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# Trauma: Surgical Management of Floating Knee Injuries in Adults and Functional Outcome in our Institution

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**Abstract:** ***In the present study, functional outcome was analyzed as a prospective study in 27 cases of floating knee injuries in Department of Orthopaedics, SVS Medical College Hospital, Yenugonda, Mahabubangar. In the present study the following results were obtained. Males are affected in 25 out of 27 patients (93%). Right lower limb was involved in 18 out of 27 patients (67%). Majority of the patients were of young age group between 18-30 years (59%). 14 out of 27 patients (52%) had type I floating knee injury and 11 out of 27 patients (41%) had type IIA floating knee injury and 2 out of 27 patients (7%) had type IIB floating knee injury. In most of the cases (80%) surgery was performed within 1 week of trauma. Our aim was early stabilization of the fractures to achieve better functional outcome. Patients were followed-up at 6 weeks, 12 weeks, 6 months, 12 months, 18 months and 2 years intervals for clinical and radiological evaluation of union status, knee range of motion and other complications. Assessment of functional outcome was done by using Karlstrom and Olerud criteria after a minimum period of 6 months from the date of injury.***

## 1. Introduction

Floating knee injuries used to denote ipsilateral femoral and tibial diaphyseal injuries. Recent literature expanded the term to include most ipsilateral fractures of the femur and the tibia. These are high velocity complex trauma cases with soft tissue injuries. ATLS protocols and rehabilitation are high demanding.

## 2. Materials & Methods

Study done at SVS Medical College Hospital, Mahabubnagar for a period of 2 years (August 2016 to August 2018) which includes 27 floating knee injuries of age group 18 – 50 years, males 25 cases (92.59%) & females 2 cases (7.41%). Karlstrom & Olerud functional outcome criteria taken, review literature done. Data was analyzed by Microsoft Excel and Graft Pad Prism software. Data was summarized by mean ± SD for continuous data and percentages for categorical data. The association between variables was done by Fischer exact test / Chi – square test for categorical data. All p-values less than 0.05 were considered as statistical significant. A prospective study.

**Inclusion Criteria**

a) All ipsilateral femur and tibial fractures in adults.
b) Both closed and opened fractures.
c) Age group 18 – 50 years.

**Exclusion Criteria**

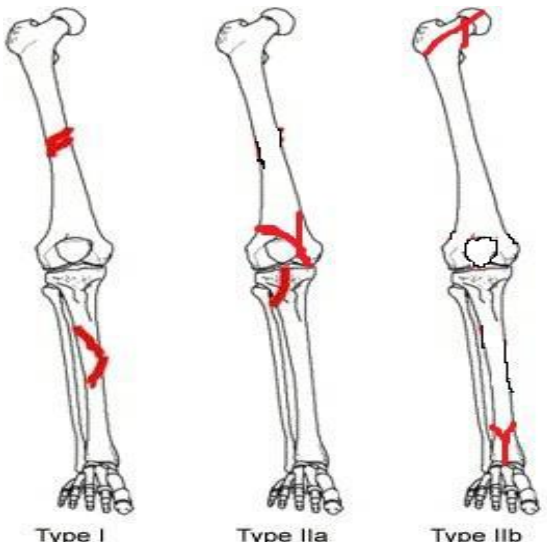
a) Age less than 18 years.
b) Associated neurological injuries such as paraplegia or quadriplegia resulting from spinal injuries.
c) Pathological fractures.
d) More than 3 weeks old fractures.
e) Patient unfit for surgery.

## 3. Classification

**Classification of Floating Knee Injuries**

**1) Blake and MC Bryde's Classification Of Floating Knee Injuries**

Type I or True floating Knee: Ipsilateral Fracture shaft Femur and Tibia
Type II or Variants of Floating Knee: Intra articular extension of fractures
Type IIA: Femoral, Tibial or both fractures extending into knee joint
Type IIB: Fracture extension into hip or ankle joint.

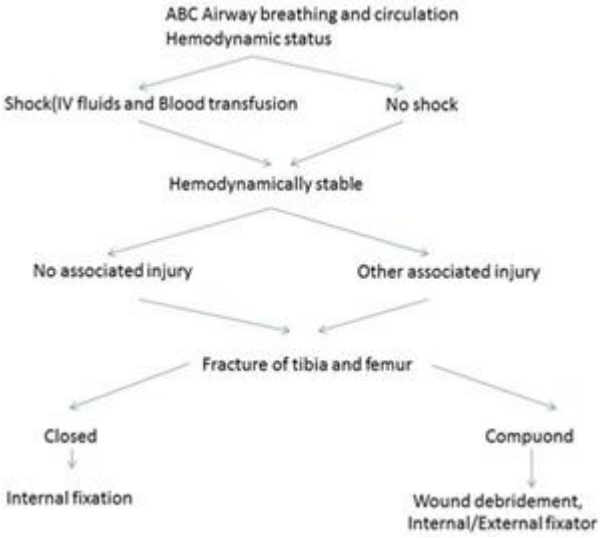


***Karlstorm and Olerud criteria:***

| Criterion | Excellent | Good | Acceptable | Poor |
|---|---|---|---|---|
| Subjective complaint from thigh or leg | 0 | Intermittent slight symptoms | More severe symptoms impairing function | Considerable functional impairment; pain at rest |
| Subjective symptoms from knee or ankle joints | 0 | Same as above | Same as above | Same as above |
| Walking ability | Unimpaired | Same as above | Walking distance restricted | Use cane, crutch or other support |
| Work and sports | Same as before accident | Given up sport; work as same before accident | Changes to less strenuous work | Permanent disability |
| Angulation, rotational Deformity or both | 0 | <10(degrees) | 10-20(degrees) | >20(degrees) |
| Shortening | 0 | <1cm | 1-3 cm | >3cm |
| Restricted joint mobility(hip, knee, ankle) | 0 | <10(degrees) at ankle: <20(degrees) at hip, knee or both | 10-20 (degrees) at ankle 20-40(degrees) at hip, knee or both | >20(degrees)at ankle; >40(degrees)at hip, knee or both |

**Excellent:** No complaints or limitations secondary to the injury to the extremity
**Good:** Occasional minor pain in the extremity or a decreased ability to participate in athletic activities.
**Acceptable:** Intermittent moderate pain in the extremity but the patient is able to perform all activities of daily living and most recreational activities.
**Poor:** Constant pain in the extremity and an inability to perform activities of daily living because of the injury to the extremity.

**Protocol on Arrival:**




***Protocol – Patient is Hemodynamically stable***

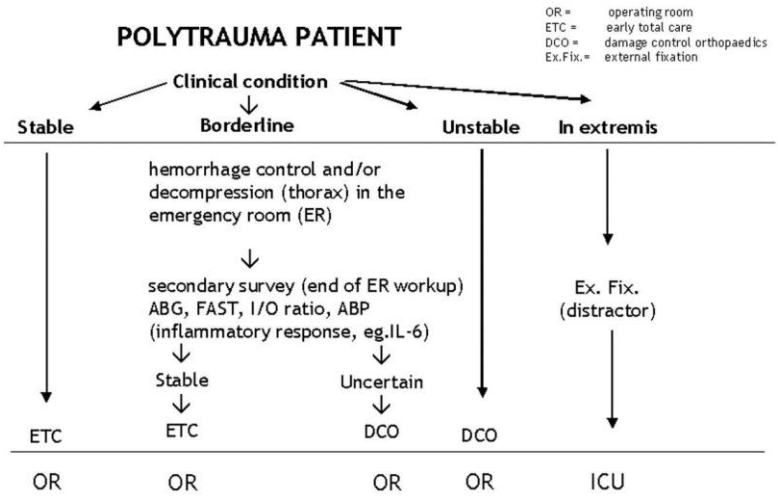
- X – ray chest, pelvis, affected lower limb including all its joitns.
- Open fractures Gustilo & Anderson's classification

***Initial emergency room management:***

- *Wound lavage*
- *Tetanus immunization*
- Anti-biotic therapy for open fractures
- Splinting the limb and immobilization with Thomas splint

CT & 3D Reconstruction for Distal Femur Communition and intra articular femur and tibia involvement.

MRI at a later stage to assess and treat ligamentous injuries.
USG, Doppler & Arteriography (suspected vascular injury)



## 4. Observation & Results

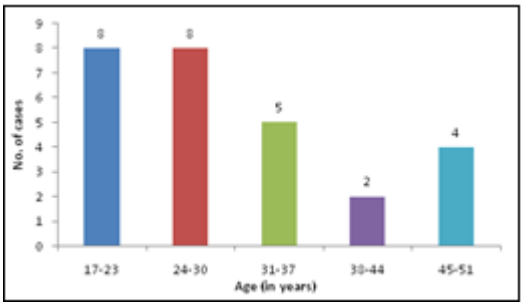
The present study includes 27 cases of Floating knee injuries treated in the Department of Orthopaedics in SVS Medical College, Hospital, Yenugonda, Mahabubangar. The Patients were followed up at 6 weeks, 12 weeks, 6 months, 12 months, 18 months and 2 years intervals. The following observations were made in the present study.

### 3.1 Demographic Characteristics

**Distribution based on Age**

In our study the youngest patient was 18 years old and oldest was 50 years.

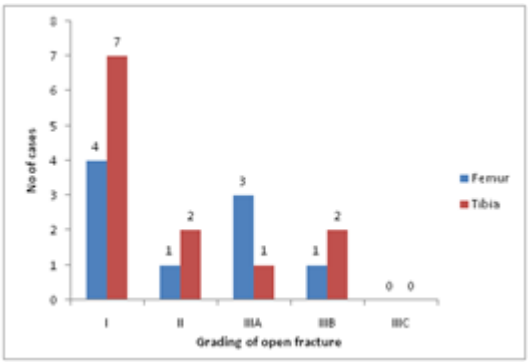
| Age in Years | No. of Cases | Percentage |
|---|---|---|
| 17-23 | 8 | 29.63 |
| 24-30 | 8 | 29.63 |
| 31-37 | 5 | 18.52 |
| 38-44 | 2 | 7.41 |
| 45-51 | 4 | 14.81 |
| Total | 27 | 100.00 |




**Grading of Fracture**

Grade I fractures were 11 (femur-4, tibia-7), Grade II fractures were 3 (femur-1, tibia-2), Grade IIIA fractures were 4 (femur-3, tibia-1), Grade IIIB fractures were 3 (femur-1, tibia-2) observed in this study. P-value=0.552, not significant.

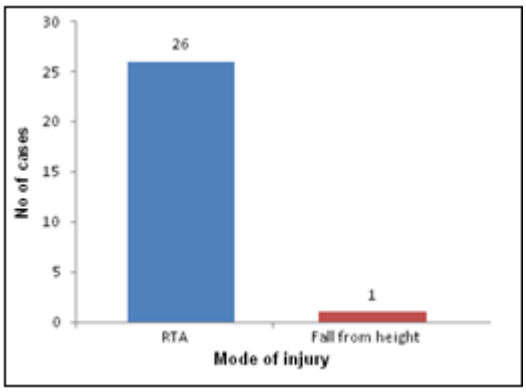
| Grading of open fracture | Femur | tibia |
|---|---|---|
| I | 4 | 7 |
| II | 1 | 2 |
| IIIA | 3 | 1 |
| IIIB | 1 | 2 |
| IIIC | 0 | 0 |
| Total | 9 | 12 |




**Distribution based on Mode of Injury**

In our study, Out of 27 patients 26 patients suffered injuries due to Road traffic accidents, 1 patient suffered injury due to fall from height.

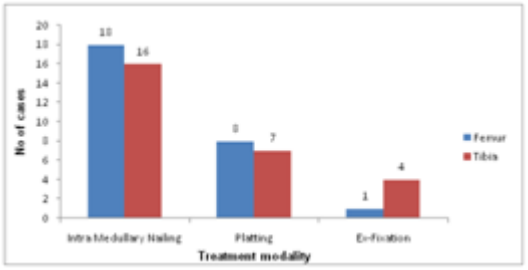
| MOI | No of Cases | Percentage |
|---|---|---|
| RTA | 26 | 96.30 |
| Fall from height | 1 | 3.70 |
| Total | 27 | 100.00 |




**Treatment Modality**

In femur Intramedullary nail fixation was done in 18 cases, platting was done in 8 cases; external fixation was done in 1 case. In tibia Intramedullary nail fixation was done in 16 cases, platting was done in 7 cases; external fixation was done in 4 cases. P-value=0.371 not significant.

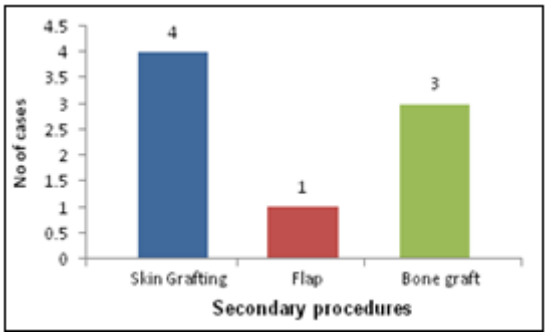
| Treatment Modality | Femur | Tibia |
|---|---|---|
| Intra Medullary Nailing | 18 | 16 |
| Platting | 8 | 7 |
| Ex-Fixation | 1 | 4 |
| Total | 27 | 27 |




**Secondary Procedures**

In this study skin grafting required in 4 patients, flap required in 1 patient, bone graft required in 3 patients.

| *Secondary procedures* | *No. of cases* |
|---|---|
| Skin grafting | 4 |
| Flap | 1 |
| Bone graft | 3 |
| Total | 8 |

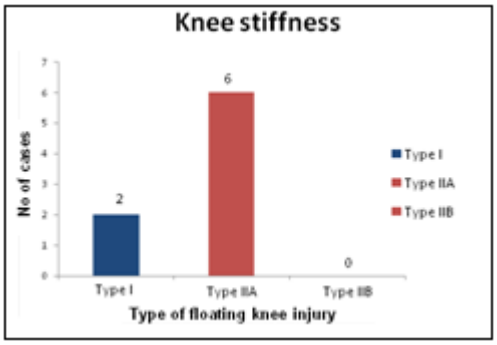



**Complications**

| Complications | | No. of cases | Percentage |
|---|---|---|---|
| Shock | | 16 | 59.26 |
| Compartment syndrome | | 1 | 3.70 |
| Knees stiffness | | 8 | 29.63 |
| Mal-union | Femur | 1 | 3.70 |
| | Tibia | 2 | 7.41 |
| Delayed union | Femur | 3 | 11.11 |
| | Tibia | 5 | 18.52 |
| Non-union | Femur | 0 | 0.00 |
| | Tibia | 1 | 3.70 |
| Superficial infection | Femur | 2 | 7.41 |
| | Tibia | 6 | 22.22 |
| Osteomyelitis | Femur | 0 | 0.00 |
| | Tibia | 1 | 3.70 |

**Knee Stiffness**

In our study, Incidence of Knee Stiffness was 54.55% in Type IIA floating knee injuries as compared to 14.29% in Type I floating knee injuries



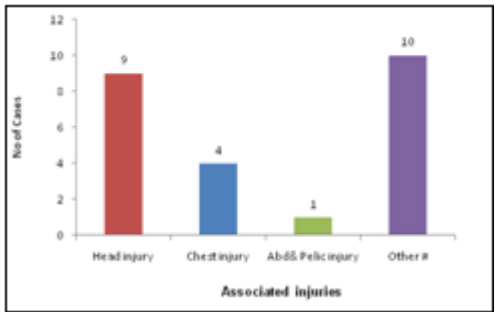

| Type | No of cases | Knee stiffness | Percentage |
|---|---|---|---|
| Type I | 14 | 2 | 14.29 |
| Type IIA | 11 | 6 | 54.55 |
| Type IIB | 2 | 0 | 0 |
| Total | 27 | 8 | 29.63 |

**Shortening:**

In our study 2 out of 27 cases developed 1-3cm shortening due to severe comminution and soft tissue injury. These were managed with heal and sole raised footwear.

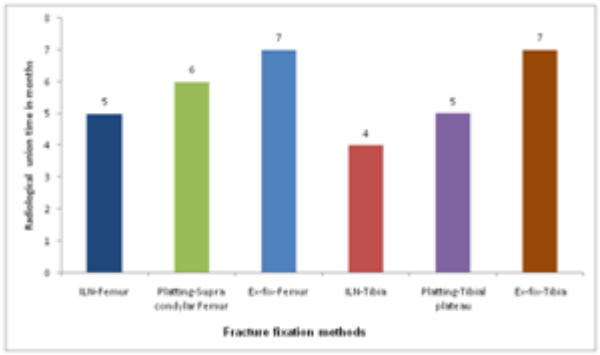
**Associated Injuries**

| Associated Injuries | No. of cases | Percentage |
|---|---|---|
| Head injury | 9 | 37.50 |
| Chest injury | 4 | 16.67 |
| Abdomen & pelvic injury | 1 | 4.17 |
| Other fractures | 10 | 41.67 |
| Total | 24 | 100.00 |




**Bony union time for Femur & Tibia fractures**

| Fracture fixation methods | No of cases | Radiological union time in months |
|---|---|---|
| ILN-Femur | 18 | 5 |
| Platting-Supra condylar Femur | 8 | 6 |
| Ex-fix-Femur | 1 | 7 |
| ILN-Tibia | 16 | 4 |
| Platting-Tibial plateau | 7 | 5 |
| Ex-fix-Tibia | 4 | 7 |




**Karlstrom and Olerud Criteria-For Functional recovery of patients with floating knee injury in our study**

| Criteria | Excellent | Good | Acceptable | Poor |
|---|---|---|---|---|
| Subjective symptoms of thigh or leg | 11 | 8 | 3 | 5 |
| Subjective symptoms from knee or ankle | 10 | 9 | 5 | 3 |
| Walking ability | 11 | 9 | 4 | 3 |
| Work and sports | 10 | 8 | 5 | 4 |
| Angular or rotational deformity or both | 10 | 9 | 5 | 3 |
| Shortening | 12 | 9 | 4 | 2 |
| Restricted joint movements | | | | |
| Hip | 16 | 9 | 2 | 0 |
| Knee | 12 | 7 | 4 | 4 |
| Ankle | 18 | 6 | 3 | 0 |

**Case:**

A 21yr old male patient sustained injuries to right lower limb due to road traffic accident two wheeler v/s car

Pre op x - ray

Post x – ray

6 months follow up

12 months follow up

12 months follow up

## 5. Discussion

The present study included 27 cases of floating knee injuries admitted in Department of Orthopaedics in SVS Medical College, Hospital, Yenugonda, Mahabubangar. The main aim of treatment floating knee injuries is to make the patient ambulatory and start rehabilitation as early as possible so as to reduce hospital stay, morbidity due to complications such as delayed union, nonunion or knee stiffness. Majority of patients in our study were males (92.59%) from 18-30 years of age involving the right side in 18 out of 27 (66.67%) floating knee injuries following the high velocity road traffic accident. Out of 27 cases of floating knee injuries only 2 patient were female (7.4%) and in only 9 cases (33.33%) left side was involved. Out of 27 cases 1 patient sustained injury due to fall from height.

The present study included 18 femur fractures which were treated with intramedullary interlocking nail, 8 cases with plating and 1 case with External fixation.

In these study 24 fractures united in average 5 months period, 3 cases of femur showed delayed union. These cases of delayed union were badly comminuted open fractures.

The present study included 16 tibial fractures which were treated with intramedullary interlocking nail, 7 cases with plating and 4 cases with External fixation.

In our study 21 fractures united in average 4 months period and 5 cases showed delayed union. 1 tibial fracture went into non-union which was required bone grafting.

Yue et al., Chirchill R.S[40] in a comparative study of operative and non-operative treatment of ipsilateral fractures

of femur and tibia concluded that operative stabilization was associated with less leg length discrepancy, angular malunion and secondary procedures from conservative treatment.

In comparison to study of Boscher, Fouque, Le Nay[29] of 26 cases of floating knee treated by internal fixation 13 healed without complication and other 6 healed after complication had been treated; where as in our study of 27 cases 3 cases of femur fracture showed delayed union, 5 cases of tibial fractures had delayed union and 1 tibial fracture developed nonunion which healed after secondary surgeries. So results in our study are consistent with study conducted by Boscher, Fouque, Le Nay.

In comparison to study of Yokoyama et al [43] in their multivariate study of 68 cases of floating knee injuries functional results are 25-excellent, 15-good, 16-acceptable and 12-poor; where as in our study functional results are 10-excellent, 7-good, 6-acceptable and 4-poor. So results in our study are consistent with study conducted by Yokoyama et al48

In comparison to study of Rethnam U[52], 29 cases of floating knee 20 out of 29 cases intrameduullary nailing was done for both fractures, functional results are Excellent-15, Good-9, Acceptable-2, Poor-3; where as in our study out of 27 cases Intramedullary nailing for femur was done in 18 cases, intramedullary nailing for tibia was done in 16 cases, functional results are Excellent-10, Good-7, Acceptable-6, Poor-4. So results in our study are consistent with study of Rethnam U,

In the present study average hospitalization period was 40 days. When both the fractures were closed & treated with early internal fixation, total hospital stay of patient was 2-3 weeks.

Recently aggressive operative treatment has been suggested for floating knee injuries by several investigators. In these reports they emphasized that the operative treatment has resulted in less hospitalization period, fewer complications and better functional outcome than does non-operative treatment.

In a study by Anastopopulous .G[34] 32 cases of floating knee were treated. The tibial fracture treated by unilateral external fixator and femoral fracture was fixed with closed intramedullary nailing, time of hospitalization ranged from 12 - 105 days (mean 30 days); where as in our study of 27 cases of floating knee all femur and tibia fractures were treated surgically, the time of hospitalization ranged from 30 to 50 days (mean 40 days).

In this study 23 patients (85%) achieved excellent to acceptable knee ROM of 0-100°. Knee stiffness that is loss of knee flexion of more than 30 degrees developed in 2 patients out of 14 McBryde & Blake Type I floating knee injuries, whereas 6 cases out of total 11 Mcbryde & Blake Type IIA floating Knee injury cases developed knee stiffness.

Intra articular extension of either one or both fractures into knee joint was associated with markedly higher incidence of knee stiffness. Compound fractures of femur and tibia which developed complication such as delayed union, nonunion or osteomyelitis lead to knee stiffness even when extra articular.. In Type I floating knee injuries treated with early internal fixation and vigorous early physiotherapy showed better results than cases treated with delayed fixation and prolonged immobilization.

The functional outcome in our study by using Karlstrom & Olerud criteria was excellent in 10 (37%) patients; good in 7 (26%) patients; acceptable in 6 (22%) patients and poor in 4 (15%) patients.

In comparison to Karlstrom G., Olerud S.[12] study of 32 cases in which overall excellent to good results were obtained in 86% , our study shows 63% of overall excellent to good results. Whereas study by Veith et al[23] had 72% excellent to good and Anastopoulas et al[12] had 81% overall excellent to good results. These results are much better than conservative series of Fraser et al[14] which shows 29% excellent to good results.

Yokoyama et al[43] concluded that involvement of knee joint, the severity grade of soft tissue injury represent significant risk factor of poor outcome of floating knee injuries.

In our study 67% of patients returned to their pre injury functional status with or without some modification in the work pattern. 14% patients never returned to their pre injury functional status due to disability. Thus floating knee injuries result in significant amount of morbidity and permanent disability.

**Comparative results of Floating knee injuries**

| Series | Excellent-Good | Acceptable-Poor |
|---|---|---|
| Karlstrom Olerud et al[12] | 86% | 14% |
| Fraser et al[14] | 29% | 71% |
| Veith et al[23] | 72% | 28% |
| Anastopulas et al[34] | 81% | 19% |
| Our series | 63% | 37% |

## 6. Conclusion

Floating knee injuries are more complex injuries. In the present study we found that most of the patients belonged to the young population ranging from 17-30 years and most of the patients were male patients.

Most of the injury pattern in the present study belonged to Type I Blake & Mc bryde`s floating knee injury with both femoral and tibial side being shaft fractures. Type I Blake & Mc bryde`s floating knee injuries managed with intra-medullary nailing for both fractures tend to have better functional outcome and knee range of movements when compared to intra-articular fractures and compound injuries. Compound injuries and soft tissue injuries were common with these groups of patients. Associated injuries were common in these groups of patients. It may range from ipsilateral limb injury to life threatening other system injuries requiring early resuscitation.

Initial resuscitation based on ATLS protocol, selecting the correct timing of definitive fixation, understanding and knowledge regarding biochemical inflammatory markers help to minimize the second hit in these patients with extensive injury.

Intra-operative and post-operative complications are common with these groups of patients which may range from infection to life threatening problems like Acute Respiratory Distress Syndrome / Multiple Organ Dysfunction Syndrome.

The overall functional outcome of these patients depend upon factors like, The type of fracture (open /closed ), Degree of comminution, Shaft /intra-articular fractures, Timing of fixation of both the fractures, Timing of initiating knee mobilisation, Associated complications, Other associated injuries and their management.

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