

## Ilizarov External Fixator in the Treatment of Complex Fractures of the Proximal Tibia at the Brazzaville University Hospital Center

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### Abstract

### Original Research Article

**Introduction:** Proximal tibial fractures are severe injuries that highly compromise knee function. Complex fractures pose a therapeutic challenge, as they require both bone healing and preservation of joint function. The aim of our study was to describe the epidemiological, therapeutic, and prognostic aspects of complex proximal tibia fractures treated with Ilizarov external fixation. **Patients and Method:** This was a descriptive, cross-sectional retrospective study carried out in the orthopaedics and traumatology department of Brazzaville University Hospital between January 2022 and December 2024. It involved patients with complex fractures of the proximal tibia with damaged skin, treated with Ilizarov external fixators and following up. Knee X-rays were utilized to analyse anatomical results, and the Merle d'Aubigné and Mazes score was used for functional assessment. **Results:** Six male patients were included, with a mean age of 36.67 years (range: 19–58 years). The fractures were classified as Schatzker V in 1 case and Schatzker VI in 5 cases. The fracture was opened in 33.33% of cases and closed with dermabrasion in 66.67% of cases. The average time to treatment was 7.16 days. The Ilizarov external fixator was used alone in 5 cases and in combination with epiphyseal screw fixation in 1 case. The short- and medium-term postoperative outcomes were uncomplicated, with all fractures healing. At the last follow-up, knee function was rated as very good or good in 4 cases and poor in 1 case. **Conclusion:** The Ilizarov external fixator is an excellent alternative in the surgical treatment of complex fractures of the proximal tibia. It authorizes secure stabilization without interrupting knee function and allows early healing of skin injuries.

**Keywords:** Proximal tibia fracture, Ilizarov external fixator, surgical treatment, case study, Schatzker classification, soft tissue.

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## INTRODUCTION

Proximal tibia fractures are complex and disabling injuries with significant morbidity [1]. They represent 25% of tibia fractures, 7% of limb fractures, and 1.32% of all fractures [2-4]. They may be extra-articular, but more often than not, they are articular, causing a serious impact on knee function and correspond the nosological framework of “tibial plateau fractures” [1]. These are osteochondral lesions, from simple depressions to epiphyseal-metaphyseal comminution, resulting from high-velocity trauma in the axial and coronal planes, during which the femoral condyles strike the tibial tubercles through various mechanisms [5, 6]. Surgery remains the gold standard for treating these injuries, allowing for anatomical reduction and strong stabilization with a goal of early knee

mobilization [7, 8]. Complex patterns, characterized by significant bone comminution (Schatzker V and VI), are challenging to manage, especially when associated with soft tissue injuries. In such cases, procedure must ensure soft tissue healing, the most anatomical bone healing possible, and good knee joint function. Many authors choose external fixation [1, 9–11], and in particular the Ilizarov external fixator, as it provides circular stability of the fracture, preserves knee motion, causes minimal damage to soft tissue, and finally allows for hybridization of the assembly (a combination of external and internal fixations) [10–13]. The aim of this study was to describe the epidemiological, therapeutic, and prognostic aspects of complex fractures of the proximal tibia treated with the Ilizarov external fixator.

## PATIENTS AND METHOD

We conducted a descriptive, cross-sectional, single-center study over a period of three years (between January 2022 and December 2024). The study included patients over the age of 18 who were admitted to the orthopaedic trauma department of the Brazzaville University Hospital during the period for complex tibial plateau fractures with skin lesions, operated on using the Ilizarov method, and followed up. We excluded patients with simple tibial plateau fractures (Schatzker I, II, and III), those with complex fractures operated on using another technique, and patients who were lost to follow-up. The parameters studied were epidemiological, diagnostic, therapeutic, and evolutive. Bone lesions were classified according to Schatzker's classification [14], while soft tissue lesions were classified according to Tscherne and Gotzen for closed fractures [15] and according to Gustilo and Anderson for open fractures [16, 17]. All patients underwent surgery using regional anaesthesia (spinal anaesthesia). Fractures were reduced using external manoeuvres such as ligamentotaxis, with image – amplification guidance. Some fragments were manipulated using a joystick or lever and temporarily held in place with Kirschner wires. The use of large-sized percutaneous spike forceps enabled fragmentary compression of the tibial tubercles, which was

subsequently maintained either with 6.5 mm diameter cancellous screws or with opposing olive pins. The Ilizarov circular frame was made of complete rings and 1/2 or 2/3 rings with diameters ranging from 120 to 190 mm (figure 1). The fixation technique combined methods already described in the literature [10, 12, 13, 18], with bone transfixion performed using 16 mm straight or olive pins, placed at two levels in the diaphysis and either at two levels or at one level coupled with epiphyseal hybridization (figure 2a). Two complete rings were positioned diaphysially, while epiphysially, a 1/2 or 2/3 ring was used alone or in combination with a complete ring. Stabilization was performed after checking the reduction, using threaded metal rods 50 to 300 mm in length, secured with nuts (Figure 2b). Knee mobilization began the day after surgery.

The anatomical assessment of the knees was performed on standard X-rays using the criteria established by Duparc and Cavagna [19], and the functional assessment of the knees was performed using the Merle d'Aubigné and Mazès score [8].

The data were processed using Microsoft Excel version 2021 software, with qualitative variables expressed as absolute frequencies and quantitative variables as averages.



**Figure 1: Components of the Ilizarov External Fixator.**

Full rings and 2/3 rings made of titanium (a), 1/2 rings made of steel (b), 16 mm Kirschner wires (c), threaded metal rods (d), nuts, bolts, pin holders, and keys (d).



**Figure 2: a) Positioning of the 16 mm pins at 4 levels. b) Assembly of the montage (rings and rods)**

## RESULTS

### Epidemiological aspects

In this study, we collected data on six (6) patients, all male. The average age was 36.67 years, with extremes of 19 and 58 years.

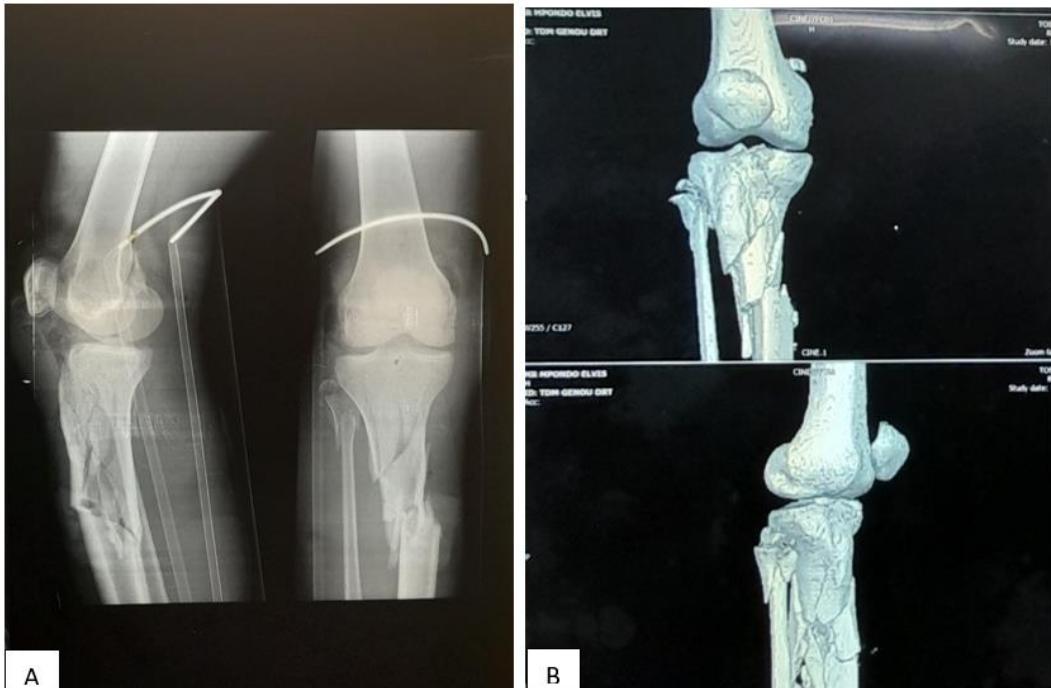
All fractures occurred as a result of trauma from a road traffic accident involving a motorized two-wheeled vehicle.

### Diagnostic and therapeutic aspects

All patients consulted for severe post-traumatic knee pain associated with complete functional impairment of the lower limb. The injury was located on the left knee in two cases and on the right knee in four cases. The adjacent skin was not intact in all patients.

Two cases involved an open fracture classified as type II according to Gustilo and Anderson, and four cases involved a closed fracture with multiple skin abrasions classified as stage 2 according to Tscherne and Gotzen in three cases and stage 3 in one case. Radiologically, all fractures were articular, either Schatzker stage V (one case) or Schatzker stage VI (five cases). In one patient, the tibial fracture was associated with a type 33B3.2 condylar fracture according to AO/OTA. Computed tomography was performed in only three patients, confirming joint involvement in one case (figure 3) and posteromedial depression in another case.

In terms of treatment, we used anteroposterior percutaneous screw fixation to treat an associated femoral condylar fracture (figure 4). The table 1 summarizes the treatment data for the patients.



**Figure 3: X-ray (A) and CT scan (B) images of a complex fracture of the proximal tibia, classified as type VI according to Schatzker's classification**



**Figure 4: X-ray control of the knee showing condylar screw fixation treating an AO/OTA type 33B3.2 fracture**

**Table 1: Therapeutic data on patients**

	<b>Outcomes</b>
Average time to surgery (days)	7.16 (1 – 21)
Average duration of intervention (minutes)	147.5 (90 – 215)
Type of fixation: Tibio-tibial external fixator	6
Ilizarov alone	5
Ilizarov + Epiphyseal screw fixation	1

#### Evolutive aspects

The average period of postoperative hospital stay was 4.17 days, ranging from 2 to 7 days. All patients underwent functional rehabilitation sessions, with an average of 20.68 sessions (ranging from 15 to 30 sessions). The limb was completely off weight for at least 45 days, and weight bearing was authorized after an average of 57.17 days.

No secondary infection of skin lesions was observed, and postoperative recovery was uneventful in five cases. We regret to report one death on the 77th

postoperative day due to pulmonary embolism complicating thrombophlebitis. The average time to consolidation was 93.5 days (range: 75 to 120 days), and the external fixator was systematically removed once the bone callus was visible on X-ray and sufficiently solid.

With a mean follow-up of 13.6 months, radiological assessment of the five remaining knees according to Duparc and Cavagna criteria gave us a good outcome in 3 cases and a very good outcome in 2 cases. The functional assessment of the knees is given in Table 2.

**Table 2: Distribution of patients according to the Merle d'Aubigné and Mazès score at the last follow-up**

<b>Score</b>	<b>Effective</b>
Very good (17 – 18)	1
Good (15 – 16)	3
Average (13 – 14)	1
Poor ( $\leq 12$ )	0
<b>Total</b>	<b>5</b>

## DISCUSSION

Complex tibial plateau fractures with damaged tissue are less common. Most studies report series consisting mainly of closed fractures. These studies, which take into account both complex and simple forms, involve large series [3, 8, 13, 20]. Randriamarotiana *et al.*, [21] report in their series that 20.3% of cases had damaged soft tissue, regardless of the type of injury. The small size of our series can be explained by the over-

selection of complex fractures with damaged soft tissue treated with an Ilizarov fixator. However, our results prompt us to make a few comments.

The patients are young, with an average age of 36.67 years. This result corresponds with that of Khatri *et al.*, [21], who observed an average age of 37.7 years in their study of Schatzker type V and VI fractures. Nevertheless, Dingamnodji *et al.*, [8] report a significantly higher average age of 46.6 years in a series

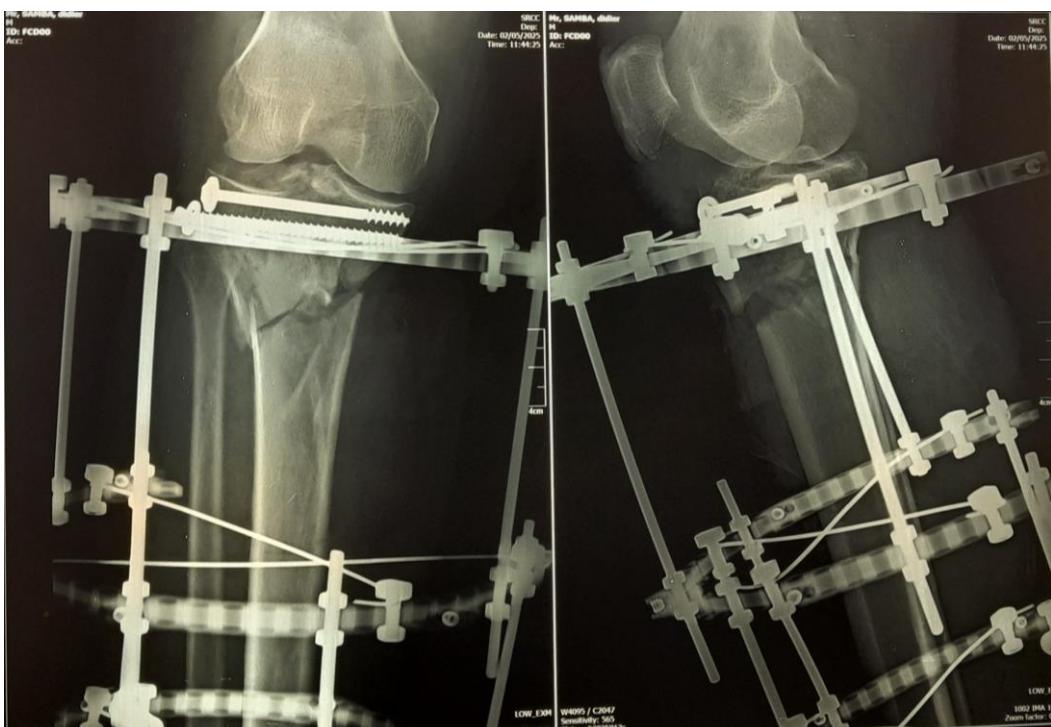
including all types of tibial plateau fractures. Road accidents involving two-wheeled motor vehicles (motorcycles) were the only traumatic circumstance in the series. This context is mentioned by the majority of African authors, especially in countries where motorcycles are used for public transport [3, 20, 22]. The male-dominated character of our series is very unusual, leading us to realize that young men are more active in our society, driving almost all motorized vehicles engaged in high-energy accidents, while prudence and fear are the preserve of women and older people.

The soft tissue surrounding the bone lesions was not healthy; its surface showed either multiple abrasions of differing degrees or a wound connecting the fracture site to the outside. Randriamarotiana *et al.*, [22] report in their series, combining all types of bone lesions that 20.3% of patients had poor skin condition. Barbary *et al.*, [13] noted 9 skin openings in a series of 29 Schatzker type VI fractures, and Selim *et al.*, [23] report 21% skin contusion and 15% open wounds in 70 Schatzker type V and VI tibial plateau fractures. It should be noted that complex forms are often accompanied by skin lesions, as these forms result from very violent trauma involving both the intrinsic mechanisms responsible for separation-depression lesions of the tibial plateau and extrinsic mechanisms causing metaphyseal-diaphyseal fractures of the tibia and soft tissue lesions.

Unlike in developed countries, the health insurance system in Congo does not cover all social classes, and patients are forced to be supported by their families. As a result, we were unable to treat all

emergency patients, despite the existence of serious soft tissue injuries. However, the extent of the soft tissue injuries led us to prefer external fixation instead of plates and screws, which are often used after skin lesions have healed, although this is not guaranteed. In this case, the external fixator is the ideal therapeutic option, as it stabilizes the bone fragments, providing patients with pain relief in their knees, but also greatly reduces aggression on the soft tissues, thus promoting the healing of skin lesions [24, 25]. The choice of the Ilizarov fixator is justified by its less invasive nature (the skin is only penetrated by Kirschner wires, which are less bulky than Schanz screws) and its stability in all three planes, which means that the knee does not need to be bridged and allows early mobilization of the knee joint.

The relatively short delay (7.16 days) between injury and surgery in our patients facilitated closed reduction procedures. Fracture reduction was achieved by ligamentotaxis and interfragmentary compression applying olive pins in five cases. In one patient treated after two weeks, it was difficult to mobilize certain joint fragments utilizing external manoeuvres; we were forced to perform splinting and then proceed with raising using a 'lever effect' and internal fixation of the tibial tubercles applying double screws (Figure 5). In their series, Barbary *et al.*, [13] used open reduction with 5 to 6 cm incisions in 6 cases. Higher proportions of skin opening procedures have been reported in the literature in the studies conducted by Weiner *et al.*, [26], with 60% open reduction, and Watson and Coufal [28], with 79% open reduction.



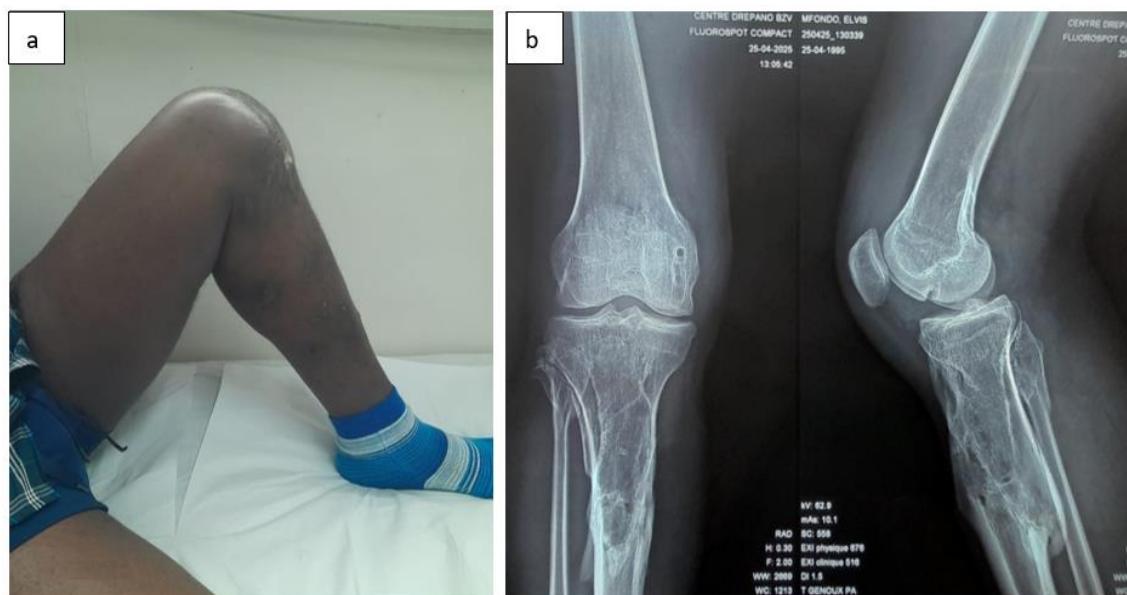
**Figure 5:** X-ray follow-up of a hybrid fixation (Ilizarov fixator and cancellous screws) for a tibial plateau fracture classified as type VI according to Schatzker

The use of hybrid fixations in this pathology is also noteworthy. Similar to our case of epiphyseal screw fixation, Barbary *et al.*, [13] combined the Ilizarov fixator with compression screws inserted percutaneously in 60% of cases, unlike Weiner *et al.*, [26], who used compression screws in all of their joint fractures. These results show how Ilizarov fixates offer real possibilities for hybridization in the stabilization of bone fractures.

The occurrence of a death after 2 months and 17 days was an exceptional situation in our study. Pulmonary embolism, which is a complication of high-risk emboligenic surgery such as pelvic limb osteosynthesis, was fatal in a patient who very quickly stopped anticoagulant treatment due to lack of financial resources. The present study reveals that no morbidity was observed in the postoperative period in the five other patients. The literature reports low rates of postoperative complications, especially infectious ones [12, 13, 26, 27]. Given the coexistence of skin lesions, one of the objectives of managing this condition is to keep the incidence of infectious complications as low as possible. Consolidation was achieved in all patients within the normal time frame. The results we obtained in this regard are better than those reported by Barbary *et al.*, [13] and Rafik *et al.*, [12], who observed relatively long bone

consolidation times. However, given the small size of our series compared to others, we must view this result with considerable caution.

According to Duparc and Cavagna's radiological criteria, our anatomical results are very satisfactory in the follow-up, providing information on the good and very good functional results of the knees (Figure 6) and are generally similar to those reported in previous studies [12, 13, 27, 28]. Although we have not observed any cases of gonarthrosis in all our patients to date, a much longer follow-up period is required for a more accurate assessment. The risk of post-traumatic gonarthrosis is often minimized by anatomical reconstruction of the tibial plateau, but we all know that this risk is never zero, even in anatomically restored knees, due to the existence of osteochondral lesions. It is also important to emphasize the role of physical medicine in the functional restoration of the knees. Physiotherapy, which aimed, through a well-established protocol, to rehabilitate the knee joint range of motion, maintain thigh muscle trophicity and strengthen muscle strength, was made possible by the freedom of movement of the unfixed knees and the stability of the assemblies, which were guarantees of the Ilizarov external fixator.



**Figure 6: Functional (a) and radiological (b) results of a Schatzker VI tibial plateau fracture treated with an Ilizarov external fixator at 14 months**

## CONCLUSION

This preliminary study highlights the clinical success and low morbidity associated with the Ilizarov method in the treatment of complex fractures of the proximal tibia in general, or specifically when these fractures are accompanied by significant soft tissue damage. This method facilitates soft tissue healing in this type of fracture, compared to screw plates, where extensive dissection sometimes aggravates soft tissue damage. In addition, the Ilizarov external fixator offers

near-anatomical reduction of the joint surfaces, with the possibility of early knee mobilization and early weight-bearing on the lower limb. Despite the small number of patients, the results obtained are very satisfactory and justify the recommendation that the Ilizarov method should be the treatment of choice for complex fractures of the proximal tibia with or without soft tissue injuries.

**Declaration of competing interest:** No conflicts of interest

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