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Study of Functional Outcome of Tibial Plateau Fractures Treated with Locking Compression Plate

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ABSTRACT
Incidence of fractures of the tibial plateau is increasing due to high speed motor vehicle accidents, natural and manmade disasters and increase in contact sports activity. Recent introduction of Locking Compression Plate (LCP) in such fractures have revolutionized the treatment of proximal tibial fractures. Present study was aimed to evaluate the radiological and functional outcome of tibial plateau fracture in south Indian patients treated with locking compression plate. Present study was prospective, observational study, conducted in patients between 18-80 years of age with tibial plateau fracture, operated with locking compression plate (LCP) with a standard protocol. Commonest mode of injury was RTA (87.88%) and majority fractures were on right side (57.58%). The majority of the fractures were found to be type VI of schatzker's classification (33.33%) followed by type II (27.27%), In eleven cases, Minimally invasive percutaneous technique was used (66.67%). 22 patients (66.67%) were mobilized on second post operative day. Twenty two patients were made to bear full weight on operated limb by 12-14 weeks and average being 13.27 weeks. All fractures in this study united without requiring any additional procedures. Average time for union of fracture was 13.27 weeks ranged from (8-20 weeks) The average range of movement achieved was 127 degrees. Sixty patients (48.48%) had excellent results, 14 patients (42.42 %) had good results, 3 patients (9.09 %) had fair result. The association between early surgical intervention (within 24 hours) and functional outcome was found be statistically significant ($p<0.05$). Majority of patients who undergo open reduction and internal fixation of tibial plateau fracture with locking compression plate do very well clinico-radiologically and return to a pre-injury functional level at the earliest.

INTRODUCTION

Incidence of fractures of the tibial plateau is increasing due to high speed motor vehicle accidents, natural and manmade disasters and increase in contact sports activity[1]. The high velocity nature of injuries in these fractures often results in severe metaphyseal and intraarticular comminution and soft tissue disruption. Open reduction and internal fixation in such conditions is extremely challenging. Surgical intervention with conventional plates is inadequate to stabilize the fracture rigidly. It also jeopardizes the subperiosteal vascularity and thus, increases the chance of delayed union and nonunion[2]. Recent introduction of Locking Compression Plate (LCP) in such fractures have revolutionized the treatment of proximal tibial fractures.

The LCP combines the principle of limited contact compression plating and locked internal fixation[3]. The plate-screw construct allows compression at the fracture site and also provides angular stability[4]. The plate is not compressed against the cortex and therefore periosteal blood supply is preserved[5]. The principles of anatomical reduction, rigid fixation and preservation of biology at the fracture site can be achieved using LCP in treatment of proximal tibia fracture[6,7]. Numerous studies have reported satisfactory functional outcome in tibial plateau fracture using LCP. Present study was aimed to evaluate the radiological and functional outcome of tibial plateau fracture in south Indian patients treated with locking compression plate.

MATERIAL AND METHODS

Present study was prospective, observational study, conducted in department of Orthopaedics, Meenakshi Mission Hospital and Research Centre, Madurai, India. Study duration was of 14 months (September 2012 to December 2013). Study approval was obtained from institutional ethical committee.

Inclusion criteria:

- Patients between 18-80 years of age, with tibial plateau fracture, operated with locking compression plate (LCP) with a standard protocol, willing to participate in the study

Exclusion criteria:

- Patients with open fracture or pathological fracture
- Patients with neuromuscular paralysis/paresis, chronic smoker, chronic cardio-respiratory problems and bed ridden patients because of chronic systemic illnesses
- Patients with inflammatory or infective arthritis in the lower limb joints
- Patients with neurovascular complications including compartment syndrome

Study was explained to patients in local language and written consent was taken for participation and study. After admission into the hospital, general and systemic examination as well as local examination was done along with thorough assessment of patient to rule out other systemic injuries. Thereafter patient is stabilized as per the ATLS guidelines. Patients with closed tibial plateau fractures associated with a tense haemarthrosis underwent aspiration of the joint under aseptic precautions. The limb was immobilised either in an above knee slab or through skeletal traction using a distal tibial or calcaneal pin traction on a Bohler Braun splint until definitive fixation was carried out. In patients complicated with excessive swelling and blistering, definitive fixation was delayed until the swelling/blistering subsided. The patients were thoroughly evaluated and received appropriate treatment for existing co-morbidities like hypertension and diabetes prior to and after surgery.

During surgery, patient was positioned supine on a radiolucent table. Torniquet was applied to the proximal thigh and the limb was prepared and draped in the standard sterile fashion. Either lateral or medial approach was used. Direct or indirect reduction was achieved by longitudinal traction and manipulation. C-arm was used to verify reduction, alignment and rotation. The plate was then guided through the incision between the tibialis anterior and periosteum along the lateral tibia. The majority of the distal portion of the plate is placed percutaneously using MIPPO technique. C-arm is used to confirm the satisfactory positioning of the plate, then the plate is secured to the screws. The wound was irrigated. The iliotibial fascia and wound is closed over a drain in standard fashion.

All patients received intravenous antibiotics for a minimum of 5 days. They also received analgesics/ anti-inflammatory drugs. The limb was elevated on a Bohler Braun splint until edema subsided. Knee mobilisation was started once the acute pain subsided (ranged 2-7 days). Non weight bearing walking was permitted from 3rd post operative day with the help of a walker. Sutures were removed on the 10th post operative day. Weight bearing was advanced based on tolerance and radiographic evidence of fracture healing.

All patients were followed up at 6 weeks, 12 weeks, 6 months. During follow up visits, the patients were evaluated clinically and radiologically. The clinical outcome was evaluated using modified Rasmussen Scoring system. Health related quality of life of the patients was evaluated using Short form musculoskeletal function health survey (SF-36) v2 at 6 months follow up. The fracture was considered as

united if three or more than three cortices on two radiographic views are continuous. Complications during this period were noted. The post operative results were designated as excellent, good, fair and poor according to pain, walking capacity, range of motion and stability of the knee using Rasmussen's grading system. Similarly, Rasmussen's radiological scoring done by assessing articular congruity, condylar widening, Valgus/Varus angulation.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. p>0.5 was considered as statistically significant.

RESULTS

We studied 33 patients with tibial plateau fracture treated with locking compression plate. Patients were in the age group 20 to 71 years with average being 44.12 years and most of patients belong to 31-50 years of age group (42.4%). The majority of the patients were male (M : F = 29 : 4). Commonest mode of injury was RTA (87.88 %) and majority fractures were on right side (57.58%). The majority of the fractures were found to be type VI of schatzker's classification (33.33%) followed by type II (27.27%), Seventeen of our patients had other associated injuries at time of initial presentation. Common associated injuries were Head injury (15.15%), Distal end of radius (ipsilateral) (9.09%), Pubic rami fracture (9.09%) and ACL avulsion (6.06%).

Different surgical approaches were used, among which antero lateral approach was most commonly used (48.48%). In eleven cases, Minimally invasive percutaneous technique was used (66.67%). Twenty two patients (66.67%) were mobilized on second post operative day. 22 patients were made to bear full weight on operated limb by 12-14 weeks and average being 13.27 weeks. All our patients were followed up periodically with a minimum follow up duration of 24 weeks and a maximum follow up duration of 52 weeks.

All fractures in this study united without requiring any additional procedures. Average time for union of fracture was 13.27 weeks ranged from (8-20 weeks) The average range of movement achieved was 127 degrees. Five patients achieved slightly more than 130 degrees of flexion, 26 achieved 110-130 degrees of flexion. In our study the average Rasmussen's clinical knee score was 26.97. Average Rasmussen's radiological score was 8.06. In our study, 16 patients (48.48%) had excellent results, 14 patients (42.42%) had good results, 3 patients (9.09%) had fair result.

In our study functional level of general population in physical and mental domain was achieved. Average SF-36v2 PHS of 33 patients was 53.13±4.13 (ranging from 42-59) and average score of SF-36v2 MHS was 54.88±4.06 (ranging from 46-60). While comparing the results with general population norm, it showed significantly better score. In our study ten patients were operated within 24 hrs and fifteen patients within 4 days of injury. The association between early surgical intervention (within 24 hrs) and functional outcome was found be statistically significant ($p<0.05$).

Complications were encountered in 7 patients and include knee joint stiffness (1), redepression (2), surgical wound edge necrosis (1), valgus deformity (1), and extensor lag (2). No purely implant related complication were noted (viz screw loosening screw breakage plate failure).

Table 1: General characteristics

Characteristic	No. of patients	Percentage
Age groups (years)		
20-30	6	18.18
31-40	7	21.21
41-50	7	21.21
51-60	8	24.24
61-70	4	12.12
>70	1	3.03
Mean age (mean±SD)	44.12±5.6	
Gender		
Male	29	87.88
Female	4	12.12
Mode of injury		
RTA	29	87.88
Assault	2	6.06
Slip and fall	2	6.06
Side		
Left	14	42.42
Right	19	57.58

Table 2: Schatzker's type and associated injuries

Characteristic	No. of patients	Percentage
Schatzker's type		
TYPE II	9	27.27
TYPE III	1	3.03
TYPE IV	6	18.18
TYPE V	6	18.18
TYPE VI	11	33.33
Associated injuries		
Head injury	5	15.15
Distal end of radius (ipsilateral)	3	9.09
Pubic rami fracture	3	9.09
ACL avulsion	2	6.06
Distal end of radius (contralateral)	1	3.03
Clavicle fracture	1	3.03
Acetabulum fracture (ipsilateral)	1	3.03
Femur fracture (contralateral)	1	3.03
Maxillary fracture	1	3.03
Humerus fracture (contralateral)	1	3.03

Table 3: Surgical Characteristic

Surgical characteristic	No. of patients	Percentage
Surgical approaches		
Antero lateral	16	48.48
Antero medial	15	45.45
Combined Antero lateral and Antero medial	1	3.03
Postero medial	1	3.03
Method of reduction and fixation		
MIPPO	11	33.33
ORIF	22	66.67

Table 4: Mobilization and weight bearing

Active ROM exercise	No. of patients	Percentage
2nd day	22	66.67
1 week	2	6.06
4 weeks	2	6.06
6 weeks	7	21.21
Full weight in weeks		
8	1	3.03
10	3	9.09
12	13	39.39
14	9	27.27
16	5	15.15
18	1	3.03
20	1	3.03

Table 5: Duration of follow up

Follow up in weeks	No. of patients	Percentage
24-25	6	18.18
26-30	7	21.21
31-35	2	6.06
36-40	8	24.24
41-45	3	9.09
>46	7	21.21

Table 6: Fracture union

Fracture union in weeks	No. of patients	Percentage
8	1	3.03
10	3	9.09
12	14	42.42
14	8	24.24
16	5	15.15
18	1	3.03
20	1	3.03

Table 7: Range of motion [ROM]

ROM degree	No. of patients	Percentage
0-90	1	3.03
0-100	1	3.03
0-120	10	30.30
0-130	15	45.45
0-140	4	12.12
5-130	1	3.03
5-140	1	3.03

Table 8: Clinico-radiological outcome

Result	No. of patients	Percentage
Excellent	16	48.48
Good	14	42.42
Fair	3	9.09

Table 9: Functional outcome with the use of SF-36v2 PHS and MHS score

SF 36v2 scores	Range	Mean±SD
PHS	42-59	53.13 ± 4.13
MHS	46-60	54.88 ± 4.06

DISCUSSIONS

Proximal tibial fractures due to high energy mechanisms (Schatzker type IV,V,VI) are inherently unstable injuries associated with fracture comminution, displacement, severe soft tissue injury and a higher incidence of complications. Closed treatment of these complex fractures have resulted in a high percentage of complications (upto 70%) as seen in long term follow up in other studies[8].

The various clinical studies established that bone beneath a rigid conventional plate becomes thin and atrophic and is prone for secondary fracture after removal of implant. It is also seen that fracture site takes longer period to heal due to soft tissue and periosteal stripping[2]. To overcome these difficulties and for early restoration of bone strength, thereby improving the functions of the adjacent joints and to prevent disuse atrophy of muscles, a new implant was designed called the locking compression plate (LCP)[3]. In our clinical study, 33 cases of simple tibial plateau fractures treated only by surgical methods using locking compression plate were studied. The indications for the surgery were the same standard indications for the tibial plateau fractures. Bone graft and bone graft substitute was used primarily in 12 patients (36.36%).

In our series, average range of movement was 127^0 which is comparable with other studies as Stannard *et al.*[9] (average ROM 110^0) and Christian Boldin *et al.*[10] (average ROM 117^0). In our series we had average time for union of fracture was 13.27 weeks. Similar findings were noted by Stannard *et al.*[9] (15.6 weeks), Christian Boldin *et al.*[10] (11 weeks) and Lee *et al.*[11] (18 weeks).

We observed that all the fractures united without any need for secondary procedure (100%). It has been compared with other studies as Stannard *et al.*[9] (87%), Christian Boldin *et al.*[10] (96%) and Lee *et al.*[11] (100%). In our series one patient developed knee stiffness due to associated ACL avulsion injury and prolonged immobilization for 6 weeks. Treated with physiotherapy and regained 90^0 of flexion. In our series one patient with dual plating using combined antero medial and antero lateral approach had surgical wound edge necrosis. Necrosed skin was excised and closure done. Wound healed and sutures were removed on fifteenth day.

In our series, one patient with type V fracture developed valgus deformity due to comminution and inadequate reduction of lateral condyle. No further intervention was done. Outcome was fair because patient was immobilized for a longer period of time. Similar findings were noted by Stannard *et al.*[9] (1 valgus, 1 varus), Christian Boldin *et al.*[10] (1 varus) and Lee *et al.*[11] (1 varus).

In our series two patients had extensor lag, treated with physiotherapy. Two patient had redepression due to collapse of the elevated fracture fragment. No intervention was done for these patients and they are expected to have early arthritis. In our study, none of the patients had superficial or deep infection. Similar findings were noted by Christian Boldin *et al.*[10] while different findings were noted by Stannard *et al.*[9] (2 Superficial infection) and Lee *et al.*[11] (2 deep infection).

Quality of life (QOL) assessments that are easily administered and which do not impose a great burden on the respondent are needed for use in large epidemiological surveys, clinical settings and clinical trials[12]. Increasingly, health care planners are recognizing that measures of disease alone are insufficient determinants of health status. Over the past decades, two classes of complementary health status measures have emerged to fill the information

Table 10: Effect of time interval between injury and surgery

			Result			
Surgical interval	No. of patients	Percentage	Excellent	Good	Fair	p-value
1 days	10	30.30	9	1	0	0.019*
2-4 days	15	45.45	5	7	3	
5-7 days	7	21.21	2	5	0	
>7 days	1	0.03	0	1	0	
Total			16	14	3	

*-fisher exact test

Table 11: Complications

Complication	No.	Percentage
Extension lag	2	6.06
Knee stiffness	1	3.03
Redepression	2	6.06
Surgical wound edge necrosis	1	3.03
Valgus deformity	1	3.03

gap objective measures of functional health status and subjective measures of health and well-being[12]. This study was designed because of increasing trend towards using functional outcome scores beside the clinical scores for Quality of life assessment in tibial plateau fracture outcome assessment and because of lack of studies in which functional scores were used to evaluate outcome in all type of fractures. We have used SF-36v2 score for analysis of functional outcome. The mean SF-36v2 PHS score was 53.13±4.13 and mean SF-36v2 MHS score was 54.88±4.06, showing above average results in both physical and mental health domains as compared normal population. Which means Patient can get back to his pre injury functional status following surgical intervention with locking compression plate for tibial plateau fractures. The limitations of our study include less number of patients involved in the study and short term follow up.

CONCLUSION

Effectiveness of locking compression plate (LCP): The study demonstrates that the LCP is an effective treatment for tibial plateau fractures. This is evident from the high rate of fracture union (100%) without the need for secondary procedures and the average range of movement (ROM) achieved (127°), which is comparable to other studies.

Comparison with other studies: The results of this study align with those of other researchers like Stannard, Christian Boldin and Lee, in terms of time taken for fracture union and the percentage of successful outcomes. This reinforces the reliability of LCP in treating these fractures.

Complications and management: The study encountered complications such as knee stiffness, surgical wound edge necrosis, valgus deformity, extensor lag and redepression of fracture fragments. These complications were managed effectively with interventions like physiotherapy and surgical procedures. The incidence of these complications was generally in line with other similar studies.

Quality of life assessment: The use of SF-36v2 scores for assessing functional outcomes showed that patients generally returned to their pre-injury functional status, with above-average results in both physical and mental health domains. This highlights the importance of considering functional outcomes and quality of life in the assessment of fracture treatments.

REFERENCES

1. Weigel, D.P. and J.L. Marsh, 2002. High-energy fractures of the tibial plateau. J. Bone. Joint. Surg. Am. Vol., 84: 1541-1551.
2. Wagner, M., 2003. General principles for the clinical use of the lcp. Injury., 34: 31-42.
3. Messmer, P., P. Regazzoni and T. Gross, 2003. Neue stabilisierungsverfahren an der proximalen tibia (liss/lcp). Therape. Umschau., 60: 762-767.
4. Sommer, C., E. Gautier, M. Müller, D.L. Helfet and M. Wagner, 2003. First clinical results of the locking compression plate (LCP). Injury., 34: 43-54.
5. Stoffel, K., U. Dieter, G. Stachowiak, A. Gächter and M.S. Kuster, 2003. Biomechanical testing of the lcp-how can stability in locked internal fixators be controlled? Injury., 34: 11-19.
6. Kenneth, A., Egol. and J. Kennith, 2005. Fracture Of Proximal Tibia. In: Robert and henchman editors. Rockwood and Green's Fracture in Adult., Rockwood, S and Green., (Eds.)., Henchman, Philadelphia, pp: 1999-2025.
7. Whittle, A.,P. and W. George, 2005. Fracture of proximal tibia (tibial plateau). In: Campbell's Operative Orthopaedics, Canale, S.T., (Ed.)., Canale, Tibial Plateau, pp: 2783-2796.
8. Rasmussen, P., 1973. Tibial condyle fractures, impairment of knee joint stability as an indicator of surgical treatment. JBJS., 1331: 1331-1350.
9. Stannard, J.,P. and T.C. Wilson, 2004. LISS in treatment of complex fractures of tibial plateau, Short term results. JOT., 18: 552-558.
10. Boldin, C., F. Fankhauser, H.P. Hofer and R. Szyszkowitz, 2006. Three-year results of proximal tibia fractures treated with the liss. Clin. Orthop.s Related. Res., 445: 222-229.

11. Lee, J.,A. and S.A.Papadakis, 2007. Tibial plateau fractures treated with the LISS. Int. Orthop., 31: 415-418.
12. Skevington, S.M., M. Lotfy and K.A. O'Connell, 2004. The world health organization's whoqol-bref quality of life assessment: Psychometric properties and results of the international field trial. a report from the whoqol group. Qual. Life. Res., 13: 299-310.