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Functional outcome of surgically treated Tibial plateau fractures

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Abstract

Background: Proximal tibia fractures are one of the commonest fractures encountered. The optimal treatment of such fractures are very important as the proximal tibia is one of the major weight bearing surface in the lower limb and it largely depends upon accurate articular reduction and the condition of the surrounding soft tissues. Thus this study aims at assessing the functional outcome of surgically treated tibial plateau fractures.

Materials and Method: A prospective study of patients admitted with tibial plateau fractures from the period of May 2014 to December 2015 who were surgically treated. The functional outcome was assessed using WOMAC score and Harkonen-Jarvinen criteria after a mean follow-up of one year. The statistical analysis was done using the paired t-test.

Results: The present study included 15 patients diagnosed with Tibial Plateau fractures. The mean duration of surgery was 2 hours & 46 minutes. The mean blood loss was 220ml. The average time to union was 122 days. The mean range of motion of knee joint was 115°. Two patients developed knee instability & was diagnosed to have Anterior Cruciate ligament injury & Medial Meniscal injury respectively by diagnostic arthroscopy. The mean WOMAC score was 11.2. All the four parameters of HJ criteria were decreased postoperatively.

Conclusion: The fractures of proximal tibia represent a wide spectrum of severity. The functional outcome of Tibial plateau fractures following surgery is good. However, surgery needs to be done once the soft tissue swelling decreases, articular reconstruction, and valgus/varus malalignment correction needs to be given preference, before internal fixation of such fractures.

Keywords: Tibial plateau fracture, surgical management, womac score, harkonen-jarvinen criteria

Introduction

Proximal tibial fractures are difficult lesions to treat because of the involvement of the articular surface, the often occurring comminution, and the precarious condition of the soft tissues, especially following high-energy trauma¹. Accurate anatomical articular reduction and internal fixation without compromising the soft tissues is the treatment choice^[2]. High-energy tibial plateau fractures are often associated with severe soft-tissue injury. Even though numerous surgical options are available they do not always guarantee a favorable outcome. Surgical options includes internal and external fixation, hybrid fixation and arthroscopically assisted techniques with plates according to fracture configuration. Operative management remains difficult and challenging and serious complications such as knee stiffness, ankylosis, deep infection, post-traumatic arthritis, malunion and nonunion³ may be associated with it.

There are various treatment options available, for tibial plateau fracture ranging from simple screw fixation to ilizarov fixation, functional outcome of surgically treated tibial plateau fracture need to be evaluated, for proper patient selection, timing of surgery, appropriate implant usage to avoid catastrophic complications.

Aim of the study

To study the Functional Outcome of Surgically treated Tibial Plateau fractures.

Materials and Methodology

Study area: Department of Orthopedics, Chettinad Hospital and Research Institute, Chennai.

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Study population: Diagnosed Tibial plateau fractures as confirmed by radiographs.

Study period: May 2014 to December 2015.

Sample size: 15 patients

Study type: Prospective Study

Parameters to be studied

1. Clinical history
2. Physical examination
3. X- ray knee joint AP & Lateral view
4. 3-D CT scan.

Inclusion criteria

- Patients admitted with history of trauma & diagnosed to have closed tibial plateau fractures.
- All patients with more than age of 18 years
- All patients who were ambulatory before the injury

Exclusion criteria

- Fractures in patients with surgically inoperable co-morbid conditions.
- Ipsilateral femur fractures.
- Patients with tibial plateau fractures treated conservatively with casting.

Study design

The study began after receiving approval from the Institutional Research Ethical Committee of Chettinad Hospital & Research Institute, Kelambakkam. All the patients who were diagnosed to have tibial plateau fracture, admitted through casualty or through outpatient department satisfying the inclusion criteria were enrolled into the study after getting

due informed consent. Detailed clinical history and thorough physical examination of those selected patients has been done. Diagnosis of Tibial plateau fractures done by plain radiographs & 3-D CT scan & the fractures were classified as per Schatzkar classification

Results

The Present Study included 15 patients diagnosed with Tibial Plateau fractures. Mean duration of surgery was 2 hours & 46 minutes. Mean blood loss was 220ml. Average time to union was 122 days. Mean range of motion of knee joint was 115°. There was no major infections. 2 Patients developed knee instability which was diagnosed during 6th month postop review & found to have Anterior Cruciate ligament injury & Medial Meniscal injury by diagnostic arthroscopy.

Table 1: WOMAC score

| Patient Name | Age | Sex | Womac Score |
|-------------------|-----|-----|-------------|
| 1. Vasantha | 40 | F | 15/96 |
| 2. Rajendran | 49 | M | 6/96 |
| 3. Rajavel | 35 | M | 15/96 |
| 4. Balachander | 30 | M | 4/96 |
| 5. Mohideen Basha | 40 | M | 26/96 |
| 6. Vanitha | 33 | F | 12/96 |
| 7. Amudha | 40 | F | 16/96 |
| 8. Poongodi | 61 | F | 10/96 |
| 9. Mariya Suseela | 47 | F | 7/96 |
| 10. Murugesan | 49 | M | 9/96 |
| 11. Shiva | 35 | M | 11/96 |
| 12. Malliga | 42 | F | 15/96 |
| 13. M.N.Rajan | 47 | M | 8/96 |
| 14. Jayaraman | 50 | M | 7/96 |
| 15. Ramkumar | 34 | M | 12/96 |

Table 2: Harkonen-Jarvinen criteria

| SL. NO | Name | Subjective | Clinical | Functional | Radiological |
|--------|----------------|-----------------|-----------------|-----------------|-----------------|
| | | Criteria | Criteria | Criteria | Criteria |
| | | Score & Outcome | Score & Outcome | Score & Outcome | Score & Outcome |
| 1 | Vasantha | 4-Excellent | 4-Good | 4-Excellent | 14-Poor |
| 2 | Rajendran | 8-Good | 9-Fair | 3-Excellent | 12-Fair |
| 3 | Rajavel | 10-Good | 10-Good | 9-Fair | 12-Fair |
| 4 | Balachandar | 2-Excellent | 6-Good | 5-Good | 9-Fair |
| 5 | Mohideen Basha | 12-Fair | 7-Good | 13-Poor | 9-Fair |
| 6 | Vanitha | 12-Fair | 8-Good | 11-Fair | 12-Fair |
| 7 | Amudha | 6-Good | 6-Good | 9-Fair | 8-Good |
| 8 | Poongodi | 13-Fair | 6-Good | 10-Fair | 10-Fair |
| 9 | Mariya Suseela | 7-Good | 4-Excellent | 4-Excellent | 8-Good |
| 10 | Murugesan | 10-Good | 4-Excellent | 5-Good | 11-Fair |
| 11 | Shiva | 12-Fair | 5-Good | 5-Good | 7-Good |
| 12 | Malliga | 12-Fair | 9-Fair | 9-Fair | 8-Good |
| 13 | M.N.Rajan | 6-Good | 5-Good | 4-Excellent | 8-Good |
| 14 | Jayaraman | 2-Excellent | 4-Excellent | 5-Good | 10-Fair |
| 15 | Ramkumar | 10-Good | 2-Excellent | 2-Excellent | 8-Good |

Table 3: Radiological Criteria

| SL. NO | NAME | AD | CW | VT | PT | AD | CW | VT | PT |
|--------|----------------|--------|--------|--------------|-------|--------|--------|--------------|-------|
| 1 | Vasantha | 10.5mm | 5.6mm | 15.7° valgus | 24° | 10.7mm | 2.3mm | 11° valgus | 11° |
| 2 | Rajendran | 8mm | 5.3mm | 11° valgus | 12° | 6.8mm | 3mm | 8° valgus | 9° |
| 3 | Rajavel | 6.5mm | 7.4mm | 9° valgus | 35° | 6.3mm | 5mm | 3° valgus | 11° |
| 4 | Balachandar | 7mm | 3mm | 5° valgus | 15° | 3mm | 2mm | 4° valgus | 10° |
| 5 | Mohideen | 15.2mm | 5.4mm | 8° varus | 15° | 4.5mm | 1.5mm | 3.08° valgus | 4.4° |
| 6 | Vanitha | 7.6mm | 9.2mm | 8° valgus | 11° | 5.5mm | 6mm | 6° valgus | 10° |
| 7 | Amudha | 1mm | 8mm | 10° | 9.27° | 0.2mm | 3.5mm | 7° | 5.8° |
| 8 | Poongodi | 13mm | 8.4mm | 13.9° valgus | 20° | 2mm | 2mm | 14° valgus | 4.44° |
| 9 | Mariya Suseela | 3.6mm | 12.6mm | 3° valgus | 6.42° | 2mm | 4.2mm | 3° valgus | 5° |
| 10 | Murugesan | 6.5mm | 15.6mm | 2° valgus | 7° | 5.5mm | 10.2mm | 2° valgus | 4° |

| | | | | | | | | | |
|----|-----------|--------|--------|-----------|--------|-------|-------|-----------|--------|
| 11 | Shiva | 1.5mm | 5.3mm | 3° valgus | 8.94° | 0.2mm | 4.4mm | 2° valgus | 5.52° |
| 12 | Malliga | nil | 0.9mm | 2° valgus | 12.63° | nil | 0.4mm | 2° varus | 10.24° |
| 13 | M.N.Rajan | 2.5mm | 11.5mm | 5° valgus | 8° | 0.5mm | 7.5mm | 3° valgus | 3° |
| 14 | Jayaraman | 11.5mm | 5mm | 7° valgus | 2° | 7.5mm | 2.6mm | 2° valgus | 2° |
| 15 | Ramkumar | 3.5mm | 3.7mm | 7° valgus | 10° | 1.5mm | 1.5mm | 2° valgus | 5° |

AD - Articular Depression
 CW - Condylar Widening
 VT - Varus/Valgus Tilt
 PT - Plateau Tilt

Statistical Analysis

Mean WOMAC score was found to be 11.2/96. (Range- 4 to 15). The Mean range of pre-op & post-op values of articular depression, condylar widening, Plateau tilt & Plateau slope angle are tabulated below.

Table 8: Mean & Range of Radiological values

| Parameter | Mean | Mean | Range | Range |
|----------------------|-------------|-------------|-----------------|----------------------|
| | Preop | Postop | Preop | Postop |
| Articular Depression | 6.56mm | 3.50mm | 7mm to 15.2mm | 3mm to 10.7mm |
| Condylar Widening | 7.6mm | 3.74mm | 3mm to 15.6mm | 2mm to 7.5mm |
| Plateau tilt | 6.4° valgus | 4.12°valgus | -13.9° to 15.7° | -3.08° to 14° Valgus |
| Plateau Slope angle | 13.084° | 6.7° | 2° to 35° | 2° to 11° |

Statistical analysis was done using paired t-test. All the four parameters showed decreased values postoperatively, and this was found to be statistically significant $p < 0.05$.

Table 9: Correlation of Radiological criteria

| Parameter | N | Correlation | Sig. |
|-----------------------------------|----|-------------|------|
| Articular depression pre and post | 15 | .823 | .000 |
| Condylar widening pre and post | 15 | .693 | .004 |
| Plateau tilt pre and post | 15 | .794 | .000 |
| Plateau slope angle pre and post | 15 | .647 | .009 |

The WOMAC & Functional score are not affected by Age & Sex distribution.

Illustrative cases



Fig 1: Cases



Fig 2: At one year, after removal of fixator



Fig 3: Immediate postop



Fig 4: (f)

Discussion

Tibial plateau fractures are the most common type of injuries treated by an Orthopaedic Surgeon. However the true incidence of this fracture pattern is not documented in the literature. Management of tibial plateau fracture holds significance as fracture pattern, energy of fracture, soft tissue injury should be taken into account in decision making. Most low energy simple fractures of tibial plateau can be treated by means of internal fixation with screws alone or with plates whereas complex fractures requires varying modalities of fracture fixation.

In our study of 15 patients, 14 patients (93.3%) had a WOMAC score of less than 24 irrespective of age and gender and only one patient (6.7%) had a score above 24 As per HJ criteria, the subjective criteria were excellent in 3 patients (20.0%), good in 7 patients (46.7%) & fair in 5 patients (33.3%). The clinical criteria were excellent in 4 patients (26.7%), good in 9 patients (60%) & fair in 2 patients (13.3%). The functional criteria were excellent in 5 patients (33.3%), good in 4 patients (26.7%), fair in 5 patients (33.3%) & poor in 1 patient (6.7%). The radiological criteria were

good in 6 patients (40.0%), fair in 8 patients (53.3%) & poor in 1 patient (6.7%).

In a study conducted by Stevens DG *et al.* [25] scores for all groups irrespective of age and gender resulted in no statistically significant difference which was similar to our study.

In our study 2 patients developed knee instability which was diagnosed in the 6th month post-op review and found to have Anterior Cruciate ligament injury & Medial Meniscal injury by diagnostic arthroscopy. In a study by Forman JM *et al.* [28] fifty-four patients with 56 tibial plateau fractures (55%) were found to have an associated meniscal tear. The average amount of joint depression in this group was 12.3 mm (range: 2.0 to 29.5 mm). The remaining 45 patients with 45 fractures (45%) had an average depression of 5.4 mm (range: 0.0 to 12.8 mm). Degree of tibial plateau depression was the only significant predictor of meniscal injury.

Incidence of Osteoarthritis- In our study majority of the patients were young adults. No osteoarthritic changes were noted at the end of one year follow-up. Decoster *et al.* [48] reported 32% of patients had radiological changes with an average follow-up of ten years. Jensen *et al.* [49] reported moderate to severe changes in 20% in follow-up of 106 cases. Rasmussen [50] reported 17% overall incidence of posttraumatic OA in his series of 260 fractures; however, its incidence in the bicondylar group was 42%. Rademakers *et al.* [26] reported a 31% incidence of osteoarthritis with symptomatic degeneration, which was more severe in cases where malalignment of more than 5 degrees was present. Gaudinez *et al.* [51] reported 83% of radiological changes in one year follow-up of patients with comminuted tibial plateau fractures.

We are aware that our study has a number of limitations including a small sample size, short term follow-up, use of different methods of fracture fixation & it is not a single surgeon's series.

The majority of the studies done used the KOOS score, WOMAC score, SF-36 questionnaire, Modified Rasmussen's criteria for assessing the functional outcome. Our study is unique in that way since none of the other studies have utilised the Harkonen-Jarvinen criteria which contains all the necessary criteria such as subjective, clinical, functional and radiological scores for assessing the functional outcome. Hence comparison was not possible with other studies.

Summary

The Tibial plateau fracture is one of the commonest fractures encountered by an Orthopaedic surgeon in a day to day practice. The severity of injury, condition of soft tissues & the general condition of the patient are some of the factors helpful in deciding the timing & the choice of surgery to be performed. In the study conducted in our institution with a total of 15 patients with tibial plateau fractures which were diagnosed with plain radiographs & 3-D CT scan, the functional outcome was determined with the help of WOMAC score & HARKONEN-JARVINEN (H-J) criteria. Both WOMAC score & H-J criteria showed good results indicating a favourable functional outcome following surgery. All the four parameters in the radiological criteria were decreased postoperatively.

Conclusion

The Tibial plateau is one of the major weight bearing surface in the lower limb. The knee flexion is essential in normal locomotion. Functional outcome of Tibial fractures following

surgery is good. However, surgery needs to be done once the soft tissue swelling becomes minimal, articular reconstruction, valgus/varus malalignment correction needs to be given preference, before internal fixation of fracture with appropriate plates & screws.

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