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Original Research Article

Management of Tibial Plateau Fractures by Minimal Invasive Surgical Procedures – A clinical study

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Abstract: Recently minimally invasive procedures are now gaining popularity in orthopaedic surgeries as they limits soft tissue infection at fracture site and have fewer complications. These procedures reduce morbidity and avoid many of the complications of both conservative and operative treatment and can have faster rehabilitation. The present prospective study was carried out in Department of Orthopaedics, Deendayal Upadhyaya Hospital, and New Delhi between October 2007 to June 2010. The study included 33 patients of tibial plateau fracture. Relevant clinical history was taken and comprehensive physical examination with local examination was done. A thorough radiological evaluation was done by taking X -ray knee including leg AP view, Lateral view, Oblique view (Internal and External), Tibial plateau view (10-15 degree caudally tilted) and Traction view. SCHATZKER‟S classification was used to classify tibial plateau fracture. The patients were treated by pre-operative skeletal traction and minimal soft tissue dissection using minimally invasive methods. Implants used were buttress plates and screws, cancellous cannulated partially threaded screws and Arbeitsgemeinschaft für Osteo synthesefragen (AO) tubular external fixators. Finally, the plate was slide extra periosteally through a very short incision. In results the most common fracture in our series was Schatzker‟s type II fracture (nine patients) followed by type VI (eight patients) followed by type V (six patients).Age range was between 24 to 61 years with majority of patients in 26 to 35 years of age group. All cases with type I and type IV fractures had excellent results. Seven cases (78%) of type II fractures had excellent results and rest 2 cases (22%) had good result. One case of both type V and type VI fracture had fair result. Only one case (3%) in our series of Type VI fracture had poor result. The overall functional end results in the follow up were 66.7% excellent, 23.3% good, 6.7% fair and 3.3% poor. In conclusion the Minimal invasive surgery for tibial pleateau fractures was associated with high rate of success across all categories of Schatzker‟s type fracture. An acceptable functional end result was obtained in 96% of the patients.
Keywords: Tibia Fracture; Less invasive; Minimally Invasive Surgery; Schatzker‟S Type Fracture.

INTRODUCTION

Fractures involving the proximal tibia affect knee function and stability [1]. These fractures can be either intra-articular (plateau) or extra-articular (proximal fourth). Fractures of tibial plateau represent only 1% to 2% of all fractures but account for approximately 8% of fractures occurring in elderly [2]. Articular fractures of proximal end of tibia not only involve the articular cartilage itself but can also involve the epiphysis, the metaphysic and in more severe injuries diaphysis as well. These fractures can be quite challenging to manage as they are notoriously difficult to reduce, align and stabilize, have skin and soft tissue involvement and are prone to develop wound complications and infections.

Recently minimally invasive procedures are gaining popularity in orthopaedic surgeries as it limits soft tissue infection at fracture site and has fewer complications [1]. Minimally invasive surgery has been advocated for both low-energy and high-energy fractures [2]. These procedures reduce morbidity and avoid many of the complications of both conservative and operative treatment and can have faster rehabilitation.[3] Minimally invasive procedures commonly used includes percutaneous plating with

minimal skin and soft tissue dissection, percutaneous screws and external fixators.

MATERIALS AND METHODS

The present prospective study was carried out in Department of Orthopaedics, Deendayal Upadhyaya Hospital, and New Delhi between October 2007 to June 2010. The study included 33 patients of tibial plateau fractures. Three patients were excluded from final analysis because they were lost in follow up. The remaining 30 patients were included in the study. Relevant clinical history was taken and comprehensive physical examination with local examination was done. A thorough radiological evaluation was done by taking X -ray Knee including leg AP view, Lateral view, Oblique view (Internal and External), Tibial plateau view (10-15 degree caudally tilted), Traction view. CT scan with Saggital reconstruction was done in case of articular disruption in patients who could afford. SCHATZKER‟S classification was used to classify tibial plateau fracture.

Preoperative evaluation:

Preoperative evaluation and pre-anaesthetic check-up was done. In the time-period between the time of admission of the patient in the hospital to the time of operation, patient was kept on lower tibial pin traction on Bohler Braun (BB) splint or pillow. This helped in reduction of fracture by ligamentotaxis and also helped in soft tissue healing.

Patient positioning:

Patients were positioned supine and tourniquet was applied. Image intensifier was positioned properly and fracture site was visualized in AP and Lateral view.

Application of Schanz pin and femoral distractor:

One Schanz pin was inserted into femoral condyle and another Schanz pin was inserted into mid tibial shaft 10-15cm distal to fracture site, and through which femoral distractor was applied and knee joint distracted. It helped in reduction by ligamentotaxis.

Reduction of fracture was done through 2 Kirschner wires used as joy stick:

Fracture was reduced using Kirschner wire in the split fragment as a joy stick. Split fragment was elevated and reduced under image guidance, and after maintaining the articular surface of tibia, fragments were held in that position using another Kirshner wire through which the cancellous cannulated screw was inserted. Fractures with depression were reduced by elevation of the depression by making cortical window on tibial metaphyseal region opposite to the fracture site. From that window depressed surface was elevated using bone tamps and punches and fixed temporarily with multiple Kirschner wires. Following articular surface elevation the void left by impacted cancellous bone was filled with autogenous bone graft. Depending upon the fracture geometry, type of fracture, skin condition, soft tissue status, implants were chosen. In less displaced, less depressed and stable fractures multiple partially threaded cannulated cancellous screws were used. In other fractures, buttress plates were used with or without addition of cancellous screw. The recently introduced (Less Invasive Stabilization System) LISS and locking plates could not be used in most of the cases.

Method of cancellous cannulated screw insertion:

A cannulated 4.5mm drill-bit to drill over Kirschner wire was used. After drilling proper size of screw was assessed using C-arm. Similarly more screws were inserted after getting proper reduction of articular surface.

Method of plating:

After getting proper reduction, the reduction was held using Kirschner wires. Proper sizes of implants were selected according to fracture anatomy. Implant was moulded according to surface of bone. A small longitudinal skin incision 3-4cm was given on the fracture site in metaphyseal region 1 cm below the joint line. A plane was created and implant was inserted through the incision extraperiosteally, and secured to bone using Kirschner wires under image guidance. Then drilling was done through stab incision in skin, guided by same size of another implant. Then plate was fixed to bone with screws and checked under image. Skin incision and insertion of plate was done through the incision. The wound was then thoroughly washed and closed in layers. Femoral distractor was removed and external fixator was applied.

Post-operative regimen:

The postoperative regimen on day one included active isometric quadriceps, hamstring, ankle and toe exercises. Post-operative AP and Lateral X - rays were taken. Limb was kept elevated on pillow. On the 4th post-operative day dressing was done and non-weight bearing ambulation was started and the patient was discharged from hospital with the advice to do physiotherapy exercises.

Follow-up and outcome measures:

The patients were assessed at all follow ups clinically, functionally and radiologically and all findings were recorded and maintained properly.

The scheduled follow-ups were done as par schedule: 1st follow-up - 2 weeks of surgery (stitch removal), 2nd follow-up - 3 weeks of surgery (external fixator removal), 3rd follow-up - 6weeks of surgery, 4th follow-up - 10weeks of surgery, 5th follow-up - 14 weeks of surgery, 6th follow-up - 6th month of surgery,

7th follow-up - 9th month of surgery and finally the 8th follow-up at 1 year of surgery

Antero-posterior and Lateral radiographs were obtained at follow-up visits. AP radiographs were used to determine coronal plane deformity (varus or valgus). The Lateral radiographs were used to determine sagittal plane deformity (flexion and extension). Change in alignment was defined as greater than five degrees change in angular measurement between the postoperative and follow-up radiographs. Malalignment was defined as ten degrees or more of angular deformity. Rotational alignment was measured clinically at follow-up visits with normal rotation being equal to the contralateral side. Union was defined as pain free full weight bearing in absence of tenderness or motion at the fracture site with presence of bridging callus across at least one cortex of the fracture site on each the AP and Lateral views. Non-union was defined as absence of progressive fracture healing for three consecutive months extending beyond six months from the injury.

Partial weight bearing with the help of walker or crutches was allowed when the fracture showed an evidence of union. Full weight bearing was allowed after clinical and radiological confirmation of fracture union in both AP and Lateral X-ray films.

Post-operative clinical assessment:

It was done according to modified Rasmussen system assessing pain, walking capacity, range of motion and stability and final results were evaluated. Any complications were noted.

RESULTS

It was a prospective study in which 33 patients with tibial plateau fracture treated by minimal invasive surgeries were included of which three patients were lost in follow-up and they were excluded from the study. Hence final study comprises of 30 patients, who came for a regular follow-up for minimum six months. Average follow-up of patients ranged from six months to 24 months (Mean=11.8 months, SD=5.13, n=30).

Of the 30 cases, 26 patients were male (87%) and four were female (13%) varying between ages of 24 years to 61 years (mean age 40.1 years). The main mode of injury was road traffic accident followed by slip in bathroom. Out of 30 patients selected 22 sustained injury due to road traffic accident (73%), three sustained injury due slip in bathroom (10%), three sustained trauma by fall on road and two sustained injury due to fall from height (7%). Out of 30 patients 7 patients (23%) sustained associated injuries like fracture radius and ulna, fracture shaft of tibia, fracture calcaneum etc. Right lower limb was involved in 17 patients (57%) while in 13 patients (43%) left lower limb was involved. Tibial plateau fracture was classified according to Schatzker‟s classification. The most common fracture in our series was Schatzker‟s type II fracture (9 patients) followed by type VI (8 patients) followed by type V (6 patients).Right lower limb (56.67 %) was involved more than left lower limb.

The most common pattern encountered in our series was split-depression fracture (Schatzker type II) of lateral condyle (30%). The next most common pattern was bicondylar fracture type VI (26.67%). Type V and type VI fracture was seen in 14 patients (47%). Lateral condyle was alone involved in 50% of the cases.

Out of 30 patients, seven patients sustained associated injuries. Two cases had associated fracture of ipsilateral shaft of tibia and one case with ipsilateral fracture of radius and ulna. One case had contralateral fracture radius and ulna and ipsilateral fracture calcaneus. Other injuries were fracture calcaneum, fracture mandible and fracture 4th metacarpal.
Median time of presentation of injury to hospital was 1.53 day (ranging from 0 days to 27 days). One patient presented after 27 days of injury. Studying the time interval from injury to operation, it ranged from 1day to 31 days (mean 9.3 days). Majority of patients (53%) were operated in first week. 87% patients were operated in first 2 weeks.

Mean duration of hospital stay was 13.93 days ranging from 2 to 32 days except in one patient. Majority of patients were discharged in second week (67%). In one patient who had communited Schatzker type VI fracture with very poor skin condition, fracture was managed by cancellous screw and external fixator. This patient had prolonged hospital stay of 32 days and was discharged after improvement in skin condition.

Among the intra-operative observations, mean time of surgery was 75 minutes (ranging from 30 minutes to 2 hours with mean 68.16 minute; SD=24.05, n=30). Blood loss was minimal with only 3 patients have more than 250 ml blood loss. Only one patient required blood transfusion. 2 patients had lateral collateral ligament affection causing varus instability. Among the post-operative period of immobilization, external fixator was applied for duration of 2-12 weeks with mean 4.33 weeks. After removal of the fixator active range of motion exercises started at knee joint. In more than 76% cases external fixator was removed within 4 weeks.

Fracture union was observed in all cases except in one between 12 to 22 weeks (Mean= 15.72 weeks SD=2.90, n=29). In half of the cases (50%) fracture union was observed within 14 weeks. 27 patients (90%) had fracture union within 20 weeks. There were post-operative complications in eight

patients out of 30 cases (26.67%). One case required operative management.

Among the various scores obtained in our study as per the Modified Rasmussen's criteria, the average pain score was 4.13. Majority of patients (87%) had either no pain or occasional pain. No patient had constant pain and only one patient had pain during mild activity. The average walking capacity score was 4.43. Majority of patients (67%) had normal walking and 20 % cases could do more than 1 hour outdoor walking. One patient (3%) required aid to walk and one patient was confined to wheel chair. The average range of motion score was 4.23. Majority of patients (47%) had full range of motion. Overall 25 patients (83%) had more than 1200 range of motion at knee. Only one patient had less than 600 range of motion. The average stability score was 4.93. Majority of patients (97%) had normal stability. Only one patient was unstable at 200 flexion at knee.

All cases with type I and type IV fractures had excellent results. 7cases (78%) of type II fractures had excellent results and rest 2 cases (22%) had good result. One case of both type V and type VI fracture had fair result. Only one case (3%) in our series of Type VI fracture had poor result. The overall functional end results in the follow-up study were 66.7% excellent, 23.3% good, 6.7% fair and 3.3% poor. An acceptable functional end result therefore was obtained in 96% of the patients.(Table 1)

Table 1: Results according to Schatzker's fracture type

Type of fracture (Schatzkers)	No of Patients	Percentage
I	4	13.33
II	9	30
III	2	6.67
IV	1	3.33
V	6	20
VI	8	26.67
Total	30	100

DISCUSSION

Surgical treatment of high-energy, bicondylar, tibial plateau fractures and proximal tibial shaft fractures remains problematic. Problems common with the bicondylar tibial plateau fractures include wound complications, infection, varus collapse, knee stiffness, and articular malreduction [4]. In high energy traumatic cases with bicondylar fractures, treated by both side plating has very unsatisfactory results [5]. Infection rate in these cases in some study found as high as 73-80% [6]. When dual incision approaches were used, a significantly higher rate of complications such as deep infection, arthrofibrosis and post traumatic arthritis has been observed [2].

In cases of Schatzker‟s type V and type VI fractures due to high energy trauma initial stabilization by distal tibial skeletal traction or external fixator for some days before operation for soft tissue healing prevented infection and soft tissue necrosis and has yielded good results. This method of staged management of high energy tibial plateau fractures has also been advocated by Barei DP *et al.;* [3] and Egol KA *et al.;* [4].

In the present study, using the MIS technique, only one subject (3%) required treatment for post-operative complications. Tibial plateau fractures are serious injuries, associated with significant secondary early and late complications. Prompt diagnosis, thorough pre-operative assessment of the bony and soft-tissue trauma [6, 7]. adequate soft-tissue monitoring and resuscitation,[8] anatomic reduction and sound fixation allowing early joint movement, and intensive rehabilitation often for over one year post injury are mandatory for good clinical results [9, 10].

Careful evaluation of soft-tissue condition was identified as the key factor for the timing of definitive fixation, as well as the major predictor of certain complications like infections and delayed wound healing. The usefulness of a staged approach and delayed fixation until local conditions are optimised, was verified in this series of 30 patients as well as by other authors [11].

Due to the complex anatomy of the knee joint and the necessity of an anatomic reduction as in all intra-articular fractures, open reduction, combined with bone grafting in any case of cancellous bone depression, and rigid internal fixation with plates and screws is considered as the gold standard approach in last decades [12]. A recent study by Erdil *et al.;* in 2006 [13] demonstrated that a good outcome occurred in 72% of their patients even if articular depression was up to 10 mm. In the present study, all cases with type I and type IV fractures had excellent results. 7cases (78%) of type II fractures had excellent results and rest 2 cases (22%)

had good result. One case of both type V and type VI fracture had fair result. Only one case (3%) in our series of Type VI fracture had poor result. The overall functional end results in the follow-up study were 66.7% excellent, 23.3% good, 6.7% fair and 3.3% poor. An acceptable functional end result therefore was obtained in 96% of the patients.

CONCLUSION

We obtained a very high rate of success using the technique in our series across all categories of Schatzker‟s type fracture. Further adequately powered randomized controlled studies are warranted to establish the outcome in a large multicentric trial.

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