International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Functional Outcome of Surgical Management of Tibial Plateau Fractures: Case Series of 30 Cases

Dr. Kulwinder Singh[1], Dr. Manjeet Singh[2], Dr. Rakesh Gautam[3]

[1, 2, 3] Department of Orthopaedics: M M Institute Of Medical Sciences & Research Mullana: Ambala ; Haryana: India

Abstract: ***Study Design: Prospective consecutive series. Objective: To evaluate the functional outcome of Surgical management of Tibial Plateau Fractures. Summary of Background data: Earlier there was great reluctance towards operative management of these fractures because of lack of proper implants and adequate fixation techniques. But now due to the better understanding of biomechanics of knee joint, types of implant, principles of internal fixation, soft tissue care, the treatment of tibial plateau fractures is changing from conservative to surgical depending upon the fracture pattern to achieve good fracture union and optimal knee function. Methods: A Prospective study of 30 cases to assess the efficacy and functional outcome of tibial plateau fractures managed surgically by Closed/Open reduction and fixation with various internal fixation devices. Results: We found acceptable results in 83.3% cases which were comparable with several other studies which prove the advantage of Surgical management of Tibial Plateau Fractures.***

Keywords: Tibial Plateau Fracture (TPF), Biomechanics, Internal fixation, Knee Function.

1. Introduction

Advances in mechanization and the acceleration of travel have resulted in increase in road traffic accidents which is associated with increase in the number of Tibial Plateau fractures. They were first called "bumper" or "fender" fracture by Cotton and Berg[1] (1929). Tibial plateau fractures constitute about 1% of all fractures and 8% of elderly people[2].Tibial plateau fractures can range from a simple lateral split pattern to very complex bicondylar injuries that can be a source of great disability. Presently the majority of tibial plateau fractures are secondary to high speed motor vehicle accidents and fall from height[3]. The direction, magnitude and location of the force, as well as the position of the knee at impact, determines the fracture pattern, location, and degree of displacement[4].Most studies have shown, that the most injuries affect the lateral plateau (55% to 70%), isolated injuries of the medial plateau occur in (10% to 23%) of cases, whereas involvement of both plateaus is found in (10% to 30%) of reported series[5]. Fractures of tibial plateau occur as a result of strong valgus or varus forces combined with axial loading[6].

The primary goal of the treatment of Tibial plateau fracture, is precise & congruent reconstruction of the articular surfaces, axial alignment, stable fixation and early mobilization to preserve normal knee function. Despite of various studies, done in the past years, the optimal method of surgical management remains controversial.

Earlier there was great reluctance towards operative management of these fractures because of lack of proper implants, adequate fixation techniques and good antibiotics. But now due to the better understanding of biomechanics of knee joint, types of implant, principles of internal fixation, soft tissue care, antibiotics and asepsis, the treatment of tibial plateau fractures is changing from conservative to surgical depending upon the fracture pattern. Conservative treatment is associated with various complications like prolonged immobilization, knee stiffness or mal union. Surgical management prevents these complications. Closed/Open reduction and internal fixation depending upon the type of fracture has been advocated using various implants including percutaneous cannulated cancellous screws, buttress plates, and LCP (Proximal Tibial locking compression plate) etc, to achieve good fracture union and optimal knee function. Soft tissue-friendly approaches and minimally invasive techniques have all recently improved outcomes following these injuries.

The purpose of this study was to assess the functional outcome of various modalities of surgical treatment in different types of Tibial plateau fractures and to compare our results with literature.

2. Materials and Methods

Over a period of 3 years,30 cases of Tibial Plateau fractures admitted to our department were treated by various surgical techniques and there functional outcome evaluated. **Inclusion criteria** Patients above 18 years of Tibial plateau fractures with 5mm or more displacement or depression or step. **Exclusion criteria** Age less than 18 years, Compound fractures, fractures with <5mm displacement or depression or step, fractures with vascular injury. The patients on admission after stabilization and splintage to the affected limb, were evaluated by AP, lateral and oblique (if required) X Ray views of the affected knee including distal femur and upper tibia. Computed Tomography (CT) scan with or without 3D (Three Dimensional reconstruction Views) reconstruction was done wherever needed. The patients were closely monitored for any signs and symptoms of compartment syndrome after admission. Also the condition of the skin of the affected leg was observed for any blister formation. Pre-operative broad spectrum antibiotics were given before surgery. All fracture were classified according to Schatzker classification[7] from Type I toType VI

Time of surgery was decided on the status of soft tissues and general condition of the patient. The surgery was performed with the patient under general or spinal/epidural anaesthesia. Pneumatic tourniquet was applied after taking proper precautions and the time of its inflation and release was noted. Surgery was performed with the patient supine on a

radiolucent operating table, with normal limb kept away from the operative limb so that it did not interfere with C-arm images.

Type of implant was decided based upon the fracture anatomy and general condition of the patient (mainly AO principles were followed). In all 30 cases we used either percutaneus cannulated cancellous screws or T buttress /L buttress /LCP (Proximal Tibial Locking Compression Plate) plate depending upon the type of fracture. Percutaneus cannulated cancellous screws were done in Schatzker type I. Type II were treated with plating with or without bone grafting. Type III were treated with elevation of depressed fragment with bone graft and fixation with plating. Type IV was managed by medial buttress plating. Type V and VI were treated with unicolumnar/bicolumnar plating with or without bone grafting depending on pattern of fracture. The surgical wound was closed in layers with a negative suction drain after achieving complete haemostasis.

Surgical Approaches (depending upon fracture configuration) Anterolateral Approach: The anterolateral approach was used for the Schatzker types I, II, and III. It was also used for the lateral part of a dual incision approach needed for internal fixation of a bicolumnar fracture. Posteromedial Approach:The Posteromedial approach was used for Schatzker types IV. In type V and VI it was used for the medial part of a dual incision approach needed for internal fixation of a bicolumnar fracture. The use of these approaches allowed good exposure of the articular surface and tibial shaft which was required and to reduce a fracture and apply plates and screws to the tibial condyle and shaft.

Postoperative Management: Intravenous antibiotics were given for three to five days with regular dressings at appropriate time interval with post operative check X-ray to assess the reduction. Sutures were removed between 10-14 days after operation (subject to condition of the wound). Patients were discharged from the hospital as wound condition and general status permits. Early mobilization of the knee after tibial plateau fractures management was encouraged. Quadriceps exercises were started from the second post operative day. All the patients were put on continuous passive motion (CPM) machine. Range of motion exercises were done daily under careful supervision.

Follow up: Minimum follow up of six months was ensured for all cases. After 12-16 weeks based on the clinical and radiological signs of union patients were allowed partial weight bearing and gradually progressed to full weight bearing.The range of movement in the injured and uninjured limbs was compared using a goniometer. After the fracture had united, the functional evaluation was done by the criteria given by Jensen et al[8](1990) which is a modification of criteria given by Hohl and Luck[9] (1956).

3. Figures and Tables

Case 1

Case 2

Case 3

Case 4

Table 1: Type of Fracture

Type of Fracture	*No. of cases*	*Percent (%)*
I	7	23.3
II	4	13.3
III	4	13.3
IV	1	3.3
V	6	20.0
VI	8	26.7
Total	**30**	**100.0**

Table 2: Functional Results (Jensen et al[8])

Functional Results	*No. of cases*	*Percent (%)*
Excellent	10	33.3
Good	15	50.0
Fair	4	13.3
Poor	1	3.3
Total	**30**	**100.0**

4. Observations

- **Age Incidence:** The youngest patient in this study was 21 years and the oldest was 66 years. Most cases were between 31-50 years with mean of 42.53 years.
- **Sex:** Among 30 patients 23 were male and 7 were female which suggests males are more common due to their outdoor activity.
- **Mode of injury:** The mechanism of injury was Road side accidents in 93.3% of the patients which shows highly significant association of these fractures road side accidents.
- **Type of fracture:** All the fractures in this study were classified according to Schatzker's classification system. Type I -7, Type II – 4, Type III- 4, Type IV – 1,Type –V- 6 & Type VI- 8.
- **Follow up**: The follow up ranged from 24 weeks to 48 weeks with mean of 36.67 weeks.
- **Time of fracture union**: The mean time for fracture union was 16.93 weeks with range of 12-22 weeks.
- **Complications:(a)**Infection: In our series 2 cases developed superficial infection, which were treated with antibiotics and regular dressings. The incidence of superficial infection was 6.7%. Implant removal was not done in any case and there was no case of deep infection.
- **(b)**Malunion and Joint Stiffness: One case of type VI in which ORIF with lateral plating and screws was done, developed varus malunion with stiffness at knee with range of motion 10-90 degree due to lack of compliance and early weight bearing . There was no case of non union.
- **Flexion at knee**: Majority of patients had good range of movements at knee with mean flexion of 120.67 degree.
- **Extension Lag:** Extension lag was present in 4 cases, which was 10 degrees in 2 cases and 5 degree in other 2 cases. Malunion was the cause in 1 case (Type VI) and in other 3 cases(2 type VI and 1 Type III) lack of physiotherapy was the cause .
- **Valgus/Varus instability at knee:** Less than 5 degree of instability was seen in 23 cases and more than 5 degree of instability was seen in 7 cases.
- **Pain during follow up:** 60%cases had no pain, 36.7% had occasional pain and 3.3 %cases had moderate pain.
- Results: The functional evaluation was done the criteria given by Jensen et al[8] (1990) which is a modification of criteria given by Hohl and Luck[9] (1956). It shows acceptable results in 83.3% cases (Excellent 33.3% and Good 50%.of cases), fair in 13.3% and poor in 3.3% cases.

5. Discussion

Tibial plateau fractures are difficult to treat because of their intra-articular nature, cancellous bone involvement, and proximity to a major weight bearing joint. Despite of many advances in the care of intra-articular fractures, management of these fractures remains challenging for orthopaedic surgeons[10] even in the present day. Open reduction and stable internal fixation is required for depressed or displaced and unstable fractures to regain the early and complete range of motion. Proper physiotherapy and compliance of patient are equally important to achieve good results.

Keeping these points in mind, the present study of Surgical management of Tibial plateau fractures was carried out with the purpose to assess the functional outcome of various modalities of surgical treatment in different types of Tibial plateau fractures and to compare our results with literature. These fractures are more commonly seen in the active productive age group (31-50 years). In our study majority of the patients were males (76.7%). This can be attributed to our Indian setup where the female population largely work indoor and do not travel much. There was not much difference in the side of the fracture. Road traffic accidents were the commonest mode of injury in 93.3% of cases, followed by fall 6.7%.

In this study 50% affected the lateral tibial condyle, medial tibial condyle occurred in 3.3% where as involvement of bicondylar lesions was 46.7%. Hohl[11] in 1991 reported 50-70% injuries affecting lateral condyle, medial condyle lesions in 10-23% and bicondylar lesions in 10-30%. Different authors used different criteria for the surgical management of these fractures. No universal agreement exists on the amount of articular depression that can be accepted. In our study, the indications for the surgery was either 5mm or more displacement, articular depression or step.

Name of the authors Year ---------Amount of depression

- Bowes and Hohl[12] 1982--- ----------5mm
- Tscherne[13]1993----------2mm
- Segal[14]1993---------- 5mm
- Seppo[15] 1994----------3mm
- Present study ----------5mm

In the present study we had followed principles as described by AO. However each case was individualized and treated accordingly to age and needs of patient, type of fracture and degree of communition. In this study group of 30 patients, 6 patients were treated with Percutaneous cancellous cannulated screw fixation and 5 patients by ORIF with Buttress Plate, 4 patients by ORIF with Buttress Plate and Bone Grafting, 8 patients by ORIF with proximal tibial locking compression plate (LCP) and 7 patients by ORIF with LCP and Bone Grafting.

Schatzker type I cases were treated with Closed/Open reduction and internal fixation with percutaneous cannulated cancellous screws was done. All patients in this group had good to excellent results.

Schatzker type II cases were treated with plating with or without bone grafting. All patients in this group had good to excellent results.

Schatzker type III cases were treated with elevation of depressed fragment with bone graft and fixation with plate. 3 patients in this group had good to excellent results and 1 had fair result due to lack of physiotherapy.

Schatzker type IV case was treated with medial buttress plating ,which had good result.

Schatzker Type V and VI cases were treated with unicolumnar/bicolumnar plating with or without bone grafting depending on pattern of fracture.

In our study type V and VI had more number of fair to poor results probably due to complexity of these fractures. These findings correlates with the study done by David et al[16]that bicondylar tibial plateau fractures with articular comminution have a significant negative effect on functional outcomes of tibial plateau fractures. Condition of soft tissue was considered important before every surgery. Delay in some cases was due to swelling, compromised soft tissue and general condition of patient. Majority of patients had good range of movements at knee with mean flexion of 120.67 degrees. Extension lag was present in 4 cases which was 5 degrees in 2 cases and 10 degrees in other 2 cases. Malunion was the cause in 1 case and in other 3 cases lack of physiotherapy was the cause .

Good range of movement in our study was due to early mobilization and use of Continuous passive motion (CPM) machine. Mean time taken for fracture union in our study was 16.93 weeks (12 to 22 weeks). The mean time of follow up in the present study was 36.67weeks (24- 48 weeks). Time of allowing weight bearing after surgery was determined by type of fracture, stability of fixation and also by associated injuries. After 12 to 16 weeks based on the clinical and radiological signs of union, patients were allowed partial weight bearing and gradually progressed to full weight bearing.

6. Functional Results

Inspite of complexity of these fracture we were able to achieve 83.3% acceptable results (33.3% Excellent and 50% good) with our methods of fixation, in addition we had 13.3% fair and 3.3% poor results. The functional evaluation was done as per the criteria given by Jensen et al[8](1990) which is a modification of criteria given by Hohl and Luck[9] (1956) These results are comparable with other documented standard studies. In our series 83.3 % of our patients had excellent to good results and this outcome may have been due to early appropriate treatment, taking care of soft tissue status and early mobilization and physiotherapy.

Name of the authors Year ----------Results

- Schatzker et al[17](1979)---------- 78%
- Blokker et al[18](1984)---------- 70%
- Savoie et al[19] (1987)---------- 87%
- Lachiewicz et al[20](1990) ---------- 81%
- Chaix et al[21](1982) ---------- 86%
- Tscherne et al[22] (1993)---------- 77%
- Touliatos et al[23] (1997)---------- 83%
- Present study---------- 83.3%

Conclusion

Finally we conclude that Tibial plateau fractures are increasing, especially in males of active age group due to increase in road traffic accidents. Each fracture pattern and soft tissue status should be analyzed appropriately before surgery. Achieving a congruous joint surface and correct alignment by open or closed reduction and stable internal fixation should be the goal to facilitate early knee mobilization and consequent good functional results. Timing of surgery with minimal handling of soft tissue is very important to achieve good results and to prevent infection. Equally important is the patients compliance and good physiotherapy and full weight bearing should be delayed until union to prevent the articular collapse. The postoperative functional outcomes indicate that surgical management is a feasible treatment option for tibial plateau fractures.

References

[1] Cotton FJ, Berg R. Fender Fractures of the Tibia at the Knee. New Engl J Med. 1929;201: 989.
[2] DeCoster TA, Nepola JV, el-Khoury GY.Cast brace treatment of proximal tibia fractures. Aten-year follow-upstudy. ClinOrthop Relat Res1988; 231:196-204.
[3] Schulak DJ, Gunn DR. Fractures of tibial plateaus.A review of literature Clin Orthop 1975;109 June:166-77.
[4] Koval KJ, Helfet DL. Tibial plateau fractures: evaluation and treatment. J Am Acad Orthop Surg 1995;3(2):86-94.
[5] Hohl M. Fractures of the proximal tibia and fibula. In: Fractures in adults. Rockwood C, Green D, Bucyholz R, eds. Philadelphia: JB Lippincott; 1991; 3rd edn: 1725-61.
[6] Kennedy JC, Bailey WH. Experimental tibial plateau fractures. Studies of the mechanism and classification. J Bone Joint Surg Am 1968; 50(8):1522-1534
[7] Schatzker J. Fractures of tibial plateau. In Schatzker J Tile M, eds Rationale of operative fracture care.Berlin:Springer-Verlag;1987:279-295.
[8] Jensen DB, Rude C, Duus B, et al. Tibial plateau fractures: a comparison of conservative and surgical treatment. J Bone Joint Surg Br. 1990;72:49–52.
[9] Hohl M, Luck JV. Fracture of the tibial condyle: A clinical and experimental study. J Bone Joint Surg Am 1956; 38-A: 1001-1018.
[10] Raikin S. Froimson MI. Combined limited internal fixation with circular frame external fixation of intraarticular tibial fractures; Orthopedics 1999 Nov; 22(11):1019-25.
[11] Hohl M. Fractures of the proximal tibia and fibula. In: Fractures in adults. Rockwood C, Green D, Bucyholz R, eds. Philadelphia: JB Lippincott; 1991; 3rd edn: 1725-61.
[12] Bowes DN, Hohi M. Tibial condyle fracture: Evaluation of treatment and out come; Clin Orthop Relat Res. 1982 Nov–Dec;(171):104–108.
[13] Tscherne H, Lobenhoffer P.Tibial plateau fractures. Management and expected results. Clin Orthop Relat Res.1993;292:87-100.
[14] Segal D, Mallik AR, Wetzler MJ et al. Early weight bearing of lateral tibial plateau fractures. Clin Orthop 1993 ; 294 : 232-37.
[15] Honkonen SE. Indications for surgical treatment of tibial condyle fractures. Clin Orthop Relat Res. 1994;199–205.
[16] David PB, Sean EN, William JM, et al. Functional outcomes of severe bicondylar tibial plateau fractures

treated with dual incisions and medial and lateral plates. J Bone Joint Surg Am 2006; 88(8):1713-1721.
[17] Schatzker J, Mc Broom R, Bruce D. The tibial plateau fracture, the Toronto experience 1968-1975. CIin orthop, 1979;138:94-104.
[18] Blokker CP, Rorabeck CH, Bourne RB. Tibial plateau fractures. An analysis of the results of treatment in 60 patients.Clin.Orthop1984;182:193-9.
[19] Savoie FH, Vander Griend RA, Ward EF,et al. Tibial plateau fractures. A review of operative treatment using AO technique. Orthopedics 1987; 10(5):745-50.
[20] Lachiewicz PF, Funcik T. Factors influencing the results of open reduction and internal fixation of tibial plateau fractures. Clin Orthop Relat Res 1990; 259:210-215.
[21] Chaix O, Herman S, Cohen P,et al. Plate fixation in fractures of the tibial plateau. Rev Chir Orthop Reparatrice Appar Mot 1982; 68(3):189-97.
[22] Tscherne H, Lobenhoffer P.Tibial plateau fractures. Management and expected results. Clin Orthop Relat Res. 1993; 292:87-100.
[23] Touliatos AS, Xenakis T, Soucacos PK, et al. Surgical management of tibial plateau fractures.Acta Orthop Scand 1997; 275:92-6.

Author Profile

Dr. Kulwinder Singh did his DNB Orthopaedics from DNB Board , New Delhi and presently working as Assistant Prof. Ortho. At M.M.I.M.S.R., Mullana ,Ambala,Haryana , India.

Dr. Manjeet Singh did his M.S. Orthoaedics from Pt. B.D.Sharma PGIMS, Rohtak, Haryana and presently working as Prof. & Head , Deptt. Of Ortho. , M.M.I.M.S.R.,Mullana, Ambala, Haryana, India.

Dr. Rakesh Gautam did his M.S. Orthopaedics from Govt. Medical College, Patiala, Punjab and presently working as Associate Prof, Deptt. Of Ortho, M.M.I.M.S.R., Mullana, Ambala , Haryana , India.