

Factors Influencing the Clinical and Radiological Outcomes of Busch-Hoffa Fracture: An Observational Study

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Abstract:

The aim of this study was to define the predicting factors and evaluate the prognosis of **Background and Objectives:** Sagittal lateral condyle fracture, coronal split fracture and medial condyle fracture are the three forms of partial articular fractures that make up distal femur AO type 33 B fractures. Coronal plane fractures of the distal femur, also known as Hoffa fractures, are less common than sagittal plane fractures. The mechanism of injury for lateral condylar fractures is frequently a direct anteroposterior force that impacts the flexed & abducted knee, whereas the cause of medial condylar fractures is a direct contact along the medial aspect of the knee in flexion. A variety of techniques have been used, including medial parapatellar for screw fixation of medial condylar Hoffa's fracture, with or without posterior technique for open reduction of Hoffa's fracture via screw or buttress plate fixation, while lateral parapatellar for lateral condylar Hoffa's fixation.

Material and Methods: The study was conducted as a hospital based prospective observational study at the Department of Orthopedics, Government Medical College and hospital of south India. Fifteen patients attending casualty/outpatient department with coronal fracture of femoral condyle were evaluated after receiving institutional ethical committee permission and the informed written consent. Cases were divided to subtypes based on Letenneur classification. Surgical approach, fixation technique, implant characteristics, quality of reduction was noted. Radiological outcome assessed with serial x-rays at 3, 6 months and further as required. Knee society clinical score (KSS) and International knee documentation committee (IKDC) was obtained at 6 months and on final follow up. All the data collected were coded and entered in Microsoft Excel sheet which was re-checked and analyzed using SPSS statistical software version 22.

Results: This study indicates Hoffa fracture is common in young adult males with main mode of injury were automobile accidents and lateral condyle is commonly injured than medial condyle. In our study, majority of the patients managed using PA screws alone had excellent final outcome in both functionally and radiologically (p= 0.016). Among the study population, patients with anatomic reduction had good functional outcome in comparison with those with near anatomic reduction (p=0.073). The average time frame for good radiological union was 12±1.6 weeks. Mean knee society score of 77.0 was obtained in present study.

Conclusion: The reestablishing of articular anatomy and its alignment is crucial for better surgical results. It is necessary to perform a closed or open reduction and a secure fixation

using cannulated anteroposterior cancellous screws. For improved outcomes, a quality post-operative rehabilitation programme must be implemented.

Keywords: Articular Anatomy; Busch Hoffa Fracture; Cancellous Screw; Mean Knee Society Score.

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Introduction

Sagittal lateral condyle fracture, coronal split fracture and medial condyle fracture, are the three types of partial articular fractures that make up distal femur AO type 33 B fractures. Less common than sagittal plane fractures of the distal femur, Hoffa fractures (AO type B3) were described by Hoffa in 1904 and have been identified as Hoffa fractures. Hoffa's fracture is a relatively uncommon tangential, unicondylar fracture of the distal femoral condyle. T

hey are uncommon and isolated fractures of the femoral condyle [1]. Hoffa fractures of the lateral condyle are threefold more prevalent than those of the medial condyle [2]. Hoffa's fracture and type 33 B fractures may damage either condyle, however, due to physiological valgus as well as the direction of force, which is often direct trauma to a flexed knee with a slight abduction component; they are more likely to injure the lateral condyle. The leading cause of a Hoffa fracture is a high-energy injury, such as those sustained in motor vehicle accidents and falls from great heights. Hoffa's fractures are overlooked on a conventional radiograph in around 30% of instances, and the prevalence of these sorts of fractures in type 33 B fractures appears to be 38%. [1].

For lateral condylar fractures, the mechanism of injury has been reported as a direct anteroposterior force to the flexed and abducted knee and a direct impact on the medial side of the knee in flexion for a medial condylar fracture. This intra-articular knee fracture may be caused by a combination of forces, including a vertical

thrust and a twisting motion. This fracture is fundamentally unstable due to skeletal instability and muscle tension [3].

Letenneur further classifies Hoffa's fractures into three categories: Type I - Fracture line is parallel to the posterior femoral cortex and involves the entirety of the posterior condyle. Type II: Fracture occurs behind the line parallel to the posterior femoral cortex; Type III: Fracture line runs obliquely; consequently, conservative management is ineffective. The conservative treatment for this fracture yields unsatisfactory results, so internal fixation is the treatment of choice. Multiple articles have documented superior functional outcomes with internal fixation [4,5,6]. Due to intra-articular involvement, multi-fragmentary morphology, and treatment strategies for type 33 B fractures, non-operative treatment for these fractures is typically unsuccessful. These fractures are treated surgically according to the condyle implicated, the precise position of the fracture line, as well as the presence of comminution. [1] Fixation can be done with 3.5 mm or 4.5mm screws. Screws may be conventional screws or headless screws. At least 2 parallel screws must be used for fixation to prevent rotation of fragment⁴. Screws are usually inserted from anterior to posterior. Ideally the screws should be perpendicular to the fracture line. If there is comminution, excessive compression should be avoided. In presence of comminution, small plates may be used as a buttress for stabilization. Current treatment recommendations for intraarticular fractures advise anatomic reduction, rigid fixation and early

mobilization. However, fracture pattern, classification, soft tissue injury, comminution, damage to articular cartilage, associated ligamentous injuries, surgical approach, method of fracture stabilization and rehabilitation protocols influence the outcome in various ways. There is a relative lack of evidence regarding the impact of clinical, radiological and treatment factors on the outcome of treatment as the published data are either case reports or retrospective case series with small number of patients. To address this void in the literature, we propose to conduct a prospective study which will collect demographic parameters, clinical features, injury characteristics, and image findings, details of treatment and rehabilitation methods to assess their correlation with the outcome of treatment. Outcome of treatment will be assessed clinically, radiologically and by using validated outcome scores and also from frequency of complication.

Aim and Objectives:

The goal of this study was to determine the factors that affect the functional and radiological outcomes of isolated Hoffa fractures of femoral condyle in adults and to identify the functional outcomes of Hoffa fracture measured using IKDC score & KSS score.

Material and Methods:

The study was conducted as a hospital based prospective study at the Department of Orthopedics, Government Medical College and hospital of south India. Fifteen patients attending casualty/outpatient department with coronal fracture of femoral condyle were evaluated. The research was accepted by the Ethical Committee and complete informed written consent was acquired from the patients.

Inclusion criteria: Both males and females above >18 years attending casualty/outpatient department with

coronal fracture of femoral condyle without other fractures in the distal femur.

Exclusion criteria:

- Pre-existing arthritis of knee
- Pathological fractures
- Patients with open physes
- Patients not willing to give consent
- Patients from remote areas or other states who cannot come for follow up

Sample size calculation:

$N = 4(SD)^2/d^2$ (N=sample size, SD=standard deviation, D=Precision) and the calculated sample size was 21, based on previous study.[7]

Method of data collection:

In this study 15 patients who had Hoffa fracture were evaluated. Patients attending casualty/outpatient department with coronal fracture of femoral condyle were enrolled in the study based on inclusion and exclusion criteria after getting consent. Demographic data, medical history, mechanism of injury and clinical findings were recorded. Cases were evaluated with AP/lateral radiographs, CT scan and if necessary by MRI. They were divided into subtypes based on Letenneur classification. Surgical approach, fixation technique, implant characteristics, quality of reduction were noted. Radiological outcome was assessed with serial x-rays at 3, 6 months and further as required. Knee society clinical score (KSS) and International knee documentation committee (IKDC) score were obtained at 6 months.

Statistical Analysis:

The SPSS statistical software version 22 was used to review and analyze all the data that had been gathered, coded, and entered into a Microsoft Excel sheet. Standard deviation (SD), together with the mean, was used to summarize quantitative data. Frequency and percentages were used to represent categorical variables. The statistical significance of the disparity in

the means of the variables among several independent groups was examined using the independent sample t test. Comparisons between groups of categorical variables were made using the Pearson Chi-square test. To determine the relationship between graft diameter and length along with various other quantitative factors, the Pearson correlation test was performed. Statistical significance was defined as a p value ≤ 0.05 .

Results:

The following observations were made from the study. 15 patients underwent the procedure were evaluated and followed up.

Age was identified to be determining factor in time taken for union of fracture in our study ($p=0.044$). However no statistically significant correlation was obtained in terms of functional outcome.

13 (86.67%) patients were males and 2 (13.33%) were females. Since only 2 females were included in the study, gender based statistical studies were not relevant. Out of 15 cases only 3 cases were open fracture (20%).

Co-morbidities influenced both functional & radiological outcome in present study which was statistically significant ($p=0.01$). [Table1]

Table 1: Demographic variables

Variables		N	%
Age groups	15-30 years	06	40
	31-45 years	03	20
	46-60 years	05	33.3
	>60 years	01	6.7
Gender	Male	13	86.67
	Female	02	13.33
Mode of injury	Road traffic accidents	13	86.67
	Fall from height	01	6.6
	After slip and fall	01	6.6
Site of injury	Right	08	53.33
	Left	07	46.67
Condyle involved	Lateral	09	60
	Medial	06	40
Associated fractures	Nil	12	80
	Tibial plateau injury	03	20
	Fibular head	01	6.66
	Shaft of femur	01	6.66
Letteneur fracture type	I	09	60
	II	04	26.67
	III	02	13.33
Fracture	Closed	12	80
	Open	03	20
Co-morbidities	Nil	13	86.67
	Diabetes Mellitus	01	6.66
	Multiple Sclerosis	01	6.66

Most commonly used management technique was ORIF with PA screws ($n=10$; 66.66%), followed by PA screws & plate ($n=3$; 20%), ORIF with k wire &

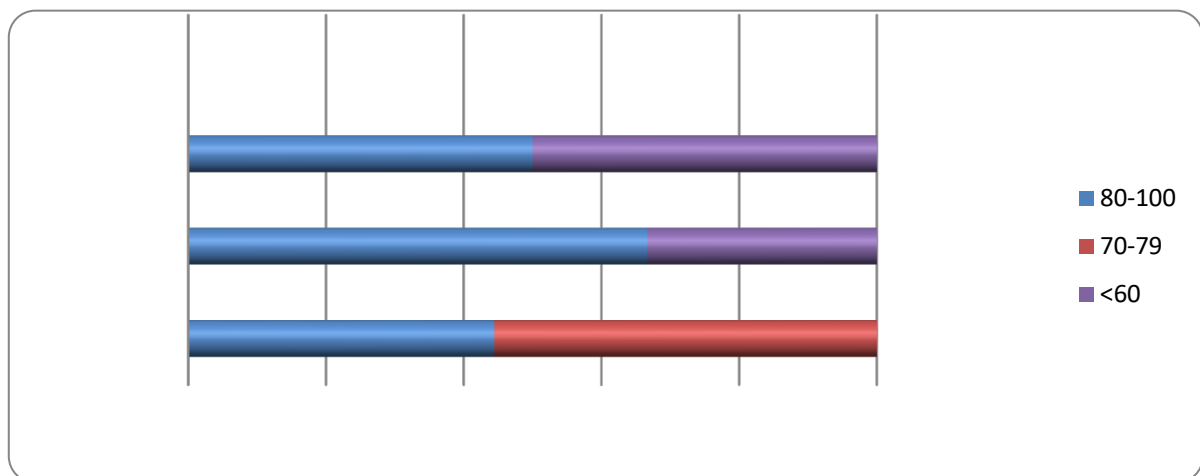
conservative (1 cases each). 86.67% of study population ($N=13$) attained union by end of 12 weeks, whereas, 2 cases took 24 weeks for union.

patients (43.3%) had excellent functional outcome measured in terms of KSS, only 2 patients had a poor outcome (13.33%). Majority patients who were managed using PA screws alone had excellent final outcome in both functionally and

radiologically ($p= 0.016$). Among the study population, patients with anatomic reduction had good functional outcome in comparison with those with near anatomic reduction ($p=0.073$). [Table 2]

Table 2: Management and outcomes of Hoffa fracture

Variables		N	%
Management	PA Screw	10	66.67
	PA Screw & Plate	03	20
	Conservative	01	6.67
Duration of union radiologically	0-3 months	13	86.67
	3-6 months	02	13.33
Complications	Nil	11	73.33
	Infections	02	13.33
	Chronic swelling	01	6.67
	Osteoarthritis with deformity	01	6.67
	Open	08	29.6
Knee Society Score (KSS)	80-100	07	43.33
	70-79	05	33.33
	60-69	01	6.66
	<60	02	13.33



Graph 1: Functional outcome vs type of fracture

Discussion

In contrast to the medial femoral condyle, the lateral femoral condyle is typically the site of an isolated Hoffa fracture, which is a rare injury. There is uncertainty regarding the precise cause of this injury. These fractures frequently result from motor vehicle collisions [6,8]. The mechanism underlying injury remains elusive. It is believed that the typical mechanism is an amalgam of vertical

shearing along with twisting forces [9]. Lewis et al. argued that the lateral femoral condyle is the earliest segment of the knee that experiences an oblique or lateral impact when the knee is flexed to just beyond 90 degrees [8].

The typical Hoffa fracture is caused by direct trauma to this location, possibly with an abduction component. The physiological genu valgum may be the fundamental cause of the predominant

involvement of the lateral condyle in these fractures [10].

Conservative management is typically associated with suboptimal outcomes; consequently, open reduction and internal fixation has become the standard treatment for intra-articular fractures, as anatomic reduction and stable fixation are essential for optimal outcome. Due to the paucity of specific data in the literature, no unambiguous and reliable management rationale has been developed. Regarding the surgical strategy and methods of fixation, there is considerable debate [11]. The anterior approach with lateral parapatellar arthrotomy was employed in the current study for lateral Hoffa's fractures, while the medial parapatellar procedure was used for medial Hoffa's fractures. We discovered that using several cannulated cancellous screws, these procedures offered the necessary visibility for the most efficient reduction and fixation. The biomechanical stability of just a single 6.5mm screw should be replicated by using at least two 3.5mm screws, and the biomechanical stability of a single 6.5mm screw ought to be copied by using at least two 3.5mm screws. Fixation utilising a posteroanterior-oriented lag screw seems biomechanically better to fixation via an anteroposterior-oriented screw, as reported by Jarit et al [12] and Arastu et al [13]. Frequent use of cannulated lag screw fixation for Letenneur II and some Letenneur III fractures nearby to the femoral condyle's posterior cortex. After securing the exposed fracture line with a Kirschner wire (K-wire), screws are placed perpendicular towards the fracture surface.

To repair the fractures, multiple screws with a diameter of 3.5 mm are also suggested. [14] Comparable to Trikha et al. [11], the age distribution of patients in the present study was 15 to 30 years, whereas in Trikha et al. [11] it was 22 to 40 years. 13 (86.67%) patients were males and 2 (13.33%) were females. Since only 2

females were included in the study, gender based statistical studies were not relevant. The study population's age and sex distribution offers evidence that young male adults frequently suffer from Hoffa fractures. Comparing to the average union duration of 11.56 ± 1.5 weeks as investigated in a group of participants by Trikha et al. [11], the average time for satisfactory radiological union was 12 ± 1.6 weeks in present study. The average union time for a fracture to heal was 15.5 weeks in a research conducted by Siddiqui et al [15], although Singh et al [16] found a fracture union time of 16 weeks. Mean knee society score of 77.0 was obtained in present study. Singh R et al noted mean knee society score of $87.5 + 10.4$. [16]

Limitations of the study:

In this study, initial sample size kept was 21. But due to covid and lockdowns, number of patients attending the OPD/Casualty was less and the researchers had to complete the study with available 15 cases. Since there was no comparison group, it is tough to say with certainty or anticipate if a certain surgical method was a more effective course of action.

Conclusion

Hoffa fractures are uncommon and may be accompanied by extra-articular fractures, which necessitate evaluation and an appropriate treatment plan. The re-establishing of articular anatomy and its alignment is crucial for better surgical results. It is necessary to perform a closed or open reduction and a secure fixation using cannulated anteroposterior cancellous screws. For improved outcomes, a quality post-operative rehabilitation programme must be implemented.

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