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Evaluation of Outcome of Posterior Column Fixation via Posterior Approach in an Intraarticular Posterior Tibial Plateau Fracture in Sir T. Hospital Bhavnagar: A Prospective Observational Study

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ABSTRACT
Tibial plateau fractures impact the knee, a crucial weight-bearing joint, leading to alterations in its stability and function. Despite advancements in surgical techniques and implants, the optimal approach for management remains a topic of debate. In this prospective study, we analyzed 30 consecutive cases of tibial plateau fractures that underwent surgical treatment through posterior column fixation using the posterior approach. The study was conducted between June 1st, 2021 and May 30th, 2022, at the Department of Orthopaedics, Government Medical College, Bhavnagar, India. The study included 30 participants with a mean age of 48 years. The most common mode of injury was road traffic accidents, accounting for 85% of cases. Radiological assessment at 3 months showed excellent results in 26% of patients, good results in 54% and satisfactory recovery. Achieving optimal outcomes in the surgical management of tibial plateau fractures involves precise reconstruction of the articular surface, elevation of depressed bone fragments and bone grafting when necessary. These measures, combined with rigid fixation allowing for early physiotherapy, promote a return to normal function. In cases of type V and type VI fractures, suboptimal results are often attributed to inadequate reconstruction and postoperative articular restoration collapse.

INTRODUCTION

Complex tibial plateau fractures pose significant clinical challenges, often falling under the Schatzker Type V and VI or 41-C categorization according to the AO/Orthopaedic Trauma Association classification[1,2]. Typically, dual plating serves as the preferred method for definitive fixation in these cases[3,4]. Nevertheless, this approach may not always be applicable for fractures exhibiting multiplanar articular comminution, particularly in cases involving posterior shearing or coronal fractures[5,6]. Historically, treatment for tibial plateau fractures has relied on two-dimensional classification systems. However, recent insights emphasize the importance of considering three-dimensional fracture patterns, as highlighted through computed tomography (CT) assessments[7,8].

In recent years, the "three-column fixation" technique has emerged for addressing complex multiplanar tibial plateau fractures, grounded in a comprehensive understanding of the fractures in three dimensions[7,8]. This classification system, as described by Zou *et al*.[9] and Lou *et al*.[10] categorizes fractures based on the involvement of relevant columns. An independent articular depression accompanied by a column wall break defines a fracture of the corresponding column. Pure depression in any of the three columns is designated as a zero column, while pure split fractures and split fractures with depression are categorized based on the involved column as observed in CT scans.

Complex bicondylar tibial plateau fractures exhibit a distinct pattern that isn't adequately represented in traditional 2-dimensional fracture classifications. A two-incision technique, commencing with the reduction of the posteromedial edge, has proven effective in achieving accurate fracture reduction with minimal complications and excellent knee function[11]. Conventional surgical approaches often struggle to adequately reduce and stabilize tibial plateau fractures, especially when there is an associated displaced posteromedial fracture pattern. This technique offers direct visualization of posteromedial tibial plateau fractures without the necessity of neurovascular bundle dissection and enables the placement of an antiglide buttress plate at the apex of the posteromedial fracture fragment[12].

An alternative surgical approach, known as the posterolateral trans fibular neck approach, was developed for treating two specific fracture subtypes: depressed and split depressed fractures located in the posterior portion of the lateral tibial condyle. This approach exposes the posterolateral aspect of the tibial plateau, situated between the posterior margin of the iliotibial band and the posterior cruciate ligament. It allows for lateral buttressing of the lateral tibial plateau and can be combined with simultaneous posteromedial and/or anteromedial approaches to the tibial plateau[13]. Another modification of the standard posterolateral approach was devised without fibular osteotomy[14].

This prospective interventional study was conducted to assess the clinical and radiologic effectiveness of posterior approaches to tibial plateau fractures, whether used in isolation or in combination with other approaches, either sequentially or in a staged manner, particularly in cases involving posterior fracture components.

MATERIALS AND METHODS

This prospective observational study involved 30 patients, conducted with approval from the Ethics Committee of Government Medical College, Bhavnagar, Gujarat, India. The patients were admitted to the orthopaedics department between June 1st, 2021 and May 30th, 2022, based on specific inclusion and exclusion criteria. Written and informed consent were obtained from all participants.

Inclusion criteria: Patients aged 18 years and above who have undergone surgery for posterior tibial plateau fractures, regardless of gender and with acute fractures, are eligible for inclusion in the study.

Exclusion criteria: Individuals determined to be skeletally immature based on X-rays, patients with open fractures of the tibial plateau, those with fractures associated with knee dislocation, patients with fractures involving the ipsilateral femur, tibia and foot, individuals younger than 18 years or older than 60 years, fractures accompanied by neurovascular injuries requiring repair, as well as patients with pathological fractures or pre-existing joint diseases like osteoarthritis or inflammatory arthritis, prior fractures, severe systemic illnesses such as active cancer, undergoing chemotherapy, having insulin-dependent diabetes mellitus, renal failure, haemophilia, or other medical contraindications for surgery and individuals with any neurological condition that may interfere with post-operative rehabilitation are excluded from the study.

Surgical approach

Posterolateral approach: The posterolateral approach is employed for fractures characterized by a coronal fracture line resulting in a displaced posterolateral fragment. This approach is typically reserved for fracture patterns that cannot be effectively addressed through the anterolateral approach due to potential complications, including stiffness and peroneal nerve injury. It should be noted that this approach necessitates extensive soft tissue dissection and patients may experience a flexion contracture of 5-10 degrees.

In terms of landmarks and incisions, key landmarks include the fibular head, posterior popliteal fossa, iliotibial tract and Gerdy tubercle. An approximately 15 cm long posterolateral skin incision is made, starting 2 cm above the joint line and following the fibula in a distal direction.

Before dissecting the popliteal fossa, a lateral arthrotomy is performed. The iliotibial tract is incised from the dorsal side and its dorsal fibers are detached from the Gerdy tubercle. The lateral capsule is incised and the tibiomeniscus ligament is dissected away from its insertion on the tibia.

Upon direct incision of the fascia, the peroneal nerve becomes exposed along the posterior edge of the biceps femoris muscle and blunt dissection is performed between the lateral head of the gastrocnemius muscle and the soleus muscle. In the popliteal fossa, after appropriate blunt preparation, the popliteal artery, vein and popliteal muscle are exposed. The artery and vein are safeguarded by the lateral head of the gastrocnemius, which retracts them, while the popliteal muscle is retracted medially and cranially.

The soleus muscle is detached from the dorsal surface of the fibula and detached distally until the peroneal nerve at the fibula neck enters the muscle. This manoeuvre allows for mobilization of the muscle approximately 4-5 cm in the distal direction, providing adequate exposure of the fragmented fracture for fixation.

Reduction methods: For single condylar injuries, longitudinal incisions are made for direct joint reduction, followed by the placement of lag or raft screws and subchondral bone support with bone graft or substitute and buttress plating. Reduction of the intra-articular portion often requires direct inspection via arthroscopy. The lateral plateau can be rotated for joint impaction assessment. Depressed areas and fragments are gently elevated and directly reduced using a bone tamp. Assessment of the intercondylar area and cruciate ligaments is essential.

In cases of simple split articular surfaces, lag screws suffice, while depressed fractures require subchondral screws to hold the elevated surface. For severe articular displacement, collinear reduction forceps or a pelvic reduction clamp may be used, with the potential aid of a femoral distractor or external fixator for indirect reduction. In bicondylar fractures, the medial plateau's large single fragment is crucial for reduction. Pushing the fragment proximally, reducing the articular surface and buttressing with an anti-glide plate can transform a type C fracture into a type B. In cases with a simple metaphyseal fracture line, perfect (indirect) reduction can be achieved without joint opening. For metaphyseal communication, prioritizing articular surface reduction and fixing the articular block to the shaft with correct length, axis and rotation is essential. Careful pre-surgical X-ray analysis helps identify key anatomical and fracture landmarks to plan the surgical approach.

Treatment approaches for posteromedial tibial plateau fractures have evolved, with a focus on simplicity and low risk while ensuring accurate articular surface reduction, leg alignment restoration and knee stability for early rehabilitation. According to Schatzker, early mobilization is essential, as prolonged immobilization can lead to joint stiffness. Internal fixation, if combined with knee immobilization, can exacerbate joint stiffness. Maintaining knee joint mobility allows for potential secondary reconstructive procedures.

Impacted articular fragments cannot be repositioned through traction alone due to the absence of soft tissue attachments. Depressed articular surface defects remain permanent, requiring surgical correction for joint stability. When joint instability is present, it often necessitates open reduction and internal fixation to achieve absolute joint congruency, which is crucial for cartilage regeneration.

In cases where open reduction and internal fixation are not indicated, skeletal traction with early motion may be recommended. For open reduction and internal fixation using a single plate, a single posteromedial or any 3.5 locking buttress plate is used. This approach involves exposing the articular surface through capsulotomy and achieving reduction under direct vision, often employing locking implants to securely hold fragments in place, even on the opposite plateau where the plate is positioned.

Open reduction and internal fixation using dual plating involves the use of two locking plates, two buttress plates, or a combination of one locking and one buttress plate, along with cancellous screws. This approach provides rigid fixation that allows for early motion but is associated with more soft tissue trauma and periosteal stripping.

RESULTS

Our study included patients aged 20-80 years, with the majority falling in the 36-50 age group (57%). The youngest patient was a 27-year-old male, while the oldest was a 62-year-old male, resulting in a mean age of 48 years (Table 1). Road traffic accidents accounted for the majority (67%) of posterior tibial plateau fractures in our study. Domestic accidents were the second most common cause (17%), particularly among patients aged over 55, attributed to falls due to osteoporotic bone. High-velocity trauma, such as road traffic accidents, predominated in younger age groups.

Table 1: Demographic characteristics of study participants

Parameters	Patients	Percentage
Age in year		
20-35	07	23
36-50	17	57
51-65	06	20
66-80	00	00
Gender		
Male	25	83
Female	05	17
Mode of injury		
Assault	02	06
RTA	20	67
Fall from height	03	10
Domestic	05	17
Occupation		
Labourer	15	50
Farmer	02	07
Student	01	03
Housewife	03	10
Other	09	30
Side involved		
Right	18	60
Left	12	40

Table 2: Duration of final follow up

Duration in number of weeks	Patients	Percentage
02	02	07
06	04	13
12	24	80
Total	30	100

Assault accounted for 6% of cases and falls from height contributed to 10% of injuries in our study (Table 1). In our study right (60%) side involved more than left (40%) side. In our study minimum duration of final follow up 2 weeks of surgery 80% patients' duration in numbers at 12 weeks (Table 2) because post operative patient had pain at fracture site, difficulty in squatting, some had plate impingement, knee stiffness for that patient again and again consult to surgeon. In our study, 80% of patients had no extensor leg deformity while 17% of patients had <10 degree of extension lag because of lack of physiotherapy and not compliance, post traumatic arthritis, lack of reduction and 3% of patient had >10 degree of deformity due to non-union, severe post traumatic arthritis, broken implants, knee stiffness.

In our study, 93 percentage had knee flexion of more than 90 degree and 07% of the patient had knee flexion of <90 degree due to lack of knee physiotherapy, Most of the patients started knee physiotherapy as soon as possible and the stitch line were dry and sealed.

In our study, 40% of patients could walk 1-2 km with no pain, while 30% could walk 500-1000 m with mild discomfort. However, 20% had limited walking ability (less than 500 m) due to issues like knee stiffness, post-traumatic arthritis, reduced reduction, plate impingement and knee pain. A majority of patients (50%) were able to walk over 1 km with excellent knee mobility, allowing them to resume their preoperative employment (Table 3).

Table 3: Follow up at three-month outcome

Parameters	Patients	Percentage
Leg extension		
Normal	24	80
<10 degree	05	17
>10 degree	01	03
>20 degree	00	00
Fracture union status		
United	28	93
Non-united	02	07
Knee involvement		
<90	02	07
90-100	10	33
101-110	12	40
111-120	04	13
>120	02	07
Walking distance ability		
>02 km	03	10
01-02 km	12	40
500-1000 m	09	30
<500 m	06	20
Ability to cross leg		
Sitting		
Possible	24	80
Difficult	05	16
Not possible	01	04
Complications		
Non union	02	06
Knee stiffness	02	06
Infection	01	03
Implant failure	01	03
No complication	24	80
Modified rasmussen clinical criteria		
Excellent (28-30)	08	26
Good (24-27)	16	54
Fair (20-23)	02	06
Poor (<23)	04	14
Radiological criteria		
Excellent (9-10)	06	20
Good (7-8)	17	56
Fair (5-6)	03	10
Poor (<5)	04	14

DISCUSSIONS

We have conducted a comparative analysis of my study with the following research investigations, all of which utilized modified Rusmmusen clinical and radiological criteria as the basis for their assessments:

- Neil *et al.*[15] study conducted in 2013 involved a prospective examination of 34 patients, assessing the functional and radiological outcomes of treating Schatzker type V and VI tibial plateau fractures. This study included a minimum of 3 years of follow-up data
- Jakinapally *et al.*[16] research in 2018 was a prospective study involving 20 patients. It focused on the functional and radiological evaluation of surgical management approaches for tibial plateau fractures

Rohra *et al.*[15] and Jakinapally SR conducted studies involving 34 and 20 patients, respectively, with mean ages of 46.2 years and 35.65 years, with male-to-female ratios of 29:5 in both cases. These demographic characteristics align with our own study's findings[16].

Jakinapally *et al.*[16] study identified road traffic accidents as the primary mode of trauma in 85% of cases, which corresponds to our study where road traffic accidents were the main mode of trauma. Interestingly, in our study, right-sided fractures were more common than left-sided ones, consistent with Rohra *et al.*[15] findings, while Jakinapally *et al.*[16] observed a higher prevalence of left-sided fractures.

In our study of 30 patients, 5 cases presented with open injuries, possibly due to high-velocity trauma such as road traffic accidents. In comparison, Rohra *et al.*[15] study included 4 patients with open fractures out of 34, while Jakinapally *et al.*[16] study had 2 open fractures among 20 cases.

Regarding the surgical approach, 87% of our patients were treated with a single incision approach, while 13% underwent double incision. These proportions align with Rohra *et al.*[15] study, which reported 85% single incision and 15% double incision, as well as Jakinapally *et al.*[16] study, with 80% single incision and 20% double incision.

In terms of complications, we observed a 6% infection rate in our study, categorized as superficial or deep based on fascial involvement. In contrast, Rohra *et al.*[15]. reported a higher 29% infection rate, while Jakinapally *et al.*[16] had a lower 5% infection rate. Nonunion at the fracture site was found in 7% of our cases, requiring revision surgery with bone grafting. Neither Rohra *et al.*[15] nor Jakinapally *et al.*[16] reported nonunion cases. Loss of reduction was observed in 3% of our patients, whereas Rohra *et al.*[15] recorded a higher 14.7% rate of loss of reduction. Additionally, 6% of our patients developed knee stiffness due to inadequate physiotherapy and severe postoperative knee joint arthritis.

Regarding return to occupation, 77% of our patients returned to their previous jobs, 13% changed their employment status and 10% remained unemployed. In Rohra *et al.*[15] study, 82% returned to their previous occupations, with only 10% changing employment status. Our study used the modified Rusmmusen clinical and radiological criteria, providing a valuable tool for assessing outcomes in proximal tibial plateau fractures treated via the posterior approach. Our study's outcomes, based on this criteria, showed that 55% of patients had a good outcome, 27% had an excellent outcome, 2% had a fair outcome and 4% had a poor outcome. In comparison, Rohra *et al.*[15] reported 88% with good to excellent results and 20% with fair outcomes, while Jakinapally *et al.*[16] had 80% with good to excellent outcomes and only 5% with fair outcomes. These results indicate that our study's outcomes align favorably with the modified Rusmmusen clinical and radiological criteria when compared to other studies.

CONCLUSION

Single plating in posterior tibial plateau fractures yields stable fixation and excellent outcomes in 87% of patients. This technique offers advantages such as enhanced vascularity for improved healing and a reduced risk of wound dehiscence. Patients who initiate early physiotherapy and maintain proper knee alignment experience a wider range of motion, contributing to better outcomes. The most common post-surgery complications, non-union and knee stiffness (12%), can typically be managed with physiotherapy. Only one patient (3%) required revision surgery in the form of debridement. Single incision approaches are preferable over dual incision approaches due to lower infection rates. Implant selection has minimal impact on range of motion and results; instead, the quality of reduction and alignment are more influential factors. When necessary, the use of locking plates and cancellous screws, either individually or in combination, can lead to improved outcomes.

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