International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2024; 10(1): 01-05

https://www.orthopaper.com
Received: 01-11-2023
Accepted: 13-12-2023

El-Sayed Essawie Ahmed El-Harmel
Department of Orthopedic Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt

Muhammad Abdelmoneim Quolquela
Department of Orthopedic Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt

Kamal Mohamed Hafez
Department of Orthopedic Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt

Mohammed Roshdy El-Tabbakh
Department of Orthopedic Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt

Corresponding Author:
El-Sayed Essawie Ahmed El-Harmel
Department of Orthopedic Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt

Using subchondral one third tubular plate as a rafting plate for elevation of depressed tibial plateau fractures

El-Sayed Essawie Ahmed El-Harmel, Muhammad Abdelmoneim Quolquela, Kamal Mohamed Hafez and Mohammed Roshdy El-Tabbakh

DOI: https://doi.org/10.22271/ortho.2024.v10.i1Sa.3483

Abstract
Fractures affecting the tibial plateau posterior aspect represent a difficult challenge in terms of treatment. Treating articular depression in tibial plateau fractures often involves elevating the fragment (s), residual defect filling utilizing bone grafts or substitutes, as well as providing support to the articular fracture reduction using screws via a plate positioned medially and/or laterally. Treatment of tibial plateau fracture may be non-operative or operative. Fracture proximal tibia can be surgically treated by various options including plate osteosynthesis, external fixator, (CRPF), (AAPPO) or primary total knee replacement. (ORIF) of tibial plateau fractures by plate as well as screws can be achieved by several types of plates and many approaches including plates [conventional non locked plates, locked plates, one third tubular plate], external spanning fixator and CRPF. There are some tibial plateau fractures complications including injury of vascular, nerve and ligaments, infection, nonunion, malunion, posttraumatic arthritis and stiffness.

Keywords: Subchondral, rafting plate, elevation

Introduction
Tibial plateau fracture represents a fracture type occurring intraarticularly, thus requiring both precise reduction as well as secure fixation to keep the joint surface in place, enabling cases to commence rehabilitation for early functional recovery [1, 3]. They often occur when forces exerted on a bone are greater than its ability to compensate, resulting in a structural bone failure [4].

Mechanism of Tibial Plateau Fracture
Force directed medially (valgus force) or laterally (varus force) or both causing split fracture and collateral ligament tear. Axial compressive force causes depression fracture. Both axial force and force from the side causing split and depression fracture with or without collateral ligament tear [5].

Management of Tibial Plateau Fractures
The patient's ability to provide a detailed description regarding the injury mechanism remains rare, however, clinicians could utilize medical history for ascertaining the force's direction, resulting deformity, or if the injury originated as a result of high- or low-velocity force [6].

Physical examination
The physical assessment represents the most precise approach to evaluate soft tissue envelope and its injuries, whether they are closed or open. It should prioritize assessing soft tissue envelope continuity as well as blisters or shallow abrasions existence. Profound tissue damage, bleeding blisters, as well as skin creases absence remain all indicative of an interior degloving injury [6, 8].

Imaging studies

Plain radiographs: It requires several views, involving anterior-posterior, lateral, as well as extra views, including oblique and tibial plateau views. Nevertheless, such modalities' significance remains diminishing with CT scans availability. Tibial plateau fractures detection could pose challenges utilizing plain radiographs, at a sensitivity of eighty-five percent [9].

CT Scans: it often reveals more joint dislocation as well as comminution as opposed to that shown on plain images. They exhibited efficacy in facilitating surgical planning as well as enhancing fracture classification accuracy and treatment decision-making [10, 12]. Figure 1.

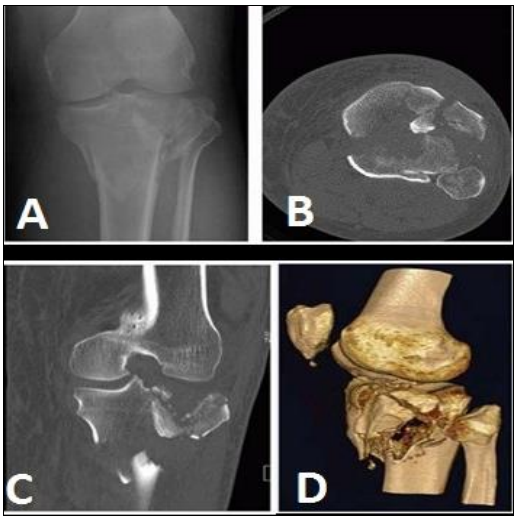

Fig 1: (A) AP X-ray reveals a high-energy bicondylar tibial plateau fracture, however, it is difficult to accurately determine more details regarding the injury. An axial CT. (B) as well as coronal reconstruction. (C) Exhibit comminution degree as well as major fragments identification, without giving an overview regarding fragments' size as well as alignment. (D) High-quality three-dimensional reconstructions reveals more data regarding fracture morphology evaluation for preoperative planning [10, 12]

MRI

MRI offers further insights into knee soft tissue injuries that remain not accessible via other imaging techniques. The controversy is in determining if MRI should be routinely involved into the tibial plateau fractures evaluation, or if it could replace CT scans. L (Figure 2) [10, 12].

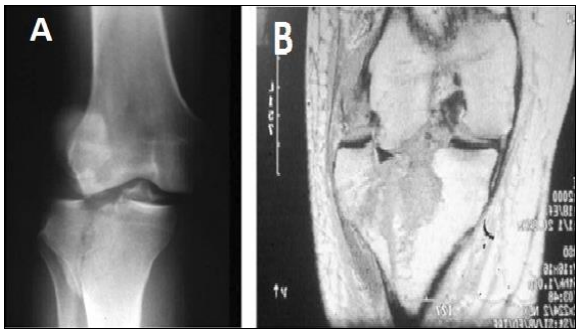

Fig 2: Radiograph (A) with accompanying MRI (B) taken after a fracture of tibial plateau. The incarcerated meniscus and anterior cruciate ligament damage are visible at the fracture site [12]

Tibial Plateau Fractures Treatment

Tibial plateau fractures provide challenges when treated due to intra-articular nature, involvement of cancellous bone, as well as closeness to main weight-bearing joint [13, 14]. The therapy's primary objectives are aimed at restoring articular stability, alignment, as well as congruity, while maintaining the whole range of motion. Under these circumstances, achieving painless knee function is possible, therefore preventing post-traumatic arthritis occurrence [10]. Treatment of tibial plateau fracture may be non-operative or operative.

Non-operative treatment of fracture tibial plateau

Non operative treatment using traction, casts or braces recommended for proximal tibial fractures healing with no profound deformities or for the elderly as well as those having related medical conditions, making surgeries risky or otherwise undesirable. Additionally, they could be also for whom a deformity would be acceptable clinically. However. While applying non-surgical intervention, it is advisable to take a CT scan of the affected extremity to detect any hidden joint depression. This information might potentially alter the treatment plan, shifting it from a non-invasive approach to a surgical one [15, 16].

Hinged knee brace, partial weight bearing for (8-12 weeks) as well as immediate passive ROM [17, 18], indications

- Minimally displaced split or depressed fractures.
- Low energy fractures stable to varus/valgus alignment.
- Those who are unable to walk or move.

Operative treatment of fracture tibial plateau [6, 19, 20], indications

- Articular step off is more than three mm.
- Condylar widening is more than five mm.
- Varus/valgus instability.
- All medial plateau fractures.
- Bicondylar fractures.
- Fractures with diaphyseal extension.

When treating a specific patient, the surgeon must consider articular congruity, stability, and alignment as well as the fracture's personality. This refers to a combination of factors related to the patient, injury, the capabilities of the medical team, as well as hospital environment suitability [21].

Techniques

Fracture proximal tibia can be surgically treated by various options including plate osteosynthesis, external fixator, CRPF, AAPPO or primary total knee replacement [21, 22].

Plate-Osteosynthesis

(ORIF) of tibial plateau fractures by plate and screws can be achieved by several types of plates and many approaches including.

Plates

Conventional non locked plates

- Compression plate for axial compression.
- Lag screw and protection plate.
- Buttress plate and lag screw (Figure 3) [22].

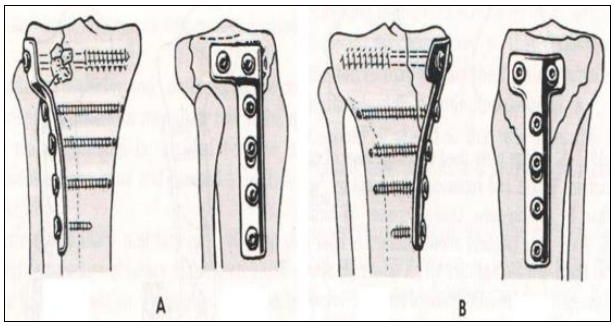

Fig 3: Various buttress plates for plateau fractures. A) L-plate on lateral plateau, B) T-plate on medial plateau [22]

Locked plates (Figure 4)

Regarding osteoporotic bone preventing sufficient thread purchase that allows adequate torque to provide stability. The successful use of these plates in clinical settings has resulted in the Locked Compression Plate development as well as current modifications to locked-plate designs by other manufacturers [6, 22].

Fig 4: Locked proximal tibia plate [6, 22]

One Third Tubular Plate (Figure 5)

Is utilized as a rafting plate for elevation of depressed tibial plateau fractures.

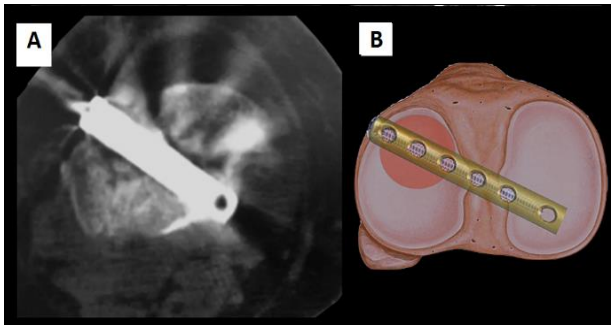

Fig 5: Both (A) & (B) are Axial CT with 3D cuts of proximal tibia showing subchondral one third tubular plate act as a rafting plate elevating the depressed tibial plateau

Approaches

- **Lateral approach:** Straight or hockey stick incision anterolaterally from just proximal to joint line to just lateral to the tibial tubercle.
- **Midline incision (if planning TKA in the future):** might result in soft tissue stripping. Therefore, avoidance must be accomplished.
- **Posteromedial approach:** Interval between PES anserinus and medial head of gastrocnemius.
- **Posterior approach:** is utilized for posterior shearing fractures.
- **Dual approaches with dual plate fixation:** In bicondylar tibial plateau fractures [8, 15].

External spanning fixator (Figure 6)

Utilizing an external fixator spanning the knee represents the first step in the sequential treatment of severe tibial plateau fractures. Spanning external fixator placement enables prompt stabilization of a fracture, prevents further injury to cartilage and soft tissues, maintains correct alignment, provides access to wounds for monitoring and treatment, stabilizes vascular repairs, as well as enhances patient comfort [23].

Fig 6: Knee Spanning External Fixator [23]

Closed reduction and percutaneous screw fixation

Utilizing the concepts of ligamentotaxis, closed reduction combined with internal fixation with percutaneous cancellous screws and washers offers a solution that overcomes the drawbacks associated with both surgical and non-surgical approaches. Nevertheless, it is unsuitable for some categories of tibial plateau fractures, involving severely comminuted as well as depressed fractures, Schatzker type-VI fractures, and open fractures [24].

Complications of tibial plateau fractures

Related injuries involve cruciate and collateral ligament ones, as well as meniscal tears [25]. Additional complications related to therapy involve knee stiffness, ankylosis, deep infection, posttraumatic arthritis, malunion, as well as nonunion [26].

Vascular injury

It is uncommon after injuries with low levels of energy. Conversely, fractures with high-energy displacement pose a potential harm to the popliteal artery and trifurcation. Vascular injury may occur due to direct artery or vein contusion or laceration, as well as by fracture fragments. It can also be indirectly induced by stretching, resulting intimal injury [27].

Nerve injury

High energy trauma that results in proximal tibial or fibular

fractures with sagnificant distal fragment varus displacement or fibular neck direct trauma could sometimes damage the peroneal nerve [28].

Ligamentous injury

Knee ligament injuries often occur in conjunction with tibial plateau fractures. They typically involve damage to the medial collateral ligament, tears within the meniscus, as well as disruption of the anterior cruciate ligament [13, 29].

Meniscus tears remain the most predominant, lateral meniscus > medial meniscus, the most prevalent peripheral tears involve [30].

- **Lateral plateau fractures:** Lateral meniscal injury.
- **Medial plateau fractures:** Medial meniscal injury.
- **Bicondylar fractures:** (ACL) injuries [30].

Infection

One of the most frequent and severe effects is wound issues resulting in a profound infection. Intra-articular fractures may result in the knee joint contamination by infection. For avoiding cartilage breakdown, it is crucial to properly inspecting the knee joint as well as performing lavage if necessary [13].

Nonunion

Nonunion often occurs due to significant comminution, improper fixation, unsuccessful bone grafting, implant's mechanical malfunction, infection, or a combination of these reasons [13, 29].

Malunion

Tibial plateau fractures could result in intra-articular malunion [13, 29].

Posttraumatic arthritis

Articular incongruity as well as joint instability represent the key factors responsible for posttraumatic arthritis and may directly induce discomfort, gait changes, as well as compartmental arthrosis development [13].

Rate increase with

- Meniscectomy while surgeries
- Axial malalignment
- Intra-articular infection
- Joint instability [13]

Stiffness

Knee motion impairment remains prevalent following tibial plateau fractures. Prolonged immobilization of the knee for a duration beyond three to four weeks often leads to a certain level of lasting stiffness [13].

Conflict of Interest

Not available.

Financial Support

Not available.

References

1. Flandry F, Hommel G. Normal anatomy and biomechanics of the knee. Sports Med Arthrosc Rev. 2011;19:82-92.
2. Gray H, Standring S, Ellis H, Berkovitz BKB. The Anatomical Basis of Clinical Practice (Gray's Anatomy In: Standring S, editor. Gray's Anatomy. 1. 39th ed. london: Elsevier Churchill Livingstone; c2005. p. 1200-39.
3. R J Last RMHM. Last's Anatomy: Regional and Applied. In: Gogalniceanu P, editor. Last's Anatomy: Regional and Applied. 1. 11 ed. London: Elsevier; c2006. p. 500-9.
4. Karim L, Bouxsein ML. Bone Biomechanics and the Determinants of Skeletal Fragility. In: Holick MF, Nieves JW, editors. Nutrition and Bone Health. New York, NY: Springer New York; c2015. p. 65-80.
5. Cohn MR, Unnanuntana A, Pannu TJ, Warner SJ, Lane JM. Materials in Fracture Fixation. In: Ducheyne P, editor. Comprehensive Biomaterials II. Oxford: Elsevier; c2017. p. 278-97.
6. Prat-Fabregat S, Camacho-Carrasco P. Treatment strategy for tibial plateau fractures: an update. EFORT Open Rev. 2016;1:225-32.
7. Fenton P, Porter K. Tibial plateau fractures: A review. Trauma. 2011;13:181-7.
8. Manske RC, Prohaska D. Physical examination and imaging of the acute multiple ligament knee injury. N Am J Sports Phys. Ther. 2008;3:191-7.
9. Mthethwa J, Chikate A. A review of the management of tibial plateau fractures. Musculoskelet Surg. 2018;102:119-27.
10. Edited by Charles A. Rockwood JDPGRWB, with c. Tibial fractures. Rockwood and Green fractures in adults. Philadelphia: Lippincott; c1991. p. 365-258.
11. Chan PSH, Klimkiewicz JJ, Luchetti WT, Esterhai JL, Kneeland JB, Dalinka MK, *et al*. Impact of CT Scan on Treatment Plan and Fracture Classification of Tibial Plateau Fractures. J Orthop Trauma. 1997;11:484-9.
12. Bergin P, Lawyer TJ. Tibial Plateau Fractures. In: Eltorai AEM, Eberson CP, Daniels AH, editors. Orthopedic Surgery Clerkship: A Quick Reference Guide for Senior Medical Students. Cham: Springer International Publishing; c2017. p. 315-21.
13. Krieg JC. Proximal tibial fractures: current treatment, results, and problems. Injury. 2003;34 2-10.
14. Lubowitz JH, Elson WS, Guttmann D. Part I: Arthroscopic management of tibial plateau fractures. Arthroscopy. 2004;20:1063-70.
15. Nikolaou VS, Tan HB, Haidukewych G, Kanakaris N, Giannoudis PV. Proximal tibial fractures: early experience using polyaxial locking-plate technology. Int Orthop. 2011;35:1215-21.
16. Pogliacomi F, Verdano MA, Frattini M, Costantino C, Vaienti E, Soncini G. Combined arthroscopic and radioscopic management of tibial plateau fractures: report of 18 clinical cases. Acta Biomed. 2005;76:107-14.
17. Siebers HL, Eschweiler J, Pinz J, Tingart M, Rath B. The effect of a knee brace in dynamic motion-An instrumented gait analysis. PLoS One. 2020;15:23-78.
18. Schatzker J. Fractures of the Tibial Plateau. In: Schatzker J, editor. The Rationale of Operative Fracture Care: Third Edition; c2005. p. 447-69.
19. Lowe JA, Tejwani N, Yoo B, Wolinsky P. Surgical techniques for complex proximal tibial fractures. J Bone Joint Surg Am. 2011;93:1548-59.
20. Hall JA, Beuerlein MJ, McKee MD. Open reduction and internal fixation compared with circular fixator application for bicondylar tibial plateau fractures. Surgical technique. J Bone Joint Surg Am. 2009;91(12)1:74-88.
21. Prat-Fabregat S, Camacho-Carrasco P. Treatment strategy for tibial plateau fractures: an update. EFORT

Open Reviews. 2016;1:225-32.
22. Hall J, Beuerlein M, McKee M, Society COT. Open Reduction and Internal Fixation Compared with Circular Fixator Application for Bicondylar Tibial Plateau Fractures. J Bone Jt Surg. 2009;91:74-8.
23. Berkson EM, Virkus WW. High-energy tibial plateau fractures. J Am Acad Orthop Surg. 2006;14:20-31.
24. Sament R, Mayanger JC, Tripathy SK, Sen RK. Closed reduction and percutaneous screw fixation for tibial plateau fractures. J Orthop. Surg. (Hong Kong). 2012;20:37-41.
25. Gardner M, Yacoubian S, Geller D. Prediction of soft-tissue injuries in Schatzker II tibial plateau fractures based on measurements of plain radiographs. J Trauma. 2006;60:319-23.
26. Papagelopoulos PJ, Partsinevelos AA, Themistocleous GS, Mavrogenis AF, Korres DS, Soucacos PN, *et al*. Complications after tibia plateau fracture surgery. Injury. 2006;37:475-84.
27. Lee CH, Chang YJ, Li TS, Chen YC, Hsieh YK. Vascular Trauma in the Extremities: Factors Associated with the Outcome and Assessment of Amputation Indexes. Acta Cardiol Sin. 2022;38:455-63.
28. Kim YC, Jung TD. Peroneal neuropathy after tibio-fibular fracture. Ann Rehabil Med. 2011;35:648-57.
29. P Brwhjdrcagd. Tibial fractures. In: Heckman BRW, editor. Rockwood and green's fractures in adults Lippincott; c2006. p. 250-9.
30. Casemyr N, Mauffrey C, Hak D. Pelvis and Lower Extremity Trauma. In: Mauffrey C, Hak DJ, editors. Passport for the Orthopedic Boards and FRCS Examination. Paris: Springer Paris; c2015. p. 237-335.

How to Cite This Article
El-Harmel ESEA, Quolquela MA, Hafez KM, El-Tabbakh MR. Using subchondral one third tubular plate as a rafting plate for elevation of depressed tibial plateau fractures. International Journal of Orthopaedics Sciences 2024; 10(1): 01-05.