

# Original Research Article

## FUNCTIONAL OUTCOME OF OPERATIVE MANAGEMENT OF FEMORAL SHAFT FRACTURES IN CHILDREN WITH TENS (TITANIUM ELASTIC NAILING SYSTEM)

### ABSTRACT

#### BACKGROUND

Femoral shaft fractures account for 1.6% of all bony injuries in children, usually caused by assault or fall during normal play. Male to female ratio being 2.6:1. Low velocity trauma leads to transverse fractures and high speed trauma causes comminuted or segmental fractures.[1-3]

In children who are five years of age or younger, early closed reduction and application of a spica cast is an ideal treatment for most diaphyseal femoral fractures[1]. In skeletally mature adolescents, use of an antegrade solid intramedullary rod has become the standard of treatment[4,5]. The best treatment for children between six and sixteen years of age is still debated. The evaluation and management of patients with femoral shaft fractures in children between 6-14 years of age continue to evolve on the basis of the improved understanding of the local anatomy, impact of treatment, and the biomechanics of fixation techniques.

#### MATERIALS AND METHODS

##### STUDY DURATION

1st September 2014 to 1<sup>st</sup> September 2015 at the Department of Orthopaedics, Calcutta National Medical College Kolkata

*Nail Selection* : Titanium Elastic Nails are available in five diameters: 2.0 mm, 2.5 mm, 3.0 mm, 3.5 mm and 4.0 mm; and are 440 mm in length.

The following sizes were typically used for children of average stature:

6–8 years old 3.0 mm nails

9–11 years old 3.5 mm nails

12–14 years old 4.0 mm nails

Two nails of the same diameter were selected so the opposing bending forces are equal, avoiding malalignment. Femoral fractures in children are typically stabilized with two nails inserted in a retrograde manner from medial and lateral entry points above the distal physis

- a.Countouring the nail
- b.Creating the entry points
- c.Insertion of the nail
- d.Reduction of the fracture
- e.Cutting of the nails :

##### *After treatment*

The patient was kept non weight-bearing for 2 weeks. During this time a long leg back slab was applied for patient comfort. After 2 weeks the back slab along with the skin sutures were removed. Active knee bending exercises were allowed. The patient was allowed partial weight bearing with axillary crutches after 4 weeks. Radiographs were obtained after 6 weeks and progression to full weight bearing was done depending on the status of fracture and amount of callus formation.

##### *Removal of the nails*

The patient was planned for implant removal after consolidation of the fracture which was on an average of 6 months from the date of injury. Self locking extraction pliers were used for this purpose

#### RESULTS

During the study period, 30 cases were randomly selected for inclusion in the study following the inclusion criteria mentioned earlier. cases were managed operatively with internal fixation using titanium elastic nails (TENS). All cases were initially treated by surface traction. applied at the earliest possible moment. Followed by, the patients underwent proper pre operative investigations and pre-anaesthetic check up followed by the definitive surgical procedure. The age range of the patients in the study was 6-14 years, with a mean of 10.2 years treated operatively by TENS. There is no significant difference in between both groups in terms of demographic data ( age, sex ), fracture type and pattern, hospital stay and co morbidities at the time of presentation. All fractures in the operative group united clinically by 8 weeks and radiologically by 10 weeks the difference was statistically significant, proving that patients in the operative group achieved healing milestones at an accelerated pace.

Although there was knee flexion ( avg. 131.50 in the operative group were found to be insignificant on statistical analysis. Shortening was found in the operative group (mean 0.1 cm), and the difference was found to be highly significant on statistical analysis. degrees of angular malalignment in the operative group with means of 1.80

No major complications were seen in patients.

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## **CONCLUSION AND RECOMMENDATIONS**

During the study period, 30 cases were selected to be included in the study which had transverse and short oblique diaphyseal fractures of the femur.30 cases were treated by operative intervention by closed intramedullary nailing with titanium elastic nails.

The age range of the patients was from 6-14 years, with a mean of 8.3 years in the operative group. Males were more frequently affected than females, the ratio being 2.3:1.

The most common mode of injury was motor vehicle accident (MVA) accounting for 70% of the cases and the rest being falls from height. The left side was more frequently found to be injured (in 60% cases). Most of the cases (in 70% cases) in the operative group had their surgeries completed by the 5th post-injury day.

**Keywords : fracture, femur, tens**

- **Introduction:**

Femoral shaft fractures account for 1.6% of all bony injuries in children, usually caused by assault or fall during normal play. Male female ratio being 2.6:1. Low velocity trauma leads to transverse fractures and high speed trauma causes comminuted or segmental fractures.[1-3]

In children who are five years of age or younger, early closed reduction and application of a spica cast is an ideal treatment for most diaphyseal femoral fractures[1]. In skeletally mature adolescents, use of an antegrade solid intramedullary rod has become the standard of treatment[4,5]. The best treatment for children between six and sixteen years of age is still debated. The evaluation and management of patients with femoral shaft fractures in children between 6-14 years of age continue to evolve on the basis of the improved understanding of the local anatomy, impact of treatment, and the biomechanics of fixation techniques.

### **Aims and objectives**

- \* To determine the demographic (age and sex distribution) of paediatric diaphyseal fractures of femur.
- \* To study the advantages of TENS
- \* To study the union rates and functional outcome of closed reduction and internal fixation of paediatric widely displaced diaphyseal fractures of femur with TENS.
- \* To compare the results with those in literature.

### **SPECIFIC OBJECTIVES OF THE STUDY:**

To assess the different types of paediatric femur fractures, their mechanism of injury  
To find the efficacy of application of TENS in femur fractures  
Analysis of result of TENS in paediatric femur fractures  
Study any complication associated with TENS technique

### **Biomechanics of Fracture, Elastic Nailing and Traction:**

The femur is subject to significant bending, axial, torsional stresses that can exceed three to four times body weight during normal activities. The torsional rigidity of a femur fracture treated with intramedullary nails is determined by a combination of nail characteristics and fracture characteristics.

The aim of this biological, minimally invasive fracture treatment is to achieve a level of reduction and stabilization that is appropriate to the age of the child. The biomechanical principle of the Titanium Elastic Nail is based on the symmetrical bracing action of two elastic nails inserted into the metaphysis, each of which bears against the inner bone at three points viz. the three point fixation principle. This produces the following four properties: flexural stability, axial stability, translational stability and rotational stability. All four are essential for achieving optimal results.

## FIG 1 : PRINCIPLE OF FLEXIBLE NAILING

F = force acting on the bone  
R = restoring force of the nail  
S = shear force  
C = compressive force

Traction used for stabilizing femur fractures in our study surface traction. The traction was used with the intention to overcome the muscle spasm and maintaining the alignment of the fracture fragments by stretching of the soft tissues. The muscles in spasm tend to draw the distal part of the body in a proximal direction. A traction force applied to the affected part of the body will overcome muscle spasm only if another force acting in the opposite direction---counter-traction--- is applied at the same time as the traction force. If counter traction is not applied, the whole body will tend to be pulled in the direction of the traction force, and muscle spasm will not be overcome.

The counter traction in case of Thomas' splint was the force applied by the padded ring on the groin while in case of skeletal traction in Bohler-Braun splint, counter traction was applied by elevation of the foot end of the patient's bed and allowing the body weight of the patient to act as the counter traction.

### Materials and methods

The study will be conducted at the Department of Orthopaedics, Calcutta National Medical College Kolkata during the period from SEPTEMBER 2014 to SEPTEMBER 2015 .

#### Study area:

Department of Orthopaedics Surgery, Calcutta National Medical College, Kolkata

#### Inclusion criteria:

- a) Children and adolescent patients from 5 to 15 year with diaphyseal femur fracture.
- b) children of both the sexes are included in the study
- c) children with closed diaphyseal fractures of femur
- d) Patient fit for surgery

#### Exclusion criteria:

- Patients less than 5 years of age and more than 15 years of age.
- Patients unfit for surgery
- Comminuted and segmental fractures
- Patients not willing for surgery
- Open fractures
- Patients unfit for surgery
- Fracture involving the distal 1/3rd of femoral shaft.

## *Operative management with titanium elastic nails*

1. *Initial management:* The patient was put on a simple surface traction with a weight, deemed appropriate for the weight of the patient was applied. The foot end of the bed was simultaneously raised to provide the counter traction.

2. The relevant blood and other investigations were done and cardiological and physician's opinion was taken for surgical fitness of the patient. The patient was then referred to the anaesthesiologist for proper pre-anaesthetic check-up.

3. The patient was then put up for operation.

a. The patient was positioned in the supine position on the fracture table. Traction was then applied using the fracture table foot holder. The image intensifier was positioned on the lateral side of the affected femur for AP and lateral views of the leg from knee to hip. Trial reduction was then attempted under C-arm guidance and proper rotational alignment was determined. In most cases rotational alignment was obtained with 15 degrees of internal rotation to neutralize the anteversion of the femoral neck.

b. After proper preparation of the operative site, the affected limb was draped and sterile C-arm covers were applied to the camera as well as

to the intensifier arms of the C-arm. Meanwhile, a prophylactic antibiotic was administered intravenously.

### *c. Operative procedure:*

*Nail Selection :* Titanium Elastic Nails are available in five diameters: 2.0 mm, 2.5 mm, 3.0 mm, 3.5 mm and 4.0 mm; and are 440 mm in length. The nails are color-coded for easy identification. The narrowest diameter of the medullary canal was measured with a ruler. The proper nail diameter is no more than forty percent of the width of the canal as per Flynn et.al[2]. Another method was used as suggested by Kasser and Beaty[20] which stated that

Nail size =  $\frac{\text{Internal diameter}}{4} - 0.5 \text{ mm}$

The following sizes were typically used for children of average stature:

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### *Removal of the nails*

The patient was planned for implant removal after consolidation of the fracture which was on an average of 6 months from the date of injury. Self locking extraction pliers were used for this purpose

All the patients in the study were assessed for complications, both major and minor according to Flynn's criteria.

**Evaluation:** The results are evaluated with TENS SCORING SYSTEM used by FLYNN et al as shown in table 1

**Table 1 : The Scoring Criteria for Tens**

	Excellent	Successful	Poor
Limb length			
Discrepancy	< 1cm	< 2cm	> 2cm
Sequence			
Disorder	5°	10°	>10°
Pain	Absent	Absent	Present
Complication	Absent	Mild	Major

The patients were put into groups as excellent, satisfactory and poor depending on these parameters

## Statistical Methods

Categorical variables are expressed as Number of patients and percentage of patients and compared across the groups using Fischer's exact test.

Continuous variables are expressed as Mean  $\pm$  Standard Deviation and compared across the 2 groups using Mann-Whitney U test.

The statistical software SPSS version 20 has been used for the analysis.

An alpha level of 5% has been taken, i.e. if any p value is less than 0.05 it has been considered as significant.

## Results and discussion

During the study period, 30 cases were randomly selected for inclusion in the study following the inclusion criteria mentioned earlier. cases were managed operatively with internal fixation using titanium elastic nails (TENS). All cases were initially treated by surface traction. applied at the earliest possible moment. Followed by, the patients underwent proper pre operative investigations and pre-anaesthetic check up followed by the definitive surgical procedure. The age range of the patients in the study was 6-14 years, with a mean of 10.2 years treated operatively by TENS.

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No major complications were seen in patients.

**Table 2 : Sex and frequency in patients**

Sex	Frequency	Percent
Female	10	33.3
Male	20	66.7

Although femoral shaft fractures constitute fewer than 2% of all paediatric fractures, the choice of treatment has remained a constant challenge to the orthopaedics fraternity. Until recently conservative treatment was preferred method for the treatment of diaphyseal fractures in children and young adolescents. However to avoid the effects of prolonged immobilization to reduce the loss of school days and for better nursing care the operative approach has been gaining popularity for the last two decades. Plate osteosynthesis is still widely used. It is associated with a large exposure relatively longer duration of immobilization and the risks of delayed union, infection and a large dissection for plate removal. The external fixator provides good stability and early mobilization but is associated with the risk of pin tract infections and it takes a longer time for weight bearing. Intramedullary K-wire fixation has also been used for pediatric femoral fracture. But stability and fracture angulation is a disadvantage to be taken care of. Interlocking nail is ideal for skeletally matured children. Reports of avascular necrosis of femoral head coxa valga have been reported with interlocking nail when attempted in skeletally immature patients. However there have been proponents for using interlocking nail in the 11-16 years of age group avoiding the pyriformis fossa as entry site with good results.

Titanium elastic nail seems advantageous over other surgical methods particularly in this age group because it is simple is a load-sharing internal splint that doesn't violate open physis, allows early mobilization and maintains alignment. Micromotion conferred by the elasticity of the fixation promotes faster external bridging callus formation. The periosteum is not disturbed and being a closed procedure there is no disturbance of the fracture hematoma, thereby less risk of infection. Flynn et al. found TEN advantageous over hip spica in treatment of femoral shaft fractures in children. Buechsenchuetz et al. documented titanium nail superior in terms of union, scar acceptance and overall patient satisfaction compared to traction and casting. Ligier et al. treated 123 femoral shaft fractures with elastic stable intramedullary nail. All fractures united. Thirteen children developed entry site irritation. Similarly Narayanan et al. found good outcome in 79 femoral fractures stabilized with TEN. There is no comparative study regarding the efficacy of Ender Nail, Rush Nail, or Titanium Elastic Nail. All the nails give good results. Moreover, Ender Nail is not elastic and flexible enough for pediatric fractures as stated by Ligier. Heinrich et al. observed good results in 78 femoral fractures treated with Ender Nail. Fracture geometry and the location is an important determinant for selection of surgical techniques. Transverse, short oblique are suitable for TEN as stated by Flynn et al. Narayanan et al. stated that transverse short oblique short spiral fractures with minimum comminution in the 5-12 years age group were the best indications for TEN. Lascombes et al. stated that TEN could be indicated in all femoral diaphyseal fractures of children above six years of age till epiphysis closed except severe Type III open fractures. Titanium elastic nail does not provide adequate stability in comminuted, long oblique or spiral fractures. Even if it is contemplated, postoperative immobilization becomes essential. Appropriate alternatives other than titanium elastic nail should be considered in such circumstances.

The most common complication of Titanium elastic nail is entry site irritation and pain. Other complications include limb length discrepancy, angulation of fracture, refractures and infection. Entry site irritation in our series was seen in two cases. We found that entry site irritation was significantly associated with long and prominent nail end (>2cm). All these findings were statistically significant. Fractures are more common in boys (2.6:1), and occur in an interesting bimodal distribution with a peak during the toddler years (usually from simple falls) and then again in early adolescence (usually from higher-energy injury).

Over the past 20 years, however, there has been a dramatic and sustained trend towards the operative stabilization of femoral shaft fractures in school-aged children using flexible intramedullary nails, external fixation, locked intramedullary nails, and more recently, submuscular plates. The ideal device for the treatment of most femoral fractures in children would be a simple, load-sharing internal splint that allows mobilization and maintenance of alignment and extremity length until bridging callus forms. The device would exploit a child's dense metaphyseal bone,

rapid healing, and ability to remodel, without risking damage to the physes or the blood supply to the capital femoral epiphysis. Both Ender nails and titanium elastic nails offer these features. The titanium flexible nail with its newer design and improved material ,however provide better inherent stiffness resulting in adequate strength and elasticity as compared to the older Ender's nails. These advances have decreased the substantial early disability for the children, as well as the family's burden of care during the recovery period.

During the study period, 30 cases were selected to be included in the study which had transverse and short oblique diaphyseal fractures of the femur.30 cases were treated by operative intervention by closed intramedullary nailing with titanium elastic nails.

The age range of the patients was from 6-14 years, with a mean of 8.3 years in the operative group.

Males were more frequently affected than females, the ratio being 2.3:1.

The most common mode of injury was motor vehicle accident (MVA) accounting for 70% of the cases and the rest being falls from height. The left side was more frequently found to be injured ( in 60% cases). Most of the cases (in 70% cases) in the operative group had their surgeries completed by the 5th post-injury day. On follow up, we found some complications . They were managed accordingly.

The nail protrusion required another stint to the operating room for trimming of the nail.

Fractures after operation, clinical union at 6.2 weeks on an average and radiological union at 9.3 weeks was seen.

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2 cases had their nails removed at 6 months. The other cases were lost to follow up before removal could be done.

The results were graded according to Flynn et al criteria. The operative group yielded 8 excellent and 2 satisfactory results.

### **Conclusion**

Age, sex, side of the patient have no significant effect on the final outcome in our study group.

There was no significant difference between two groups in terms of demographic data, fracture type and associated co-morbidities.

Internal fixation with titanium elastic nails provide better results, at least in the short term, than conservative treatment in traction. Long term follow up was not done, hence commenting on the final outcome would be inappropriate keeping in mind the remodeling potential in the patients of the study group.

Hence we concluded that internal fixation with titanium elastic nails (TENS) is a better treatment modality for treating pediatric shaft of femur fractures as compared to treatment in traction.

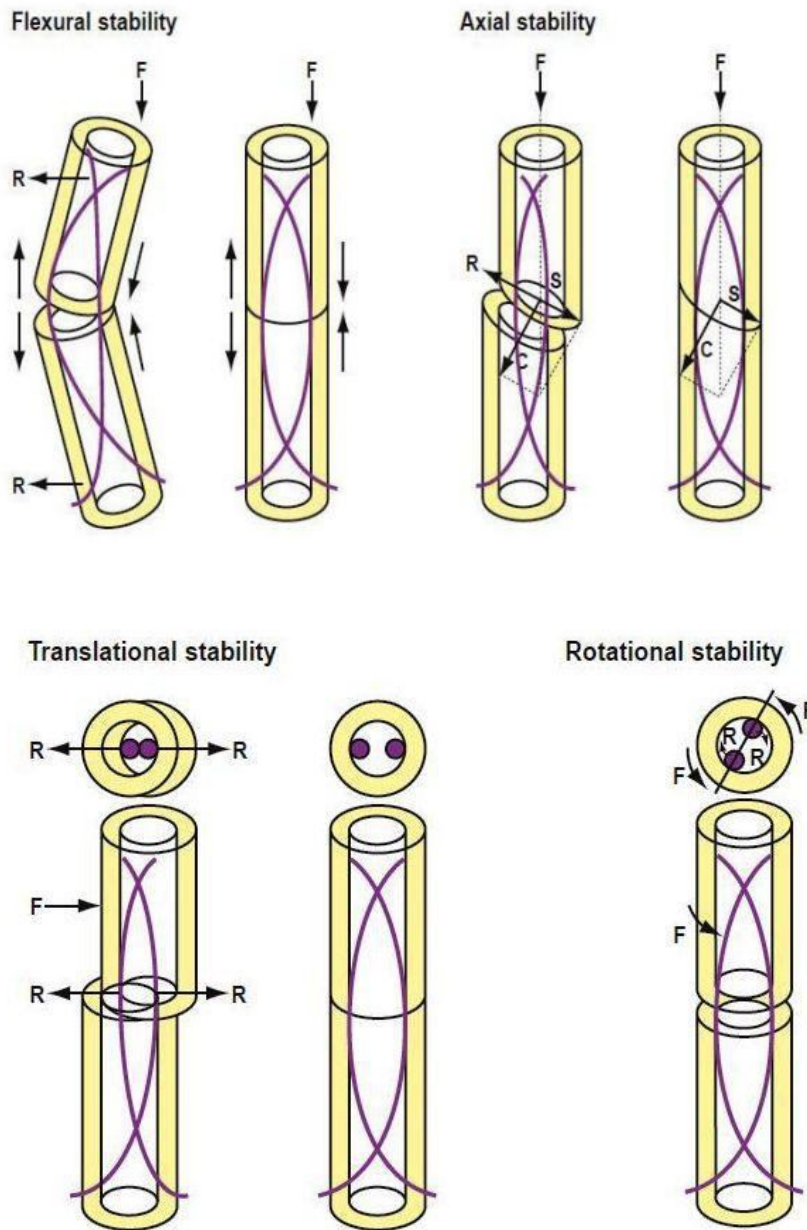
The reasons behind this conclusion were the short period of immobilization, shorter interval between trauma and progression to full weight bearing and accelerated achievement of milestones of fracture healing. The patients in the operative group also had lesser degrees of malalignment at the fracture site

### **References**

1. Rockwood and Wilkins Fractures in Children, Beaty, James H.; Kasser, James R, 7th Edition,(2010) Lippincott Williams & Wilkins, Femoral Shaft Fractures, p.798-838
2. Flynn JM, Schwend RM. Management of pediatric femoral shaft fractures. J Am Acad Orthop Surg 2004;12(5):347-359.
3. Hedlund R, Lindgren U. The incidence of femoral shaft fractures in children and adolescents. J Pediatr Orthop 1986;6(1):47-50.

4. Flynn JM, Skaggs D, Sponseller PD, Ganley TJ, Kay RM, Leitch KK. The operative management of pediatric fractures of the lower extremity. *J Bone Joint Surg Am.* 2002;84:2288 -300
5. Stans AA, Morrissy RT, Renwick SE. Femoral shaft fracture treatment in patients age 6 to 16 years. *J Pediatr Orthop.* 1999; 19:222 -8
6. Fabiano Prata Nascimento et al. Short hospitalization period with elastic stable intramedullary nails in the treatment of femoral shaft fractures in school children. *J Child Orthop* (2010) 4:53–60
7. Beaty JH, Austin SM, Warner WC, Canale ST, Nichols L. Interlocking Intramedullary nailing of femoral shaft fractures in adolescents : preliminary results and complications. *J Pediatr Orthop* 1994; 14:178-83
8. Letts M, Jarvis J, Lawton L, Davidson D. Complications of rigid intramedullary rodding of femoral shaft fractures in children. *J Trauma* 2002;52:504-16
9. Lagvender Shekhar, JC Mayengar. A clinical study of Ender's nail fixation in femoral shaft fractures in children. *Indian Journal Of Orthopaedics; Jan 2006; Volume 40 : Number 1 : p 35-37*
10. Rockwood & Green's Fractures in Adults, Bucholz, Robert W.; Heckman, James D.; Court-Brown, Charles M, 6th Edition(2006) Lippincott Williams & Wilkins, Fractures of the Tibia and Fibula, p2080-2143.
11. Rockwood & Green's Fractures in Adults, Bucholz, Robert W.; Heckman, James D.; Court-Brown, Charles M, 6th Edition(2006) Lippincott Williams & Wilkins, Fractures of the Shaft of the Femur, p 1845-1914.
12. Gustilo RB, Mendoza RM, Williams DM. Problems in the management of type III (severe) open fractures. A new classification of type III open fractures. *J Trauma* 1984;24:742-746.
13. Traction and Orthopaedic appliances, John DM Stewart, Jeffrey P Hallett, 2nd edition(1993), BI Churchill Livingstone Pvt. Ltd., Traction; The Thomas's and Fisk Splints; Fixed traction; Sliding traction, p1-55.
14. The Titanium Elastic Nailing System; Technique Guide; Issued by *Synthes*.
15. John M. Flynn, MD1, Lael M. Luedtke, MD2, Theodore J. Ganley, MD1, Judy Dawson, RN1, Richard S. Davidson, MD1, John P. Dormans, MD1, Malcolm L. Ecker, MD1, John R. Gregg, MD1, B. David Horn, MD1 and Denis S. Drummond, MD. Comparison of Titanium Elastic Nails with Traction and a Spica Cast to Treat Femoral Fractures in Children. *The Journal of Bone and Joint Surgery (American)* 86:770-777 (2004)
16. KC Saikia, SK Bhuyan, TD Bhattacharya, SP Saikia. Titanium elastic nailing of femoral diaphyseal fractures in children in 6-16 years of age. *Indian Journal of Orthopaedics*, Oct-Dec 2007; Issue 4.
17. MK Mam, DJ Dwyer, B John. Fracture shaft of femur in children-Results of treatment. *IJO*, vol 35, no 2, April 2001, p 28-30
18. Atul Bhaskar et.al. Treatment of long bone fractures in children by flexible titanium elastic nails. *IJO*; vol. 39, no.3, July 2005; p 166-168.
19. Usha S. Mani, MD, Christopher T. Sabatino, MS, Sanjeev Sabharwal, MD, David J. Svach, MS, Adam Suslak, MS, and Fred F. Behrens, MD. Biomechanical Comparison of Flexible Stainless Steel and Titanium Nails with External Fixation Using a Femur Fracture Model. *J Pediatr Orthop* 2006;26:182Y187.
20. Kasser JR, Beaty JH. Femoral shaft fractures. In: *Rockwood and Wilkins Fractures in Children*. 5th ed. New York: Lippincott Williams and Wilkins; 2001. 941-80
21. González-Herranz P, Burgos-Flores J, Rapariz J, Lopez- Mondejar J, Ocete J, Amaya S (1995) Intramedullary nailing of the femur in children eVects on its proximal end. *J Bone Joint Surg [Br]* 77(B):262–266
22. Gray's anatomy : the anatomic basis of clinical practice, Susan Standring, 40th edition (2010), Churchill Livingstone, Chapter 80, Pelvic girdle, Gluteal region and Thigh. p 2013-2078.

UNDER PEER REVIEW



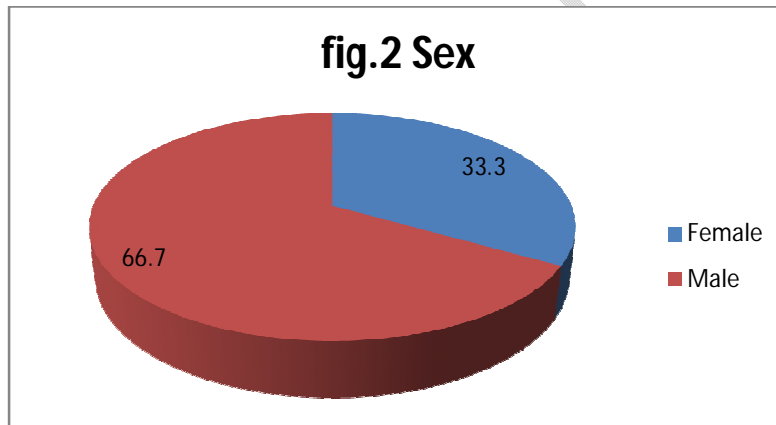
**FIG 1 : PRINCIPLE OF FLEXIBLE NAILING**

F = force acting on the bone  
 R = restoring force of the nail  
 S = shear force  
 C = compressive force

Sex	Frequency	Percent
Female	10	33.3

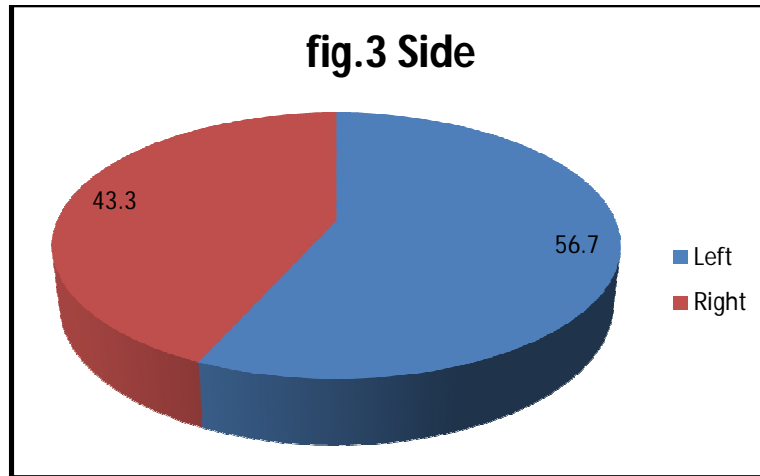
Male	20	66.7
Total	30	100.0

Comment: More male patients were included in the study as they outnumbered the female patients in admission. The cause of more male patient admission was their increased exposure to outdoor activities



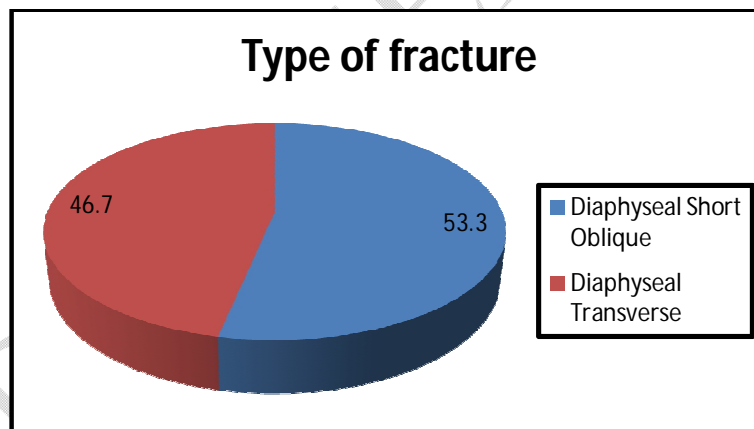
Side	Frequency	Percent
Left	17	56.7
Right	13	43.3
Total	30	100.0

Comment: In my study left femur(56.7%) is more commonly injured than right(43.3%)



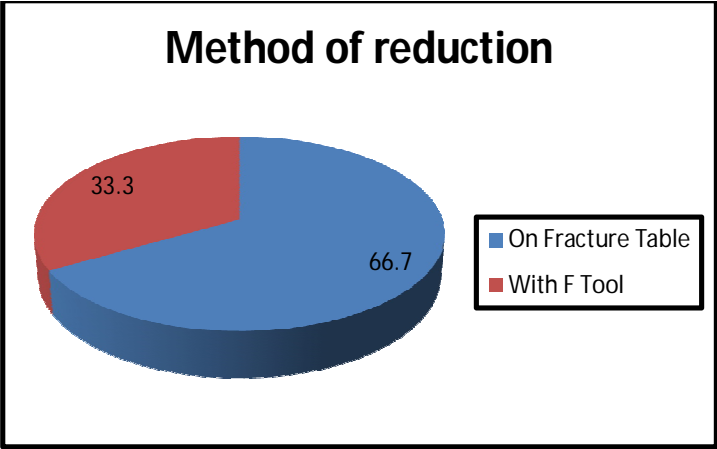
Type of fracture	Frequency	Percent
Diaphyseal Short Oblique	16	53.3
Diaphyseal Transverse	14	46.7
Total	30	100.0

Comment: Diaphyseal short oblique type of femur fracture is mostly encountered (53.3%) in my study other than transverse fracture (46.7%)



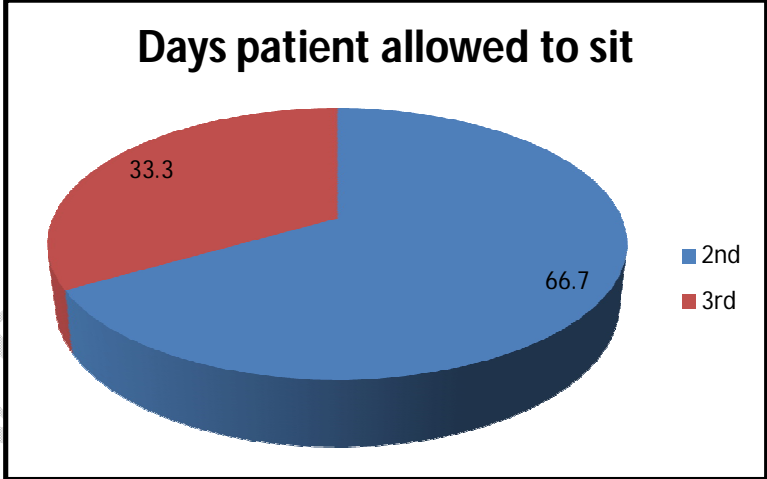
Method of reduction	Frequency	Percent
On Fracture Table	20	66.7
With F Tool	10	33.3
Total	30	100.0

Comment: It is easy and methodical to reduce the fracture on fracture table (66.7%) than to use the F tool (33.3%)



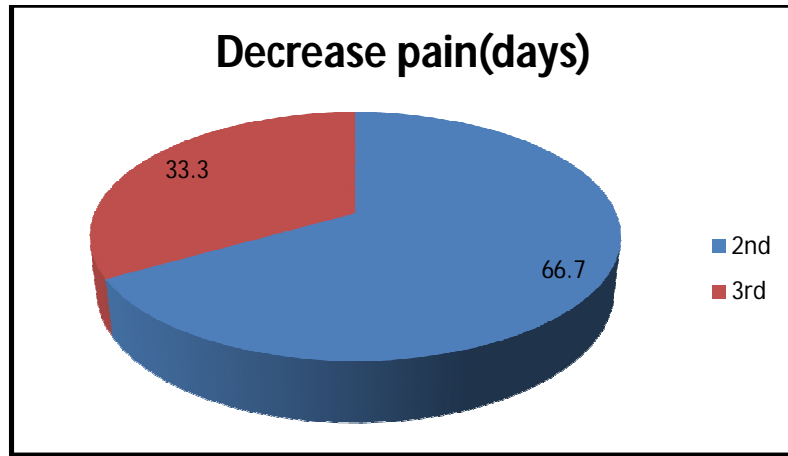
Days patient allowed to sit	Frequency	Percent
2nd	20	66.7
3rd	10	33.3
Total	30	100.0

Comment: most of the patient able to sit on 2<sup>nd</sup> day(66.7%). Few patient allowed to sit on 3<sup>rd</sup> day(33.3%) after pain subside



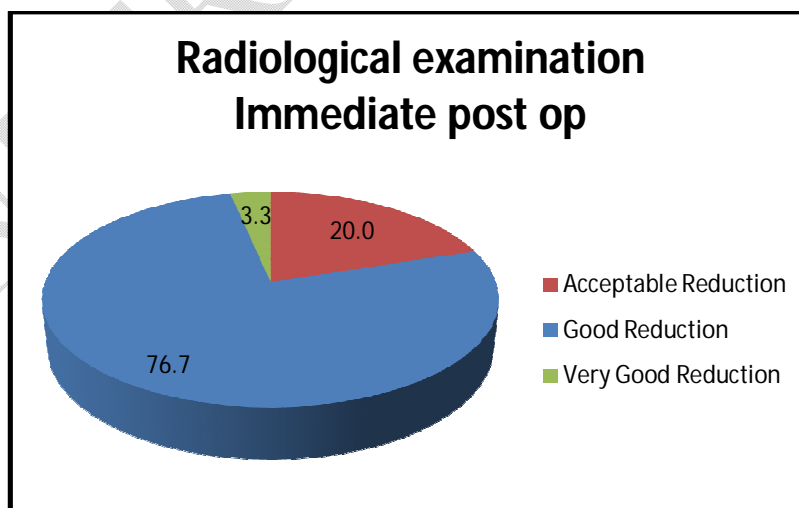
Decrease pain(days)	Frequency	Percent
2nd	20	66.7
3rd	10	33.3
Total	30	100.0

Comment: Most of my patient in my study group not complain of pain after 2<sup>nd</sup> day(66.7%). Few among them are apprehensive with complaining of pain on 3<sup>rd</sup> day(33.3%)



Radiological examination Immediate post op	Frequency	Percent
Acceptable Reduction	6	20.0
Good Reduction	23	76.7
Very Good Reduction	1	3.3
Total	30	100.0

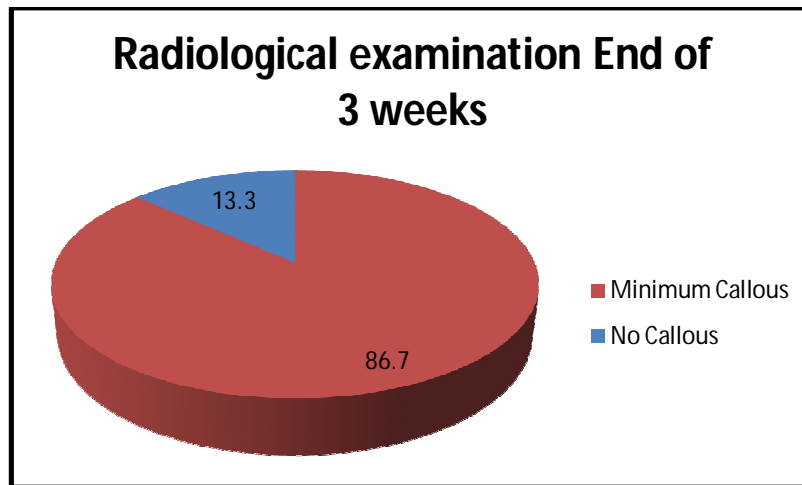
Comment: In total number of 30 patient, immediate post operative image shows 6 patient(20.0%) having acceptable reduction 23 patients having good reduction(76.7%) and one patient (3.3%) shows very good reduction



Radiological examination End of 3weeks	Frequency	Percent
Minimum Callous	26	86.7

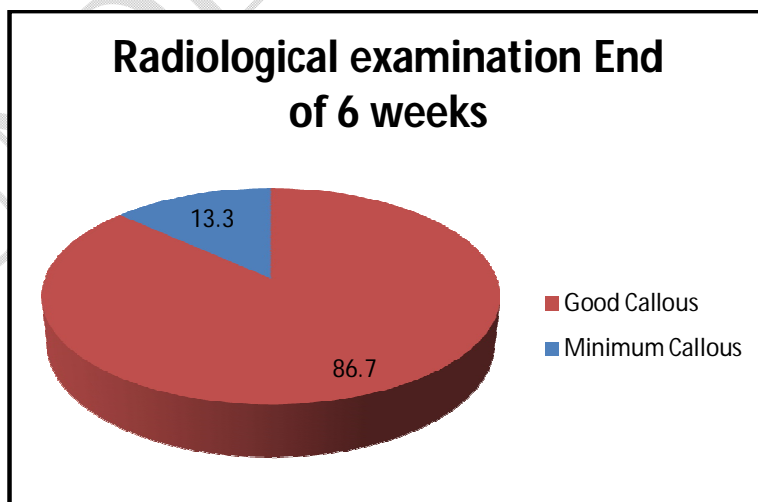
No Callous	4	13.3
Total	30	100.0

Comment: End of 3<sup>rd</sup> weeks 26 patients(86.7%)shows minimum callous where as only 4patients(13.3%)having no callous.



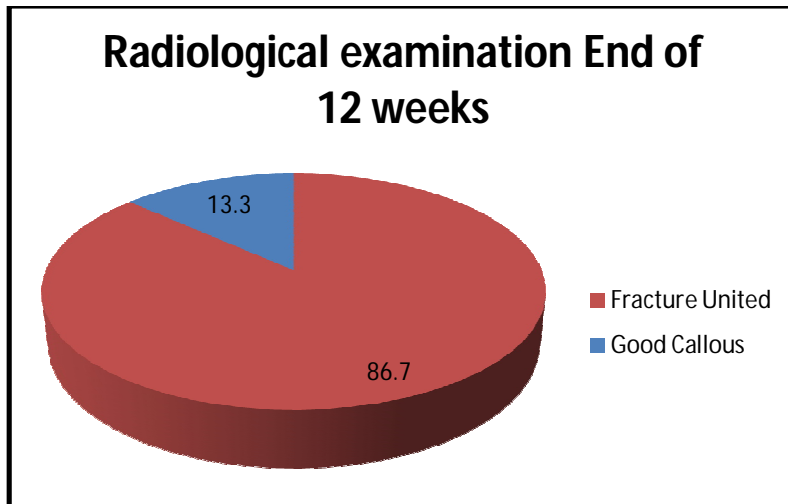
Radiological examination End of 6 weeks	Frequency	Percent
Good Callous	26	86.7
Minimum Callous	4	13.3
Total	30	100.0

Comment: By the end of 6weeks those 4patients(13.3%) started minimum callous formation and those 26patients(86.7%) have already minimum callous in 3<sup>rd</sup> week having progress to good callous



Radiological examination End of 12 weeks	Frequency	Percent
Fracture United	26	86.7
Good Callous	4	13.3
Total	30	100.0

Comment: After end of 12weeks 26 number of patients(86.7%) got their fracture united where as 4 patients(13.3%)progress to good callous

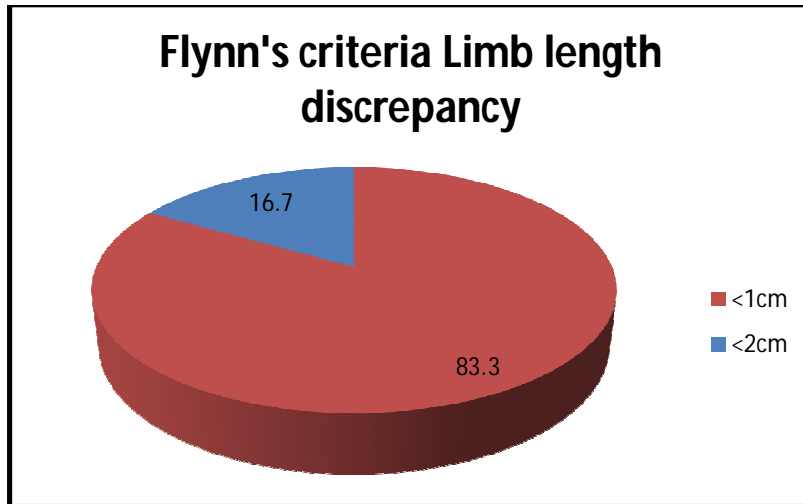


Radiological examination End of 6 months	Frequency	Percent
Remodeling Seen	30	100.0

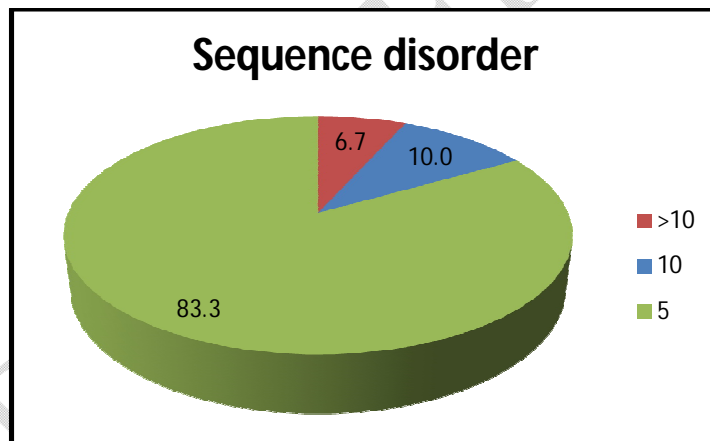
Flynn's criteria Limb length discrepancy	Frequency	Percent
<1cm	25	83.3
<2cm	5	16.7
Total	30	100.0

Comment:Finally at the end of 6months all 30 patints shows remodeling at the fracture site



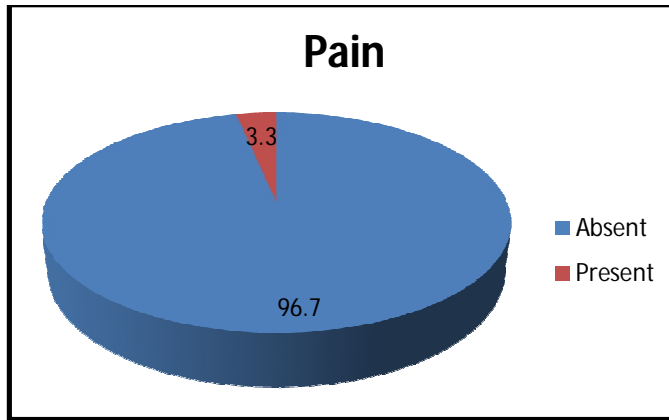
Sequence disorder	Frequency	Percent
>10	2	6.7
10.	3	10.0
5.	25	83.3
Total	30	100.0

Comment: As per Flynn criteria 25 patients(83.3%) are within 5 deg angulation whereas 3patients(10.0%) within 10 deg and 2 patients(6.7%) more than 10 deg



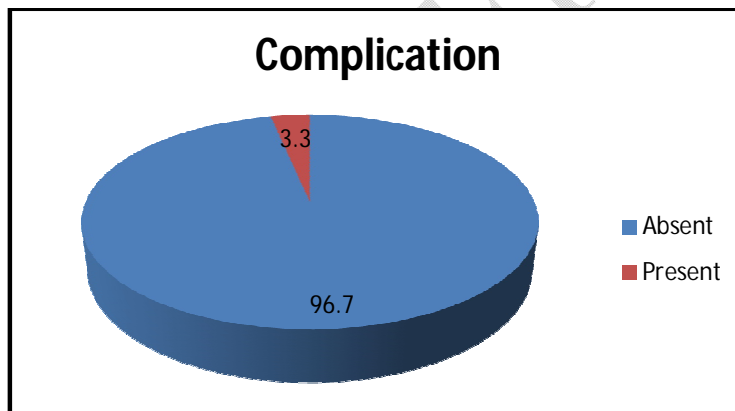
Pain	Frequency	Percent
Absent	29	96.7
Present	1	3.3
Total	30	100.0

Comment: only one patient complaining of pain at the nail entry site(3.3%)



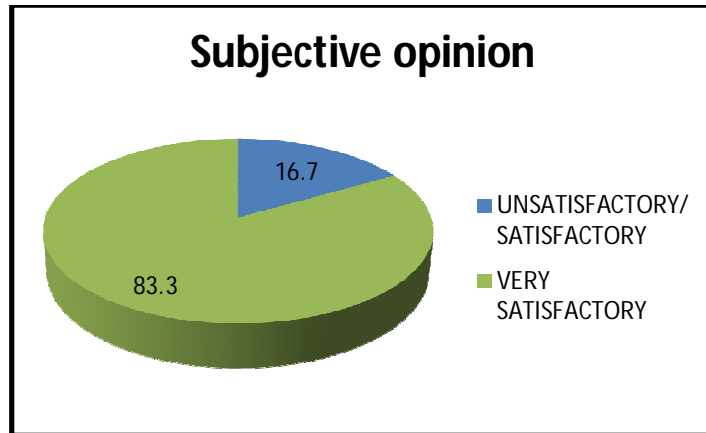
Complication	Frequency	Percent
Absent	29	96.7
Present	1	3.3
Total	30	100.0

Comment: The one case treated with TENS which had developed nail protrusion through the skin, required another stint to the operating room for trimming of the nail. The follow up of all these cases were uneventful



Subjective opinion	Frequency	Percent
UNSATISFACTORY/SATISFACTORY	5	16.7
VERY SATISFACTORY	25	83.3
Total	30	100.0

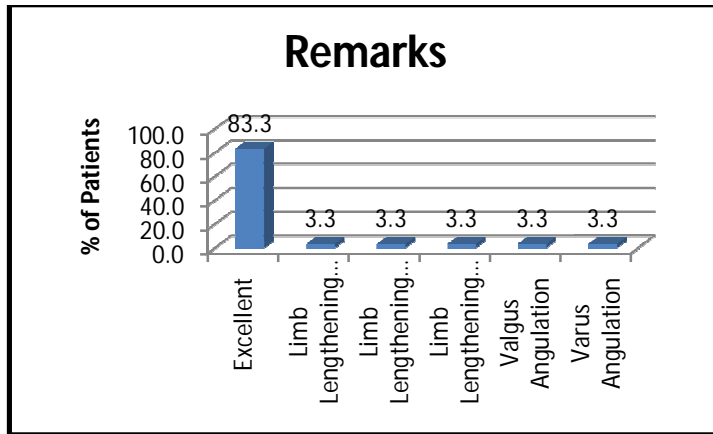
Comment: 25 patients(83.3%) in my study group shows very satisfactory result as per Flynn criteria and radiological image and satisfactory result comes from rest of my 5 patients(16.7%)



Remarks	Frequency	Percent
Excellent	25	83.3
Limb Lengthening 1.2cm	1	3.3
Limb Lengthening 1.3cm	1	3.3
Limb Lengthening 1.4cm	1	3.3
valgus angulation	1	3.3
varus angulation	1	3.3
Total	30	100.0

Comment: Among the five satisfactory case three of them having limb lenthenin one varus and one valgus angulation found in long term follow up.

		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Side	Left	3(60)	14(56)	17(56.67)	0.869	Not Significant
	Right	2(40)	11(44)	13(43.33)		
Total		5(100)	25(100)	30(100)		



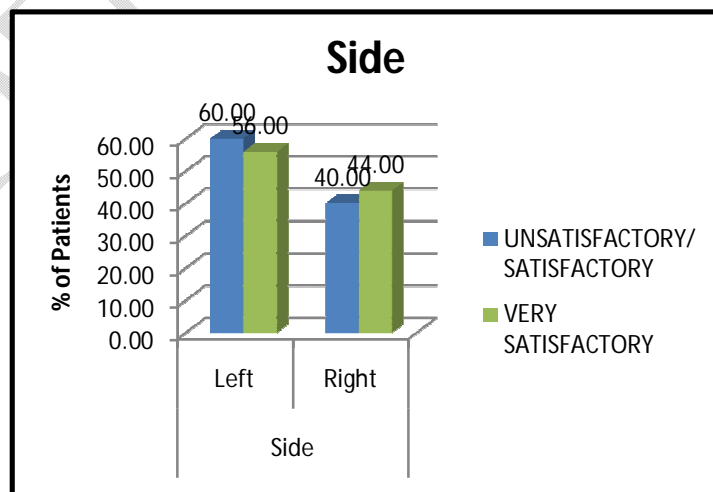
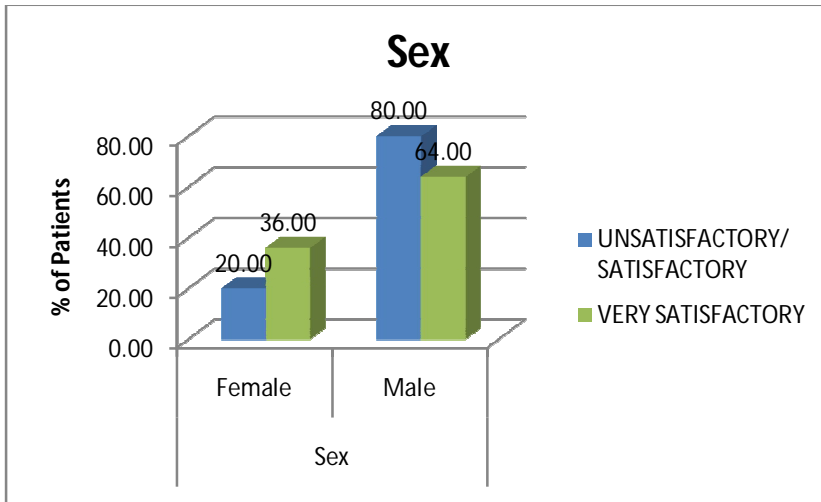
Descriptive Statistics				
	Minimum	Maximum	Mean	Std. Deviation
Age(Yrs)	6	12	8.73	1.84
Time of surgery	60	90	70.33	10.33
Nail diameter	2.5	4.0	3.283	0.34
Length of hospital stays	7	12	8.13	1.25
Follow up	4	6	5.67	0.66
Full wt bearing	6	18	8.73	2.24

Comment: In my study average age is 8.73yrs with average time of surgery is 70.33 mins and the length of hospital stay was 8.13 days. long term follow up and average time of full weight bearing is 8.73 weeks.

		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Sex	Female	1(20)	9(36)	10(33.33)	0.640	Not Significant
	Male	4(80)	16(64)	20(66.67)		
Total		5(100)	25(100)	30(100)		

Comment:

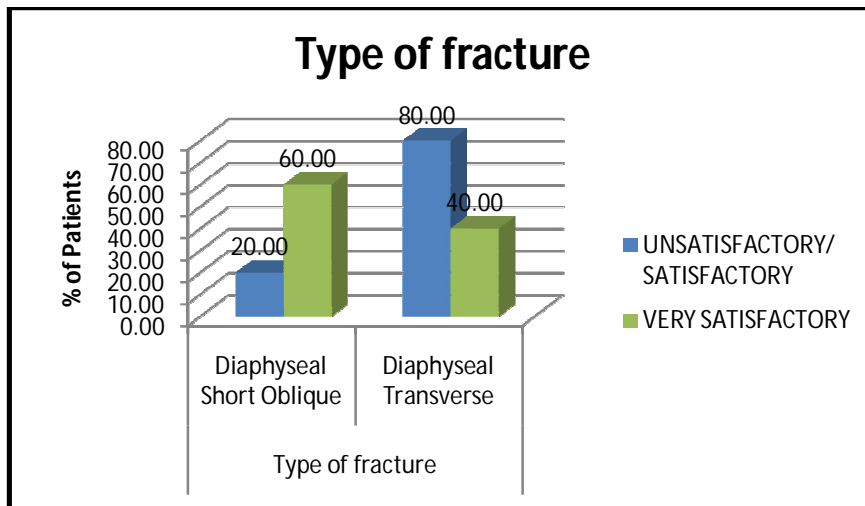
In my study out of 10 female patients only one can developed satisfactory and four male patients developed satisfactory results with statistically p value is 0.640 which is not significant.



	Subjective opinion	Total		
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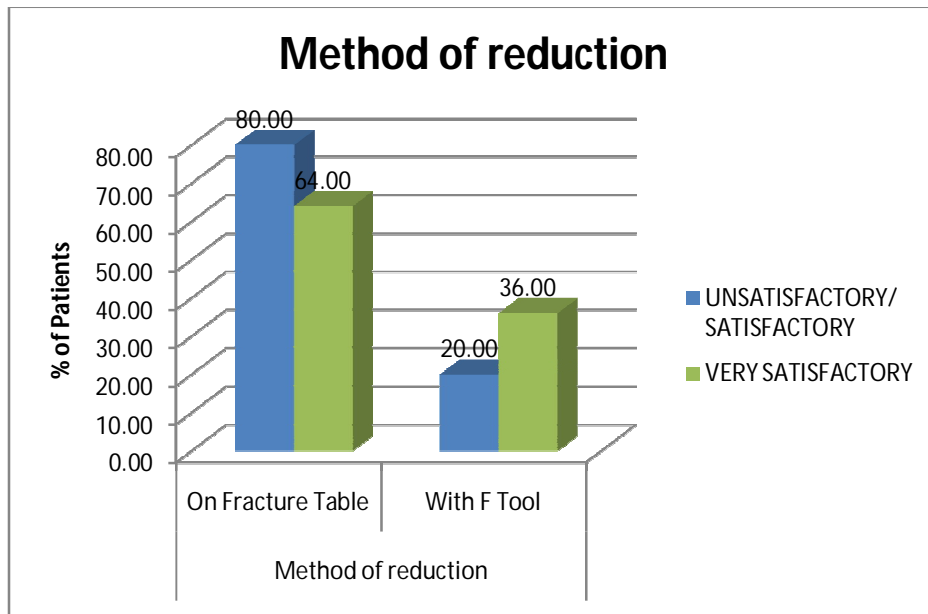
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY		p Value	Significance
Type of fracture	Diaphyseal Short Oblique	1(20)	15(60)	16(53.33)	0.157	Not Significant
	Diaphyseal Transverse	4(80)	10(40)	14(46.67)		
Total		5(100)	25(100)	30(100)		

Comment: In my study either it is short oblique or transverse fracture statistical analysis shows that very satisfactory and satisfactory results are 16(53.33),14(46.67) with p value is 0.157 which is statistically insignificant.



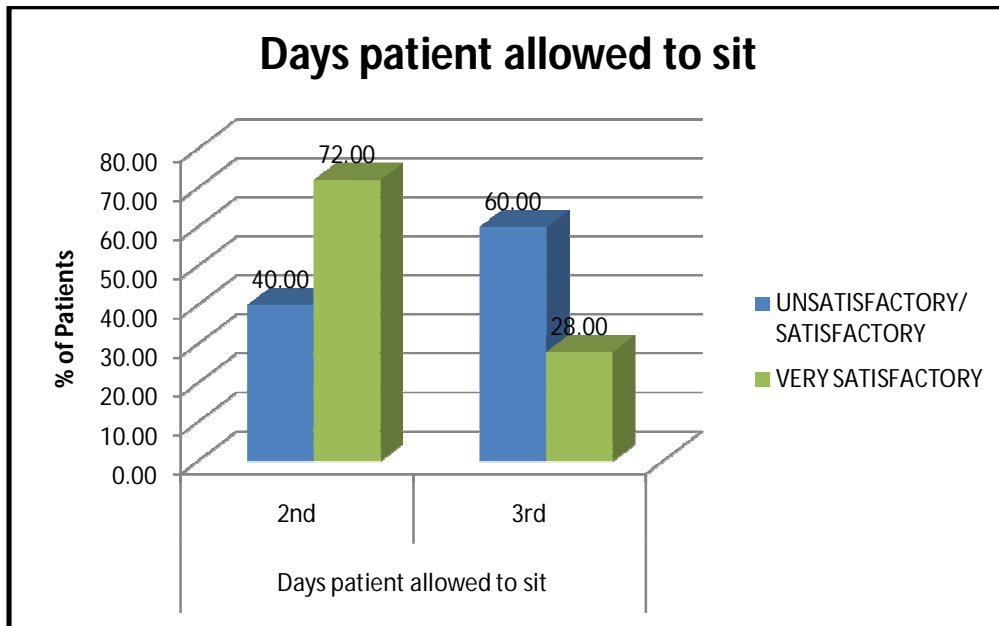
		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Method of reduction	On Fracture Table	4(80)	16(64)	20(66.67)	0.640	Not Significant
	With F Tool	1(20)	9(36)	10(33.33)		
Total		5(100)	25(100)	30(100)		

Comment: Statistically there is no significance whether patient put on fracture table with good reduction and F tool with good reduction. p value is 0.640 which is statistically insignificant.



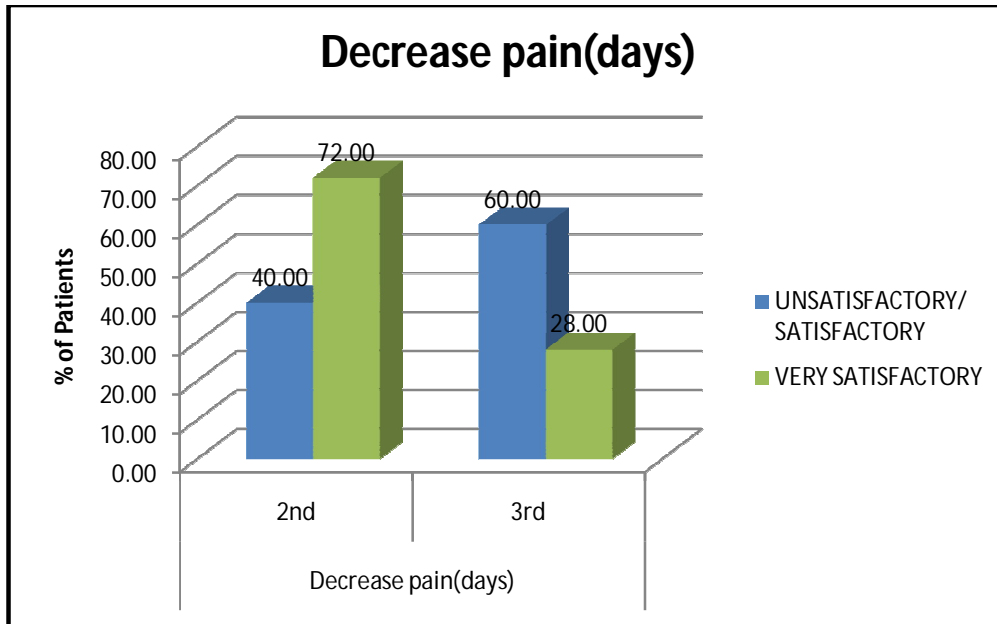
		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/ SATISFACTORY	VERY SATISFACTORY			
Days patient allowed to sit	2nd	2(40)	18(72)	20(66.67)	0.300	Not Significant
	3rd	3(60)	7(28)	10(33.33)		
Total		5(100)	25(100)	30(100)		

Comment: In my study 20 patients (66.67) are allowed to sit on 2<sup>nd</sup> post operative days whereas Only 10 patients allowed to sit on 3<sup>rd</sup> post operative days. Statistical analysis shows the p value is 0.300 which is statistically not significant.



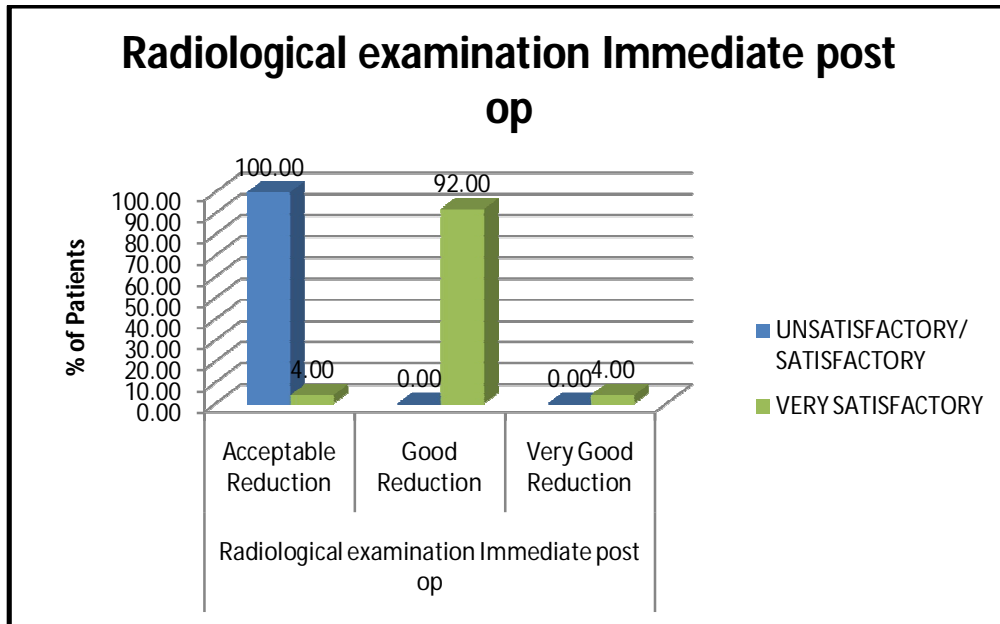
		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Decrease pain(days)	2nd	2(40)	18(72)	20(66.67)	0.300	Not Significant
	3rd	3(60)	7(28)	10(33.33)		
Total		5(100)	25(100)	30(100)		

Comment: In my study total 20 patients reduced their pain by end of 2<sup>nd</sup> day(66.67%) whereas 10 patients not complaining of pain after 3<sup>rd</sup> day of their operation. Statistically p value is 0.300 which is not significant.



		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Radiological examination Immediate post op	Acceptable Reduction	5(100)	1(4)	6(20)	<0.001	Significant
	Good Reduction	0(0)	23(92)	23(76.67)		
	Very Good Reduction	0(0)	1(4)	1(3.33)		
Total		5(100)	25(100)	30(100)		

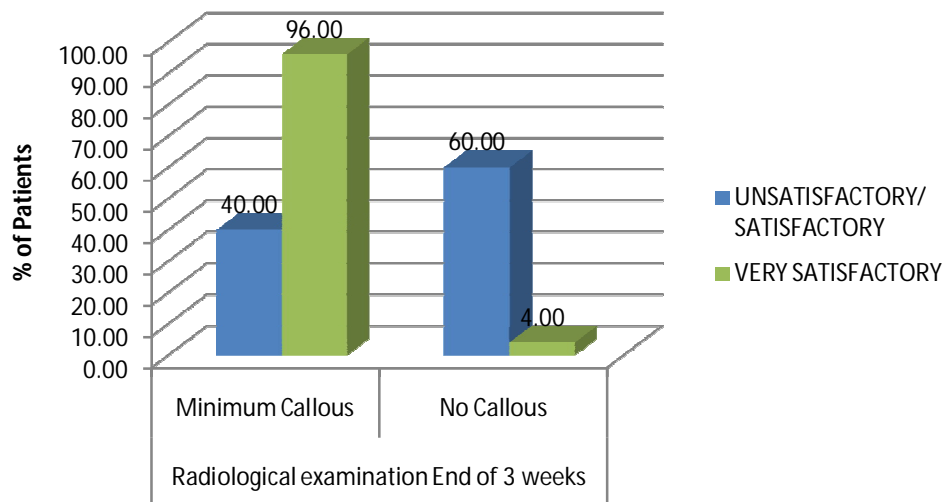
Comment: in post operative images acceptable reduction is six out of which one is very satisfactory, 23 patients shows good reduction whereas only one patients shows very good reduction. After statistical analysis the p value became <0.001 and this is statistically significant



		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Radiological examination End of 3 weeks	Minimum Callous	2(40)	24(96)	26(86.67)	0.009	Significant
	No Callous	3(60)	1(4)	4(13.33)		
Total		5(100)	25(100)	30(100)		

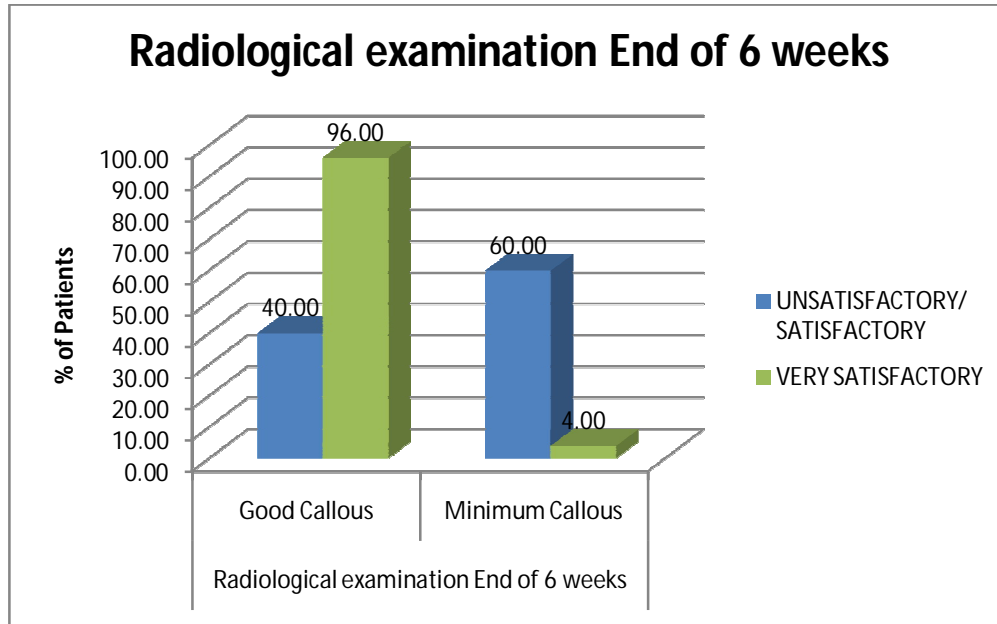
Comment: On 3<sup>rd</sup> week of radiological evaluation there is significant p value with 0.009

### Radiological examination End of 3 weeks



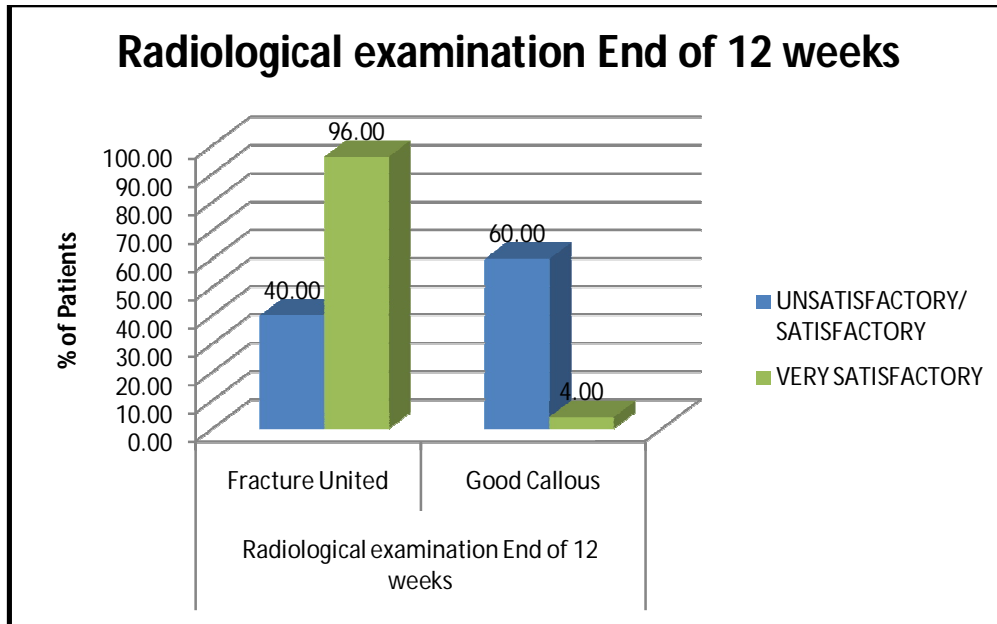
		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Radiological examination End of 6wks	Good Callous	2(40)	24(96)	26(86.67)	0.009	Significant
	Minimum Callous	3(60)	1(4)	4(13.33)		
Total		5(100)	25(100)	30(100)		

Comment: After the end of 6 weeks of radiological evaluation very satisfactory callous formation has seen among 24 patients and 1 patient shows minimum callous with very satisfactory reduction. On statistical testing the difference proved to be highly statistically significant.( $p < 0.05$ ). p value here is 0.009



		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Radiological examination End of 12 wks	Fracture United	2(40)	24(96)	26(86.67)	0.009	Significant
	Good Callous	3(60)	1(4)	4(13.33)		
Total		5(100)	25(100)	30(100)		

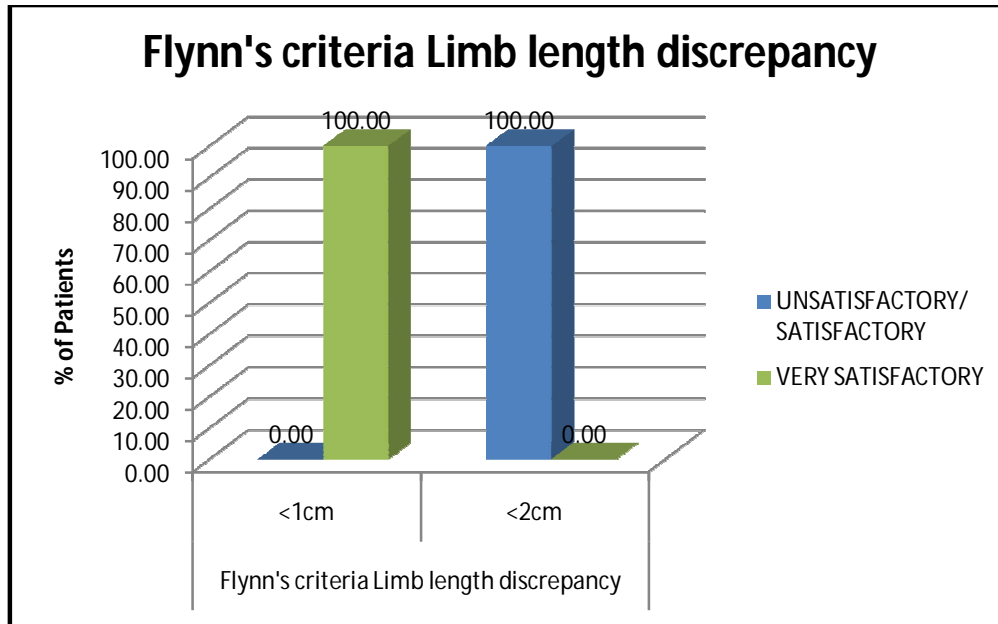
Comment: Statistical analysis shows that the end of 12 weeks of radiological examination is significant with p value 0.009.



		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Radiological examination End of 6months	Remodeling Seen	100.0%	100.0%	100.0%	NA	NA
Total		100.0%	100.0%	100.0%		

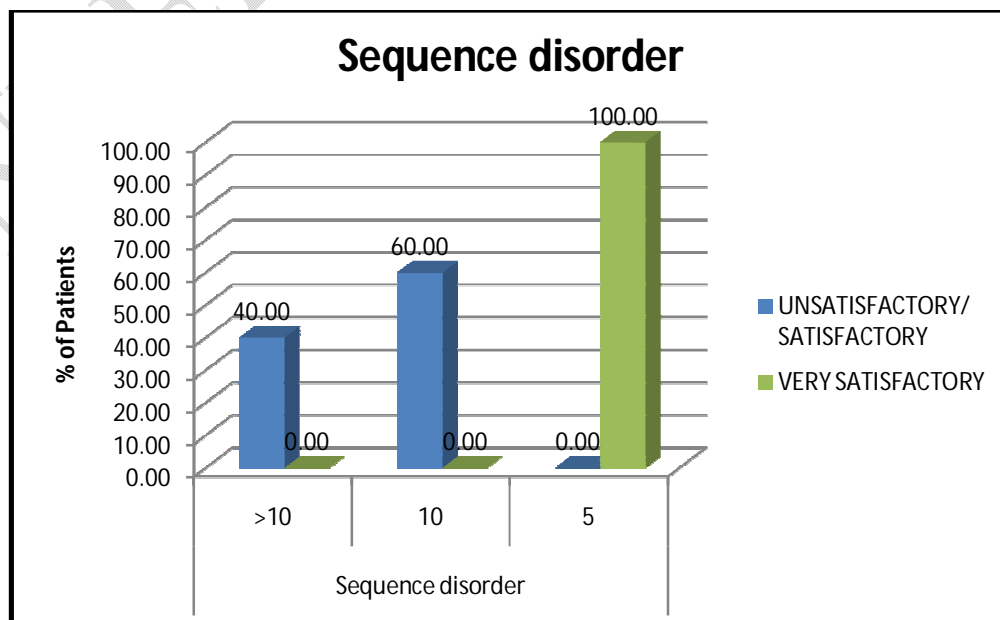
		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Flynn's criteria Limb length discrepancy	<1cm	0(0)	25(100)	25(83.33)	<0.001	Significant
	<2cm	5(100)	0(0)	5(16.67)		
Total		5(100)	25(100)	30(100)		

Comment: In my study out of 30 patients only 5 patients shows limb length discrepancy as per Flynn criteria with a p value of <0.001 which is statistically significant.



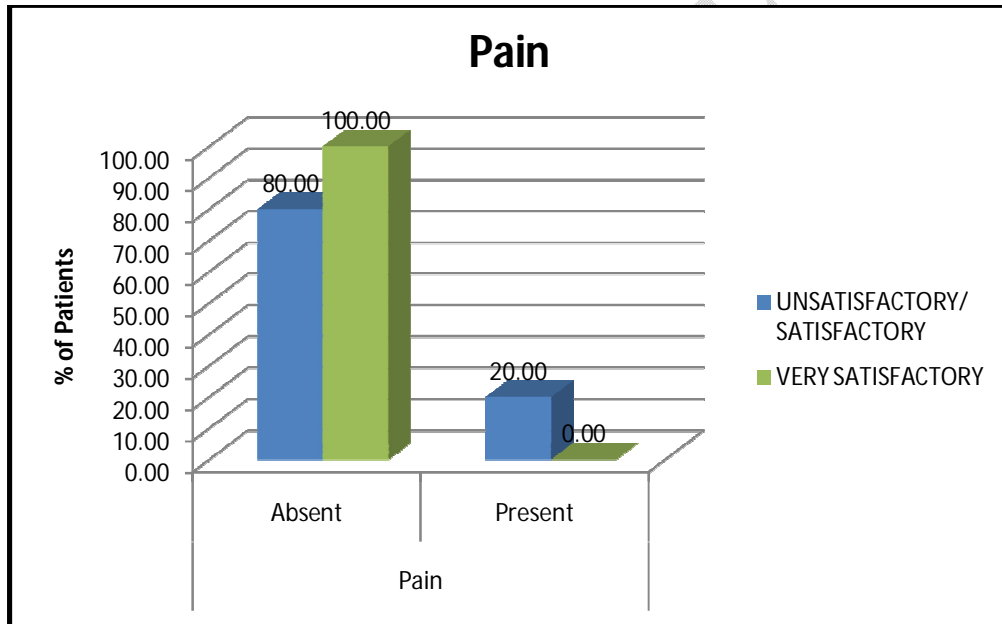
		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Sequence disorder	>10	2(40)	0(0)	2(6.67)	<0.001	Significant
	10.	3(60)	0(0)	3(10)		
	5.	0(0)	25(100)	25(83.33)		
Total		5(100)	25(100)	30(100)		

Comment: At the end of my study all of my patients shows 100% remodeling.



		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Pain	Absent	4(80)	25(100)	29(96.67)	0.167	Not Significant
	Present	1(20)	0(0)	1(3.33)		
Total		5(100)	25(100)	30(100)		

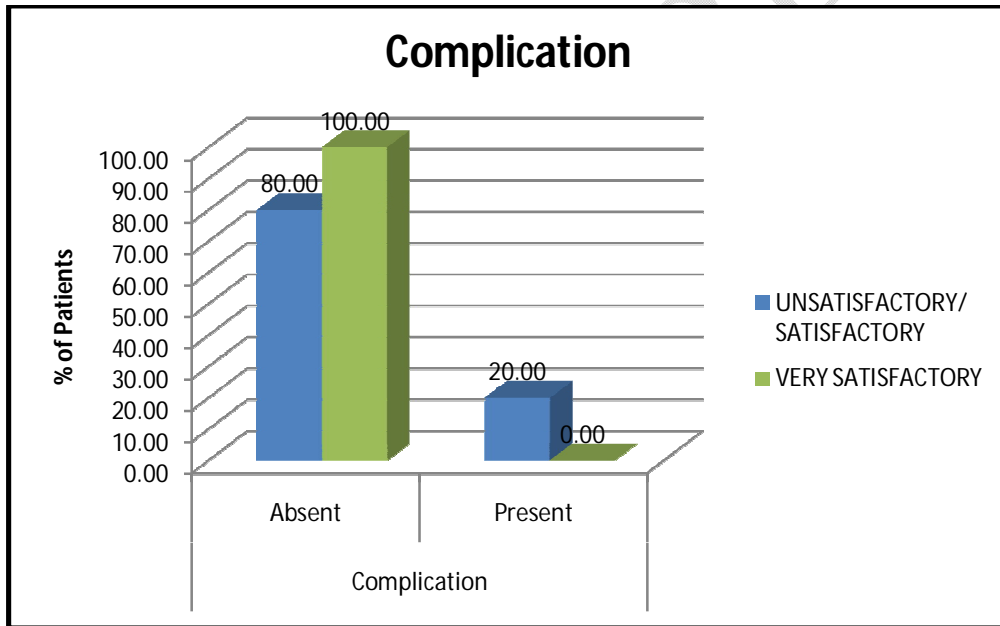
Comment: In my study 2 patients are in the unsatisfactory group with >10 deg angulation and 3 patients in the satisfactory group with 10 deg angulation ,rest 25 patients shows 5 deg angulation with very satisfactory results.After statistical analysis the p value is <0.001 which is significant



		Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			

Complication	Absent	4(80)	25(100)	29(96.67)	0.167	Not Significant
	Present	1(20)	0(0)	1(3.33)		
Total		5(100)	25(100)	30(100)		

Comment: The one case treated with TENS which had developed nail protrusion through the skin, required another stint to the operating room for trimming of the nail. The follow up was uneventful. Statistically p value is not significant.



Remarks	Subjective opinion	Subjective opinion		Total	p Value	Significance
		UNSATISFACTORY/SATISFACTORY	VERY SATISFACTORY			
Excellent		0(0)	25(100)	25(83.33)	<0.001	S

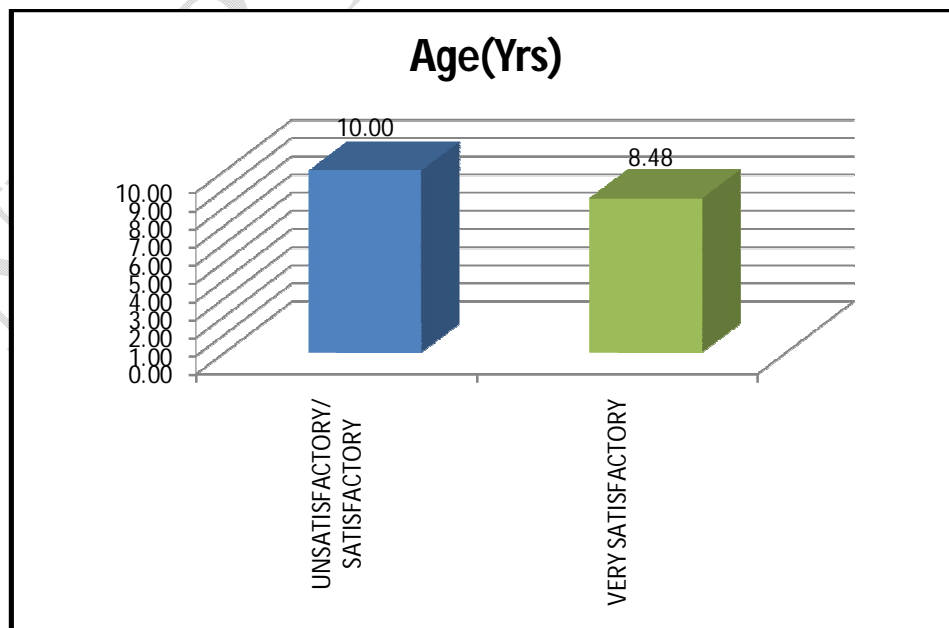
	Limb Lengthening 1.2cm	1(20)	0(0)	1(3.33)	ig ni fi c a nt
	Limb Lengthening 1.3cm	1(20)	0(0)	1(3.33)	
	Limb Lengthening 1.4cm	1(20)	0(0)	1(3.33)	
	Valgus angulation	1(20)	0(0)	1(3.33)	
	Varus angulation	1(20)	0(0)	1(3.33)	
	Total	5(100)	25(100)	30(100)	

Comment:

Among the 30 patients 5 were developed limb length discrepancy and varus valgus angulation as per Flynn criteria. One patient developed 12 deg varus angulation while another one developed 15 deg of valgus angulation..Limb lenthening of less than 1.5cm was found in three cases both clinically and radiologically as well. Statistically p value is <0.001.

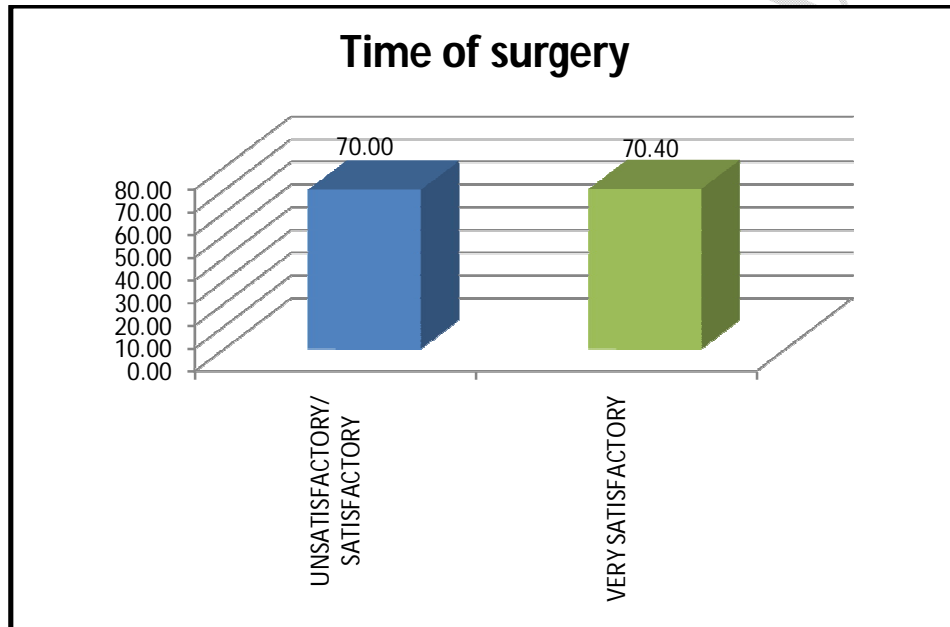
	Subjective opinion				p Value	Significance
	UNSATISFACTORY/SATISFACTORY		VERY SATISFACTORY			
	Mean	Std. Deviation	Mean	Std. Deviation		
Age(Yrs)	10.00	1.58	8.48	1.81	0.086	Not Significant

Comment: Average age of my patients age group is 10.00. Where standard deviation is 1.58 come into a satisfactory group. But in very satisfactory group along with Mean Age is 8.48 with standard deviation is 1.81 and p value is .086. statistically not significant.



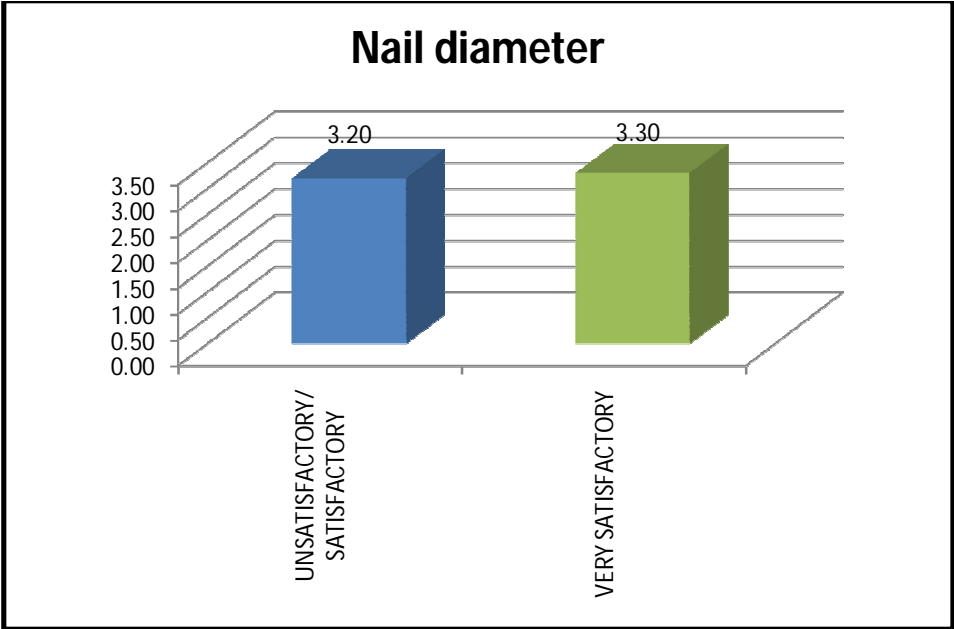
	Subjective opinion				p Value	Significance
	UNSATISFACTORY/SATISFACTORY		VERY SATISFACTORY			
	Mean	Std. Deviation	Mean	Std. Deviation		
Time of surgery	70.00	12.25	70.40	10.20	0.833	Not Significant

Comment: Average time of surgery is 70.00 statistically with Std deviation is 12.25 in satisfactory group but in very satisfactory group it is 70.40 mins along with Std deviation is 10.20. Here p value is not significant



	Subjective opinion				p Value	Significance
	UNSATISFACTORY/SATISFACTORY		VERY SATISFACTORY			
	Mean	Std. Deviation	Mean	Std. Deviation		
Nail diameter	3.20	0.27	3.30	0.35	0.518	Not Significant

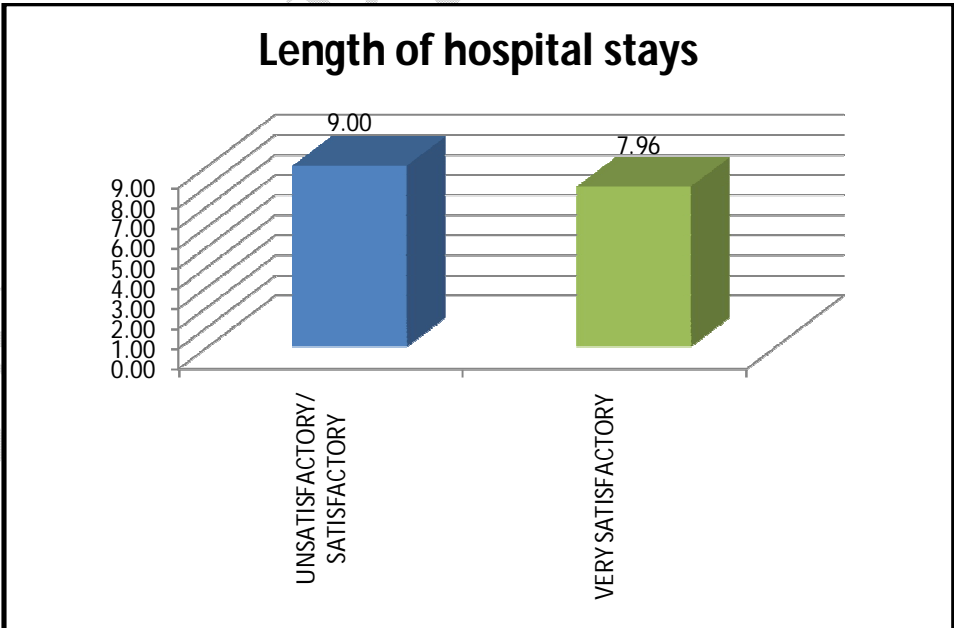
Comment: In my study average nail diameter is mean 3.20mm with Std deviation is 0.27 in satisfactory group. But in very satisfactory group average nail diameter was 3.3 with Std deviation is 0.35. The p value is 0.518.



	UNSATISFACTORY/SATISFACTORY		VERY SATISFACTORY		p Value	Significance
	Mean	Std. Deviation	Mean	Std. Deviation		
Length of hospital stays	9.00	2.00	7.96	1.02	0.229	Not Significant

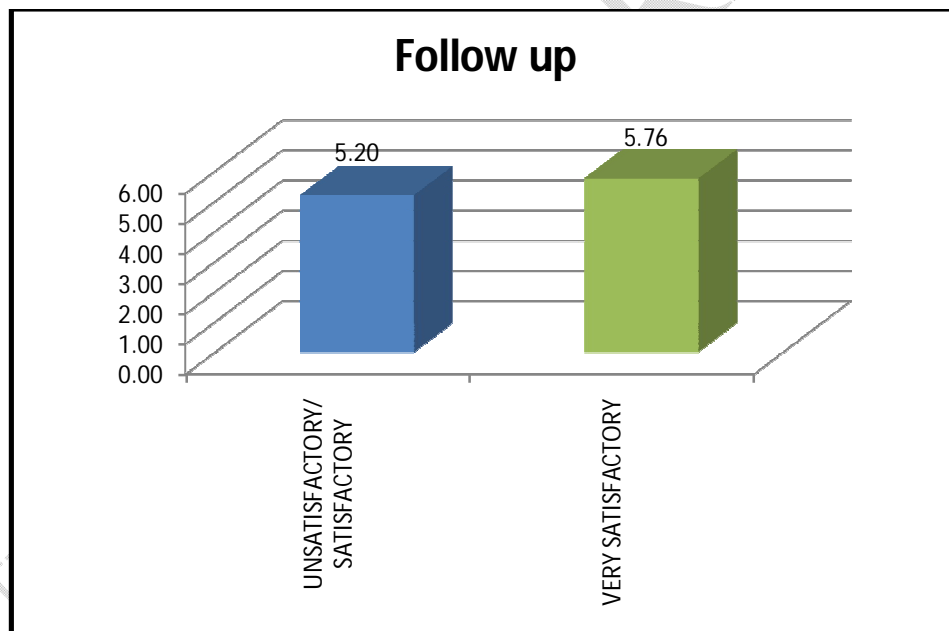
Comment:

Average length of hospital stay mean is 9.0 days and in very satisfactory cases length hospital is very less. mean is 7.95 days and Std deviation is 2.00. and in very satisfactory group mean is 7.95 days. p value is not significant.



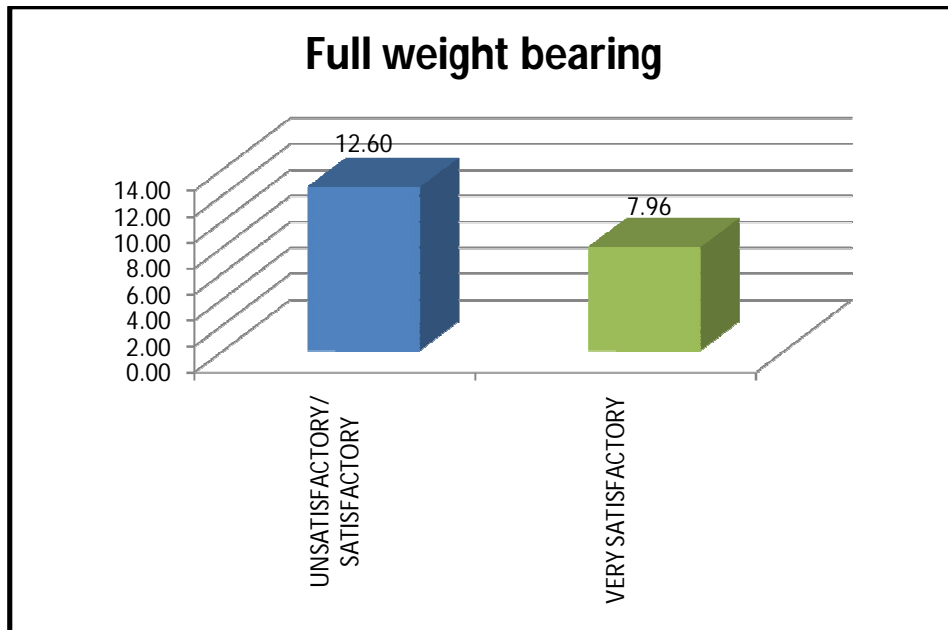
	Subjective opinion				p Value	Significance
	UNSATISFACTORY/SATISFACTORY		VERY SATISFACTORY			
	Mean	Std. Deviation	Mean	Std. Deviation		
Follow up	5.20	0.84	5.76	0.60	0.046	Significant

Comment: Average mean 5.76% and Standard deviation 0.60. p value not significant.



	Subjective opinion				p Value	Significance
	UNSATISFACTORY/SATISFACTORY		VERY SATISFACTORY			
	Mean	Std. Deviation	Mean	Std. Deviation		
Full weight bearing	12.60	3.13	7.96	0.84	<0.001	Significant

Comment: In my study full weight bearing given in satisfactory group with mean 12.60 and std deviation is 3.13 but in very satisfactory group mean is 7.96 and std deviation is 0.84. p value is <0.001 which is statistically significant



## Statistical Methods

Categorical variables are expressed as Number of patients and percentage of patients and compared across the groups using Fischer's exact test.

Continuous variables are expressed as Mean  $\pm$  Standard Deviation and compared across the 2 groups using Mann-Whitney U test.

The statistical software SPSS version 20 has been used for the analysis.

An alpha level of 5% has been taken, i.e. if any p value is less than 0.05 it has been considered as significant.



**PHOTOGRAPH 1 : INSTRUMENTATION SET FOR TENS with CANNULATED HAMMER, SOLID HAMMER, ATTACHMENT ROD, SMALL F-TOOL, UNIVERSAL**

**CHUCK, GIANT WIRE CUTTER, NAIL END BENDER, a bunch of NAILS of various different diameter, AWL.**



**PHOTOGRAPH 2 : PATIENT POSITIONING ON FRACTURE TABLE IN PROGRESS**



UNIVERSITY

LEW



FEMUR  
AP  
BAIDAH DAS 10Y Female  
DISHA DIAGNOSTIC CENTRE, IN FRONT OF MAGRAHAT HOSPITAL.

FEMUR  
LATERAL

Date: 15.06.2015  
DR. C. PURKAIT

UNIL

VIEW



Femur AP

DEPTT. OF RADIODIAGNOSIS, EMG.

CNMC&H & MIDNAPORE DIAGNOSTIC Pvt. Ltd.

BAIDYA DAS. 10 Female

PPP 1036

24/06/2015 10:18:12 AM





Femur LAT

DEPTT. OF RADIODIAGNOSIS, EMG.

CNMC&H & MIDNAPORE DIAGNOSTIC Pvt. Ltd.

BAIDYA DAS. 10 Female

PPP 1036

24/06/2016 10:18:12 AM



28.07.2015  
2008

L

28.07.2015  
190



FEMUR  
AP  
SARAFI SAS 19Y Female  
DINA DIAGNOSTIC CENTRE, in front of MARRIOTT HOTEL.

FEMUR  
Lateral  
AP  
28.07.2015  
MR. C. B. S. C. S. S.

06.09.2015  
1971

06.09.2015  
1

L

8cm

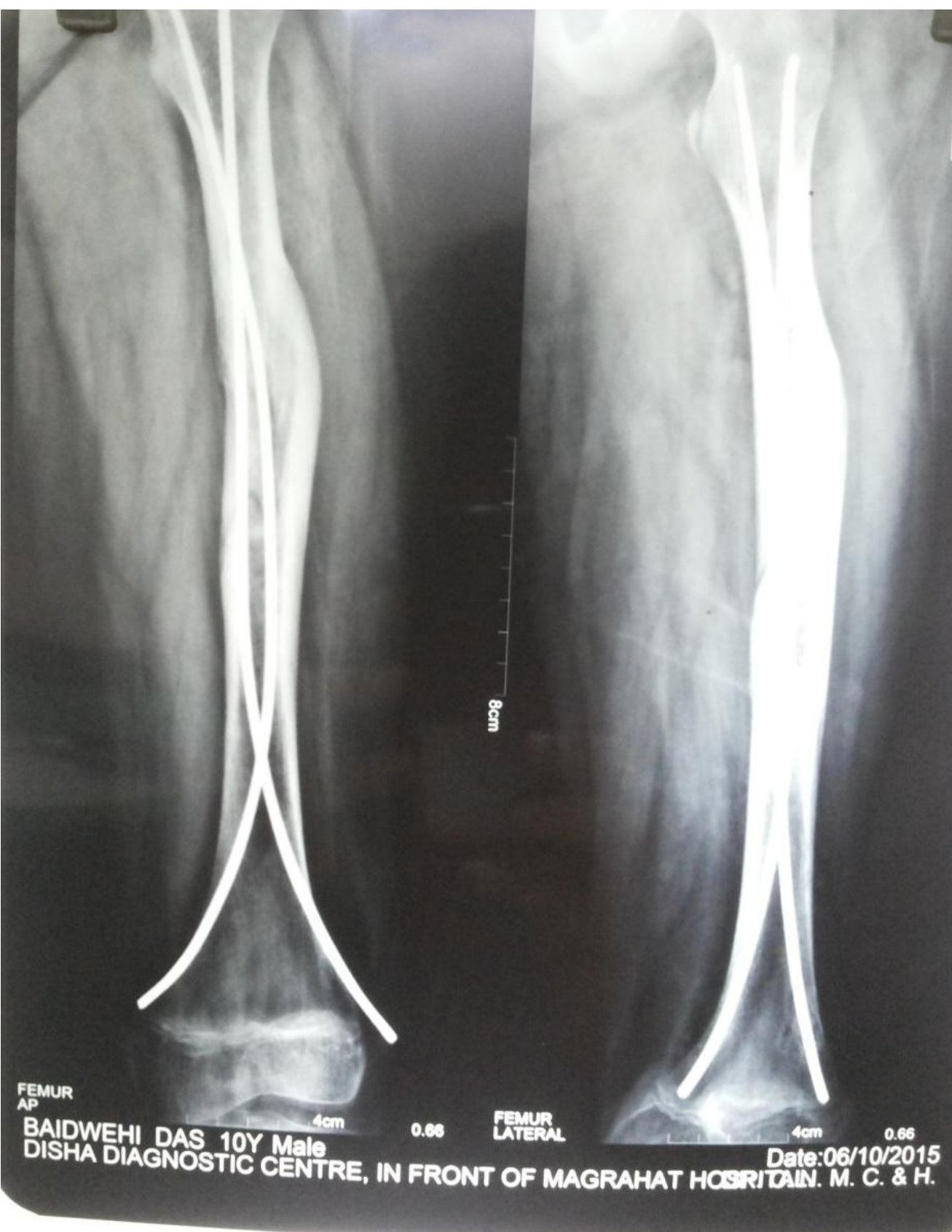
8cm

FEMUR  
AP  
SAIDWENI DAS 10Y Female  
DISHA DIAGNOSTIC CENTRE, IN FRONT OF MAGRAHAT HOSPITAL.

FEMUR  
LATERAL

Date: 06.09.2015  
DR. C. N. M. C. & H.

M



FEMUR  
AP

BIDWEHI DAS 10Y Male

DISHA DIAGNOSTIC CENTRE, IN FRONT OF MAGRAHAT HOSPITAL, M. C. & H.

4cm

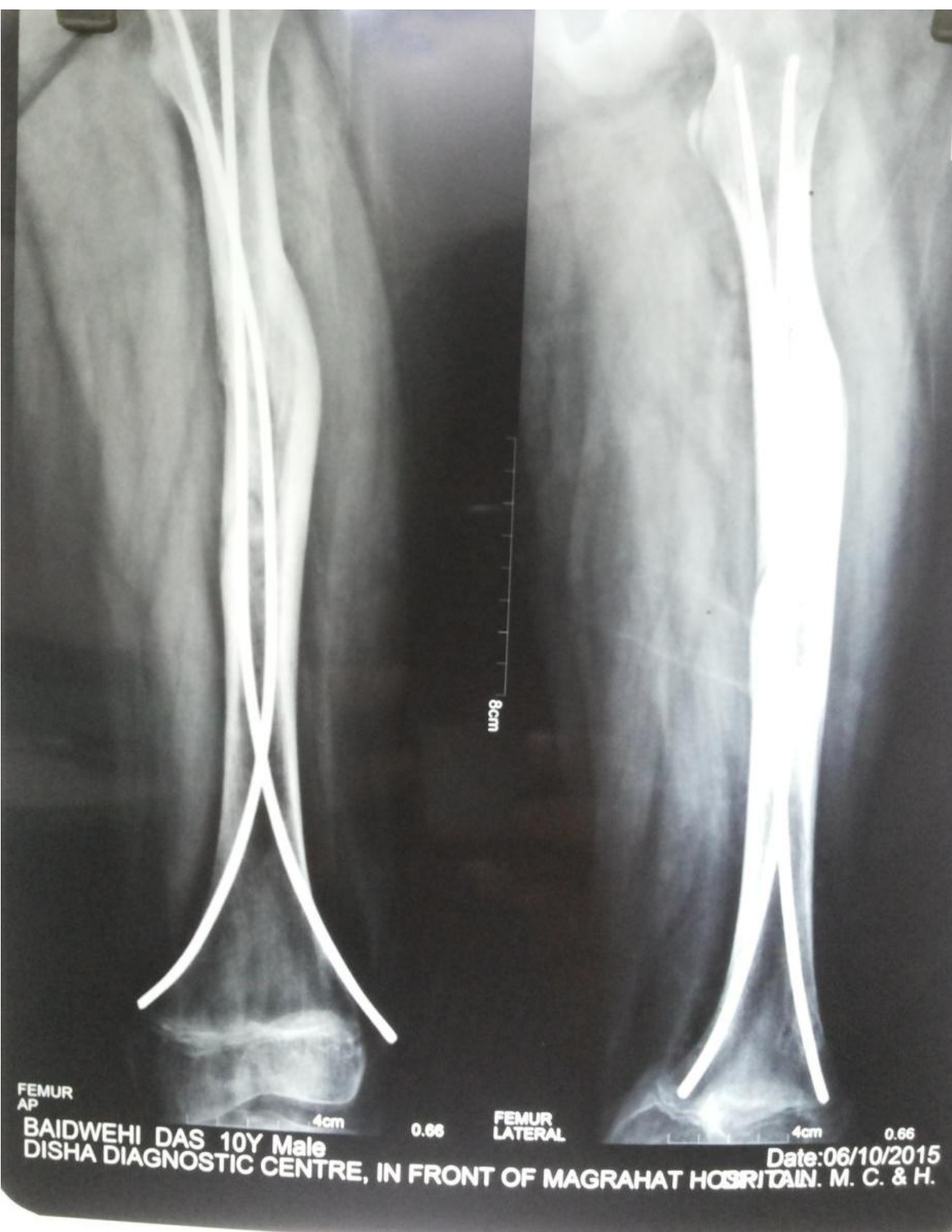
0.66

FEMUR  
LATERAL

Date:06/10/2015

4cm

0.66



FEMUR  
AP

BIDWEHI DAS 10Y Male

DISHA DIAGNOSTIC CENTRE, IN FRONT OF MAGRAHAT HOSPITAL, M. C. & H.

4cm

0.66

FEMUR  
LATERAL

Date: 06/10/2015

4cm

0.66

