

To assess the outcome after early internal fixation of both, femur & tibia in floating knee injuries: Hospital based single center cross sectional study

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Abstract

Aim: To assess the outcome after internal fixation of floating knee.

Materials and Methods: Hospital based single center cross sectional descriptive type of observational study among 80 patients in the department of Orthopedics in teaching hospitals attached to S.M.S Medical College and hospital. After obtaining clearance and approval from the institutional ethical committee and patients detailed history was obtained using the study proforma with special attention to mechanism of injury. Examination of other associated symptoms was based on history and clinical examination. Open reduction internal fixation of floating knee under spinal anaesthesia under c-arm guidance. Routine antibiotics and analgesic/anti-inflammatory drugs were administered. Post-operative evaluation was carried out by clinical examination and X-ray. Functional assessment and final outcome were measured according to the Karlstrom criteria.

Results: Male (85%) prominence was higher than females (15%). Mean age of male and female was almost same. In the study, 17 (21.3%) patients did not have any associated injuries while 63 (78.1%) patients have any associated injuries among them, 52.5% patients have Contralateral Limb Injury, 15% patients have head injury and 11.3% patients have pelvic injury. In the study, 55% patients have grade I type, 20% patients have grade IIa type, 10% patients have grade IIb type and 15% patients have grade IIc type. Right side (65%) most common affected than left side (35%). RTA (80%) most common cause of trauma than FFH (15%) and assault (5%). Close (60%) type of injury recorded higher than compound (40%). Interlocking nail femur (70%) was most common treatment for fixation of femur fracture than plating (20%) and external fixation (10%). Interlocking nail tibia (50%) was most common treatment for fixation of tibia fracture than plating (30%) and external fixation (15%). Excellent results was found in 40% patients, good results was found in 30% patients, fair results was found in 20% patients and poor results was found in 10% patients.

Conclusion: The most important factors which determine the functional outcomes were the type of fractures (open or closed), pattern of fracture, intraarticular involvement, and treatment modality used. Fraser's classification effectively classifies the injury and helps to determine the eventual outcome of injury. Karlstrom criteria are an effective scoring system to grade the functional outcome of floating knee injuries.

Keywords: Functional outcomes, floating knee injuries, Fraser's classification

Introduction

Floating Knee Injuries are becoming more and more common as a result of increasing industrialization and increase in number of vehicles as these injuries are caused by high energy trauma primarily involving high velocity motor vehicle accidents.

Due to complex nature of injury and associated complications such as compartment syndrome, vascular injuries, collateral ligament and meniscal injuries, management of these types of fractures is a challenging therapeutic problem. Most often these kinds of ipsilateral fractures are compound and associated with severe damage of soft tissues ^[1].

Characteristically, floating knee presents associated injuries that can sometimes be life threatening. It is almost always associated with soft-tissue injuries, including ligament injuries. Vascular injuries are more commonly associated with this type of injury when the fractures present singly, which in some reported studies occurs in up to 29% of cases although other authors believe these complications are less frequent. Some reports have described the presence of open floating knee in 60-80% of cases ^[2-4]. It is also associated with neurological injuries and fat embolism.

Poor outcome and high disability consequent to these injuries and its impact on the day-to-day activity and productivity of an individual have been shown. Being a highly specialized structure in human weight bearing, it bears considerable amount of stresses and demands more attention and specialized care for satisfactory locomotion. But comprehensive data still lacks about the incidence of such injuries to gauge the burden of problem, severity of orthopedic injury to predict evidence-based effect on locomotion/knee function and associated systemic injury incidence that add to the mortality risk and need for the specialized care. Such study has more relevance for the country in which most of the population comprises of younger age group ^[5]. Surgical stabilization of both the femur and tibia fractures, early rehabilitation of the patient produces best clinical outcome. Although treatment planning for each fracture in the extremity should be considered individually to achieve the optimal results, the effect of that decision must be considered in the light of overall injury status of the entire extremity and general condition of the patient.

For best clinical and functional outcome, early surgical stabilization of both the femur and tibia fractures along with early rehabilitation of the patient is necessary. For the accomplishment of good/excellent functional outcome, treatment planning for each and every type of fracture in the extremity should be considered exclusively, the effect of that decision must be considered in the light of overall injury status of the entire extremity and general condition of the patient. When the fractures are diaphyseal or extra articular, the results will be better and the complications will be less than compared to intra articular fractures. The main aim of the early internal fixation of both the femur and tibia in floating knee injuries is to obtain the union of the fractures in the anatomical reduction position with the maximal functional outcome of the patient and to reduce delayed union, non-union, infection and knee stiffness/arthritis like complications.

Nowadays, soft tissue envelope and preservation are paid more attention. Soft tissue friendly approaches and minimally invasive techniques have improved the overall results of functional outcome. Treatment of these floating knee injuries using minimally invasive techniques minimizes soft tissue injury and damage to vascular integrity of fracture fragments. Newer techniques had the advantages of reducing the articular surface, aligning the limb, and mobilizing early after injury with less encumbering external devices. Fraser RD *et al.* in the year 1978 suggested a classification system for the floating knee injuries in adults, which is also most widely used ^[6]. In the year 1977, Karlstorm G and Olerud S, in a review of 32 patients, focused on the importance of rigid fixation of both the fractures in floating knee injuries ^[7]. Karlstorm and Olerud also gave a prognostic system to assess the functional results following floating knee injuries. Hence the present study was conducted to assess early internal fixation of both, femur & tibia in floating knee injuries is to obtain union of the fractures in the anatomical position compatible with maximal functional return of the extremity and to reduce the complications.

Materials and Methods

Hospital based single center cross sectional Descriptive type of Observational study. Patients in the department of Orthopedics in teaching hospitals attached to S.M.S Medical College and hospital. Data collection was started first after the approval from institutional research review board and ethical committee up to November 2020 or till sample size is achieved, whichever is earlier. It was taken another month for follow up and one month for data processing and writing thesis.

Sample size

Sample size was calculated 76 subjects at 95% confidence limit and 10% absolute error. Assuming 73% excellent or good result of management of floating knee injury. So for study purpose 80 cases of floating knee injury was taken.

Inclusion criteria

- Floating knee (distal femur and proximal tibia fracture).
- Age group 18 to 70 years of age.
- Both sexes.
- Fracture duration less than 7 days after hemodynamic stabilization.
- Patients who are fit for anesthesia and surgery.
- Patients who will give written informed consent and are willing for follow up.

Exclusion criteria

- Patient with vessel injury: > 6hr.
- Uncontrolled Diabetes Mellitus, Hypertension, Psychiatric illness, Acute Myocardial infarction less than 1 year.
- Peri prosthetic fractures.
- Associated major visceral injury.

Collection of the data was as follows

After obtaining clearance and approval from the institutional ethical committee and patients detailed history was obtained using the study proforma with special attention to mechanism of injury. Examination of other associated symptoms was based on history and clinical examination. Open reduction internal fixation of floating knee under spinal anaesthesia under c-arm guidance. Routine antibiotics and analgesic/anti-inflammatory drugs were administered. Post-operative evaluation was carried out by clinical examination and X-ray.

Assessment of outcome

Functional assessment and final outcome were measured according to the Karlstrom criteria.

Assessment of complications

Peri-operative-difficulty in reduction, hypotension, neurovascular compromise.
Immediate Postoperative-Acute Renal Failure (ARF), pulmonary embolism, fat embolism, cardiovascular compromise (MI).
Late postoperative- infection, nonunion, malunion, failed fixation.

Follow-up

Clinical follow up was be at 2 weeks, 6 week, 3, 6, 12 months then yearly intervals regarding healing of the fracture, pain and functional outcome. Radiological follow up was done at 6 weeks, 3 months, 6 months intervals in accordance with symptoms. Wound inspected on 3rd day and suture removal on done on 14 post-operative days.

Statistical analysis

The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) Windows software program. Descriptive statistics included computation of percentages, means and standard deviations. Level of significance was set at $P \leq 0.05$.

Results

Table 1: Distribution of age according to gender

		Sex		Total
		Female	Male	
Age	<20	1	6	7
	20-30	3	18	21
	30-40	4	25	29
	40-50	3	12	15
	50-60	1	6	7
	>60	0	1	1
Total		12	68	80
Mean \pm SD		36.08 \pm 10.49	36.19 \pm 1.64	36.18 \pm 11.41

Highest number of patients were found in 30-40 year age groups (36.3%) followed by 20-30 age groups (26.3%), 40-50 age groups (18.8%), 50-60 year age groups (8.8%) and >20 years age groups (8.8%). Male (85%) prominence was higher than females (15%). Mean age of male and female was almost same.

Table 2: Distribution of associated injuries, fracture type, side involved, cause of trauma and type injury

Associated Injuries	Frequency	Percent
Nil	17	21.3
Contralateral Limb Injury	42	52.5
Head Injury	12	15.0
Pelvic injury	9	11.3
Fracture type		
I	44	55.0
II a	16	20.0
II b	8	10.0

II c	12	15.0
Side involved		
Left	28	35.0
Right	52	65.0
Cause of trauma		
Assault	4	5.0
FFH	12	15.0
RTA	64	80.0
Total	80	100.0
Type of Injury		
Close	48	60.0
Compound	32	40.0
Total	80	100.0

In the study, 17 (21.3%) patients did not have any associated injuries while 63 (78.1%) patients have any associated injuries among them, 52.5% patients have Contralateral Limb Injury, 15% patients have head injury and 11.3% patients have pelvic injury. In the study, 55% patients have grade I type, 20% patients have grade IIa type, 10% patients have grade IIb type and 15% patients have grade IIc type. Right side (65%) most common affected than left side (35%). RTA (80%) most common cause of trauma than FFH (15%) and assault (5%). Close (60%) type of injury recorded higher than compound. (40%)

Table 3: Distribution according to fixation method

Fixation of femur fracture	Frequency	Percent
External Fixator	8	10.0
Interlocking nail femur	56	70.0
Plating	16	20.0
Fixation of tibia fracture		
CC Screw	4	5.0
External Fixator	12	15.0
Interlocking nail tibia	40	50.0
Plating	24	30.0
Total	80	100.0

Interlocking nail femur (70%) was most common treatment for fixation of femur fracture than plating (20%) and external fixation (10%). Interlocking nail tibia (50%) was most common treatment for fixation of tibia fracture than plating (30%) and external fixation (15%).

Table 4: Distribution of outcome assessment Karlstrom Criteria

Outcome	Frequency	Percent
Excellent	32	40.0
Fair	16	20.0
Good	24	30.0
Poor	8	10.0
Total	80	100.0

Excellent results was found in 40% patients, good results was found in 30% patients, fair results was found in 20% patients and poor results was found in 10% patients.

Discussion

For floating knee injuries in the 1970s and 80s, conservative management was favoured and

surgical intervention with implant fixation was criticized. Complications such as non-union, delayed union, osteomyelitis, knee stiffness and deformities were common. The management of these difficult injuries gradually evolved due to Better understanding of functional anatomy and biomechanics of the knee femur and tibia, Awareness of the associated injuries, The advent of internal fixation devices, Microsurgery for neurovascular injury, Aggressive soft tissue management.

In our study 80 cases of floating knee were treated in SMS Medical College Hospital, Jaipur. Most of the patients were between 30-40 years (36.3%) age group indicating that it is an injury occurring commonly in young adults.

In the study, male (85%) prominence was higher than females (15%). Males predominated the study (88.88%) by the study Patel N *et al.* (2020) and Yadav U *et al.* (2020) was found 86.3% male prominence^[8, 9].

In the study, 55% patients have grade I type, 20% patients have grade IIa type, 10% patients have grade IIb type and 15% patients have grade IIc type. According to Patel N *et al.* (2020) the most common type of injury was type 1 according to Fraser's classification i.e. 23 cases (48.93%) followed by 8 cases (17.02%) of type 2A, 7 cases (14.89%) of type 2B and 9 cases (19.14%) of type 2C^[8]. According to Yadav U *et al.* (2020), 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)^[9]. Chavda A *et al.* (2018) was showed that 71.5% of patients were of Type I, 8.2% of Type IIa, and 11.6% of Type IIc^[10]. Shukla R *et al.* (2020) was noticed that there were 15 (50.0%) fractures; in type 2A, there were 4 (13.3%) fractures; in type 2B, there were 5 (16.7%) fractures; and in type 2C, there were 6 (20.0%) fractures^[11].

In the study, 17 (21.3%) patients did not have any associated injuries while 63 (78.1%) patients have any associated injuries among them, 52.5% patients have Contralateral Limb Injury, 15% patients have head injury and 11.3% patients have pelvic injury. The Associated other injuries were seen in 25 cases (55.55%), which includes other 31 bony injuries, 4 cases of head injuries (8.8%), 6 cases of chest injuries (13.33%) and 3 cases of abdominal injury (6.66%) by Patel N and Yadav U was seen that an associated chest injury was seen in 6 patients (28%), out of which 4 were managed conservatively while intercoastal 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^[8, 9]. In a recent study by Kao FC (2010) *et al.*, floating knee has been reported to be associated with head injuries in 26% of the study population in contrast to this study where 15.3% had head injuries. Furthermore, Kao *et al's* study reported that 8.8% patients had pelvic injuries and 54.8% had contralateral extremity injury, whereas this study shows about 11.5% and 13.4% of patients with pelvic and contralateral limb injuries, respectively^[3].

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. 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.

In the present study, right side 52 (65%) most common effected than left side 28 (35%). Patel N *et al.* (2020) was found that 31 patients had right sided injury and 12 patients had left lower limb injury^[8]. Yadav U *et al.* (2020) was found 54.5% right side involvement^[9].

A recent study by Goel SA *et al.* (2015) reports road traffic accidents as the most common cause of lower limb injuries^[12]. In our study, the most common mode of injury was RTA (80%). Our findings are comparable to the studies made by Andrade Silva *et al.* (2017) and Kulkarni MS *et al.* (2018)^[13, 14]. However, they have reported that injury is more common in the left lower limb as compared to right though the value was not significant, whereas this study shows that injuries to right lower limb are more common.

Close (60%) type of injury recorded higher than compound (40%) in the present study.

According to Patel N *et al.* (2020) 47 (61.70%) were closed fractures and 18 (38.29%) were open fractures^[8]. Yadav U *et al.* (2020) was found 72.7% closed fracture involvement^[9].

In our study for femur fracture, Interlocking nail femur (70%) was most common treatment for fixation of femur fracture than plating (20%) and external fixation (10%). For tibia, Interlocking nail tibia (50%) was most common treatment for fixation of tibia fracture than plating (30%) and external fixation (15%). By Patel N *et al.* (2020); Out of the 47 fractures of tibia, 31(65.95%) were closed and 16 (34.04%) were open fractures. For femur, intramedullary nailing was done in 30 cases (63.82%), plating in 14 cases (29.78%), screw fixation in 2 cases (4.2%) and external fixator in 1 case (2.1%). For tibia, intramedullary nailing was done in 25 cases (53.19%), plate fixation in 13 cases (27.65%), screw fixation in 1 case (2.12%) and external fixator in 8 cases (17%). Interlocking nailing was performed by Yadav U *et al.* (2020) in both tibia (27.28%) and femur (36.36%) fracture^[9]. In a prospective study by Rethnam U *et al.* (2007) 29 patients with floating knee injuries were followed up over a period of 3 years^[1]. By using Karlstrom criteria the functional outcome was excellent in 32 patients (40%), good in 24 patients (30%), fair in 16 patients (20%) and poor in 8 patients (10%). Thus excellent to good results were obtained in 70% patients as compared to 86% in karlstrom and olerud series, 72% in Veith RG (1984) series and 81% in Anastropopulas G (1992) series^[15, 16]. Fraser RD *et al.* (1978) had 28.57% good and 71.42% poor outcomes^[6]. Yokoyama K *et al.* (2002) found 58.82% good and 41.17% poor outcomes^[17]. Kumar A *et al.* (2006) got 50% good and 50% bad outcomes^[18]. Pietu G *et al.* (2007) showed 52.58% good and 47.41% poor outcomes^[19]. Shukla *et al.* (2018), Kulkarni MS (2018) and Feron JM (2015) was found 63.4%, 53.3% and 53% excellent results respectively^[11, 40, 20].

Conclusion

Floating knee injuries are due to high velocity trauma. Road traffic accidents particularly two wheeler accidents is the commonest cause. Young Males are more commonly affected. These associated injuries can make an impact on management and rehabilitation but not on final functional outcome. The most important factors which determine the functional outcomes were the type of fractures (open or closed), pattern of fracture, intraarticular involvement, and treatment modality used. Fraser's classification effectively classifies the injury and helps to determine the eventual outcome of injury. Karlstorm and Olerud criteria is an effective scoring system to grade the functional outcome of floating knee injuries. Thorough assessment of injury along with proper management of associated injuries, proper planning and early aggressive intervention and good post-operative care and rehabilitation can result in good outcomes. A multidisciplinary approach is essential for management of these injuries including hemodynamic stabilization.

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