol. J Orthop Trauma Vol 19, No 7 Aug 2005 448-455

The results of this case series supported use of a staged treatment protocol for management of complex tibial plateau fractures. Compared with historically high rates of wound complications associated with early definitive management of complex tibial plateau fractures (from 13%-88%), the incidence of infection or wound problems in this case series of patients managed with a staged protocol was 5%.

6. Liporace F, et al. Decisions and Staging Leading to Definitive Open Management of Pilon Fractures: Where Have We Come From and Where Are We Now? J Orthop Trauma Vol 26, No 8 August 2012 488-498

This article provides a detailed chronological review of key publications on the treatment and complications for pilon fractures, comparing the high rates of complications reported in series of

patients treated with early definitive surgical care in the 1990s with the clearly lower rates of complications reported in series of patients treated with a staged management protocol following the publication by Sirkin (1999)². The article also provides technical tips for staged and definitive management, and a review of considerations for timing of the surgery.

7. White T et al. The Results of Early Primary Open Reduction and Internal Fixation for Treatment of OTA 43.C-Type Tibial Pilon Fractures: A Cohort Study. J Orthop Trauma Vol 24, No 12 Dec 2010 757-763
8. Unno F et al. Is Early Definitive Fixation of Bicondylar Tibial Plateau Fractures Safe? An Observational Cohort Study. J Orthop Trauma, Vol 31, No 3 March 2017 151-157

These two articles describe a retrospective cohort study of patients managed with early definitive fixation – pilon fractures in White 2010, and plateau fractures in Unno 2017. The median time from injury to surgery was 23h (pilon fractures) and 18h (plateau fractures). Complication rates and outcomes were comparable to those reported in case series of patients undergoing staged management.

9. Borade A, et al. Is “Early Total Care” a Safe and Effective Alternative to “Staged Protocol” for the Treatment of Schatzker IV-VI Tibial Plateau Fractures in Patients Older Than 50 Years? J Orthop Trauma Vol 31, No 12, Dec 2017 e400-e406.

A retrospective cohort study comparing a group of 53 patients treated with staged protocol and a group of 28 patients treated with early total care. The type of management was at the discretion of the surgeon, with consideration of factors such as excessive swelling, blisters, compartment syndrome, internal degloving, and ecchymosis. Patients in the early total care group had a median delay from injury to surgery of 3.8 days. No significant differences were found between groups in terms of perioperative complications, knee function (Rasmussen) score, soft tissue or bony complications, and the rate of secondary procedures.

10. Virkus W, et al. Costs and Complications of Single-Stage Fixation Versus 2-Stage Treatment of Select Bicondylar Tibial Plateau Fractures. J Orthop Trauma Vol 32, No 7, July 2018 327-332

A retrospective cohort study comparing a group of 28 patients treated with single stage surgical management and a group of 24 patients treated with 2-stage surgical management. The type of management was at the discretion of the surgeon, and typically while fracture blister were considered a contraindication to early surgery the absence of skin tension and “wrinkle test” were not. Patients in the early surgery group had a mean delay from injury to surgery of 1.2 days. There were no differences between groups with respect to surgery-related complications and function outcome (PROMIS) score. Median hospital inpatient charges in the 2-stage group exceeded the 1-stage group by more than \$61,000 for patients with an isolated bicondylar plateau fracture.