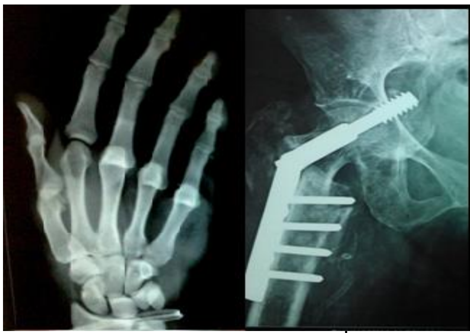

International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2023; 9(3): 182-187

https://www.orthopaper.com
Received: 07-04-2023
Accepted: 03-06-2023

Dr. D Raja Sujith Kumar
Department of Orthopedics Saveetha Medical College and Hospital, Thandalam, Chennai, Tamil Nadu, India

Dr. Nitheesh S
Department of Orthopedics Saveetha Medical College and Hospital, Thandalam, Chennai, Tamil Nadu, India

Dr. M Meenakshi Rakesh
Department of Orthopedics Saveetha Medical College and Hospital, Thandalam, Chennai, Tamilnadu, India

Dr. G Arjun Krishnan
Department of Orthopedics Saveetha Medical College and Hospital, Thandalam, Chennai, Tamil Nadu, India

Dr. Yeshwanth Subash
D.N.B (Ortho), M.N.A.M.S
Department of Orthopaedics Saveetha Medical College and Hospital, Thandalam, Chennai, Tamil Nadu, India

Corresponding Author:
Dr. Yeshwanth Subash
D.N.B (Ortho), M.N.A.M.S
Department of Orthopaedics Saveetha Medical College and Hospital, Thandalam, Chennai, Tamil Nadu, India

A comparative study of plating vs nailing- retrograde nailing for femur and antegrade nailing for tibia for floating knee

Dr. D Raja Sujith Kumar, Dr. Nitheesh S, Dr. M Meenakshi Rakesh, Dr. G Arjun Krishnan and Dr. Yeshwanth Subash

DOI: https://doi.org/10.22271/ortho.2023.v9.i3c.3425

Abstract

Background: Floating knee injuries are complex injuries that are generally caused by a high-energy trauma such as a motorcycle or a car accident. Local trauma to the musculoskeletal and the soft tissues is often extensive and life-threatening; associated injuries may also be present, producing a challenging problem to manage. In this study, we presented the outcome of these injuries after surgical management.

Patients and Methods: In this prospective study, 30 patients with floating knee injuries were managed over a 1-year period; both fractures of the floating knee injury were fixed surgically by different modalities. Fractures were classified according to the modified Fraser classification, and the outcome was evaluated by the Karlstrom criteria.

Results: The main mode of injury was motorcycle accident (70%). The complications presented in 4 (13%) patients. According to the Karlstrom criteria, the end results were as follows: Excellent − 8 (26.6%), good − 17 (20.6%), acceptable − 2 (23.6%), and poor − 2 (11.8%).

Conclusion: Surgical fixation is an effective treatment for floating knee injuries worldwide. On long-term follow-up of patients treated surgically, the functional and radiological outcomes were good with few complications rate.

Keywords: Fraser classification, floating knee, Karlstrom criteria, ILIM nailing.

Introduction

The floating knee refers to the occurrence of fractures in both the femur and tibia on the same side, resulting in a flail knee joint. These injuries can involve various types of fractures in the tibia and femur, including diaphyseal, metaphysical, and intra-articular fractures [1, 2]. The term "Floating Knee" was coined by McBryde and Blake in 1974 [3]. Such knee injuries are becoming increasingly common due to high-energy traumas, primarily caused by high-speed motor vehicle accidents or road traffic accidents (RTAs). The Fraser classification has been modified to categorize floating knees into three types: Type I, involving fractures outside the joint; type II, involving fractures within the joint surface; and type III, involving the patella. Type II injuries are further classified as type IIA (simple articular) or type IIB (complex articular) injuries [4]. Managing floating knee injuries is challenging due to the association with multiple complications such as compartment syndrome, vascular injuries, infection, difficulties in achieving union, ligament and meniscal injuries, as well as the complex nature of the injury. These injuries are often compound, involving extensive damage to the surrounding soft tissues. Additionally, life-threatening head injuries, spinal cord injuries, and thoracic and abdominal (visceral) injuries may be present. To achieve optimal clinical and functional outcomes, it is crucial to perform early surgical stabilization of both the femur and tibia fractures, followed by early rehabilitation. Treatment planning should carefully consider the effect of each decision, aiming for good to excellent functional outcomes which were assessed by Karlstorm and Olerud criteria [5]. The primary objective of early internal fixation of both the femur and tibia in floating knee injuries is to achieve anatomical reduction and union of the fractures, thereby minimizing the risk of delayed union, non-union, infection, and complications such as knee stiffness and arthritis.

The aim of this study was to compare and assess the outcome of different surgical treatments for floating knee injuries and to determine prognostic factors and complications of these injuries.

Patients and Methods

This was a prospective study of 30 patients with floating knee injuries, studied between MAY 2022 to MAY 2023 at the Department of Orthopedics, Saveetha medical college and Hospital, Thandalam. Patients with established fractures of the femur and tibia, willing for treatment and for follow up were included in our study, while skeletally immature patients, patients who were not hemodynamically stable or unfit for surgery, fractures with extensive local soft tissue injuries (including open injury grades IIIB and IIIC), knee ligament injuries and pathological fractures were excluded. All the patients underwent clinical and radiographic examinations. The fractures were classified according to the Modified Fraser classification system based on the X-ray images. For open fractures, Gustilo–Anderson classification was used. Patients of floating knee injuries were admitted to the ward. A detailed history of all patients was taken and recorded in inpatient files. All patients were assessed clinically. The preoperative medical evaluation of all patients was done to prevent potential complications that can be life-threatening or limb-threatening. All patients were due to RTA or fall from height. On arrival, patients were resuscitated according to the advanced trauma life support (ATLS) protocol (maintenance of airway with cervical spine control, breathing, and circulation). The general condition of the patient was assessed with regard to hypovolemia, associated orthopaedic, or other systemic injuries. Any systemic injury if present was given priority in treatment. Fracture femur and tibia were immobilized with Thomas splint. All patients received analgesics and antibiotics intravenously (IV). In case of open fractures, immediate debridement and an external fixator were applied under spinal anaesthesia. Necessary and adequate management was given for those associated with medical problems such as anemia, diabetes, hypertension, ischemic heart disease, chronic obstructive pulmonary disease, and asthma that were evaluated and treated before taking them to surgery. A strict preoperative protocol was followed which included obtaining a pre-anaesthetic checkup and various required clearances, and part preparation. Arrangement of adequate blood was done. Keeping patient nil by the mouth from 6 hours before surgery. Written and informed consent taken. Other required consents such as high-risk consent were obtained.

Permanent surgical management of both fractures was carried out once patients fit to undergo surgery with good local conditions. All procedures were performed under spinal/general anaesthesia under antibiotic cover. Injection. Cefoperazone 1 gram and sulbactam 500 milligrams were given at the time of induction of anaesthesia and were continued for 3 days postoperatively. The procedures were performed with the patient in the supine position. Sterile preparation was done from thighs to toes and draped. Type of fixation (nailing or plaiting) depends on the patient factors, fracture pattern, and the extent of soft tissue injury. Intramedullary interlocking nailing was done wherever possible. Tibial nails were inserted antegrade, while femur nail was inserted retrograde manner through the same 4 cm medial parapatellar incision. Femoral nailing is performed first, while the tibia is temporarily stabilised with a splint or, in cases of severe comminution, with an external fixator. If the tibia were stabilised first, the movement and deformation of the femur during surgery would cause greater damage to the soft tissues and pose an increased risk to the patient's general condition, including the increased incidence of fat embolism. Anatomical reduction was achieved for intra-articular fractures and fixed with plates and screws. Plating should be used in cases of intra-articular involvement of the distal femur and distal tibia. The reduction of the articular surface is of paramount importance and cannot be over-emphasised. As the fractures in the femur and tibia are often different it is not always possible to achieve optimal fixation with the same implant for both fractures. For the lower part of the femur, a retrograde nail or locking plates are the most common implants used and treatment choice should probably not differ from a similar isolated femur fracture, regardless of the tibial fracture. For the tibia fracture in the upper half, antegrade nail and locking plates are used most widely. Nails with advanced locking options can manage some simple articular fractures, but locking plates supplemented with lag screws are more commonly used for complex intra- articular fractures in the proximal tibia.

Thromboprophylaxis was initiated in all patients after the admission and extended to the postoperative period. Patients' rehabilitation was initiated on the basis of hip and ankle active-assisted mobilization, as soon as possible after surgery, while the patients were seated in a wheelchair, maintaining the limb in full extension. Knee range of motion (ROM) increased progressively according to pain tolerability of patients and degree of stability of the fracture-implant construct. Strengthening of quadriceps and hamstrings muscle started early together with lumbopelvic and ankle muscles. The program extended until the patient returned to normal daily activity. Patients were followed-up monthly until bony union (clinical and radiological) and then every 3 months until the last follow-up. Final outcome was measured at last follow-up using the Karlstrom's criteria. The collected data was analyzed using IBM SPSS Version 22.0. The Chi-square test, Fisher's exact test, and Mann-Whitney U method were employed to compare the baseline demographic characteristics between the two groups. The Chi-square test was used to assess differences in proportions, with a P-value of less than 0.05 considered statistically significant.

Results

30 Patients of floating knee (fracture of femur and ipsilateral tibia) with a mean age of the patients was 38.3 years (range, 25-49 years) were studied between May 2022 to May 2023 [Table 4]. There were 19 males and 11 females in our study. 21(70%) patients were involved in RTA, whereas 9(30%) patients were injured due to a fall from height [Fig 1]. The right side was involved in 17 and the left side in 13 knees. There were 16 patients with Frazer type 1, Ten with type 2A, three with type 2B floating knee injuries (Modified Fraser's classification) [Table 3]. There were five open fractures. The average time interval between initial and permanent treatment was 12.4 days (range, 0–30). Intramedullary nailing for both fractures was performed in 15 knees with an average surgery duration of 2 hours (range 2 to 2 hours 40 mins) and an average blood loss of 243 ml (range, 220 to 325 ml). A combination of plating for tibia and nailing for femur was done in 10 knees with an average surgery duration of 3 hours and 30 mins (range, 3 hours and 10 mins to 3 hours and 50 mins) and an average blood loss of 338 ml (range 320 to 410 ml). Plating for both fractures were performed in 3 knees with an average duration of 3 hours and 36 mins (range, 3 hours

and 30 mins to 3 hours and 40 mins) and an average blood loss of 346 ml (range, 330 to 365 ml) [Table 4]. Plating for femur and nailing for tibia was done in 2 knees. The average duration for fracture union of tibia following nailing was 17 weeks and 7 days (range, 16 to 20 weeks). The average duration for fracture union of femur following nailing was 20 weeks and 7 days (range, 18 to 28 weeks). The average duration for fracture union of tibia following plating was 20 weeks and 6 days (range, 20 to 25 weeks). The average duration for fracture union of femur following plating was 23 weeks and 2 days (range, 22 to 24). The complications encountered in this study included knee stiffness in two patients which was treated with physiotherapy and two patients developed infection which settled down well after treatment with antibiotics. In the assessment of results at the last follow-up according to the Karlstrom criteria [Table 1, 2], the following results were obtained: Excellent − 8(26.6%), good −17 (56.6%), acceptable − 2(6.6%), and poor − 2(6.6%) [Fig 2]. None of our patients were lost to follow-up.

Table 1: Karlstorm and Olerud Criteria

Criteria	3 points	2 points	1 point
Pain	No	Little	Severe
Difficulty in walking	No	Moderate	Severe Limp
Difficulty in stairs	No	Supported	Unable
Difficulty in previous sports	No	Some Sports	Unable
Limitation at work	No	Moderate	Unable
Status of skin	Normal	Various Colours	Ulcer/Fistula
Deformity	No	Little, Upto 7*	> 7 Degrees
Muscle atrophy(cm)	< 1	1-2	> 2
Shortening(cm)	< 1	1-2	> 2
Loss of motion at the knee joint	< 10 Degrees	10-20*	> 20 Degrees
Loss of subtalar motion	< 10 Degrees	10-20*	> 20 Degrees

Table 2: Patient Demographics and Data

1)	34/M	Right	RTA	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours	240	21/18	Nil	Excellent
2)	41/M	Left	RTA	Type 2a	Open – Type 2	Wound Debridement with ex-fix application	Plating (Tibia) + Nailing (Femur)	3 ½ Hours	330	27/25	Infection	Acceptable
3)	28/F	Right	RTA	Type 2b	Closed	Ex-Fix Application	Nailing	2 Hours 40 Min	325	18/16	Nil	Excellent
4)	45/M	Left	RTA	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours 10 Min	250	21/20	Nil	Good
5)	48/F	Left	Fall From Height	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours 20 Mins	235	22/18	Nil	Good
6)	29/M	Right	RTA	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours 20 Min	280	18/16	Nil	Excellent
7)	47/M	Right	RTA	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours 15 Min	240	23/20	Nil	Good
8)	35/F	Left	Fall From Height	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours 30 Min	240	21/16	Nil	Good
9)	39/F	Left	RTA	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours 15 Min	235	21/18	Nil	Good
10)	43/F	Right	RTA	Type 2a	Closed	Ex-Fix Application	Plating	3 Hours 40 Min	330	24/22	Knee Stiffness	Poor
11)	48/F	Right	RTA	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours	220	22/18	Nil	Good
12)	26/M	Right	RTA	Type 2a	Open– Type 2	Wound debridement with ex-fix application	Plating (Tibia) + Nailing (Femur)	3 Hours 10 Min	340	28/24	Infection	Acceptable
13)	25/M	Left	Fall From Height	Type 2a	Closed	Ex-Fix Application	Plating (Tibia) + Nailing (Femur)	3 Hours 20 Min	290	19/22	Nil	Excellent
14)	36/F	Left	Fall From Height	Type 2a	Closed	Ex-Fix Application	Plating (Tibia) + Nailing (Femur)	3 Hours 25 Min	325	20/22	Nil	Good
15)	44/M	Right	RTA	Type 1	Open– Type 2	Ex-Fix Application	Nailing	2 Hours 10 Min	220	22/20	Nil	Good
16)	30/M	Right	RTA	Type 2b	Closed	Splinting (Pop)	Plating (Femur) + Nailing (Tibia)	3 Hours 15 Min	350	23/18	Nil	Good
17)	37/F	Left	RTA	Type 1	Closed	Splinting (Pop)	Plating	3 Hours 30 Min	345	24/21	Nil	Good
18)	48/M	Left	RTA	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours 10 Min	230	20/16	Nil	Good
19)	34/F	Left	RTA	Type 1	Closed	Splinting (Pop)	Plating	3 Hours 40 Min	365	22/24	Nil	Good
20)	46/F	Right	RTA	Type 2a	Open– Type 2	Ex-Fix Application	Plating (Tibia) + Nailing (Femur)	3 Hours 10 Min	325	21/24	Knee Stiffness	Poor
21)	37/F	Right	Fall From Height	Type 2a	Closed	Ex-Fix Application	Plating (Tibia) + Nailing (Femur)	3 Hours 20 Min	340	19/23	Nil	Excellent
22)	33/M	Right	Fall From Height	Type 2a	Closed	Ex-Fix Application	Plating (Tibia) + Nailing (Femur)	3 Hours 25 Min	345	17/20	Nil	Good
23)	49/M	Left	Fall From	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours 25 Min	240	21/18	Nil	Excellent

			Height									
24)	41/M	Left	Fall From Height	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours 15 Min	220	21/17	Nil	Good
25)	44/M	Right	RTA	Type 1	Open–Type 2	Wound Debridement With Ex-Fix Application	Nailing	2 Hours 30 Min	260	22/19	Nil	Excellent
26)	42/M	Right	RTA	Type 2a	Closed	Ex-Fix Application	Plating (Tibia) + Nailing (Femur)	3 Hours 35 Min	360	19/21	Nil	Good
27)	23/M	Left	RTA	Type 1	Closed	Splinting (Pop)	Nailing	2 Hours 10 Min	220	18/16	Nil	Excellent
28)	49/M	Right	RTA	Type 2a	Closed	Ex-Fix Application	Plating (Tibia) + Nailing (Femur)	3 Hours 50 Min	410	19/22	Nil	Good
29)	29/M	Right	RTA	Type 2b	Closed	Splinting (Pop)	Plating (Femur) + Nailing (Tibia)	3 Hours 30 Min	350	23/17	Nil	Good
30)	39/M	Right	Fall From Height	Type 2a	Closed	Ex-Fix Application	Plating (Tibia) + Nailing (Femur)	3 Hours 10 Min	320	18/20	Nil	Excellent

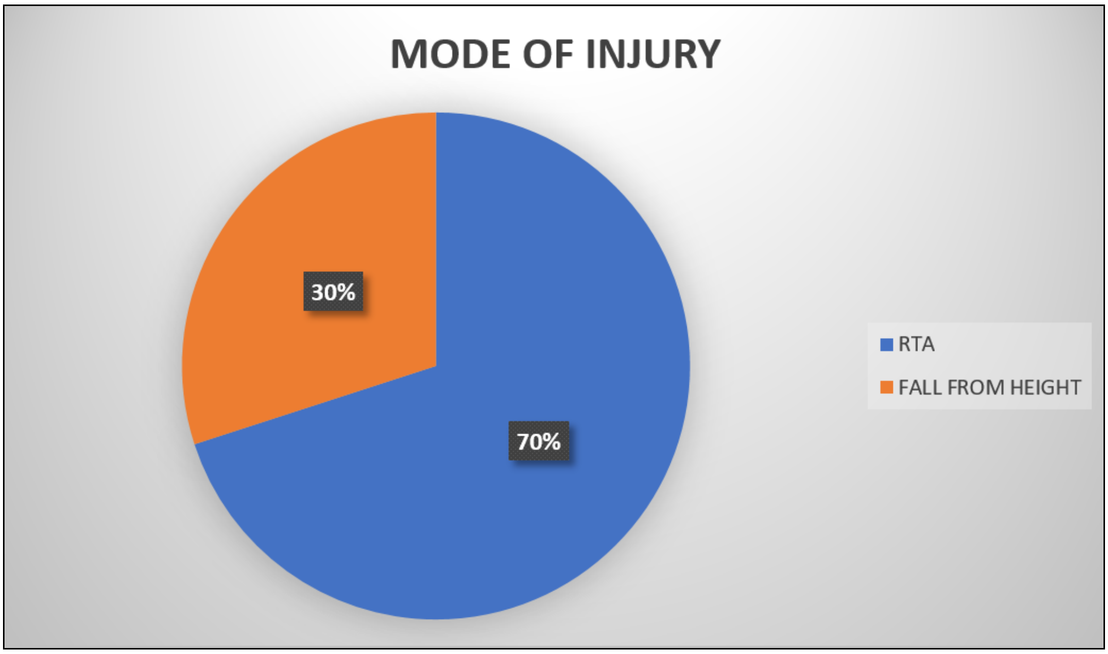

Fig 1: Chart based on the mode of injury among the patients

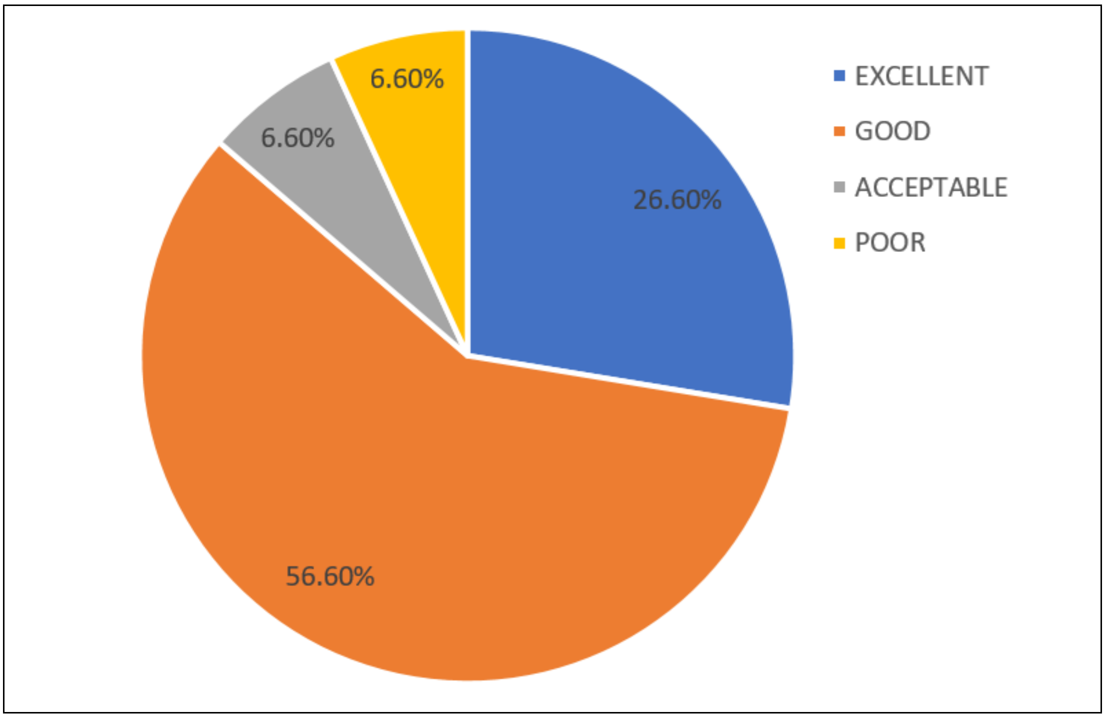

Fig 2: Chart showing outcome for surgical management of patients with floating knee

Discussion

Floating knee is defined as the isolation of the knee joint resulting from fractures of the shafts or adjacent metaphysis of the femur and ipsilateral tibia. Careful evaluation of these injuries and resuscitation of the patient must precede the definitive management of specific fractures. Injuries that were associated with floating knee were head injuries, chest injuries, abdominal injuries, and injuries to other extremities. Most of the injuries to the head, chest, and abdomen were life-threatening. Adamson *et al*. [6] in their study encountered 71% major associated injuries; of them, 21% were vascular injuries. The reported mortality rate ranged from 5 to 15%, reflecting the seriousness of the associated injuries. Patients in our study had only isolated floating knee injuries. Systemic and careful examination of the patient must be carried out in order to determine whether any major intracranial, abdominal, or thoracic injury is presented. The mechanism of floating knee injuries of automobile passengers was that their feet were braced firmly against the sloping floor of the front seat, just before the collision, which resulted in their legs getting crumpled under the massive decelerating forces produced by the impact. Pedestrians were frequently thrown some distance from the point of impact and were further injured by striking the pavement. In a study of 222 cases of floating knee by Fraser *et al*. [7], all cases were involved in road traffic accidents. In our study, apart from road traffic accidents patients also came with an alleged history of fall from height. Optimal management of complex floating knee injuries with extensive soft tissue damage necessitated aggressive physiotherapy and early mobilization to reduce the complication rate and obtain good functional results. Several authors have reported good results after internal fixation of both tibial and femoral fracture sites. The general concept in recent studies is that the best management for the floating knee is surgical fixation of both fractures with intramedullary nails. Lundy and Johnson FYJ [9] recommended surgical stabilization of the fractures for early mobilization, which produced the best results. Dwyer *et al*. [8] used combined modalities of treatment, with one fracture managed conservatively and the other surgically. They concluded that the external fixation of the fractured femur resulted in a decreased range of movement at the knee due to quadriceps muscle fixation, but in our study, the surgical management of the femur did not affect the joint movement. Theodoratos *et al*. recommended intramedullary nailing as the best choice of treatment. Our management consisted of treating both the femoral and tibial fractures surgically, most of them by intramedullary nailing using an interlocking nail. With this management, we found the fracture union time and functional recovery was better than the other surgical modalities. This was in accordance with studies by Ostrum [10], who achieved excellent results with fixation of both fractures by intramedullary nailing. Similar to our study, the author used retrograde nailing for the femur with safe time of set up and surgical and anaesthetic procedures with less blood loss. In our study, the rate of excellent and good results after surgical treatment of floating knee injuries was 86.6%, whereas the complication rate in different degrees was 13.3%.

Several studies have shown that significant indicators of poor outcome results of floating knee injuries are intra-articular involvement of the fractures, severity of skeletal injury, and severity of soft tissue injuries. Hee *et al*. [11] suggested a preoperative scoring system, which took into consideration the age, smoking status at the time of injury, injury severity scores, open fractures, segmental fractures, and comminution to prognosticate the final outcome of these fractures. The best results were seen when both fractures were treated by intramedullary nailing. We found that these patients returned to their maximum level of activity earlier than when the fractures were treated with other modalities because it was indicated in extra-articular fractures. The four patients who had poor or acceptable outcomes in our study were two patients with intra-articular fractures who had knee stiffness and two patients with open comminuted fractures that were complicated by deep infection and treated by external fixation followed by definitive fixation. This shows that the poor prognostic factors were related to the type of fracture (open or closed, intraarticular fractures, severe comminution). In comparison with other studies, our outcomes are similar, but we had less complication. From our study, we found that floating knee injuries were complex injuries that needed careful assessment to detect poor prognostic factors and associated injuries. This should be combined with thorough planning of surgeries, appropriated surgical fixation of the fractures and aggressive rehabilitation to improve the outcome of these patients.

Conclusion

The floating knee injury is more complex than just ipsilateral fractures of the femur and tibia. The prognostic indicators of the final outcome are associated injuries and type of fracture (open, intraarticular, comminution, and knee ligament injuries). We recommend a thorough initial assessment of patients with regard to life-threatening associated injuries, surgical fixation of both fractures (preferred by intramedullary nailing), and early aggressive postoperative rehabilitation to improve final outcome.

Declarations

Funding: None.

Conflict of interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical approval: Not required

References

1. Lundy DW, Johnson KD. Floating knee injuries: Ipsilateral fractures of the femur and tibia. J Am Acad Orthop Surg. 2001;9:238-45.
2. Jeong GK, Pettrone SK, Liporace FA, Meere PA. Floating total knee: Ipsilateral periprosthetic fractures of the distal femur and proximal tibia after total knee Arthroplasty. J Arthroplasty. 2006;21:138-40.
3. McBryde A Jr., Blake R. The floating knee, ipsilateral fractures of femur and tibia. JBJS. 1974;56:1309.
4. Fraser RD, Hunter GA, Waddell JP. Ipsilateral fracture of the femur and tibia. J Bone Joint Surg Br. 1978;60-B:510-5.
5. Karlstrom G, Olerud S. Ipsilateral fractures of femur and tibia. J Bone Joint Surg. 1977;9:240-3.
6. Adamson GJ, Wiss DA, Lowery GL, Peters CL. Type II floating knee: Ipsilateral femoral and tibial fractures with intraarticular extension into the knee joint. J Orthop Trauma. 1992; 6:333-339.
7. Fraser RD, Hunter GA, Waddell JP. Ipsilateral fracture of the femur and tibia. J Bone Joint Surg Br 1978;60:510-515.

8. Dwyer AJ, Paul R, Mam MK, Kumar A, Gosselin RA. Floating knee injuries: Long-term results of four treatment methods. Int. Orthop. 2005;29:314-318.
9. Lundy DW, Johnson KD. 'Floating knee' injuries: Ipsilateral fractures of the femur and tibia. J Am Acad Orthop Surg. 2001;9:238-2.
10. Ostrum RF. Treatment of floating knee injuries through a single percutaneous approach. Clin Orthop Relat Res. 2000;375:43-50.
11. Hee HT, Wong HP, Low YP, Myers L. Predictors of the outcome of floating knee injuries in adults: 89 patients followed for 2-12 years. Acta Orthop Scand. 2001;72:385-389.

How to Cite This Article
Kumar DRS, Nitheesh S, Rakesh MM, Krishnan GA, Subash Y. A comparative study of plating vs nailing- retrograde nailing for the femur and antegrade nailing for tibia for the floating knee. International Journal of Orthopaedics Sciences. 2023;9(3):182-187.