CASE SERIES

Case Series of Tibial Plateau Fracture Treated Using Illizarov External Fixator – Functional and Radiological Outcome

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ABSTRACT

Introduction: Tibia plateau fracture consist of 1% of the total fractures caused by road vehicle accident. It is commonly associated with high energy trauma and usually presented either as open fracture or closed fractures with poor soft tissue condition. External fixation is commonly used in higher grade open fracture due to high risk of infection but conventional external fixator is not suitable as it is unable to address intra articular fractures. Illizarov external fixator uses olive wires to achieve compression of the intra-articular fragments and hence a better option. **Case series:** 8 cases of tibia plateau fracture treated in our institution from January 2019 to December 2020. 7 cases completed treatment but one patient deceased before the treatment was completed due to medical reason. The objective of the studies is to assess the functional and radiological outcome of tibia plateau fracture using IEF. It was performed clinically using knee injury and osteoarthritis score (KOOS) and radiologically using Rasmussen score during the 1st month follow up after the removal of the IEF. The mean KOOS score is 82% and the mean Rasmussen radiological score is 14. **Conclusion:** Illizarov external fixator is a good choice for treatment of tibia plateau fracture due to its various advantages.

Keywords: Tibial Plateau Fracture, Ilizarov frame, External Fixator

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INTRODUCTION

The proximal tibia is part of the bone that made up the knee joint and it plays an important role for weight bearing. Any fracture involving the proximal tibia will result in major impact on the knee function and accelerate the progression of osteoarthritis. Tibial plateau fracture accounts for 1% of total fractures and have an incidence of 10.3 in 100,000 annually.(1,2). It is commonly associated with high energy trauma injury which result in significant soft tissue injuries or open fracture thus increase in the risk of developing infection. The type of fixation – implant choice play an important role in determining the outcome of treatment of these fractures. Fixation using internal implants such as non-locking plates or locking plates will requires dissection of the skin and soft tissue for reduction of the fractures and insertion of the implants. In a milder form of tibia plateau fracture such as Schatzker 1 & 2, screw by itself only as an internal fixation can be used but this is not applicable when it comes to higher grade fractures. Conventional external fixator itself is not suitable as it is difficult to achieve compression of the fragments thus it is mainly used as a spanning device to allow soft tissue healing while maintaining the length before an internal implant is used for fixation of the fractures. Ilizarov external fixator (IEF) utilizes olive wires to hold the fractures fragments so that compression and reduction of the fragments can be achieved with the help of the tensioning device. Various authors have reported good clinical outcome when treating tibia plateau fractures by using IEF however no recent local studies have been published (3,4). The objective of this study is to investigate both functional and radiological outcome of tibia plateau fractures treated using IEF in our institution.

CASE SERIES

Cases

A review of tibial plateau fractures cases in our institution admitted between January 2019 to December 2020 has revealed 8 patients whose fractures were treated using Ilizarov external fixator. These patients' injuries were classified accordingly using Gustillo Anderson classification in the presence of open fracture and Schatzker classification for closed fracture respectively (5). Radiographs and CT scans of the knees were done to assess the severity of the fracture to enable preoperative planning fixation of the fractures. For open fractures, initial

debridement was performed by general orthopaedician to remove all the contaminant and non-viable soft tissues before cross knee external fixation were applied for temporary stabilization prior to definitive fixation. Patients with closed fracture were put on backslab and cryocuff were applied to reduce swelling while waiting for operation to avoid compartment syndrome and for easing the process of surgery later on. The definitive treatment - Ilizarov external fixation was done by the Advanced Musculoskeletal team which comprises one consultant and two specialist under our elective operation. Post operation patients were kept in the ward for 1 or 2 days to observe for swelling and to teach the patients dressing of the pin sites. Patients were started on range of motion exercises the day after the surgery. All patients were started on partial weight bearing with the help of crutches or walking frame at 1-month post operation. Patients were referred to the physiotherapist for the quadriceps strengthening, range of motion exercise of the knee and partial weight bearing. However we are unable to standardized the physiotherapy regime as some of the patients had difficulties to come to our centre for physio session. For those that unable to come, we referred them to the nearest centre for their physio follow up. The patients were assessed functionally using Knee Injury and Osteoarthritis Outcome Scores (KOOS) and radiologically using Rasmussen radiological score during the 1st month follow up after removal of the Ilizarov frame (6,7).

Surgical Technique

Operations were performed under general or spinal anaesthesia with the patients in supine position. Indirect reduction of the tibia plateau was attained using olive wire on the medial and lateral plateau which were confirmed intraoperatively with the help of image intensifier. First olive wire inserted either from lateral or medial after ensuring it is parallel to the joint using the distal femur condyle as a guide. After fixation of the wire, it is pulled using the tensioner to reduce the fracture under image intensifier guidance and subsequently tensioned before final lock using the bolt and nut on the Ilizarov ring. The next olive wire was inserted from the opposite condyle and the process of pulling and tensioning were repeated. Additional olive wire inserted reduce any other fracture fragments. The metadiaphyseal part of the tibia fixed using Schanz pins which were locked to the Ilizarov ring after ensuring proper alignment on the anterior, posterior, and lateral view on the image intensifier intraoperatively. Four of the cases need extension of the Ilizarov fixation across the knee as the fractures were comminuted to allow edema to subside and avoid loss of the reduction.

RESULTS

A total of 8 patients with tibia plateau fracture were treated with Ilizarov external fixator. 5 of the patients sustained open fracture while the other 3 of suffered from closed tibial plateau fracture. 6 patients presented with Schatzker 5, while 1 patient each suffered from Schatzker 4 and Schatzker 6 as shown in Table 1.

The duration of surgery ranges from 90 to 120 minutes with minimal blood loss as no dissection of the soft tissues were done in order to reduce the fractures. All patients were discharged well with no complications. One of the patients passed away due to medical cause before the treatment was completed. For those 4 patients with the cross-knee fixation as shown in picture e and f in Figure 1, cross-knee pin and ring were removed during the follow up at 1st month to allow for range of motion of the knee. 5 patients were off the IEF on the 4th month while another 2 patients at 5th month as shown in picture c and d in figure 1. The results we obtained were mean KOOS of 82% and mean Rasmussen radiological score of 14 (Table 1). The functional outcome of each patient was further analysed in terms of symptoms, stiffness, pain, function for daily activities, function for recreational activities and quality of life (Figure 2).

Table 1: Demography, classifications, type of fixations and outcomes

Case	Age	Fracture classification	Fixation	Time on frame	KOOS (%)	Rasmussen Radiological Score (n/18)
1	35	Gustillo-Anderson 3A Schatzker 5	Cross knee IEF	4 months	86%	16
2	47	Schatzker 5	Cross knee IEF	4 months	85%	12
3	33	Schatzker 4	Knee sparing IEF	4 months	91%	16
4	70	Gustillo-Anderson 3A Schatzker 5	Cross knee IEF	4 months	86%	16
5	55	Gustillo-Anderson 3A Schatzker 5	Cross knee IEF	5 months	79%	16
6	47	Gustillo-Anderson 3A Schatzker 6	Knee sparing IEF	5 months	70%	10
7	35	Schatzker 5	Knee sparing IEF	4 months	77%	12
8	52	Gustillo-Anderson 3A Schatzker 5	Cross knee IEF	Deceased	-	-

Figure 1: a,b – representative case of Schatzker 5 fracture, c,d – representative case of cross knee illizarov construct, e,f – representative cases of knee sparing IEF and g,h – representative case of post removal of IEF construct.

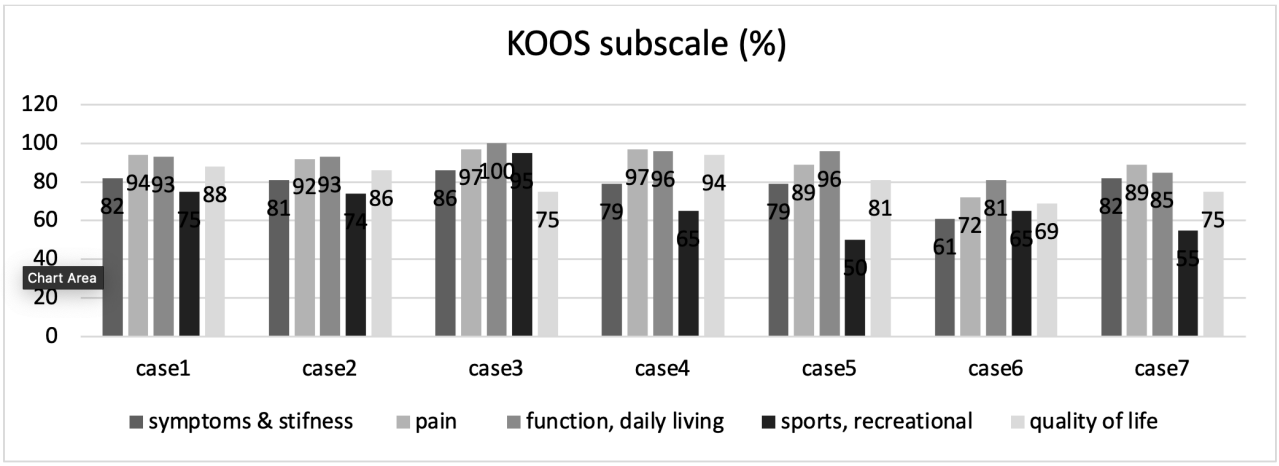

Figure 2: 5 Subscales of KOOS scores for individual cases. Each subscales have multiple questions in it. The outcome of the subscales will be in percentage and finally with all the subscales result , reflects the final result-quality of life in percentage as shown in Table 1.

DISCUSSION

Tibia plateau fracture usually is associated with high energy injury thus, higher-grade tibia plateau fracture such as Schatzker 4,5 and 6 presented with significant soft tissue and commonly presented as an open fracture. This will increase the risk of infection post operation especially when treated with internal implants. Henkelmann et al perform literature review and concluded that those patients with open fractures show a risk of 12.9% developing infection post operatively. In his studies he also mentioned that the risk of infection in tibia plateau fractures post operatively range from 2.6% - 45% (8). Henkelmann also mention in his study that duration of operation and open fracture are independent factors for the risk of infection in tibia plateau fractures post operatively. The notion of longer duration of operation resulting in higher risk of infection post operatively is further enhance with the study by Colman et al where in his study, he mentioned that operative time approaching 3 hours are at higher risk of developing surgical site infection(9). According to Moore and Harvey, as high as 23% of tibia plateau got infected when treated with internal implant (10). Lin et al reported that risk of 7.8% surgical site infection when tibia plateau fractures treated with open reduction and internal fixation (11). IEF show less risk of infection when used to treat tibia plateau fracture as it reduce and fix the fracture indirectly.

Rasmussen radiological score is used for assessment of the radiological outcome as it is reliable and constant with the result. It assesses 3 parameters which are articular depression, condylar widening and valgus or varus deformity(12). Articular depression and condylar widening more than 5mm is considered poor outcome. We are able to achieve articular depression less than 5mm for 5 of our patients while the remaining 2 more than 5mm due to severity of the comminution of fractures. All of our patients have less than 5mm of condylar widening and less than 10 degree of Varus/Valgus angulation. Our outcome of radiological assessment are comparable to other studies using IEF or internal implants(5,6). Mao et al reported there is no difference in the radiological score when assessment was done at 3 months and 12 months (13).

The assessment of the clinical function and radiological

score were perfomed for the patients treated in our Centre using the KOOS score and Rasmussen radiological score. The reason KOOS score chosen as functional score as it is reliable for its consistency, test result reproducibility, age and sex specific responsiveness (7). 6 of the patients show fair functional clinical KOOS score except for one patient which show poor result. However, we found out that for this particular patient despite of poor KOOS score, his Rasmussen radiological score was good. The reason for his low KOOS score was mainly due to poor motivation, social support and poor compliance to physiotherapy. All of our patient unable to achieve full knee flexion which correspond to the study by Arslan A et al. where despite of immediate range of motion after stable internal fixation still unable to achieve full range of motion (6). Similar result was also reported by IR Ranatunga et all treated his patients with tibia plateau fractures using illizarov external fixator (14). This inability to achieve full range of motion most likely due to the soft tissue injury such as meniscus and cruciates ligament injury that hinder the efficient early range of motion post operatively (6). The compliance itself to physio and self-motivation is also very important as early range of motion and weight bearing are really dependent on the patient's own initiative. To further improve the range of motion we would suggest maybe to keep the patient longer in the ward or better still if rehab ward available to train the range of motion and partial weight bearing so that they can gain confidence before they were discharged. This will definitely help with the training of range of motion and weight bearing at home later. KOOS score used for clinical result because of its wide range of scope which include 5 subscales, its test and retest reliability and responsiveness for condition and age subscales. Other type of functional knee score are the knee oxford scores, WOMAC scores and Lysholm scores. The knee oxford scores are specifically used for knee arthroplasty usage. WOMAC score can be used for osteoarthritis, post traumatic osteoarthritis and arthroplasty. WOMAC scores has the widest range of languages version available for usage. KOOS on the other hand has less version of different languages available but it contains the most items - 42 items from 5 subscales which cover wide range of functional assessment. KOOS score can be used for assessment of arthroplasty, post traumatic OA and even post ACL reconstruction (15). WOMAC score can also be derived from KOOS score (7).

Usage of IEF for fixation tibia plateau fracture enable early weight bearing due to the biomechanics of the fixator itself. The tensioned wires enable strong fixation on the cancellous bones and will act as a raft to prevent the subchondral bone from collapsing. The compression of the fragments was maintained by the olive part of the wires Illizarov external fixator allow the force to be evenly distributed upon weight bearing and show great shear stiffness (16). Axial stiffness is the ability to resist gap closure – the space between the bone ends. The low axial stiffness upon axial loading occur due to the tensioned wire which act like a 'trampoline' effect on loading and upon unloading, it returns back to its original straight form. This effect enhances the process of osteogenesis thus help in hasten the process of union (17). It is believed that cyclical axial loading is beneficial for bone healing while translation is deleterious to healing of bone as it will result in fibrous tissue formation (18).

CONCLUSION

This study shows that usage of IEF as an option to treat tibia plateau fracture able to provide a good radiological and functional outcome as it allow early motion and weight bearing and we believe that it can be further improve with the active involvement of the physiotherapist or occupational therapist.

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