International Journal of Research in Medical Sciences
Swarup A et al. Int J Res Med Sci. 2016 Mar;4(3):908-912
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20160541

Research Article

Functional outcome of surgical management of tibial plateau fractures in adults

Arunim Swarup*, Avinash Rastogi, Siddharth Singh, Kamal Swarn

Department of Orthopaedics, Subharti Medical College, Meerut, UP, India

Received: 23 January 2016
Revised: 26 January 2016
Accepted: 15 February 2016

***Correspondence:**
Dr. Arunim Swarup,
E-mail: arunimswarup@hotmail.com

ABSTRACT

Background: Tibial plateau fractures are one of the commonest intra articular fractures. These injuries encompass many varied fracture configuration that involve medial, lateral or both tibial plateau with varied degree of compression and articular displacements. Being one of the major weight bearing joints of the body, these fractures are of paramount importance. Since there are various modalities for fixation of these fractures with satisfactory results, but there is no general consensus as to which modality is the best in terms of functional outcome and proving the superiority of one over the other. Keeping this aim in mind, we have conducted the present study to determine the efficacy of different practised methods of fixation, and if one are superior to the other.
Methods: Sixty cases of tibial plateau fractures were treated with various surgical modalities and were followed up for a period of 2 years (2013 to 2015) at N.S.C.B Subharti hospital and their functional outcome was evaluated using Rasmussen's functional score.
Results: On selection these patients were classified according to Schatzker classification and were fixed accordingly using percutaneous cannulated cancellous screw, plating using LCP/ buttressing by open or MIPPO technique and screws depending upon the fracture configuration. Early range of motion was started as soon as pain subsided and weight bearing was deferred until radiological signs of union were evident. The knee range of motion was excellent to very good and weight bearing after complete union was satisfactory. Infection and stiffness in 2 cases was seen and there was one case of non-union in this series.
Conclusions: Surgical management of tibial condylar fracture will give excellent anatomical reduction and rigid fixation to restore anatomical congruity, facilitate early motion, hence to achieve optimal knee function and reducing post traumatic osteo-arthritis.

Keywords: Tibial plateau fractures, Ligamentotaxis, Schatzker, Rasmussen

INTRODUCTION

Tibial plateau fractures occur when proximal tibia experiences an excessive axial load. The mechanism of injury and the energy required to cause these fractures are age dependent. Younger patients tend to sustain these fractures secondary to high energy trauma such as fall from height and motor vehicle accidents, while older patients sustain tibial plateau fractures secondary to low energy trauma such as low level fall or stumble.

The management of these types of injuries has for long been subject of controversies. The spectrum of treatment ranges from simple casting and bracing to skeletal traction and early motion to open reduction and internal fixation.[1,2] Moreover, the appropriate treatment for injuries of different severities is unclear.

A brief review of literature reveals that different avenues are being explored for these fractures. Ali, et al reported a 31% fixation failure for tibial plateau fracture in their elderly population.[3] Stevens et al noted that only 57% of

cases showed good functional outcome after surgical management of tibial plateau fractures in age <40 years.[4] Open reduction and internal fixation has a significant complication rate.[5,6] So a middle path of minimally invasive technique of closed reduction by ligamentotaxis and stabilizing the fracture by limited internal fixation was developed and practised to overcome the drawbacks of non-operative and operative modalities.[7-9] These techniques utilize percutaneous screws and Kirschner wires (K wires), external fixation frames or combination of external fixation with limited internal fixation.[7-10] The minimally invasive technique of closed reduction by ligamentotaxis and fixation with percutaneous screws and K wires, combines attributes to both operative and non operative philosophies.

Therefore there are various modalities for surgical management of tibial plateau fractures ranging from percutaneous screw fixation to plating (unicondylar to bicondylar), MIPO technique of fixation to external fixator application. Various studies have shown efficacy of these methods of fixation with satisfactory results but no general consensus exists as to which modality is best in terms of results and functional outcome and proving superiority of one over the other. With this aim in mind, this study was conducted to determine the efficacy of different practised methods of fixation of proximal tibial plateau fractures and if one method was superior to other.

METHODS

The cases studied in this series were included from inpatient of N.S.C.B Subharti Medical College, Meerut. The total number of cases included in the study was 60. The average age of patient was 41.89 years with the oldest patient being 70 years old and the youngest was 22 years old. The aim of the surgical management was to obtain a pain free, stable and mobile joint and to compare the efficacy of different surgical modalities of fixing such type of fractures. The total duration of study conducted was 2 years (2013 to 2015). All simple or Gustilo Anderson Grade I fractures of tibial plateau presenting in adults requiring open or closed reduction and internal fixation to restore the articular anatomy were selected for this study and any fracture having Gustilo Anderson severity of more than Grade I, all pathological fractures or fractures having associated condition such as compartment syndrome, ipsilateral meniscal or ligamentous injury, floating knee or any other polytrauma were rejected as they would have affected the rehabilitation and ultimate functional outcome of the study. After recording identification data, antero-posterior and lateral roentgenograms were used to classify the facture according to Schatzker classification.

Surgical intervention was done under suitable antibiotic cover and fluoroscopic control and as soon as local soft tissue conditions were favourable, operation was performed. Fracture site reduction was done under fluoroscopic guidance with the use of percutaneous clamps and distracters judiciously and repeat fluoroscopic assessment was done to assess anatomical reduction. Wherever needed open reduction was performed. Buttress plates were used since the proximal end of tibia contains a large amount of cancellous bone and has a tendency of axial deviation or bending under the effect of compression or shearing forces. The different types used were T shape having a vertical and horizontal limb and helps in preventing a thin cancellous bone from collapsing, L shape having a right or left offset and a double bed to fit into the plateau and Hockeystick plate which is stouter and majority of times used to buttress the lateral plateau. Locking compression plates were used in cases of high energy bicondylar fractures, severe comminution and in osteoporotic bones.

Interfragmentary compression cannot be achieved by locked plate alone and therefore, supplementary use of interfragmentary screws may be required to prevent loss of reduction and to ensure adequate compression of fragments. For this purpose cortical screws (4.5 mm of various diameters), cancellous screws (16 mm, 32 mm, partially and fully threaded) and locking screws were used. The implants used were selected according to the fracture configuration and the preference of the surgeon. Post operatively patients were kept on injectable antibiotics for 3 to 5 days and static quadriceps and ankle pump exercises were started from 2nd day. If the fixation was deemed stable then intermittent knee mobilization was started once pain subsided. Weight bearing was deferred until evidence of union was seen on X ray. Partial weight bearing was started at around 10 to 14 weeks depending upon the fracture configuration. The results were evaluated using the functional grading of Rasmussen et al.[11]

RESULTS

A total 60 number of cases were included in this study. The average duration of hospitalization was 7 days (range 4-18 days). Majority of patients were male (78%) mostly because the most common mode of injury was road traffic accident (89%) and males are more involved in outdoor activities. Thirty seven patients were operated within 2 to 3 days of injury and showed excellent to good results. Twelve patients presented at 5 to 7 days of injury. Amongst them, those patients who had swelling around the proximal leg were kept on skeletal traction and were operated as soon as local tissue condition was optimized for surgery. Ten patients had delayed presentation and were operated as soon as next O.T was available. One patient presented 2 months post injury and had remained on bed rest since then. The distribution of patients according to Schatzker classification and their outcome of treatment are summarized in Table 1.

Seven patients were managed with cancellous screws; sixteen patients underwent open reduction and fixation with plating while plating supplemented with bone grafting was done in ten patients. Plating with MIPO

technique was performed in twelve patients and external fixator was applied in four patients. Eight patients had fixation done with dual plating. Average time gap between operation and partial weight bearing was around 8.74 weeks (8 to 13 weeks). The mean period of radiological union was 12.85 weeks (range 12 to 16 weeks). Most of the patients were allowed complete weight bearing at 11 to 14 weeks. Average time gap for complete weight bearing was 13.15 weeks. Most of the patients (60%) had 120º or more knee flexion. Average range of motion was 112.8º. The distribution of patients on the basis of time to union is summarized in Table 2.

Table 1: Distribution of patients according to Schatzker classification and their outcome of treatment.

Schatzker type	No. of patients (n=60)	No. (%) of patients with acceptable outcome
I	7	7 (100%)
II	13	13 (100%)
III	4	3 (75%)
IV	8	6 (75%)
V	16	1 1 (68.75%)
VI	12	8 (67%)

Table 2: Distribution of patients on basis of time to union.

Union	Number	Percent
Less than 12 weeks	34	57%
12 to 14 weeks	10	16%
More than 14 weeks	15	25%
Non union	1	2%
Total	60	100%

A total of 6 patients (10%) had residual pain at the end of 1year of follow up which was not significant and the patients had normal walking capacity with normal knee range of motion. These patients belonged to Schatzker type I, III and IV category. The cause of pain could not be sorted although they could perform all activities of daily living. One patient had infection on 7th post operative day and was managed with intravenous antibiotics and subsequently developed implant exposure and implant removal was done followed with skin grafting for soft tissue coverage and kept immobilized. It belonged to Schatzker type VI and remained in non union at 1 year follow up. Another patient had infection which was managed with antibiotics and debridement although ultimate outcome was not acceptable. One patient managed with dual plating had R.O.M of 60º by the end of 1 year. This patient after implant removal was started on physiotherapy and finally had R.O.M of 90º. One patient had varus deformity of 10º due to collapse of medial condyle, probably due to early mobilization.

Final end result as per Rasmussen's criteria was excellent in 37, good in 11, fair in 6 and poor in 6 patients.

DISCUSSION

Tibial plateau fractures, one of the commonest intra articular fractures, are major traumatic injury occurring due to road traffic accidents, fall from height, violence etc. It is sometimes associated with other bony or soft tissue injuries. Any fracture around the joint (especially weight bearing joint in the lower limb) is of paramount importance as it would result in significant morbidity and quality of life. Hence the treatment of upper tibial fractures with intra articular extension has become a challenge for orthopaedic surgeons.

Keeping this aim at high, we presented the clinical study of surgical treatment of 60 closed tibial plateau fractures. The analysis of the results were made in terms of age, sex distribution, mode of violence, analysis of the type, modalities of treatment, complications and the functional outcome. We have endeavoured to present the various types of tibial plateau fractures in our Indian setup. It is found that the zeal of modernization, mechanization and industrial development made more automobile accidents due to increase in population and automobiles.

The majority of fractures occur between 20 to 50 years of age with maximum incidence involving productive age group of 30 to 50 years (54%). The mean age in this study was 42.85 years. In a similar study done by Rasmussen et al the average age of patients was 55 years.[11] In our series the majority of patients were male (78%). This can be attributed to our Indian set up where the female population largely remains indoors and is less prone to automobile accidents. In this study the commonest mode of injury was road traffic accident (89%) and next being fall. This correlates well with previous study by Chiax et al who in their series reported that 71% of the injuries occurred due to RTA.[12] There was a significant preponderance to the right side in laterality of the fracture (53%).

In this series we studied 60 cases of simple tibial plateau fractures treated only by surgical method. Different authors use different criteria for surgical management of these fractures. Seppo E Honkoenen in his series of 130 tibial plateau fractures, conducted surgery taking into consideration condylar widening of >5 mm and lateral condyle step off >3 mm.[13] The indication for surgery in these types of injuries has evolved steadily with time. Burri, et al in his study in 1979 advised internal fixation at 1 mm of depression, Hohl et al and Segal et al advocated fixation at 5 mm of depression and Honkonen et al took 3 mm of depression in consideration in his study in 1993.[13-16] In this study the indication for surgery were the same standard indications as for those tibial plateau fractures, 3 mm depression was considered as an indication for surgery in this series.

In our series Schatzker type V dominated the total fractures (26%), followed closely by type II and VI (21%). Fourteen percent of the cases were of type IV and 11% and 7% of the cases were of type I and III respectively. These incidences were comparable with cases at Tampara hospital, Finland where there were 11.5% cases of type I, 30.5% cases of type II, 9.9% type III, 9.2% of type IV, 21.3% of type V and 17.5% of type VI.

The method of fixation for a particular type of fracture was formulated depending on the morphology of the fracture and quality of the bone. So each case was individualized and treated accordingly to achieve articular alignment, axial alignment and rigid fixation of the fracture. Most of the type I and some type II were treated with percutaneous cancellous screw fixation. The split fracture of >3 mm displacement was treated with MIPO with buttress/locking plate and screws. In most of the cases the articular depression was corrected by traction on fracture table reduction and cortical window with joystick manipulation and correction was maintained with K wires until definitive fixation was done. Bone grafting was done in 10 cases where articular depression was persisting after anatomical reduction of >3 mm.

The period of immobilization was individualized depending upon the rigidity of fixation. The benefits of early knee movement include reduced knee stiffness and improved cartilage regeneration. However these benefits are to be cautiously weighted against their negative impact such as loss of fracture reduction, failure of internal fixation and compromised soft tissue healing. J Schatzker and Robert Mcbroom[5] stated that the prognosis is given by the degree of displacement, type of fracture, method of treatment and quality of post operative care. The problem faced during this study was infection and wound dehiscence in 2 patients ultimately leading to unacceptable outcome. The infection might be attributed to nosocomial infection. In spite of all the complications we were able to achieve 70% excellent, 15% good results. Fifteen percent of patients had unacceptable outcomes. These results are at par with other documented studies. Ebraheim et al in his series of 117 tibial plateau fractures had excellent results in 68% of cases, good in 13%, fair in 11% and poor in 8% of the patients.[17]

Recent trend is to do minimal invasive surgeries. Many centers have shown good results with arthroscopic assisted internal fixation, hybrid external fixator; minimal internal fixation supplemented with external fixation, Ilizarov ring fixation and most recently MIPPO (minimal invasive percutaneous plate osteosynthesis).[9,18-21] We have employed MIPPO technique and had satisfactory results with the method proving that minimal invasive surgery leads to less operative trauma to soft tissue thereby reducing the period of post-operative immobilization and less chance of infection, stiffness leading to excellent functional outcome.

CONCLUSION

The surgical management of tibial plateau fractures is an orthopaedic challenge and needs a comprehensive understanding of fracture, soft tissue, time interval from injury to surgery and post-operative rehabilitation. Modalities like LCP in MIPPO and bone grafting can give excellent results in desirable patients but requires an optimum learning curve. The functional outcome is inversely proportional to the severity of the fracture. Bicondylar fractures, compound fractures, advanced age are less likely to have favourable results as compared to unicondylar fractures, closed fractures and younger age group patients. Infection rates are minimal in MIPPO as there is minimal soft tissue injury and preservation of vascularity and fracture hematoma. Malunion is one of the complications and therefore careful attention has to be given to overcome this by achieving anatomical reduction and stable implant fixation.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. De Coster TA, Nepola JV, el-Khoury GY. Cast brace treatment of proximal tibia fractures. A 10 year follows up study. Clin Orthop Relat Res. 1988;231:196-204.
2. Apley AG. Fractures of tibial plateau. Clin Orthop North Am. 1979;10:61-74.
3. Ali AM, El-Shafie M, Willet KM. Failure of fixation of tibial plateau fractures. J Orthop Trauma. 2002;16(5):323-9.
4. Stevens DG, Beharry R, McKee MD, Waddell JP, Schemitsch EH. The long-term functional outcome of operatively treated tibial plateau fractures. J Orthop Trauma. 2001;15(5):312-20.
5. Schatzer J, McBroom R, Bruce D. The tibial plateau fracture: the Toronto experience 1968-1975. Clin Orthop. 1979;138:94-104.
6. Yong MJ, Barrack RL. Complications of internal fixation of tibial plateau fractures. Orthop Rev. 1994;23(2):149-54.
7. Keogh P, Kelly C, Cashman WF, McGuinness AJ, O'Rourke SK. Percutaneous screw fixation of tibial plateau fractures. Injury. 1992;23(6):387-9.
8. Duwelius PJ, Rangitsch MR, Colville MR, Wall TS. Treatment of tibial plateau fractures by limited internal fixation. Clin Orthop Relat Res. 1997;339:47-57.
9. Marsh JL, Smith ST, Do TT. External fixation and limited internal fixation for complex fractures of tibial plateau. J Bone Joint Surg Am. 1995;77(5):661-73.
10. Mikulak SA, Gold SM, Zinar DM. Small wire external fixation of high energy tibial plateau fractures. Clin Orthop Relat Res. 1988;356:230-8.

11. Rasmussen PS. Tibial condyle fractures. Impairment of knee joint stability and indication for surgical intervention. J Bone Joint Surg Am. 1973;55(7):1331-50.
12. De Mourgues G, Chiax D. Treatment of tibial plateau fractures. Rev Chir orthop Reparatrice Mot. 1969;55(6):575-6.
13. Honkonen SE. Indications for surgical treatment of tibial condyle fractures. Clin Orthop Relat Res. 1994;302:199-205.
14. Burri C, Bartzke G, Coldewey J, Mugglar E. Fractures of tibial plateau. Clin Orthop Relat Res. 1979;138:84-93.
15. Bowes DN, Hohl M. Tibial condyle fractures. Evaluation of treatment and outcome. Clin Orthop Relat Res. 1982;171:104-8.
16. Segal D, Malik AR, Merrick J, Wetzler MJ, Franchi AV, Whitelaw GP. Early weight bearing of lateral tibial plateau fractures. Clin Orthop Relat Res. 1993;294:232-7.
17. Ebraheim NA, Sabry FF, Haman SP. Open reduction and internal fixation of 117 tibial plateau fractures. Ortho Blue Journal. 2004;27(12):1281-7.
18. Watson JJ, Wiss AD. Fractures of proximal tibia and fibula. Bucholz RW, Heckman JD (eds). Rockwood and Green's fracture in adults, 5 ed. Philadelphia: Lippincott Williams and Wilkins. 2001:1799-1839.
19. Buchko GM, Johnson DH. Arthroscopy assisted operative management of tibial plateau fractures. Clin Orthop Relat Res. 1996;332:29-36.
20. Oh JK, Oh CW, Jeon IH, Kim SJ, Kyung HS, Park IH, et al. Percutaneous plate stabilization of proximal tibial fractures. J Trauma. 2005;59(2):431-7.

Cite this article as: Swarup A, Rastogi A, Singh S, Swarn K. Functional outcome of surgical management of tibial plateau fractures in adults. Int J Res Med Sci 2016;4:908-12.