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Radiographic and Functional Outcome of Depressed Tibial Plateau Fractures Treated with Raft Plate with Bone Graft – A Prospective Study

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Abstract:- Tibial plateau fractures are the fractures that involve the articular surface of the tibial condyles. The Schatzker and OA classifications are the most commonly used to classify these fractures. The Schatzker classification system is a widely recognized method used by orthopedic surgeons to categorize tibial plateau fractures into six distinct types. This classification helps in assessing the initial injury, planning the appropriate management strategy, and predicting the prognosis. Each type represents a different pattern of fracture, which can guide treatment decisions and expectations for recovery. These fractures typically result from the external(valgus) or internal(varus) forces on the knee with axial loading. In younger individuals, tibial plateau fractures are most commonly caused by road traffic accidents due to the high-energy impact. However, in elderly patients with osteopenic bone, even a simple fall can lead to these fractures because their bones are more fragile and susceptible to injury. The tibial plateau fractures are intra-articular fractures of the knee joint and are often difficult to treat and have a high complication rate, including early-onset osteoarthritis. Surgery is the preferred modality of treatment for these fractures, along with bone void fillers to address bone defects caused by the injury. At present, there is no consensus on the optimal method of fixation or the void filling to treat such fractures. Techniques of operative management of tibial plateau fractures have become more successful in achieving and maintaining reduction of the fracture. Still, avoiding malalignment of the limb has been shown to be at least as important as articular congruity to long-term joint viability.

Keywords:- *Tibial Plateau Fractures, Proximal Tibia Fracture, Knee Fracture, Trauma, Schatzker Classification, Articular Fracture, Articular Depression.*

I. INTRODUCTION

Tibial plateau fractures are often a result of a combination of excessive axial loading and bending forces applied to the knee joint. These forces can include valgus or varus stress. Adequate and timely management of these injuries can prevent knee malalignment, instability, and stiffness. However, the initial assessment of the injury plays a crucial role in formulating an effective treatment plan. By thoroughly evaluating the nature and severity of the injury, surgeons can tailor the approach to optimize patient outcomes. The classification system most commonly utilized is the one introduced by Schatzker and colleagues., that divides the tibial plateau fractures into six groups[1]. The classification is divided into six groups, of which the second group of fractures is the most common one encountered[1]. Reduction and fixation with plate and screws has been the cornerstone of surgical management for these types of injuries. In contemporary practice, the standard surgical approach for split depression fractures of the tibial plateau involves elevating the depressed articular fragment, filling the bone void, and securing the area with plates and screws.[2-4]

Important Anatomy: The widened proximal end of the tibia forms two relatively flat surfaces, known as condyles or plateaus, which articulate with the femoral condyles. They are divided at the midline by the intercondylar eminence, which features both medial and lateral intercondylar tubercles. It has a coronal and sagittal slope to allow movement in six degrees of freedom. The lateral condyle is elevated due to its convex articular surface, whereas the medial condyle is lower because of its concave shape. The lateral plateau is also higher than the medial plateau accounting for the few degrees of varus of the tibial plateau in relation to the shaft. The proximal articular surface slopes in relation to the shaft from the front, which is high, to the back, which is low. Restoring this alignment through surgical reconstruction is essential to reestablish kinematic loading, maintain ligament tension, and prevent knee recurvatum.

➢ *Whenever a Tibial Plateau Fracture Occurs, it can also Harm the Surrounding Soft Tissue Structures. the Most Commonly Injured Structures Around the Knee Joint are:*

- Meniscal Injuries: Approximately 60-75% of patients with tibial plateau fractures may experience meniscal injuries. Menisci act as shock-absorbing structures within the knee joint.

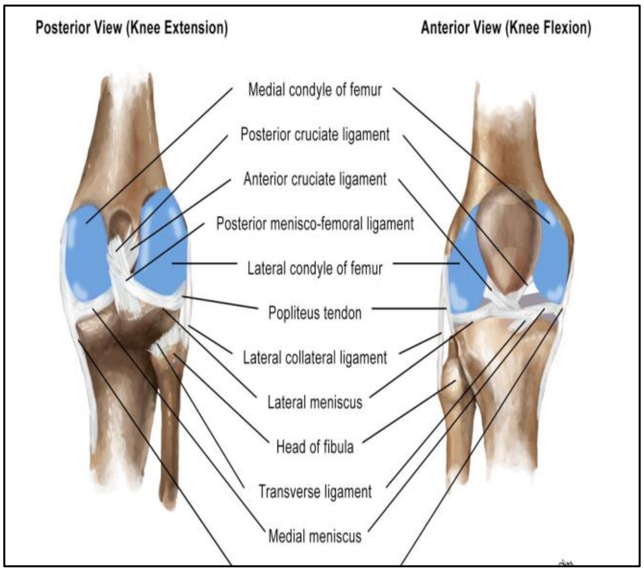

Fig 1: Anatomy of the Knee Joint

- Cruciate Ligaments: In about 1/5th to half of the cases, cruciate ligaments can be injured alongside the tibial plateau fracture.
- High Index of Suspicion: When the tibial plateau is depressed by >10mm, surgeons should maintain a high index of suspicion for concurrent soft tissue injuries.
- Neurovascular Bundle: The popliteal artery and vein, along with their genicular branches, and the sciatic nerve with its tibial and common fibular branches, pass posterior to the knee, making them highly susceptible to injury.

➢ *Compartment Syndrome is Reported to Occur in Approximately 10-40% of Cases Following Tibial Plateau Fractures. Several Risk Factors Contribute to Its Development, Including:*

- Higher Energy Trauma: Fractures resulting from high-velocity trauma are more likely to lead to compartment syndrome.
- Greater Comminution: Increased fragmentation of the fracture can elevate the risk.

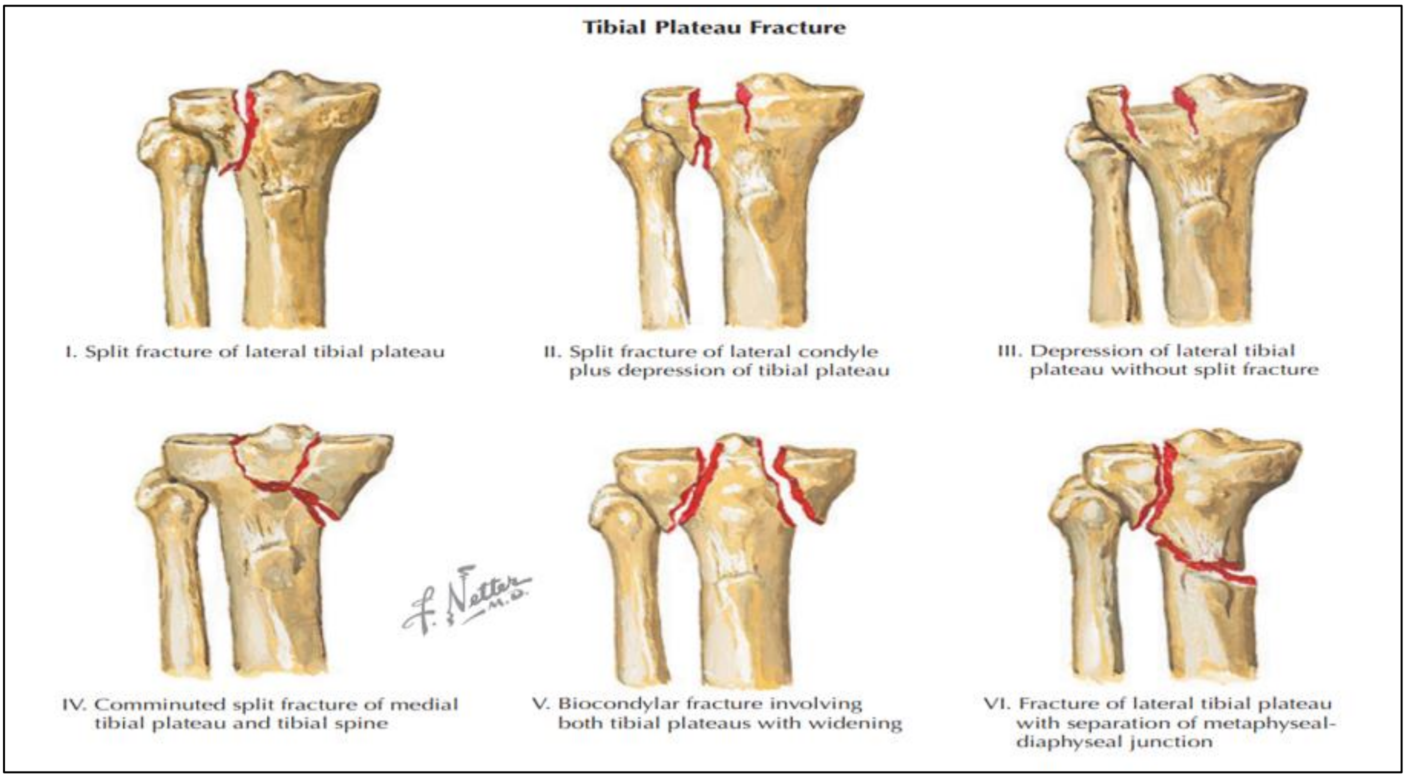

Fig 2: Schatzker Classification System

- Fracture-Dislocations: Tibial plateau fractures associated with dislocation pose a higher risk.
- Male Sex: Male patients are more susceptible.
- Younger Age: Younger individuals are also at increased risk.

➢ *The Current Standard Surgical Management For Split Depression Fractures of the Tibial Plateau I.E., Schatzker II, Involves Several Key Steps:*

- Restoring the articular congruity: We carefully lift the depressed portion of the articular surface to restore its normal alignment. This step aims to improve articular congruity and minimize the risk of early onset osteoarthrosis.

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- Bone Void Replacement: If there are gaps or voids within the fractured bone, we use bone grafts or synthetic substitutes to fill these spaces. This promotes healing and provides structural support.
- Fixation with Plate and Screws: To stabilize the fracture, we use plates and screws. These implants hold the bone fragments in place during the healing process, allowing for optimal recovery.

Traditionally, using the buttress plate with lag screws was the preferred method for stabilizing lateral condyle split-depression tibial plateau fractures. However, with recent advances, juxta articular plates have evolved into precontoured, lower-profile implants that offer locking options. These advancements enhance surgical outcomes and provide more versatile treatment options. Locking screws were initially designed for use in Schatzker IV fractures, where maintaining angular stability is crucial for the best outcome. Additionally, they are valuable in low density bone, where the risk of fixation failure is higher. However, it's important to note that there is sparce clinical evidence specifically addressing the benefit of locking plate screw fixations in partial articular tibial plateau fractures. In our institution, we used the locking system in Schatzker II injuries to study the radiological and functional outcome of the surgery.

II. MATERIALS AND METHODS

Between May 2022 and May 2023, the patients that had surgical fixation of the depressed tibial plateau fractures were considered for the study. After proper radiological evaluation the classification of fracture was done according to the Schatzker[2] classification. The patient details, the mechanism of injury and the overall condition of the patient at the time of injury, details of surgical procedure, the total duration of hospital stay, complications, and clinical and functional outcomes were taken from hospital records. Patients who were lost for follow up and those treated nonoperatively were excluded from the study. The surgical procedure was identical in all cases. Patient is in supine on the operating table and administered spinal anaesthesia. An anterolateral approach to the knee joint was used, and the fracture site is reached. The preliminary fracture reduction is done using the K-wires under the guidance of image intensifier.

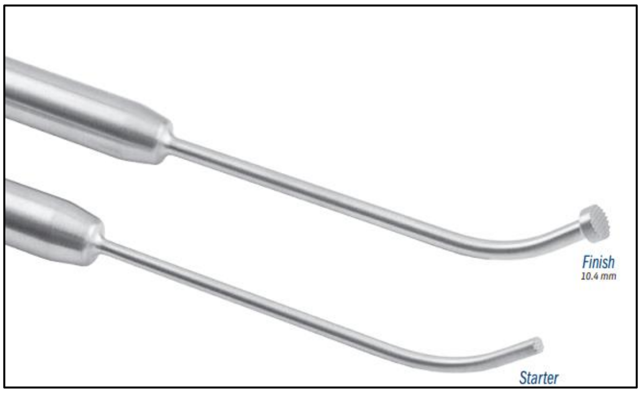

Fig 3: Bone Tamp/Bacastow Elevators

A bone window is made in the anteromedial aspect of the tibia and the depressed fracture fragments are elevated using the tibial plateau elevators(bacastow)/bone tamps and confirmed with IITV. This void is then filled with the bone graft harvested from the iliac crest, using the bone tamp, through the cortical window that was created. The fracture is then fixed using the juxta articular precontoured locking plate under the IITV guidance and the wound is then closed in layers over a drain after achieving haemostasis.


Fig 4: Pre Operative Radiographs

Postoperatively, Patients are instructed in range-of-motion exercises which they perform in a hinged brace from day 1. The range is not restricted. Non-weightbearing walking with crutches or with walker was allowed for 1 ½ to 2 months. Partial weightbearing was started at 8 (range, 6–14) weeks and progressed to full weightbearing when signs of union was seen on radiographs. The patient was called at monthly interval for follow up and evaluated functionally and radiologically. Patients were radiologically assessed for malunion, nonunion, delayed union.

The patient was evaluated radiologically with the regular radiographs of Anteroposterior and lateral views. These images were analyzed for signs of fracture healing, hardware complications, any remaining articular depression, and the mechanical alignment of the knee joint. The knee joint's range of motion was assessed using a goniometer.

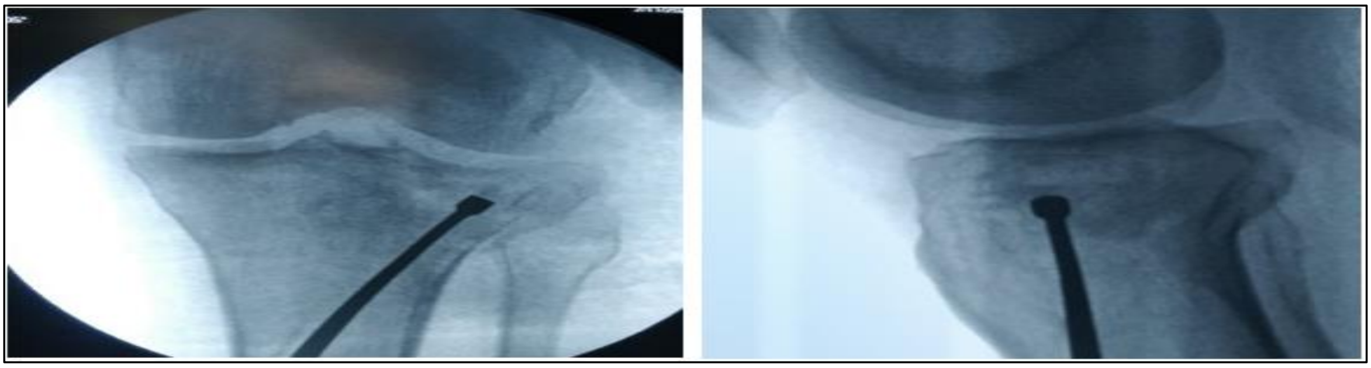

Fig 5: Intra Operative IITV Images

Intra operative images showing the cortical window and the elevation of depressed fragment with bone tamp.

Fig 7: Immediate Post-Operative Radiograph of the Patient

III. RESULTS

Over the study period of one year, 20 cases that satisfied the inclusion criteria were identified and chosen for the study. The mean age the injury was 45.7 years comprising of both sexes.

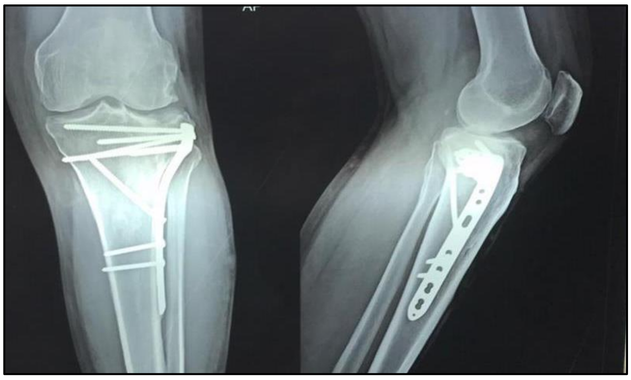

Fig 8: One Year Follow up Radiograph

Of the 20 patients who underwent ORIF with raft plate and bone grafting, 13 were male and 7 were females. 16 patients showed good union radiographically and 3 patients developed wound dehiscence which required secondary suturing and regular dressing. The average radiological union was 14 weeks (range 12-16 weeks). 1 patient developed infection of the wound which required surgical exploration and debridement with secondary suturing. The average range of motion was 120º, with a range from 90º to 130º. At approximately 6 months of follow-up, the bone density in the subchondral defect area was comparable to that of the surrounding metaphyseal bone in all patients. The most frequent mechanism of injury was road traffic accidents, followed by low-velocity falls, particularly in the elderly group. All patients were followed up for a minimum of 12 months.

Fig 9: One Year Follow Up Image of Patient Showing Range of Motion

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The articular surface was assessed using the Rasmussen scoring as presented in the table 1. This scoring provides the radiological assessment as well as the clinical assessment of the patient post operatively.

Based on the Rasmussen score the majority of the patients had Excellent (12) score, some had good (7) and one patient had fair score.

Table 1: The Rasmussen Radiological Scoring System 5

Subjective	Points
A. Articular depression	
Not present	6
<5 mm	4
6–10 mm	2
>10 mm	0
B. Condylar widening	
Not present	6
<5 mm	4
6–10 mm	2
>10 mm	0
C. Angulation (valgus/varus)	
Not present	6
<10°	4
10–20°	2
>20°	0
Maximum	18
Excellent	18
Good	12–17
Fair	6–11
Poor	<6

IV. DISCUSSION

The main goal of the operative treatment of intraarticular fractures is restore the stability of the joint, congruity of the joint and the axial alignment, thus delaying the onset of post traumatic osteoarthritis. It is important to elevate the depressed fracture fragments so as to maintain the articular congruity of the joint since it is involved in weightbearing[7,8]. The treatment of the elderly, especially those that have osteoporotic bone and soft tissue damage can be challenging[9-11]. The combination of fragile bone and compromised soft tissues requires careful consideration and tailored approaches to achieve optimal outcomes. Hence, the use of a raft system through the locking plate gives an excellent stability to the weak subchondral bone, to help with weightbearing, along with filling the void created by elevating the depressed fragment with bone graft provides an additional support and it helps in radiological union at an earlier rate.

The use of a juxta articular raft plate in anatomically reduced split-depression tibial plateau fractures (Schatzker II) provides sufficient strength and prevents the collapse, irrespective of the underlying bone quality[12,13]. After trauma, there is an immediate loss of proteoglycans at the fracture site due to reduced synthesis or increased destruction, even before cartilage changes occur. This leads to increased fluid permeability into the bone, causing damage to the chondrocytes. When this damage is reversed in time, the remaining chondrocytes play a crucial role in restoring the damaged matrix and enhancing the mechanical stability of the bone. Their ability to promote tissue repair and maintain bone health is essential for overall recovery.[14]. Utilizing a juxta-articular raft system with a locking plate helps prevent further chondrocyte damage by maintaining anatomic reduction and promoting bone healing.

When it comes to fixing tibial plateau fractures, using small-fragment screws are recommended. These screws provide comparable pullout strength[15,16]. Also, the use of 3.5-mm small fragment screws and a buttress plate offers several advantages for fixation in small fragments. With the reduction in hardware bulk, these implants provide improved stability while also minimizing the overall impact on the surrounding tissues[17]. Indeed, the use of an antiglide screw or buttress plate does not offer any additional advantage over lag screw fixation alone. In cases where lag screws provide sufficient stability, the additional hardware may not significantly enhance outcomes.[18]. Also, the buttress plate offers greater stiffness compared to lag screws alone. This additional stability can be advantageous in specific cases where increased rigidity is needed for fracture fixation[19]. The study suggests that fixation using a raft (composed of 3.5-mm subchondral screws and bone grafting) provides greater resistance to local depression loads compared to using a buttress plate alone, with or without bone graft[20]. This finding highlights the importance of considering specific fixation techniques based on fracture characteristics and load-bearing requirements. Fixation with screws through the plate gives more stability against plateau displacement[21].

V. CONCLUSION

Indeed, utilizing a juxta-articular raft construct through a locking plate, along with bone grafting, is an excellent approach for managing split-depression proximal tibial plateau fractures. This method offers several benefits:

- High Union Rate: The overall rate of bone union is favorable, promoting healing and stability.
- Excellent Functional Outcome: Patients tend to achieve good functional outcomes after treatment.
- Restored Articular Congruity: By addressing the depressed tibial plateau, this approach helps restore the alignment of the joint surface, thus delaying the early onset of osteoarthrosis.

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REFERENCES

- [1]. 1 Markhardt BK, Gross JM, Monu JU. Schatzker classification of tibialplateau fractures: use of CT and MR imaging improves assessment. Radiographics 2009;29(2):585–597
- [2]. 2 Schatzker J, McBroom R, Bruce D. The tibial plateau fracture. The Toronto experience 1968–1975. Clin Orthop Relat Res 1979;(138):94–104
- [3]. 3 Savoie FH, Vander Griend RA, Ward EF, Hughes JL. Tibial plateau fractures. A review of operative treatment using AO technique. Orthopedics 1987;10(5):745–750
- [4]. 4 Touliatos AS, Xenakis T, Soucacos PK, Soucacos PN. Surgical management of tibial plateau fractures. Acta Orthop Scand Suppl 1997;275:92–96
- [5]. 5 Rasmussen PS. Tibial condylar fractures. Impairment of knee joint stability as an indication for surgical treatment. J Bone Joint Surg Am 1973;55:1331–50.
- [6]. 6 Honkonen SE. Degenerative arthritis after tibial plateau fractures. J Orthop Trauma 1995;9:273–7.
- [7]. 7 Hohl M, Luck JV. Fractures of the tibial condyle; a clinical and experimental study. J Bone Joint Surg Am 1956;38:1001–18.
- [8]. 8 Hohl M. Tibial condylar fractures. J Bone Joint Surg Am 1967;49:1455–67.
- [9]. 9 Stannard JP, Wilson TC, Volgas DA, Alonso JE. The less invasive stabilization system in the treatment of complex fractures of the tibial plateau: short-term results. J Orthop Trauma 2004;18:552–8.
- [10]. 10 Watson JT, Coufal C. Treatment of complex lateral plateau fractures using Ilizarov techniques. Clin Orthop Relat Res 1998;353:97–106.
- [11]. 11 Weigel DP, Marsh JL. High-energy fractures of the tibial plateau. Knee function after longer follow-up. J Bone Joint Surg Am 2002;84:1541–51
- [12]. 12 Barei DP, Nork SE, Mills WJ, Coles CP, Henley MB, Benirschke SK. Functional outcomes of severe bicondylar tibial plateau fractures treated with dual incisions and medial and lateral plates. J Bone Joint Surg Am 2006;88:1713–21.
- [13]. 13 Wu CC. Salvage of proximal tibial malunion or nonunion with the use of angled blade plate. Arch Orthop Trauma Surg 2006;126:82–7.
- [14]. 14 Marsh JL, Buckwalter J, Gelberman R, Dirschl D, Olson S, Brown T, et al. Articular fractures: does an anatomic reduction really change the result? J Bone Joint Surg Am 2002;84:1259–71.
- [15]. 15 Duwelius PJ, Rangitsch MR, Colville MR, Woll TS. Treatment of tibial plateau fractures by limited internal fixation. Clin Orthop Relat Res 1997;339:47–57.
- [16]. 16 Westmoreland GL, McLaurin TM, Hutton WC. Screw pullout strength: a biomechanical comparison of large-fragment and small-fragment fixation in the tibial plateau. J Orthop Trauma 2002;16:178–81.
- [17]. 17 Benirschke SK, Swiontkowski MF. Knee. In: Hansen S, Swiontkowski MF, editors. Orthopaedic trauma protocols. 1st ed. New York: Raven Press; 1993:313–325. 32.
- [18]. 18 Koval KJ, Sanders R, Borrelli J, Helfet D, DiPasquale T, Mast JW. Indirect reduction and percutaneous screw fixation of displaced tibial plateau fractures. J Orthop Trauma 1992;6:340–6
- [19]. 19 Denny LD, Keating EM, Engelhardt JA, Saha S. A comparison of fixation techniques in tibial plateau fractures. Orthop Trans 1984;10:388–9.
- [20]. 20 Karunakar MA, Egol KA, Peindl R, Harrow ME, Bosse MJ, Kellam JF. Split depression tibial plateau fractures: a biomechanical study. J Orthop Trauma 2002;16:172–7.
- [21]. 21 Cross WW 3rd, Levy BA, Morgan JA, Armitage BM, Cole PA. Periarticular raft constructs and fracture stability in splitdepression tibial plateau fractures. Injury 2013;44:796–801.