

Assessment of Treatment Approaches for Compound Supracondylar Femur Fractures: A Prospective Comparative Study

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ABSTRACT

Introduction: Distal femur fractures, especially open fractures with polytrauma, pose significant challenges and can result in long-term disability. These fractures, comprising a small percentage of overall fractures, often occur due to high-velocity trauma in younger males or low-velocity injuries in the elderly. Management of such fractures, particularly in the elderly with osteoporosis, requires careful consideration. This study aims to evaluate the outcomes of different treatment strategies for open supracondylar and distal femoral fractures and to find the functional outcome. **Materials and Methods:** A prospective study was conducted on 20 patients aged 18 and above presenting with open supracondylar and distal femoral fractures between June 2021 and June 2023. Clinical and radiological evaluations were performed, and patients were grouped based on specific criteria. Treatment strategies included wound debridement, internal fixation using locking compression plates or dynamic condylar screws, external fixation, and minimal internal fixation. Patients were followed up at regular intervals for evaluation using the Knee Rate System Scoring. **Results:** The study included males with a mean age of 41 years. Road traffic accidents were the leading cause of fractures. Gustilo Anderson and Muller's classifications were used to categorize the injuries. Various treatment strategies were employed, with outcomes ranging from excellent to poor. Knee stiffness was the most common complication, with factors such as fracture severity and delayed surgery contributing to poor outcomes. **Conclusion:** While advancements in treatment have improved outcomes for distal femur fractures, particularly with early stable internal fixation, challenges remain, especially for severe injuries. External fixation, although useful as a temporary measure, often results in unsatisfactory outcomes. Soft tissue damage and adherence to early rehabilitation play crucial roles in determining functional outcomes. Overall, timely intervention and appropriate treatment selection are essential for optimizing outcomes in patients with open supracondylar and distal femoral fractures.

Keywords : Distal Femur , Compound Injuries, Plating, Ex Fix, Functional Outcome

INTRODUCTION

More severe injuries, such as distal femur fractures, can lead to varying degrees of long-term disability. The proliferation of highways and high-speed

Tragic injuries like open femur fractures with polytrauma are on the rise due to the increased frequency of driving. Traumas of this kind can cause a wide range of bone and soft tissue losses.[1] Fractures of the distal femur account for 3-6% of all femoral fractures and fewer than 1% of all fractures overall.

[2] Such Fractures usually have a Bimodal age distribution, High-velocity injury which includes Direct trauma to the knee usually occurring in Younger Males and Low-velocity injuries in the elderly like trivial falls from standing height, Degenerative pre-existing condition of the knee causing stiff knee can act as a contributing factor in resulting a fracture are the main mechanisms of injury of such type of fractures. Complex fractures include femur supracondylar and intercondylar fractures [3]. They often accompany other types of injuries in young people

[4, 5] Managing a patient with such type of fractures with rigid stable fixation could turn out to be a challenge due to osteoporosis-affected bones in the elderly population. [5,7]. The knee's position when injured is a major factor in the fracture pattern. In this case, the patient would have a swollen and deformed knee, be unable to put any weight on it, and have very limited and painful mobility. Among the many types of fractures seen in the knee, 27% are open fractures and 58% have intra-articular extensions [7]. To better evaluate the extent and shape of the fracture, radiographic examinations such as a computed tomography (CT) scan are essential. Fracture type and treatment planning have both been simplified by the AO classification system. A spanning external fixator is used as part of the primary treatment strategy for distal femur fractures. A CT scan of the fracture is then performed, and the approach, location, and fixation are planned. Minimally invasive techniques that are based on the idea of biological osteosynthesis have greatly reduced the complication rates of these types of fractures. To keep the blood supply going and to leave the fracture hematoma undisturbed so that it can continue to produce healing factors that will aid in the fracture's healing, a biologically friendly insertion technique with minimal soft tissue stripping is utilized with locking plates. Intramedullary nails, first used by Green in 1988, are introduced retrogradely and represent a significant advancement in the treatment of these fractures as it shares many of the assets of a locking plate and has been claimed to have high healing rates [8] Although skeletal traction has been an effective treatment for distal supracondylar femoral fractures in the past, it has been associated with a high rate of morbidity and death.[9-11].Early union, adequate knee range of motion, weight-bearing, and return to normal activity were some of the outstanding functional outcomes observed after distal femur fractures were fixed using a locking compression plate (LCP). No significant problems were reported during this procedure.[12,13]. There is a significant probability of late amputation and a poor functional result with conventional care for Gustilo Anderson Grade IIIA and IIIB fractures, which involves many surgical operations.[14] The aim of this study is to evaluate the outcomes of different treatment strategies for open supracondylar and distal femoral fractures and to find the functional outcomes

MATERIALS AND METHODS

This is a prospective study of 20 patients above the age of 18 who had presented to Saveetha Medical College from June 2021 to June 2023 with open supracondylar and distal femoral fractures, who at the time of admission were clinically and radiologically evaluated with Anteroposterior, Oblique & Lateral Views & CT Scans were done in complex fracture patterns & in fracture with comminution to assess the geometry of the fracture and to help with the fixation options. Age, sex, mode of injury, and side of involvement were documented in the case record. Patients were selected in the study based on the inclusion and exclusion criteria as given below. Inclusion criteria included All patients above 18 years with open supracondylar femur fractures extending up to 15 cm from the articular surface According to the below-listed inclusion and exclusion standards. The criterion for inclusion comprised all patients older than eighteen years who have open fractures of the supracondylar femur that extend up to fifteen centimetres from the articular surface. i) Compound supracondylar fracture of the femur, grades I, II, IIIA, and IIIB (Gustilo Anderson's categorization). ii) Reporting within 12 hours of the injury, TYPE A1, A2, A3, B1, B2, B3 as well as C1, C2, C3 ("MULLER'S CLASSIFICATION"). Exclusion criteria included 1) Pathological Fracture 2) Associated Vascular Injuries 3) Related Multiple Comorbid Disorders 4) Associated Fractures of the Tibial Plateau. Following the acquisition of pre-anaesthesia fitness, the patient provided surgical and anaesthetic consent. Utilizing the conventional lateral method Patients underwent minimal internal fixation using k wires as well as cancellous screws, knee-spanning external fixator, dynamic condylar screw fixation, and rigid internal fixation utilizing locking compression plates. The patients were then divided into three groups, and the results were examined. Below are the three groups: Group 1: delayed debridement of the wound and stable internal fixation, Group 2: Minimal external as well as internal fixation, Group 3: Only a small amount of internal fixing, Group 4: only external fixation Group I treatment was administered to the open wounds of Gustilo's type grades I and II. Muller's A1, A2, A3, and C1, C2, C3 fracture types were included. Open grades IIIA and IIIB of Gustilo's were treated with Group 2; the fracture types that were used were Muller's C1, C2, and C3. Open grades I, II, and III of Gustilo's-type fractures were treated with group three, and the fracture types were Muller's B1, B2, and B3. The A3 and C3 types were treated with Group 4 using compound Grades I, II, and III. Postoperatively Patient was mobilized on Day 2, the Patient was put on weight bearing for 6 weeks and suture removal was done on Day 12, Patients were followed up in 3 months, 6 months, and One-year post-follow-up and was evaluated with

Knee Rate System Scoring [Figure 1, Figure 2, Figure 3]

Gathered data was evaluated by utilizing IBM SPSS Version 22.0 based on SPSS Statistical and an I P value of 0.005 was found to be statistically Significant

RESULTS

Twenty patients were included in the investigation, ranging in age from twenty-five to sixty-five years old, with a mean age of forty-one years [Table 1]. The majority of the fractures were caused by road traffic accidents (13 cases), falls from heights (4 cases), and assaults (3 cases) [Table 2]. Twelve patients were male and eight were female[GRAPH 1]. Twelve patients suffered injuries to their right sides and eight to their left side[GRAPH 2]. Based on the Gustilo Anderson Classification, five patients had Grade 1 injuries, five had Grade 2, three had Grade 3A, and seven had Grade 3B injuries out of the total number of open injuries [Table 3]. Each crack was assigned a unique number and typed. Out of the twenty patients analysed, two had A1 fractures (10%), three had A3 fractures (15%), three had B1 fractures (15%), one-half of a dozen had B2 fractures (5%), five had C2 fractures (25%) and five had C3 fractures (25%) [GRAPH 3]. Bone grafting was necessary for five patients; two had C2 fractures, two had C3 fractures, and one had an A3 type fracture [Table 4]. The patients were examined in one of four groups for the purpose of management. Group 1 had 6 patients, 1 of whom had an excellent outcome and 5 good ones; Group 2 had 5 patients, 4 of whom had good ones and 1 had a fair one; Group 3 had 4 patients, 1 of whom had an excellent one and 3 of whom had good ones. This group consisted of 5 patients; 1 had a good outcome, 1 had a fair one, and 2 had a bad one.[Table 5]show that out of a total of ten patients, five-and-a-half percent had positive outcomes, three patients had great outcomes, and two patients had fair outcomes. In Total 3 patients had Excellent outcome ,13 patients had good outcome ,2 patients had fair outcome and 2 patients had poor outcome [GRAPH 4].Our investigation found that knee stiffness was the most common consequence. Flexion of the knees averaged 70 degrees. Many factors, including postponing surgery, fracture patterns, infection, fixation stability, noncompliance with many procedures, and rigorous physiotherapy, contributed to the patient's knee stiffness. One patient underwent wound debridement and antibiotic therapy for an infection; however, he had a poor functional outcome, and bone union has not yet been accomplished.

DISCUSSION

Distal femur fractures, even with contemporary treatment procedures, can lead to poorer results and ongoing impairment.

[7]. A comprehensive assessment of the soft tissues is essential in cases of open fractures, as these injuries often result from major surgeries. When treating an open supracondylar fracture, it is crucial to do thorough wound exploration, debridement, and washing. In Our Study All patients underwent thorough wound debridement, Wound Exploration and Wound wash

Our study, which included 20 patients with open femur fractures supracondylar fractures, indicated that the average age of fracture occurrence was 41.1 years, which is slightly different from the values previously published. Consistent with previous research, we found that fractures were more prevalent in those over the age of 40, and that the leading cause of these breaks was injuries sustained in car accidents. Furthermore, our study's male preponderance was in line with other research that has shown a similar trend over the last 47 years (JM SILISKI et al., 2019)[15], 50 years (Gellman et al., 2019), and 32 years (HERSCOVICI and WHITEMAN, 2019).[16]

The anterior side, which is via the extensor compartment, was the most typical location for open wounds. This result was consistent with previous research.[17] , In our study, external fixators were applied for Nine of our patients , Five patients for whom it was applied as standalone treatments.External Fixator Application for these fractures were applied on Day 1-2 ,whereas The average time interval between time of occurrence of injury and definitive fixation was around 12 days, The main reason being giving adequate time for the subsidence of swelling, and elevated inflammatory markers [C-Reactive protein level and ESR levels] and due to unavailability of operation theatre . In cases where there was significant comminution or severe osteoporosis, bone graft was applied to the site of the fracture. On Referring previous Literature not enough consensus could be raised regarding the right timing for bone grafting in compound supracondylar fractures of femur,Two to three weeks following effective wound covering is the average suggested length for bone grafting, according to a research by Edward and colleagues.. In Our study bone grafting was done during one and a half

weeks after the soft tissue healing mostly during definitive fixation .

One patient in our research experienced dynamic condylar screw implant failure owing to substantial medial comminution. The use of bone grafts and locking plate fixation helped alleviate this issue. The results are like those of the SCHATZKER J UPDATE.

[18] In our study Significant complication included Knee stiffness of variable degrees in Four Patients variable degrees out of which the outcomes were poor in two, fair in one, and good in one and one case contacted infection for which the patient developed non-union later on and the outcome was poor and has not attained bony union. The development of extension contracture can be attributed to a number of factors. These include the following: the severity of the fracture pattern like in Type C2, and C3 Fracture Patterns, the length of time between the injury and surgery, the amount of time spent operating, the fact that the soft tissue envelope surrounding the fracture is frequently contused, and patients' lack of compliance with various procedures, such as quadriceptoplasty and early aggressive physical therapy. Of these, Four of these patients developed knee stiffness due to which 3 had poor outcomes, however one of them had a good outcome, while 4 patients had good outcomes and 2 had fair outcomes. A subsequent arthritic alteration was the only time residual discomfort was considered substantial. Most patients were satisfied so long as they could flex the knee as well as had strong extensor power to a mean of 74 degrees. Their increased range of flexion allowed them to climb stairs normally, whereas their decreased range of flexion made them ascend stairs sideways. Their increased range of flexion allowed them to climb stairs normally, while their decreased range of flexion made them ascend stairs sideways. In our research, we found that patients receiving external fixators alone experienced pin tract infections in three to five weeks.[19] These infections caused the pin to become loose, which led to the pin's removal and subsequent flexion of the distal fragment, which resulted in non-union and subpar functional outcomes. Six of our patients felt anterior knee pain without any localized tenderness, and one patient found it more difficult to go about their everyday business. Four individuals experienced a 1-3 cm difference in limb length as a result of significant metaphyseal comminution. ROY SANDERS AND M.SWIONTKOWSKI[20] emphasized the significance of injuries to the muscles and capsules as well as the formation of large quadriceps adhesions. They concluded that the limited flexion was the reason for the poor functional results even with a satisfactory union and alignment. Although the exact role that neutrophil recruitment mediated by nitric oxide and cytokines may play in soft tissue injury, this is yet unclear. This could account for the study's findings of knee stiffness despite a good bone union. The variation in the rehabilitation regimen and the fixation latency may be the cause of the varying results in a range of motion. A limited range of motion is related to the severity of soft tissue damage and intraarticular comminution.

CONCLUSION

Even while we can successfully align complicated supracondylar femur fractures, the functional outcome is still inadequate for patients with severe (Grade IIIB) injuries. Rather of being a long-term solution, external fixation is best used as a stopgap. Results were better when patients were quickly transferred from external fixation to stable internal fixation; our study demonstrated unsatisfactory results in individuals treated with ex fix alone. Poor results are linked to more extensive damage to soft tissues. The type of fracture is less important than the severity of the complex wound in determining the result. Failure to adhere to early rehabilitation physical treatment and postponing stable stabilization also affect the final function.

Declarations

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Conflicts of Interest: None Declared

Ethical Approval :Not Required

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FIGURE 1,2&3 showing – KNEE RATING SYSTEM

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**KNEE RATING SYSTEM BY THE HOSPITAL FOR
SPECIAL SURGERY**

PAIN - 30 POINTS

Walking	NO OF POINTS
NONE	15
MILD	10
MODERATE	05
SEVERE	00
AT REST	
NONE	15
MILD	10
MODERATE	05
SEVERE	00

FUNCTION -22 POINTS

WALKING	NO OF POINTS
WALKING AND STANDING UNLIMITED	12
5-10 BLOCKS STANDING >30 MINUTES	10
1-5 BLOCKS STANDING >30 MINUTES	8
<1 BLOCK	4
CANNOT WALK	0
STAIRS	
NORMAL	5
WITH SUPPORT	2
TRANSFER	
NORMAL	5
WITH SUPPORT	2

RANGE OF MOTION-15 POINTS

80 DEGREES	10
90 DEGREES	11
100 DEGREES	12
110 DEGREES	14
120 DEGREES	15

MUSCLE STRENGTH-15 POINTS

GRADE -5	15
GRADE -4	12
GRADE -3	09
GRADE -2	06
GRADE -1	03
GRADE -0	00

FLEXION DEFORMITY-10 POINTS

NONE	10
0-10 DEGREES	08
10-20 DEGREES	05
>20 DEGREES	00

INSTABILITY - 5 POINTS

NONE	05
0-5 DEGREES	04
6-15 DEGREES	02
>15 DEGREES	00

SUBTRACTION

ONE CANE	1
ONE CRUTCH	2
TWO CRUTCHES	3
EXTENSOR LAG	
5-DEGREES	2
10 -DEGREES	3
15 -DEGREES	5
DEFORMITY (5 DEG = 1 POINT)	
VARUS	
VALGUS	
TOTAL SUBTRACTION	

Knee score = Total Points – Total Subtractions

EXCELLENT	85 POINTS OR MORE
GOOD	70-84 POINTS
FAIR	60 – 69 POINTS
POOR	<60 POINTS

TABLE 1: AGE Grouping
AGE GROUP IN YEARS

	NO OF PATIENTS
20-29	1
30-39	5
40-49	11
50->50	3
TOTAL	20

TABLE 2: Mode of Injury

ASSAULT	3
ROAD TRAFFIC ACCIDENT	13
FALL FROM HEIGHT	4

TABLE 3: Compound Injuries

COMPOUND GRADE 1	5
COMPOUND GRADE 2	5
COMPOUND GRADE 3A	3
COMPOUND GRADE 3 B	7

TABLE 4: Fracture Types Requiring Bone Graft

MULLERS GRADE	NO OF PATIENTS
C2	2
C3	2
C1	0
A3	1

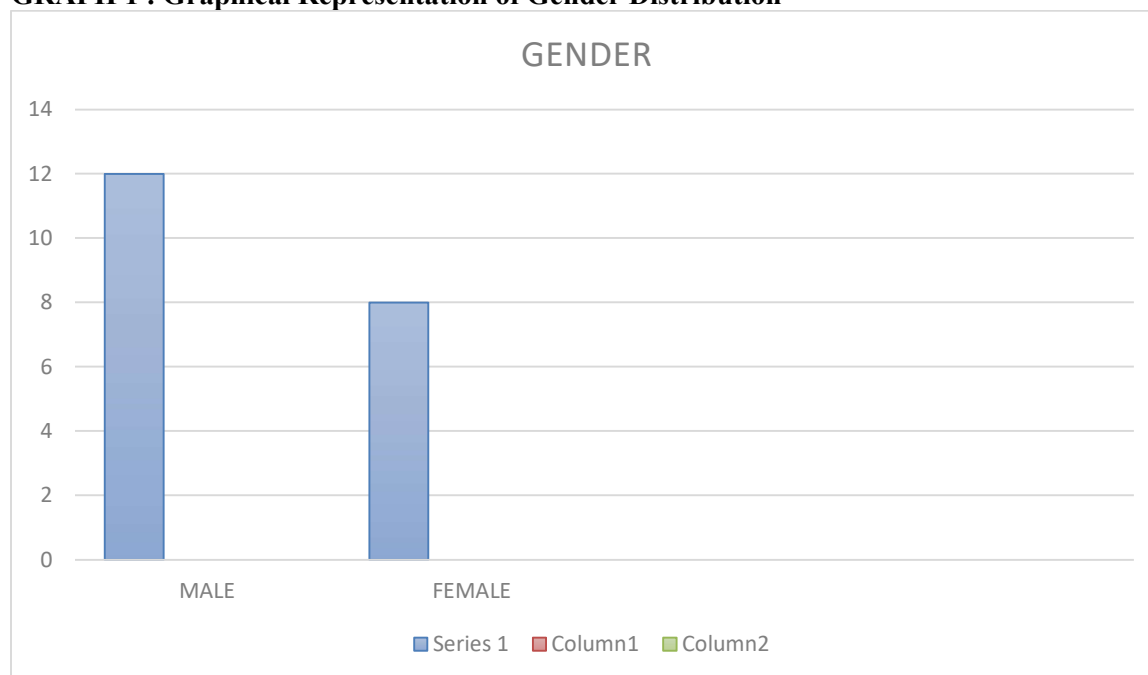
TABLE 5 :MASTERCHART

S. No	Name	Age	Sex	Mode of Injury	Side	Open Wound	Type of Fracture	Initial Management	Time of Surgery	Definitive Management	Union in weeks	Complications	Time for Union	Score	Outcome	GROUP
1	Peerumal	30	M	ASSAULT	R	I	B1		5	WD, CC24 SCREW FIXATION	0-80		22 weeks	70	GOOD	GROUP 3
2	Munuswamy	28	M	MRTA	L	II	C2		14	ORIF WITH LCP +BG	23-90	Knee Stiffness	28 weeks	76	GOOD	GROUP 1
3	Raja	40	M	MRTA	R	II	A1	WOUND DEBRIDEMENT,	15	ORIF WITH LCP	17-90		18 weeks	75	GOOD	GROUP 1

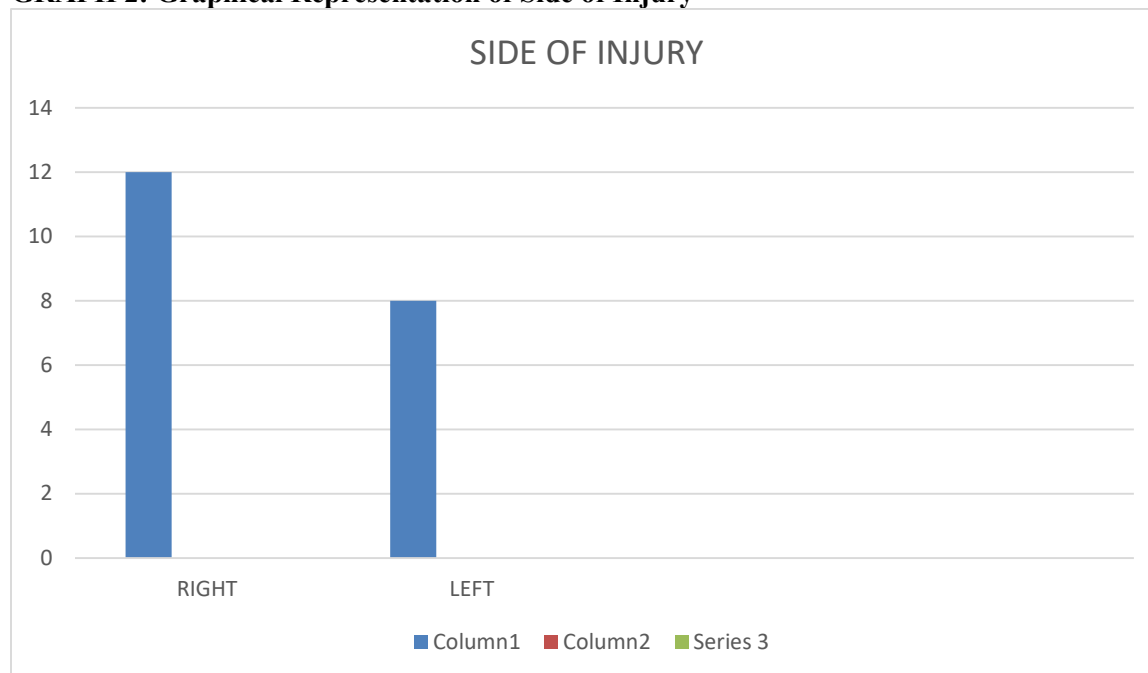
4	Krishnan	53M	FALL	R	IIIB	C3	WOUND DEBRIDE, EX FIX	1		30	0- 30	KNEE STIFFN ESS, Knee Pain LLD	1 year foll ow andup	58	POOR	GROUP 4
5	Raju	50M	RTA	L	II	B1		1	WD, CC SCREW FIXATIO N	12	0- 10 0		10 wee ks	82	GOOD	GROUP 3
6	Prabhakar	48M	ASSA ULT	L	IIIA	C1	BIPLANAR EX FIX	14	CRIF WITH CC SCREW FIXATIO N	19	0- 90		24 wee ks	77	GOOD	GROUP 2
7	Selvi	47F	RTA	L	IIIB	C2	MIF+SSG	19		28	0- 30	KNEE STIFFN ESS	28 wee ks	64	FAIR	GROUP 2
8	Muthuprathiba	57F	FALL	R	II	A1		15	ORIF WITH LCP	20	0- 80		14 wee ks	75	GOOD	GROUP 1
9	Megha	34F	RTA	R	IIIB	C3	EX FIX	1		29	0- 70		30 wee ks	68	FAIR	GROUP 4
10	Palani	47M	RTA	R	I	A3	WD, EXFIX	1		22	0- 70		22 wee ks	77	GOOD	GROUP 4
11	Sowmya	39F	RTA	L	IIIB	C2	WD, EXFIX	16	ORIF WITH CC SCREW	30	0- 80	Knee Stiffness, Knee Pain LLD	24 wee ks	75	GOOD	GROUP 2
12	Bharathi	48F	ASSA ULT	L	II	B1		4	WD, CC SCREW	25	0- 11 0		12 wee ks	85	EXCELL ENT	GROUP 3
13	Pattammal	44F	FALL	R	I	C3		12	ORIF WITH LCP+BG	24	0- 11 0		13 wee ks	88	EXCELL ENT	GROUP 1
14	Janaki	39F	FALL	R	II	B1		1	WD, CC SCREW	28	0- 10 0			79	GOOD	GROUP 3
15	Arjun	46M	RTA	L	II	A3		14	ORIF WITH LCP + BG	25	0- 90		12 wee ks	85	GOOD	GROUP 1
16	Krithi	42F	RTA	R	I	C3		15	ORIF WITH LCP+BG	23	0- 90		13 wee ks	83	GOOD	GROUP 1
17	Rajashekar	44M	RTA	L	IIIB	A3	WD, EXFIX	1		37	0- 20	KNEE STIFFN ESS, NON- UNION	-	48	POOR	GROUP 4

										INFECTION				
18	Manoharan	45	MRTA	R I	C3	WD, FIX	EX1	18	0-11	0	32	64	FAIR	GROUP 4
19	Suresh	32	MRTA	L III	AC2	EX FIX	15	ORIF WITH DCS	25	0-10	16	82	GOOD	GROUP 2
20	Ashwin	38	MRTA	R IIIB	C2	EX FIX	15	ORIF WITH DCS→BG +LCP	23	0-11	14	85	GOOD	GROUP 2

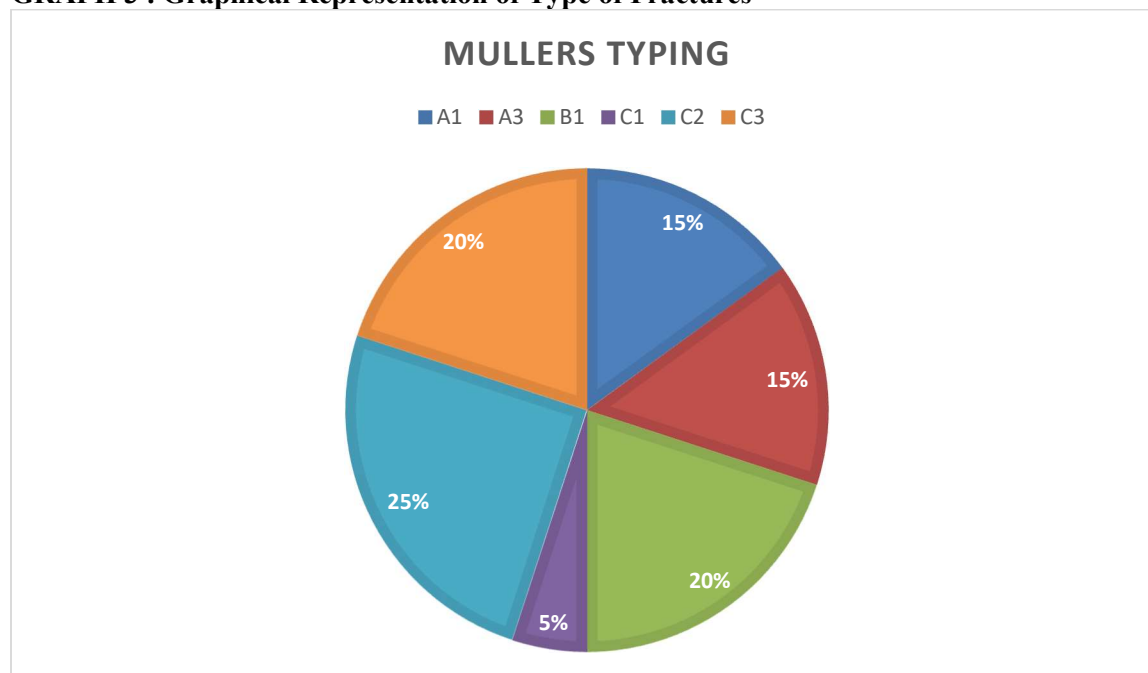
GRAPH 1 : Graphical Representation of Gender Distribution



GRAPH 2: Graphical Representation of Side of Injury



GRAPH 3 : Graphical Representation of Type of Fractures



GRAPH 4: Graphical Representation of Functional Outcome

