Outcome of Schatzker Type VI Tibial Plateau Fractures Treated with Dual Plating

Mian Amjad Ali, Faaiz Ali Shah, Abdur Rahman Qureshi, Haroon ur Rasheed, Naeemullah

ABSTRACT

Objective: To determine the radiological and functional outcome of dual plating of tibial plateau Schatzkar type VI fracture.

Methods: This descriptive study was conducted in Orthopaedic B unit Lady Reading Hospital Peshawar from February 2015 to August 2017. All patients with type VI tibial plateau fractures fulfilling the inclusion criteria were enrolled. All were treated with dual platting with double incisions. Minimum follow up period was one year. Outcome was assessed radiologically by Modified Rasmussen Assessment Criteria and functionally by Oxford Knee Scoring system.

Results: A total of 42 patients with mean age 36.6 years(range 18-52 years) ±SD 7.7 were treated with dual plating. Male patients were 33(78.5%) while female patients were 9(21.4%). The radiological evaluation at one-year follow up produced excellent results in 33(78.5%) patients, good in 7(16.6%) and fair in 2(4.7%) patients. Functional outcome was excellent in 34(80.9%) patients, good in 5(11.9%), fair in 2(4.7%) and poor in 1(2.3%). 5(11.9%) patients developed superficial wound infection while 2(4.7%) patients suffered from deep wound infection. No delayed union, non-union or deformity was reported.

Conclusion: Schatzker type VI fractures treated with open reduction and dual plating produce excellent and good radiological and functional outcome in majority of patients. We therefore recommend dual plating with two incisions as treatment of choice for the treatment of such fractures.

Key words: Tibia plateau fracture, dual plating, Oxford knee scoring system.

INTRODUCTION

Fractures of the tibial plateau constitute approximately 1 to 2 percent of all fractures [1], predominantly in male gender between 30 and 60 years of age [2]. These fractures are classified by Schtzker on anterioposterior radiograph into six types with type VI being the most complex high energy comminuted fracture characterized by intra articular bi condylar fracture with dissociation of metaphysis from diaphysis [3]. Type VI fracture is caused by motor car or motor bike accidents and fall from height [4]. It is a challenging fracture to orthopaedic surgeon because it is not only difficult to treat but often associated with other injuries, had a higher postoperative complication rate and the optimal treatment is still controversial [5]. The aim of treating this fracture is to achieve perfect anatomical reduction of the articular surfaces with a stable implant, maintaining normal limb alignment, minimal soft tissue damage and early knee joint mobility [6]. These objective can be achieved by external fixator, open reduction and internal fixation with a single condylar plate, double condylar plate or less invasive stabilization system [6,7,8,9,10]. External fixator causes knee joint stiffness because of delay in mobilization while single lateral locking plate is an insufficient fixation and leads to more medial plateau collapse than dual plating which is mechanically stronger and stable [11,12,13,14]. Dual plating technique using two separate anterolateral and medial or posteromedial incision yields excellent post operative radiological and functional outcome with minimal soft tissue complications and prompt rehabilitation [15].

Department of Orthopaedics B Unit
Lady Reading Hospital Peshawar
Correspondence: Faaiz Ali Shah
Email: faaizalishah@yahoo.com
Citation: Amjad MA, Faaiz AS, Qureshi AR, Haroon UR, Naeem u. Outcome Of Schatzker Type VI Tibial Plateau Fractures Treated With Dual Plating. J Pak Ortho 2017 Sep;29(3): page 119-125

Previously we would treat these fractures either conservatively or referred them to specialized centres for treatment. We conducted this study to determine the radiological and functional outcome of dual plating of Schatzkar type VI fractures in our set up.

METHODS

This descriptive study was conducted in Orthopaedic B unit Lady Reading Hospital Peshawar from February 2015 to August 2017. Patients of either gender and all ages with closed Schtzker type VI fractures [3] received within one week after sustaining the fractures were included in the study. All those patients who have pathological fractures, compartment syndrome or deep venous thrombosis, associated lower limb fractures, spine or pelvis fractures, abdominal injuries, thoracic, vascular and brain injuries requiring surgical interventions and those previously received surgical treatment for the same fractures were not included in the study. The study protocols were approved by the Ethical Review Board of the hospital. Informed written consent was taken from all the participants of the study. Patients of proximal tibia fractures received in Accidents and Emergency Department of Lady Reading Hospital Peshawar were thoroughly assessed and resuscitated according to Advance Trauma Life Support(ATLS) protocols. Every patient was administered parental analgesics and the fracture was splinted with a long leg backslab. X-ray of knee joint antero posterior and lateral view including joint above and below were done. In the included subjects complete history and physical examination was done. Three dimensional (3D) CT scan and Magnetic Resonance Imaging (MRI) of knee joint was done in each case to know the exact configuration of fracture fragments and ligament and menisci injuries respectively. In case of sever skin and soft tissue injury, swelling or fracture blisters surgery was delayed and calcaneal stemin pin was passed with weight suspended to it and limb was elevated till skin wrinkles appeared and the limb ready for surgery.

Operative Procedure

All surgeries were performed under general or spinal anaesthesia on radiolucent table in the supine position with a sandbag under the affected gluteal area and knee joint. Preoperative dose of intravenous Cefuroxime 1.6 gm[15] was administered at induction of anaesthesia. Pneumatic tourniquet was used in all cases. The medial plateau was fixed first with one third tubular plate through a medial 10 cm incision after exposing the bone by subperiosteally elevating the pes anserinus muscle. The reduction of fragments and screw positions was confirmed with image intensifier. The lateral plateau was exposed with a 10 cm curve anterolateral incision starting from tip of lateral plateau downwards over Gerdy's tubercle and parallel to tibial boarder. The fracture was exposed subperiosteally, reduced and provisionally stabilized with k wires. Depressed articular fragments were elevated, checked under image and fixed with "L" type locking plate. The knee was checked clinically for any ligament injury. Ligament avulsion injuries and meniscal tears were treated at the same time. Wound was closed and soft compression dressing was applied. In case of knee instability or ligament surgery a back slab was given to the limb postoperatively. Check x-ray was done post operatively and reduction of fracture, articular congruity and alignment was recorded. Active quadriceps and knee flexion and extension exercises were started by physiotherapist on second post operative day except patients with ligament avulsion fixation. Intravenous antibiotics(second generation) was be given for three days. Patient was discharge home on third postoperative day with clear instruction for wound care, rehabilitation, and follow up schedule. Review visits of all such patients were be done at 2 weeks for the first month and then monthly for at least one year. In each visit radiological union of fracture and clinically range of knee joint motion was recorded. Union time failure of reduction or fixation, infection, deformity and signs of arthritis was documented in each visit. All patients were mobilized non-weight bearing with crutches at two weeks postoperatively and thereafter partial and full weight bearing depending upon the radiological union at each follow up visit. Union at fracture side was defined as callus formation on anteroposterior and lateral radiographs on at least three bone cortex [16], while absence of callus at six months postoperative was considered non union [10].

Radiological outcome was evaluated through X-ray AP and lateral view before surgery, immediately after surgery and then monthly till one year through Modified Rasmussen Assessment criteria (table 1) [17]. Functional outcome was assessed with Oxford Knee Scoring System [18] every 3rd month till twelfth month. Data was entered into SPSS (version 18) for statistical analysis. All categorical variables like gender was represented as frequency and percentages while

numerical variables like age was represented as mean and standard deviation. P value was calculated for radiological outcome immediately post op and at final follow up and Oxford knee score at six months and at one year and statistically significant if p< 0.05.Data was presented in tables.

RESULTS

A total of 42 patients with mean age 36.6 years (range 18-52 years) ±SD 7.7 were included in the study. Male patients were 33(78.5%) while female patients were 9(21.4%). 26(61.9%) fractures involve right side while 16(38%) were of left side. Road traffic accidents were responsible for 35(83.3%) fractures while fall from height was the cause of fracture in 7(16.6%). Majority (n=31,73.8%) of fractures were operated within 2-3 days while 11(26.1%) surgeries were delayed by 7-10 days because of skin blisters. Fibula fracture was found in 11(26.1%) patients.

Table 1: Radiological evaluation of Schatzker type VI fractures.

S.No	**Modified Rasmussen Criteria**	**Pre-operative Modified Rasmussen Score**		**Immediate Post-operative Modified Rasmussen score**	**One year Post-operative Modified Rasmussen score**
1	**Articular depression** None 3 Less than 5 mm 2 6-10 mm 1 More than 10 mm 0	Score Grading	Patients number	Patients number	Patients number
2	**Condylar widening** None 3 Less than 5 mm 2 6-10 mm 1 More than 10 mm 0	**Excellent**	Nil	38(90.4%)	33(78.5%)
3	**Varus/valgus angulation** None 3 Less than 10 degrees 2 10-20 degrees 1 More than 20 degrees 0	**Good**	Nil	4(9.5%)	7(16.6%)
4	**Osteoarthritis** None/no progress 1 Progressive by 1 grade 0 Progressive by more than 1 grade -1	**Fair**	7(16.6%)	Nil	2(4.7%)
Score Interpretation Excellent 9-10 Good 7-8 Fair 5-6 Poor less than 5		**Poor**	35(83.3%)	Nil	Nil

Mostly (n=28,66.6%) surgeries were performed under spinal while general anaesthesia was used in 14(33.3%). The mean operating time was 49 minutes(37-75 minutes). Primary bone grafting was done in only 4(9.5%) patients. Anterior cruciate ligament was avulsed in 3(7.1%) patients and fixed with a screw. 2(4.7%) patients had tear of anterior cruciate ligament and one (2.3%) patient had posterior cruciate ligament and were reconstructed after fractures had been healed. Medial meniscus tear was found in 2(4.7%)

patients while lateral meniscus tear in 1(2.3%) patient and excision of menisci was performed at the time of fracture fixation. The radiological evaluation was done through Modified Rasmussen Criteria and majority (n=33,78.5%) of patients had excellent radiological outcome at one year follow up while 7(16.6%) patients had good and 2(4.7%) patients had fair outcome. The average preoperative articular depression was 9 mm and at one year follow up it was 2-3 mm. The average condylar widening was 8mm and 2mm and varus and valgus 10 degrees and none while osteoarthritis was 1 pre and postoperatively respectively.

No statistically significant difference in radiological outcome was found immediate post operatively and at one year follow up.($p > 0.05$) Functional outcome was assessed through Oxford Knee scoring system(Table 2) and majority(n=34,80.9%) of patients had excellent functional outcome at one year follow. Among the fair and poor outcome patients, two patients were treated for deep wound infection post operatively while one for anterior cruciate ligament reconstruction respectively. The Oxford knee score at six months was lower than at twelfth months.($p< 0.05$)There was no significant difference in radiological outcome ($p > 0.05$) between 6weeks,6 months and 1year follow up. Also there were no association between the radiological and functional outcome as there was excellent functional outcome in patients good and fair radiological outcome. Knee flexion was 125 degrees and above in all of our patients while extension lag of less than 10 degrees was observed in only three (7.1%) patients. Age of the patient, side or mechanism of fracture had not been found to be associated with better radiological and functional outcome.

Table 2: Functional outcome of Schatzker type VI fractures.

Oxford Knee Score	No. of patients	Percentage
Excellent (if score is 40 to 48)	34	80.9
Good(30 to 39)	5	11.9
Fair(20 to 29)	2	4.7
Poor (0 to 19).	1	2.3

All fractures healed at 10 weeks (range 7 to 16 weeks) and no delayed union or non union was reported. 5(11.9%) patients had superficial wound infection and culture yielded Staphylococus and successfully treated with antibiotics. 2(4.7%) patients developed deep wound infection and successfully treated with regular debridement and antibiotics. All the 7(16.6%) infected patients were diabetics. No varus or valgus deformity was noted in our study.

Fig 1 to 5: Schatzker type VI fracture in 23 year old man treated with with dual plating

Fig. 1: Plain X-ray

Fig. 2: 3D CT Scan

Fig 3: X-ray immediate after surgery.

Fig.4: X-ray after 10 months.

Fig. 5 to 08: Schatzker type VI fracture in a 40 year old lady fixed with dual plating.

Fig. 5: Pre op X-ray of Schatzker type VI fracture.

Fig. 6: 3D CT scan

Fig. 7: Immediately postoperative radiograph.

Fig. 8: After 08 months radiograph

DISCUSSION

We treated 42 patients of Schatzker type VI proximal tibia fractures with dual platting and followed postoperatively for one year. Radiologically excellent outcome was obtained in majority (n=33,78.5%) patients at twelfth month post operatively while good and fair outcome was documented in7(16.6%) and 2(4.7%) patients respectively. No statistically significant difference in radiological outcome was found immediate post operatively and at one year follows up in our study. (p= 0.09) Rohra [15] treated 34 Type VI Schatzker fractures with dual plating and reported excellent radiological outcome in 11(32.3%), good in 21(61.7%) and fair in 2(5.8%) patients. But he documented statistically significant difference (p=0.032) in radiological outcome reported at six weeks and six months with excessive articular depression and varus deformity in five of his cases. However, Rohra's

follow up was three years while our was one year. Yu and Zhang [7] findings support present study as they also observed no significant difference in radiological parameters over the follow up period in their 54 patients. In this study majority (n=34,80.9%) of patients had excellent functional outcome at one year follow up while good, fair and poor functional outcome was reported in 5(11.9%), 2(4.7%) and 1(2.3%) respectively. The results of our study are consistent with international studies. Khatri [19] reported excellent outcome in 45(83%), good in 7(10.7%) fair in 3(4.6%) and poor in 1(1.5%) patients. Prasad [14] documented excellent outcome in 16(40%) patients, good in 16(40%) and fair in 8(20%) patients. Rohra[15] reported excellent results in 29 patients (85.2%) and good in 5(14.7%) patients by using Objective Knee Society score while evaluation through functional knee Society Score yielded excellent results in 24(70.5%) patients, good in 8(23.5%) and fair and poor in 1(2.9%) patient each.

We found that Oxford Knee Score at six months was lower than that at twelfth months.($p = 0.001$) Improvement in functional outcome score($p< 0.0001$) with longer follow up was reported by Rohra [15] as well. However, Yu and Zhang [7] treated 54 patients with dual plating and found no statistically significant difference at six months and 23.7 months in Hospital for Special Surgery (HSS) score, Lysholm score and Knee Society Clinical Rating Score. In our study all the patients who developed infection had lower mean Oxford Knee Score than others. This observation was confirmed by Khatri [19] as well. Among the fair and poor functional outcome in our patients, two patients were treated for deep wound infection post operatively while one for anterior cruciate ligament reconstruction respectively. Decrease compliance with physiotherapy and delayed weight bearing can be the possible reasons for this low Oxford Knee Score in these patients.

All the fractures in our study united at mean of 13 weeks (range 10 to 17 weeks). Rohra [15] reported union time of 15.7 weeks, Yu and Zhang [7] 13.7 to 14.1 weeks and Prasad [14] 8-22 weeks. Delayed union and non union was not reported in this study. Rohra [15] had similar results to this study in his 34 treated cases but Khatri [19] reported delayed union in two cases and nonunion in one case of his series of 38 type VI fractures. Yu and Zhang [7] documented 1 case of delayed union in his series of 54 patients.

We reported a total of 7(16.6%) cases of wound infection among which 5(11.9%) patients had superficial wound infection while 2(4.7%) had deep infection but all were treated successfully with antibiotics and debridement with implant in place. Barei [4] reported superficial wound infection in 3(5.4%) patients and deep infection in two(3.6%).Yu and Zhang [7] documented deep wound infection in two patients in their study which were treated with removal of metal works and application of external fixator. Rohra [15] reported 2 cases of superficial wound infection which resolved with antibiotics and debridement. Khatri [19] Reported superficial infection in 6(15.7%) patients and deep infection in 3(7.8%) patients in his series of 38 patients.

We searched the literature and found that there is a large variation in the frequency of ligamentous injuries associated with Schatzker type VI fractures. This may be due to the fact that some authors like Stannard [20] and Schatzker [4] did not use MRI for the detection of ligamentous injuries but clinical examination. Stannard [20] reported 85% ligament injuries while Schatzker [4] reported 7.4%. Prasad [14] reported ACL injury in 6.5% and collateral ligament injury in 21% . Ligamentous and meniscus injuries were reported in 8(12.3%) patients by Khatri [19] and diagnosed after fixation of the fractures. We detected ligamentous and meniscal injuries pre operatively with MRI in 6(14.2%) and 3(7.1%) patients respectively. Two (4.7%) ACL tear and one (2.3%) PCL tear was reconstructed after fracture healing at 12th weeks and these patients had lower mean Oxford Knee Scores than the others ($p=0.0006$).

In our study we did not notice any new osteoarthritic changes in the operated knee compared to the normal knee. The possible explanation for this can be the relatively younger age of our patients (mean age 36.6 years) and a short follow up of one year. We therefore recommend longer follow up to confirm this findings. Prasad [14] had reported similar findings while Yu and Zhang [7] reported 10 cases of postoperative osteoarthritis.

CONCLUSION

Dual patting with two incision is a stable fixation for Schatzker type VI fractures.It allows early mobility and yields excellent functional outcome.It is associated with less chances of infection and non union. We therefore recommend this technique as first line treatment to treat such fractures.

REFERENCES

1. Cole P, Levy B, Schatzker J, Watson JT. Tibial plateau fractures. In: Browner B, LevineA, Jupiter J, Trafton P, Krettek C, editors. Skeletal Trauma: Basic Science Management and Reconstruction. Philadelphia, PA: Saunders Elsevier; 2009. pp. 2201-2287.
2. Albuquerque RP, Hara R, Prado J, Schiavo L, Giordano V, do Amaral NP. Epidemiological study on tibial plateau fractures at a level I trauma center. Acta Ortop Bras. 2013 Mar-Apr;21(2):109-115.
3. SCHATZKER, JOSEPH M.D., MCBROOM, ROBERT M.D.; BRUCE, DAVID B.A. The tibial plateau fracture: The Toronto experience. 1968-75. Clin Orthop 1979 Jan-Feb;138: 94-104.
4. Barei DP, Nork SE, Mills WJ, Coles CP, Henley MB, Benirschke SK. Functional outcomes of severe bicondylar tibial plateau fractures treated with dual incisions and medial and lateral plates. J Bone Joint Surg Am 2006 Aug;88:1713-1721.
5. Pun TB, Krishnamoorthy VP, Poonnoose PM, Oommen AT, Korula RJ. Outcome of Schatzker type V and VI tibial plateau fractures. Indian J Orthop 2014 Jan-Feb;48(1): 35-41.
6. Ranatunga IR, Thirumal M. Treatment of type VI fractures with the Ilizarov technique using ring external fixators across knee: A retrospective review. Malaysian Orthopaedic Journal 2010*;* (4) 2:34-39.
7. Yu Z, Zheng L, Zhang Y, Li J, Ma B. Functional and radiological evaluations of high energy tibial plateau fractures treated with double-buttress plate fixation. Eur J Med Res. 2009 May;14(5):200-205.
8. Berkson EM, Virkus WW. High-energy tibial plateau fractures. J Am Acad Orthop Surg 2006 Jan;14:20-31.
9. Tejwani NC, Hak DJ, Finkemeier CG, Wolinsky PR. High-energy proximal tibial fractures: Treatment options and decision making. Instr Course Lect 2006;55:367-379.
10. Jiang R, Luo CF, Wang MC, Yang TY, Zeng BF. A comparative study of Less Invasive Stabilization System (LISS) fixation and two-incision double plating for the treatment of bicondylar tibial plateau fractures. Knee 2008 Mar;15:139-143.
11. Lasanianos NG, Garnavos C, Magnisalis E, Kourkoulis S, Babis GC. A comparative biomechanical study for complex tibial plateau fractures: Nailing and compression bolts versus modern and traditional plating. Injury 2013 Oct;44:1333-9.
12. Ali AM, Yang L, Hashmi M, Saleh M. Bicondylar tibial plateau fractures managed with the Sheffield Hybrid Fixator: Biomechanical study and operative technique. Injury 2001 Dec;32(Suppl 4):86-91.
13. Higgins TF, Klatt J, Bachus KN. Biomechanical analysis of bicondylar tibial plateau fixation: How does lateral locking plate fixation compare to dual plate fixation? J Orthop Trauma 2007 May;21:301-306.
14. Prasad GT, Kumar TS, Kumar RK, Murthy GK, Sundaram N. Functional outcome of Schatzker type V and VI tibial plateau fractures treated with dual plates. Indian J Orthop 2013 Mar-Apr;47(2):188-94.
15. Rohra N, Suri HS, Gangrade K. Functional and radiological outcome of Schatzker type V and VI tibial plateau fracture treatment with dual plates with minimum 3 years follow-up: A prospective study. J Clin Diagn Res 2016 May;10(5):5-10.
16. Cho KY, Oh HS, Yoo JH,Kim DH, Cho YJ,Kim K. Treatment of Schatzker Type V and VI tibial plateau fractures using a midline longitudinal incision and dual plating. Knee Surg Relat Res 3013 Jun;25(2):77-83.
17. Rasmussen PS. Tibial condylar fractures. Impairment of knee joint stability as an indication for surgical treatment. J Bone Joint Surg Am 1973 Oct;55:1331-1350.
18. Williams DP, Blakey CM, Hadfield SG, Murray DW, Price AJ, Field RE. Long-term trends in the Oxford knee score following total knee replacement. J Bone Joint Surg 2013 Jan;95(1): 45-51.
19. Khatri K, Lakhotia D, Sharma V,Kumar GN, Sharma G, Farooque K. Functional evaluation in high energy(shatzker type V and type VI) tibial plateau fractures treated by open reduction and internal fixation. International Scholarly Research Notices 2014 Oct:538-45.
20. Stannard JP, Lopez R, D. Volgas D. Soft tissue injury of the knee after tibial plateau fractures. The Journal of Knee Surgery 2010 Dec:23(4);187-192.