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Floating knee fractures: patterns, treatment strategies and outcomes of 30 patients

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ABSTRACT

Background: The "floating knee," described by Blake and McBryde in 1975, involves ipsilateral femur and tibia fractures, usually from high-energy trauma like RTAs or falls. Common in young males, presenting with polytrauma and severe soft tissue damage. Management is complex, requiring early surgical fixation and intensive rehabilitation. Classification systems like Fraser's help guide treatment and predict complications, including vascular, neurological, and ligament injuries.
Methods: This retrospective study was conducted at a tertiary care hospital from March 2024-25, including 30 patients with surgically treated floating knee injuries. Fractures were classified using the Fraser system. Fixation methods and anaesthesia were selected based on clinical indications. Patients were followed up at 6 weeks, 6 months, 1 year. Data on demographics, surgical details, and functional outcomes were collected and analysed.
Results: Analysis of 30 floating knee injury cases revealed that most patients were young males (76.7%), commonly aged 20-39 years, and predominantly injured in road traffic accidents (RTAs) (66.7%). Pain (80%) and swelling (63.3%) were the most frequent symptoms. Fraser type I fractures (50%) and closed injuries (76.7%) were most common. Spinal anaesthesia (56.7%) and intramedullary nailing (56.7%) were the preferred surgical approaches. Outcomes were excellent in 30% and good in 20%, though 50% experienced some complications, including delayed union, stiffness, or persistent limp.
Conclusions: Floating knee injuries predominantly affect young males involved in high-energy trauma. Intramedullary nailing under spinal anaesthesia offers favourable outcomes with early mobilization and reduced morbidity. Despite good recovery in many cases, complications like stiffness and delayed union persist, underscoring the need for precise surgical technique, timely intervention, and comprehensive rehabilitation support.

Keywords: Floating knee, Tibia, Fibula, Road traffic accident, Trauma

INTRODUCTION

Traumatic injuries can be broadly categorized into several types: penetrating, non-penetrating blunt, blast-related, thermal, chemical, and others such as crush and barotrauma injuries. The mortality pattern in trauma follows a characteristic trimodal distribution of death: immediate deaths, accounting for approximately 50% of trauma-related fatalities, occur within the first hour of injury; early deaths, comprising around 30%, occur within one to three hours; and late deaths, constituting about 20%, typically occur from one to six weeks post-injury. The guiding principle in trauma care is to address life-threatening injuries first, followed by continuous reassessment and timely treatment or transfer as necessary.[1]

Management begins with a primary survey and resuscitation, which includes systematic evaluation using the ABCDE approach-A: Airway maintenance with cervical spine protection, B: Breathing and ventilation, C: Circulation with haemorrhage control, D: Disability or neurological status, and E: Exposure with environmental control. This is supplemented with adjunct investigations such as X-rays and ultrasonography (USG).[2] Following stabilization, a secondary survey is performed to identify and manage other injuries, leading to definitive treatment. Consideration should also be given to early transfer to appropriate facilities when needed to optimize outcomes in trauma patients.[3]

The term "floating knee," introduced by Blake and McBryde in 1975, denotes a traumatic injury involving ipsilateral fractures of both the femur and tibia. These injuries commonly arise from high-energy mechanisms, particularly RTAs and falls from significant heights.[4] They primarily affect males in their third decade of life and are frequently accompanied by polytrauma and extensive soft tissue damage.

This injury pattern disrupts the structural continuity of the knee joint, leading to a complex clinical presentation associated with a high incidence of complications. These may include significant soft tissue injury, vascular compromise, and long-term functional deficits.[5] Management typically requires surgical stabilization of both fractures, and prompt initiation of rehabilitation plays a pivotal role in enhancing functional outcomes and minimizing long-term disability.

Floating knee injuries are distinguished by their complexity, severity, and the significant challenges they present in both management and rehabilitation. These injuries, characterized by simultaneous fractures of the ipsilateral femur and tibia, typically result from high-energy trauma such as motor vehicle accidents or falls from substantial heights.[6] The multifracture nature of floating knee cases often includes a combination of shaft, intra-articular, and comminuted fractures, making surgical fixation and healing particularly complicated. Additionally, these injuries frequently involve extensive soft tissue damage, risk of compartment syndrome, and potential neurovascular compromise, all of which increase the risk of complications such as infection, non-union, malunion, limb length discrepancies, and long-term functional impairments.[7]

Floating knee injuries commonly occur in the context of polytrauma, necessitating a multidisciplinary approach focused on both life-saving and limb-salvaging measures. Rehabilitation in such cases is demanding, often requiring extended periods of physiotherapy, and patients may experience delayed or incomplete return to pre-injury function.

Research has significantly contributed to the understanding and management of floating knee injuries. Classification systems such as the Fraser classification have been developed to guide surgical planning and prognostication (Table 1).[8] Comparative studies on surgical techniques, including intramedullary nailing versus plating and strategies such as early total care versus damage control orthopaedics, have led to evidence-based protocols that improve outcomes. Moreover, ongoing research has helped identify predictors of complications and functional outcomes, which assist clinicians in risk stratification and patient counselling.[9] Validated scoring systems have been established to assess long-term function and quality of life, while advances in rehabilitation science have produced tailored physiotherapy protocols designed to address the specific challenges associated with floating knee injuries. Collectively, this body of research supports improved survival rates, enhanced limb salvage, and better functional recovery for patients affected by this complex and high-risk injury pattern.[10]

Floating knee injuries are often accompanied by a range of complications that can significantly affect patient outcomes. Vascular injuries are particularly concerning, with the popliteal and posterior tibial arteries being most commonly affected, posing a serious threat to limb viability. Neurological complications, such as peroneal nerve damage, are also frequent and typically result from traction forces, which may lead to neurapraxia. While this condition often resolves over time, full neurological recovery is not always guaranteed.[11]

Open fractures are another common complication, occurring in approximately 50-70% of floating knee cases. The typical presentation involves a closed femoral fracture in conjunction with an open tibial fracture, which adds complexity to both surgical management and infection control. Additionally, knee ligament injuries frequently accompany floating knee fractures, particularly those affecting the ipsilateral femur and tibia. Anterolateral rotatory instability is the most prevalent ligamentous injury pattern observed. However, diagnosing these injuries can be challenging, as hemarthrosis-induced joint swelling may mask clinical signs and mimic sympathetic effusion.[12]

In paediatric populations, floating knee injuries are relatively rare, but when they do occur, the injury mechanisms and associated complications mirror those seen in adults. Treatment strategies often include intramedullary fixation for femoral fractures and either casting or flexible intramedullary nailing for tibial fractures, depending on the fracture characteristics and patient age.[13]

Effective management of floating knee injuries necessitates a multidisciplinary approach due to the high-energy trauma and associated polytrauma these patients typically present with. Key components of management include early surgical stabilization, thorough vascular and neurological assessments, and timely intervention for soft tissue injuries. Utilization of classification systems-such as

Fraser or Letts and Vincent-plays a vital role in formulating treatment plans and predicting outcomes, ultimately guiding clinicians toward more tailored and effective care strategies.[13]

The objective of the present study was to evaluate the patterns of injury, treatment strategies employed, associated complications, and functional outcomes in 30 patients with floating knee fractures treated at our institution, and to analyze factors influencing prognosis in order to contribute to improved management protocols for this complex injury pattern.

Table 1: Classification of the floating knee.[22-25]

Blake and McBryde classification		Fraser classification		Letts and Vincent classification	
Type I	Fractures of both shafts of the femur and tibia.	Type II A	Tibial plateau fracture combined with a femoral shaft fracture	Type I	Simple diaphyseal or metaphyseal fractures with minimal comminution, corresponding to Gustilo-Anderson grade I and II or closed injuries.
Type II-A	Involvement of the knee joint	Type II B	Articular fracture of the distal femur associated with a tibial shaft fracture	Type II	More complex comminution with partial joint involvement, corresponding to grade III A and B of the Gustilo-Anderson classification
Type II-B	Involvement of the hip or ankle joints	Type II C	Fractures of both the tibial plateau and an articular fracture of the distal femur	Type III	Complex comminution patterns extending into the articular surfaces, also classified under Gustilo grade III A and B
-	-	-	-	Type IV	Extensive comminution involving joint surfaces and periarticular regions, categorized as Grade III C under the Gustilo-Anderson system, often associated with vascular injuries

METHODS

The study was conducted to assess the long-term functional outcomes of surgically treated floating knee injuries. This retrospective observational study was conducted in the Department of Orthopaedics, MGM Medical College and Hospital, Aurangabad, Sambhajinagar, India, a tertiary care teaching institute, between March 2024 and March 2025. A total of 30 patients who sustained floating knee injuries and underwent surgical fixation during the study period were included.

Inclusion criteria were: (1) patients aged ≥18 years; (2) ipsilateral fractures of the femur and tibia (floating knee injuries), irrespective of fracture type or Fraser classification; and (3) patients who underwent surgical fixation at our institution with a minimum follow-up of one year.

Exclusion criteria included: (1) patients managed conservatively; (2) pathological fractures; (3) patients with incomplete medical records; and (4) patients lost to follow-up before completion of one year.

Patients were identified based on admission records and operative registers during the specified study period. Information regarding the study was explained to the patients, and informed consent was obtained. Ethical approval for the study was obtained from the institutional ethics committee of MGM Medical College and Hospital, Aurangabad.

All patients received surgical fixation under appropriate anaesthesia, which included spinal, epidural, or general anaesthesia, depending on individual patient factors and surgical requirements. The choice of fixation method was determined by the fracture pattern, location, soft tissue condition, and surgeon's discretion. Fractures were classified according to the Fraser classification system (Table 1). Patients were followed up at intervals of 6 weeks, 6 months, and 1-year post-surgery. Functional outcomes were assessed using standard clinical and radiological parameters.

Data collected included demographic information, mechanism of injury, fracture classification, associated injuries, surgical details, complications, and functional outcomes. Statistical analysis was performed using IBM SPSS Statistics V. 30. Descriptive statistics were used to summarize demographic and clinical data. Continuous

variables were expressed as mean ± standard deviation, and categorical variables were presented as frequencies and percentages.

This comprehensive methodological approach enabled evaluation of injury patterns, treatment strategies, complications, and long-term functional outcomes in patients with floating knee injuries, thereby providing insights into prognostic factors influencing recovery.

RESULTS

The analysis of 30 cases (Table 2) reveals a diverse distribution of age, symptoms, injury mechanisms, and management approaches. The age distribution was fairly balanced, with the highest proportion of cases (30% each) observed in the 20-29 and 30-39-year age groups, followed by 23.3% in the 40-49 age group and 16.7% in those aged 50-59. There was a clear male predominance, with males constituting 76.7% of the cohort, and females only the 23.3%.

In terms of clinical presentation, pain was the most frequently reported symptom (80%), followed by swelling (63.3%). Deformity (30%), inability to walk or move (26.7%), and open wounds or bleeding fractures (23.3%) were also common, indicating the severity of injuries. Less frequent symptoms included bruising (20%), leg shortening or visible fracture ends (13.3%), and crepitus (10%).

The most common cause of injury was RTA, accounting for two-thirds of all cases (66.7%), highlighting the need for continued public health efforts around road safety. Falls were the second most common cause (20%), while other causes contributed to 13.3%.

Fracture classification using the Fraser system showed that Fraser type I fractures were most prevalent (50%), followed by type IIA (26.7%) (Figure 1 and 2) and type IIB (Figure 3 and 4) (23.3%). A majority of the injuries were closed fractures (76.7%), with open fractures making up the remaining 23.3%.

Spinal anaesthesia was used more frequently (56.7%) than general anaesthesia (43.3%) during surgical interventions. Regarding surgical management, intramedullary (IM) nailing was the most common procedure (56.7%), particularly for femoral and tibial fractures. Other methods included open reduction and internal fixation (ORIF) in 20%, plating in 13.3%, and external fixation in 13.3%. A smaller proportion (10%) underwent mixed or multiple procedures.

When assessing clinical outcomes, 30% of patients achieved excellent recovery (Figure 5), while 20% had good healing with restored range of motion (ROM). However, complications were noted in several cases: mild complications occurred in 16.7%, delayed union or infection in 13.3%, and persistent issues such as limp, stiffness, or partial functional loss in 20%.

Table 2: Case history and management of cases.

Parameters	N	Percentage (%)
Age distribution (in years)		
20-29	9	30.0
30-39	9	30.0
40-49	7	23.3
50-59	5	16.7
Sex distribution		
Male	23	76.7
Female	7	23.3
Common symptoms		
Pain	24	80.0
Swelling	19	63.3
Deformity	9	30.0
Bruising	6	20.0
Inability to walk/stand/move	8	26.7
Open wound/bleeding/fracture	7	23.3
Leg shortening/visible fracture	4	13.3
Crepitus	3	10.0
Cause of injury		
RTA	20	66.7
Fall	6	20.0
Other	4	13.3
Type of fracture (Fraser classification)		
Fraser type I	15	50.0
Fraser type IIa	8	26.7
Fraser type IIb	7	23.3
Type of injury		
Closed	23	76.7
Open	7	23.3
Type of anaesthesia		
Spinal	17	56.7
GA (General)	13	43.3
Surgery type		
IM nailing (Femur + Tibia)	17	56.7
ORIF	6	20.0
Plating	4	13.3
External fixator	4	13.3
Others (Mixed/ Multiple)	3	10.0
Outcome summary		
Excellent/full recovery	9	30.0
Good healing/ROM	6	20.0
Mild complications	5	16.7
Delayed union/ infection	4	13.3
Limp/stiffness/partial	6	20.0

Overall, the data indicate that most patients were young males affected by high-energy trauma such as RTAs, commonly presenting with pain and swelling. IM nailing

remains the preferred treatment modality, and although many achieved favourable outcomes, a significant proportion experienced varying degrees of complications, underlining the importance of follow-up care and rehabilitation.

Figure 1: Fraser classification type IIA X-ray of a case before operation.

Figure 2: Fraser classification type IIA X-ray of a case after operation.

Figure 3: Fraser classification type IIB X-ray of a case before operation.

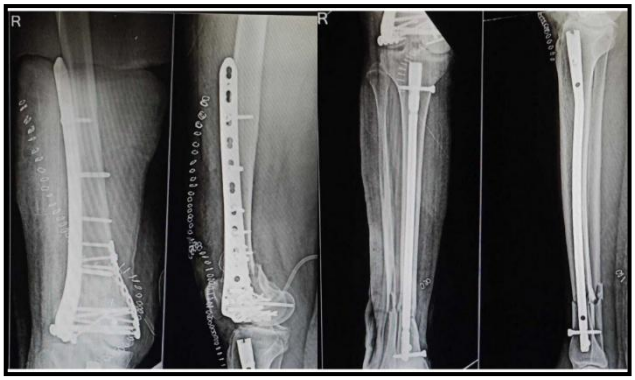

Figure 4: Fraser classification type IIB X-ray of a case after operation.

Figure 5: Fraser classification type IIB case after operation with good recovery.

DISCUSSION

The present study predominantly involved young to middle-aged adults, with 60% aged between 20 and 39 years. This aligns with earlier observations by Hegazy et al who reported a mean age of 34.8 years in patients with floating knee injuries (ipsilateral femur and tibia fractures), a demographic similarly affected by high-energy trauma such as RTAs.[1] The male predominance (76.7%) in our series further reflects established gender trends in trauma epidemiology.[14]

Clinically, patients most frequently presented with pain (80%), swelling (63.3%), deformity (30%), functional impairment (26.7%), and open injuries (23.3%), consistent with the injury profile of complex lower limb fractures seen in high-energy trauma.[15]

Our finding that RTAs account for ~67% of injuries, with falls contributing 20%, is in agreement with European data highlighting RTAs as the leading cause of severe long-bone fractures.[16]

Fracture classification in our dataset revealed a predominance of Fraser type I injuries (50%), followed by type IIa and IIb. Hegazy et al similarly found Fraser type I injuries most prevalent in floating knee cases treated surgically.[14]

We observed a 76.7% rate of closed fractures and 23.3% open fractures, in line with previous findings. Notably, a strong preference for intramedullary (IM) nailing was evident-56.7% of cases underwent IM nailing, with smaller proportions managed by ORIF (20%), plating (13.3%), and external fixation (13.3%).

These findings echo current standards recommending IM nailing as the primary fixation modality for femoral and tibial fractures. The clinical orthopaedics and related research study by Hegazy emphasized excellent outcomes when both fractures are stabilized with IM nails and patients are mobilized early.[15] Moreover, Ghouri et al highlight that shorter time to IM nailing correlates with superior functional outcomes in femoral shaft fractures.[16]

Recent meta-analyses in tibial fractures also support IM nailing over external fixation, reporting lower infection rates and improved union times.[17] Liu et al similarly concluded that IM nailing is superior for open tibial fractures when soft-tissue status permits.[18]

Spinal anaesthesia was more frequently utilized (56.7%) than general anaesthesia (43.3%). IM nailing under spinal block is extensively accepted and facilitates reduced perioperative morbidity.

Regarding outcomes, 30% of patients had excellent recovery, 20% achieved good healing with full ROM, while 16.7% had mild complications, 13.3% experienced delayed union or infection, and 20% endured persistent limp, stiffness, or partial disability. This mirrors results reported by Hegazy, who observed eight excellent and four good functional outcomes among 15 cases of floating knee treated with IM nails.[14]

Although IM nailing is associated with favorable results, complications such as delayed union, infection, and malalignment must be considered. Rotational malalignment-a known complication of IM nails-can affect up to 35% of cases.[19] Notably, Theriault et al demonstrated that rotational errors >15° are poorly tolerated20, emphasizing the importance of surgical precision and intraoperative alignment checks.

Our use of IM nailing follows the paradigm established by Küntscher, who introduced intramedullary nailing in 1939 and paved the way for modern fracture fixation.[21]

The experience of the patients, patients in this study commonly reported severe pain, swelling, deformity, and impaired mobility, reflecting the high physical and emotional impact of lower limb trauma. Those with open fractures experienced added distress due to visible injuries and fear of complications. RTA victims often described emotional trauma, while females expressed concerns about dependence and long-term recovery.

Postoperatively, patients who underwent intramedullary nailing under spinal anaesthesia reported quicker pain relief and mobility restoration. However, some experienced ongoing issues such as stiffness, limp, or delayed healing. Overall, patient experience highlighted the importance of early intervention, effective pain management, and rehabilitation support for both physical and psychological recovery.

CONCLUSION

Floating knee fractures represent complex high-energy injuries frequently associated with significant soft tissue damage and polytrauma, demanding prompt multidisciplinary management and individualized surgical strategies. In this series of 30 patients, early surgical stabilization tailored to fracture pattern and soft tissue condition resulted in satisfactory functional outcomes in the majority of cases, although complications such as infection, delayed union, and knee stiffness remained important concerns. The Fraser classification proved useful in guiding treatment planning and prognostication. This study contributes to the existing body of literature by providing institution-based outcome data and reinforcing the importance of systematic evaluation, timely surgical intervention, and structured rehabilitation in optimizing long-term functional recovery. These findings enhance understanding of injury patterns, management approaches, and prognostic factors in floating knee fractures, thereby supporting evidence-based decision-making in complex trauma care.

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