



Study to Determine the Efficacy of Illizarov Fixator for the Treatment of Complex Tibial Plateau Fractures

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To evaluate the results of illizarov external fixation using ligamentotaxis technique in high-energy plateau fractures of the tibia.

Methodology: The external fixation of illizarov external fixation using ligamentotaxis was performed in 32 patients aged 18-50 years due to high-energy plateau fractures of the tibia. 18 on the right knee and 14 on the left knee. 28 had closed wound and four had open wound fractures. According to the classification of Schatzker's; classification was carried out for fractures. After two years (range 12 to 24 months) of follow-up, each affected knee was assessed using the Knee Society Score (KSS).

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Results: There were 24 Schatzker type VI and eight type V fractures of the tibia. Complications included deep infection in two cases, one patient had pin tract infection, deep vein thrombosis in two patients and one had fusional defect. The knee motion mean range was 120 degrees of flexion and six degrees of deficiency in extension. According to the KSS criteria, the outcomes were excellent in 22 patients (68.75%), 4 patients (12.5%) have good results, moderate in 5 patients (15.65%) and weak in 1 patient (3.12%).

Conclusion: Ilizarov External fixation gives good anatomical reduction of joint surface, early pain free weight bear, stable fixation and maintain soft tissue envelope without major complications.

Keywords: Ilizarov technique; tibial plateau fractures; external fixators.

1. INTRODUCTION

Plateau tibia fractures are high energy injuries and often accompany underlying crush and soft tissue damage, which is visible as swelling, scratches, and blisters [1,2]. The injury mechanism is grounded on the occurrence of an initial axial load followed by angular forces leading to rupture of the epiphysis and joint surface, respectively [3]. Plateau tibia fractures are classified by Schatzker, who divides these injuries into six types (Table 1), of which the most difficult are types V and VI injuries due to extensive bone and soft tissue damage. These injuries can be treated by various methods, such as traction, splinting, percutaneous fixation, closed reduction, internal rotation and open reduction with reinforcement plates, and the Ilizarov fixation method [4,5].

Internal fixation and open reduction permit for precise reduction of fracture fragments, but injure the already damaged soft tissue sheath, resulting in high rates of infection. Ilizarov's fixation method is an accepted treatment for these injuries. It is a minimally invasive technique that uses fine wires in the periarticular region to rigidly immobilize intra-articular fractures, weight transfer and early joint mobilization, minimal soft tissue changes and easy monitoring of wound [6-7]. We consider the minimally invasive method of Ilizarov's stabilization to be the best method of treating condylar fractures of the tibial plateau due to the above-mentioned advantages [8-9]. The purpose of this analysis is to present our experience with the Ilizarov fixator in the management of high-energy bicondylar fractures of the tibia.

2. METHODOLOGY

This study was conducted at the Orthopedic department of Ameer-u-Din Medical college Lahore General Hospital Lahore for one-year duration from October 2019 to October 2020. Our study included 32 patients, 11 women and 21

men. All patients were admitted to the emergency department, where the first resuscitation and a limb splintage were performed according to the ATLS protocol. The criteria of inclusion were as follows:

1. over 18 and under 50 years of age
2. Bicondylar fractures (Schatzker V / VI)
3. A fully mobile patient.

The exclusion criteria were as follows:

1. Patients with multiple injuries
2. single-condyle fractures
3. Bilateral fractures of the tibial plateau
4. Patients with pre-existing disease of the knee joint.

Anterior-posterior radiographs were taken to know the extent of lateral and medial plateau involvement, while to measure the posterior condyle displacement extent; lateral radiographs were taken in addition to know the degree of joint depression. Open fractures were washed and cleaned just prior to final anastomosis. Severe soft tissue damage occurred in 10 out of 28 closed fractures. Preoperative immobilization was performed using a calcaneal traction or distal tibial pin. Prophylactically cephalosporin antibiotics were given. Coronal and sagittal and reconstructed computed tomography (CT) scans with 3D reconstruction exhibit the degree and exact location of incongruity and joint depression, and identification of intact plateau areas was done where wires to be insert. The patient was placed supine on the table. Knowing the soft tissue envelope around the knee joint is important to guide the wire through safe passageways. Two or three 1.8 mm wires were passed through the proximal tibia and distal femur just distal to the metaphysis and tensioned adequately. The rings are connected by threaded rods in the knee joint. The fracture was reduced by ligamentotaxis. Articular step or spacing of up to 3 mm was found to be compatible; otherwise, an acceptable

congruency was achieved by direct or indirect open reduction. In both techniques, both directly and indirectly, the surface of the joint was reconstructed, and the remaining epiphyseal defect was grafted with bone. After reduction was achieved, the joint surface was fixed in an articular area (1.5 cm below the joint surface) with two or three 1.8 mm diameter olive wires. The wires were laid perpendicular to the main fragments of the fracture for reduction and compression. The lateral wire was always inserted through the head of the fibula when it was intact, thus serving as a support for the lateral condyle. The most distal ring is positioned just above the ankle joint. The rings should leave at least 1.5 cm of play in the anterior crest and 4 cm around the calf to accommodate the post-operative swelling. Exercises to strengthen the quadriceps were started on the first day after surgery. At week 4: removal of femoral ring was done to allow the movement of the knee joint. The load was gradually increased from down contact to partial load and then from partial load to full load based on clinical and radiological evaluation at revision visits. The frame was dynamized after the union was observed radiographically. Additional treatments such as frame correction, bone grafting, pin exchange, complications and union have been reported. At

the last visit, the score was assessed using the Knee Society Score (KSS).

3. RESULTS

There were 24 Schatzker type VI and eight type V fractures of the tibia. Complications included deep infection in two cases, one patient had pin tract infection, deep vein thrombosis in two patients and one had fusional defect. The knee motion mean range was 120 degrees of flexion and six degrees of deficiency in extension. According to the KSS criteria, the outcomes were excellent in 22 patients (68.75%), 4 patients (12.5%) have good results, moderate in 5 patients (15.65%) and weak in 1 patient (3.12%).

All fractures united after an average of 4 months. The external fixator was well tolerated throughout the period. Deep vein thrombosis, Pin tract infection, local skin necrosis, Union defects, traumatic peroneal nerve paralysis, and deep infection were the major complications encountered during treatment. There was one pin tract infections that did not affect the bone. Treatment consisted of oral antibiotics and care of pin site.

Table 1. Types of injuries

Type	Description
Type-I	Split type lateral plateau fractures
Type-II	Split depressed lateral plateau fractures
Type-III	Depressed tibial plateau fractures
Type-IV	Medial tibial plateau fracture
Type-V	Bicondylar plateau fracture
Type-VI	Bicondylar fracture with meta-diaphyseal dissociation

Table 2. The demographic features

Gender	No	%age
Males	21	65.62%
Females	11	34.37%
Side of fractures of the tibia		
Left	14	43.75%
Right	18	56.25%
Schatzker type V fractures	8	21.87%
Schatzker type VI fractures	24	78.12%

Table 3. The Functional scoring of the patient's mobility was assessed using KSS scoring

Excellent	22	68.75%
Good	4	12.5%
Moderate	5	15.65%
Poor	1	3.12%

The pin tract infection was healed without the need to replace the wire. One fracture resulted in 10-degree valgus union that was completely asymptomatic. Two patients were diagnosed with deep vein thrombosis by ultrasound and was treated with low molecular weight heparin. The fractures were complicated by a deep infection that later led to non-union. Affective therapy was used as wound debridement and intravenous antibiotics followed by plating and bone grafts. In most cases, the fixator was removed after an average of 4 months. In subsequent clinical evaluations, the range of motion of the knee joint was increased. During one year of observation, the range of knee motion was 110 degrees of flexion and 6 degrees of extension deficiency.

4. DISCUSSION

Plateau tibia fractures are high-energy injuries that can cause poor functional outcomes if not properly treated [9,10]. There are several ways to treat these fractures, including traction and cast braces, external fixation extending across the knee, percutaneous fixation and restricted open reduction, internal fixation and open reduction, and indirect reduction and stabilization with hybrid or circular external fixation devices [11,12]. Cast bracing and traction produces bad results. Limited open reduction and percutaneous stabilization also do not provide a sufficient reduction of V / VI type highly fragmented injuries, the elongation of the external fixator does not allow for an early range of motion and hinders the healing of joint fractures [13,14]. Dual plating and Open reduction result in a precise reduction of fragments of fractures and the rebuilding of the joint surface, while at the same time causing excessive soft tissue separation leading to tarnishing and poor wound healing [15]. Approximately 23% of infections were reported for dual plating of bicondylar fracture [16]. For comminuted fractures of the condyles, an 87.5% rate of deep infections were noticed in dual plating and a 100% rate of complications were reported [17]. Closed reduction or limited open reduction and fixation by means of finely stretched olive wires prevents further separation and tarnishing of soft tissues and provides excellent periarticular and epiphyseal retention. Enables early weight transfer and range of motion of the knee joint. The olive wires perfectly reduce and compress the condylar component of the tibial plateau fractures [18]. Small external stabilization wires that run along the length of the knee keep the joints distracted and help reduce the principles of the ligamentotaxis. It combines

the advantages of traction, external stabilization, limited internal stabilization and provides access to wound care and nail zone care, tightness syndrome and vascular condition. Due to the above advantages, it is recommended in the case of highly comminuted fractures of the tibial plateau with metaphysical-diffusion relationship [19,20]. These ring fixators can be used differently in different situations. They can then be used to pass through a gap that can be filled with bone fragments later. Primary compression can occur in small gaps without the need for additional bone grafts. Angular and translational deformations can be corrected to keep the healing process going [21]. When insufficient wires are placed, the joint surface tends to collapse. Therefore, it is strongly recommended to place at least 3 wires in the periarticular area. These fractures are accompanied by meniscus injuries, which we prefer to treat when the bone injury has healed and the knee has regained its range of motion. Surgery on the knee meniscus to try to regain range of motion is pointless [22,23]. Treatment of these injuries with ring fixators is highly desirable and appropriate pre-operative planning should be planned in advance. Before performing these procedures, the surgeon needs to be familiar with the anatomy of the neurovascular system. Pin tract infection is the most common complication even with thin wires and septic arthritis, as they can be minimized by keeping a distance of at least 15mm from the joint surface [24].

5. CONCLUSION

A fining wire fixator is suitable for high-energy fractures of the bicondylar tibia. It provides adequate reduction, adequate stability, early weight transfer, early rehabilitation of the knee joint, less soft tissue wear and easy wound care. It is not suggested for simple uni-condylar fractures of the tibial plateau.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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