Functional Outcomes and Complications in the Treatment of Floating Knee Injuries

Shahin Talebi[1], Salman Ghaffari[2], Mohammad Tehrani[3], Akbar Ehsani[1], Reza Zandi[1*]

[1] *Musculoskeletal Injuries Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran*

[2] *Department of Orthopedic Surgery, Orthopedic Research Center, Mazandaran University of Medical Sciences, Sari, Iran*

[3] *Student Research Committee, School of Medicine, Mazandaran University of Medical Sciences, Sari, Iran*

Received: 10 Apr. 2025; Accepted: 01 Mar. 2026

Abstract- Ipsilateral femur and tibia fractures (floating knee injury) is a complex injury with severe associated injuries. The aim of this study was to assess the characteristics and treatment outcomes in patients with floating knee in a single trauma center. A retrospective study was conducted among patients with floating knee treated between January 2012 and January 2019 in a single trauma center. Patients with knee osteoarthritis, inflammatory arthritis, pathologic fracture, and with a history of previous fracture in ipsilateral leg were excluded. Data demographics, associated injuries, complications, and treatment outcome were collected. Karlstrom's criteria were used to assess the results. We identified 48 patients aged 18 to 50 years old. All patients sustained a road traffic accident. Fraser type 1 was the most frequent type (62.5%). Open fracture reported in 25 cases (52.1%) at least in one bone. According to Karlstrom's criteria, 8 cases (16.67%) with excellent results, 19 cases (39.58%) with good results, 14 cases with (29.17%) fair results, and 7 cases (14.58%) poor results were reported. Floating knee injury occurs in a high energy trauma context. Complication rate remains high, and surgeons should focus on reducing these complications.

Acta Med Iran 2026;64(7):443-446.
https://doi.org/10.18502/acta.v64i7.22420

Keywords: Floating knee; Polytrauma; Femur fractures; Tibia fractures; Outcome

Introduction

Floating knee, a complex injury of the lower extremity, is defined as fractures of the ipsilateral femur and tibia (1). It is usually caused by high-energy trauma and may be associated with severe injuries and even death (2). It is classified as type 1 the diaphyseal fracture of femur and tibia, type 2a the fracture of tibial plateau with femoral shaft fracture, type 2b the distal femur articular fracture with tibial shaft fracture, and type 2c the tibial plateau fracture with distal femur articular fracture (2,3).

Although immediate fixation was the goal in past, nowadays it is based on patient's hemodynamic, and it is done after managing critical injuries (2). The mortality and limb amputation rates have been reported to be 10% and 26%, respectively (4). The preferred treatment option remained uncertain, however intramedullary nailing of both fractures is considered an ideal approach (2,4). Numerous complications have been listed for these types of injuries such as nonunion, malunion, joint stiffness, and infection which lead to severe functional impairment (4). Articular fractures, open fractures, segmental fractures, and simultaneous cruciate injuries are accompanied with worse outcome (5,6).

We conducted this study to assess the outcome of the operative management of the patients with floating knee injuries.

Materials and Methods

After obtaining ethical approval, granted by medical ethical committee, this study was conducted among patients with floating knee injuries who were diagnosed and treated between January 2012 and January 2019 at a

Corresponding Author: R. Zandi
Musculoskeletal Injuries Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
Tel: +98 2122432560, E-mail address: Reza.zandi.md@gmail.com

single trauma center. Informed consent was obtained from all of the participants.

In this retrospective study, patients with floating knee injuries who underwent surgical management were enrolled. The inclusion criteria were concomitant lower extremity long bones (femur and or tibia), and age between 18 to 50 years old. Patients with knee osteoarthritis, inflammatory arthritis such as rheumatoid arthritis, pathologic fracture, and with a history of previous fracture in ipsilateral leg were excluded. All demographic data along with other important variables such as gross functional status of the patients, were collected. The pre-operative and post-operative x-rays were collected for analysis. The floating knee injury was classified according to Fraser *et al.*, (3) (Figure 1).

Initial management included resuscitation of patient, splinting of the affected limb with a long leg splint, and a complete survey to identify other injuries. Radiographs of pelvis, chest, affected limb, and other suspected bony injuries were done. Initial wound dressing, tetanus immunization, and antibiotic therapy were initiated for open fractures. Patients with concomitant chest, abdomen, and head injury were managed appropriately prior to surgical stabilization of floating knee. Surgical management of both fractures were done once patients were stable and fit to undergo surgery. The tibia fracture was fixed after fixation of femur in a separate stage. Femoral fracture was fixed first in order to facilitate tibia fixation. After fixation of both fractures, knee ligamentous assessment was done through Lachman's test, posterior drawer test, and varus/valgus stress test. Thromboprophylaxis was initiated in the postoperative period for all patients and continued for six weeks. Joint mobilization and Physiotherapy started as soon as possible after surgery; usually after fixation of second bone. Because joint stiffness is an important complication that can significantly affect patient function and knee range of motion, efforts were made to minimize this complication. Functional assessment was measured using Karlstrom's criteria (7), two years after surgical procedures. In two years, we can handle the complications such as nonunion, joint stiffness, and surgical site infection.

Descriptive statistics were performed to summarize the characteristics of the study group and subgroups, including means and standard deviations of all continuous variables. The t-test was used to compare continuous outcomes. The Chi-square test was used to compare categorical variables, as well as analysis of variance (ANOVA)test for quantitative variables. Linear regression analysis was used to assess the determinants of Karlstrom's score. Statistical significance was set at $P<0.05$.

This retrospective study involving human participants was in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The Human Investigation Committee of Mazandaran University of Medical Sciences approved this study (IR.MAZUMS.IMAMHOSPITAL.REC.1399.6428).

Results

Our study included 48 patients with floating knee injuries, seven female and 41 males. The mean age was 34.56±10.84 years. All patients were involved in road traffic accidents. Twenty-one patientswere involved in motorcycle-to-car accidents, 17 in car-to-car accidents, and 10 patients in pedestrian-to-car accidents. There were 30 type 1(62.5%), 13 type 2A (27.1%), 2 type 2B (4.2%), and 3 type 2C (6.2%) floating knee injury according to Fraser classification. Open fractures were reported in 25 cases (52.1%) involving at least in one bone. One patient had segmental bone defect about 6 cm and concomitant traumatic brain injury (TBI). According to Zandi et al. (8), exuberant callus formation may occur after TBI; therefore, bone grafting may not be necessary in such defects (Figure 1A and B).

Associated injuries were brain injury (10.4%), chest (14.5%), and abdomen (16.6%) injuries. Knee ligament injuries occurred in five cases (10.4%), neurovascular impairment in one case (2.1%), and other orthopedic trauma in ten cases (20.8%). Complications included surgical site infection in 8 cases (16.7%), knee stiffness in 12 cases (25.0%), compartment syndrome in 2 cases (4.2%), and nonunion in 7 cases (14.6%). Patients with compartment syndrome underwent emergently fasciotomy. There were no DVT, amputation, nerve injury, or vessel injury.

According to the Karlström criteria, 8 patients (16.67%) had excellent outcomes, 19 (39.58%) had good outcomes, 14 (29.17%) had fair outcomes, and 7 (14.58%) had poor outcomes. In the linear regression analysis, open fracture was significantly associated with the Karlström score ($P=0.027$) (Table 1). There was no significant difference in the mean Karlström score among the fracture types. However, the latter fracture types were associated with higher rates of stiffness ($P=0.001$) and nonunion ($P<0.001$) (Table 2).

Table 1. Factors associated with the Karlström score

Variable	Beta	Standard error	*P*	95% Confidence interval for beta	
Sex	0.534	0.382	0.170	-0.238	1.305
Age	0.004	0.012	0.748	-0.021	0.029
Mechanism	0.151	0.170	0.382	-0.194	0.495
Type of Fracture	-0.010	0.161	0.949	-0.335	0.314
Open fracture	-0.620	0.270	0.027*	-1.165	-0.076
Concurrent injuries	-0.421	0.288	0.152	-1.003	0.162

**P* less than 0.05 were considered significant

Table 2. Functional outcomes and complications according to fracture type

Outcome	Type 1	Type 2A	Type 2B	Type 2C	*P*
Mean Karlstrom score	2.43±0.89	2.15±0.80	4.00±0.001	2.33±1.52	0.077
Complications					
Infection	6 (20.0)	1 (7.7)	0 (0.0)	1 (33.3)	0.574
Stiffness	5 (16.7)	2 (15.4)	2 (100)	2 (66.7)	0.001*
Compartment	1 (3.3)	0 (0.0)	0 (0.0)	1 (33.3)	0.067
Nonunion	4 (13.3)	0 (0.0)	2 (100)	1 (33.3)	<0.001*

**P* less than 0.05 were considered significant

Figure 1. Fraser type 1 with segmental bone loss and traumatic brain injury (A). 5 months later the union was completed (B). Fraser type 2a treated with femoral nailing and plating the plateau fracture (C). Fraser type 2C plating both articular side of femur and tibia was done (D).

Discussion

The floating knee is an infrequent injury of currently uncertain incidence (9). Based on the severity of these injuries, amputation and even death are frequent (2). As previously discussed, these are associated with injuries such as head injury, chest injury, abdominal injury, and injuries to other extremities (10).

The treatment protocol for multiple trauma patients has been revised in the last decades. The main issue is determining between Early Total Care (ETC) and Damage Control Orthopedics. Generally, ETC is the preferred approach for stable patients, while DCO is preferred for unstable or in extremis patients (2,10). Besides, soft tissue situation is a crucial factor in management of these patients suggesting the use of external fixators and staged protocol. Previous studies such as Muñoz et al., and Fraser et al reported high rate of open fractures (up to 70%) (2,3).

According to Feron et al., and Piedra-Calle CA *et al*., Fraser type 1 was the most frequent among all types (5,11). In this type nailing both femur and tibia are recommended (2). Although most authors suggested to nail the femur first (12), in some situation's tibia can be nailed priorly (11). It is noteworthy that the infection rate can rise up to 11% in situation of continuing external fixation for more than three weeks and immediate conversion to nail; so in this situation it's better to remove external fixation and nail conversion done with a delay (13). In cases with intra-articular involvement, plating may be used to achieve adequate reduction and restore joint congruity (2). Since the joint congruency can be established.

The incidence of menisco-ligamentous injuries varies

in article, and it is reported up to 70.3% of cases (2,14). Different approaches have been considered the management of menisco-ligamentous injuries; however, delayed reconstruction has been associated with less favorable outcomes (2,15).

Numerous complications have been reported regardless of treatment option such as infection, malunion, non-union, knee stiffness, and prolonged hospitalization (4,16). A satisfactory outcome is defined as an excellent or good result according to the Karlström criteria (2). Satisfactory outcome was 56.2% and unsatisfactory outcome was 43.7% according to our study. Prognostic factors of final outcome are type of fracture, soft tissue injury severity, age, and associated injuries (2). Open fractures also had poorer outcomes in comparison to closed fractures (17), as we mentioned in results and Table 1.

This study showed some limitations. First, the retrospective nature of the study limits the level of evidence compared with prospective studies. The second one is the heterogeneity of treatments applied. Meanwhile, considering prolonged follow-up, data provided on incidence and functionality and the fact that all patients have been managed by the same surgical team highlights the importance of this work.

In conclusion, floating knee injury is a complex injury of lower extremity with numerous associated injuries which requires optimal treatment protocol. Our experience revealed that the rate of complications associated with the floating knee remains high. Surgeons should focus on reducing complications when dealing with the floating knee. Initial assessment of patients with appropriate management of life-threatening injuries, and soft tissue injuries is mandatory.

References

1. Blake R, McBryde A. The floating knee: Ipsilateral fractures of the tibia and femur. South Med J 1975;68:13-6.
2. Muñoz Vives J, Bel JC, Capel Agundez A, Chana Rodríguez F, Palomo Traver J, Schultz-Larsen M, et al. The floating knee: a review on ipsilateral femoral and tibial fractures. EFORT Open Rev 2016;1:375-82.
3. Fraser RD, Hunter GA, Waddell JP. Ipsilateral fracture of the femur and tibia. J Bone Joint Surg Br 1978;60-B:510–5
4. Kenmegne GR, Zou C, Lin Y, Yin Y, Huang S, Fang Y. The current issues and challenges in the management of floating knee injury: a retrospective study. Front Surg 2023;10:1164032
5. Feron JM, Bonnevialle P, Pietu G, Jacquot F. Traumatic Floating Knee: A Review of a Multi-Centric Series of 172 Cases in Adult. Open Orthop J 2015;9:356-60.
6. Kulkarni MS, Aroor MN, Vijayan S, Shetty S, Tripathy SK, Rao SK. Variables affecting functional outcome in floating knee injuries. Injury 2018;49:1594-601.
7. Karlström G, Olerud S. Ipsilateral fracture of the femur and tibia. J Bone Joint Surg Am 1977;59:240-3.
8. Zandi R, Talebi S, Ehsani A, Sheibani S. Exuberant Callus Formation After Traumatic Brain Injury in Femoral Fractures with Segmental Bone Defects: Two Case Reports and Literature Review. J Orthop Rep 2023;2:100181.
9. Rethnam U, Yesupalan RS, Nair R. The floating knee: epidemiology, prognostic indicators & outcome following surgical management. J Trauma Manag Outcomes 2007;1:2.
10. Rollo G, Falzarano G, Ronga M, Bisaccia M, Grubor P, Erasmo R, et al. Challenges in the management of floating knee injuries: Results of treatment and outcomes of 224 consecutive cases in 10 years. Injury 2019;50:S30-8.
11. Piedra-Calle CA, García-Sánchez Y, Teixidor-Serra J, Tomás-Hernández J, Selga-Marsá J, Porcel-Vázquez JA, et al. Challenges and outcomes in the treatment of floating knees. A case series of ipsilateral femur and tibia fractures around the knee. Eur J Orthop Surg Traumatol 2022;32:325-31.
12. Ratliff AH. Fractures of the shaft of the femur and tibia in the same limb. Proc R Soc Med 1968;61:906-8.
13. Noumi T, Yokoyama K, Ohtsuka H, Nakamura K, Itoman M. Intramedullary nailing for open fractures of the femoral shaft: evaluation of contributing factors on deep infection and nonunion using multivariate analysis. Injury 2005;36:1085-93.
14. Liu Y, Zhang J, Zhang S, Li R, Yue X. Concomitant ligamentous and meniscal injuries in floating knee. Int J Clin Exp Med 2015;8:1168-72.
15. van Raay JJ, Raaymakers EL, Dupree HW. Knee ligament injuries combined with ipsilateral tibial and femoral diaphyseal fractures: the 'floating knee'. Arch Orthop Trauma Surg 1991;110:75-7.
16. Kao FC, Tu YK, Hsu KY, Su JY, Yen CY, Chou MC. Floating knee injuries: a high complication rate. Orthopedics 2010;33:14.
17. Bozgeyik B, Büyükbebeci O, Güner S, Mert A. Comparative analysis of open and closed floating knee injuries. Acta Ortop Bras 2023;31:e262810.