

Surgical management of tibial plateau fractures

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From 1992 to 1996, 49 patients with 49 tibial plateau fractures underwent operative treatment at the First Orthopaedic Department of the General Hospital of Athens. There were 3 type I fractures, 12 type II, 5 type III, 9 type IV, 5 type V and 15 type VI according to Schatzker's classification. 7 of the type VI fractures were open (5 grade II and 2 grade IIIA). All fractures were managed with open reduction and in-

ternal fixation and were followed to complete healing which averaged 4 months. 28 patients had excellent results, 13 good, 6 fair and 2 poor results. The fair and poor results were in polytrauma patients and in patients with open (grade II and grade IIIA) type VI fractures. Open reduction and internal fixation, when not strongly contraindicated, was found to be the preferred treatment in displaced tibial plateau fractures.

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Open reduction and internal fixation of tibial plateau fractures, as advocated by the Association for Study of Internal Fixation (AO/ASIF), ensure anatomic reduction of the joint and stable fixation of the intra-articular fragments to permit early motion without loss of articular fragments reduction leading to malunion or nonunion (Mueller et al. 1991). In addition, accurate reduction and stable fixation of intraarticular fragments enhances articular cartilage regeneration (Mitchell and Shepard 1980), which may diminish the risk for later arthrosis. However, open reduction and internal fixation may give complications, especially in comminuted and/or open type V and type VI fractures. This has led to other methods of fixation, including indirect reduction and percutaneous screw fixation (Keogh et al. 1992, Koval et al. 1992), hybrid external fixation (Mallik et al. 1992, Stamer et al. 1994) or a combination of external fixation with limited internal fixation (Marsh et al. 1995). We assessed the effectiveness of open reduction and internal fixation in 49 patients.

Patients and methods

We operated on 49 tibial plateau fractures between 1992 and 1996. Displacement of the fragments resulting in a widening of the tibial plateau or an articular step-off were considered as indications for surgery. Other factors taken into account included, patient's age, medical history, concurrent health problems, oc-

cupation, leisure activities, expectations from treatment and osteoporosis. The operation was performed within 1–2 days. Additional radiographs and tomographs were obtained, if necessary, for a more accurate definition of the fracture and the preoperative planning.

Surgery was performed under regional or general anesthesia. With the exception of open fractures, a tourniquet was applied and a straight parapatellar approach was used for fracture types I–IV, while a midpatellar approach was used for fracture types V and VI (Schatzker 1988). Visualization of the articular surface was accomplished by a horizontal incision over the capsule and elevation of the meniscus. The meniscus was preserved and once the osteosynthesis was completed, its periphery was sutured to the capsule. Since it shares in weight transmission, distributing the weight over a broad surface area, we always tried to preserve the meniscus (Scrive 1974, Walker 1975). For better visualization of the articular surfaces of both tibial plateaus in fractures type V and VI, the joint was opened, after a midpatellar skin incision, with two parapatellar incisions.

Fixation of fragments in fractures type I–IV was done with 1 L- or T-buttress plate and additional free lag screws, if there was a concomitant posterior fragment needing fixation. To support the elevated surfaces, autologous cancellous bone grafts were used when the articular surfaces were depressed (Figure 1). 2 buttress plates were used for bicondylar fractures type V, while 1 buttress plate on the lateral surface of the tibia and 1 neutralization plate (DC-plate) on the me-

Figure 1. Type II fracture with a split depression of the lateral tibial plateau (left). The lateral plateau was exposed beneath the meniscus and the depressed articular surface fragments were elevated 'en masse' by opening the peripheral fracture defect. Autologous cancellous bone grafts were inserted into the remaining metaphyseal void, followed by reduction of the split fragment and fixation with a buttress plate and lag screws, with anatomic reduction of the articular fragments and rigid fixation (right).

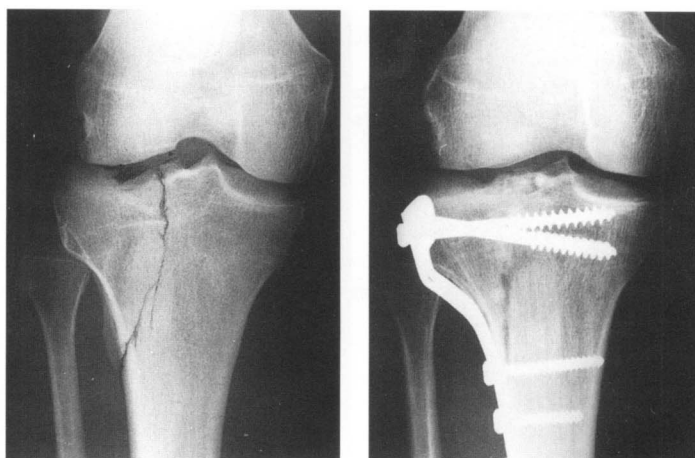
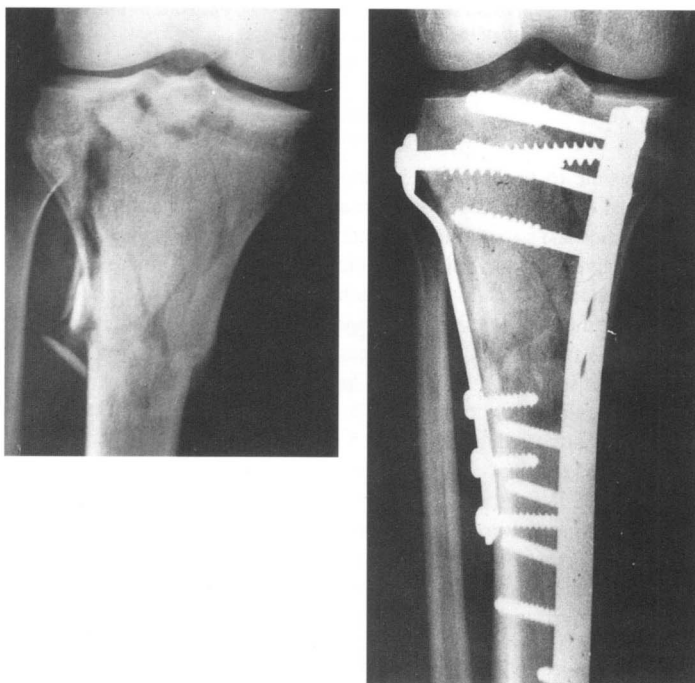


Figure 2. A type VI fracture with separation of the metaphysis and depression and comminution of both condyles, more on the lateral side (left). Two plates were used, both acting as buttresses, and one, a DC-plate, on the medial surface of the tibia reconnecting the metaphysis to the diaphysis also acting as neutralization plate (right).



dial surface of the tibia were used for fractures type VI (Figure 2). On completion of the osteosynthesis, the stability of the fractures and the knee were checked and any ruptured collateral ligament was repaired. When the anterior cruciate ligament was avulsed, it was fixed to the tibia with a lag screw.

Open fractures were treated with irrigation and thorough debridement of the wound, followed by either open reduction and internal fixation or ring external fixation, using tensioned wires proximally and distally to the fracture site (Figure 3). Delayed primary closure of the wound took place at 5–6 days.

The knees were immobilized in 40°–60° of flexion on a plaster splint for the first 2–3 days postoperatively and then the splint was removed and active motion was encouraged. At the end of the first week the patient was mobilized with the aid of crutches and non-weight bearing walking was initiated. Partial weight bearing was allowed after 2–3 months. In 2 multitrauma patients, the knee was bridged with an external fixator to prevent shortening and collapse of the fracture until definitive care of the fracture. 2 weeks later, open reduction and internal fixation was performed (Figure 4).

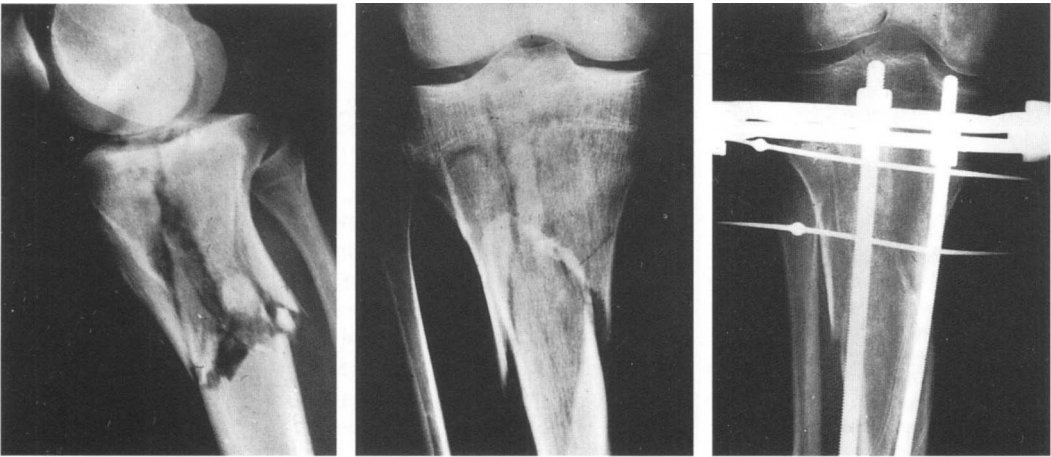


Figure 3. An open grade IIIA type VI fracture with severe comminution, secondary to high energy trauma, which was primarily treated by irrigation and thorough debridement of the wound, followed by the application of a ring external fixator using tension wire for fixation of the condylar fragments.

Results

Average time to healing was 3.8 months. 28 knees were rated excellent, 13 good, 6 fair and 2 poor. The average knee and patient function scores were 88 and 86 respectively (Knee Society Clinical Rating system). The excellent results were all achieved in type I, II, III fractures and in 6 type IV fractures, while in the remaining 3 type IV fractures, the results were good in 2 and fair in 1. Type V fractures had excellent results in 2 cases and good results in 3. 8 patients with type VI fractures had good results, 5 fair and 2 poor results. Good results were achieved in 6 closed and in 2 open grade II fractures (Gustilo 1984, 1990). The fair results were in 1 grade IIIA open fracture treated, which developed venous thrombosis, and in 2 open grade II fractures primarily treated with a ring external fixator using tensioned wires. A pin tract infection developed in 1 patient, while the other patient presented with a tibial compartment syndrome. The remaining 2 patients with fair results were multitrauma patients, where the knee was bridged with an external fixator and an open reduction and internal fixation was performed 2 weeks later. The 2 poor results were in 2 patients with open, grade II and grade IIIA, fractures type VI, treated by open reduction and internal fixation, which developed deep wound infection and residual ankylosis.

Discussion

Open reduction and internal fixation of tibial plateau fractures type I-IV produced satisfactory results in all

cases, with the exception of 1 type IV fracture which had a fair result, due to a posterior fragment which was left unfixed and resulted in instability, pain and limited motion.

The application of one buttress plate in combination with additional interfragmentary lag screws, when necessary, was not associated with more complications postoperatively compared to the application of 1 plate alone. The suggestion that the amount of hardware used is one of the main reasons for the high rate of complications in open reduction and internal fixation (Young 1994) did not appear to apply to fractures type I, II, III and IV. Rather, the amount of hardware used may be considered as an indirect measure of the severity of the comminution of the fractures and the concomitant soft tissue damage, particularly for type V and VI fractures. In this regard, open reduction and internal fixation of displaced type I, II, III, and IV fractures, when properly executed, ensured satisfactory results and few complications, no matter what amount of hardware was used.

Techniques of indirect reduction (ligamentotaxis) and percutaneous screw fixation can effectively reduce only split fractures, but not depressed fragments (Koval 1992). The same applies for the closed bicondylar fractures type V and VI, where the application of an external fixator using tensioned wires cannot ensure anatomic reduction of the fragments, especially in comminuted fractures with depression of the articular fragments. Residual widening of the fragments is an unfavorable prognostic factor (Ruggieri 1991). In addition, this method does not exclude the development of pin tract infection or even deep wound infection and does not appear to present any

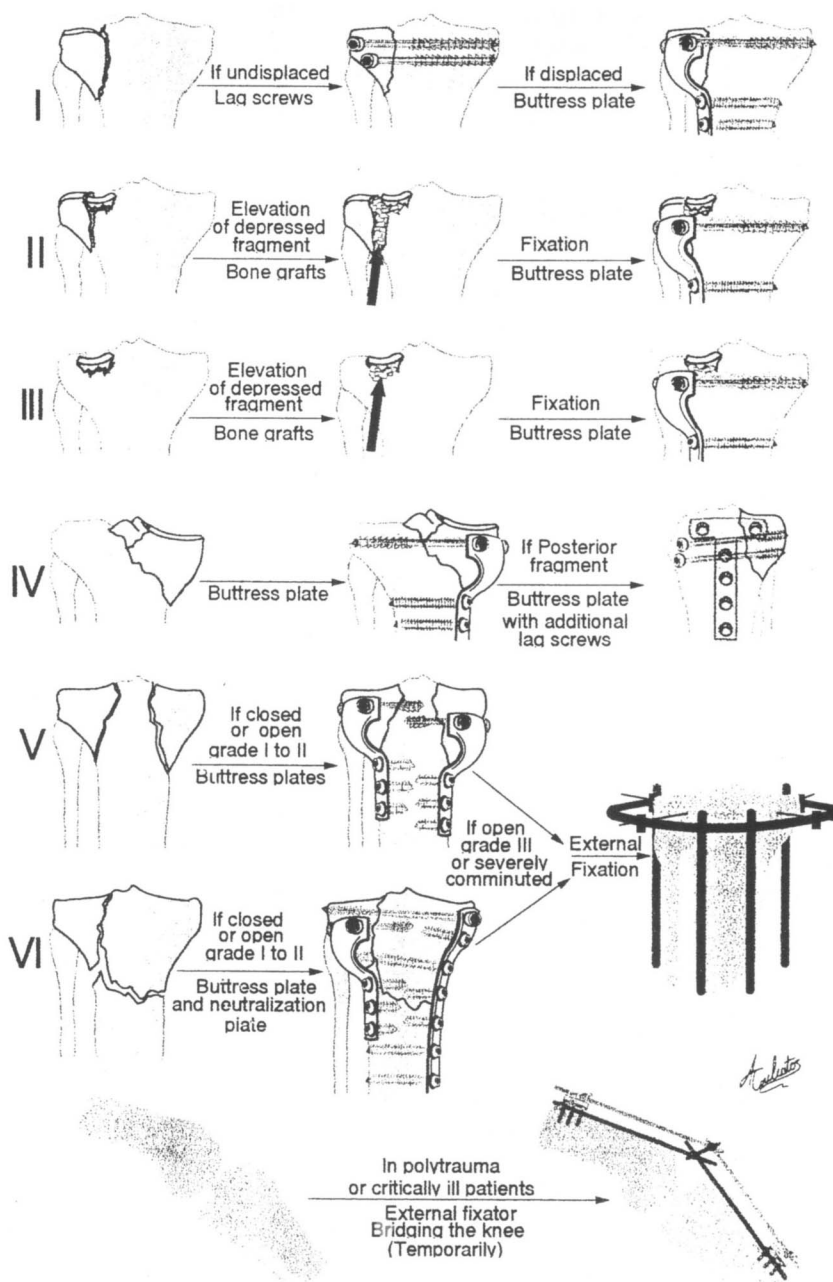


Figure 4. Surgical protocol for management of tibial plateau fractures.

advantage compared to open reduction and internal fixation in the treatment of closed, displaced tibial plateau fractures type V or VI.

Although the number of patients is small, the findings suggest that, in cases without extensive soft tissue damage and comminution, immediate internal fixation with delayed primary closure of the wound in

open type V and VI fractures is not contraindicated (Benirschke 1992). Otherwise, the application of an external fixator appears to be a safer solution. When there is an indication to defer the treatment of tibial plateau fracture in multitrauma patients, bridging of the knee with an external fixator provides a satisfactory temporary solution. Definitive care of the fracture

should be performed as soon as possible, since extensive delays are known to lead to permanent knee disability.

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