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Research Article

TO EVALUATE THE FUNCTIONAL OUTCOME IN PATIENTS WITH FLOATING KNEE WHO UNDERWENT MAGNETIC RESONANCE IMAGING

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ABSTRACT

Objective: The incidence of floating knee injuries has traditionally been underestimated. However, with the increased use of magnetic resonance imaging (MRI) and arthroscopy, their frequency has risen. There is a crucial need to classify this complex injury pattern by also considering associated soft-tissue injuries. Soft-tissue injuries might be missed during clinical examination due to tenderness and swelling but can be detected through immediate MRI scans. This study aimed to evaluate the functional outcomes of patients with floating knee injuries who underwent MRI for soft tissue injuries.

Methods: This study was conducted at a tertiary care center from February 2021 to January 2024. The study involved 100 patients with floating knee injuries who underwent MRI assessments for soft-tissue injuries. Follow-ups were scheduled at 1 month, 3 months, 6 months, and 1 year, with a maximum follow-up duration of 2½ years. The outcomes of floating knee injuries were assessed using the Karlstrom Olerud criteria.

Results: Among 100 patients with floating knee injuries who underwent MRI, 72 had meniscus or ligament injuries, and nine had patellar fractures with extensor mechanism rupture. According to the Karlstrom Olerud criteria, seven patients had excellent outcomes, 46 had good outcomes, 33 had fair outcomes, and six had poor outcomes. Eight patients were lost to follow-up.

Conclusion: Our aim is to ensure timely and accurate treatment by thoroughly addressing all associated injuries, including often-overlooked ligament damage around the knee. To improve clinical outcomes, we recommend a multidisciplinary approach involving various specialists in the care of these patients.

Keywords: Floating knee, Ipsilateral femur and tibia, Ligament injury, Magnetic resonance imaging, Soft tissue injury.

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INTRODUCTION

In literature, authors have utilized the term "Floating" to describe a range of complex injuries, surgical procedures, normal anatomical structures, and congenital anomalies. However, the term "Floating knee" may not adequately convey the intricacies of an injury involving simultaneous fractures of the femur and tibia, along with adjacent soft tissue damage. This injury is not only delicate but also carries significant risks if not promptly addressed. Therefore, it may be more appropriate to advocate for the term "precarious knee" instead of "floating knee." Initially introduced by Hayes in 1964 [1], McBryde and Blake [2] popularized the term "Floating Knee" in 1974 to emphasize the vascular complexities, particularly around the knee joint, where complications frequently arise. Determining the precise prevalence of these injuries, their association with specific fracture patterns, the utility of pre-surgical magnetic resonance imaging (MRI) scans, indications for immediate repair during initial surgery, and the potential improvement of overall functional outcomes through early surgical intervention present considerable management challenges in cases of precarious knee injuries [3]. Among 30 reviewed series, only three studies have documented the incidence of ligament and meniscal injuries, with eight focusing solely on ligamentous associations, while 15 studies did not mention menisco-ligamentous injuries at all. Floating knee injuries, often occurring as part of polytrauma, frequently coincide with life-threatening conditions, additional fractures, and varying degrees of soft tissue trauma [3]. Consequently, patients commonly present with hemodynamic instability, necessitating immediate and attentive post-injury monitoring and resuscitation. While MRI remains the gold standard for evaluating knee ligament injuries, performing an MRI before surgically stabilizing fractures in a precarious knee may pose risks, particularly if the patient is hemodynamically unstable. Moreover, post-surgical stabilization may result in interference artifacts from the metalwork, potentially impeding accurate visualization of knee ligaments. Therefore, in such cases, MRIs are typically deferred until the patient achieves hemodynamic stability [3].

METHODS

The study, conducted at a Tertiary Care Center, spanned 3 years from February 2021 to January 2024 after receiving approval from the Hospital Research and Ethics Committee. It involved 100 patients with floating knee injuries who underwent MRI assessments for soft tissue injuries. Initial management included immobilizing fractured femurs and tibias with a Thomas splint, administering intramuscular analgesics, and intravenous antibiotics. For compound fractures, immediate debridement was performed, followed by the application of an external fixator under anesthesia. Clean and uncontaminated wounds were closed primarily after proper debridement, while large wounds with skin loss required secondary closure, skin grafting, or local flaps. Routine investigations were conducted, and X-rays were taken in anteroposterior and lateral views. All patients provided written and informed consent. Surgical interventions included intramedullary interlocking nailing wherever possible and anatomical reduction with plates and screws for intra-articular fractures, performed under

spinal or general anesthesia. Follow-ups were scheduled at 1 month, 3 months, 6 months, and 1 year, with a maximum follow-up duration of 2.5 years. The outcomes of the floating knee injuries were assessed using the Karlstrom Olerud criteria [4]. Ethical guidelines were strictly adhered to, with human ethical committee clearance obtained for the study.

Inclusion criteria

The following criteria were included in the study:

- Ipsilateral fracture of femur and tibia
- Age: 18 years and above
- Sex: Both sexes.

Exclusion criteria

The following criteria were excluded from the study:

- Children <18 years of age
- Pathological fractures
- Patients with Grade IIIC injuries according to the modified Gustillo Anderson classification
- Patients having ipsilateral fracture dislocation of the hip joint and/or any contralateral limb fracture.

Statistical analysis

The collected data were coded, compiled, and entered into Microsoft Excel for organization. Subsequent analysis and statistical evaluation were conducted using the Statistical Package for Social Sciences-PC-17 version. Quantitative data were summarized using mean and standard deviation, while qualitative data were presented as percentages. The Chi-square test was used to assess differences between proportions.

RESULTS AND DISCUSSION

There were 88 (88%) males and 12 (12%) females. The right lower limb was involved in 72 (72%) patients and the left lower limb was involved in 28 (28%) patients. The mean age of the patients was 36.6 years. Most of the patients sustained injury due to road traffic accidents and majority being two-wheeler motorcycle accidents. Two patients had a history of fall from height. Thirty-eight patients had open fractures, out of which 39 patients had open femur fractures and 35 patients had open tibia fractures. Nine patients had patellar fractures with extensor mechanism rupture. Ten patients had segmental fracture, of which 3 had segmental femur, 5 had segmental tibia fracture, and 2 patients had segmental involvement of both femur and tibia.

As per Fraser and Hunter's classification [5], there were 40 type I, 23 type IIA, 24 type IIB, and 13 type IIC injuries. As per the Agarwal *et al*. classification system [3] for Floating knee based on MRI, in 100 patients who underwent MRI, there were 17 type Ia, 23 type Ib, 6 type IIa, 18 type IIb, 4 type IIIa, 19 type IIIb, 1 type IVa, and 12 type IVb.

The mean delay between injury and admission was 0.7 (±1) days and the mean delay between admission and surgical intervention was 1.3 (±2.9) days. Nineteen patients were treated with knee-spanning external fixator.

Out of 58 patients who were treated with a primary external fixator (Femur 18 and Tibia 40), 21 patients underwent permanent fixation with an external fixator (Femur 9 and Tibia 12). There were four vascular injuries and all of them underwent vascular repair/reconstruction. The vascular repair was successful in one patient and the remaining three patients underwent mid-thigh amputation.

Fifty-four patients with femur fracture were treated by antegrade nailing, 36 were treated using locking plates and one patient was treated using CC screw. Thirty-seven tibia fractures were treated by nailing, 27 were treated using locking plates, five patients were treated using screws and 19 were treated conservatively. The average time of bone union for the femur was around 11.5 months and for the tibia was around 10.5 months. There were three malunited tibia, one malunited femur, 22 limb length discrepancy, and 36 knee stiffness. As per the Karlstrom and Olerud criteria [4], there were seven excellent, 46 good, 33 fair, and six poor outcomes (Table 1). Eight patients have lost to follow-up.

Associated ligament injuries: Out of 100 patients with floating knee injuries who underwent MRI, seventy-two patients had meniscus/ligament injury. Thirty-two patients had anterior cruciate ligament (ACL) injury out of which 10 patients had complete ACL tear and 21 patients had partial or incomplete ACL injury. One patient lost to follow-up. There were seven patients who had posterior cruciate ligament (PCL) injury out of which two patients had isolated PCL injury. Thirty-three patients had pure meniscus injury, out of which 24 had medial meniscus and nine had lateral meniscus injury. Seven patients were lost to follow-up. There were nine patients who had medial collateral ligament (MCL) injury and two patients who had lateral collateral ligament (LCL) injury.

A 34-year-old male sustained right side type 1 Fraser and type IB Agarwal *et al*. Floating knee injury [3] showed complete ACL tear with lateral meniscus posterior horn tear and partial PCL tear had been managed with nailing for ipsilateral shaft Femur and Tibia fracture and Arthroscopic ACL reconstruction was performed at a later stage. The patient achieved excellent functional outcomes after 2 years of follow-up (Fig. 1a-d).

Previous literature indicates that the outcomes of floating knee injuries are influenced by the complexity of fractures and soft-tissue conditions [3]. Fracture classification has a crucial role in treatment selection and determining the prognosis. Classifying floating knee injuries has posed a challenge for orthopedic surgeons, and only a few have successfully devised straightforward and effective classification systems. No classification in the literature tells about the associated ligament and soft-tissue injuries; therefore, there is an utmost need to classify the precarious knee injury pattern and to lead to the prognosis of this injury. The time at which MRI should be performed which is quite important, has been subjective to the critical condition of the patient, although an MRI is the gold standard investigation for evaluating knee ligament injuries [3]. Arte facts can hamper the proper visualization of the ligaments and soft tissue, therefore as soon as the patient was hemodynamically stable; MRI was performed [3]. In some patients, who had a score (<7) on the Glasgow Coma Scale were omitted from the study. We suggest that in these patients MRI can be performed once they are stable or can be considered for clinical examination under anesthesia or a diagnostic arthroscopy. Eight patients were lost to follow-up after 6 months of follow-up. We found nine patients out of 100 who had associated patella fracture with extensor mechanism rupture and were treated with tension band wiring or encirclage and repair. We recommend incorporating patellar fractures into classifications due to their impactful influence on the overall results. The incidence of knee ligament injuries in the floating knee is as high as 53% documented in the literature [6].

Doyle and Oliver [7] attributed the suboptimal functional outcomes of floating knee injuries to delayed diagnoses of ligamentous knee injuries. Similarly, Liu *et al*. [8] found that 70.3% of patients with floating knee injuries had knee ligamentous injuries. Szalay *et al*. [9] reported that 53% of patients with ipsilateral fractures of the femur

Table 1: Functional outcome in patients with floating knee according to Karlstorms Olerud criteria

Karlstorms criteria	Number of patients
Excellent (33)	7
Good (32–30)	46
Fair (29–24)	33
Poor (23–21)	6

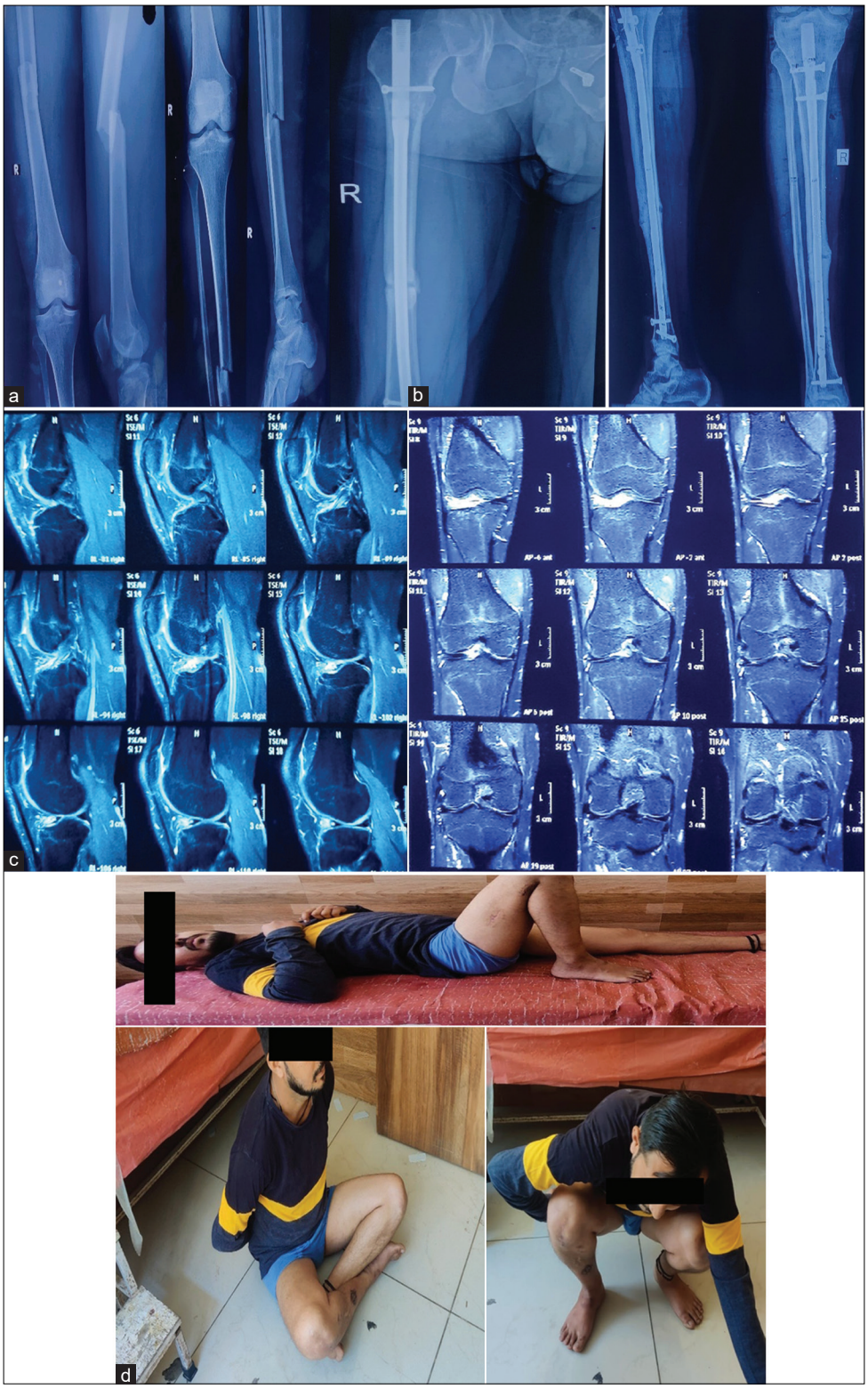

Fig. 1: (a) Pre-operative X-ray AP and lateral view of 34 year old male having type 1 Fraser and type IB Agarwal and Singh floating knee injury. (b) Post-operative X-ray at 1 year. (c) Pre-operative magnetic resonance imaging saggital and coronal view showing complete anterior cruciate ligament tear with lateral meniscus posterior horn tear and partial posterior cruciate ligament tear of the same patient. (d) Clinical picture at 2 years follow-up of the same patient with 130 degree knee flexion, cross-leg sitting, and squatting

and tibia showed ligamentous laxity of the knee, compared with only 27% of patients with isolated fractures. In our study, we found that 72 out of 100 patients had ligamentous or meniscus injuries around the knee detected on MRI. Predominantly, ACL injury was the most commonly identified ligamentous injury. Liu *et al*. [8] found that 21 (56.8%) patients had ACL injuries, with complete injury in six cases and incomplete injury in 15 cases. Three (8.1%) patients experienced PCL tears, with complete injury in one case and incomplete injury in two cases. Varus and valgus stress tests revealed that 10 (27.0%) and 7 (18.9%) patients had MCL and LCL laxity, respectively. ACL injury

Table 2: Demographic data compared with similar studies

Parameters	Karslı and Tekin [10]	Rollo *et al.* [11]	Chavda *et al.* [12]	Feron *et al.* [13]	Ran *et al.* [14]	Rethnam *et al.* [15]	Our study
Year	2021	2019	2018	2015	2013	2009	2024
Number of subjects	70	224	52	172	28	29	100
Mean age	32.3	29.6	31.6	31	43	28	36.6
Gender	Male - 64 Female - 6	Male - 49 Female - 7	Male – 46 Female – 6	Male - 135 Female - 37	Male - 21 Female - 7	Male - 27 Female - 2	Male - 88 Female - 12
Side	Right - 37 Left - 33	-	Right - 34 Left – 18	Right - 60.5 Left - 39.5	-	Right - 19 Left - 10	Right - 72 Left - 28
MOI	RTA - 49 Fall - 8	RTA - 208 Fall - 4 Agri – 12	RTA - 48 Fall - 4	RTA - 90	RTA - 22 Fall - 4	RTA - 27 Fall - 2	RTA - 98 Fall - 2
Type of #: Fraser	I - 29 II - 4 IIB - 7	I - 128 IIA - 40 IIB - 32	I - 29 IIA - 10 IIB - 4	I - 123 II - 14	I - 2 IIA - 8 IIB - 7	I - 21 IIA - 4 IIB - 5	I - 40 IIA - 23 IIB - 24 IIC - 13
Open #	Open - 45 I - 4 II - 8/13 III - 20/28	Open - 128 II - 92 III - 36	Open - 21 I - 6 II - 7 III - 8	Open - Femur - 38 Tibia - 57	Open - 14 I - 3 II - 7 III - 4	-	Open - 38 Femur - 39 Tibia - 35
Mean follow-up	30.26 months	36 months	21±6 months	34.2 months	29 months	24.2 months	30.2 months
Karlstorm criteria	Excellent - 16 Good - 23 Fair - 12 Poor - 19	At injury-8 at 3 years - 27	Excellent - 21 Good - 17 Fair - 8 Poor - 6	Excellent - 15 Good - 33 Fair - 30 Poor - 11	Excellent - 7 Good - 13 Fair - 5 Poor - 3	Excellent - 15 Good-10 Fair - 1 Poor - 3	Excellent - 7 Good - 46 Fair - 33 Poor - 6

was associated with meniscal injury in 15 (71.4%) cases, including medial meniscal injury in 9 (42.9%) and lateral meniscal injury in 6 (28.6%). Medial meniscal tears were detected in 14 (37.8%) cases, and lateral meniscal tears in 11 (29.7%). In our study, we found that 32 patients had ACL injuries, including complete injuries in 10 cases that underwent arthroscopic reconstruction, and incomplete injuries in 21 cases managed conservatively with physiotherapy. One patient with ACL and meniscus injury was lost to follow-up. There were no isolated ACL injuries. Seven patients had PCL tears, including complete injuries in three cases treated with arthroscopic reconstruction and incomplete injuries in four cases managed with physiotherapy. Isolated partial PCL injuries were found in two patients, both of whom were managed conservatively. All patients with ACL injuries also had associated meniscus or collateral injuries. Among the 21 cases with ACL injury, 21 were associated with meniscal injuries: Medial meniscal injuries in 14 cases, lateral meniscal injuries in five cases, and combined ACL, medial meniscus, and lateral meniscus injuries in two patients. ACL injuries combined with meniscus tears and collateral ligament injuries were found in 11 cases: Medial meniscal tears in 8 cases, lateral meniscal tears in two cases, and combined ACL, medial meniscus, and lateral meniscus injuries in one case; MCL tears in nine cases and LCL tears in two cases. Thirty-three patients had pure meniscus injuries, out of which seven were lost to follow-up. Medial meniscal tears were detected in 24 cases and lateral meniscal tears in nine cases. Physicians should pay attention to concomitant ligamentous and meniscal injuries in floating knee injuries. MRI, careful clinical examination, and arthroscopic examination aid in the early diagnosis and treatment of these injuries. We compared our demographic data and functional outcomes with similar studies and found almost identical results (Table 2).

CONCLUSION

Our goal is to begin treatment promptly and accurately by addressing all associated injuries comprehensively, particularly previously overlooked ligament damage around the knee. This approach is crucial for achieving excellent functional outcomes and promoting better patient recovery. A thorough clinical examination, supplemented by arthroscopic assessment, assists in early detection and focused treatment of the injured tissues. Regarding the treatment of knee ligament injuries, there are differing opinions, but there is consensus on the less favorable outcomes associated with delayed reconstruction of damaged knee ligaments.

AUTHOR'S CONTRIBUTION

All the authors contributed significantly to the study.

CONFLICTS OF INTEREST

None.

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REFERENCES

1. Hayes JT. Multiple fractures in the same limb: Some problems in their management. Surg Clin North Am. 1961;41(5):1379-88. doi: 10.1016/S0039-6109(16)36499-4
2. McBryde A Jr., Blake R. The floating knee: Ipsilateral fractures of femur and tibia. J Bone J Soint Surg. 1974 Sep;56(A):1309.
3. Agarwal S, Singh H, Sharma A, Gupta K. To develop a classification system for prognosis of cases of floating knee. Int J Pharm Clin Res. 2024;16(1):1630-3.
4. Karlstrom G, Olerud S. Ipsilateral fracture of the femur and tibia. J Bone Joint Surg. 1977;59(A):240-3.
5. Fraser RD, Hunter G. A Ipsilateral fractures of the femur and tibia. J Bone Joint Surg. 1978;142(B):115-22.
6. Paul GR, Sawka MW, Whitelaw GP. Fractures of the ipsilateral femur and tibia: Emphasis on intra-articular and soft tissue injury. J Orthop Trauma. 1990;4(3):309-14. doi: 10.1097/00005131-199004030-00013, PMID 2231130
7. Doyle P, Oliver CW. Complex floating knee; Trifocal tibial and ipsilateral femoral fracture. Injury. 1998;29(7):553-5. doi: 10.1016/s0020-1383(98)00111-9, PMID 10193502
8. Liu Y, Zhang J, Zhang S, Li R, Yue X. Concomitant ligamentous and meniscal injuries in floating knee. Int J Clin Exp Med. 2015 Jan 15;8(1):1168-72. PMID 25785109
9. Szalay MJ, Hosking Szalay MJ, Annear P. Injury of knee ligament associated with ipsilateral femoral shaft fractures and with ipsilateral femoral and tibial shaft fractures. Injury. 1990;21(6):398-400.
10. Karslı B, Tekin SB. The floating knee injuries: Does it need a new

classification system? Indian J Orthop. 2020 Nov 3;55(2):499-505. doi: 10.1007/s43465-020-00298-x, PMID 33927831

11. Rollo G, Falzarano G, Ronga M, Bisaccia M, Grubor P, Erasmo R, *et al*. Challenges in the management of floating knee injuries: Results of treatment and outcomes of 224 consecutive cases in 10 years. Injury. 2019 Aug;50(Suppl 4):S30-8. doi: 10.1016/j.injury.2019.03.016, PMID 30910244
12. Chavda AG, Lil NA, Patel PR. An approach to floating knee injury in Indian population: An analysis of 52 patients. Indian J Orthop. 2018 Nov-Dec;52(6):631-7. doi: 10.4103/ortho.IJOrtho_31_17, PMID 30532304
13. Feron JM, Bonnevialle P, Pietu G, Jacquot F. Traumatic floating knee: A review of a multi-centric series of 172 cases in adult. Open Orthop J. 2015 Jul 31;Suppl 1 M11:356-60.
14. Ran T, Hua X, Zhenyu Z, Yue L, Youhua W, Yi C, *et al*. Floating knee: A modified Fraser's classification and the results of a series of 28 cases. Injury. 2013;44(8):1033-42. doi: 10.1016/j.injury.2012.12.012, PMID 23312566
15. Rethnam U, Yesupalan RS, Nair R. The floating knee: Epidemiology, prognostic indicators and outcome following surgical management. J Trauma Manag Outcomes. 2007;1(1):2.