

Original Research Article

A retrospective analysis of twenty two cases of floating knee

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ABSTRACT

Background: With increase in road traffic accidents, incidence of floating knee injuries is increasing day by day. Along with bony injuries, multiorgan injuries are generally present which require urgent intervention. Despite advance in surgical management and implants, achieving a good functional knee still remains a challenge to the surgeons.

Methods: This retrospective study was conducted to assess management, functional outcome and complications of patient presenting with floating knee injury to a tertiary care centre. 22 patients with floating knee injury admitted in trauma centre from 2017 to 2019 were analysed and functional assessment was done.

Results: Males with mean age 33.5 years were exclusively victims of road traffic accident. 14 patients presented with multisystem injury. After stabilization fractures were fixed with nails/plates/screws. Knee stiffness was most common complication seen in 37% cases. Functional assessment was done using modified Karlstrom Olerud criteria which revealed excellent results in 22.7% cases while poor results in 18.2% cases.

Conclusions: Floating knee injury is not merely bony injury but a multisystem injury and should be managed on principles of Damage control Orthopaedics. Regarding bony injuries, achieving union and acceptable range of motion remains the prime target.

Keywords: Trauma, Floating knee, Damage control orthopaedics, Triage

INTRODUCTION

Blake and McBryde coined the term 'floating knee' to describe fractures of the ipsilateral femur and tibia ranging from simple diaphyseal to complex articular type. Type I constitutes the true 'floating knee' in which neither the femoral nor the tibia fracture extends to the knee. Type II is a variant in which one or both fractures involve the knee.^{1,2}

Classification

In 1978, Fraser classified type II according to knee injury type as depicted in (Figure 1). Type II a is a tibia plateau fracture associated with a femoral shaft fracture, type II b

is an articular fracture of distal femur associated with a tibial shaft fracture and type II c is a fracture of the tibia plateau and articular fracture of the distal femur.^{2,3}

Floating knee injuries are associated with high-velocity mechanisms like road side accident, fall from height and often accompanied by other injuries to other parts of the body, including severe soft tissue injury.⁴ Earlier the concept of immediate definitive reduction and fixation of femur fracture was thought to reduce complications and mortality by preventing fat embolism.^{5,6} With the introduction of damage control orthopaedics, this practice is obsolete now. Today the condition of a patient who has sustained a major orthopaedic trauma must be ranked as 'stable', 'borderline', 'unstable' or 'in extremis' and

treatment should be guided according to the concepts of damage control orthopaedics. Priority is given to chest injury, head injury and abdominal injuries. Till then femoral and tibial fractures should be temporary stabilized by external fixation or traction. Immediate definitive reduction and fixation is reserved for hemodynamically stable patients. Intramedullary nailing of both fractures is ideal - the femur fracture being fixed prior to the tibia fracture, except in the case of an open tibial fracture in which the tibia should be fixed first.^{7,8}

This retrospective study was conducted to assess management, functional outcome and complications of patient presenting with floating knee injury to a tertiary care centre.

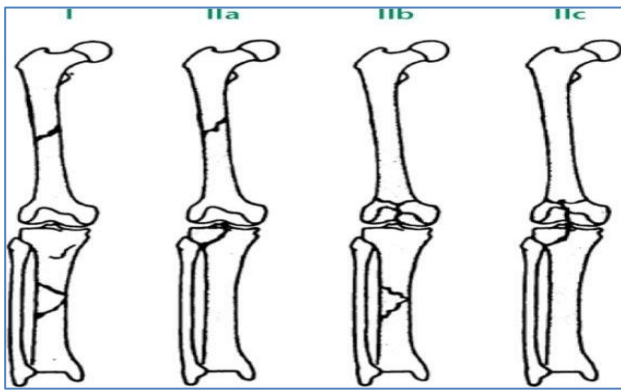


Figure 1: Fraser classification of the floating knee.³

METHODS

This retrospective observational study included 22 adults admitted in trauma centre of a tertiary care centre PGIMS, Rohtak from 2017 to 2019. All patients with floating knee injury irrespective of open/closed were included in study. As most of the patients with Floating knee injuries were victims of polytrauma, patients were initially resuscitated and hemodynamically stabilized as per ATLS guidelines. Patients with head injury, chest injury and pelvic injuries were managed accordingly before surgical stabilization of fracture. Surgical treatment was done after hemodynamic stabilization of the patient.

For open fractures, Gustilo and Anderson's Classification was used and for further classification of floating knee injuries Fraser classification was used.^{3,9}

Open fractures were thoroughly washed with saline and debridement was done. Intravenous antibiotics were administered to patients with open fracture at the time of admission. After informed consent, patients were operated in emergency as well as elective operation theatre. Femur fracture was fixed first followed by tibia fracture. Intra medullary nail was used for diaphyseal fractures and plate was used for metaphyseal and intra-articular fractures. Hospital records suggested patients were in follow up at regular intervals at 2 weeks, 1 month, 3 months, 6 months.

On each follow up clinical and radiological assessment was done. Radiological assessment was done by X-ray to assess bony union. Functional assessment was done using modified Karlstrom and Olerud score after bony union was confirmed.¹⁰

RESULTS

Mean duration of follow up was 18.4 months ranging from (10 months to 36 months) while mean age of patients was 33.5 years (16-64 years). As seen in Table 1, males outnumbered females in terms of incidence with ratio of 6:1. Right side (54.55%) was more commonly involved than left (45.45%). All the cases were exclusively secondary to road traffic accident out of which two-wheelers (bike, scooter) were mainly involved (63.64%) while four-wheelers (car, jeep) were involved in rest of the case (35.36%).

Table 1: Demographic profile of patients and injury pattern (n=22).

Parameter	Number of cases	Percentage
Age in years		
<20	2	9.09
20-40	14	63.64
40-60	5	22.73
>60	1	4.54
Sex		
Males	19	86.36
Females	3	13.64
Side		
Right	12	54.55
Left	10	45.45
Mechanism of injury		
Road traffic accident	22	
a. Two wheelers	14	63.64
b. Four wheelers	8	35.36
Type		
Open fracture	6	27.28
Closed fracture	16	72.72
Other injuries		
Chest injuries	6	28
Head injuries	4	18
Abdominal injuries	2	9
Pelvic injuries	2	9

Out of 22, 16 patients had close fracture while 6 patients (27.28%) presented as compound fractures. Further classification according to Gustillo Anderson classification revealed that four patients had type I fractures while 1 patient presented with grade IIA and one patient had grade IIb injury.

Out of 22 patients, an associated chest injury was seen in 6 patients (28%), out of which 4 were managed conservatively while intercostal drainage tube was put in

2 patients. 4 patients (18%) had associated head injury out of which 3 patients were managed conservatively while one patient had to undergo craniotomy. Associated abdominal and pelvic injuries were noted in 2 patients each which were managed conservatively and fracture fixation was done after clearance from surgeon.

Table 2: Fracture classification and treatment modalities used (n=22).

Variables	Number of cases	Percentage
Fraser classification		
Type 1 extra articular fracture of femur and tibia	10	45.45
Type 2a extra articular femur and intra articular tibia fracture	3	13.64
Type 2b extra articular tibia and intra articular femur fracture	3	13.64
Type 2c intra articular femur and tibia fracture	6	27.27
Implant used femur		
Interlocking nail	8	36.36
Distal femoral plate	12	54.55
External fixator	2	9.09
Tibia		
Interlocking nail	6	27.28
Locking plate	10	45.45
External fixator	4	18.18
Screws only	2	9.09

Further classifying the bony injuries as per Fraser classification, type 1 fracture (45.45%) were most common followed by type 2c (27.27%) while 3 cases each (13.6%) were seen each of type 2 (a and b). Distal femoral locking plate was most common implant used (n=12, 54.55%) for fixation of intra-articular and supracondylar fractures. Even grade I compound fractures were thoroughly washed and debrided and internal fixation was done with nails/plates. For diaphyseal fractures, intramedullary nailing was done in 8 cases (36.36%). For grade II fractures, knee spanning external fixator was used.

For fixation of tibia fractures, depending on fracture location nails and plates were preferred. For 2 patients with intra-articular fractures, fixation with screws worked well. For compound fracture, external fixator was used after thorough debridement and supplemented with K wires fixation, if needed.

As seen in Figure 2, knee stiffness remains the main complication after surgery seen in 8 patients (37%) while diffuse knee pain and swelling was seen in 6 patients (28%). Manipulation under anesthesia was done in 4 patients with knee stiffness. Nonunion of femur was

noticed in 3 patients (18%) while 4 patients had nonunion of tibia. More compound nature of tibia fractures can be attributed to this. Superficial skin necrosis was seen in 3 patients which was healed with time which was exclusively seen in proximal tibial region. 2 patients developed deep seated infection resulting in chronic discharging sinus but luckily fracture healed even after infection and finally discharge discontinued after implant removal. One patient developed chronic osteomyelitis of femur with nonunion which was further treated with illizarov fixator.

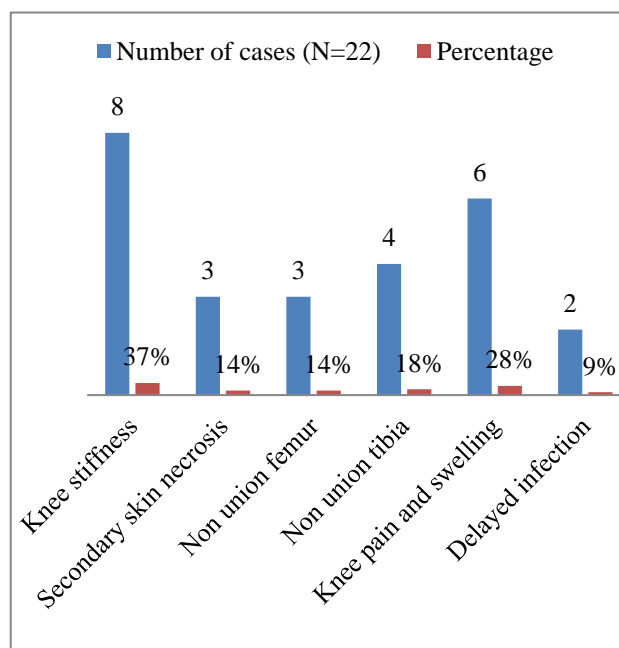


Figure 2: Complications.

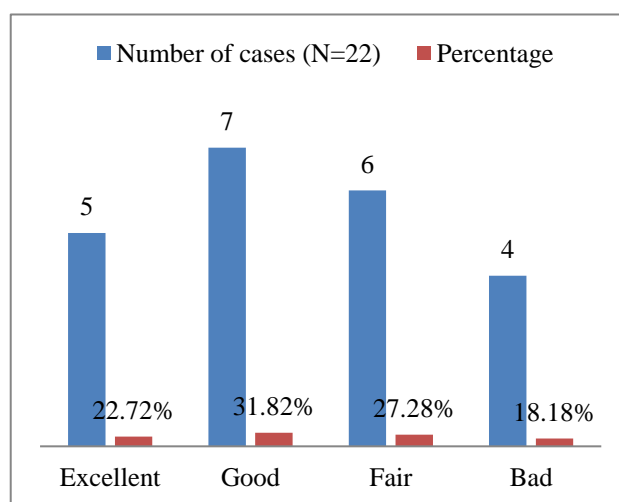


Figure 3: Functional outcome according to modified Karlstrom Olerud criteria.

As seen in above chart, excellent results were seen in 22.7% cases while good results were seen in seven patients (31.82%). 4 patients performed badly as per modified Karlstrom Olerud criteria.

DISCUSSION

Although floating knee injury with is a rare injury but increasing population and rise in motor vehicles, there is a rise in incidence of these injuries. Though small sample size and retrospective analysis are a few limitations of our study but still our observations were consistent with the literature. Male preponderance and with mean age of 20-40 years is repeatedly reported in literature.¹¹⁻¹⁶



Figure 4 (a-c): Fraser IIc fracture treated with medial locking plate for femur and screws for tibia. Union achieved in 14 months.



Figure 5 (a-d): 45 years old male with bilateral floating knee injury managed in staged manner with bilateral plating.



Figure 6 (a-f): Seropositive 40 years old male with floating knee managed with plating developed union with good range of movements. Patient developed superficial infection at distal most end of tibial incision which was managed satisfactorily by oral antibiotics alone.

As evident in Table 3, closed fractures are more common than open types and further classification revealed that Fraser Type was most common type observed. Our results were consistent with the literature. Few things which require special mention here are discussed separately.

Multisystem injuries

Floating knee injuries are not only bony injuries but one of the spectrums of multi organ injury some of which can be life threatening and require urgent surgical intervention. In our study, 14 out of 22 patients had other system involvement. Management protocol for these patients involves haemodynamic stabilization followed by surgical fixation. Following the principles of damage control orthopaedics, overall patient stabilization is priority and skeletal stabilization is done by fixators at first and final definitive fixation is to be done once patient is stable.

Choice of implant

The fractures in floating knee injuries range from simple diaphyseal to complex articular types. Soft tissue injuries are major determining factor in deciding the type of implant. In case of compound fractures or closed fractures with poor skin condition, external fixator is preferred. In a retrospective study of 172 cases, Piteu at al reported use of external fixator in 25% of cases. In our study external fixator was applied in 6 out of 22 patients (27%) which is consistent with literature.

For the lower part of the femur, a retrograde nail and 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. Retrograde nails and locking plates have shown similar

outcomes and complication rates and it is therefore the surgeon’s personal experience that decides which implant is most suitable in each case.¹⁷

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 intraarticular fractures in the proximal tibia.

Complications

As shown in Figure 4, knee stiffness remains the main complication after treatment. Decreased range of motion and diffuse pain persists years after treatment and fracture healing. Although early range of motion and knee physiotherapy can somehow decrease the knee stiffness but final outcome is still unpredictable. Although soft tissue damage, type of fracture may affect the functional outcome but final results are totally variable in literature. Manipulation under GA remains the next treatment option.

Complications related to union are also frequently common in floating knee injuries. In our study nonunion was seen in 32% cases which further needed another surgery with bone grafting or bone grafting alone. Malunion (17%) was main problem in study conducted by Kulkarni et al while delayed union was a complication mainly noted in study conducted by Yadav et al.^{11,13}

Functional outcome

The functional assessment after treatment of floating knee injuries is evaluated by most authors using the Karlstrom and Olerud grading system. In order to simplify it, most surgeons consider a satisfactory outcome as those cases with excellent or good results, and an unsatisfactory outcome as those with just acceptable or poor results. By using these criteria, most series described excellent and good results (86% by Karlstrom et al, 72% by Veith et al, 81% by Anastopoulos et al and 65% by Gregory et al.¹⁸⁻²⁰ In our study also excellent outcome was seen in 22.72% while good results were seen in 31.82% while fair outcome in 27.28% and poor functional outcome in 18.18%.

Table 3: Comparison of result with previous studies in literature.

Study (year)	Kulkarni et al ¹²	Chavda et al ¹³	Yadav et al ¹⁴	Nouraei et al ¹⁵	Kaliamoorthy et al ¹⁶	Our study
Number of patients	89	52	12	220	25	22
Open/closed	NA	21/31	9/3	NA	NA	6/16
Fraser types						
I		56	41.7			45.45
IIA	NA	19	16.7	NA	NA	13.64
IIB		8	16.6			13.64
IIC		17	25			27.27
Complications	Knee stiffness (43%)	Knee pain (50%)	Delayed union femur (33%)	Knee haemarthrosis (14%)	Shock (68%)	Knee stiffness (37%)
	Tibia malunion (17%)	Knee stiffness (17%)	Delayed union tibia (33%)	Knee osteoarthritis (13.6%)	knee stiffness (44%)	Non-union (32%)
	Malunited femur (7%)	Early infection (14%)	Early infection (41%)	Ligament injuries (6.8%)	Chronic osteomyelitis (20 %)	Malunion (16%)
	Limb length disturbancy (11%)	Peroneal nerve palsy (7.6%)	Knee stiffness (41%)	Flexion contracture (6.8%)	Non-union (16%)	Knee pain and swelling (28%)
Karlstrom Olerud criteria (%)						
Excellent	24.4	40.4	25	NA	40	22.72
Good	28.9	32.7	41		20	31.82
Fair	26.7	15.4	25		12	27.28
Bad	12.12	11.5	9		28	18.18

CONCLUSION

To conclude, floating knee injury is not only a bony injury but a multisystem injury some of which may be life threatening. A multidisciplinary approach is essential for

management of these injuries including hemodynamic stabilization. The current recommendation is surgical stabilization of both fractures; however, there is not a single ideal technique. The surgical choice of implants is determined partly by the patient’s clinical state and fracture characteristics. The surgical sequence should be

individualized for each patient and each fracture should be addressed according to its general status. The chosen method depends on the fracture pattern, location, soft-tissue injury, available resources, surgical capability and preference. Knee stiffness remains the most common complication despite best efforts. Achieving a good functional knee still remains a challenge for the surgeons.

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Ethical approval: The study was approved by the institutional ethics committee

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