

Stability of Raft construct through Locking Compression Plate for depressed Tibial Plateau Fractures

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Abstract

Background: In spite of all the advances, tibial plateau fractures still pose a challenge to the orthopaedic surgeons due to the following reasons: presence of hinge joints at the knee and the ankle which allows no adjustment for rotatory deformity after fracture, occurrence of open fractures and higher rate of post-operative infection. The aim of surgical treatment of tibial plateau fractures is to restore congruent articular surfaces of the tibial condyles maintaining the mechanical axis and restoring ligamentous stability eventually can achieve functional painless and good range of motion in the knee joint.

Materials and methods: Records of 53 knees in 38 men and 15 women aged 20 to 70 (mean, 37.9) years who underwent open reduction and internal fixation using a periarticular raft construct through a 3.5-mm locking plate without use of a bone graft or bone substitute for split-depression and depressed (>5 mm) proximal tibial plateau fractures (Schatzker type II and type III or AO/OTA type 41 B2 and B3). Out of the total 53 cases, 33 were of schatzkers type II while 20 cases were of type III who underwent the surgery between April 2016 and April 2018 at our institute were reviewed. Clinical and radiographic examinations were conducted in Follow-up at 1, 3 and 6 months. The Rasmussen radiological and clinical score, Lysholm knee score and Oxford knee score were assessed.

Results: All patients achieved bone union after a mean of 12.87 (range, 8–24) weeks. The mean range of motion was 119.32° (range, 80°–135°). The Rasmussen radiological score was good to excellent in 48 cases while fair and poor outcome was seen in 4 and 1 cases respectively. The Rasmussen clinical score was good to excellent in 48 cases, while fair and poor outcome was seen in 4 and 1 cases respectively. As per Oxford Knee score, good to excellent outcome was obtained in 90.56% cases while fair and poor outcome was seen in 7.55% and 1.89% cases. As per Lysholm's score, excellent and good outcome was obtained in 71.7% and 18.87% cases while fair and poor outcome was seen in 7.55% and 1.89% cases respectively.

Conclusions: The stability of the internal fixation of proximal tibia fractures (Schatzker type II and type III or AO/OTA type 41 B2 and B3) after open reduction and internal fixation using a periarticular raft construct through a locking plate without use of a bone graft for split-depression tibial plateau fractures is a viable option.

Keywords: Tibial Plateau, Raft Construct, Oxford knee score, Rasmussen score, Lysholm score.

Introduction

In spite of all the advances, proximal fractures of tibia still pose a challenge to the orthopedic surgeons due to the following reasons: presence of hinge joints at the knee and the ankle which allows no adjustment for rotatory deformity after fracture, occurrence of open fractures and higher rate of post-operative infection(1). The aim of surgical treatment of proximal tibia fracture is to restore congruent articular surfaces of the tibial condyles maintaining the mechanical axis and restoring ligamentous stability eventually can achieve functional painless and good range of motion in the knee joint(1). Treatment for proximal tibial plateau fractures is difficult, especially when metaphyseal comminution is associated with osteoporosis(2) and soft tissue injury(3). Schatzker type II fractures(4) with severe depression of the articular surface require open reduction to elevate the depressed fragment with a bone tamp through a cortical window in the metaphysis, followed by rigid internal fixation.

To maintain the reduction, the subchondral void is usually filled with cancellous autografts, allografts, or bone substitutes(5). The use of a raft screw construct in the subchondral bone through a locking plate can avoid these potential problems and provide adequate stability to the articular surface of the lateral and medial condyles of the proximal tibia, irrespective of bone quality and the type of fixation. This approach prevents collapse, even in the absence of bone grafts or bone substitutes. Present study is thus conducted to evaluate the stability of the internal fixation of proximal tibia fractures after open reduction and internal fixation using a periarticular raft construct through a locking plate without use of a bone graft or bone substitute for split-depression tibia plateau fractures.

Material & Method

Records of 53 knees in 38 men and 15 women aged 20 to 70 (mean, 37.9) years who underwent open reduction and internal fixation using a periarticular raft construct through a 3.5-mm locking plate without use of a bone graft or bone substitute for split-depression and depressed (>5 mm) proximal tibial plateau fractures (Schatzker type II and type III or AO/OTA type 41 B2 and B3). Out of the total 53 cases, 33 were of Schatzkers type II while 20 cases were of type III who underwent the surgery between April 2016 and April 2018 was reviewed. Patients with open fractures, previous knee joint

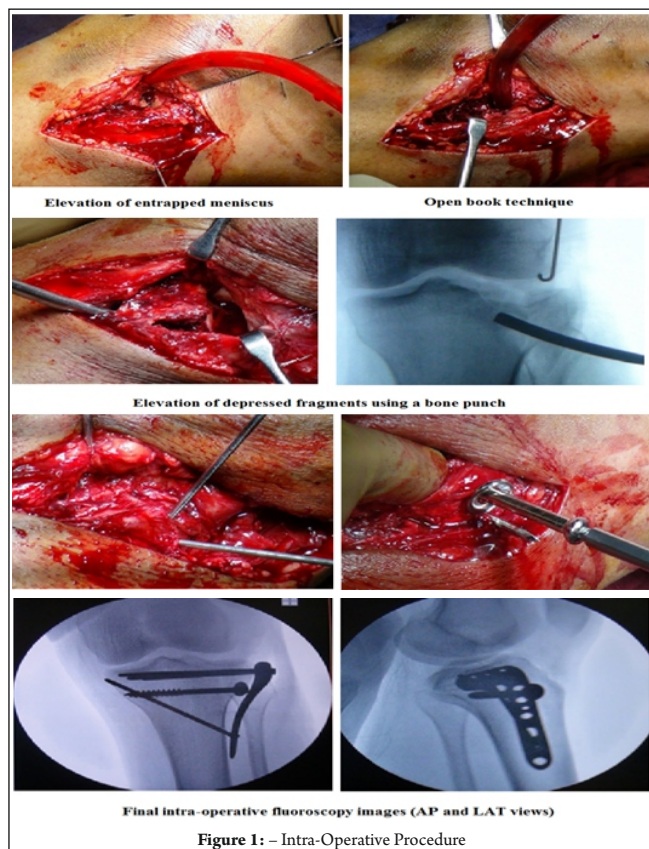
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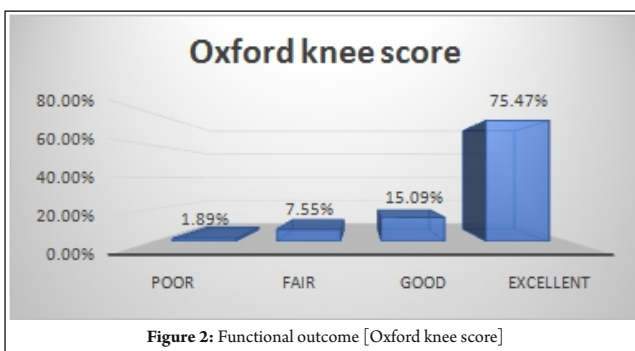
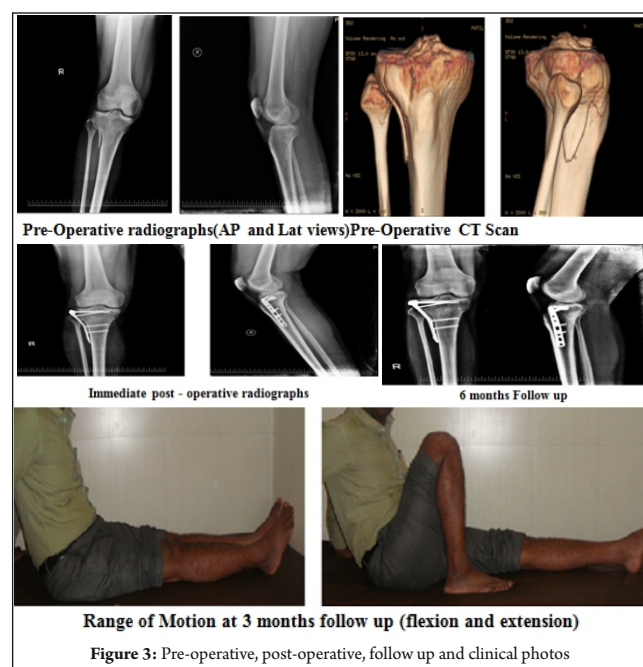
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surgery, other fractures of the lower limb, pelvis or spine, or tibial plateau depression of <5 mm were excluded, as were those with conservative treatment or insufficient follow-up. The causes of injury included road traffic accident (n=33), motorcycle skid and fall (n=20). Amongst the 53 knees, Right side of the leg was more involved than the left side (n=31 vs 22). A total of 21 cases were operated within 1 day or less while 23 cases were operated within 1-3 days and 9 cases were to be operated after 3 days. Injured legs were elevated to decrease local swelling; surgery was performed within one week of injury. Perioperative intravenous antibiotics were



administered. Patients were placed in a supine position under combined spinal epidural anesthesia, and a high thigh tourniquet was used. An anterolateral incision was made. The menisci were tagged and conserved. The depressed fragment was elevated with the help of a bone tamp through a cortical window, and the articular surface was reduced anatomically. Reduction was maintained using Kirschner wires. The articular surface congruency was checked under fluoroscopy before definitive fixation using 3.5-mm locking subchondral screws (raft technique) through a 3.5-mm locking plate. Postoperatively, continuous passive motion with the assistance of a physiotherapist was allowed at day 1 to 2. Non-weightbearing walking with crutches or walker was allowed for 6 to 8 weeks. Partial weightbearing was started in 8 (range, 6–14) weeks and progressed to full weightbearing when bridging bone trabeculae were seen on radiographs. The integrity of the articular surface was assessed using radiographs. The Rasmussen radiological score (Table-1) and clinical score (Table-2)(6) the Lysholm knee score,(7) and the Oxford knee score(8) were also assessed.

Results

All patients achieved bone union after a mean of 12.87 (range, 8–24) weeks. The mean range of motion was 119.32° (range, 80°–135°). At 6 months, bone density in the subchondral defect area was equivalent to the surrounding metaphyseal bone in all patients. The Rasmussen radiological score was good to excellent outcome was obtained in 48 cases while fair and poor outcome was seen in 4 and 1 cases respectively. The Rasmussen clinical score was good to excellent in 48 cases, while fair and poor outcome was seen in 4 and 1 cases respectively. As per Oxford Knee score, good to excellent outcome was obtained in 90.56% cases while fair and poor outcome was seen in 7.55% and 1.89% cases. As per Lysholm's score, excellent and good outcome was obtained in 71.7% and 18.87% cases while fair and poor outcome was seen in 7.55% and 1.89% cases respectively. Most common associated complications were delayed union (3 cases) and wound infection (2 cases). One case each was observed of knee instability and non-union. Two patients developed superficial infection and delay in wound healing (within one week), which was resolved by debridement, insertion of antibiotic-impregnated beads for 4 weeks, and intravenous antibiotics. None had any intra-

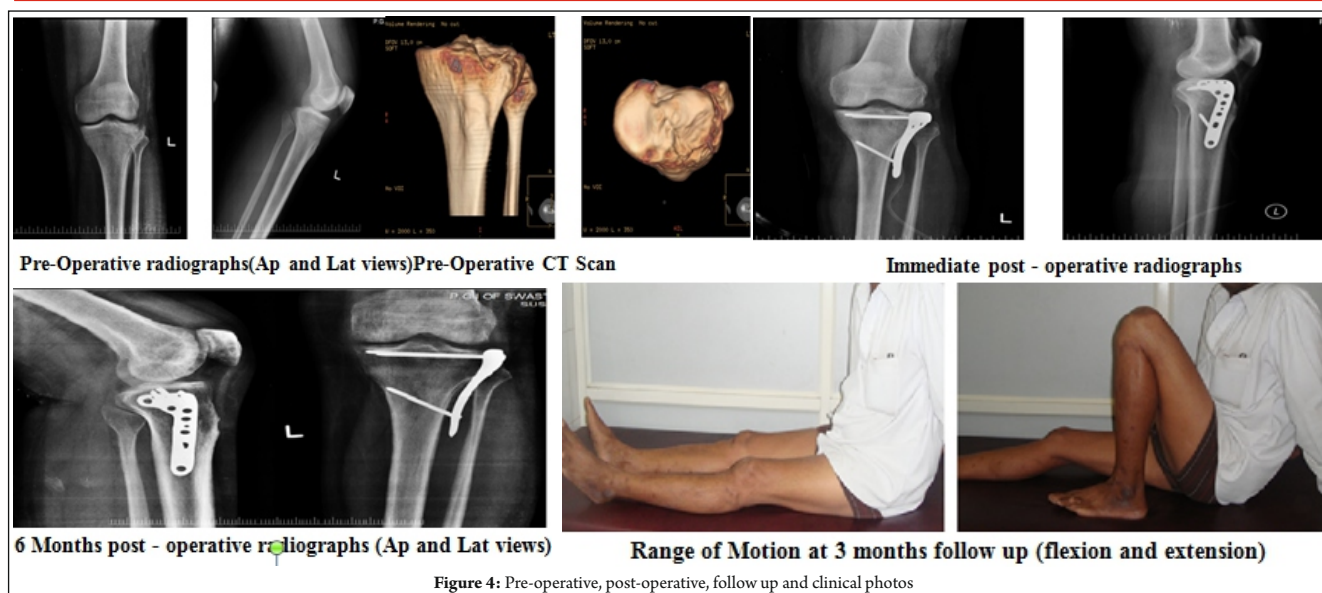


Figure 4: Pre-operative, post-operative, follow up and clinical photos

operative complication, frank infection, osteomyelitis, osteoarthritis, implant failure, breakage, or screw backout.

Discussion

Fractures around knee are challenging injuries despite improvements of fixation techniques and plate designs. The goal of treatment for intra-articular fractures is to restore joint mobility, joint stability, articular surface congruence, and axial alignment, and to avoid posttraumatic osteoarthritis(9). Some authors have demonstrated the ability of locked plates to absorb more energy before failure compared with conventional non-locking plates, angled blade plates, thereby having a lower incidence of loss of fixation. Although no agreement exists on management of complex fractures, the results reported by several authors suggest modern locking plates represent an advance for fixing different fracture patterns in this region. The use of a raft construct through a locking plate provides adequate stability to the subchondral bone without filling the metaphyseal void with a bone graft or bone substitute and achieves radiological union after a mean of 12.87(range 8-24) weeks. Similarly, Lee et al.(10) Studied 27 type C fractures and nine type B fractures according to AO/OTA classification treated with the less invasive stabilisation system (LISS). The average time to healing was 4.2 months (3-7 months). The mean radiological fracture union time was 13.87 weeks in a study by Parikh M et al.(11) Complications after bone grafting have been reported. In patients with iliac crest bone grafting, up to 3% developed infection necessitating readmission, up to 22% developed minor complications such as persistent discomfort, cutaneous nerve damage, local wound complications (superficial wound infection, seroma, and haematoma), and up to 38% had pain after 6 months and in some cases beyond 2 years(12). The use of a raft screw construct in the subchondral bone through a locking plate is a novel technique in the management of tibial plateau fractures. The use of a periarticular raft plate provides sufficient rigidity and prevents collapse, irrespective of the underlying bone

quality(13)(14). After trauma, there is immediate loss of proteoglycans due to decreased synthesis or increased destruction, even before cartilage changes occur, leading to increased permeability of fluid into the bone causing damage to the chondrocytes. If damage is not irreversible, the remaining chondrocytes restore the damaged matrix and mechanical stability.(15) The use of a periarticular raft construct through a locking plate prevents further damage to the chondrocytes by maintaining the anatomic reduction and enables bone healing without the need for a bone graft or substitute, which decreases operating time and morbidity(13-15). The use of small-fragment screws for fixation of tibial plateau fractures is recommended, as the pull-out strength of 6.5-mm, 4.5-mm, and 3.5-mm screws is comparable(16)(17). The 3.5-mm small fragment screws and T-plate decrease the bulk of hardware and improve fixation for small fragments(18). The antiglide screw or buttress plate has no additional advantage over lag screw fixation alone(19). The buttress plate has greater stiffness than lag screws alone(20). Fixation with a raft using 3.5-mm subchondral screws is more resistant to local depression loads than a buttress plate with or without a bone graft(21). Fixation with screws through (rather than outside) the plate enables more stability against plateau displacement(22). In a study by Parikh M et al.(11) At final follow-up visits, 26 patients out of 30 achieved an excellent result, 2 had good result and 2 had fair result. In another study by Gupta et al.(23). 34 (85%) patients had excellent, 4 (10%) patients had good outcome and 2 (5%) patients had failure in the final result.

Conclusions

The stability of the internal fixation of proximal tibia fractures (Schatzker type II and type III or AO/OTA type 41 B2 and B3) after open reduction and internal fixation using a periarticular raft construct through a locking plate without use of a bone graft for split-depression tibia plateau fractures is a viable option.

Table 1: Modified Rasmussen radiological scoring system

Articular Depression	Points
None	3
<5 mm	2
6-10 mm	1
>10 mm	0
Condylar widening	
None	3
<5 mm	2
6-10 mm	1
>10 mm	0
Varus/valgus angulation	
None	3
<10°	2
10-20°	1
>20°	0
Osteoarthritis	
None/no progress	1
Progression by 1 grade	0
Progression by >1 grade	-1
Maximum score	
Excellent	9-10
Good	7-8
Fair	5-6
Poor	<5

Table 2: Modified Rasmussen clinical scoring system

Clinical Features					
Rating	Pain	Walking Capacity	ROM	Clinical signs	Stability
Excellent	No	Normal	Normal	No	Normal
Good	Minimal	Walking outdoor for at least 1 h	75% of normal	+	Minimal
Fair	Pocccational ache	Walking outdoor for 15 min	>50% of normal	Swelling, ++	Instability in flexion
Poor	pain at rest	Walking indoor only	50% of normal or less	+++	Instability in flexion as well as in extension

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