Functional outcome of tibial plateau fractures treated with locking compression plates

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Abstract

Introduction and Objectives: Tibial plateau fractures are one of the most common fractures around the knee joint and cases are increasing due to high number of vehicular accidents. Because of the involvement of the knee joint, restoration of articular congruity is of prime importance since knee joint is main weight bearing joint of the body. The new generation locking plates have an edge over regular buttress plates by overcoming few of the limitations of these plates. Locking plates can be used in a biological fixation manner, there by promoting secondary bone healing and faster healing also.

Materials and Methods: A total of sixty three patients with tibial plateau fractures were included in the study who were operated between June 2014 to June 2017. Out of the sixty three patients, forty eight patients were operated using conventional open reduction method and fixed with locking compression plate, whereas fifteen patients under went internal fixation by minimally invasive technique.

Results: All patients were followed up till complete union of the fracture. Average follow up period ranged from 16 to 24 weeks. All the fractures went for union in an average period of 18 weeks and the time for union ranged from 16 to 24 weeks. Those patients in whom fracture was fixed in a biological manner using minimally invasive technique went in for early union compared to patients treated by open reduction techniques. We used oxford criteria for the evaluation of clinical results. We had excellent results in thirty three, good results in twenty one patients, fair results in six patients and poor results in a total of three cases. We had 6 patients with knee joint stiffness, 3 infections, 3 with varus deformity and 3 cases of knee instability. There were no cases of implant failure or implant related complication in our case series.

Conclusion: Majority of the tibial plateau fractures in our series were a result of road traffic accidents. In patients whom fractures were fixed by minimally invasive technique fracture went in for early union when compared to fractures treated by open reduction technique. The advent of locking compression plates have brought in a lot of advantage over conventional plating systems in that the operative time is less, blood supply to fracture is preserved and soft tissue is preserved. However, a long learning curve and technical skills are required for doing locking plate fixations.

Keywords: Locking compression plate, Tibial plateau fractures, Interal fixator, Bridge plating.

Introduction

Most of the weight transmission of the body is through the knee joints. Tibial plateau fractures being intra articular fractures significantly alter the anatomy of the knee joint and as a result deformities occur and early arthitic changes occur and increased morbidity due to changes in load transmission. Most of the tibial plateau fractures occur as a result of vehicular accidents[1] and fall from heights producing high axial loads with associated varus or valgus forces and indirect shearing type of injuries.[2] The principal of surgical treatment in tibial plateau fractures is to recreate the lost articular anatomy as much as possible and start early mobilization, also bringback the normal mechanical axis and ligammentous stability.[3] Conventional plates are rigid and cause thinning and atrophy of the underlying bone and also secondray displacements can occur due to improper fixations and incidences of refractures is also common due to thinning of the bone.[4] Time for union of the fracture may also be longer and can go for non union also due to stripping of the periosteum and soft tissue trauma resulting in hampered blood supply to underlying bones. After the advent of locking compression plates which are technically more superior to conventional plating systems, fixations have been more stable and more useful in comminuted and complicated cases and in osteoporotic fractures.[5,6] We have conducted a prospective study on the use of locking compression plating system in the tibial plateau fractures. Objectives of our study were to analyze the functional outcome, time duartion to union and complications following the use of locking compression plating system in the tibial fractures.

Materials and Methods

The study was conducted in a BGS Global institute of Medical Siences from June 2014 to June 2017 for a period of 3 years in a prospective manner. Total number of patients included in the study was 66, out of which 3 patients lost to follow-up and were excluded from the study. So a final tally of 63 patients were included for the study.

Tibial plateau fractures of Schatzker`s[7] type IV to type VI with age above 18 years were included in the study. Patients who were of above the age of eighteen years and Gustilo and Anderson compound type 3 fractures were not included for the study. Patients who

dint turned up for follow up were not included for the final study. After admitting, patients were evaluated for any other fractures elsewhere and also for any other medical co morbidites. After x rays were taken, fracture was classified according to Schatzker classification system and surgery was planned accordingly. Where ever required Computed tomographic scans were obtained whenever articular involvement was there. Temporary immobilization was done with plaster of paris whenever the surgery was delayed. After thorough pre op evaluation, patients were taken up for surgery. Open fractures were admitted immediately and taken up foe surgery within 3 to 4 hours of admission. They were debrided immediately and definitive internal fixation was done. Multiple surgeons belonging to different units of the institute have performed the surgeries. The time interval between injury and time of surgery varied from several hours to twelve days. Patients who had huge swelling and impending compartment syndrome were given strict limb elevation and were waited for surgery till the subsidence of swelling. Those patients who had compartment syndrome were treated with fasciotomy and external fixator application and were excluded from the study.

Operative technique

All the surgeries were done with patient in supine position under the C -arm guidance. Multiple surgeons belonging to different units of the Institute perfomed the surgeries.The approach was either anteromedial parapatellar or anterolateral parapatellar incision in cases where minimally invasive surgeries were performed. In patients, who required open reduction, anterior midline approach was performed. Schatzker type IV fractures were fixed with a single anatomical proximal locking compression plate for tibia. For type V and type VI fractures dual plating was performed, either using a midline or two separate minimal incisions on anteromedial and anterolateral aspects. In locking compression plating system, screw head gets locked in the threads in the screw holes of the plate. Direction of the drilling should be guided by the drill sleeves and it should not change.

Post operative protocol

Whenever stable internal fixation was achieved, the patient was mobilized after 48 once the operative pains subsided. Static quadriceps and knee range of motion exercises were satrted with Continuos Passive Motion and knee flexion was gradually increased to 90^0. Before suture removal full range of movement was achieved in as many patients as possible. All patients were asked to come for follow up at 6^{th}, 12^{th} and 20^{th} week and x rays were taken and assessed clinically for union and any deformites. Patients were followed up routiney every three months until the union. At each follow up, patients were assessed for knee range of motion, fracture union by clinical and radiological methods. A minimum follow up of 6 months and a maximum follow up of 24 months was done.

Method of evaluation

Oxford knee score criteria[8] was used to analyze the results of our study. When the patints came for follow up. They were questioned about the amount of knee pain, distance they can walk without any pain, difficulty in squatting, difficulty in getting up, any limp while walking, any pain during the night times, whether they can do household activities, daily rotine work and community ambulation is possible or not. Patients were also questioned about instability of the knee during walking. They were also questioned regarding any giving way of the knee. After scoring grading was done as excellent (40-48), good (30-39), moderate(20-29) and poor (0-19).

Results and analysis

A total of 63 patients were included in the study after 3 patients who lost to follw up were excluded. A total of thirty three patients out of the sixty three patients were of the age group of 31 to 50 years.(Table 1). Our study comprised prdominantly of males, that is because majority of working population in Indian set up are males. Among sixty three patients, fifty one patients (81%) were males and remaining twelve were female patients(19%). Road traffic accidents were the most common cause for majority of the fractures. Right sided fractures were more common, with a total of thirty six patients having right side fractures and remaining twenty seven patients had sustained left side fractures. When the cases were categorized as per Schatzker clssification system, most of the cases in our series fell into type IV, V and VI types, which are generally a result of high energy injuries(Table 2).

Open reduction and internal fixation was performed in 48 cases and 15 cases were operated by minimally invasive plate fixation techniques. The duration of surgical procedure and amount of soft tissue damage in minimally invasive technique is less when compared to that in open reduction surgeries. Healing of the tissues also occurs in a rapid rate in minimally invasive surgeries. However more surgical expertise and technical skills are required for the minimally invasive surgeries and also a long learning curve is needed for these kind of surgeries. In twelve patients, locking compression plate was used in a compression mode, in twenty one patients it was used in a bridging fashion whenever severe comminution was noted in the metaphyseal region. In thirty of the sixty three patients both compresssion and bridging method of fixation were used.

In thirty three patients, anteromedial approach was used whenever there was medial condyle was displaced and minimally invasive techniques were used. This approach had an advantage in that, soft tissue stripping was less. In patients with, lateral condyle fragments, a

total of thirty patients anterolateral approach was used. There were no cases of implant failures such as breaking of screws, breaking of plates in our case series. Fractures went in for union at an average of eighteen weeks with a range of 16 to 24 weeks.

Three patients with knee joint stiffness is due to associated ipsilateral intercondylar fracture of femur. Another three patients with knee joint stiffness is due to lack of postoperative mobilization.

Three patients with knee instability due to associated anterior cruciate ligament injury.

Three patients developed deep infection of operative site were plate removed and treated with antibiotic and above knee pop cast applied later, fracture united at 24 weeks. Three patients developed varus deformity due to collapse of medial condyle post operatively. (Table 3). We used oxford criteria for the evaluation of clinical results. Among the sixty three cases in the series, there were thirty three excellent, twenty one patients had good, six patients had fair and three patients had poor outcomes (Table 4).

Table 1: Age distribution

Age group (in years)	Number of patients	Percentage
18-20	9	14.3
21-30	9	14.3
31-40	18	28.6
41-50	15	23.8
51-60	9	14.3
Above 60	3	4.7
Total	63	100

Table 2: Type of fracture and percentage of cases: Schatzker's classification

Type of fracture	Number of patients	Percentage
Type I	9	14.29
Type II	-	
Type III	-	
Type IV	18	28.57
Type V	15	23.80
Type VI	21	33.34
Total	63	100

Table 3: Complications

Complication	Number of patients
Knee joint stiffness	06
Post opeartive loss of reduction	03
Infection	03
Varus deformity	03
Knee instablity	03
Total	18

Table 4: Clinical results

Clinical result	Number of cases	Percentage
Excellent	33	52.38
Good	21	33.33
Fair	06	9.53
Poor	03	4.76
Total	63	100

Table 5: Comparison of different study series in functional outcome

Rambold[10] 1992	93% acceptable
Seppo E 1993	85% satisfactory
Joseph Schatzkar[11] 1986	85% satisfactory
Our study 2008	85% satisfactory

Discussion

Tibial plateau fractures are one of the most common intra articular fractures and involve the most important weight bearing joint of the body. Tibial plateau fractures are increasing everyday due to ever increasing accident rates. There is change in the treatment plans for the tibial plateau fractures with the evolution of newer treatment plans and newer implants. Being a major weight bearing fracture of the body, management of these tibial plateau fractures is of prime importance, since it results in significant disability and alters quality of life. To overcome this difficulties and to early restoration of strength of bone and function of knee joint with minimal injury to soft tissue the innovators developed new technologies of minimally invaive techniques and developmemt of locking plates.

We studied the functional outcome in a total of sixty three patients treated surgically with locking compression plates. Patients were analyzed in parameters of age and sex, side of the fracture, Schatzker type of fracture, type of surgery and fixation, approach for surgery and complications following surgery.

Most of the fractures occured between the age group of 18 to 65 years. Fifty two percent of the cases

involved 31-50 years of age group. In a case series studied by Boune et al, majority of the patients belonged to the age group of 15 to 55 years. A study by Seppo et al also correlated well with our study with majority of the patients belonging to age group of 20 to 60 years.

In this series we studied 63 cases. Out of them most of the patients fall into type IV, type V and type VI Schatzker's classification. Different authors use different criteria for the surgical management of these fractures. Seppo E. Honkonen[9] conducted 130 tibial plateau fractures taking into consideration of

1. Condylar widening of > 5mm
2. Lateral condyle step off > 3mm
3. All medial condylar fracture

In our series the indications for the surgery were the same standard indications as for the tibial plateau fractures. 3mm depression was considered as an indications for surgery in our series.

In our series we used minimally invasive technique for reduction and fixation in 15 patients (23%), in which both duration of procedure and soft tissue injuries are less compare to open reduction technique, wound healing also better and faster compare to open reduction technique but it demands more surgical techniques.

In our series we used combined principle of fixation in 30 patients (47.6%) and achieved good articular reconstruction and protection from collapsing during post operative period. We used bridging type of principle of fixation in 21 patients (33.33%) in metapyseal comminution fractures and osteoporotic patient where bone graft was needed we have not done bone graft in these patient as LCP implant system provide good fixation and prevent collapse of fracture during postoperative period. We used compression type principle of fixation in 12 patients (19.04%) where both rigid fixation and buttress effect were needed, but postoperatively due to toggling of condylar screws (non locking screws) there was an collapse of condyle in two patients.

In our series we approached with antero medial incision in 33 patients this approach need less soft tissue stripping from bone can contour plate to bone appropriately and easy to perform minimally invasive technique and we preferred antero lateral approach in 30 patients with lateral condylar displacement fracture and soft tissue injury on medial side of proximal tibia.

The period of immobilization was again individualized depending on the security of stable fixation. The benefits of early knee motion include reduce of knee stiffness and improved cartilage healing (regeneration) and promote good callus formation and remodeling.

We are able to achieve 52.38% excellent result and 33.33% good result (overall 85.7%, acceptable results) with our standard surgical care. In addition we have 9.5% fair and 4.7% poor results in term of functional outcome. These results are comparable and on par with other documented standard studies. (Table 5)

Conclusion

We conclude that the locking compression plate system with its various type of fixation act as an good biological fixation including difficult fracture situations, especially for Schatzker`s type IV, V and VI fractures. But this also involve the risk that may occur unless properly planned preoperatively and follow guided principles intraoperatively.

Conflicts of interest: None

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