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# Complications in Ilizarov Ring Fixation in Schatzker Type VI Tibial Plateau Fracture.

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***Abstract***
***Background:*** *The risk of wound complications following open reduction and internal fixation is notably high owing to extensive soft tissue dissection. Alternatively, application of Ilizarov ring fixator minimizes soft tissue dissection and provides adequate fracture stabilization to allow early range of motion and correction of any mal-alignment. Knowledge of complications in treating with Ilizarov Ring Fixation in Schatzker type VI tibial plateau fracture is helpful in the treatment of such cases.*
***Aim of the study:*** *The aim of this study was to assess thecomplications of the patients in treating with Ilizarov ring fixation in Schatzker type VI tibial plateau fracture.*
***Methods:*** *This prospective interventional study (Clinical trial) was conducted during the period from Jan 2012 to December 2013 in the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka. Ten (10) patients with tibial plateau fracture Schatzker type VI selected for treating with Ilizarov ring fixator were finalized as study population. Patients were visited routinely and final outcome evaluation done according to Rasmussen's functional grading system and radiological evaluation. All the findings were collected and displayed by several tables and figure of MS Office.*
***Result:*** *In total 08 patients (80%) were affected by RTA, 01 patient (10%) by fall from height and 01 patient (10%) from physical assault. In terms of complication, in 02 (20%) of the patient's pin track infection was noticed and in 02 (20%) patients breakage of wire/ wire fixation bolt were occurred. In total 6 (60%) participants were found free from complication. Finally, 03 patients (30%) showed excellent, 05 patients (50%) showed good and 02 patient (20%) showed fair result.*
***Conclusion:*** *In this study, using Ilizarov ring fixation in Schatzker Type VI tibial plateau fracture we found very limited complications. Though there were some complications with the fixator the ability of this stable frame provided good union without any second surgical procedure or bone grafting and prevented any mal-union.*
***Keywords:****Complication, Ilizarov ring fixation, Schatzker, Tibial plateau fracture.*

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## I. Introduction

The risk of wound complications following open reduction and internal fixation is notably high owing to extensive soft tissue dissection. Alternatively, application of Ilizarov ring fixator minimizes soft tissue dissection and provides adequate fracture stabilization to allow early range of motion and correction of any mal-alignment. Knowledge of complications in treating with Ilizarov Ring Fixation in Schatzker type VI tibial plateau fracture is helpful in the treatment of such cases.Tibial plateau fracture is an intra-articular complex fracture. These fractures can be caused by motor vehicle accidents or bumper strike injuries; however, sports injuries, falls, and other less violent trauma frequently produce them, especially in elderly patients with osteopenia. The mechanism of injury is based on the presence of an initial axial load, which fractures the tibial articular surface resulting in impaction. In most of the cases the initial load is combined with angular forces, leading to comminution not only of the articular surface, but of the metaphysis as well. The medial compartment is split in a medio-lateral direction with a postero-medial main fragment, combined with

various amounts of multi-fragmental lateral compartment depression. Schatzker et al[1] described a systematic classification of six types of tibial plateau fractures that was based on anteroposterior tibial plateau radiographs. These six types include pure cleavage of lateral plateau as Type I, cleavage combined with depression as Type II, pure central depression as Type III, isolated fracture of the medial tibial plateau as Type IV,bi-condylar fracture as Type V andbi-condylar fracture associated with transverse or oblique fracture through metaphysis as Type VI. Schatzker type VI tibial plateau fracture truly encompassed transverse or oblique fractures of the proximal third of the tibia with a fracture of one or both tibial condyles and articular surfaces and a dissociation of the metaphysis and diaphysis regions[2]. Agnew et al[3] reported in his study that out of 2440 reported tibial plateau fractures there were only reported 41 cases of Schatzker type VI fractures. The rarity of this type of fracture has caused very limited documentation of the treatment. Most of the papers published have advocated operative intervention[4]. Schatzker type VI tibial plateau fractures are caused by considerable high energy trauma. This traumatic force not only causes severe bony comminution but also considerable soft tissue injury. Watson et al.[5] described these high energy injuries as those which cause significant articular depression, condylar displacement, meta-diaphyseal fracture extension with open wounds or extensive closed degloving injuries of the proximal tibia. Complications include severe soft tissue compromise requiring coverage procedures, lower limb compartment syndrome, peroneal nerve injury, vascular injury and eventual knee arthrosis[6]. If the soft tissue injuries are not adequately treated, amputation may be necessary in the end. Associated injuries include ipsilateral femoral and tibial diaphyseal fractures, cruciate and collateral ligament injuries and meniscal tears[7]. All these complications directly impact surgical treatment and finally long term outcomes. The goals of treatment are anatomical reconstruction of the articular surface, restoration of the limb axis, fixation spanning the metaphyseal comminution and further minimization of morbidity to an already traumatized soft tissue envelope[8]. These objectives can be achieved with internal fixation, bridge plating, of percutaneous screws with casting, external fixators with or without limited open and bone grafting or a combination of these methods. Treatment difficulty is further compounded by problem of choosing the stabilization option to provide a stable fixation of a commonly comminuted fracture. The most popular treatment has been open reduction and internal fixation with double plating[5,9], but this is associated with many complications such as joint stiffness, mal-union, skin loss, osteomyelitis, amputation and even death[10]. The incidence has been as high as 50% in some studies[11] and the occurrence of post-operative skin infection and osteomyelitis has been reported as 42% and 33%, respectively[12]. To reduce the incidence of such problems minimal internal-external fixation through limited approaches has been attempted with some good results[13] and an alternative method was proposed by Ilizarov[14]. Minimally invasive techniques using periarticular fine wires allow rigid fixation of small pieces of cancellous bone and intra-articular fractures, easy wound surveillance, early joint mobilization and weight bearing, and minimal soft tissue disruption[15].The aim of this study was to assess the complications of the patients in treating with Ilizarov ring fixation in Schatzker type VI tibial plateau fracture. All the parts of intervention had been executed to fulfil the objectives of this study.

## II. Objectives

**General Objective**:

To assess the complications of the patients in treating with Ilizarov ring fixation in Schatzker type VI tibial plateau fracture.

**Specific Objective:**

To determine time of union and functional outcome among the participants.

To find out the post-operative complications among the participants.

## III. Methodology & Materials

This prospective interventional study was conducted during the period from Jan 2012 to December 2013 at National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka. Ten (10) patients with tibial plateau fracture Schatzker type VI selected for treating with Ilizarov ring fixator were finalized as study population. Patients were visited routinely and final outcome evaluation done according to Rasmussen's functional grading system and radiological evaluation. In this study, purposive sampling was followed considering the inclusion and exclusion criteria. Informed written consent was taken from the patient and patient's guardian after duly informing the procedure of treatment, anticipated result, possible advantages, disadvantages and complications considering all ethical issues. Protocol was approved by ethical committee of National Institute of Traumatology & Orthopedic Rehabilitation, Dhaka. According to the inclusion criteria patients with Schatzker type VI tibial plateau fracture,patients above 18 years of age who are mentally fit and physically alert presented within two weeks of injury were selected. On the other hand, according to the exclusion criteria patients with other Schatzker type of tibial plateau fracture, cases with pathological fracture, patients with neurovascular injuries, patients below 18 years and poly trauma patients were excluded from the study. Surgery was with detailed preoperative x-ray analysis and in some cases with analysis of CT scan with

3D reconstruction images. For every patient a full length AP and LAT x-ray including knee and ankle was taken. Ilizarov ring was used from local manufacturer and ring size is measured by ring template. As investigations anesthetic fitness, TC, DC, ESR, Hb%, RBS, serum creatinine, urine RME, ECG and Chest X-ray P/A view tests were completed for all the participants. Injection ceftriaxone 1gm was administered intravenously in operation theatre to every patient. The patients were allowed to start range of movement exercises of the knee and ankle joint on the 1st post-operative day, and allowed to walk without bearing weight on the affected limb with crutches. Most patients were discharged after three to four days. Follow up were done at OPD and also in Ilizarov clinic of NITOR at monthly interval up to complete fracture healing. Wound condition, pin tract infection, fracture alignment, bone infection, proximal and distal joint mobility were assessed and recorded. Final evaluation was done according to Rasmussen Functional Grading Criteria. Fixators were planned to be removed after radiological evidence of healing of the fractures and when patient could walk without any support and without any pain with full weight bearing on the affected limb with fixator. The fixators were dynamited by loosening the connecting rods and patient were advised to bear full weight and come back after two weeks. If there was no pain or any complaints then fixator were removed. Rehabilitation is started soon after fixation of frame. Movements of the joints and gradual increase of weight bearing was started soon after fixation. Patients were encouraged to go outside and to perform sedentary works and attend social functions. Fracture healing (RUST), union time, complications and final outcome were considered as the major variables in this study. Data were collected with containing history, clinical examination, laboratory investigations, pre-operative, peri-operative, post-operative complications and postoperative follow-up findings. Data sheet was formulated to evaluate the final outcome according Rasmussen Functional Grading Criteria for this study.After enrolment of the patients the data were collected.Data were collected and tabulated according to key variables. Data were analyzed. Post-operative evaluation criteria followed to assess functional outcome as well as merits and demerits. Data were processed and analyzed. Qualitative data had been expressed as frequency and corresponding percentage, while the quantitative data as mean and range. Post-operative final outcome was evaluated. All the findings were collected and displayed by several tables and figure of MS Office.

## IV. Result

In this study 50% of the respondents belonged to 31-40 years of age, followed by 30% belonged to 21-30 years of age and the rest 10% belonged to 41-50 years of age. The mean (±SD) age was found 36.6±8.63 years. The lowest and the highest ages were 25 and 55 years respectively. All of the patients were male. Out of 10 patients, 3 patients were service holder which includes 30% and 2 were day laborer which was 20% among the total participants. Besides these, as student, teacher, farmer, businessman and policeman were found single participant. In this study, out of 10 patients, 08 patients (80%) were affected by RTA, 01 patient (10%) by fall from height and 01 patient (10%) from physical assault. On the other hand, out of 10 patients, 06 patients (60%) were affected by right side and 04 patients (40%) by left side. The mean hospital stay was 11 days with SD±4.43; the lowest and the highest stay were 6 and 16 days respectively. The mean union time of fracture was 97.6 days and the lowest and the highest time were 78 and 132 days respectively. In terms of complication, in 02 (20%) of the patients pin track infection was noticed and in 02 (20%) patients breakage of wire/ wire fixation bolt were occurred. The individual cortical scores (anterior, posterior, medial, and lateral) are added to provide an overall RUST value ranging from 4 to 12 for a set of radiographs. Out of 10 cases, 6 cases (60%) showed presence of callus & invisible fracture line and 4 cases (40%) showed presence of callus but visible fracture line. Mal-union or non-union was not found. In this study the mean ROM (Range of motion) was found $95.5^0$ and the lowest and the highest ROM were $65^0$ and $115^0$ respectively. In this current study, in analyzing the final clinical outcome of the participants we observed, out of 10 patients, 03 patients (30%) showed excellent, 05 patients (50%) showed good and 02 patient (20%) showed fair result. That is why satisfactory (Excellent and Good) result was fond in 80% and unsatisfactory (Fair and Poor) result was found in 20% participants.

**Table I:** Age distribution of participants (n=10)

| Age (Years) | n | % | Mean± SD |
|---|---|---|---|
| **21-30** | 3 | 30 | **36.6±8.63** |
| **31-40** | 5 | 50 | |
| **41-50** | 1 | 10 | |
| **51-60** | 1 | 10 | |
| **Total** | 10 | 100 | |

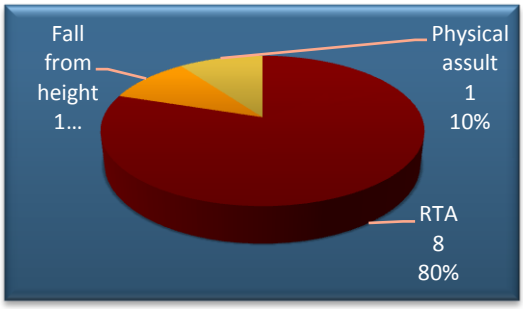


**Figure I:** Distribution of mechanism of injury among participants (n=10)

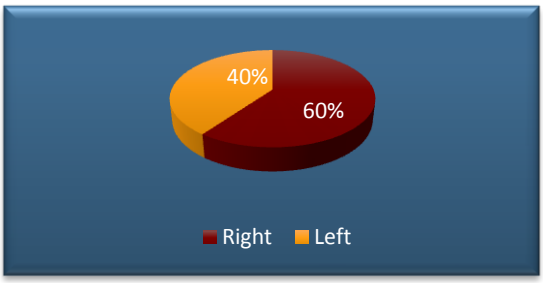


**Figure II:** Distribution of side of injury among participants (n=10)

**Table II:**Hospital staying of the participants (n=10)

| Duration | n | % | Mean± SD |
|---|---|---|---|
| **≤1 week** | 3 | 30 | **11±4.43** |
| **≤2 weeks** | 4 | 40 | |
| **≤ 3 weeks** | **3** | **30** | |
| **Total** | 10 | 100 | |

**Table III:** Distribution of union times amongthe participants (n=10)

| Union time (days) | n | % |
|---|---|---|
| **76-90** | 5 | **50** |
| **91-105** | 2 | **20** |
| **106-120** | 2 | **20** |
| **121-135** | 1 | **10** |
| **Total** | **10** | **100** |

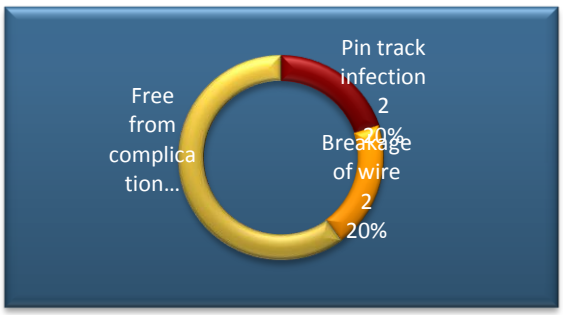


**Figure III:** Distribution of complications among participants (n=10)


**Figure IV:** Distribution of clinical outcome among participants (n=10)

## V. Discussion

The aim of this study was to assess the complications of the patients in treating with Ilizarov ring fixation in Schatzker type VI tibial plateau fracture.Tibial plateau Schatzker type VI energy fractures, caused by high energy trauma, inflict extensive damage to the bone and more injury to the soft tissue. Early problems in management of this high energy complex fracture include fracture instability and inability to internally fixate to address the stability when open reduction is attempted. Postoperative complications include infection, wound dehiscence and wound healing problems[16]. Long term complication includes secondary knee osteoarthritis, loss of reduction, collapse of articular fragments, mal-union and nonunion[17]. Dissociation of the metaphysis from the diaphysis does not allow for conservative treatment with traction. It has been shown that long term immobilization can cause decreased function of the knee joint[18]. We had 10 patients, all of them are male. Mean age was 36.6 years; age range was 25-55 years. Majority of the patients (50%) were from age 31 to 40 years. Kataria H et al[19] had study over 38 patients, age ranges were between 21 and 60 years (Mean 32 years) which is comparable with present study. Among the patients, 30% were service holder, 20% day laborer; student, teacher, businessman, farmer and policeman were 10% each. Right side involvement was 60% and left side involvement was 40%. The cause of injury was RTA 80%, accidental fall in 10% and physical assault 10% cases. In our study, 40% patient stayed in hospital after admission less than 2 weeks. Mean hospital stay was 11±4.43days.Ranatunga& Thirumal[2] investigated of 18 patients with tibial plateau fractures Schatzker type VI, where mean union time was recorded at 3.72 months.Dendrinos GK[10]treated 24 patients with high-energy fractures of the tibial plateau by the Ilizarov fixator and transfixion wires. All the fractures united, with an average time to healing of 14.4 weeks. In our study mean union time was recorded at 3.26 months (14 weeks); with highest time 19 and lowest 11 weeks.Treatment of high-energy tibial plateau fractures remains controversial. Traction and cast bracing provides poor results[20].Open reduction and internal fixation with double plating requires large amounts of soft tissue mobilization and stripping to achieve satisfactory results. This devitalizes soft tissue and hinders wound healing. A 23% infection rate was reported with dual plating of bicondylar fractures[16].An 87.5% deep infection rate and 100% complication rate were reported with dual plating for comminuted or bicondylar fractures[21]. Kataria[19] treated 22 type-VI and 16 type-V Schatzker tibial plateau fractures. Complications consisted of: 2 superficial infections, 3 pin site infections, and 4 peroneal nerve palsies. In this study, complications included minor pin tract infections two cases (case no.1 and 8) and hardware problems in two cases (Breakage of wire- case no.3 and Breakage of wire fixation bolt- case no.5); which was managed by simple measure like antibiotic and realignment. No case of nerve injury is encountered.Pin tract infection is a potential problem despite the use of small wires. To avoid the disastrous complication of septic arthritis, we recommend placing wires at least 15 mm away from the joint surface, monitoring the status of pin sites (especially at juxta-articular locations) and removing any pin revealing features of infection. When surgery is performed early, anatomical reduction and ligamentotaxis are more easily achieved, with the extent of open surgery minimized. Small wire external fixation is the only viable option for early surgery, whenever severe soft tissue injuries are present. In cases of delay, patients must be maintained in calcaneal or tibial pin traction to avoid additional trauma and reduce swelling and soft tissue compromise[19].Adequacy of reduction is the most important factor to predict outcome. Intra-articular comminution with depression is difficult to treat; even if accurate anatomical reduction is obtained, late collapse and deformity on weight bearing precludes good functional results[22].We have shown in the present study that despite extensive articular comminution satisfactory functional results can be achieved with the Ilizarov frame. Reduction of intraarticular fragments is confirmed indirectly by the image intensifier. Opponents of this technique may argue that congruous reduction can only be confirmed by open reduction, but even with open reduction one requires imaging to confirm congruous reduction. Ranatunga[2]performed a retrospective

review of 18 patients with tibial plateau fractures Schatzker type VI. Mean flexion of the affected knee joint was 85° at final follow up at one year post trauma. According to Ali et al[23], flexion of less than 60° is incompatible with normal gait. In the current study, the mean flexion of the affected knee joint was 95.5° at final follow up; with a range of $65^0$ -$115^0$ . Most of the patients were able to walk and achieved functional knee flexion which allowed them to go back to their original occupation. Kataria[19] treated 22 type-VI and 16 type-V Schatzker tibial plateau fractures. The mean Rasmusssen functional score was 26 (range, 17–30): excellent in 19 patients, good in 17, and fair in 2. In our study, the mean Rasmusssen functional score was 23.6 (range, 16–28): excellent in 3 patients, good in 5, and fair in 2.Regarding final outcome, out of 10 patients, 8 (80%) had satisfactory (excellent and good), 2 (20%) had unsatisfactory (fair and poor) outcome. It was quite acceptable outcome. We enjoyed a short learning curve on the use of these frames. Results improved with experience, careful preoperative planning, and thorough knowledge of neurovascular anatomy. Good intraoperative radiographs are needed to decrease the incidence of mal-reduction while learning. Among the drawbacks of the Ilizarov technique are the risk of losing full range of movement of the knee joint and the visually less appealing and cumbersome ring external fixator. In addition, it is also a very demanding technique with a steep learning curve, requiring specialized training and experience.

***Limitations of the study***

This study has several limitations. The study sample was small (10), duration of study was one and a half year and there was lack of adequate facilities, difficulties in follow up. The sample size was too low to generalize the findings of the present study to reference population. As this was a single centered study with a small sized sample, the findings of this study may not reflect the exact scenario of the whole country.

## VI. Conclusion and Recommendations

In this study, using Ilizarov ring fixation in Schatzker Type VI tibial plateau fracture found very limited complications. Though there were some complications with the fixator the ability of this stable frame provided good union without any second surgical procedure or bone grafting and prevented any mal-union. Basically the results of tibial plateau fracture Schatzker type VI by Ilizarov Ring Fixator has been found to be satisfactory. Large scale studies with longer follow-up are essential requirement for an optimum outcome comparison and for the assessment of complications. Though the study was very small which may not represent the whole scenario but the results of the study can be utilized for future large study. For getting more specific findings we would like to recommend for conducting more studies regarding the same issue with larger sized sample.

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