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Clinico-Radiological Evaluation Of External & Minimal Internal Fixation System In Tibial Plateau Fracture With Compromised Soft Tissue

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Abstract:
Background: *Tibial plateau fractures are common & many times associated with compromised soft tissue envelop.*
Aims & Objectives: *Clinico-radiological evaluation of Hybrid External & minimal internal fixation system in Tibial plateau fracture with compromised soft tissue*
Results: *The patients mainly belong to younger age group with male predominance and all operated within five days of fracture. All the fractures were united within an average period of 13 weeks with a range of 10 – 16 weeks. The average total range of motion at 6 months was 122 degrees. 52 % of patients showed an outcome that can be classified as EXCELLENT according to the KSS score*
Conclusion: *The combined use of External fixator and cannulated cancellous screw may provide good fracture reduction and stability and good functional outcome in patient with Tibial Plateau fracture with compromised soft tissue envelop.*
Keywords: *Tibial plateau,Hybrid, soft tisues envelop, KSS score.*

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I. Introduction

Tibial plateau fractures comprise nearly 1% of all fractures. Among these, isolated lateral plateau fractures are more common (about 55% to 70%) of all Tibial plateau fractures.(1) Isolated medial plateau fractures and bicondylar fractures each account for about 10% to 25% of the fractures. Mechanism of these type of intra-articular fractures are usually high-velocity trauma involving the knee joint resulting in axial loading combined with varus or valgus stress forces. The primary goals in the treatment of Tibial plateau fractures include restoration of articular congruity, axial alignment, joint stability, functional range of motion, and prevention of post-treatment joint stiffness.(2)

There are variety of treatment options which includes: Non-operative treatment with plaster cast, Closed reduction with minimal internal or external fixation,(3) Minimally invasive osteosynthesis by percutaneous plating, Open reduction and plate fixation & Primary Arthroplasty in selective cases.

Non-operative treatments are successful in case of undisplaced fractures providing the advantage of low risk of infections and other operative complications.(4)

In the case of displaced fractures, however non-operative treatments, like casing and traction, do not properly restore the articular surface and they lack the necessary stability leading to unacceptable rates of varus and valgus deformities, collapse of the articular surface, and stiffness from the prolonged immobilization. As a result, there has been an upward trend towards surgical management of these fractures.(5,6)

For closed and displaced fractures that occur as a result of relatively low-energy trauma, open reduction and internal fixation provide good results. But open and displaced plateau fractures due to high velocity injury very difficult to manage. Open surgical procedures, despite their good reduction results, do not protect the already damaged soft-tissue envelope,(7) leading to skin or muscle necrosis and high rates of infection. Several methods of external fixation have been tried to address this issue.(4,8)

In this study we will evaluate the results of using closed reduction with minimal internal fixation along with the construction of an external stabilization system in cases of proximal tibia fractures with very compromised soft tissues.

II. Materials And Methods

Study Area
The prospective study was carried out in the Department Orthopaedics at IPGME&R and SSKM Hospital , Kolkata, a tertiary healthcare centre catering to people of West Bengal and adjacent states of Eastern India.

Study Population
The patients coming to Orthopaedics OPD and Emergency Room with fracture of proximal tibia will be screened and recruited based on fulfillment of inclusion and exclusion criteria.

Study Period
From July 2017 to June 2019 (24 months duration)

Sample Size
42 cases of fracture of the Tibial plateau were recruited for the study.

Sample Design
Consecutive patients coming to Orthopaedics OPD and Emergency Room of SSKM Hospital with fracture proximal tibia have been included.

Inclusion Criteria
- Adult Age Group (18 - 75 years)
- Type of Fracture: Tibial Plateau Fracture (with compromised soft tissue)
- Fractures of duration <3 weeks will be selected
- Those willing to participate in the study through the consent form

Exclusion Criteria
- Patients with comorbid conditions not fit for surgery
- Unsalvageable distal limb due to vascular injury or other reasons
- Sufficient loss of bone from distal fragment rendering reduction impossible
- Pathological fracture
- Old and neglected fractures (>3 weeks)
- Patient unwilling to undergo surgery
- Closed fractures with minimal or no soft tissue compromise

Study Design
This is an institution based, prospective, longitudinal study.

Parameters Studied
The result of using closed reduction and minimal internal fixation combined with the construction of an external stabilization system in cases of proximal Tibial fractures with compromised soft tissues in adults were evaluated by:
● Radiological imaging
● Range of Motion tests
● The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC score)
● Knee Society Score (KSS)

Study Tool
● Clinical Methods
● Fluoroscopy (C-Arm)
● External Stabilization System with the associated instrumentation
Including:
-Threaded and non-threaded Kirschner (K) wires
-Link joints of stainless steel blocks with 2 offset holes to which K-wires and connecting rods are clamped
- Allen Keys
-K-wire bender
- K-wire cutter
-Hand-drill / T-handle
- Cannulated screws (full and partially threaded) with necessary instrumentation set

III. Procedure & Methodology

Patient's history was taken and name, age, gender recorded. Patients were evaluated regarding the pre-injury mobility status on the basis of their ability to walk within their place of residence, their ability to walk

outside and their ability to go shopping, use public transport etc. History and any other co-morbid diseases were obtained.

Mode and time of injury was noted. Thorough clinical examination of the patient was done to rule out associated intra-abdominal, intra-thoracic, head and neck injuries and to rule out other associated fractures. The affected limb was thoroughly examined to rule out vascular or neurological injury. Antero-posterior and lateral view radiographs of affected knee were obtained. To minimize discomfort, all fractures were initially immobilized in a long knee brace. Prior to surgery, all patients were evaluated medically for hypertension, ischemic heart disease, diabetes mellitus, chronic obstructive pulmonary disease, cerebro-vascular disease, urinary tract infection to minimize any potential risk for surgery. Analgesics, antibiotics and proper care of any fracture or injury were taken.

SURGICAL TECHNIQUES

The closed reduction and external fixation performed with the patient under general or spinal anaesthesia in a supine position with the affected leg elevated on a pillow under the distal thigh. The peri-articular fragments will be reduced with the use of gentle, closed pressure or percutaneously inserted reduction forceps, femoral distractor, or periosteal elevator under fluoroscopic guidance. In some cases the articular fragments has been elevated through a window made on proximal Tibia. After reduction, it was secured using cancellous screws passing parallel to the joint from a lateral to medial direction under fluoroscopic control.

Construction of the external stabilization system done by the passage of one K-wire parallel to the joint surface anteriorly and one K-wire parallel to the joint surface posteriorly. The third and the fourth K-wires were passed through the shaft of the tibia distal to the fracture. A connecting rod is then used to connect the two proximal K-wires on the medial side and another on the lateral side. A rod was then used to join the medial rod with the first wire in the shaft medially and another to connect the lateral rod with the same K-wire laterally. A similar assembly was constructed with the second K-wire in the shaft, if required, to provide more stability. A K-wire is then bent half-circle to join both sides of the axes at the proximal level. Similarly, another K-wire is bent half-circle to join both sides of the axes at the diaphyseal level. Stability of the construct and the reduction was checked under fluoroscopy as well as clinically. The surgical and traumatic wounds were then closed, as required.

POSTOPERATIVE PROTOCOL

-Intravenous antibiotics was given preferably Injection Cefuroxime 1.5 gm twice daily for 3 days.
-Post operative AP and lateral radiographs were obtained on the next day following surgery.
-After 48 hrs dressing was changed taking sterile measures.
-40 patients were discharged from hospital 3-4 days after surgery and 2 patients were discharged later after plastic surgery intervention.

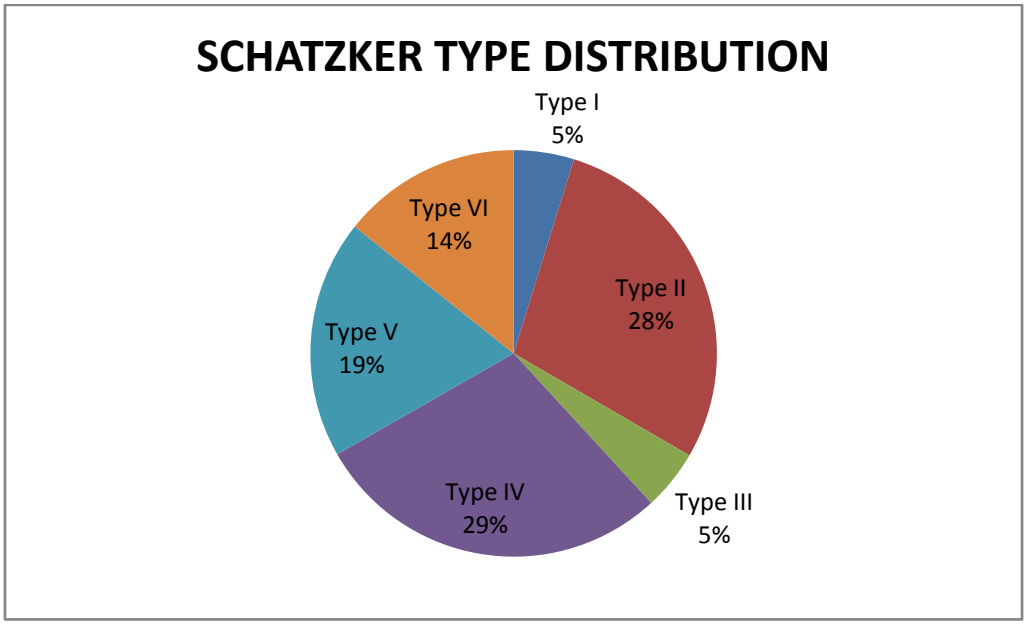
REHABILITATION PROTOCOL

-Patients were encouraged passive knee mobilization within tolerable limits of pain immediately after surgery as soon as the effect of anesthesia weaned off.
-Regular pin-track dressing was encouraged with the use of fluoroquinolone eye-drops at the pin insertion sites
- Patients were evaluated clinically and radio logically at 2 weeks, 6 weeks, and 12 weeks interval
- Active and passive range-of-motion exercises are encouraged throughout the rehabilitation period
- Weight bearing as tolerated, is encouraged at the sign of radiological union
-Following a trial of weight-bearing for one week with the external fixators on, they are removed under aseptic conditions with the help of K-wire cutters, T-handles, and pliers.
- The pin sites are advised to be treated with local application of povidone-iodine ointment till they heal.
- In case of a patient requiring plastic surgical intervention for the open wound, the fixators are removed immediately on appearance of signs of radiological union.

IV. Results

- 42 patients with proximal tibia fractures with compromised soft tissues were studied.
-The average age of the patients was 44.24 years.
-The patients comprised of 90.5% males (38 subjects) and 9.5% females (4 subjects).
-The most commonly associated soft tissue injury was a GA Type III wound followed by blisters.
- The average injury to operative time was 4.8 days. Most patients were operated between Days 3-5 of the injury.
- Schatzker Types II and IV were the two most common types of injury, each comprising of 28.6% of the fractures.
- The average operative time was 53 minutes in our study.

-The average time to radiological union was 12.86 weeks in the study.
-The average time to full-weight bearing by the patients was 13.14 weeks in the study.
- The WOMAC score at 6 months was 79.71 on average.
- The Knee Society Score average at 6 months was 77.76 which falls in the category of GOOD.
- The average total range of motion at 6 months was 122.14 degrees.
- 52.4% of patients showed an outcome that can be classified as EXCELLENT according to the KSS score.



V. Discussion

The management of proximal tibia fractures has always been a subject of debate because of their variety and complexity.(9) In the search for perfection, any treatment modality that has a varied opinion is a subject for research and study. High-energy intra-articular fractures of the tibial plateau cause ongoing management problems and remains challenging for orthopaedic surgeons.

We presented a prospective clinical study of surgical management of 42 patients of proximal tibial fractures. The analysis of the results were made in terms of the age of the patients, sex distribution, analysis of the types of fractures, injury associated complications, and the functional outcomes.

In the present series, the ages of the patients vary between 19-65 years with a mean age of 44.24 years. The sex ratio in our study was 90.5% males and 9.5% females. These ratios, when compared to Western studies, show that the average of the patient is slightly lower in our study. This can be attributed to the fact that the working population is relatively younger in our country. Similarly, the workforce in our country, who comprise the majority of the victims of road-traffic accidents, is primarily male in our country. Over the years, many classification systems have been developed and used for fractures of the proximal tibia.(4,10) These include the Hohl and Luck classification, the Moore classification, the Schatzker classification, the AO/ASIF classification systems etc. Nowadays, the most widely used classification system is the Schatzker classification system as it amalgamated many of the features of the previous classification systems.(1,11) It is simple, easy to remember and is relevant to both treatment and outcome. However, the system is also not complete, as many fractures do not neatly fall into the categories of this classification system. In our study, we found that Type II and Type IV fractures were the most commonly found types (both at 28.6%).

Tibial fractures are associated often associated with compromised soft tissues. A significant percentage of these fractures are associated with high-velocity injuries and they result in open fractures. In other cases, they can be associated with blisters that indicate significant soft-tissue injury. These soft tissue compromises often delay the definitive management of open reduction and internal fixation.(12)

Spanning external fixators provide a time window for the healing of the soft tissue before definitive management can be done. However, keeping the knee fixed has the complication of postoperative stiffness of the joint.

Hybrid external fixator with minimal internal fixation offers a solution to this problem. It allows for early knee mobilization while maintaining articular congruity. And it provides access to the soft-tissue injuries so they can be dealt with accordingly.

Another advantage of the hybrid external fixator system is early intervention. The mean injury-to-surgery time in our study was 4.8 days. Waiting for the soft tissues to heal so internal fixation can be attempted often lead to indefinite delays and this may result in difficulties in achieving reduction later on and also stiffness of the joint.(13)

The hybrid external fixator system used in our study was devised in accordance with the AOSR guidelines and cannulated cancellous screws were used as per the recommendation.(14)

However, we modified the external fixator system by using pre-bent K-wires for the rings and not using the Ilizarov ring fixators for reducing the operative time and as a low-cost alternative requiring less technical expertise.

The average time for radiological union to occur in our study was 12.86 weeks. The functional outcomes in our study were measured using the WOMAC and the KSS scores. The mean WOMAC score at the end of the study was 79.71. The mean KSS score at the end of the study was 77.76 which fall in the category of GOOD results.

We found no significant correlation between the age of the patients and the final outcome. Also, no significant correlation could be found between the Schatzker type of the fracture and the final outcome. Although a trend towards poorer final outcomes with bi-condylar fractures could be appreciated.

48hrs Post -operative Clinical Pictures

4 weeks Post-operative: Radiological & Clinical pictures

12 weeks Post-operative : Radiological & Clinical Pictures (Full range of Motion of Knee)

VI. Conclusion

The study shows that the hybrid technique when combined with minimal internal fixation is a safe and effective treatment method with relatively less complication rates. It produces good results in all Schatzker types. The results are comparable with other reported studies. Early and definitive fixation has been done with the hybrid technique. Closed reduction and application of a hybrid fixator with minimal internal fixation resulted in a shorter hospital stay, fewer severe complications, marginally faster return to activities of daily living, and superior or similar clinical outcomes compared to other conventional methods of open reduction and internal fixation. These benefits are obtained without compromising the quality of fracture reduction. Limitation of our study was that it was not a long-term follow-up study, so long-term complications and outcomes cannot be concluded from our study.

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