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Surgical management of proximal tibia plateau fracture: 4 year prospective study

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Abstract
Introduction: Tremendous advance in mechanization and fastness of travel have been accompanied by steep increase in number and severity of fractures and those of tibial plateau are no exception. Knee being one of the major weight bearing joints of the body, fractures around it will be of paramount importance.
Materials and Methods: A 4 year prospective study was conducted, to know the functional outcome in operatively treated tibial plateau fractures in adults were included from BLDE University, Vijayapura. The total number 60 patients.
Results: Out of 60 cases treated with surgical procedure, 39 cases gave excellent result, 12 cases came out with good result, fair in 3 case and 3 case had poor result, mainly due to the severity of the injury and infections. It was found that high velocity injuries (type IV - VI) have poor outcome than low velocity injuries (type I-III) 4. All fractures united within expected time. Not a single case of nonunion was noted in our series. Average time for union was 14 weeks (range 10-22 weeks). The three cases had wound infection two had stiffness of the knee joint and one case had malunion.
Conclusion: We conclude that the functional outcome is good in operatively treated tibial plateau fractures in adults. The surgical management of tibial plateau fractures is challenging and gives excellent anatomical reduction & rigid fixation to restore articular congruity, fascilitate early knee motion by reducing post-traumatic osteoarthritis and thus achieving optimal knee function.

Keywords: Key words-proximal tibia fracture, MIPPO, knee stiffness, wound dehiscence

1. Introduction
Tibial plateau fractures are one of the commonest intra-articular fractures. They results from indirect coronal or direct axial compressive forces. They comprises of 1% of all fractures [1]. These fractures encompass many and varied fracture configurations that involve medial, lateral or both plateaus with many degrees of articular depressions and displacements. Each fracture type has its own characteristic morphology and response to the treatment. It is essential to determine the force of injury since high-energy trauma is associated with considerable soft tissue and neurovascular damage. Apart from tibial plateau bony injury, meniscal tear and ligament injuries should also be assessed [2].
Advance in mechanization and the acceleration of travel have been associated with increase in the number and severity of fractures. Fractures of the upper part of the tibia are no exception to this. The twentieth century has seen a lot of changes in medical field, especially in orthopaedic trauma. A better understanding of biomechanics, quality of implants, principles of internal fixation, soft tissue care, antibiotics and asepsis have all contributed to the radical change [3]. Thus we have advanced from the conservative approach to internal fixation in fractures as an acceptable mode of treatment.
Fractures of the upper tibia are difficult to treat, apart from the usual problems of confining patients to bed. Conservative treatment at any age, may be complicated by knee stiffness, malunion and nonunion. Open reduction and internal fixation has been advocated using various implants including Locking plates (MIPPO), Buttress plates, cancellous screws, external fixators etc., to achieve good fracture union and optimal knee function.

Materials and methods
A 4 year prospective study was conducted, to know the functional outcome in operatively treated tibial plateau fractures in adults were included from inpatients of Shri BM Patil Medical College Hospital and Research Centre, Vijayapura.

The total number of cases studied was 60. Those patients who where between the age of 20 and 60 years and operatively treated were included in this study to know the functional outcome after the surgery.

The objective of the study were to know functional outcome of fracture healing in operatively managed tibial plateau fractures treated with plates and screws, screws alone and with hybrid fixation and to restore the optimum functions in fractured limbs with tibia plateau fractures as early as possible. The patients who are between the ages of 18 and 60 with tbia plateau who were managed surgically are included in the study. Fractures in children and those below 18 years and above 60 years of age and those treated non surgically, medically unfit patients and pathological fractures are excluded from the study.

Out of 60 patients treated surgically, 30 cases treated with MIPPO locking plate, 6 cases with cancellous screws and bone grafting, 12 patients were treated with bicondylar locking plate and buttress plate, 6 patients were treated with bone grafting and buttress plate, 6 cases were treated with hybrid fixator.

Whenever rigid internal fixation was achieved, the patient was mobilized 48 hours after removal of the drains, for 2- 5 days the range of motion allowed was 0-20°, from the 5th day the range of motion was gradually allowed to be increased to 90° or more. After suture removal, full range of movement was allowed. Whenever there was doubt about the rigidity of fixation, external splinting in the form of plaster of paris slab was given for support. Range of motion exercises (CPM) were done daily under careful supervision and splint reapplied. All the patients were taught and advised to do static quadriceps exercises and dynamic exercises with a quadriceps board as much as possible and throughout the day.

Partial weight bearing was delayed until 6 – 8 weeks and full weight bearing allowed after 12-16 weeks. The best time for open reduction and internal fixation was within 4 hours of injury or 1 week after the injury, when the swelling and the inflammatory reactions have subsided.

Results

Functional outcome of results was done in relationship to age, sex, occupation, laterality of fracture, type of fracture, method of treatment, duration of immobilisation, complications and the remarks of different age groups in details is as follows. The youngest being 18 years and the eldest being 60 years.

The tibial plateau fractures are commonly seen in the active and productive age group in our setup as they engage in more activities and travels. The type of fracture and fracture pattern depends on many factors like amount of force, age, degree of knee flexion, rate of loading of force, valgus/varus stresses, etc. The graph shows patient age groups Vs number of cases.

In our series, the majority of the patients are found to be between the age group of 31-40 years (39) and 41-50 years (15).

The least number of cases are found in the age group between 21-30 (3) and 51-60 (3) years.

The increased incidence of male sex in upper tibial fractures can be attributed to an over whelming large proportion of male patients, because in our Indian setup, the female population largely work indoors or in the agricultural fields and do not indulge themselves in travelling or out door activities.

The relationship of fractures to different occupations is shown below.

The tabular column clearly shows that the major preponderance of upper tibial fracture is seen in people with a high level of activity, who indulge themselves in travelling like businessmen, because all cases are due to R.T.A. Workers and labourers tend to have violent injuries commonly due to industrial accidents, automobile accidents, housewives sustaining fractures through fall from height, when they climb up ladder or stool to pickup objects from the shelves.

In our series, there was right sided predominance, compared to the left side.

In our series, the majority of the fractures were found to be of type III and type V fracture types i.e., pure cleavage fractures and medial condyle fractures.

None of the patients were immobilized when secure, rigid fixation was done. When there was doubt about rigidity of fixation, associated ligament injury or ostoeporosis the immobilization extended preferably in above knee cast upto 3 weeks. Two cases of infection and another case of severe metaphyseal comminution had to be immobilized for 6-8 weeks.

Most of the cases had good range of painless knee motion (0-130°), except for the last group where one patient developed knee stiffness.

All fractures united within expected time. Not a single case of nonunion was noted in our series. Average time for union was 14 weeks (range 10-22 weeks). The three cases had wound infection two had stiffness of the knee joint and one case had malunion.

Out of 60 cases treated with surgical procedure, 39 cases gave excellent result, 12 cases came out with good result, fair in 3 case and 3 case had poor result, according to Rasmussen Functional score mainly due to the severity of the injury and infections. It was found that high velocity injuries (type IV – VI) have poor outcome than low velocity injuries (type I-III) [4].

Discussion

In the early half of the 20th century an author reported two studies having satisfactory percentage of good to excellent short and long term results with surgical method of treatment [5, 6].

In another published study of 159 cases of Tibial plateau fracture of all types, treated by conservative (46%) and surgery (54%), evaluated by Hohl and Luck method, reported better good-excellent results in surgery (84%) than conservative (62%) methods [7].

Roberts [8] in 1968 reported 100 cases of tibial condyle fractures treated by conservative and surgical. The results were good in 72% conservative, 80% tractions-mobilisation and 81% surgical. He advocated early mobilization, preservation for menisci and repair of torn ligaments for best results.

Another study of 68 cases, both non-surgical and surgical methods observed excellent-good results in 96% of cases by conservative methods with depression < 10mm, 47% in depression > 10 mm and 80% in surgical methods. They advocated good anatomical reduction for best results [9].

Schatzkar [10], in 1979, reported 70 cases of tibial plateau fractures of all types treated by conservative (56%) and surgical (44%) methods with average follow- up of 28 months. Acceptable results were obtained in 58% of cases of conservative group and 78% by open methods. Fractures treated by ORIF with buttress plate and Bone grafting achieved 88% acceptable results.

A study of 278 cases of tibial plateau of fractures with an average follow up of 2.5 years, all treated by surgical methods. 89% acceptable results when surgery was done by inexperienced surgeons, 97% when done by experienced. They concluded the prognosis improves with the experience and with accurate reconstruction of articular surface. They also said posttraumatic osteoarthritis was directly proportional to

the amount of displacement [11].

The fracture of the proximal end of the tibia, particularly intra-articular ones, are considered to be difficult management problems because of the malalignment, incongruity and instability that frequently result from their surgical or nonsurgical treatment. Cadavaric and clinical studies reproduced the same results. They concluded that loss of articular congruity leads to the degenerative arthritis and is less likely to produce so if joint function is maintained. However, there is no general agreement or clear understanding as to the degree of incongruity, malalignment or residual instability necessary to produce such clinical symptoms [12].

Most recently, the minimal invasive methods of fixation like MIPPO has made a difference in treating tibial plateau fractures. A published report in 2005 has shown excellent results with key hole incision and using locking compression plate. The results of this study are encouraging because of less infection rate, minimal soft tissue damage, high rate of early fracture union and above all it is a biological fixation [13].

Name of the authors	Year	Amount of depression
Burri [11]	1979	1mm
Hohl [14]	1979	5mm
David Segal [15]	1991	5mm
Seppo E. [16]	1993	3mm
Our series	2016	3mm

Amount of fracture fragment depression seen in various studies

In our series, Schatzkar type III and type V dominated the total fractures making 70%.

Type of %	Tampere Hosp. Finald [16]		Wellesley Hosp. Toronto [17]		Our series	
	No	%	No	%	No	%
Type I	15	11.5	4	6	4	7
Type II	40	30.5	18	25	8	13
Type III	13	9.9	25	36	30	50
Type IV	12	9.2	7	10	6	10
Type V	18	21.3	2	3	10	10
Type VI	23	17.5	14	20	2	10

Comparisions of Schatzkar classification type encountered in other studies we have not formulated the stringent criteria as to particular method of fixation for particular type of fracture. So each case was individualized and treated accordingly as it needed. Most of the type I, some type II were treated with percutaneous cancellous screw fixation. The split fracture, of >3mm displacement was treated by MIPPO LCP. Bone grafting was included along with ORIF with Buttress plate and screws in type II, III, V and VI wherever necessary.

The benefits of early knee motion include - reduce knee stiffness and improved cartilage healing (regeneration). However, these benefit are to be cautiously balanced by risks, including loss of fracture reduction, failure of internal fixation and compromised ligament and soft tissue healing. Schatzker, Robert McBroom in 1978, Magonhobi, Steven and Gauscwitz in 1984 stated that the prognosis is given by the degree of displacement, type of fracture, method of treatment and quality of postoperative care [10].

Patients in whom operation could not be carried out and in patients who have <3mm articular step off are treated conservatively which are not included in this study.

The major problem faced by us during the study was infection and wound dehiscence, hence immobilization was more in these patients. Inspite with all these associated bony fractures ligament injuries and complications, we are able to achieve 60% excellent result 30% good results (overall 90% acceptable results) with our standard surgical care using various standard fixation methods. In addition we have 5% fair and 5% poor results in terms of functional outcome. These results are comparable and on par with other documented standard studies.

Seppo E. 1993 [16] - 86% satisfactory
Joseph Schatzkar [10] 1986 - 86% satisfactory
Our study 2007 - 90% satisfactory.

Comaprisions with other studies

Table 1: Age Distribution

Age in years	No. of cases	Percentage
21-30	3	5%
31-40	39	65%
41-50	15	25%
51-60	3	5%
Total	60	100%

Table 2: Sex incidence

Sex	No. of cases	Percentage
Male	54	90%
Female	6	10%
Total	60	100%

Table 3: Association of injury with occupation

Occupation	No. of cases	Percentage
Agriculturist	9	15%
Employee	12	20%
Businessman	27	45%
Housewife	6	10%
Labourer	6	10%
Total	60	100%

Table 4: Laterality of fracture

Laterality of fractures	No. of cases	Percentage
Right	39	65%
Left	21	35%
Total	60	100%

Table 5: Classification according to Schatzker classification

Type of fractures	No. of cases	Percentage
I) Pure cleavage	4	7%
II) Cleavage with depression	8	13%
III) Central depression	30	50%
IV) Medial condyle fracture	6	10%
V) Bicondylar fracture	10	17%
VI) Metaphysio diaphyseal dissociation	2	3%

Table 6: Type of fixation used

Methods of treatment	No. of cases	Percentage
Mippo lcp	30	50%
Orif with buttress plating	6	10%
Bicondylar plating	12	20%
Cancellous screw with bone grafting	6	10%
Hybrid fixator	6	10%

Table 7: Complication

Complications	No. of cases
Knee stiffness	2
Malunion	1
Infection and wound dehiscences	3

Table 7: clinical results according to Rasmussen Functional score

Clinical results	No. of cases	Percentage
Excellent	36	60%
Good	18	30%
Fair	03	05%
Poor	03	05%

Case 1

Fig 1a: Preoperative anteroposterior and lateral view.

Fig 1b: Immediate postoperative 6 weeks follow up.

Fig 1c: 3 months follow up.

Fig 1d: 6 months follow up.

Fig 1e: Complete extension.

Fig 1f: Complete flexion.

Fig 1g: Full weight bearing.

Case 2

Fig 2a: Preoperative-AP view.

Fig 2b: Immediate postoperative AP.

Fig 2c: 3 months follow up AP view lateral view.

Fig 2d: 6 months follow up shows union.

Fig 2e: Flexion.

Fig 2f: Extension lag of 10 degrees.

Fig 2g: Full weight bearing.

Case 3

Fig 3a: Preoperative AP and lateral view.

Fig 3b: Postoperative AP and lateral view.

Fig 3c: Complete extension.

Fig 3d: Complete flexion.

Fig 3e: Full weight bearing.

Conclusion

We conclude that the functional outcome is good in operatively treated tibial plateau fractures in adults. The surgical management of tibial plateau fractures is challenging and gives excellent anatomical reduction & rigid fixation to restore articular congruity, fascilitate early knee motion by reducing post-traumatic osteoarthritis and thus achieving optimal knee function. In the background, it reminds us to remember the remarks given by Hohl at the presidential guest lecture at the Chicago Orthopaedic Society (1997). "These fractures are tough".

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