SURGICAL MANAGEMENT OF TIBIAL PLATEAU FRACTURES USING MINIMALLY INVASIVE TECHNIQUE WITH LOCKING COMPRESSION PLATING

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ABSTRACT

BACKGROUND

The objective of this study is to study the functional outcome of internal fixation of tibial plateau fractures by minimally invasive locking compression plating.

MATERIALS AND METHODS

A prospective study of internal fixation of tibial plateau fractures fixed with locking compression plating using minimally invasive technique was conducted during the period from Nov. 2013 to Nov. 2015 at Shadan Institute of Medical Sciences, Hyderabad, T. S.

Study sample size - 20 patients both male and female aged 20 to 70 yrs. admitted for tibial plateau fractures and operated between Nov. 2013 and Nov. 2015 and fulfilling the inclusion criteria were enrolled in a prospective study of 2 years' duration from Nov. '13 to Nov. '15. The followup period was 6 to 18 months. All cases were post traumatic.

RESULTS

Minimally invasive procedure using locking compression plating for fixation of tibial plateau fractures gives good results, as there is less soft tissue damage and stable fixation and comparatively better functional outcome.

CONCLUSION

This surgical procedure is a better option for fixation of tibial plateau fractures in terms of overall functional results.

KEYWORDS

Tibial Plateau Fractures, Minimally Invasive Technique, Locking Compression Plate, Internal Fixation, Functional Outcome.

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BACKGROUND

Management of tibial plateau fractures are being modified continuously, tibial plateau fractures are one of the common fractures because of exposure of lower limbs to trauma and its management is crucial because of weight bearing nature of lower limbs. Before deciding on the line of management keep in mind following facts:

1. Extent of damage in tibial plateau fractures is often greater than what is seen on x-ray.
2. Malunion is extremely common, whereas nonunion is unknown.
3. Painful knee and stiffness are the most serious and common complications of tibial plateau fractures.

The LCP is an example of new technology, which combines the principle of limited contact compression and locked internal fixation. The operative treatment of the fracture using plates and screws is a successful technique. Internal fixation with plates and screws leads to additional trauma and disturbance of blood supply to bone.

To overcome these difficulties, the recently developed locking compression plating is gaining popularity. The technology supports what is known as MIPPO. The LCP technology offers improved fixation stability in osteoporotic bone, comminuted and periarticular fractures.¹

Aims and Objectives

1. To study the functional outcome of management of fractures of tibial plateau.
2. To study the duration to achieve the union in tibial plateau fractures treated with LCP.
3. To assess the range of motion of knee joint and functional outcome after surgical management.

Review of Literature

Fractures of tibial condyles were brought into prominence in 1929 by the papers of Cotton F. J. and Berg R. in Boston and Cubbins W. R., Seiffert G. and Coneley A. H. from Chicago.

In 1940 Barr J. S. described the operative treatment of tibial plateau fractures, where depressed plateau is elevated by spike and supported by cancellous bone grafts.² In 1956, G. Apley published the series of patients treated by skeletal traction and early mobilisation with excellent results.³

In the meantime, different experimental studies were carried out. Haldeman K. O. in 1939 proved that hyaline cartilage is replaced by fibrocartilage. Hohl M. in 1956 proved that prolonged immobilisation leads to formation of intra-articular adhesions.

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A. G. Apley in 1956, Hohl M in 1956, Rasmussen P. S. in 1973 put forward the system of grading the results.⁴

Moore T. M. and Harvey J. P. in 1974 describing the plateau view of measuring the exact depression of tibial plateau.⁵

Many varieties of implants have been developed and used to fix the plateau fractures. Later A. O. (ASIF) described the surgical treatment to be mandatory for tibial plateau fractures.

Aim is to achieve anatomical reduction, rigid internal fixation and early mobilisation.

Wilsons and Jacobs in 1952 used the articular surface of the patella for replacing the severely depressed comminuted fractures of lateral condyle.⁶

Rasmussen S. Poul and Gothenberg in 1973, followed a series of 260 fractures of one or both condyles. The main indication of surgery was evidence of instability of extended knee.⁷

Schatzker and McBroom in 1979 considered that open reduction with anatomical restoration of articular cartilage provides best results.⁸

The operative treatment of fracture using plate and screws is a successful technique. Internal fixation with plate and screws leads to additional trauma and disturbance of blood supply to bones.

To overcome these difficulties, the recently developed locking compression plating is gaining popularity.

Surgical and Applied Anatomy

Fracture patterns in proximal tibia are dictated by the forces applied combined with the osseous anatomy of proximal tibia. Occasionally, muscle forces or ligament attachments play a part in the fracture pattern.

Gross Anatomy

Schatzker's Classification

Mechanism of Injury

Tibial plateau fractures are intra-articular fractures of proximal tibia with the highest incidence in the 3rd to 5th decades of life.

The magnitude, type and direction of forces that injure the knee dictate the fracture pattern, the greater the energy absorbed by the proximal tibia the more severe is the fracture and more the fragments are displaced and comminuted.⁹ Generally, axial loading forces are more rapid and release greater energy than angular forces.

Tibial plateau fractures also have typical local soft tissue injuries that are important to recognise, because they may influence management and prognosis. Associated intra-articular soft tissue injuries to both cruciate ligaments and menisci play a role in managing tibial plateau fractures.¹⁰

Posterior View of Specimen Anterior View

CT-Image of Fracture Anterior View

MATERIALS AND METHODS

A prospective study on tibial plateau fracture fixation with locking compression plating using minimally invasive technique was conducted in the period from November 2013 to November 2015.

Study Area

Shadan Institute of Medical Sciences, Hyderabad, T. S.

Study Population

All male and female patients aged 20 to 70 years admitted in the hospital.

Study Sample Size

Twenty patients who were admitted and operated between Nov. 2013 and Nov. 2015 and had fulfilled the inclusion criteria were enrolled for the study.

Duration of Study

Nov. 2013 to Nov. 2015 (2 years).
Followup ranged from 6 to 18 months.
All the fractures were post-traumatic.

Inclusion Criteria

1. The patients with tibial plateau fractures (Schatzker classification).
2. Age 20 to 70 years.
3. Patients with Gustilo-Anderson type 1 and 2 tibial plateau fractures.

Exclusion Criteria

1. Patients with pathological fractures.
2. Gustilo-Anderson type 3 tibial plateau fractures.
3. Associated segmental tibial fractures with plateau fractures.
4. Ipsilateral femoral fractures.
5. Children before closure of epiphyses.
6. Gross comorbid conditions.

General Principles for using LCP¹¹

Conventional compression plating needs good bone quality and precise anatomical reduction. In multi-fragmentary shaft fractures, precise anatomical reduction is often not possible without a great risk of an iatrogenic soft tissue trauma. The primary and the secondary loss of reduction leading to

malalignment and instability. Conventional plating leads to compression of the periosteum, which causes a disturbance of the blood supply. Plate and screw systems where the screw can be locked in the plate form, one stable system and the stability of the fracture depends on the stiffness of the construct.

No compression of the plate on the bone is required to suppress the risk of primary loss of reduction and preserve the blood supply. Locking the screws in the plate ensures both angular as well as axial stability and eliminates the possibility of the screw to toggle, slide or be dislodged.

The LCP with combination holes allows the surgeons to use it as a conventional plate as well as an internal fixator with locking head screws. There are different indications to use LCP for different techniques and biomechanical principles.

Locking Compression Plate and Screws: Implants

LCP screw. Hockey stick, buttress plate, LCP.

Locking L-Plate Locking Buttress Plate

Surgical Procedure

Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) with Locking Compression Plate for Tibial Plateau Fractures

All surgeries were performed on an elective basis using standard procedures under spinal or general anaesthesia. In supine position, ipsilateral iliac crest was prepared and draped for possible autogenous bone grafting. Fracture was reduced indirectly under C-arm guidance by using a proximal pin in the distal femur and a distal pin in tibia distal to fracture; 2 mm K-wires were used as joy stick to reduce and hold fracture fragments. Temporary fixation was done with K-wires.

An incision of 2 to 3 cms over proximal aspect of tibia over the medial or lateral side (depending on the fracture pattern) was taken. A submuscular plane was created and a pre-contoured stainless steel 4.5 mm locking compression plate was slid in the anterior submuscular plane. The plate was held in place by K-wires. It was then fixed with screws, which were inserted percutaneously through the primary surgical incisions. Distally, 3.2 mm drill bit was used for drilling and 4.5 mm cortical screws were inserted and fixed. Reduction was satisfactory and wound closed.

Post-Operative X-Rays and Schematic Diagram of LCP

Mobilisation

Splints are removed and mobilisation of the limb started on the 3rd or 4th postoperative day. Mobilisation with non-weight bearing was started from the first post-operative week till 6 to 8 weeks.

Depending on the fracture pattern and then partial weight bearing after confirmation of beginning of healing process till fracture union.

Follow-up: At the time of discharge the patients were asked to come for follow-up after 6 weeks and for further follow-up at 3 months, 6 months and 1 year. The patients who turned for followup or whose details could be collected were finally taken up for the assessment of functional results.

At follow-up, patients were evaluated according to Neer's scoring system for pain, limp, the use of support, walking distance, ability to climb stairs, ability to squat and sit cross-legged, ability to put on shoes and socks sitting on chair, ability to enter the public transportation, deformities, leg length discrepancy and movements. The radiograph of operated tibial plateau was taken at regular intervals at each followup.

RESULTS

Age (Years)	No. of Patients	Percentage
20 - 30	06	30
31 - 40	06	30
41 - 50	06	30
51 - 60	01	5
61 - 70	01	5
TOTAL	20	100

Table 1. Age Distribution

Sex	No. of Patients	Percentage
MALE	18	90
FEMALE	2	10

Table 2. Sex Distribution

Mechanism of Injury	No. of Cases	Percentage
ROAD TRAFFIC ACCIDENT	17	85
FALL FROM HEIGHT	03	15
TOTAL	20	100

Table 3. Mechanism of Injury

Schatzker	No. of Cases	Percentage
TYPE-1	01	5
TYPE-2	11	55
TYPE-3	0	0
TYPE-4	08	40
TYPE-5	0	0
TYPE-6	0	0

Table 4. Classification

Hospital Stay (Days)	No. of Patients	Percentage
10 - 15	14	70
15 - 20	4	20
> 20	2	10

Table 5. Hospital Stay

Union (Weeks)	No. of Cases	Percentage
< 14	03	15
14 - 16	07	35
16 - 18	06	30
18 - 20	04	20

Table 6. Time to Union

Achieved Times (Weeks)	No. of Cases	Percentage
< 16	04	20
16 - 18	08	40
18 - 20	05	25
20 - 22	03	15

Table 7. Full Weight Bearing Achieved

Knee Flexion (Degrees)	No. of Cases	Percentage
< 90	03	15
91 - 119	06	30
> 120	11	55

Table 8. Knee Flexion

Complication	No. of Cases	Percentage
Stiffness	08	40
Delayed Union	02	10
Infection	01	10
Knee Pain	04	20
Skin Necrosis	00	00
Implant Failure	00	00
Implant Exposure	00	00

Table 9. Complications

Rating (Points)	No. of Cases	Percentage
Excellent (> 85)	30	6
Good (70 - 85)	60	12
Fair (55 - 69)	5	1
Poor (< 55)	5	1

Table 10. Rating

DISCUSSION

This study comprised of twenty patients. Overall functional outcome was assessed in terms of regaining. Lost knee function using Neer's score.

The advent and development of locking compression plating method has effectively improved management of tibial plateau fractures as common complex fractures. The present study shows good results. This superiority seems to be preserved in terms of other parameters including ROM index, function score, bone graft need and even post-operative complications.

Stannard and Colleagues collected data from a series of 39 cases, all of which healed without further intervention and with only two superficial infections.¹²

Cole et al reported the results of 42 consecutive tibial plateau fractures with 91% union, 9% mal-alignment and 4% infection rate.¹³

Krupp et al found that locked plating was associated with a decreased time to union, decreased incidence of articular malunion, decreased knee stiffness and decreased overall complications.¹⁴

In the present study we preferred Schatzker classification, because it is simple and no special x-rays are required. Its practical utility to carry out treatment and prognosis assessment has got an upper hand.

According to Muller M.E., Allgower and Willenger, depressed type of fractures are very commonly associated with ligamentous injury 20%.

Diagnosis of ligamentous injuries should be made at the earliest to prevent residual disabilities.

CONCLUSION

1. Locking compression plating is a good fixation system for tibial plateau fractures.
2. Operative time is certainly reduced with minimal invasive technique and the soft tissue damage is considerably less.
3. The device provides good angular stability and helps in early mobilisation. Thus locking compression plate is an optimal tool for tibial plateau fracture management. Minimal invasive technique under guidance of image intensifier provides better plate placement.

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