



Floating knees: Epidemiological, clinical, therapeutic and developmental study at the national reference university hospital centre in N'Djamena

Andjeffa Valentin^{1*}, Adendjingué Daniel Mossalbaye¹, Parteina Dogossou¹, Zamzam Ibrahim¹, Sané André Daniel²

¹ Orthopaedic and Trauma Surgeon of National Reference University Hospital, N'Djamena, Chad

² Orthopaedic and Trauma Surgeon of Dallaldjam University Hospital, Dakar, Senegal

Abstract

Background: The floating knee is an ipsilateral fracture of the femur and tibia. It occurs in the context of high-energy trauma, mainly caused by road accidents.

Objective: The aim of this study was to analyse the management of fractures at Centre Hospitalier Universitaire la Référence Nationale.

Materials and method: This was a retrospective, descriptive study from 1 January 2016 to 31 December 2021 on the records of patients treated and monitored for floating knees in the Orthopaedics and Traumatology Department of the Centre Hospitalier Universitaire la Référence Nationale. Fractures were classified according to the Fraser classification, and the opening was according to the Gustilo-Anderson classification. Functional and anatomical results were assessed according to the Karlstrom and Olerud criteria.

Results: This is a retrospective series of 23 floating knees out of 1578 pelvic limb fractures, i.e. a frequency of 1.45%, including 20 in men (87%) with a sex ratio of 6.6. The mean age was 33.2 years. The aetiologies were dominated by AVP (95.7%) involving the motor-vehicle pair (52.2%). The lesion was more localized on the left (60.9%). There were 73.9% skin openings, mainly on the leg (58.8). Gustilo-Anderson type II predominated in the femur and tibia. FRASER type I fractures were the most common at 43.5%, followed by type II (21.7%). Surgical treatment (73.9%) used plates screwed to the femur (63.2%) and tibia (58.8%). Complications were dominated by stiffness (50%). With an average follow-up of 68 months, the anatomical and functional results were deemed satisfactory (excellent 30.4% and good 34.8%).

Conclusion: The floating knee is a complex, uncommon, but severe injury. It mainly affects young men, requiring urgent medical and surgical intervention. Diagnosis is based on clinical examination and radiological confirmation. Treatment must be surgical and early to maximize recovery and minimize complications. Prevention of road accidents remains essential.

Keywords: Floating knees, Trauma, Road accidents, Treatment, Chad

Introduction

A floating knee combines ipsilateral fractures of the tibia and femur that may involve a diaphysis, metaphysis or intra-articular fractures [1]. Blacke and McBride first used this term to describe simultaneous fractures of the femur and tibia [2]. These highly complex lesions, with various anatomopathological types, making exhaustive coding difficult. As a result, Fraser *et al.* proposed another classification that did not consider several anatomopathological types [3, 4].

The prevalence and incidence of floating knees are constantly on the increase, given the growth in the population and the high frequency of accidents on public roads, linked to the development of road traffic and excessive speeding, especially in a context where two-wheeled vehicles are one of the most popular means of travel.

These fractures are characterized by their complex management and complications: fat embolism, amputation, infection, delayed consolidation, callus, knee stiffness and instability [5].

Many authors have emphasised the frequency of associated injuries (polytrauma) resulting from high-energy trauma, and the high risk of complications and serious functional sequelae [6, 7].

Management must be multidisciplinary, early and optimal, with the essential aim of stabilizing vital functions in

polytrauma patients, with effective and definitive treatment of bone lesions to allow early release. The latter will enable maximum prevention of complications and well-managed rehabilitation [8].

The aim of this study was to analyse the management of floating knees at the CHU-RN.

Patients and methods

This was a 72-month retrospective study (January 2016 to December 2021) conducted in Orthopaedic Surgery and Traumatology Department of the Centre Hospitalier Universitaire la Référence Nationale (CHURN). The study population consisted of all patients admitted to the department of floating knees during the study period. All patients with a floating knee admitted and managed in the department with a follow-up of at least 6 months were included in the study. Patients with fractures other than floating knee, those whose medical records could not be retrieved, or those lost to follow-up were excluded from the study. The parameters studied were sociodemographic, lesion-related, therapeutic and evolutionary.

The Fraser classification was used for fractures, and the Gustillo and Anderson (GA) classification for soft tissue injury [3, 9].

Patients were operated under spinal anaesthesia (87%; n=20) or general anaesthesia (13%; n=3). The operative chronology was based on the GA classification. The first

stage of the operation always began with the closed lesion in the case of an open fracture. In the case of an open fracture of 2 sites, surgery began with the least severe lesion, according to GA. Trimming was systematic for all open fractures. Orthopaedic treatment consisted of a cruropedic cast in the case of fractures classified as type IIB or IIC with acceptable joint congruence. The results were presented in the table and text format. Anatomical and functional results were assessed according to the criteria of Karlstrom and Olerud V.

Data were collected using a pre-designed individual survey form. Data were entered and analysed using Word, Microsoft Excel 2016 and SPSS 18.

Results

During the study, we recorded 1,578 cases of pelvic limb fractures, including 23 (1.45%) cases of floating knees. Of these, 12 (32.4%) were discharged against medical advice and 2 (5.4%) died. We selected 23 (62.2%) patients for the study. The average admission time was 17.47 (range 0.5-48) hours. The age group most affected was 15-30 (56.5%; n=13). The mean age of our patients was 33.2 years, with extremes of 20 and 73 years. Males predominated in 87% of cases (n=20) with a sex ratio of 6.6. The origin of the subjects was urban (65.2%; n=15) versus rural (34.8%; n=8). Occupations were as follows: pupils/students (34.8%; n= 8), moto-taxi drivers (21.7%; n= 5), farmers/breeder (17.4%; n= 4), shopkeepers (13.1%; n= 3), mechanics (8.7%; n= 2), military (4.3%; n= 1). The aetiological circumstances found were public road accidents, which accounted for 95.7% (n=22), and assault with a firearm (4.3%; n=1). These MVAs involved the motorcycle-auto pair in 87.1% (n=20) of cases, while the pedestrian-auto and car-auto pairs each occurred once (4.1%).

The mechanism was a direct shock in all cases, with a predominance of involvement in the left (69.9%; n=14).

Open fractures were the most common (73.9%; n=17), followed by closed fractures (26.1%; n=6). The sites of open lesions were thigh (17.5%; n=3), leg (59%; n=10), thigh and leg (23.5%; n=3). According to the GA classification, they

were the type I (23.5%; n=4), type II (64.7%; n=11), type IIIA (29.4%; n=5) or B (1.7%; n=1). The distribution of lesions according to Fraser's classification is shown in Table 1. Sixteen (69.6%) had another fracture associated with the floating knee (Table 2).

The mean time to treatment was 15.04±5.2 (ranges 2-80) days. The final treatment was surgical (73.9%; n=17), orthopaedic (17.4%; n=4) or mixed (8.7%; n=2). Associated fractures were treated with a screw plate for the humerus, a screw plate for the femur, screw fixation of the femoral neck, pinning of the lateral malleoli, pinning of the metatarsals and surgical abstention at the fibular shaft.

The average length of hospitalization was 26.52±14.55 (ranges 6-67) days.

The average follow-up time for patients in this series was 32.48 months. We recorded secondary complications in 5 (21.72%) patients, distributed as follows: 3 (13.04%) cases of knee joint stiffness, including 2 (8.68%) after orthopaedic treatment, a surgical site infection (4.34%) and pseudoarthrosis of the tibia (4.34%). Table 3 shows the anatomical and functional results according to Fraser's classification (p=0.00<0.05).

Table 1: FRASER classification

	n	%
Type I	10	43,5
Type Iia	5	21,7
Type IIb	4	17,4
Type IIc	4	17,4
Total	23	100,0

Table 2: Location of associated fractures

	n	%
Homolateral fibular shaft	7	43,7
Humeral shaft	3	18,7
Homolateral lateral malleolus	2	12,5
Femoral shaft	2	12,5
Homolateral femoral neck	1	6,3
Metatarsals	1	6,3
Total	16	100,0

Table 3: Functional and anatomical results according to FRASER classification

Fraser's classification	Results					Total
	Excellent	Good	Medium	Bad		
Type I	6(26,6)	3(13,1)	-	1(4,3)	10(44)	
Type II a	1(4,3)	2(8,6)	1(4,3)	1(4,3)	5(21,5)	
Type II b	-	3(13,1)	1(4,3)	-	4(17,4)	
Type II c	-	-	3(13,1)	1(4,3)	4(17,4)	
Total	7(30,9)	8(34,8)	5(21,6)	3(12,9)	23(100%)	

Discussion

Floating knees are still a relatively rare injury. Very little has been written about this type of stepped trauma in Africa. They tend to occur during high-energy trauma. In this 72-month series, 23 cases of floating knees were recorded out of a total of 1,578 patients hospitalized in the Trauma and Orthopaedics Department of the CHU-RN for pelvic limb fractures, representing a prevalence of 1.45%. This frequency is close to that reported in the African literature [2, 11]. It remains relatively high and may be due to the fact that the CHU-RN is one of the largest centres in the country, receiving patients from all walks of life. We found a very young population in our series, with an average age of 33.2 years and a predominance of males, in line with the data in

the literature, which reports the young age of patients [1, 12]. This age group would appear to be the most active, but also the most reckless. This male predominance has also been reported by authors in Africa and the rest of the world [2, 13]. This can be explained by the fact that young men are the economic mainstays of families in large cities and are often forced to travel by motor vehicles, causing accidents on public highways. All occupational groups may be affected. However, in our series, pupils/students followed by motorbike taxi drivers are the most represented, with 34.8% and 21.7% of cases, respectively. This observation was also made by Traore *et al.* [13] in Mali in 2020, who also found a predominance of pupils/students in 50% of cases. Road traffic accidents were the main cause of floating knees in

95.7% of cases in our series and in all series by other authors [2, 14]. This predominance of public road accidents in the circumstances of occurrence may be due to the growth in the use of two-wheeled vehicles as the main means of transport, and failure to comply with the standards for technical inspection of these vehicles and the highway code, combined with the poor condition of most of our roads.

The mean time to hospital admission was 17.47 hours, with extremes ranging from 30 minutes to 48 hours. This delay is close to that found by Kulkarni *et al.* [15], but much longer than that of Oudrhiri *et al.* [8], who found an average delay of 1.5 hours. This delay in admission could be explained by the absence of a SAMU (emergency medical service) on the one hand, and on the other, by the fact that some patients often consult traditional healers before being admitted to health facilities.

In this series, the left side predominates in 60.9% of cases, as do other authors [8, 9]. On the other hand, other authors such as Chouhan *et al.* [13] in 2021 in India found a predominance of the right side at 74.1%. The high frequency of right-handedness means that trauma to the right side can be minimized by the withdrawal of this limb, thus exposing the left limb to impact. Also, in traffic, the left limb is exposed to vehicles travelling in the opposite direction, which could explain the frequency with which this occurs in our results.

The rate of skin opening exceeds half the cases in most series, and open fractures predominate in the tibia compared with the femur [8, 14, 17], as was the case in this study, with 73.9% of cases. The velocity of the trauma, combined with the anatomical situation, could explain this result, which also shows that the floating knee often occurs in a context of high-energy trauma. Lesions were associated in 69.6% of this series. This is close to the data in the literature [8, 15]. Radiologically, Fraser type I is the most frequently reported in the majority of the series in the literature [1, 9, 10, 18] as well as in this series (43.5%). The predominance of Fraser type I may be explained by the fact that the femoral and tibial diaphyses, which make up a large proportion of these bones, are the most susceptible to impact.

Management time varies according to the presence or absence of skin lesions. The mean time is 15.04 days, with extremes ranging from 2 to 80 days in our series, which is close to that reported by Traore *et al.* [13]. However, Kulkarni *et al.* [15] in 2018 obtained a mean delay of 1.4±2.24 days, which is less than ours. The inadequacy of the technical platform, the absence of an independent trauma emergency department, and the low socio-economic status of some of our population, on the one hand, and on the other hand, recourse to traditional treatment before arriving at the hospital would explain the lengthening of our delay.

In terms of treatment, surgery was the most common type of treatment, accounting for 73.9%, with screw-retained plates predominating in the femur (623.2%) and tibia (58.8%). This is in line with some of the results reported in the literature [1, 2, 13]. In the majority of cases, this surgical treatment results in a stable set up allowing early rehabilitation.

On the other hand, Oudrhiri *et al.* [8] in Morocco in 2020 found a predominance of osteosynthesis by centromedullary nailing of the femur and tibia. The precariousness of the technical platform during the study period, on the one hand, and the low socio-economic level of the patients, on the

other hand, would explain the high rate of orthopaedic treatment in our series.

During the follow-up of the patients in this series, with a mean follow-up of 32.48 months, a high rate of complications was observed despite the treatment. Among these complications, joint stiffness predominated in 13.04% of cases, as observed in reviews [9, 18]. This can be explained by the orthopaedic and mixed treatment in some of our patients, which increased the duration of immobilization. In relation to treatment, in this series, the proportion of complications was higher in patients treated orthopaedically (13%). This may be explained by the fact that the limb is immobilized for a long time, without early physiotherapy in the case of orthopaedic and mixed treatments, but also by the use of screw plates in a large proportion of cases.

The results were considered satisfactory in 65.2% (30.4% excellent and 34.8 good) of cases in this study. This result is close to that reported in the literature [13, 19]. This is due to the fact that surgical treatment is most often used for the management of this lesion.

Limits

This study of floating knees has a number of weaknesses: it is retrospective and subject to selection bias, being limited to hospitalized patients. In addition, the variable quality of the data leads to information bias. However, it also has strengths: a sample of 23 cases over six years, comprehensive data on a range of parameters including demographics, mechanisms of injury, fracture types, management times, surgical treatments, and a follow-up of over five years to assess long-term outcomes.

Conclusion

A floating knee is a complex and serious injury due to the circumstances in which it occurs and the association of injuries. It affects a relatively young population, dominated by men. It is a medical and surgical emergency, and its management must be multidisciplinary. Diagnosis is initially clinical; paraclinical examinations, particularly X-rays, confirm and complete the lesion assessment and enable these fractures to be classified. Treatment is essentially surgical, allowing more stable osteosynthesis and early patient discharge. This considerably reduces complications and facilitates the patient's socio-professional reintegration. Raising awareness of the importance of obeying the highway code remains the best means of prevention.

Conflicts of interest

The authors declare no conflict of interest in this study.

Financing

The authors did not receive any funding for the study.

References

1. Yadav V, Suri HS, Vijayvargiya M, Agashe V, Shetty V. Floating Knee, an uncommon injury: analysis of 12 cases, 2018;54:53-9. Rev Bras Ortop.
2. Mohamed AA, Garba I, Younoussa H, Abdoul Karim S. The Traumatic Floating Knee: A report of 38 Cases at the National Hospital of Niamey. The Journal of Medicine and Health Sciences, 2017;18(3):72-5.
3. Fraser RD, Hunter GA, Waddell JP. Ipsilateral fracture of the femur of tibia. J Bone Joint Surg (Br), 1978;60:510-5.

4. Blake R, McBryde A JR. The floating knee: ipsilateral fractures of the tibia and femur. *South Med*,1975;68:13-6.
5. Kao FC, Tu YK, Hsu KY, Su JY, Yen CY, Chou MC. Floating knee injuries: a high complication rate. *Orthopedics*,2010;33(1):14.
6. Omer GE Jr, Moll JH, Bacon WL. Combined fractures of the femur and tibia in a single extremity. Analytical study of cases at Brooke General Hospital from 1961-1967. *J Trauma*,1968;8(6):1026-41.
7. Gillquist J, Rieger A, Sjodahl R, Bylund P. Multiple fractures of a single leg. A therapeutic problem. *Acta Chir Scand*,1973;139(2):167-72.
8. Oudrhiri I, Manouk R, Baba HF, Touondounko P, Abid H, El Idrissi M, *et al.* Genoux flottants: aspects lésionnels et thérapeutiques (à propos de 72 cas). *PAMJ Clinical Medecine*, 2020, 3(163).
9. Karlstrom G, Olerud S. Ipsilateral fracture of the femur and tibia. *J Bone Joint Surg (American)*,1977;59(2):240-3.
10. Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones. *J Bone JT Surg Am*,2002;58(4):682-14.
11. Monka M, Zengui ZF, Ngaste-oko A, Moyikoua A. Genoux flottants: Résultats thérapeutiques à propos de 15 cas traités au CHU de Brazzaville. *Médecine d'Afrique Noire*,2016;63(12):636.
12. Eone DH, Lamah L, Bahiya JL, Nonga BN, Ibrahima F, Bahebeck J, *et al.* Assessment of concomitant floating knees injuries severity. *Pan African Medical Journal*, 2016, 25:83.
13. Traore T, Toure L, Coulibay K, Diallo M, Hans-moevi A, Coulibay T. Genoux Flottants: Difficultés de prise en charge liées à une association d'entités traumatologiques homolatérales. *Health sciences & Disease*,2020;21(10):64-8.
14. Rollo G, Falzarano G, Ronga M, Bisaccia M, Grubor P, Erasmo P, *et al.* Challenges in the management of floating knee injuries: Results of treatment and outcomes of 224 consecutive cases in 10 years. *Injury. Int.J. Injury*,2019;50:S30-8.
15. Kulkarni MS, Aroor MN, Vijayan S, Shetty S, Tripathy SK, Rao SK. Variables affecting functional outcome in floating knee injuries. *Injury*,2018;49(8):1594-1601.
16. Chouhan D, Chouhan DK, Kanodji RK, Behera P. Comparison of functional outcomes among subtypes of Fraser's type II floating knee. *Chinese Journal of traumatology*,2021;24(1):25-29.
17. Tata TJF, Razafimahatratra R, Razafimahandry HJC, Solofomalala GD. Genoux flottants au CHU-JRA: résultats fonctionnels de prise en charge. *Revue de chirurgie Orthopédique et de traumatologie Malgache*, 2018, 8.
18. Chavda AG, Patel PR, Lil NA. An approach to floating knee injury in India population: An analysis of 52 patients. *Indian J Orthop*,2018;52(6):631-7.
19. Demirates A, Azboy I, Alemdar C, Gem M, Ozkul E, Bulut M, *et al.* Functional outcomes and quality of life in adult ipsilateral femur and tibia fractures. *Journal of Orthopedic Translation*,2019;16:53-61.