Original Research Article

Functional Outcomes after Management of Floating Knee Injuries

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Abstract

Background: The floating knee is defined as ipsilateral fracture of femur and tibia that isolates the knee from the rest of the lower limb. Due to the complex nature of the injury and associated complications these injuries pose a challenge to the treating surgeon. We conducted this study to evaluate the functional outcome of the management of the patients with floating knee injuries. **Material and Methods**: This study was conducted on 20 patients of floating knee who presented to the emergency department of our institution between June 2016 to June 2019. All the patients were followed up for clinical, radiological outcome and complications. Functional outcome was assessed by using Karlstrom and Olerud criteria. **Results:** The mean age of patients was 35.5 years with range of 18-70. Mean duration of follow up was 16.4 months ranging from 11 months to 37 months. Mean operating time was 141±10.25 minutes. Mean blood loss was 540±10.5 ml. Mean time for union was 15.15±1.35 weeks. Knee stiffness was the main complication after surgery seen in 6 patients (30%) while diffuse knee pain and swelling were seen in 4 patients (20%). **Conclusion:** These injuries have high propensity of involving multiple systems of the body, so a multidisciplinary approach is essential for management of these injuries in the emergency.

Keywords: Floating knee, Hemodynamic stabilization, Complications, Functional outcomes.

Introduction

With the rise in motor vehicle accidents there has been increase in the floating knee injuries. Concept of floating knee was originally established by Blake and McBryde in 1975[1]. It refers to fractures involving ipsilateral femur and tibia. These fractures may involve metaphysic, diaphysis or reach upto knee joint.2 These injuries are generally caused due to high energy trauma. Open injuries are frequent. There are also high chances of life threatening injuries to chest, head and abdomen and fat embolism may be present[2,3]. We conducted this study to evaluate the outcome of the management of the patients with floating knee injuries.

Materials and methods

The retrospective observational study was conducted on 20 patients of floating knee who presented to the emergency department of PGIMS Rohtak between June 2017 to June 2019. All the floating knee injuries irrespective of open/closed which were managed surgically during this period were included in the study. The patients were treated as per protocols of emergency team on duty. The patients were initially hemodynamically stabilized and appropriately splinted in emergency department. All necessary radiographs including limb, chest, spine and pelvis were performed. Patients with head, chest and abdominal injuries were managed appropriately by the emergency general surgery and neurosurgery team. Surgical treatment was done only after adequate hemodynamic stabilization of the patient.

Open injuries were classified according to Gustilo Anderson classification. Fraser classification was used to classify floating knee injuries. Open fractures were adequately debrided and wound irrigation with normal saline done. Intravenous antibiotic therapy was appropriately given. Patients were surgically treated only after they were hemodynamically stable and fit for surgery. Nailing was used for diaphyseal fractures and was the most common treatment method. Plating was done for metaphyseal and intra articular fractures. Postoperatively IV antibiotics were given for 5 days and sutures were removed on the 14th postoperative day. Physiotherapy was started at the earliest and the patients were mobilized. Partial weight bearing was started once adequate callus at the fracture site was seen in the X-ray.

Patients were followed up at regular intervals at 3 weeks, 6 weeks, 12 weeks and 6 months. Functional assessment of patients was done using Karlstrom`s and Olerud criteria.

Results

The mean age of patients was 35.5 years with range of 18-70. Mean duration of follow up was 16.4 months ranging from 11 months to 37 months. There were 16 males (80%) and 4 females (20%). Right side was involved in 15 patients (75%) while left side was involved in 5 patients (25%). All the patients had Road side accident (RSA) as mode of trauma for their fracture. Out of 20, 14 patients had close fracture while 6 patients 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. According to Fraser classification (Table 1), type 1 fracture (n=12) were the most common type followed by type 2c (n=4) while 2 cases each were of type 2a and 2b. With respect to femoral implants (Table 2), femoral intramedullary nailing was used in 10 patients, distal femoral locking plate were used in 8 patients for fixation of intra-articular and supracondylar fractures and 2 patients were managed by knee spanning external fixator. In Tibia, 12 patients were managed by intramedullary nailing, 4 patients were managed by locking plates and 4 patients were managed by external fixator (Fig 1-4). Even grade I compound fractures were thoroughly washed and debrided and internal fixation was done with nails/plates. For compound fracture, external fixator was used after thorough debridement and supplemented with K wires fixation, if needed.

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Table 1: Fracture Classification

Fraser Classification Type	Number	Percentage (%)
Type 1 extra articular fracture of femur and tibia	12	60
Type 2a extra articular femur and intra articular tibia fracture	2	10
Type 2b extra articular tibia and intra articular femur fracture	2	10
Type 2c intra articular femur and tibia fracture	4	20

Table 2: Implant Used

Femoral Implants	Number
Interlocking Nail	10
Distal Femoral Locking Plate	8
Fixator	2
Tibial Implants	
Interlocking Nail	12
Locking Plates	4
Fixator	4

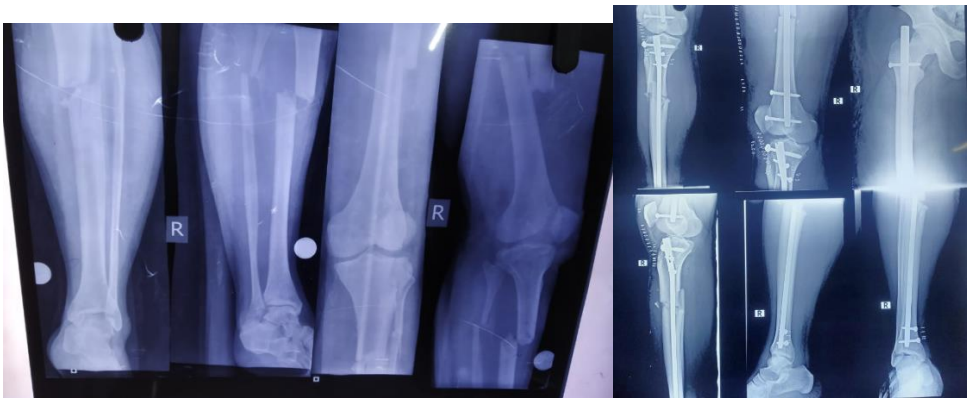

Fig 1: Preoperative and Postoperative Xray showing fixation with interlocking nails

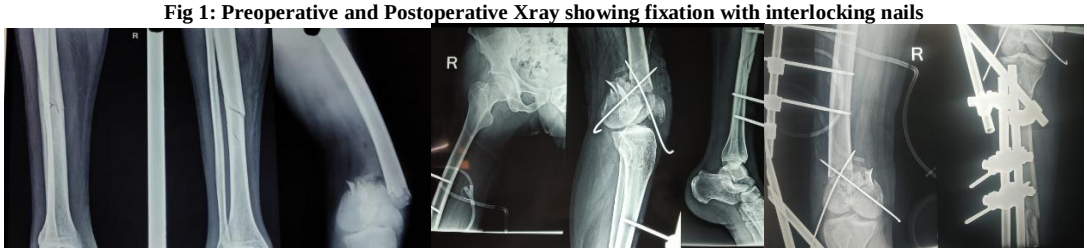

Fig 2: Compound Grade 2 floating knee injury fixed with Knee spanning External Fixator

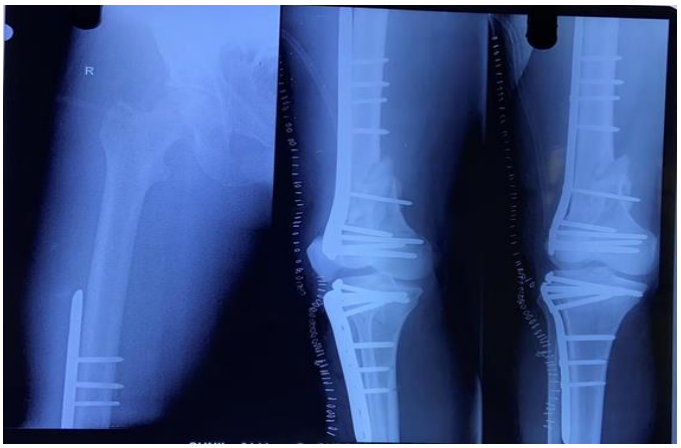

Fig 3: X-ray showing fixation with Locking plates

Fig 4: X-ray showing fixation with Distal femoral nail and Interlocking Tibial nail

Chest injury was seen in 3 patients, out of which 1 was managed conservatively while intercostal chest tube was put in 2 patients for drainage. Associated head injury was seen in 5 patients out of which 4 patients were managed conservatively in the surgery ward however, one patient had to undergo craniotomy which was done by the neurosurgeon. Associated abdominal and pelvic injuries were noted in 2 patients each which were managed conservatively. All the patients were operated for the floating knee after proper clearance from the general surgeon.

Mean operating time was 141±10.25 minutes. Mean time for union was 15.25±1.30 weeks (Table 3).

Table 3: Demographic profile and results

Parameter	Number
Mean Age	35.5
Sex	M=16 F=4
Side	R=15 L=5
Open Fractures	6
Closed Fractures	14
Mode of Injury	RSA-20
Mean time of fracture healing (weeks)	15.25±1.30
Mean operating time (minutes)	141±10.25
Chest injury	3
Head Injury	5
Abdominal and Pelvic Injury	2

Knee stiffness was the main complication after surgery seen in 6 patients (30%) while diffuse knee pain and swelling were seen in 4 patients (20%). Manipulation under anesthesia was done in 2 patients with knee stiffness to improve the range of motion at knee. Nonunion of femur was noticed in 4 patients (20%) while 3 patients had nonunion of tibia. 2 patients developed superficial infection which were managed by disciplinary antibiotics course. One patient developed chronic osteomyelitis of tibia with nonunion which was further treated with illizarov fixator. As seen in chart 1, excellent results were seen in 6 patients (30%) cases while good results were seen in 10 patients (50%). Fair results were seen in 3 patients (15%) while poor result was seen in 1 patient (5%) as per Karlstrom Olerud criteria.

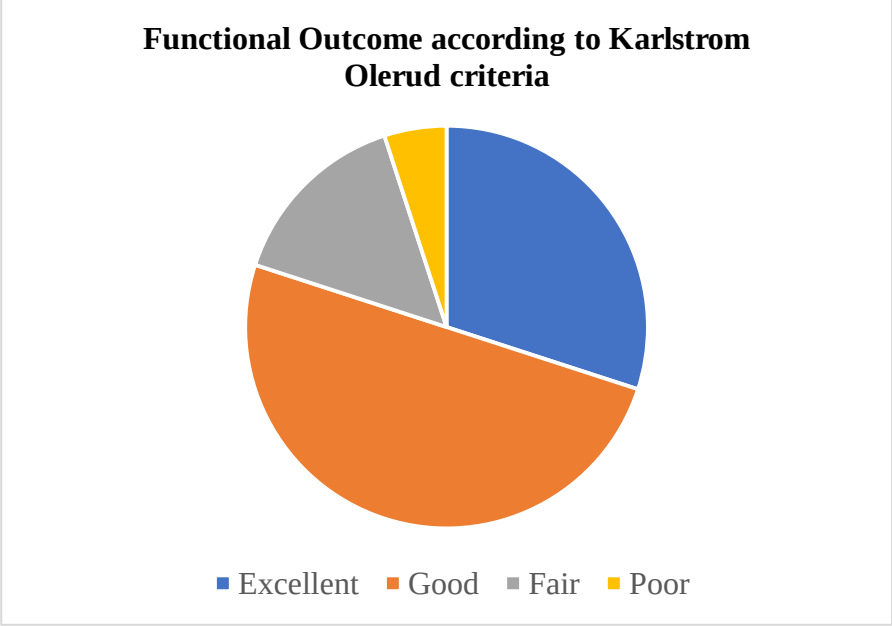

Fig. 5: Functional outcome according to Karlstrom Olerud criteria

Discussion

When the knee joint is isolated partially or completely due to fracture of the femur and tibia the term "Floating Knee" is used. Floating knee injuries result from high energy trauma and patients often have injuries to several organs as well as multiple fractures which require careful evaluation of these injuries and adequate resuscitation of the patient before proceeding to the definitive management of the specific fractures[4]. Studies showed associated injuries like head injuries, chest injuries, abdominal injuries and injuries to other extremities[5,6]. Most of the injuries to the head, chest and abdomen were life threatening. Adamson et al[7] in their study encountered 71% major associated injuries with 21% vascular injuries and they also reported mortality rate ranging from 5– 15%, thus reflecting the serious nature of the associated injuries with the floating knee. Kao et al. found that floating knee injuries are usually associated with high rates of complications and mortality, regardless of the treatment regimen used. They reported that complications were more common in patients aged 60-89 years, greater in type II (Fraser classification) injuries and more in distal tibia and open fractures[8]. In planning treatment for these injuries, it is essential to take into account the patient's overall condition and the local situation of the limb. In some cases, amputation is the best management option for the patient especially in open fractures.

Male preponderance and mean age of 20- 40 years has been reported in various studies in the literature which corroborates with the results of our study (mean age 35.5 years)[9-11]. Floating knee injuries are not only restricted to bones but can involve multisystem injuries. In our study, 10 out of 20 patients had other system injuries like chest, head and abdomen. Management protocol for these patients involves hemodynamic stabilization of the patients followed by surgical fixation of the fractures. Soft tissue injuries are major determinant factor in deciding the type of implant to be used for these injuries. In case of open fractures and closed fractures with poor skin condition, external fixator is preferable method of initial treatment. Also, in patients who are hemodynamically unstable due to associated injuries, external fixator is applied as a part of damage control orthopaedics. Piétu et al[12] reported use of external fixator in 25% of cases in their retrospective study which is comparable to our study in which external fixator was applied in 20% patients (n=4). For the distal femoral fractures, a retrograde nail and locking plates are the most common implants used. In cases of ipsilateral distal femur and tibial shaft fracture, retrograde femoral nail and antegrade tibial nail can be used, as both these implants can be inserted through a single incision thus giving the improved cosmesis to the patient. In our study, 2 patients of ipsilateral femoral and tibial shaft fractures were managed by retrograde femoral and tibial nail through single incision as shown in Fig 4**.**

While doing surgery for floating knee, femoral nailing is performed before the tibia. Tibia is temporarily stabilized with a splint or with an external fixator during the surgery. If the tibia is stabilized first, the movement of the femur fracture during the surgery would cause greater damage to the soft tissues and increase the chances of fat embolism and also risk of vascular injury are high with femoral fracture fragments during the surgery as shown in the literature[13,14]. We also in our study performed femoral fracture fixations prior to the tibial fracture fixations.

Single incision technique for intramedullary nailing of both the fractures have been recommended by several authors in the literature[15,16]. Rios et al compared single incision versus traditional antegrade nailing of the fractures and found the former to have less surgical & anaesthesia time with reduced blood loss.[17] Intra-articular involvement of the fractures, higher skeletal injury scores and severity of soft tissue injuries are significant indicators of poor functional outcomes of these fractures[2].

Floating knee injuries are usually associated with ligamentous injuries resulting in the knee instability. The reduction of articular surface is important in the management of these fractures. Pietu et al[12] reported incidence of 15.7% of knee laxity due to anterior cruciate ligament tear in their study. Rethnam et al[2] reported 10.5% of early ligament ruptures and diagnostic arthroscopy and ligament repair were performed whenever knee instability was found in their study. Knee stiffness remains the most complication after treatment of these injuries. Early range of motion and knee physiotherapy can decrease the knee stiffness incidence. Manipulation under GA remains the next treatment option. In our study nonunion was seen in 32% cases which further needed another surgery with bone grafting or bone grafting alone. Rethnam et al[2] in their study detailed the prognostic factors and functional outcome in floating knee injuries management in 29 patients. They reported that prognostic and risk factors for poor functional outcome in these injuries were type of fracture (open, with intraarticular extension, comminution), severity of the associated injuries, time delay before the definitive surgery and duration of the surgery. Studies in the literature[2,3,6] have shown that the functional outcomes are better in Blake and McBryde type I injuries than in type II injury due to intraarticular nature of type 2 injuries which has higher propensity for the stiffness of the knee after the surgery. Hung et al[18] in their study reported the knee involvement causes produces functional outcomes in the patients than the any other joint involvements of the body. Yokohoma et al[19] in their study on 65 patients also reported a similar result that severe knee joint injury have adverse effects on functional outcomes in the patients. The limitation of this study is small no of cases and short term follow up. The long-term effects of floating knee injuries on knee joint function are yet to be identified.

Conclusion

Floating knee injuries should not be seen only as orthopaedic injuries alone. These injuries have high propensity of involving multiple systems of the body, so a multidisciplinary approach is essential for management of these injuries in the emergency. The surgical stabilization of both fractures is essential however, the choice of implant is determined by the patient's general physical condition and fracture pattern. Achieving a good functional knee poses a challenge for the orthopaedic surgeons worldwide so a rigorous and dedicated post-operative rehabilitation program is needed to achieve a good functional outcome in these complex injuries.

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