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Research Article

Clinical and functional outcome of different operative modalities of treatment for floating knee

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Abstract

Introduction: Ipsilateral fractures of the femur and tibia are called as floating knee injuries and may include a combination victims are usually young adults. As the byproduct of horse power race, high velocity accidents are now a common place. Major consideration from this injury is condition of knee. The aim of the study was to evaluate clinical and functional outcome of different operative modalities of treatment for ipsilateral fractures of femur and tibia in Indian scenario.

Material and Methods: The study was a prospective study conducted between 2017 and 2020. The study is about functional outcome of surgical management of Ipsilateral Fracture of Femur and Tibia in Adults (The Floating Knee). Floating knee was classified according to Blake and McBryde's classification. The plan of management for the given patient was made depending on the fracture type, and associated soft tissue injuries. Follow Up was taken post operatively and functional assessment was done with respect to type of fixation and classification.

Conclusion: Floating knee injuries are due to high velocity trauma. Road traffic accidents particularly two wheeler accidents is the most common cause. Males are affected more commonly. Many are associated with other injuries such as patellar fractures, radius fractures and vascular injuries. Good postoperative results are obtained in patients with diaphyseal fractures of both bones treated with intramedullary interlocking nails. And mobilized early in the post-operative period with hip, knee and ankle active range of motion. Patients with compound fractures with external fixation as primary treatment had prolonged immobilization of knee joint and are associated with poor results. Most of the patients with floating knee injuries are young adults, stiffness of the knee or ankle can be an enormous handicap to these patients, whose demands and expectations are high.

Keywords: floating knee, femur fracture, tibia fracture, external fixator, intramedullary nailing, plating

INTRODUCTION

With modernization and advances in motorized technology, the pattern and problems associated with trauma are also changing. The 'floating knee' is one such injury, the incidence of which appears to be increasing. It is described as an ipsilateral concurrent break in the femur and tibia. Most of the patients are in their third decade with a preponderance of males [1].

Road Traffic Accident (RTA) accounts for majority of the cases and this is followed by Fall From Height (FFH). The word Floating knee was introduced for the first time by McBryde in 1965. This injury is defined as the simultaneous ipsilateral disruption of skeletal integrity above and below the knee, which is usually associated with high-energy impact and likely a part of polytrauma. 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 abdomen [2, 3].

Some other complications attributable to floating knee injuries include infection, excessive blood loss, fat embolism, malunion, delayed or nonunion, knee stiffness, prolonged hospitalization, and inability to bear weight. Stiffness imposes a severe handicap and a degree of disability that compels a complete change in patient's way of life. The patients work and leisure pursuits are both drastically affected and this is more disastrous when it occurs in an otherwise fit and vigorous young patient.

Although the exact incidence of a floating knee is unknown, it is not a common injury. The largest series of reported patients in the literature was of 222 cases over a period of 11 years. These may also be associated with life-threatening injuries to the head, chest, or abdomen and a high incidence of fat embolism and their management is varied. Many of these fractures are open with associated vascular injuries [4].

The floating knee is a complex injury with more than just ipsilateral fractures of the femur and tibia. The prognostic indicators of the initial and final outcome in patients include injuries and the type of fracture (open, intraarticular, comminution) [5].

A disturbing factor was the 30% incidence of osteomyelitis in patients treated by fixation of both fractures, almost three times the incidence when only one fracture was fixed. A 30% incidence of delayed union or non-union occurred in patients managed conservatively. Of sixty-three patients personally examined, the worst results found were those following conservative management of both fractures [6].

More use of rigid external fixation and of cast bracing is recommended in the management of the fractured tibia, combined with internal fixation of the femoral fracture. Earlier papers highlighted the elevated risk of complications and permanent disabilities associated with floating knee injuries. Bansal et al. and Chhina et al. concluded that rigid fixation of both fractures results in excellent or good results [7, 8].

Until now very few studies are conducted in India about post-operative outcome of floating knee. The aim of the study was to evaluate clinical and functional outcome of different operative modalities of treatment for ipsilateral fractures of femur and tibia in Indian scenario.

MATERIALS AND METHODS

The study was a prospective study conducted between 2017 and 2020. The study is about functional outcome of surgical management of Ipsilateral Fracture of Femur and Tibia in Adults (The Floating Knee). The patients were classified according to Blake and McBryde's Classification for floating knee injuries.

Inclusion criteria

- Patients presenting with recent history of trauma
- Both closed and open fractures

Exclusion criteria

- Patients with pathological fractures
- Patients with old neglected fractures
- Fractures in paediatric age groups
- Associated neurological injuries such as paraplegia or quadriplegia resulting from spinal injuries

Patients presenting with floating knee injuries are usually victims of poly trauma and compound fractures. These are considered as surgical emergencies. The initial assessment and management of these patients are in accordance with Advanced Trauma Support (ATS) guidelines. Primary survey and resuscitation are undertaken simultaneously by a multidisciplinary team.

All immediate life threatening conditions are identified in primary survey and treated in following sequence:

A - Airway with cervical spine control.

B - Breathing.

C - Circulation.

D - Disability.

These phases were performed simultaneously by trauma team. The most common life threatening injuries occurring to chest, abdomen and head were assessed and dealt with rapidly. Early radiological assessment of head, chest and pelvis was done. Assessment of skin and soft tissue damage was done immediately after stabilizing the patient. All wounds were debrided and cleaned thoroughly with sterile normal saline as early as possible. Wounds were covered with saline soaked sterile dressings. Appropriate tetanus coverage and antibiotics was administered. X rays of all suspected fractures were obtained followed by Computed Tomography (CT) scans to evaluate articular fractures. The subject was included into the study once the diagnosis of floating knee was made. Floating knee was classified according to Blake and McBryde's classification. The plan of management for the given patient was made depending on the fracture type, and associated soft tissue injuries as shown below:

- Assessment of injury-Muscular, vascular and neurological. Salvageable and Non salvageable
- No immediate primary internal fixation done
- In cases of grade III compound fractures Knee spanning External fixator was applied
- Internal fixation of both bone fractures was performed as soon as soft tissue condition permitted

Post-operative management was as follow:

- Immediately after the operation, the treated lower limb was positioned above the level of heart to minimize swelling
- Parenteral antibiotics (Inj.Cephalosporin+Amikacin) given for 2 postoperative days for closed fractures and for 5 days in compound fractures
- Articular fractures of knee are given Continuous Passive Movement (CPM) daily, until discharge from hospital
- Partial weight bearing (toe-touch) was allowed after first week in shaft fractures treated with intramedullary interlocking nails; full weight bearing allowed after callus formation and as patient becomes comfortable
- In cases of intra-articular fractures treated with plates, partial weight bearing allowed after 4 weeks. Full weight bearing after 10-14 weeks
- In cases of skin loss, skin grafting was performed

- Wound debridement performed for infected wounds
- Bone grafting performed for delayed union

RESULTS

The 41 patients were classified according to Blake and Mcbryde's Classification. Of these 18 were type-I, 21 were type-IIA and 2 were type-2B. Out of the 41 patients 2 patients ended up in amputation. So they were excluded from the study.

Of the remaining 39 patients, 33 patients came for regular follow up. 6 patients were lost in follow up, so the final study comprised of 33 patients. Follow up study was done at 15 days, 4 weeks, 6 weeks, 12 weeks, 24 weeks, 24 weeks, 9 months, 12 months 18 months and 24 months. Serial X-rays and functional assessment was carried out at each visit using Karlstrorm and Oleruds criteria.

Out of the 33 patients, who came for follow up type I were 18, type IIA were 15, and type IIB were 0 patients [Table 1]. The details of preoperative status like mode of injury, fracture patterns, closed or open and other associated injuries was also evaluated.

The age distribution of the patients ranged from 18 to 64 years. Males were the most of victims in our study. Out of the 33 patients, 31 (94%) were male and remaining 2 (6%) were female. In our study, out of 33 patients, 20 (66%) patients had right lower limb injury, and 13 patients (34%) had left lower limb injury. The mechanism of injury was as per details mentioned in Table 2. Out of the 33 fractures of the femur 18 were closed fractures and 15 were compound. Out of 33 fractures of tibia 16 were closed and 17 were compound [Table 3]. Out of the 33 femur fractures, the type of femur fractures included 2 proximal femur fractures, 17 were shaft, and 14 were distal femur fracture [Table 4]. Out of 33 tibia fractures, 9 were proximal, 24 were shaft and there was no involvement of the medial malleolus in any of the patients [Table 5]. The initial type of surgery was carried out for fracture stabilization which was as follows [Table 6] which was then followed by provision of definite treatment [Table 7]. The Functional Outcome was taken with respect to the Classification of Fracture as well as the method of fixation. The association between BLAKE AND McBride classification and the functional outcome were statistically significant [Table 8]. Type Of fixation of femur and tibia and functional outcome are found to be statistically significant [Table 9]

Table 1. Blake and Mcbryde's classification of cases

Blake and Mcbryde's Type	TYPE-I	TYPE-IIA	TYPE-IIB	Total Cases
Number of Cases	18	15	0	33

Table 2. Mechanism of injury

	Mechanism of injury	Number of cases	Percentage
1	Motor Vehicle Accident (MVA)	2	0.06
2	Motor Cycle Accident (MCA)	25	0.7575
3	Pedestrian	4	0.1212
5	Fall from height	2	0.06
	Total	33	1

Table 3. Distribution of Types of Fractures

Closed	Compound
18	4
16	6
12	11
44	22

Table 4. Type of femur fractures

Femur Fracture	Number of Fractures	Percentage
A) Proximal (Intertroch/ Subtroch)	2	6%
B) Types of Shaft		
Simple	13	52%
Segmental	4	
Total Shaft	17	
C) Distal Femur A.O type		
a	1	42.42%
b	4	
c	9	
Total Distal Fractures	14	
Total	33	100%

Table 5. Type of tibia fractures

Tibia Fracture Type	Number of Fractures	Percentage
Proximal Tibia		
Schatzker Type 1	6	0.2727
Type 2	0	
Type 3	2	
Type 4	0	
Type 5	0	
Type 6	1	
Total	9	
Shaft		
Simple	17	0.7272
Segmentel	7	
Total	24	
Medial Malleolus	-	
Total	33	1

Table 6. Type of initial surgery

Type of surgery	Total
Ex fix both bones	6
Poximal femoral nail/D.H.S.	2
Femur imil	14
Distal femur plating	10
C.C. Screw fixation of femoral condyles	1
Tibia imil	18
Proximal tibia plating	4
C.C. Screw fixation of tibia condyles	3
Tibia ex. Fix.	2

Table 7. Definitive Treatment

Sr. No.	Definitive Treatment	No of Patients
1	Femur Nailing+Tibia Nailing	12
2	Femur Nailing+Tibia Plating	1
3	Femur Plating +Tibia Nailing	5
4	Femur Plating +Tibia Plating	3
5	P.F.N.+ Proximal Tibia Plating	1
6	D.H.S.+Tibia Nailing	1
7	C.C. screw Fixation Of Femoral Condyles with Tibia Nailing	1
8	Femur plating+C.C. Screw Fixation Of Tibia Condyles	2
9	EX. Fixation with C.C. Screw Fixation of Both Bone Condyles	2
10	Ex. Fixation Of Both Bones Followed By Ilizarov Fixator	2
11	Femoral Nailing+ tibia Ex. Fixation	1
12	Ex. Fixator Followed by Femur nailing+Tibia Ilizarow	1
13	Ex. Fixation Followed by Both Bone Plating	1

Table 8. Blake and mcbryde classification and functional outcome

Blake and McBride Type	Functional Outcome				Total
	Excellent	Good	Acceptable	Poor	
Type I	6	5	4	3	18
Type II A	1	2	3	9	15
Total	7	7	7	12	33

Table 9. Type of fixation and functional outcome

Type of fixation	Excellent	Good	Acceptable	Poor	Total
Both bone nailing	6	4	2	0	12
Femur nail+Tibia plate	0	1	0	0	1
Femur plate+Tibia nailing	0	1	1	2	4
Both plating	0	0	0	3	4
External fixation	0	0	1	7	8
Femur Plate+C.C.Screw Tibia Condyle	1	1	0		1
Femur Condyle C.C.Screw+Tibia Nail		0	1		1
P.F.N.+Tibia Nail		0	1		1
P.F.N.+Tibia Plate		0	1		1
TOTAL	7	1	7	12	33

Table 10. Comparison of different studies

Name of study	No. of patients	Excellent outcome	Good outcome	Acceptable outcome	Poor outcome
Fraser et al. 1978 [13]	63	3 (5%)	15 (24%)	30 (47%)	15 (32%)
Schieldts et al. 1994 [11]	18	4 (22%)	7 (39 %)	-	7 (38%)
Hee et al. 2001 [12]	89	6 (7%)	53 (60%)	25 (28%)	4 (5%)
Yokoyama et al. 2002 [14]	68	25 (37%)	15 (22%)	16 (24 %)	12 (18%)
Anoop Kumar et al. 2006 [15]	42	7 (17%)	14 (33%)	14 (33%)	7(17%)
A Elmrini et al. 2006 [23]	18	7 (38 %)	6 (33%)	-	5 (28%)
Ulfin Rethnam et al. 2007	29	15 (52%)	9 (31%)	2 (7%)	3 (10%)
Alla M Hegazy 2011 [16]	15	8 (53%)	4(27%)	2 (13%)	1 (7%)
This study	33	7 (21%)	7 (21%)	7 (21%)	12 (36%)

DISCUSSION

The term floating knee is used when the knee joint is isolated partially or completely due to a fracture of the femur and tibia. Survivors of high speed traffic accidents often have injuries of several parenchymal organs as well as multiple fractures. A careful evaluation of the injuries and resuscitation of the patient must precede the definitive management of specific fractures. Immediate assessment of the vascular status and appropriate treatment are essential if amputation is to be avoided.

In our study the most common mechanism of injury was road traffic accidents (94%) The rest (6%) were due to fall from height. Among the R.T.A.s two wheeler accidents were most common. Four wheeler accidents accounted to about 6% and 12 % were pedestrians.

Hayes [9] suggested that automobile passengers with floating knees should have had their feet braced firmly against the sloping floor of the front seat prior to the collision, their legs becoming crumpled under the massive decelerating forces produced by the impact. Pedestrians are frequently catapulted some distance from the point of impact and are further injured by striking the pavement. In a study of 222 cases of floating knees by Fraser et al. [6] all cases were the results of road traffic accidents.

Males predominated our study. 94% males and 6% females were included in our study. Other studies also describe male predominance. Age distribution was from 18 years to 64 years of age (mean 34.15, median 35, mode 35, Standard Deviation-11.866). Most of the studies show involvement of younger age group in similar manner. Right sided injuries (66%) were more common than left side injuries. Compound fractures of the tibia were more common than compound femoral fractures. Fractures were classified according to Blake and McBryde classification of which Type I were 18 (54.54%) and type IIA were 15 (45.45).

There are different management options for floating knees. Hayes [9] suggested that in a patient with multiple fractures in the same extremity surgical fixation of one or more of the fractures was valuable in the management of the entire limb. Ratliff [10] found that internal fixation of the fractures should be done whenever possible as these patients were less likely to develop knee stiffness or shortening and were in hospital and off work for less time than those treated conservatively.

Fraser et al. [6] recommended use of rigid external fixation or of cast bracing in the management of the fractured tibia, together with internal fixation of the femur, this combination allows early mobilization of the patient and the knee. Omer et al. [11] treated a floating knee using both conservative and surgical fixation, and found that where internal fixation was done for both femoral and tibia fractures, the healing time was approximately 8 weeks earlier than the group managed conservatively.

Behr et al. [12] treated patients with floating knee with Ender nails and achieved femoral union at an average of 10.3 weeks and tibia union at 18 weeks. Ostrum [13] treated patients with a retrograde femoral interlocking nail and antegrade tibia nail through a 4 cm medial parapatellar incision. The mean time to union of the femoral and tibia fractures was 14.7 and 23 weeks, respectively. They opined this method was an excellent alternate option.

Kao et al. [14] summarized the indications of surgical treatment and concluded that patients with closed fractures or open type I or II fractures were treated according to the fracture site. Femoral fractures around the cervico-trochanteric area were fixed under traction with dynamic compression screws, or cannulated screws on a fracture table. Some femoral fractures are fixed with interlocking nails by performing an open reduction with the patient in the decubitus position or by closed reduction under traction on a fracture table. Some femoral shaft fractures were fixed by an open reduction with compression plates and internal fixation. Femoral fractures in the supracondylar area were fixed by an open reduction and internal fixation with condylar plates or dynamic compression screws. Tibia fractures around the tibia plateau, proximal tibia or distal tibia were fixed by open reduction using buttress plates or dynamic compression plate. Some tibia shaft fractures were fixed with interlocking nails by open or closed reduction. Some tibia shaft fractures were fixed by open reduction with dynamic compression plates with internal fixation. For type III open fractures, temporal external skeletal fixators were applied. Internal fixators with plates or nails were applied after the wound condition had stabilized.

Dwyer et al. [15] used the combined modalities of treatment with one fracture managed conservatively and the other surgically. They concluded that the treatment method for tibia did not interfere with joint mobilization. Lundy and Johnson [16] recommended surgical stabilization of the fractures for early mobilization, which produced the best results.

Theodoratus et al. [17] recommended intramedullary nailing as the best treatment except for grade IIIB and IIIC open fractures. Single incision technique for nailing for both fractures has been recommended by several authors. Rios et al. compared a single incision with traditional ante grade nailing of the fractures and found the former to have less surgical and anesthesia time with reduced blood loss. Schiedts et al. [18] reported an increased incidence of fat embolism when both fractures treated with reamed nails. Intra articular involvement of fractures, higher skeletal injury scores and the severity of soft tissue injuries are significant indicators of a poor outcome.

Hee et al. [19] suggested a preoperative scoring system that considered age, smoking status at the time of injury, injury severity scores, open fractures, segmental fractures and comminution to affect the final outcome of these fractures. The best results were obtained when both the fractures were treated by intramedullary nailing. These patients returned to their normal level of activity earlier than when the fractures were treated with other modalities.

Comparison with Other Studies

This study is compared with other studies of functional outcome of floating knee injuries and the results according to Karlstrom and Olerud criteria are as follows [Table 10]

Excellent Outcomes

There were 7 patients (21%) with excellent outcome. Most of these patients had shaft fractures of both femur and tibia (Type I) treated with intramedullary interlocking nails. One patient distal femur fracture (A.O. type A) with tibia lateral condyle fracture (schatzker type I) treated with Distal femur locking plate and c.c. screw fixation. All these patients had no pain or any deformity. After an average period of 6 months these patients returned back to their work as before accident.

Good Outcomes

There were 7 patients (21%) with good outcome. Out of these 7 patients Intramedullary Interlocking nailing of both femur and tibia was done in 4 patients, femoral nailing and proximal tibia plating was done in 1 patient, distal femoral plating and c.c. screw fixation of lateral tibia condyle done in 1 patients, distal femoral plating and tibia nailing done in 1 patient. These patients had symptoms of intermittent pain and slightly restricted movements at knee joints.

Acceptable Outcomes

Acceptable outcomes were seen in 7 (21%) of patients. Out of these 7 patients 2 patients 2 patients had proximal femoral fractures treated with proximal femoral nails. Walking distance of these patients was restricted and patients had symptoms of hip pains. 2 patients had both bones nailing done and significant knee pains and restricted mobility. Other 3 patients had fracture extension into the knee joint.

Poor Outcomes

Poor outcomes were seen in 12 patients. Most of these patients (7) had compound Type IIA type floating knee with involvement of the knee joint and had initial treatment with knee spanning external fixation. 1 patient had plaster immobilization for about 8 weeks before internal fixation.

3 patients had associated fracture of ipsilateral patella. 1 patient had fracture patella with segmental fracture femur with non-union treated with Illizarow fixator. Infection was seen in 2 patients. The average range of motion was 0 degree to 50 degrees. 3 patients need support for waking in form of walker.

CONCLUSION

Floating knee injuries are due to high velocity trauma. Road traffic accidents particularly two wheeler accidents is the most common cause. Males are affected more commonly. Many are associated with other injuries such as patellar fractures, radius fractures and vascular injuries.

Good postoperative results are obtained in patients with diaphyseal fractures of both bones treated with intramedullary interlocking nails. And mobilized early in the post-operative period with hip, knee and ankle active range of motion.

Patients with compound fractures with external fixation as primary treatment had prolonged immobilization of knee joint and are associated with poor results. Most of the patients with floating knee injuries are young adults, stiffness of the knee or ankle can be an enormous handicap to these patients, whose demands and expectations are high.

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