*Section A-Research paper*

# An Overview about Managment of Depressed Lateral Tibial Plateau Fractures

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**Abstract**

**Background:** Tibial plateau fractures represent approximately 1.2% of all fractures in the adult population, with an incidence of 13.3 per 100,000 per year. The mechanism of injury often highlights the severity of injury pattern observed .medical comorbidities increase surgical risk and the incidence of wound complications .extensive medical comorbidities often can prevent surgical intervention and non-operative management may be required The treatment techniques that result in the most favorable patient outcomes depend on the patient and the fracture pattern. A variety of techniques are currently popular, have good results, and new techniques continue to be developed. However, for a given patient with a given fracture pattern, there is little evidence to indicate one technique is superior to others.

**Keywords:** Tibial plateau fractures

## Introduction

The diagnosis of a tibial plateau fracture is typically made on plain radiographs, and for some simple fractures, this may be the only imaging necessary. Anteroposterior (AP), lateral, and an AP view in the plane of the plateau (10- to 15-degree caudal view) are the standard examinations. The caudal view provides a better view of the articular surface and helps assess displacement and depression better than the standard AP view **(1).**

Moore and Harvey found that the standard AP view could not reliably determine the amount of articular depression (54), but that a 14-degree caudal view accurately estimated central and posterior displacement but could overestimate anterior displacement and depression. Less frequently, oblique views are obtained to assess the location of fracture lines or degree of displacement, but are not routine**(2).**

Axial CT scans are routinely obtained for most tibial plateau fractures. They provide excellent details of the fracture pathoanatomy and serve as a critically important aid to preoperative planning for operative approaches and fixation techniques. Although CT may be used to help decide on the need for surgery, there is lack of good data to indicate that the additional detail apparent on a CT helps determine which fractures will benefit from surgery. CT typically demonstrates more articular displacement and comminution than is apparent on plain films**.(3)**

CT has been shown to help surgical planning and to lead to more reliability of classifying the fracture and deciding on a treatment plan**.(4)** The location of depressed fragments, the size of articular segments, and the location and orientation of fracture lines are important details in planning an operative strategy and they are best visualized on CT. Three dimensional (3D) reconstructions have been increasingly utilized and found to demonstrate spatial relationships of fracture fragments better than plain radiographs (**5)**

In one study, the addition of spiral CT with 3D reconstructions frequently resulted in modifications and adjustments in operative plans compared with using plain radiographs alone**.(6)**

Current multidetector row CT provides CT datasets of the fractured plateau that may be visualized in any two-dimensional plane or with high-quality 3D images **(7).**

Tibial plateau fractures represent approximately 1.2% of all fractures in the adult population **(8),** with an incidence of 13.3 per 100,000 per year **(9).**

These fractures include a wide range of different patterns, from simple configurations to very complex multifragmentary fractures, with various degrees of displacement and articular depression **(10).**

Even if there is no consensus on the best method of fixation for these fractures, open reduction internal fixation (ORIF) is the mostly used technique. The goal is to obtain anatomic reduction of the articular surface, lower limb axis alignment and knee joint stability**(11).**

**Non-operative treatment**

**Indications for non-operative treatment :**

- Minimal displacement with an articular fracture gap and/or stepoff of less than 2 mm **(12)**
- Significant medical comorbidities that preclude surgical treatment
- Elderly patients with low functional demands in whom subtle deformities are tolerated **(13)**

**Disadvantages of non-operative treatment :**

- Risk of displacement and need for surgery
- Prolonged recumbency and delayed weight bearing
- Knee joint stiffness
- Post-traumatic arthiritis in the long term

**Techniques for non-operative treatment :**

Patients with tibial plateau fracture can be treated with various methods such as long leg cast, skeletal traction or hinged knee brace. Most patients with nonoperatively treated tibial plateau fractures should be kept nonweight-bearing during the initial weeks after injury.the duration of nonweight-bearing depends on the fracture pattern but is typically 4-8 weeks.Although injured knees with tibial plateau fractures tolerate up to 6 weeks of cast immobilization before becoming increasingly stiff, most surgeons prefer early mobilization with a hinged brace, which allows joint mobility and provides some coronal support **(14)**

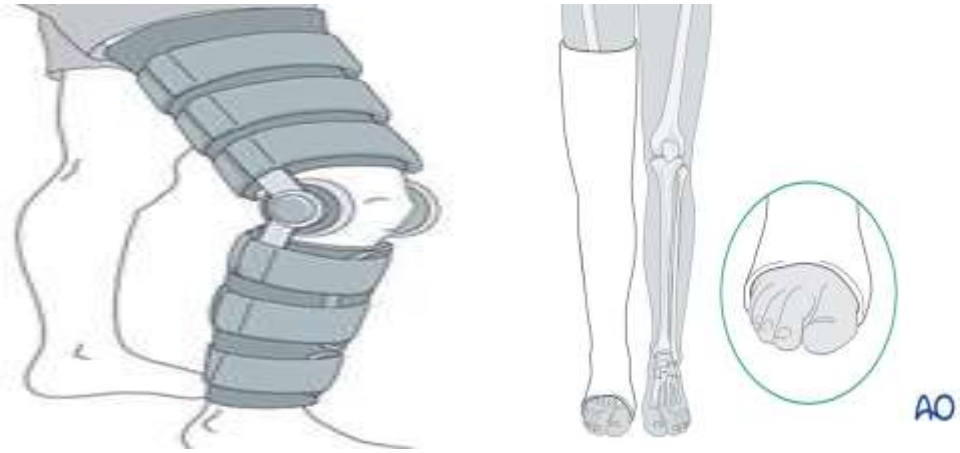


**Figure 1.Hinged fracture brace (14)**

**Operative treatment**

**Indications for surgical treatment (15)**

- Displaced and unstable tibial plateau fractures.
- Displaced medial plateau fractures and lateral plateau fracture patterns where valgus alignment will occur without surgically reducing and fixing the fracture.
- For the lateral patterns, the presence of A split fragment, a depression affecting over half of the lateral articular surface.
- Valgus alignment on injury radiographs, and Clinical valgus alignment on examination
- Metaphyseal -diaphyseal translation of more than 1 cm.

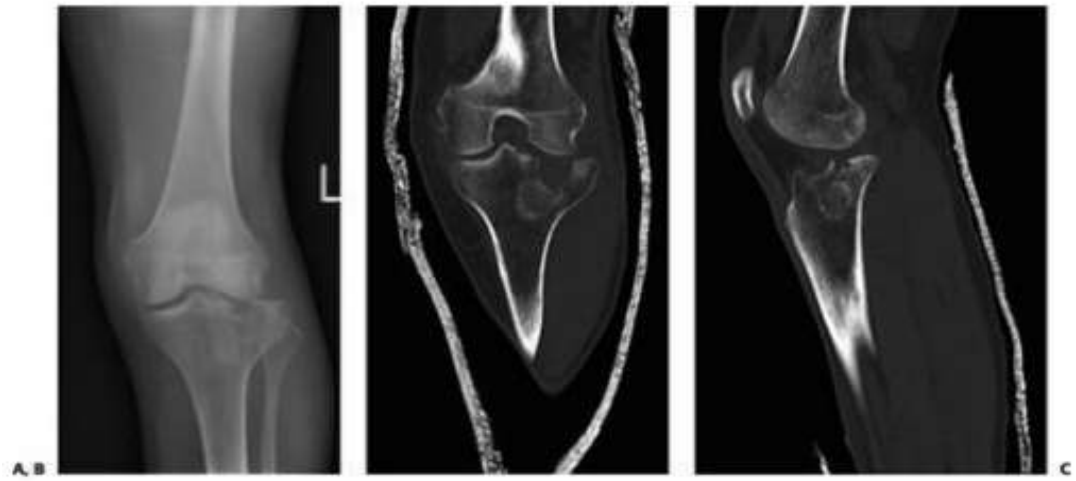


**Figure 2.) AP x-ray (A) and coronal (B) and sagittal (C) CT scans of a 52-year-old woman who sustained a lateral split depression–type tibial plateau fracture (15)**

**Techniques for surgical treatment :**

- The treatment techniques that result in the most favorable patient outcomes depend on the patient and the fracture pattern. A variety of techniques are currently popular, have good results, and new techniques continue to be developed. However, for a given patient with a given fracture pattern, there is little evidence to indicate one technique is superior to others. **(16)**

For instance, for one of the most common fracture patterns, a split depression lateral plateau fracture, currently acceptable techniques for visualizing the articular surface reduction include fluoroscopic, arthroscopic, and joint arthrotomy with infra or anterior meniscal incision. The same fracture might be stabilized with either small or large plates and screws, or screws alone. **(17)**

**Internal fixation can be accomplished by means of the following :**

- Biologic fixation – screw fixation , minimally invasive plate osteosynthesis**.(16)**
- Arthroscopic-assisted fixation **( 17 )**
- Conventional plating**(18)**

**External fixation can be accomplished with the following :**

- Ilizarov fixator **(19)**
- Hybrid fixator
- Spanning fixator

**Open reduction and internal fixation**

Plates and screws are the most frequent implants used to stabilize tibial plateau fractures and all major manufacturers have recently developed precontoured periarticular plates and locking plates, resulting in diverse plate choices.the soft tissue envelope must be ready to withstand further traumatic insult. Although reduction of fracures is easier if performed early, delaying surgery is essential to reduce wound complications if internal fixation is planned **.(20)**

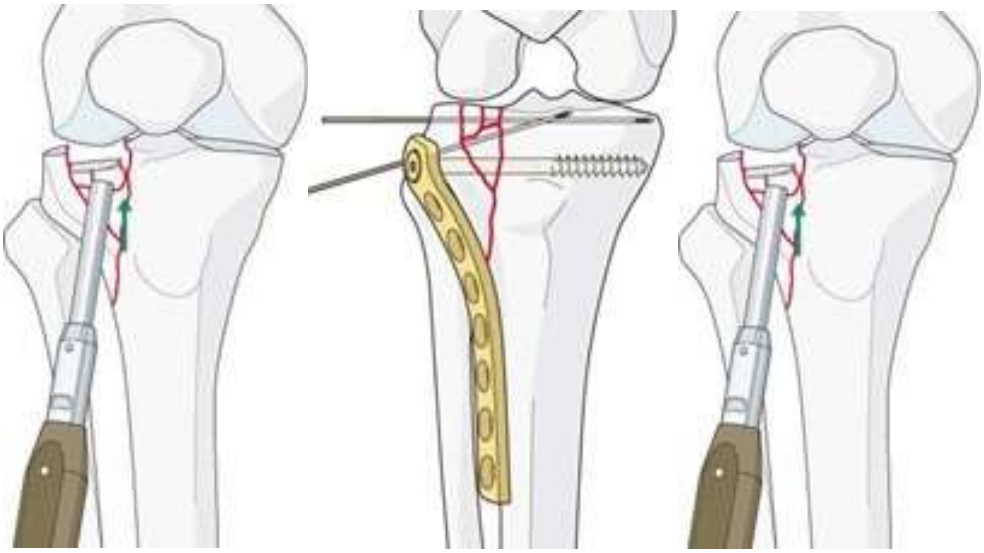

**Figure 3.(ORIF) by plate and screws (20 )**

**Surgical Approach :**

**Anterolateral approach**

This is the most common approach, used for most tibial plateau fractures. The incision is centered over Gerdy‟s tubercle and either a lazy „S‟ or „hockey stick‟ incision is made. The Centre of then incision crosses the joint line at the mid- axial point and should extend distally 1-2 cm lateral to the tibial crest. **(21)**

Proximally the iliotibial band is incised in line with its fibers and the fascia over tibialis anterior divided and elevated bluntly from the tibia distally. A sterile needle can be used to locate the joint and dissection performed anteriorly and inferior to the meniscus to perform the submeniscal arthrotomy **(22).**

Stay sutures are place in the meniscus (usually 2) and can be used to retract the meniscus to visualize the joint surface to aid reduction. Often the meniscus will have detached from the coronary ligament at the periphery and be trapped in the fracture site; if so it should be removed to enable anatomic reduction. If possible a rim of tissue should be left on the margin of the tibia to reattach the meniscus to the coronary ligament at the end of the procedure. The peripheral meniscus can then be reattached to the coronary ligament or to small holes in the superior aspect of the plate**.(23)**

**Figure 4.Specimen showing the anterolateral approach and location for plate placement (22)**

**Other approaches**

Posterolateral approaches, with or without a fibular osteotomy, have also been described. Some fracture patterns involve the posterolateral aspect of the fibula that cannot be reduced using an anterolateral approach. The soft tissue tension of the popliteal corner structures can prevent reduction. **(24)**

**External fixation**

External fixation is now frequently used as a temporary treatment by spanning the knee. This technique restores length and aligns the fracture during soft tissue recovery prior to definitive treatment with internal fixation. Definitive external fixation still has a role in complex tibial plateau fractures based on surgeon preference, or in cases with severe soft tissue injury, when despite delay, internal fixation is not felt to be safe. The use of a fine wire external fixator in conjunction with limited-access internal fixation provides similar stability to ORIF, but with fewer complications. **(25)**

**Indications**

- Open fractures with severe contamination .
- compartment syndrome
- Widely displaced fractures with soft tissue injuries such as tense swelling, fracture blisters.

**Advantages**

An external fixator provides good, temporary stability until the patient is healthy enough for the final surgery. Other times, an external fixator can be used as the device to stabilize the bone until healing is complete. (**26)**

**Disadvantages**

Bridging of the joint, risk of pin-track infection, risk of muscle scarring and risk of knee stiffness

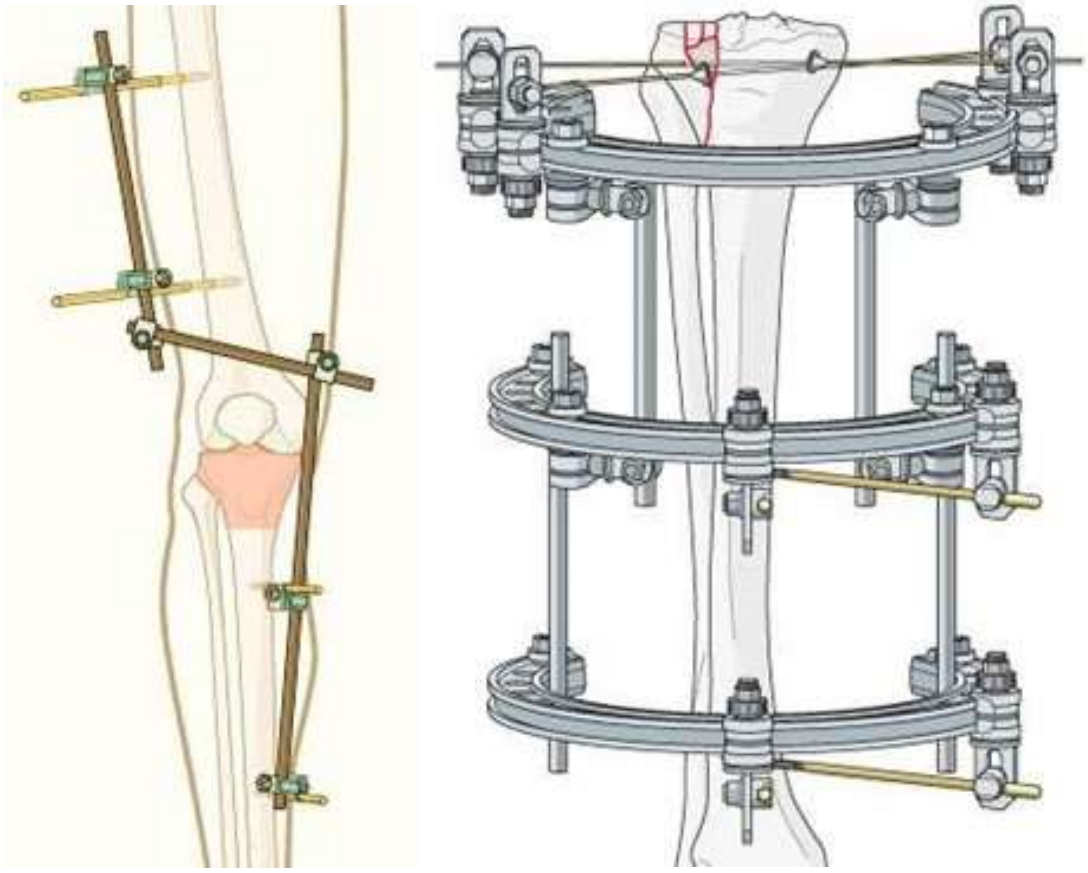

**Figure 5.(A) bridging external fixator (B) Ring external fixator (25)**

**Raft screw construct :**

Using Raft construct to obtain a stable, pain-free, mobile joint, to prevent the development of premature osteoarthritis without using bone graft or substitute and to correlate the radiological findings with the type of fracture and the functional end result. The use of a raft screw construct in the subchondral bone provide support to the articular surface of the lateral and medial condyles of the proximal tibia, irrespective of bone quality and the type of

fixation either ORIF, percutaneous or arthroscopic assisted. This technique prevents collapse, even in the absence of bone grafts or bone substitutes. **(27)**

**Advantages of raft screw construct**

- Hold and maintain the anatomical reduction of articular surface
- Resist subchondral bone collapse
- Prevent donor site morbidity complications
- Prevent bone transmitted disease
- Decrease the risk of infection **(27)**

**Types of rafting technique**

### *1. Independent free raft screw construct*

After anatomical reduction of the articular surface under visual control and temporary fixation with Kirschner wires. One or more locking screws are placed subchondral from lateral to medial for permanent stable fixation of the articular surface. (28)

**Figure 6.AP view radiograph of independent raft screw fixation (28)**

***Independent free raft screw construct and side plate support***

If needed the lateral tibial condyle is supported with a 3.5 mm locking or non- locking compression side plate applied below the free subchondral screws. (**29)**

**Figure 7. Independent free raft screw construct and side plate support (29)**

### *2. Periarticular Raft Plate*

A raft plate is both stronger and more efficient in supporting the articular surface. Especially in comminuted and osteoporotic cases.The screw hole pattern allows a raft of subchondral locking screws to buttress and maintain reduction of the articular surface. This provides resistance to local depression loads in addition to the stability of the fixed-angle construct created by locking the screws into the plate **(30).**

**Figure 8.AP and lat. View x-ray of raft plate construct of tibial plateau (30)**

*Figure 9. raft plate*

Complications

***Wound Breakdown and Infection***

The most devastating complication associated with the management of tibial plateau fractures is infection. Its incidence can be decreased by careful surgical timing and soft tissue handling. Indirect reduction techniques and minimally invasive surgery also decrease the likelihood of further devascularization **(31).**

Treatment of wound breakdown and infection depends on the clinical presentation. The authors of a recent paper speculated that current infections were easier to treat and less severe because of more limited approaches for reducing the fracture and inserting the implant.Irrigation and debridement in the operating room and organism-specific antibiotics are central to all treatment techniques.**(32)**

***Posttraumatic Arthritis in Tibial Plateau Fractures***

After tibial plateau fracture, the knee is less likely to develop severe arthrosis than the hip after acetabular fracture or the ankle after tibial plafond fracture. Study found that at 7 years of follow-up of patients treated operatively and nonoperatively have arthritis in only 17%. other study found that 10/43 operatively treated knees had arthritis at almost 3 years of follow-up.**(33)**

Post-traumatic knee osteoarthritis is a common complication which occurs after a lateral tibial plateau fracture. Comminution of the lateral tibial plateau fracture, articular depression, and irregularity of the articular surface are poorly correlated with the post-traumatic knee osteoarthritis. According to Manidakis et al., post-traumatic knee osteoarthritis was found in 26.4% out of 125 cases **(34).**

***Knee Stiffness in Tibial Plateau Fractures***

The knee injuries, subsequent immobilization, and surgery are the major contributory factors in causing knee stiffness. McNamara et al. **(35)** , in a meta-analysis, identified several risk factors for motion loss after the knee injuries. These included fracture severity, external fixation, malreduction, soft-tissue injury, surgical timing, and postoperative immobilization. On the contrary, a well-performed surgery with achieving anatomic fracture reduction and stable internal fixation, and early range of motion(ROM) is crucial in decreasing the risk of arthrofibrosis.

***Complaications of using bone graft***

Despite the wide acceptance of autologous iliac bone graft as the gold standard (36), some reports have shown that 0.76% to 39% of cases sustain complications at the harvest site that are capable of negatively influencing functional outcome; these include pain, hematoma, infection, and nerve injury (37). Additionally, both operative duration and length of stay may be prolonged following bone-graft harvest **(38).**

***Malunion in Tibial Plateau Fractures***

Preventing malunion is one of the major goals of treating tibial plateau fractures. Tibial plateau fractures can lead to extra-articular angular malunion, intra-articular malunion, or combinations of both. Angular malunion may occur in any plane. If angular deformity is significant, it will cause functional problems, be cosmetically objectionable, and increase the risk for posttraumatic osteoarthritis.**(32)**

The degree of deformity that will predictably cause these problems is uncertain and must be assessed on a case-by-case basis. If correction is necessary, the surgical approach and technique will depend on the direction and amount of the deformity, the presence of pre-existing implants, and the condition of the soft tissue envelope. **(33)**

***Nonunion in Tibial Plateau Fractures***

The majority of tibial plateau fractures heal without difficulty. Split depression fractures need void filler solely for the purpose of support of the reduced articular surface and not to ensure union which occurs reliably. High energy OTA/AO C3 and Schatzker 6 fractures, particularly when widely displaced and open, are at increased risk of healing delays or nonunion. (**34)**

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