


Lesional and Therapeutic Aspects of Tibial Plateau Fractures at the BSS University Hospital Center in Kati

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Abstract

Introduction: Tibial plateau fractures are solutions of continuity of the epiphyseal-metaphyseal block of the upper end of the tibia of which at least one line enters the joint. They threaten the stability and mobility of the knee and can compromise walking and standing. These fractures are on the increase, especially affecting young and active subjects. Orthopedic treatment is a rare indication apart from non-displaced or slightly displaced forms. Surgical treatment is required in displaced forms, particularly in depression fractures. The aim of this work was to report the lesional and therapeutic aspects of tibial plateau fractures in our department. **Patients and Method:** Patients and method: This was a retrospective study over 36 months from January 2019 to December 2021. Included in this study were patients treated for a tibial plateau fracture in our department and followed up for at least 10 months. The epidemiological and clinical data analyzed were age, sex, affected side, etiology, mechanism of injury, pathological anatomy and associated lesions. The fractures were classified according to the classification of Duparc and Ficat. The slightly or non-displaced forms were treated orthopedically while the displaced forms were treated surgically. The minimum follow-up was 10 months. The results were evaluated by the anatomical criteria according to Mazas and Duparc and functional according to Merle d'Aubigné. **Results:** The authors collected 71 cases of tibial plateau fractures. They accounted for 4.0% of all limb fractures, 5.8% of lower limb fractures and 33.8% of knee fractures in our service. The male sex was the most represented at 78.9% with a sex ratio of 3.7. The age group of [20 - 40] years was the most affected, *i.e.*, 53.5%. The average age was 41 years with extremes of 17 and 82 years. The

left side was affected (n = 47) and the right side (n = 24). Road traffic accident was the main cause. The mechanism of injury was mainly represented by lateral and sagittal compressions. Lateral unituberosity and bi-tuberosity fractures were the most frequent pathological types in our series, respectively 42.2% and 28.2%. The associated lesions were mainly represented by bone, ligament, skin and neurological lesions. The treatment was orthopedic in 52.1% and surgical in 47.9%. According to the functional criteria of PMA, our results were very good and good at 77.4%, Average at 14.1% and poor at 8.5%. **Conclusion:** It appears in this study that fractures of the tibial plateaus are frequent and serious because of their articular nature. Lateral and sagittal compressions are the most evoked injury mechanisms. Lateral unituberosity and bituberosity fractures are the most frequent pathological types. Functional and anatomical results are significantly better with surgical treatment.

Keywords

Fractures, Tibial Plateau, Pathology, Osteosynthesis

1. Introduction

Tibial plateau fractures are solutions of continuity of the epiphyseal-metaphyseal block of the upper end of the tibia of which at least one line enters the joint. In 1875 Richet singled them out as an entity apart from other tibial fractures [1]. A study carried out in 2018 at the CHU Gabriel Touré found a frequency of 1.13% [2]. These fractures are on the increase, especially affecting young and active subjects. They are twice as common in men as in women and extremely rare in children [3]. These fractures are frequent, representing 1% of all fractures and 25% of tibial fractures [4]. In 1980, in industrialized countries, the incidence of tibial plateau fractures was 123 per 10,000 inhabitants among women and 104 per 10,000 inhabitants among men [5]. The main etiologies remain dominated by accidents on public roads and sports accidents [3]. They are frequent and serious because of their joint nature. They threaten the stability and mobility of the knee and can compromise walking and standing [1]. In our country, very few studies have focused on tibial plateau fractures, although these fractures rank third among pelvic limb injuries [6]. Orthopedic treatment is a rare indication apart from non-displaced or slightly displaced forms. Surgical treatment is required in displaced forms, particularly in depression fractures. Early and stable osteosynthesis will provide better functional results after early rehabilitation. The aim of this work was to report the lesional and therapeutic aspects of tibial plateau fractures in our department.

2. Patients and Method

Our study was carried out at the University Hospital of Kati. This was a retrospective study over 36 months, from January 2019 to December 2021. The sampling was done taking into account the selection criteria of our study population.

Our study concerned patients of all ages, male or female, admitted to the Orthopedics-Traumatology department of the CHU-Pr. BSS of Kati. Included in this study were patients treated for a tibial plateau fracture in our service and followed up for at least 10 months. Incomplete records and patients lost to follow-up were not included in this study. We used consultation registers, patient files and operating report registers. The epidemiological and clinical data analyzed were age, sex, affected side, etiology, mechanism of injury, pathological anatomy and associated lesions. The anatomopathological study of these fractures was carried out on a standard radiographic analysis of the face, profile and often of 3/4 external and internal. Some patients benefited from computed tomography, in order to better appreciate the lesions. The fractures were classified according to the Duparc and Ficat classification [7] [8] (Table 1). The slightly or non-displaced forms were treated orthopedically while the displaced forms were treated surgically. The minimum follow-up was 10 months. The results were evaluated by the anatomical criteria according to Mazas and Duparc and functional according to Merle d'Aubigne (Table 2 and Table 3). Data were analyzed with IBM SPSS

Table 1. Classification of Duparc and Ficat.

Fracture Group	Fracture type
Unituberosity fractures (lateral or medial)	<ul style="list-style-type: none"> • Type I: mixed fractures • Type II: separation fractures • Type III: settlement fractures
Bi-Tuberosity Fractures	<ul style="list-style-type: none"> • Simple V, Y, or inverted T fractures • Complex bi-tubercular fractures • Comminuted bi-tubercular fractures
Spinotubercular fractures (medial or lateral)	<ul style="list-style-type: none"> • Type I: no or minimal displacement • Type II: subluxation above and outside the diaphyseal-epiphyseal fragment with minimal overhang of the tibia in relation to the femur • Type III: dislocation above and outside the diaphyseal fragment with rupture of the contralateral capsuloligamentous plane
Posterior separation fractures	<ul style="list-style-type: none"> • Posteromedial separation fracture • Separation fracture of one plateau with spinotuberosity fracture of the other plateau

Table 2. PMA functional criteria.

Criteria	Walking	Pain	Mobility	Stability
Very good	Normal	No pain	Full extension, flexion of 120° or more	Perfect, no laxity
Good	Normal or slight claudication	Rare and moderate pain	Flexion of more than 90°, full extension or flossum of less than 10°.	No laxity in extension, unilateral squatting possible but with minimal difficulty
Average	Limited or with a cane	At the effort	Flexion from 60° to 90°, Flossum below 20	Laxity in extension, unilateral squatting impossible
Bad	No walking or with 2 canes	Permanent	Flexion less than 60°, flossum greater than 20	Severe instability, monopodal support impossible

Table 3. Anatomical criteria of MAZAS and DUPARC.

Criteria	Joint surface	Interline	Osteoarthritis	Axis
Very good	Perfect Reconstruction	Normal	Absent	No axis defect
Good	Small residual and localized depression	Minimal alterations	Minor signs	No varus deviation, valgus of <15°.
Bad	Significant indentation	Severe alteration	Frank signs	Varus deviation, valgus of more than 15°.

statistics 22.0 software and entered into Microsoft Word 2016.

3. Results

The authors collected 71 cases of tibial plateau fractures. They accounted for 4.0% of all limb fractures, 5.8% of lower limb fractures and 33.8% of knee fractures in our department. The male sex was the most represented at 78.9% with a sex ratio of 3.7. The age group of [20 - 40] years was the most affected, *i.e.*, 53.5%. The average age was 41 years with extremes of 17 and 82 years. The left side was affected (n = 47) and the right side (n = 24). The etiology was road traffic accident (n = 59) or 83.1%, domestic life accident (n = 10) and intentional blows and injuries (n = 2). The injury mechanisms (**Table 4**) were lateral compression (n = 24), sagittal compression (n = 21), axial compression (n = 5) and mixed compression (n = 1). The mechanism was unknown in 20 cases or 28.2%. The pathological types (**Table 4**) were lateral unituberosity fracture (n = 30), bituberosity fracture (n = 20), spinotuberosity fracture (n = 8), medial unituberosity fracture (n = 5), lateral spinotuberosity fracture (n = 4) and epiphyseal-metaphyseal diaphyseal fracture (n = 4). Associated lesions were mainly represented by distant bone (n = 13), knee ligament (n = 6), skin (n = 4) and nerve (n = 1) lesions. The treatment was orthopedic in 37 patients or 52.1% and surgical in 34 patients or 47.9%. The sociodemographic and clinical characteristics are summarized in **Table 4**. The orthopedic treatment was ensured by cruro-pedial plaster in 97.2% and 2.8% by transcalcaneal traction. The surgical implants (**Figure 1** and **Figure 2**) used were the L-plates (n = 18), the T-plates (n = 13), the blade plate (n = 1), the screw (n = 1) and the fixator external (n = 1). The postoperative complications listed (**Figure 3**) were osteoarthritis (n = 6), instability (n = 5), vicious callus (n = 4), stiffness (n = 2), axial deviation (n = 2) and infection (n = 1). According to the functional criteria of PMA, our results were very good and good at 77.4%, Average at 14.1% and poor at 8.5%. According to the MAZAS and DUPARC anatomical criteria, our results were very good and good in 84.5% and bad in 15.5%.

4. Discussion

This was a retrospective study of 71 patients operated on for tibial plateau fracture. Surgery for tibial plateau fractures accounted for 5% of surgeries in our department. The injury mechanisms were mainly represented by lateral and sagittal compressions. The high frequency of the indirect mechanism by lateral

Table 4. Sociodemographic and clinical characteristics of patients.

Variables		Number	Percentage
Number of patients		71	
Sex	Male	56	78.9
	Female	15	21.1
	Total	71	100
Age (years)	0 - 20	3	4.2
	20 - 40	38	53.5
	40 - 60	20	28.2
	>60	10	14.1
	Total	71	100
Affected side	Right	24	33.8
	Left	47	66.2
	Total	71	100
Etiologie	Etiology Road traffic accident	59	81.1
	Domestic accident	8	11.3
	Intentional injury	2	2.8
	Accident at work	1	1.4
	Sports accident	1	1.4
	Total	71	100
Mechanism	Lateral compression	24	33.8
	Sagittal compression	21	29.6
	Axial compression	5	7
	Mixed compression	1	1.4
	Not identified	20	28.2
	Total	71	100
Pathological lesions	Unituberosal fracture External	30	42.2
	Bituberositary fracture	20	28.2
	Medial spinotubercular fracture	8	11.3
	Medial unitary fracture	5	7
	Lateral spinotubercular fracture	4	5.6
	Epiphyseal-metaphyseal fracture	4	5.6
	Total	71	100
Associated injuries	Ligamentous	6	25
	Cutaneous	4	16.7
	Nervous	1	4.1
	Remote bone	13	54.1
	Total	24	100

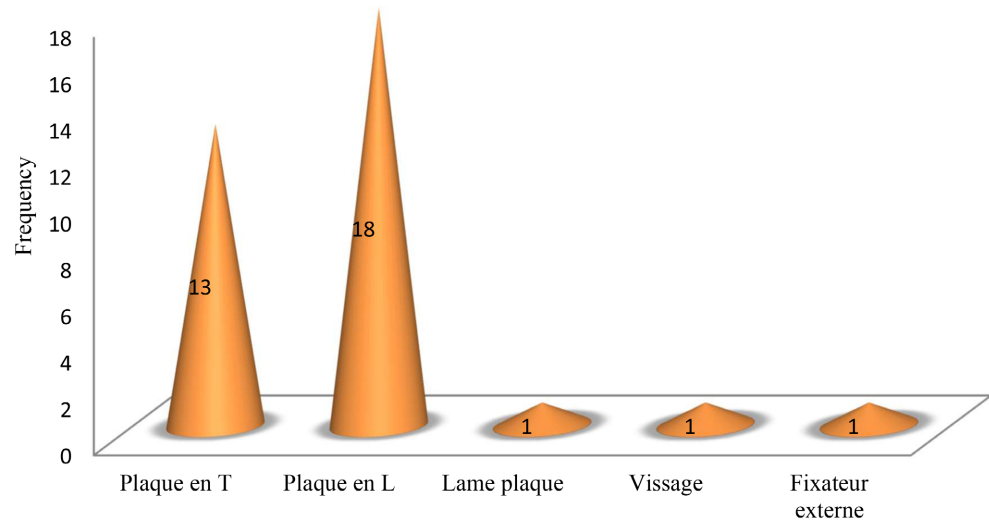


Figure 1. Implants for osteosynthesis.

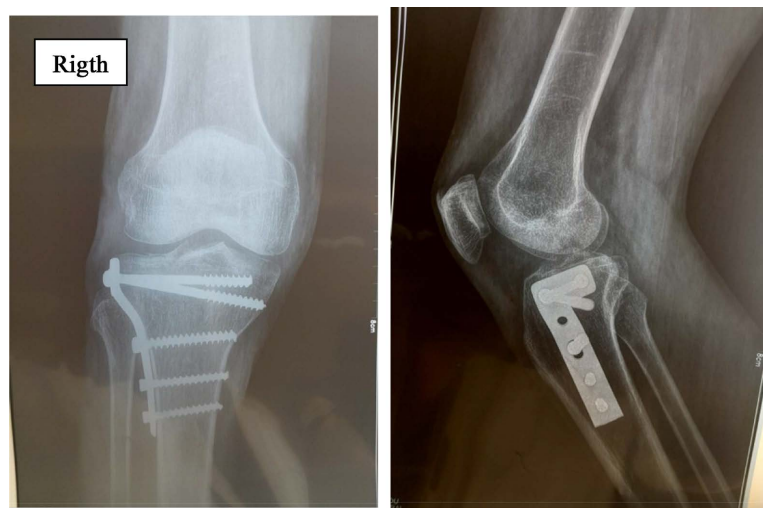


Figure 2. Lateral unituberosal fracture operated with L-plate, consolidated.

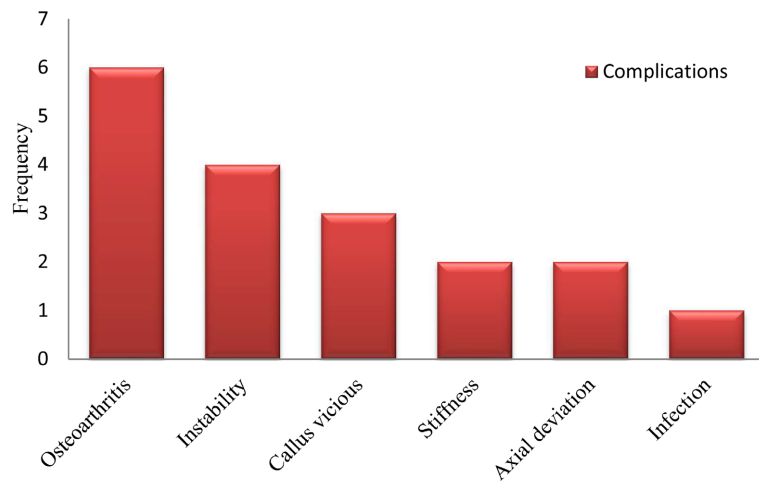


Figure 3. Post-operative complications.

compression has been mentioned by several authors [9] [10]. The high frequency of the lateral compression mechanism can be explained by the fact that the knee is a joint very exposed to various attacks. Its bone architecture favors this type of mechanism. It should also be noted that the mechanism was unknown in 28.2% of cases, our patients poorly specified the mechanism due to the violence of the trauma and the lesion association. Lateral unituberosity and bi-tuberosity fractures were the most frequent pathological types in our series, respectively 42.2% and 28.2%. Our results were comparable to those of Chan Y.S. *et al.* [11] and Yacoubian *et al.* [12] who respectively had 39% and 29% of lateral unituberosity fractures. This high frequency could be linked to the existence of an area of weakness in the lateral tibial plateau. The most frequent associated lesions were remote bone lesions, 54.2%, and knee ligament lesions, 25%. The overall rate of osteosynthesis in our series was 47.9%. This rate is lower than those of Da *et al.* [2], Honkonen and Järvinen [13], and Koulali *et al.* [14] with respectively 59.7%, 58% and 68%. Surgical treatment is the treatment recommended by the majority of authors [1] [15]. It is for them the only one capable of reducing a significant depression, of fixing a separation in a stable manner and thus obtaining an assembly allowing immediate mobilization. The frequent use of the screwed plate could be explained by the stability and solidity of the fixation it offers. A bone graft was necessary in 11.49% of cases during the osteosynthesis in order to fill the metaphyseal defect created by the lifting of the hollow plate. It involved a corticocancellous graft taken from the ipsilateral iliac crest. This attitude is consistent with the literature as noted by Koulali *et al.* [14] and Le Huec [16]. The choice of osteosynthesis material strongly depended on the type of fracture and the stability offered by the latter. In our study, 79.4% of operated patients were treated with a screwed plate. We noted 25.5% of complications. These complications were dominated by osteoarthritis (33.3%), instability (22.2%) and malunion of the knee (16.6%). The orthopedic treatment was responsible for 37.8% of complications. On the other hand, 11.7% of complications were recorded after the surgical treatment. This result suggests that the indication for surgical treatment should be extended as much as possible in tibial plateau fractures, even in non-displaced forms. Solid osteosynthesis after anatomical reduction will allow early mobilization which will considerably reduce the rate of complications. According to the functional criteria of PMA, our results were very good and good at 77.4%. Our functional results are similar to those of Koulali *et al.* [14], Sawadogo *et al.* [17] and Kassé NA *et al.* [18], who had respectively 67%, 79% and 88% very good and good results. According to the anatomical criteria of MAZAS and DUPARC, our results were classified as very good and good in 84.5%. Our work has limits. This is a single-center retrospective study that has certain biases in data collection. The workforce is small and the recoil is weak. The latter can influence the evaluation of the anatomical complications of these fractures. Satisfactory functional results at the start could deteriorate later. On the other hand, the results of this study are consistent with data published in developing

countries. Multicenter studies with large numbers and a significant follow-up are necessary to compare our results.

5. Conclusion

It appears in this study that fractures of the tibial plateaus are frequent and serious because of their articular nature. Lateral and sagittal compressions were the most evoked injury mechanisms. Lateral unituberosity and bi-tuberosity fractures were the most frequent pathological types. The functional and anatomical results were significantly better with the surgical treatment. This is why the indication for surgical treatment must be extended as much as possible in tibial plateau fractures, even in non-displaced forms.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Hutten, D., Duparc, J. and Cavagna, R. (1990) Fractures des plateaux tibiaux de l'adulte. *Encyclopédie Médico-Chirurgicale*, 14082B10.
- [2] Fofana, A. (2018) Etude épidémiologique et thérapeutique des fractures de l'extrémité proximale du Tibia dans le service de chirurgie orthopédique et traumatologique du CHU Gabriel TOURE. Université de Bamako, Bamako.
- [3] Duparc, F. (1998) Reconnaître et traiter une fracture des plateaux tibiaux de l'adulte. *Concours Médical*, **120**, 1179-1189.
- [4] Charalambous, C.P., Tryfonidis, M., Alvi, F., Moran, M., Fang, C., Samaraji, R. and Hirst, P. (2007) Inter- and Intra-Observer Variation of the Schatzker and AO/OTA Classifications of Tibial Plateau Fractures and a Proposal of a New Classification System. *Annals Royal College of Surgeons of England*, **89**, 400-404. <https://doi.org/10.1308/003588407X187667>
- [5] Bengner, U., Johnell, O. and Redlund-Johnell, I. (1986) Increasing Incidence of Tibia Condyle and Patella Fractures. *Acta Orthopaedica Scandinavica*, **57**, 334-336. <https://doi.org/10.3109/17453678608994405>
- [6] Da, S.C., Ouedraogo, S., Dieme, C., Kafando, H., Zan, A., Nacoulma, S.I. and Ouedraogo, R.K. (2008) Fractures des membres aux urgences traumatologiques à Ouagadougou (Burkina Faso). *Journal des Sciences*, **8**, 1-9.
- [7] Duparc, J. and Ficat, P. (1990) Articular Fractures of the Upper End of the Tibia. *Revue de Chirurgie Orthopédique et Réparatrice de l'Appareil Moteur*, **46**, 399-486.
- [8] Gicquel, T., Najihi, N., Vendeuvre, T., Teyssedou, S., Gayet, L.-E. and Hutten, D. (2013) Tibial Plateau Fractures: Reproducibility of Three Classifications (Schatzker, AO, Duparc) and a Revised Duparc Classification. *Revue de chirurgie orthopédique et traumatologique*, **99**, 668-679. <https://doi.org/10.1016/j.rcot.2013.08.003>
- [9] Bounabe, R. (2010) Les fractures des plateaux tibiaux. Thèse de médecine, Marrakech.
- [10] Delloul, I. (2015) Fracture des plateaux tibiaux, à propos de 40 cas. *22ème congrès national de la SACOT 2015*.
- [11] Chan, Y.-S., et al. (2008) Arthroscopy-Assisted Surgery for Tibial Plateau Fractures: 2-to 10-Year Follow-Up Results. *Arthroscopy*, **24**, 760-768.

<https://doi.org/10.1016/j.arthro.2008.02.017>

- [12] Yacoubian, S.V., Nevins, R.T., Sallis, J.G., Potter, H.G. and Lorich, D.G. (2002) Impact of MRI on Treatment Plan and Fracture Classification of Tibial Plateau Fractures. *Journal of Orthopaedic Trauma*, **16**, 632-637.
<https://doi.org/10.1097/00005131-200210000-00004>
- [13] Honkonen, S.E. and Jarvinen, M.J. (1992) Classification of Fractures of the Tibial Condyles. *The Journal of Bone and Joint Surgery*, **74-B**, 840-847.
<https://doi.org/10.1302/0301-620X.74B6.1447244>
- [14] Koulali, K.I., Rafai, M., Cohen, D., Fnini, S., Largab, A., Ouarab, M. and Trafteh, M. (2003) Les fractures des plateaux tibiaux: à propos de 100 cas. *Revue Marocaine de Chirurgie Orthopédique et Traumatologique*, **18**, 14-21.
- [15] Ibtissem, L., Khatir-leyla, M. and Walid, S. (2015) Etude clinique et épidémiologique des fractures du plateau tibial. Thèse de médecine, Tlemcem.
- [16] Le Huec, J.C. (1996) Fractures articulaires récentes de l'extrémité supérieure du tibia de l'adulte. *Société Française de Chirurgie Orthopédique et Traumatologique*, No. 55, 97-117.
- [17] Sawadogo, M., Dakouré, P., Tall, M., Kafando, H., Ouédraogo, S. and Da, S.C. (2013) Fractures des plateaux tibiaux au Centre Hospitalier Régional de Ouahigouya (Burkina Faso): résultats du traitement chirurgical. *Orthopedics Emergency of Africa*, **2**, 19-21.
- [18] Kasse, N.A., Soulama, M., Diao, S., Diallo, M., Thiam, B. and Sy, M.H. (2016) Traitement des fractures complexes des plateaux tibiaux par la méthode d'Ilizarov. *Journal Africain de Chirurgie Orthopédique et Traumatologique*, **1**, 120-125.