



Research Article

Tibial Plateau Fractures: Therapeutic and Prognostic Aspects of Surgical Management

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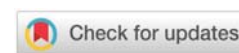
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Abstract

Introduction: Tibial plateau fractures account for 5–8% of lower limb fractures and 1% of fractures in adults.

Materials and methods: This was a prospective, single-center, descriptive, continuous study conducted over an 18-month period, from September 15, 2022, to March 15, 2024, in the Orthopedics and Traumatology Department of CHNDJ.

We studied the therapeutic and evolutionary aspects of surgical treatment for tibial plateau fractures.

Results: The time to treatment was 2 to 6 days in 56.2% of our patients. The anterolateral approach was used in 74% of cases. Lateral screw plates were used in 53.1% of our patients, and external fixators combined with screws in 15.6% of patients. The average length of hospital stay was 4.6 days, ranging from 1 to 54 days. The average time to bone union was 12 weeks, ranging from 8 to 16 weeks. Our anatomical results were very good or good in 79.2% of cases, and the overall functional results were very good or good in 95.8% of cases.

We recorded 15.8% infection, 5.3% skin necrosis, 10.5% knee stiffness, 5.3% malunion, 15.8% gonarthrosis, and 15.8% proximal tibial necrosis.

Conclusion: Tibial plateau fractures are clearly on the rise in our societies with the advent of motorized two-wheeled vehicles as a means of public transportation.

Introduction

Tibial plateau fractures are breaks in the bone continuity affecting the metaphyseal-epiphyseal spongy bone at the upper end of the tibia, at least one of which divides the articular cartilage [1].

They account for 5% – 8% of lower limb fractures and 1% of fractures in adults. They are the result of high-energy trauma and are associated with soft tissue injuries in half of all cases [2], although low-energy mechanisms, such as sports

injuries or falls from a standing height, can cause fractures of the proximal tibia.

These are joint injuries that present a wide spectrum of clinical manifestations and are frequently associated with long-term complications. The classification proposed by Schatzker, et al. in 1974 is the most widely used to describe injuries and guide management. However, this classification, based on conventional double-incidence X-rays, does not accurately take into account joint comminution and, in particular, posterior bone fragments. The injury mechanisms associated

with these fractures are responsible for distinct injuries in all three planes of space [3].

As these fractures are intra-articular lesions, they must be treated in accordance with AO principles, which include anatomical reduction, absolutely stable fixation, repair of soft tissue lesions, and unlimited postoperative range of motion [4].

To limit morbidity and complications, lateral plating alone, instead of double plating, has been proposed as an alternative to limit soft tissue dissection and wound complications. Lateral plating alone may be an alternative for the elderly population to limit morbidity, but concerns remain regarding bone quality, fracture fixation, and secondary loss of reduction [5].

The objective of our study was to investigate the therapeutic and evolutionary aspects of surgical treatment for tibial plateau fractures.

Materials and methods

Type and duration of study

This was a prospective, single-center, descriptive study conducted over an 18-month period, from September 15, 2022, to March 15, 2024, in the Orthopedics-Traumatology Department of the CHNDJ.

Study material

Inclusion criteria: All patients aged 18 years and older who were admitted for a tibial plateau fracture, treated surgically, and followed up in the department during the study period were included in our study.

Exclusion criteria: The following were not included in this study: all patients treated orthopedically, patients who refused the treatment proposed by the department, patients lost to follow-up, and unusable records.

Study population: Our study included 32 male and female patients aged 18 years and older who met our inclusion criteria.

There were 28 men (87.5%) and 4 women (12.5%) with a sex ratio of 7. The mean age of our patients was 43.8 ± 14.2 years, with extremes of 22 and 73 years. The most affected age group was 36 to 45 years (37.5%), followed by 26 to 36 years (28.1%). The most common socio-professional groups in our series were manual workers (31.3%), followed by delivery drivers (18.8%), shopkeepers (12.5%), and teachers/Koranic teachers (12.5%). Road traffic accidents were the most frequent cause of injury, accounting for 87.5%, followed by domestic accidents, accounting for 6.3%. Most of our patients came from Guédiawaye (37.5%), Pikine (15.6%), and Keur Massar, Malika (9.4%). We found 34.4% of lateral compression associated with valgus, and mixed mechanisms in 18.7%. Direct impact accounted for 25% of mechanisms. High blood pressure was the most common personal medical history, found in 9.4% of patients. The right knee was the most affected in our series,

with 65.6% of cases; and the left knee in 34.4% of cases. Closed fractures were the most common, accounting for 81.3%. Skin lacerations were observed in 18.3% of cases; type II was the most common, accounting for 50%, followed by type III and type I, accounting for 33.3% and 16.7%, respectively. All of our patients underwent standard frontal and lateral knee X-rays, followed by oblique (3/4) X-rays in all cases (100%). However, only 59.8% of patients underwent knee CT scans. In our series, Schatzker types II and VI were the most common, each accounting for 28.1%, followed by type I with 18.7%. Fractures of the proximal end of the fibula were the most common in our series, accounting for 68.4% of cases, with fractures of the femur coming in second place with 15.7% of cases.

Study materials: Our data were collected from information provided by medical records, hospitalization records, surgical report records, and a pre-established survey form.

Methods

Parameters studied: In our series, the following aspects were studied:

Therapeutic aspects: From a therapeutic standpoint, we addressed the following treatments:

Medical treatment: All our patients received analgesics, anticoagulants, and antibiotics. Patients with open fractures received tetanus prophylaxis.

Surgical treatment: The study focused on the following parameters: time to treatment, patient placement, type of anesthesia, approaches, surgical technique (type of surgical treatment), post-operative care, rehabilitation, length of hospital stay, and immediate post-operative complications.

Evolving aspects

(Clinical and paraclinical): Our patients were assessed in terms of: Anatomy, Function, Complications,

Evaluation of results: Table 1 shows the parameters studied for the functional assessment of our patients according to the criteria of Merle d'Aubigné and Mazas.

Table 1: Functional criteria of Merle d'Aubigné and Mazas.

Criteria	Walking	Pain	Mobility	Stability
Very good	Normal	No pain	Full extension 120° Flexion	Perfect No laxity
Good	Normal or slight claudication	Rare and moderate	Full extension or flexion of less than 10° 90° flexion	No laxity in extension. Slight laxity in semi-flexion. Monopodal support. Unilateral squatting possible but with minimal difficulty.
Means	Walks with a limp. Uses a cane	Minor but frequent pain.	Flessum <20° Flexion 60 to 90°	Laxity in extension, unable to squat on one side.
Poor	Unable to walk or can only walk with two canes	Significant and frequent pain	Flessum > 20° Flexion < 60°	Severe instability, unable to stand on one foot

Data entry and analysis

Our data were entered using Word and Excel 2016 software and analyzed using Epi Info version 7.2.2.

Results

Therapeutic aspects

Medical treatment: All our patients received medical treatment with analgesics (1 g of paracetamol for infusion + 100 mg of tramadol for injection every six hours) and anticoagulants for injection once a day subcutaneously, as well as antibiotics for injection 1 g/125 mg three times a day. Six patients with open fractures received tetanus serum and vaccine (SAT, VAT), representing 18.75%, and four (04) patients with a history of hypertension continued their antihypertensive treatment, representing 12.5%.

Time to treatment: The time to treatment was 2 to 6 days in 56.2% of our patients, less than or equal to 1 day in 18.8% of patients, and greater than or equal to 7 days in 25% of patients.

Installation: For open fractures, patients were positioned on a standard table with a cushion under the ipsilateral buttock, a tourniquet at the root of the thigh, and the ipsilateral iliac crest was prepared in advance and within the surgical field for a possible cortico-cancellous bone graft (Figure 1). For closed fractures, they were placed in the supine position with or without a tourniquet at the root of the thigh.

Image intensifier: Of the 32 patients, only 13 (40.6%) underwent surgery with the use of an image intensifier.

Anesthesia: All patients received regional anesthesia in the form of spinal anesthesia, i.e., 100%.

Approaches: We approached the fractures via the anterolateral approach in 74% of cases. The double approach was used in 13% of cases, and the medial approach was used in 13% of cases.

Type of surgical treatment: Lateral screw plate was used in 53.1% of our patients, external fixator combined with screw fixation in 15.6% of patients, external fixator alone in 12.5% of patients, double screw plate and medial screw plate combined with screw fixation in 9.4% of patients each

We correlated the types of fractures, the type of osteosynthesis, and the approach (Table 2, Figures 1,2).

According to the Schatzker classification, we recorded nine (09) type II cases, representing 28%, and two (02) type III cases, representing 6.3%, which underwent augmentation with cortical-cancellous bone grafting.

Postoperative care

Postoperatively, all patients continued treatment with analgesics, antibiotics, and anticoagulants.

Local care was provided until the sutures were removed.



Figure 1: Tibial plateau fractures treated with lateral screw plate + cortico-cancellous graft harvesting; postoperative follow-up X-ray.

Table 2: Distribution according to the correlation between fracture type, osteosynthesis type, and approach.

Types of fractures	Types of osteosynthesis	Approaches	Workforce	Percentage (%)
Type I	Side screw plate	Anterolateral	06	18.7
Type II	Side screw plate	Anterolateral	09	28.1
Type III	Side screw plate	Anterolateral	02	6.3
Type IV	Medial screw plate + screw fixation	Anteromedial	03	9.4
Type V	Double screw plate	Double approach	03	9.4
Type VI	External fixator alone/ screw fixation	V. Scopique	09	28.1
Total			32	100



Figure 2: Tibial plateau fracture treated with external fixator.

After a follow-up X-ray, the knee was mobilized the day after surgery, and patients were then mobilized with the aid of a pair of canes without support.

A removable splint (Zimmer splint) protected the osteosynthesis with a screw plate for a period of up to three weeks.

Rehabilitation

Rehabilitation began the day after surgery with knee mobilization and isometric quadriceps contraction and continued with physical therapy until the fracture had healed in all of our patients.

Immediate postoperative complications

We recorded three cases of postoperative infection (75%) and one case of skin necrosis (25%).

Evolution

At a mean follow-up of 12 months, 24 of the 32 patients were evaluated.

Overall results

Anatomical: The average time to bone healing in our series was 12 weeks, ranging from 8 to 16 weeks.

According to the criteria of Merle d'Aubigné and Mazas, our overall anatomical results were very good in 29.2% of cases, good in 50% of cases, and average in 20.8% of cases. We did not record any poor anatomical results in our series (Table 3).

Functional: According to the criteria of Merle d'Aubigné and Mazas, our overall functional results were very good in 33.3%, good in 62.5%, and average in 4.2%. We did not record any poor functional results in our series (Table 4).

Complications: We recorded two (02) cases of knee stiffness, one (01) case of malunion of the lateral tibial plateau, three (03) cases of knee osteoarthritis, and three (03) cases of necrosis of the lateral tibial plateau as late complications.

Analytical results

Results according to the anatomopathological type of tibial plateau fractures and the Merle d'Aubigné and Mazas functional score.

We established a correlation between the anatomopathological types of tibial plateau fractures and the Merle d'Aubigné and Mazas functional score. We found 100% very good results in type I. We also collected one case of average results in our series (Table 5).

Results according to surgical treatment of tibial plateau fractures and complications (secondary and late)

We collected three (03) cases of proximal tibial necrosis only in surgical treatment with screw plates. However, we recorded two (02) cases of knee stiffness, one (01) case of malunion, and three (03) cases of knee osteoarthritis in surgical treatment using external fixation alone or combined with screw fixation (Table 6).

Table 3: Overall patient results according to Merle d'Aubigné and Mazas' anatomical (radiological) assessment.

Anatomical criteria	Workforce	Percentage (%)
Very good	07	29.2
Good	12	50
Means	05	20.8
Poor	00	00
Total	24	100

Table 4: Overall patient results according to the functional criteria of Merle d'Aubigné and Mazas.

Functional criteria	Workforce	Percentage (%)
Very good	08	33.3
Good	15	62.5
Means	01	4.2
Poor	00	00
Total	24	100

Table 5: Results according to the anatomopathological types of tibial plateau fractures and the Merle d'Aubigné and Mazas functional score

Anatomopathological types	Functional score by Merle d'Aubigné and Mazas				
Schatzker	Very good	Good	Means	Poor	Total
Type I	4	0	0	0	4
Type II	1	6	0	0	7
Type III	0	2	0	0	2
Type IV	1	4	0	0	5
Type V	1	2	0	0	3
Type VI	1	1	1	0	3
Total	8	15	01	0	24

Table 6: Results according to surgical treatment of tibial plateau fractures and complications (secondary and late).

chirurgical treatment	Complications						Total
	Secondary			Late			
	Infection	Skin necrosis	Knee stiffness	Vicious calluses	Proximal Tibia necrosis	Gonarthrosis	
Screw Plate	2	0	0	0	3	0	5
External fixator	1	1	1	0	0	1	4
Combined	0	0	1	1	0	2	4
Total	3	1	2	1	3	3	13

Discussion

Therapeutic aspects

The average time to treatment was 3 days in our series. This was relatively short compared to the time found in several series [6–8].

This result can be explained by the availability of implants and an experienced surgical team on the one hand, and the occurrence of skin complications such as wounds, making treatment much more urgent on the other.

In our series, the anterolateral approach was used in 74% of cases. The medial approach and the double approach each accounted for 13%.

These results corroborate those found in the literature, which show a predominance of the anterolateral approach [9–12].

In our series, this could be explained by the frequency of types I–III, which justified the indication for the anterolateral approach.

We performed 100% of the surgical treatment in our series. Zhou X, et al. [7] and JIANG W [13] also reported 100% surgical treatment in their respective series.

Lateral screw plates were used in 53.1% of our patients, external fixators combined with screws were used in 15.6% of cases, external fixators alone were used in 12.5% of cases, and double screw plates were used in 9.4% of patients.

Our results are similar to several series in the literature, which also found a predominance of lateral screw plates alone [11-12].

However, Hörmandinger C, et al. [4] performed double screw plates in 73.2% of their series.

Our results may be explained by the predominance of Schatzker types I-III, which justified the indication for lateral screw plates alone.

In our series, the average length of hospital stay was 4.6 days, with extremes ranging from 1 to 54 days. Fakoor M, et al. [14] reported an average length of stay of 5.8 ± 9.3 days, with extremes ranging from 3 to 29 days.

Our results may be explained by complications such as surgical site infections in some patients, and the transfer of one patient to the intensive care unit before the fracture was treated following multiple trauma, on the other hand.

Evolving aspects

The average bone consolidation time in our series was 12 weeks, ranging from 8 to 16 weeks. This result is comparable to those found in several series. Biswas B, et al. [11] found the following results in their series: ORIF 14 ± 2.71 weeks MIPPO 12.49 ± 1.96 weeks.

Which were controlled by targeted antibiotic therapy after pus was collected for culture and antibiogram; 01 case of skin necrosis, or 5.3%, where a necrosectomy was performed and guided healing was achieved.

In the long term, we recorded 02 cases of knee stiffness, or 10.5%, where patients underwent knee mobilization under general anesthesia until 90° flexion and full extension were achieved. Three cases of knee osteoarthritis and three cases of proximal tibial necrosis, each representing 15.8%, and one case of lateral tibial plateau malunion (varus <10°), representing 5.3%. These latter complications did not benefit from surgical correction, but all these patients received treatment for pain and/or inflammation.

In the literature, similar cases have been reported by several authors: Mekkaoui M.J.El, et al. [15], Akhil Kumar K [16] Dingamnodji M, et al. [12].

Proximal tibial necrosis is a complication that is often found in patients who have undergone surgery for a lateral tibial plateau fracture. It can be idiopathic or iatrogenic. The latter has risk factors that are either primary (severity of the injury, aggressiveness of the surgical procedure) or secondary (age, osteoporosis, corticosteroid therapy, metabolic disease).

Sané AD, et al. [17] reported a case of lateral proximal tibial necrosis in a case study.

In our series, lateral proximal tibial necrosis could be explained by the rupture of blood vessels supplying the lateral tibial plateau following trauma and/or surgical treatment.

In addition, Sarangi G, et al. [18] reported one case of septic pseudarthrosis in their series. Sameer MM, et al. [6] recorded only two cases of medial-lateral instability as complications, which were treated with knee braces.

Our results can be explained by the presence of open fractures, three of which progressed to postoperative infection and one to skin necrosis. One patient had a femorotibial fixation with an external fixator for eight weeks. At a mean follow-up of 12 months, we evaluated 24 patients who responded to the call. Our overall functional results were very good in 33.3%, good in 62.5%, and fair in 4.2%. Our overall anatomical results were very good in 29.2%, good in 50%, and fair in 20.8%. We did not record any poor functional or anatomical results in our series.

Dingamnodji M, et al. [12] found 45.7% very good results and 42.9% good functional results. The anatomical criteria were good in 62.9%.

The absence of poor functional and anatomical results in our series may be attributed to the quality of the synthesis (anatomical reduction, solid fixation) as well as early mobilization and continued physical therapy until consolidation.

Conclusion

Tibial plateau fractures are epiphyseal-metaphyseal fractures of the proximal end of the tibia, which have been increasing steadily since the widespread use of motorized two-wheeled vehicles as a means of public transportation. They occur mainly in young males and are often the result of high-energy trauma causing complex injuries.

We conducted an 18-month prospective, single-center study from September 15, 2022, to March 15, 2024, at the Dalal Jamm National Hospital Center, involving 32 patients with an average age of 43 years who were admitted for tibial plateau fractures and treated and followed up in the department during the study period.

Males were the most affected in 87.5% of cases, and the most common circumstances of occurrence were road traffic accidents in 87.5% of cases. The right knee was the most affected in 65.6% of cases; Schatzker type II and type VI were the most common, each accounting for 28.1% of cases. Associated injuries were dominated by fractures of the head and neck of the fibula, accounting for 68.4%.

Treatment was surgical, with lateral screw fixation performed in 53.1% of cases. The anterolateral approach was the most commonly used, accounting for 74% of cases.

At a mean follow-up of 12 months, we evaluated 24 patients who responded to the call. We used the Merle d'Aubigné and Mazas functional score and anatomical criteria. Our overall anatomical results were very good and good in 79.2% of cases, and the overall functional results were very good and good in 95.8% of cases.

The functional evaluation found 10.5% knee stiffness.

The anatomical evaluation found: 15.8% knee osteoarthritis, 15.8% proximal tibial necrosis, and 5.3% malunion.

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