Original Article
Orthopaedics

MANAGEMENT OF FLOATING KNEE INJURIES

Ramachandra S[1], Gaya B T[2], Lakshmisha N[2]

[1] - Assistant professor, Department of orthopaedics, Bangalore medical college and research institute, Bangalore
[2]- Junior Resident, Department of orthopaedics, Bangalore medical college and research institute, Bangalore

Corresponding Author
Dr. Gaya BT
Junior Resident,
Department of orthopaedics,
Bangalore medical college and research institute,
Bangalore

Article submitted on: 27 November 2019
Article Accepted on: 28 November 2019

Abstract

Background And Objectives: Floating knee, referred to as ipsilateral fractures of the femur and tibia, is a condition resulting from high energy trauma usually associated with minor to life threatening associated injuries. The type of fractures, soft tissue and associated injuries make this a challenging problem in terms of management. This study analyses the prognostic factors, plan of management and functional outcomes of the complex injury.

Methods: A prospective with forty patients of floating knee injuries treated over a period of 18 months are included. After management of life threatening injuries and stabilisation of general condition, floating knee injury were classified according to Fraser`s classification and were surgically fixed using different modalities and followed up for mean duration of 10 months. The outcome was assessed using Karlstrom criteria following union.

Results: The mechanism of injury was road traffic accident in 36/40 patients. There were 9 associated injuries. 15/40 patients had intramedullary nailing for both fractures. The immediate complication was hypotension, early being fat embolism and late complications were knee pain and stiffness mainly ,with infection ,delayed union and non-union in open fractures . The mean bony union time was 20 weeks According to the Karlstrom criteria the end results were Excellent – 21, Good – 14, Acceptable – 3 and Poor – 2.

Conclusion: The associated injuries and the type of fracture (open, intra-articular, comminution) are prognostic indicators in the Floating knee. Appropriate management of the associated injuries, intramedullary nailing of both the fractures and post-operative rehabilitation are necessary for good final outcome.

Keywords: *Floating knee, Intramedullary nailing, karlstrom criteria*

Introduction:

With modernization and advancement in motorized technology ,the pattern and problems associated with trauma are challenging .The term "floating knee" was first described by Blake and McBride in 1975.[1]It is an ipsilateral fracture of the femur and tibia with fractures ranging from simple diaphyseal to complex articular pattern. Although exact incidence is unknown, this condition is rare showing increasing trends in recent years. Besides being caused by high-energy trauma with extensive skeletal and soft tissue damage, they are also associated with potentially life-threatening injuries of the head,chest, and the abdomen.[2]Complications attributable to floating knee injuries include infection, excessive blood loss, fat embolism , mal-union, delayed union or non-union , knee stiffness, prolonged hospitalisation ,and inability to bear weight.[3,4]Various classifications of floating knee have been proposed. The one that is most commonly employed is that of Fraser *et al*.[5], who distinguished two types of injury; one with diaphyseal fractures in both bones, and the other with articular fractures, in one or both bones (figure:1) Ran *et al*. recently proposed a modification of this classification, to take into consideration, in addition, the impact on the patella and the complexity of the articular fracture . The purpose of these classifications, in principle, is to contribute to establishing a prognosis, because diaphyseal fractures present fewer complications and functional recovery is better than those affecting the joint.[6] However, Ran's classification does not take into account diaphyseal fractures associated with a fractured patella, and neither of these classifications considers associated soft-tissue injury or ligament injuries. Nevertheless, these questions should be addressed because they may influence treatment planning and can provoke multiple post-surgery complications.[7]

Figure:1(Fraser classification)

Our study appraises the radiological, clinical, functional outcomes, prognostic factors and the complications of this complex injury.

Materials and Methodology:

This descriptive study was carried out at a tertiary care hospital in India between January 2018 to July 2019, after approval from ethical committee

Inclusion criteria:

- Skeletally mature –Age 18 to 60 years
- Traumatic Ipsilateral femur and tibia fractures
- Surgical management

Exclusion criteria:

- Primaryamputation
- Vascular injury
- Associated pelvis, spine, contralateral or upper limb injuries
- Pathological fractures

The fracture injuries were classified according to Fraser classification, and Gustilo-Anderson classification was also used to classify open or closed fracture sites. At the Emergency department ATLS protocol was followed and initial management involved the resuscitation of patients, fluid and pain management and splinting of fractures, thorough wound wash with 9 litres of normal saline for open injuries, and traction immobilization by Thomas or Bohler Braun splint. Tetanus prophylaxis, and tetanus immunoglobulin were also administered to the patient. A secondary survey was done to rule out other associated injuries. Furthermore, once patient was stabilised plain radiographs of the chest, pelvis, spine and affected limbs were taken. In addition, portable ultrasonography of the abdomen and chest was carried out in all the patients to rule out any intra-abdominal and chest traumas. In suspected cases of head injury, computed tomography of the brain was done. Patients who had an associated chest injury, head injury, or abdominal injury were managed according to the extent of their injuries before surgical stabilization of any fracture. Immobilization of these patients was done to stabilize the fracture site until definitive fixation could be done. The methods used in these cases include skeletal traction by calcaneal pin, posterior stabilization by above knee plaster of Paris slab. Patients with isolated floating knee injuries were closely monitored for haemodynamic stability and signs of fat embolism and were managed accordingly. The following algorithm was followed (Table:1)

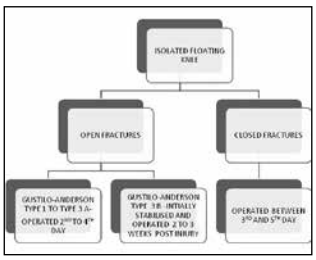

Table :1

Patients with associated head, chest and abdomen trauma were taken over from concerned speciality between 7 to 10 days following injury and was surgically managed for floating knee .Physiotherapy and mobilization were started as early as possible after surgery depending on the stability of the fracture fixation and stage of wound healing. Depending on patient and injury related factors In-Patient stay varied from 5 days to 3 weeks and were followed up clinically and radiologically for bony union at 3 weeks ,6 weeks ,3 months ,6 months and 9 months Patients with noncomminuteddiaphyseal fractures treated with intramedullary nailing were allowed partial weight bearing with walker at 2 weeks of postoperative period. Fracture union was identified clinically by patient not having pain on palpation at the fracture site and no pain on full weight bearing on affected limb. Union was also determined radiologically when three out of the four cortices were found to be united, and a good amount of callus formation occurred at the fracture site seen on a plain X-ray. Functional assessment and final outcome were measured using the Karlstrom criteria.

Data were collected, and significance or association between positive predictive variables and clinical outcomes were analysed using the Chi-square method within a 95% confidence interval.

Results:

A total number of 61 patients were analysed during the study with 21 being excluded as per the exclusion criteria with majority of the excluded patients having upper limb or contralateral limb injury. Out of 40 patients as per the inclusion criteria 77% were males (figure:2) and 68% of injures classified under Fraser type 1 and type II B suggesting Tibia diaphysis fracture being the most common injury in the complex pattern (figure:3). A overwhelming majority of 88% of injuries were as a result of road traffic accidents,31 of 40 patients were isolated floating knee injuries and remaining 9 needed intervention from other speciality. Among the 9 head injury was commonest associated injury with 66%. A significant percentage of 32% had open injury ranging from Gustilo-Anderson type 1 to type III B with type II injuries constituting 54% of the open fractures. The average time to surgical intervention among the pure isolated floating knee injury were 72 hours, whereas in patients with associated injuries delayed it to 5 days. The mean Duration of surgery was 120 minutes and 38 of the 40 patients needed at-least 1 packet of red blood cell transfusion . Majority of the time tibia was fixed first followed by femur in traction table ,in cases where femur was fixed first proximal tibial traction with stienman pin was used .Femur fractures were stabilized using intramedullary nailing in 21 patients, plate fixation in 14 patients, cancellous screws in 3 patients and external fixation in 2 patients. Tibial fractures were stabilized using intramedullary nailing in 24 patients, plate fixation in 7 patients, CC screw in 3 patients, and external fixation in 6 patients. There were 15 patients with intramedullary nailing in both femur and tibia(figure:6), 7 patients with plating in both, and 2 patients with cancellous screws in both. Ante-grade intramedullary nailing of both bones was the most common technique used in diaphyseal fractures (Fraser Type I). Type I patients were all managed by definitive intramedullary nailing in both the femur and tibia with six cases initially stabilised by external fixator either in femur or tibia followed by nailing. The mean duration of External fixator was 2 weeks except in 2 cases which needed plastic surgery intervention.57% of the times Intramedullary nail was used during treatment of the combined injury .Most common combination involved in fixation of single bone was Cannulated screws and plate device. Twenty seven patients had closed fractures and the rest had open fractures. Open fractures were classified as per the Gustilo-Anderson classification (open Grade I (three), open Grade II (seven), open Grade IIIa (one), and open Grade IIIb (two)). There were 8 patients that were managed with early external fixations. These included all three open Grade IIIa and IIIb fractures, three out of six open Grade II, one open Grade I, and two closed fractures. We found that we did not encounter any compartment syndrome and majority of open fractures in type III and above as our exclusion criteria did not include associated fractures in skeletal system, this might suggest the incidence of increase in open fractures with increase in velocity of trauma. The outcomes of patients with early external fixations were 37.5% poor, 37.5% good, and 25% excellent, the two patients with poor outcomes from the entire study group were from these patients and both had type IIIb open injury. None of the early external fixation of both the tibia and femur was continued as definitive fixation. In five patients allograft was used to reconstruct the articular surface. The average time for union was 20 weeks (range 14-32 weeks). Patients were followed up at 3 weeks, 6 weeks,3 months, 6 months, and then a final follow-up. The average follow-up was

10 ± 1 months. The mean knee range of motion observed was 105° ±25 °.The mean duration of full weight bearing was 12±2 weeks. Majority of patients went back to occupation in 4 to 5 months duration post injury. Functional assessment and final outcome were measured according to the Karlstrom criteria, 52.5% had excellent results, 35% had good, 7.5% fair and 5% had poor results.

Initially 5 patients had signs of fat embolism and was appropriately managed, 2 of this and 4 accounting for 6 in total had signs of fat embolism in post-operative period and all recovered. Knee pain was the most common complication experienced by 28 patients (figure:4). Knee stiffness occurred in thirteen patients. Knee stiffness was considered in patients with the range of motion of knee ≤80°. Knee stiffness was seen more in open grade fractures as compared to closed fracture ($P < 0.05$). However, knee pain was the most common complication of the study but was not associated with open or closed nature of injury ($P > 0.05$). Early infection was seen in six patients of which one had fair, and three had good and two had poor outcome. Four patients needed debridement of the wound after the infection was detected initially and antibiotics were administered, according to the culture and sensitivity of the isolated organism. Dry dressings were done regularly until sutures were removed. One patient required revision. None had nerve palsy. Mal-union was seen in six and delayed union was seen in two patients and nonunion in two patients in this study. Bony union was achieved around 12 months in both patients with delayed union. The patient with nonunion was re-operated with bone grafting (autograft) and intramedullary fixation. Six patients had associated ligament injury. In general, complications were seen more in Type II Fraser which was significant ($P< 0.05$). Complications were also more prominent in open fractures ($P < 0.05$). The average duration of a hospital stay was 16 days for closed fractures and 20 days for open fractures (figure:5).

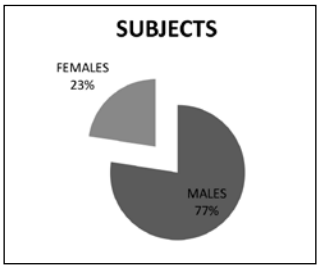

Figure:2 Subjects

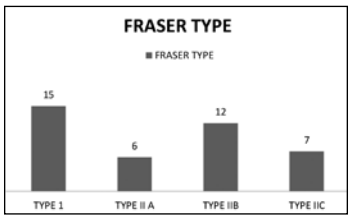

Figure:3 Fraser Type

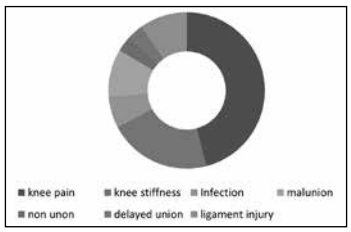

Figure:4 complications

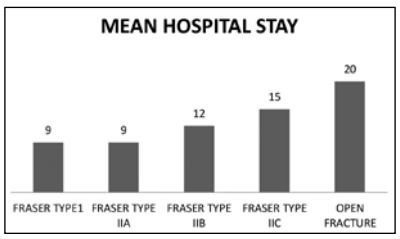

Figure:5 Hospital stay

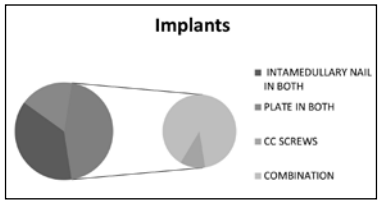

Figure:6 Implants used

Discussion:

An expanding population, increasing number of motor vehicles on limited infrastructure of most cities in developing countries, various modes of treatment and their effectiveness made floating knee injury a target of concern from both medical and socio-economic standpoints. Men aged 21-30 years were most commonly involved in RTAs, as they are less risk-averse in their driving habits. Male preponderance, a younger age group, and high-energy RTAs leading to this injury have been observed. A study by Goel *et al*. reports road traffic accidents as the most common cause of lower limb injuries. This finding is in accordance with this study. In a recent study by Kao *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% had head injuries. Currently, the reported mortality rate ranges from 5% to 15% reflecting the impact of associated injuries, This study did not report any mortality in patients with floating knee.[8] In a study by Rethnam et al., 29 patients with floating knee injuries were managed over a 3 year period. The mechanism of injury was RTA in 27 patients. There were 38 associated injuries.[9] Twenty patients had intramedullary (IM) nailing for both fractures. The complications were knee stiffness, foot drop, delayed union of tibia, and superficial infection. The mean age of the study group was 28 years (18-56). The right side was involved in 19 and left side in 10 patients. There were 20 Type 1, 3 Type 2A, and 6 Type 2B floating knee injuries according to the Fraser classification. Results of this study showed that the frequency of injured men was higher than in females and

the most common cause of injury was vehicle accidents. It was also shown that almost half of the patients were in the age group of 20-29 years.

There are many studies in literature suggesting internal fixation of both the fractures of floating knee should be done as early as possible. Ratliff found that internal fixation of both fractures was less likely to cause the development of knee stiffness and lessen the duration of hospital stay.[10,11] Ostrum treated patients with retrograde femoral nailing and antegrade tibia nailing through 4 cm medial parapatellar incision. The average time to union of femoral fracture was 14.7 weeks and for tibial fracture was 23 weeks. This study shows an average union time of 20 weeks. They opined that this method was an excellent treatment option.[12]

Piétu et al., in a retrospective analysis of 172 cases according to the Fraser classification, reported that 71.5% of the cases were type I and the repartition of the type II in the three subgroups was as follow: II A 8.2%, II B 11.6%, and II C 8.7%.[13]This study shows only 37.5% are Fraser type 1 injury and 30 % are type II B contrary to his 11.6%.[13]The Intramedullary nailing was the preferred method at the femur site (73%, 126 cases), the tibia Intramedullary nailing was performed in 54.4% of cases, and external fixation was used in one in every four patients, our study is in accordance with this.In a study by Abalo et al. on 43 patients with floating knee injuries, the results showed that there were 32 males and 11 females with a mean age of 37 years.[14]All patients had sustained their injuries in motor vehicle accidents. According to the Fraser's classification, there were 21 type I, 10 type IIa, 7 type IIb, and 5 type IIc. Oh CW et al. noted the complications encountered were 1 case of fat embolism, 8 cases of knee stiffness, 10 cases of delayed union, 9 cases of infections, and 7 cases of nonunion.[15]In our study we had 6 cases of fat embolism and 28 patients out of 40 having knee pain or stiffness.. Feron *et al*. noted that the Karlstrom score was significantly dependent on the level of femoral fracture. [16]They found that 66.2% of good or excellent results were in diaphyseal fractures while that percentage dropped to 12.5% in distal third femoral fractures. In this study, the management of femur fractures significantly affected the outcomes as per the Karlstrom criteria; femoral intramedullary nailing was associated with excellent outcomes ($P < 0.05$) as there were more excellent outcomes with intramedullary nailing than compared with other methods of management. In contrast, there was no significant association found between tibial fracture management and outcome ($P > 0.05$) of the floating knee injuries. Patients with Fraser Type I floating knee injuries were also associated with significant low complication rate ($P < 0.05$). Furthermore, patients with closed fractures had more excellent outcomes than open fractures ($P < 0.05$). The age of the patient did not affect the outcomes of the floating knee injuries ($P > 0.05$). In addition, there is no significant association found between the associated injury and range of motion of knee observed in patients with floating knee injuries in this study ($P > 0.05$). Our limitation of study was mean follow up. There are no conflicts of interest.

Conclusion:

The current recommendation for floating knee is surgical stabilization of both the fractures. There are a number of methods to do this but there is not a single ideal technique. The surgical sequence should be individualized for each patient and each fracture should be addressed according to its quality. The chosen method depends on the fracture pattern, location of the fractures, the soft tissue injury, available resources, surgical capability, and preference. The impact of the osteosynthesis technique on the overall physiology of the patient should be kept in mind. Floating knee injury is more than just an ipsilateral fracture of the femur and tibia with associated life-threatening conditions. Management by step wise systemic approach according to patient's associated injuries. Definitive fixation should considered early unless until the patient's condition is not suitable for surgery or there is an associated injury. Mobilization should be started as soon as possible keeping the patient non-weight bearing after the fixation of fractures for better functional outcomes. Closed fractures and diaphyseal fractures have better outcomes with low complications rate. Most patients have an excellent or good outcome with timely and orderly management.

References:

1. Blake R, McBryde A. The floating knee: Ipsilateral fractures of the tibia and femur. South Med J. 1975;68:13–6. [PubMed] [Google Scholar]
2. Veith RG, Winquist RA, Hansen ST., Jr Ipsilateral fractures of the femur and tibia. A report of fifty-seven consecutive cases. J Bone Joint Surg Am. 1984;66:991–1002. [PubMed] [Google Scholar]
3. Elmrini A, Elibrahimi A, Agoumi O, Boutayeb F, Mahfoud M, El-bardouni A. Ipsilateral fractures

of tibia and femur or floating knee. IntOrthop. 2006;30:325–8. [PMC free article] [PubMed] [Google Scholar]

4. Veith RG, Winquist RA, Hansen ST., Jr Ipsilateral fractures of the femur and tibia. A report of fifty-seven consecutive cases. J Bone Joint Surg Am. 1984;66:991–1002. [PubMed] [Google Scholar]
5. Fraser R.D., Hunter G.A., Waddell J.P. Ipsilateral fracture of the femur and tibia. J. Bone Joint Surg. Br. 1978;60-B(4):510–515. [PubMed] [Google Scholar]
6. Ran T., Hua X., Zhenyu Z., Yue L., Youhua W., Yi C., Fan L. Floating knee: a modified Fraser's classification and the results of a series of 28 cases. Injury. 2013;44(8):1033–1042. doi: 10.1016/j.injury.2012.12.012. [PubMed] [CrossRef] [Google Scholar]
7. Sharma S., Kumar V., Dhillon M.S. Comment on Ran et al.: floating knee: a modified Fraser's classification and the results in a series of 28 cases. Injury. 2013;44(11):1663–1664. doi: 10.1016/j.injury.2013.04.032. [PubMed] [CrossRef] [Google Scholar]
8. Kao ,Dwyer AJ, Paul R, Mam MK, Kumar A, Gosselin RA. Floating knee injuries: Long-term results of four treatment methods. IntOrthop. 2005;29:314–8. [PMC free article] [PubMed] [Google Scholar]
9. Rethnam U, Yesupalan RS, Nair R. The floating knee: Epidemiology, prognostic indicators and outcome following surgical management. J Trauma Manag Outcomes. 2007;1:2. [PMC free article] [PubMed] [Google Scholar]
10. Kumar R. The floating knee injury. J ClinOrthop Trauma. 2011;2:69–76. [Google Scholar]
11. 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;6:333–9. [PubMed] [Google Scholar]
12. Ostrum RF. Treatment of floating knee injuries through a single percutaneous approach. ClinOrthopRelat Res. 2000;375:43–50. [PubMed] [Google Scholar]
13. Piétu G, Jacquot F, Féron JM. The floating knee: Aretrospective analysis of 172 cases. Rev ChirOrthopReparatriceAppar Mot. 2007;93:627–34. [PubMed] [Google Scholar]
14. Abalo A, Randolph S, Ayouba G, Walla A, Dossim A. Floating knee: Epidemiology and results of treatment. Niger J Orthop Trauma. 2011;10:23–7. [Google Scholar]
15. Oh CW, Oh JK, Min WK, Jeon IH, Kyung HS, Ahn HS, et al. Management of ipsilateral femoral and tibial fractures. IntOrthop. 2005;29:245–50. [PMC free article] [PubMed] [Google Scholar]
16. Arslan feron H, Kapukaya A, Kesemenli CC, Necmioğlu S, Subaşi M, Coban V. The floating knee in adults: Twenty-four cases of ipsilateral fractures of the femur and the tibia. ActaOrthopTraumatolTurc. 2003;37:107–12. [PubMed] [Google Scholar]