Hong Kong Journal of Orthopaedic Research
(An Open Access Journal for Orthopedics and Trauma Research)

Case Report

Hong Kong J Orthop Res
2022; 5(2): 10-12
ISSN (e): 2663-8231
ISSN (p): 2663-8223
Received: 31-08-2022
Accepted: 27-09-2022

www.hkorthopaedicjournal.com
DOI: 10.37515/ortho.8231.5201

Combined Approaches in Treatment of Complex Tibial Plateau Fractures: A Case Report

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Abstract

Abstract: Complex tibia plateau fracture is common and it requires treatment with open reduction and internal fixation. This type of fracture is difficult to reduce adequately and stabilized by the conventional techniques and approaches. Case report: A case of bicondylar fractures of the right tibia plateau is reported where the patient sustained from a motor vehicle accident. A dual approach of anterolateral and posterior inverted L is used to deal with this fracture in order to address the lateral, medial and posterior column of the tibia plateau based on the three-column concept described by previous literature. Conclusion: Complex tibial plateau fracture fixation can be challenging, and it is crucial to restoring articular surface reduction anatomically and reliable fixation in order to prevent complications.

Keywords: Tibial plateau, Three column concept, Knee Trauma.

INTRODUCTION

Complex tibial plateau fracture is an intra-articular fracture that comprises around 1-2% of all the fractures and 30% of all the tibia fractures [3-9]. Complex bicondylar tibial plateau fractures are about 18 to 39% of all tibia fractures [5, 10]. The aim of treatment in managing bicondylar tibial plateau fracture is the anatomical reduction of articular congruity, stabilization of the axis of the limb, and restoration of stability and early motion of the knee joint [5, 6, 8, 9, 11, 12]. The most widely used classification for tibial plateau fracture is Schatzker's classification and AO Foundation/Orthoapedic Trauma Association (AO/OTA) classification [7, 8, 13-17, 29]. Bicondylar tibial plateau fractures are type V/VI according to Schatzker's classification and type 41-C based on AO/OTA classification [14]. Luo et al. reported a three-column concept classification system based on computed tomography (CT) and three-dimensional image (3D) reconstruction [7, 15]. Complications in tibial plateau fracture are postoperative joint stiffness and osteoarthritis [4, 18]. The aim of treatment in bicondylar tibial plateau fractures is the stabilization of medial and lateral columns to restore the articular surface and prevention of varus collapse [3]. Meulenkamp et al reported that 30% of cases in post-fixation of bicondylar tibial plateau fracture had articular malreduction [19]. Complex tibial plateau fractures are treated with open reduction and internal fixation [1]. Conventional dual plating is one of the common recommended definitive fixations. However, this type of fixation cannot be applied when multiplanar articular comminution is involved [20]. Complex tibial plateau fractures commonly involve the posteromedial and posterolateral aspects of the tibial plateau [1]. The conventional techniques and approaches face a challenge in reducing the fracture and achieving stabilization of the fixation [2]. The quality of reduction for example articular step-offs and angular deformities of tibial plateau fractures affects the clinical outcome. Hence, it is crucial the managing tibial plateau fractures to achieve anatomical reduction without step-offs [21]. The posteromedial aspect is often displaced significantly and is undertreated. This can lead to further distal displacement and cause the medial femoral condyle to subluxate [22]. Several literatures have reported several approaches and methods for the reduction and fixation of complex tibial plateau fractures.

The informed consent is taken from the patient.

CASE REPORT

A 54-year-old male with no known medical illness sustained a motor vehicle accident where he was skidded from a motorcycle. He had pain and swelling over the right knee after a fall and subsequently he was unable

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to bear weight on the injured side. On examination, gross effusion over the right knee was noted with swelling of the surrounding soft tissue. Each compartment of the leg was noted to be soft, and pulses of the lower limb were all palpable comparable to the contralateral limb. The sensation over the lower limb was intact. Plain radiographs showed there was a fracture over the medial and lateral tibial plateau extending to the metaphysis with a fracture over the head of the fibula. (Figure 1) Computed tomography (CT) scan was done and showed comminuted bicondylar fractures of the right tibial plateau with extension into metadiaphysis. CT scan also showed the head of the fibula fracture with comminution. (Figure 2) The patient was initially put on a cryo cuff and adequate elevation of the right lower limb. The operation was done 3 days after the trauma when the swelling over the knee reduced. A combined approach of posterior inverted L-shaped approach and anterolateral approach was used for open reduction and internal fixation. The patient was put in a supine position initially for the induction of anesthesia. Subsequently, the patient was positioned in a floating position with support and padding on a radiolucent table. The knee was flexed slightly with support placed over the anterior aspect of the ankle to relax the posterior soft tissue. This position of the patient allows the anterolateral approach to address the lateral column of the fracture and the posterior inverted L approach to address the medial and posterior column of the fracture without the need to reposition the patient. The incision of an inverted L shape was made at the center of the popliteus muscle parallel to Langer's line superiorly and medial. The incision is made deep down into the fascia as it passes the corner of the popliteal fossa. The protection of the sural nerve and short saphenous vein is made by elevating the full thickness of fasciocutaneous flaps. The gastrocnemius medial head was retracted laterally to protect the neurovascular bundle. This allows the full visualization of the posterior aspect of the tibia. The dissection is done from the medial to lateral underneath the popliteus muscle to protect the vascular and nerve structures in the popliteal space. The access to the fracture site is through elevation of popliteus and soleus muscles. The congruity of the articular surface is reduced and restored. Kirschner wires were used to maintain the reduction temporarily. The medial and posterior column of the tibial plateau was reduced with adequate visualization via this approach. The posterolateral fragment of the tibial plateau was buttressed with a 3.5mm T-plate. Subsequently, dissection is made along the medial edge of the incision to address the medial column fracture. The medial column of the tibial plateau is supported with a 3.5mm LCP Medial-Proximal (Synthes). Lastly, an anterolateral incision is made to address the lateral column fracture of the tibial plateau. The fracture is reduced and a 3.5mm LCP Lateral-Proximal (Synthes) is placed. The fracture reduction and placement of plates were assisted with the guidance of fluoroscopy. The wound was closed at the level of subcutaneous and skin. The patient was followed up and began partial weight-bearing at the sixth to eighth-week post-operation. Full weight-bearing was allowed when radiographs showed the fracture healed and callus present. Plain radiographs of anteroposterior and lateral were taken at follow-up for evaluation of bony union. (Figure 3). Patient able to ambulate with full weight bear after 3 months post-operation with wound healed and right knee range of motion 0-130 degree.

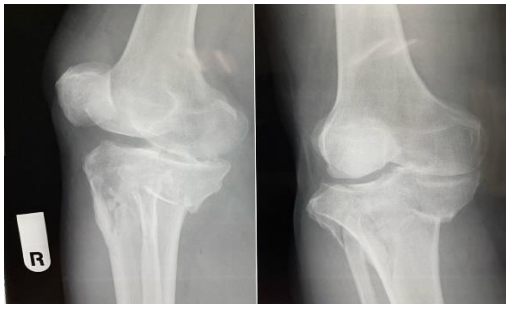

Figure 1: Plain Radiograph (Anteroposterior and Lateral View) of Right Knee

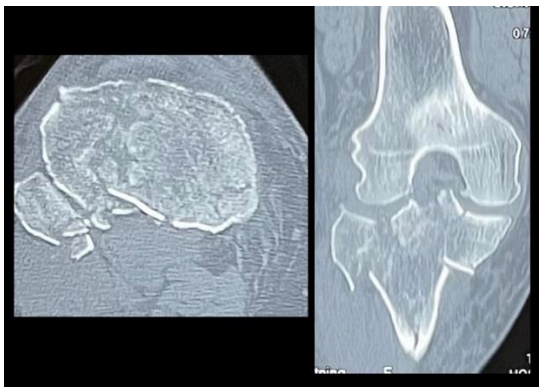

Figure 2: Computed tomography of the right knee

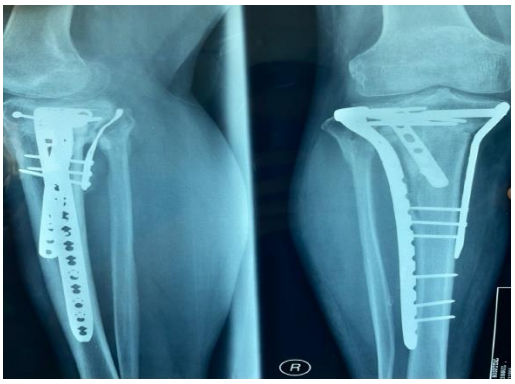

Figure 3: Plain Radiographs (Anteroposterior and lateral view) of Right Knee

DISCUSSION

Complex tibial plateau fractures account for approximately 2% of all fractures [8]. Tibial plateau fractures are made up of medial and lateral articular surfaces anatomically and it involves various fracture patterns. Chang et al. described the tibia plateau into four quadrants which are anterolateral, posterolateral, anteromedial, and posteromedial [12]. 28.8% of the tibial plateau fractures involve posterior tibial plateau and one-third of the fractures is a posteromedial fragment. It is crucial to restoring congruity of the articular surface, avoiding nonunion and risk of infection and early motion of the knee with stable fixation [10, 23]. Sun et al. described the importance to give attention to posterior column fractures because it has influential advantages biomechanically [17]. It is crucial to address the posterior column, especially the posteromedial because fractures tend to displace further even at a low angle of flexion as it is unstable [13]. Common complications such as pain, early stage of osteoarthritis, and long-term disability can be due to the results of malreduction and failure to restore the knee alignment and articular surface congruity [9, 20, 24]. The consideration is required for the fracture comminution, extension of the fracture, articular surface depression, and soft tissue injuries in tibial plateau fractures as it is important [25]. The gold standard of the treatment for bicondylar tibial plateau fractures is open reduction and internal fixation [8]. Dual plating with various approaches is reported in the treatment of lateral and medial columns of the fracture. Approaches such as posteromedial, posterolateral, and posteromedial, transfibular are used to address posterior column fractures either posterolateral, posteromedial, or both [6]. The surgical approaches consist of Carlson's and inverted L-shaped commonly used for posterior column tibial plateau fractures [4]. The common approach for dual plating is recorded to have a rate of infection of 8.6 to 22.3%. On the other hand, reversed L-shaped approach alone or together with other approaches such as the anterolateral approach reported only 2% of superficial infections [24]. Barei et al reported that 74% of the tibial plateau fractures involve a posteromedial aspect and an anterolateral with the posteromedial approach is used [26]. Few authors reported challenges in using the posterolateral approach to deal

with posterolateral fragments such as common peroneal nerve injury and posterior tibial recurrent artery management [15]. Iatrogenic injury to the common peroneal nerve and local vascular structure is reported as a high risk in using posterolateral and posterior approaches [27]. It is difficult to assess the direct reduction of posterolateral fragments although it is reported that the posteromedial approach with the patient in a supine position allows reduction of the posteromedial fragment [20]. The patient in this case is positioned in a floating position similar to semi-prone as allows combined approaches of anterolateral and inverted L shapes. This provides the advantage of achieving a good reduction of the fractures involving three columns. The posterolateral and medial tibial plateau reduction and fixation are performed first. Zeng et al reported that a posterior T-shaped buttress reduces the chance of subsidence of the posterolateral fragment and has a high mean failure load [10]. The limitation of the inverted L approach is if the patient has big muscles and is heavy which may require a longer incision. Displaced fractures require an anatomical reduction, autogenous cancellous bone grafting in the metaphyseal defect. The instability will persist and causes early degenerative arthritis due to joint incongruity and axial overload. Tibial plateau fractures can lead to secondary osteoarthritis due to loss of the normal axis of the lower limb, loss of surface congruity, and ligamentous injuries. Hence, efficient surgical management is crucial in order to decrease the chance of secondary osteoarthritis [28].

CONCLUSION

Complex tibial plateau fracture fixation can be challenging, and it is crucial to achieving the anatomical reduction of the articular surface and stabilization in fixation in order to prevent complications. The combined approach used in our case allows adequate visualization of the fracture and allows reduction and placement of implants. It enables restoration and maintenance of the alignment.

Conflict of Interest

None declared.

Financial Support

None declared

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