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Original Research Article

Functional evaluation of various modalities of management in floating knee injuries at a tertiary care centre in central India

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ABSTRACT

Background: The injuries involving femur and tibia fractures due to high velocity are known as floating knee injuries. These fractures may involve the shaft, metaphysis or the articular surface. There are many complications associated with these injuries. This study evaluates the functional, clinical and radiological outcomes of floating knee injuries.
Methods: A Prospective and interventional study was performed at MGMMC and MYH Hospital, Indore. We included 30 patients in our study. Femur fractures are managed by intramedullary nailing or distal femur plating. Tibia fractures are managed by Intramedullary nailing or tibia plating. Patient were called for regular follow up for a minimum of 6 months. Functional and clinical evaluation done by Karlstorm and olerud scoring system and radiological outcome by union on x rays were done.
Results: Out of 30 patients 28 (93.33%) male and 2 (6.66%) female. According to Fraser classification, 17 (56.66%) type 1, 4 (13.33%) type 2A, 4 (13.33%) type2B, 5 (16.66%) type 2C injuries. A majority of the injuries occurred due to road traffic accidents involving right limb 21 (70%) more then left 9 (30%). Knee stiffness occurred in 8, infection in femur 3, infection in tibia 2, malunion of femur 2, limb length discrepancy in 2 patients. Outcome was excellent in 5 (16.66%), Good in 10 (33.33%), Acceptable in 9 (30%) and poor in 6 (20%).
Conclusions: Fraser type 1 fracture has excellent results and Fraser type 2C has poor results. Closed fracture has better outcome compared to compound Fractures. A better functional outcome can be determined on the basis of implant choice based on Fraser Classification, level of injury, open or closed injury, simple or compound type of fracture.

Keywords: Floating knee, Fraser, Karlstorm and olerud, Ipsilateral

INTRODUCTION

With the world's ongoing development and the increasing pace of industrialization, we observe a significant rise in high-speed car accidents. These accidents often attributed to the current emphasis on high horsepower in racing. Consequently, such accidents lead to severe and intricate injuries, including an elevated occurrence of multiple fractures within the same limb, thereby introducing new complexities in their treatment.[1] Floating knee term was given to fracture pattern involving tibia and femur on the same side. This type of injury encompasses fractures both within and outside of the joint.[2] The spectrum of floating knee injuries ranges from uncomplicated shaft fractures to more intricate articular fractures. As the population has increased over the years, these types of fractures are being commonly seen specially in high energy road traffic accidents. Floating knee injuries are relatively rare as

compared to other routine trauma cases.[3] Hyes et al in 1964 gave the initial description of these injuries followed by Blake Robert and McBryde who coined the term "floating knee" in 1974. This helped to understand the vascular aspects of the knee and surrounding region which was more commonly involved in these types of injuries and needed better care and understanding of the fracture pattern due to higher rate of complications.[4] Due to the intricate nature of this injury and the potential complications it entails, including compartment syndrome, infection, significant blood loss, vascular damage, collateral ligament and meniscus injuries, delayed union or non union, fat embolism, stiff knee, extended hospitalization, and weight-bearing difficulties, treating fractures of this kind poses a challenging therapeutic dilemma. Frequently, these concurrent femur and tibia fractures are compounded by extensive soft tissue damage.[1] These injuries consistently lead to a high level of morbidity, resulting in enduring disabilities. There are various other system involvements usually seen with these injuries including head injury, spinal cord injury, thoracic and abdominal (visceral) injuries, etc. These fractures are also associated with high rate of fat embolism.[4-9]

Floating knee injuries may also be associated with vascular injury. The best method of treating these types of injuries is by surgical fixation of both femur and tibia fractures with early mobilization of the affected limb. The implant to be used for stabilizing the fracture depends on the type of fracture and soft tissue injuries.[10] Pre operative planning is important in treating these fractures looking at the condition of the patient and other body system involvement. There may also be associated medial and lateral collateral ligament and meniscal injuries. Some of the common complications associated with these fractures include stiff knee, compartment syndrome and in rare cases even amputation of the limb.

Fractures involving shaft of femur and tibia have relatively better outcome and low number of complications as compared to the articular fractures.[11] Floating knee injuries should be considered as an emergency and require rapid intervention. Early internal fixation of the femur and tibia in an anatomically correct position helps to achieve better union of the fractures and thus a better functional recovery of the limb. The complications which can occur in delaying management of fractures include stiff knee, delayed union, non-union. Previous studies on these types of injuries suggest higher complication rate and disabilities associated with these fractures. Various authors have put forth classification systems for floating knee injuries, including Blake and McBryde in 1975 for adults, Fraser in 1978, and Bohn and Durbin and Letts et al. for pediatric patients. Karlstorm and Olerud in 1977 suggested a new universal system for assessment of functional outcome of floating knee injuries. As there have been advances in fracture fixation techniques and surgical methods, the management of floating knee injuries has progressively improved over the years. To achieve a good to excellent functional outcome, it is imperative to plan treatment for each fracture type considering the pros and cons of the decisions. The objective of our study is to determine the functional and radiological outcome of patients who sustained floating knee injuries and to determine various factors which affect the outcome in such patients.

METHODS

This study is a prospective randomized trial done at M. G. M. Medical College & M. Y. Hospital, Indore, Madhya Pradesh, which is one of the biggest tertiary care centres in Central India. The study period was from November 2020 to October 2022. All the patients coming to the hospital with ipsilateral femur and tibia fractures were considered for study.

The sample size was calculated based on previous three years database. We considered thirty-six patients for our study out of which six patients were lost to follow up. Patients with age 18 to 60 years, ipsilateral tibia and femur fractures, closed type or open type 1 and 2 according to Gustilo Anderson Classification were included in the study whereas patients with any other fractures in ipsilateral or contralateral limb, pathological fractures, Gustilo Anderson Type 3 Open fractures and patients with any other comorbidity or neurovascular injury were excluded from the study. For all the patients coming to the hospital, they were hemodynamically stabilized primarily. Patients who fulfilled the inclusion criteria were explained regarding the study and were recruited after taking pre-informed consent.

Post Operative, Knee bending was started on Suture Removal. Suture Removal on postoperatively day 14**.** Partial weight bearing was started as tolerated by the patient**.** Total weight bearing started after clinical and Radiological union**,** as tolerated by the patient. Follow up; 2nd week/4th week/ 8th week/ monthly till 6th month**.** Follow ups done at; 2nd week/4th week/8th week/monthly till 6th month Functional & Clinical; By Karlstorm & Olerud Evaluation Scoring (on each follow up). Radiological Evaluation-By union (on each follow up) (Figure 1-6). Final Evaluation and Scoring is done at 6 months. All our patients were statistically stratified using SPSS 21.0 software.

Figure 1: Pre-op. images of one of the study patients.

Figure 2: Immediate post-op. images.

Figure 3: 4 weeks follow up.

Figure 4: 8 weeks follow up.

Figure 5: 6 months follow up.

RESULTS

The study was conducted in one of the biggest tertiary care centres in Central India. Thirty patients were included in the study out of which 28 (93.33%) were male and 2 (6.66%) were female.

Figure 6: Clinical images at 6 months follow up.

Majority of patients were included in the age group 31 to 45 years (47.82%) followed by 26.08% each in 18-30 year age group and 46-60 years age group. According to Fraser classification, 17 (56.66%) were included as type 1, 4(13.33%) as type 2A, 4 (13.33%) as type2B, 5 (16.66%) as type 2C injuries. Majority of the patients sustained two wheeler accidents (53.33%) followed by 4 wheeler accidents (26.66%) followed by pedestrian injuries (20.0%).

Table 1: Distribution on the basis of age groups.

Age (years)	N	%
<30	7	23.3
30-40	10	33.3
40-50	9	30.0
50-60	4	13.3
Total	30	100.0

Table 2: Distribution on basis of sex groups.

Sex	N	%
Female	2	6.7
Male	28	93.3
Total	30	100.0

The injuries involving right limb i.e. 21 patients (70%) more than left side (30%). According to the Fraser Classification, majority of the patients were Type 1 (56.66%) followed by Type 2C (16.66%) followed by 13.33% each in Type 2A and Type 2B. In 17 cases, both femur and tibia were closed fracture injuries. Six patients had Femur Open fracture and Tibia closed fracture. Five patients had Closed Femur Fracture and Open Tibia Fractures. Two patients had open femur and tibia fractures. In Seventeen patients, femur and tibia Nailing was done. Both Femur and Tibia Plating was done in five patients, four patients underwent Femur Nailing and Tibia Plating, four patients underwent Femur Plating and Tibia Nailing.

Most of the patients got their surgery done in their first week of injury (66.66%). Seven patients underwent procedure within one to two weeks. Three patients were operated after 2 weeks time. Half of the total patients (50%) were discharged within one week of surgery. Nine patients were kept in hospital ward for one-two weeks. Six patients were kept for wound monitoring for more than two weeks.

Table 3: Distribution on basis of Fraser type.

Fraser type	N	%
1	17	56.7
2A	4	13.3
2B	4	13.3
2C	5	16.7
Total	30	100.0

Table 4: Distribution on basis of definitive fixation; femur.

Definative fixation-femur	N	%
DFLCP	9	30.0
Femur Nail	21	70.0
Total	30	100.0

All the patients were evaluated using Karlstorm & Olerud Evaluation Scoring at each follow up at two weeks, four weeks, two months and six months. The final scoring in Type 1 injuries was excellent in four patients, good in ten patients and fair in three patients.

Table 5: Distribution on basis definitive fixation; tibia.

Definative fixation-tibia	N	%
Tibia nail	20	66.7
Tibia plating	10	33.3
Total	30	100.0

Table 6: Distribution on the basis of complications.

Complications	N	%
Infection of Tibia	3	10.0
Knee stiffness	3	10.0
knee stiffness, LLD	1	3.3
Knee stiffness, Infection of Femur	2	6.7
knee stiffness, Infection of Tibia	1	3.3
Knee stiffness, Infection of Tibia	1	3.3
Malunion of Femur, LLD	1	3.3
Malunion of Tibia	1	3.3
Nil	15	50.0
Non-union of Tibia	1	3.3
Non-union of Femur	1	3.3
Total	30	100.0

In Type 2 A fractures, the final scoring was good in one patient, acceptable in two patients and poor in one patient. In Type 2 B, the final outcome was good in one patient, average in one patient and poor in two patients. In Fraser Type 2 C injuries, result was good in one patient, fair in one patient and poor in three patients. The average time of union was 20.48 weeks for femur and 18.93 weeks for Tibia in Type 1 injuries. In Type 2 A injuries, it was 20.48 weeks for Femur, 23.45 weeks for Tibia. In Type 2 B injuries, it was 25.55 weeks for Femur and 18.93 weeks for Tibia. In Type 2 C, it was 25.55 weeks for femur and 18.93 weeks for Tibia. Knee stiffness occurred in 8, infection in femur 3, infection in tibia 2, malunion of femur 2, limb length discrepancy in 2 patients. Outcome was excellent in 5 (16.66%), Good in 10 (33.33%), Acceptable in 9 (30%) and poor in 6(20%) (Table 1-6).

DISCUSSION

In our research, we observed a patient age range spanning from 18 to 60 years. Our study's findings were in line with those from previous research which showed majority of their patients in the age range of 20 to 35 years. Furthermore, in our study, most of the patients were male, comprising 28 out of 30 (93.3%), while only two patients were female (6.66%). This trend in our study's findings aligns with similar studies that have also noted a higher proportion of male patients.

This phenomenon of a higher preponderance of males can be attributed to their role as primary breadwinners, extensive travel, and therefore a heightened susceptibility to accidents. Our study's results corroborate these patterns observed in other studies. Regarding the side of fractures, in our study, the majority of fractures occurred on the right side, accounting for 21 out of 30 (70%), compared to the left side, which represented 9 out of 30 (30%). Nevertheless, our study did not reveal any specific correlation between the side of fractures. For the mechanism of injuries, a majority of floating knee injuries in our study were attributed to high-wheelers in this region, where lower limbs are more exposed to trauma.

High-velocity injuries were also more prevalent. Factors such as the lack of pedestrian walking paths and insufficient knowledge of safe traffic rules appeared to contribute to the increased incidence among pedestrians and motorcyclists. In a study done by Fraser et al, there were 222 patients included in the study and all were motor vehicle accidents. In another study by Rethnam et al, he showed that majority of studies had Road traffic accidents as most common cause for floating knee.[12,13]

In our study, we classified fractures according to Fraser type, and our findings indicated that a majority of the fractures, specifically 17 out of 30 (56.66%), belonged to Fraser Type 1. This was followed by 5 cases (16.66%) belonging to Fraser Type 2C, and 4 cases (13.33%) each of Type 2A and Type 2B. Diaphyseal fractures of the femur and tibia (Fraser Type I) were the predominant pattern of osseous injury among our patients, consistent with existing literature. In terms of treatment, in our study, 70% of femur fractures (21 out of 30) were treated with

intra-medullary interlocking nails, while the remaining 30% were treated with plating.

Initially, all fractures were temporarily stabilized with splinting. For tibia fractures, 66.7% (20 out of 30) were treated with Tibia Nails, while 33.3% (10 out of 30) were treated with Tibia Plating. Rios et al compared single incision versus traditional antegrade nailing of the fractures and found the former to have shorter surgical and anaesthesia time, with reduced blood loss.[14]

Complications noted in our study primarily included knee stiffness, infection, malunion, and delayed union/nonunion for both femur and tibia fractures. Overall, complications were observed in 10.0% of tibia cases, primarily infection and knee stiffness, followed by a lower proportion of 6.7% for knee stiffness, infection of the femur, and a minimum of 3.3% for knee stiffness, limb length discrepancy, infection of the tibia, and tibial nonunion. Notably, 50% of cases showed no complications. These complication patterns in our study were consistent with those reported in other studies.

Lastly, when it comes to road traffic accidents, the highest number of accidents occurred among motorcyclists (53.33%), followed by occupants of four-wheelers (26.66%), and pedestrians (20%). This observation is consistent with the higher incidence of injury observed among motorcyclists, which can be attributed to the greater severity of two-wheeler accidents. The average knee ROM reported by Veith et al and Gregory et al was 129° and 120°, respectively.[15,16] Our study concludes that Fraser type 1 fracture has excellent results and Fraser type 2C has poor results. Closed fracture has better outcome compared to compound Fractures. Certain factors which determine a better functional outcome depends on the choice of implants, comminution at the fracture site, intra- or extra-articular nature and whether the fracture is open or closed.

Limitations

The limitations of current study include small sample size, short follow up period. We also experienced loss of follow up in six of our patients. We hope to have a new study with more number of follow up patients with their clinical and radiological analysis.

CONCLUSION

Current study concludes that Fraser type 1 fracture has excellent results and Fraser type 2C has poor results. Closed fracture has better outcome compared to compound Fractures. Certain factors which determine a better functional outcome depends on the choice of implants, comminution at the fracture site, intra- or extra-articular nature and whether the fracture is open or closed.

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