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ORIGINAL ARTICLE

TO COMPARE THE EFFICACY OF DIFFERENT DESIGNS OF INTERLOCKING NAILS SINFRACTURE SHAFT OF TIBIA

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ABSTRACT: INTRODUCTION: Interlocked intramedudallary nailing has become the golden standard procedure for the diaphyseal fractures of tibia. Both cannulated reamed nailing and solid unreamed nailing for fracture shaft tibia has its own list of theoritical advantages and disadvantages. With a prospective randomized study we intend to find the difference between cannulated and solid nails. **MATERIALS AND METHODS:** 30 patients of fracture tibia (open & closed) were alternatively operated with cannulated and solid nailing in a tertiary hospital, by the same team of surgeons. Immediate and late postoperative complications, union rate were followed up for 1 year. **RESULTS:** No difference was observed in the incidence of complications like wound infection, embolism. There was no significant difference in the union rate. **DISCUSSION:** As per our study there is no advantage or disadvantage of reamed nailing over unreamed nailing

KEYWORDS: Reamed vs unreamed nailing, union rate, tibia nailing, infection rate, thromboembolism.

INTRODUCTION: With the technological advancement and the advent of faster conveyances and better road facilities in this Era of race for the survival of the fittest, there has been a tremendous increase in the incidence of high velocity trauma. All grades of compound, comminuted and displaced fractures of tibia are encountered, so often in the casualty. This strikes the youth of our country, the most bread earners of the society.

Intramedullary nails with interlocking capabilities were developed in an effort to provide a more stable fracture construct and to expand the spectrum of fractures that could be nailed while avoiding the complications of malunion[2].The tibial nutrient artery supplies 62 % of cortical blood flow in the diaphysis and the normal blood flow is centrifugal. Intramedullary reaming destroy the nutrient artery and the end steal surface of the diaphysis (kuntscher 1958), thus depriving the diaphyseal cortex of its centrifugal arterial blood supply.[1].

Trias and Fery in 1979 however showed that there were anastomoses between the periosteal and the end steal systems in the middle layers of the cortex and argued that anatomically blood could flow either centrifugally or centripetally, depending on the prevailing physiological conditions[3].This study is aimed to compare the results of tibial shaft fractures treated with closed cannulated reamed nails and closed solid unreamed nails.

Different designs of interlocking nails are available with regards to the level and angle of Herzog's bend. In this study standard level and angle of Herzog's bend were used.[2] Interlocking nails have different designs of distal locking holes; the nails which we have used have two distal locking holes. The nails used were made of stainless steel.

Titanium and nails of other material were not used.

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MATERIAL AND METHODS: The present study was conducted at a tertiary level hospital. Thirty consecutive cases with fractures of shaft of tibia were treated with closed interlocking tibial nailing. Duration of study was 2yrs from May 2005 to May 2007.In this study transverse, short oblique, long oblique, spiral, comminuted fractures either closed or open (Gustilo type I, II,IIIA) were included[4]. Closed or open diaphyseal fractures of shaft tibia 4cm away from articular surface of knee and ankle were included.

In this study open fractures shaft tibia grade IIIB and IIIC Gustilo and Anderson classification were excluded. Fractures which lie either 4 cm with in the vicinity of knee and ankle joint were excluded. In this study two designs of interlocking nails solid and cannulated were used. It was a randomized study, every case of fracture shaft tibia was operated with solid nail and cannulated nail alternately.

In cases of simple closed fracture of tibia the limb was splinted using a posterior slab (plaster of Paris slab). If the fracture was compound (Gustilo type I, II, III) the wound was thoroughly cleaned using savlon, hydrogen peroxide (H2O2), normal saline and providine iodine. A sterile dressing was then applied over the wound, and the limb was splinted. Thereafter as soon as the patient was stable a thorough debridement of wound was done and immobilized. Strict aseptic precautions were taken during above procedure. The wounds were left open and daily dressings were begun.

In case of compound fractures, I.V. antibiotics, anti-tetanus serum and anti-gas gangrene serum were given. Radiological examination included A.P and Lateral views of tibial shaft along with knee and ankle joints. All relevant hematological investigations required prior to administration of anesthesia were done.

PREOPERATIVE PLANNING: Size of interlocking nail was calculated by taking measurement on normal side (from tibial tuberosity to medial malleolus) or by taking the X-rays of opposite normal tibia. The diameter of proposed nail was calculated from the X-rays at the narrowest part of the medullary canal and deducting 10% for magnification. Part preparation was done a day prior. I.V antibiotics (usually a first generation cephalosporin) were given just prior to induction of anesthesia.

A) SOLID NAIL: Standard AO type stainless steel nail with regular level of Herzog's bend and two anterior-posterior distal holes, some nails with medio-lateral hole was used.

B) CANNULATED NAIL: Standard AO type cannulated nail stainless steel with regular level of Herzog's bend and two anterior-posterior distal holes, some nails with medio-lateral hole.

OPERATIVE PROCEDURE: The procedure was done under spinal anesthesia. The patient was given supine position. The leg was painted and draped from mid-thigh up to the foot. A tourniquet was applied at mid-thigh level. Studies have shown that use of tourniquet has to higher incidence of pulmonary embolism. In current study complete care was taken to avoid this complication and there wasn't a single case of pulmonary embolism. Two approaches have been described for insertion of nail:

1. A patellar tendon splitting approach and
2. Medial Para patellar tendon approach.

Both approaches were used according to the convenience of the surgeon. After the skin incision of 4 cm the deep fascia was divided and the patellar tendon was exposed.

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The patellar tendon was split and the periosteal of tibia above tibial tuberosity was elevated using a periosteal elevator. The insertion site of the nail was selected by palpating the tibial tuberosity and going above and medial to the tuberosity, approximately 1.5cm distal to the knee joint. An entry point was made with a diamond bone owl and was passed in to the medullary canal to prepare a way for guide wire insertion.

Reduction was checked under the C-arm and the guide wire was passed in under the image intensifier control. After passing the guide wire the position of the guide wire was checked. Then reaming was done by flexible reamers 8mm,8.5mm, 9mm, 9.5mm, 10mm, 10.5mm and 11mm according to the size of the medullary canal. The cannulated nail was inserted along the guide wire. Proximal locking was done using a special jig designed for the same.

Two Distal locking bolts were done under image intensifier (C-Arm) by free hand technique. For the solid nail after making the entry point the nail was inserted by rocking movement and whenever necessary light hammering was done. Nail was inserted without reaming. Proximal locking was done using a special jig designed for the same. Two Distal locking bolts were done under image intensifier(C-Arm) by free hand technique.

X-rays were taken at each visit and compared with immediate post-operative X-rays along with control X-rays:

After 1 month.
After 3 months.
After 6 months.
After 1 year.

RESULTS: The present series was of 30 cases, 15 cases of solid nails and 15 cases of cannulated nails were studied. Age group statistics of the patients showed that 60% were in 20yrs-40yrs of age group. This may be due to the fact that maximum number of patients in this series had Road Traffic Accidents (80%) as the cause of fracture tibia. There were 25 males patients (83.33%) out of which 13 patients(43.33%) were treated with cannulated nails and 12 patients(40%) with solid nails. 5 females patients (16.67%) out of which 2(6.67%)were treated with cannulated and 3(10%)were treated with solid nails in the present study.

In the present study mean time required for radiological union in 15 cases treated with cannulated nail was 20.27weeks and mean time required for radiological union in i5 cases treated with solid nail was 20.53 weeks, with P value >0.05 there was no significant change in the union in both the nails used. In the present series of cannulated and solid nailing there was only 1(6.67%) case of deep infection in both the groups which were treated with regular dressing and oral antibiotics.

Superficial infection was seen in 1 case of cannulated nail and 2 cases of solid nail which did not require any treatment. Infection did not affect the process of union in any of these groups. This study did not have any case of nonunion or delayed union. 2 patients of cannulated nailing and solid nailing each required dynamization after 4 to 6 weeks for union. There was not even a single case of implant failure in the form of bending of nail or breakage of screws in both the nails which were used in this study. In this series of cases there wasn't a single case of compartment syndrome or fat embolism in the post-operative period.

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DISCUSSION: Intramedullary interlocking nailing is the best modality of treatment in closed and open tibial fractures. Different designs of interlocking nails don't have any significant role in fracture healing; it is the intramedullary fixation that has the main role in fracture healing.

Cannulated nail has the following advantages over the solid Nail:

1. Cannulated nails provide the surgical ease for the surgeons while inserting the nail over the guide wire which is not possible in solid nails.
2. Larger diameter nails can be used after reaming which is not possible in solid nails.
3. In comminuted, segmental and long oblique fractures, to maintain reduction while inserting the nail is easier in cannulated nails than solid nails.

Solid nail has the following Theoretical advantages over the cannulated Nail:

1. Solid nails have less chances of infection.
2. Fat embolism is less seen in solid nails due to unreaming.
3. Solid nailing require less time for complete procedure.
4. Solid nail is stronger than cannulated nail.

But our study didn't find any significant difference in the time taken for the fracture union, Incidence of infection or incidence of symptomatic thromboembolism. We suggest further studies with more sample numbers may be help.

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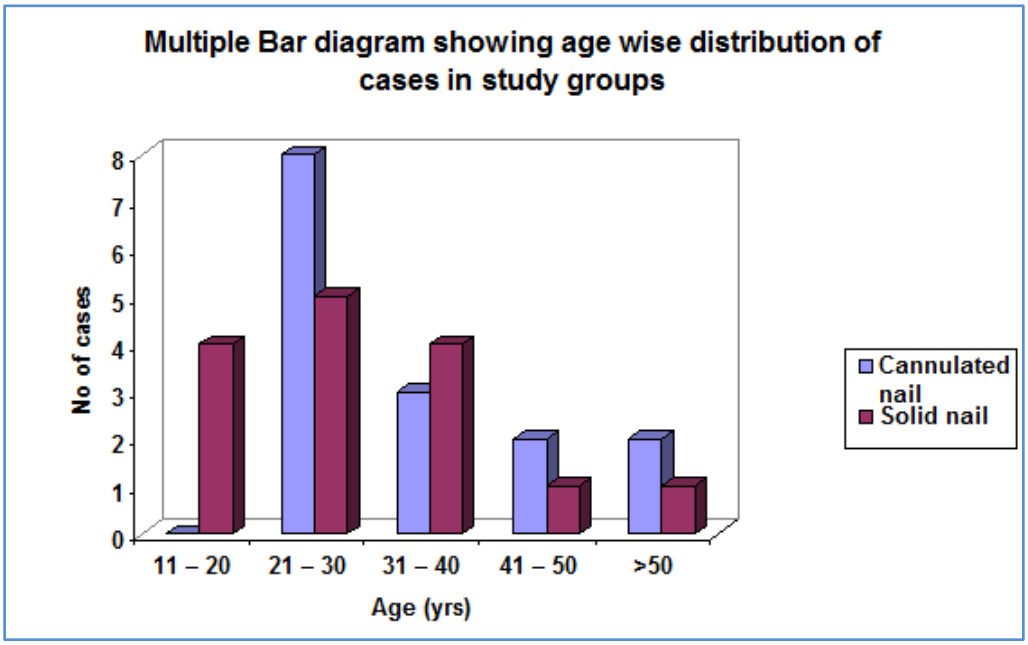
Age (Yrs)	Cannulated nail No. (%)	Solid nail No. (%)	Total No. (%)
11 – 20	0 (0)	4 (13.33)	4 (13.33)
21 – 30	8 (26.66)	5 (16.67)	13 (43.33)
31 – 40	3 (10)	4 (13.33)	7 (23.33)
41 – 50	2 (6.67)	1 (3.33)	3 (10)
>50	2 (6.67)	1 (3.33)	3 (10)
Total	**15 (50)**	**15 (50)**	**30 (100)**

Table 1: Age wise distribution of cases in study groups



Sex	Cannulated nail No (%)	Solid nail No (%)	Total No (%)
Male	13 (43.33)	12 (40)	25 (83.33)
Female	2 (6.67)	3 (10)	5 (16.67)
Total	**15 (50)**	**15 (50)**	**30 (100)**

Table 2: Sex wise distribution of cases in study groups

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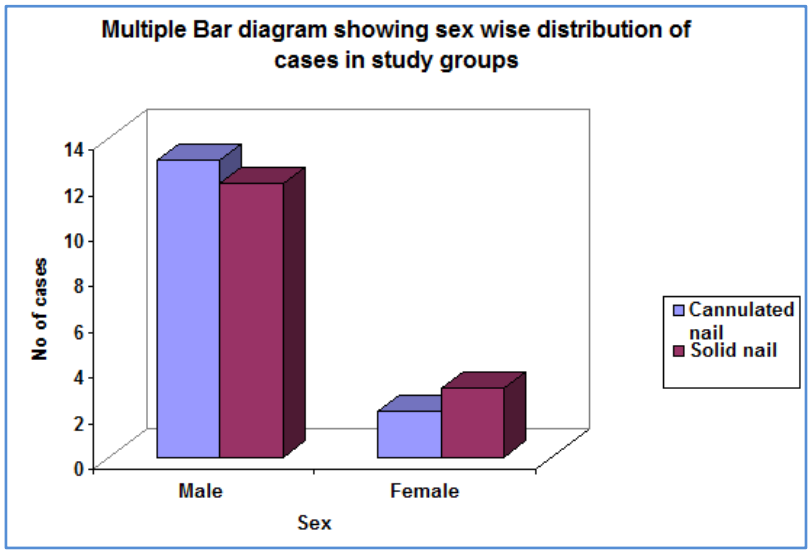
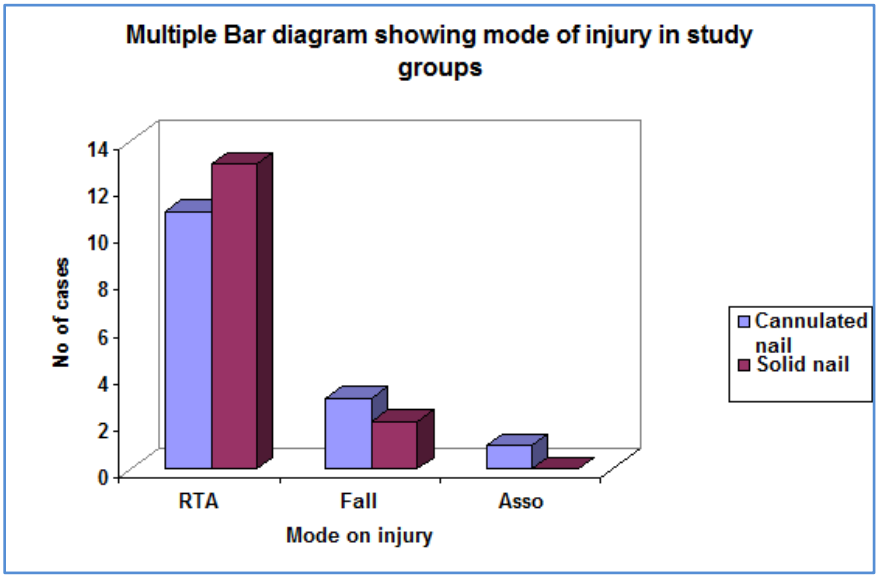


Mode of injury	Cannulated nail	Solid nail	Total
	No (%)	No (%)	No (%)
Road traffic accidents (RTA)	11 (36.67)	13 (43.33)	24 (80)
Fall	3 (10)	2 (6.67)	5 (16.67)
Assault	1 (3.33)	0 (0)	1 (3.33)
Total	15 (50)	15 (50)	30 (100)

Table 3: Mode of injury in study groups

$\chi^2 = 1.37$, $P>0.05$.



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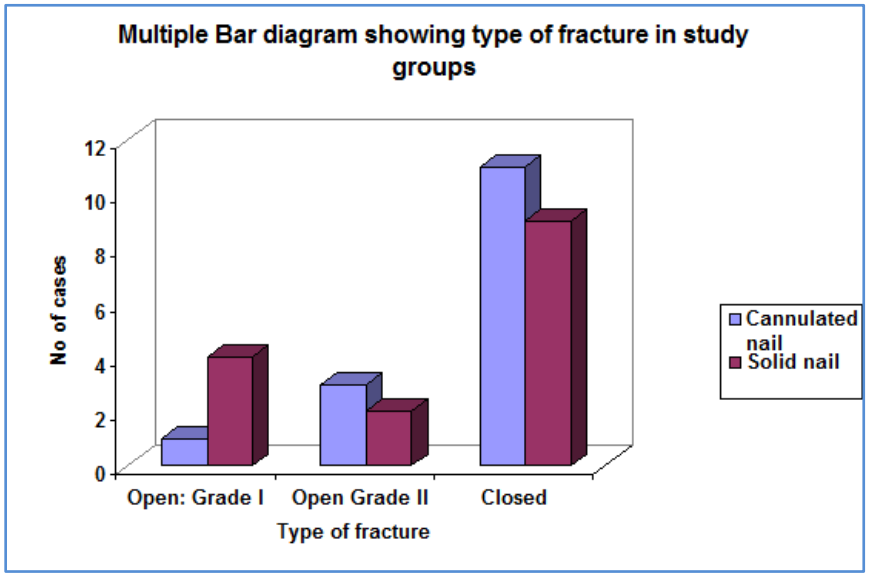
Type of fracture	Cannulated Nail	Solid nail	Total No (%)
	No (%)	No (%)	
Open: Grade I	1 (3.33)	4 (13.33)	5 (16.66)
Grade II	3 (10)	2 (6.67)	5 (16.67)
Closed	11 (36.67)	9 (30)	20 (66.67)
Total	**15 (50)**	**15 (50)**	**30 (100)**

Table 4: Type of fracture in study groups

$\chi^2 = 1.37$, P>0.05.



Location	Cannulated nail	Solid nail	Total No (%)
	No (%)	No (%)	
Upper / 3 – middle /3	4 (13.33)	3 (10)	7 (23.33)
Middle / 3	7 (23.33)	7 (23.33)	14 (46.66)
Middle / 3 – lower / 3	3 (10)	5 (16.67)	8 (26.67)
Lower / 3	1 (3.33)	0 (0)	1 (3.33)
Total	**15 (50)**	**15 (50)**	**30 (100)**

Table 5: Location of injury in study groups

$\chi^2 = 1.64$, P>0.05

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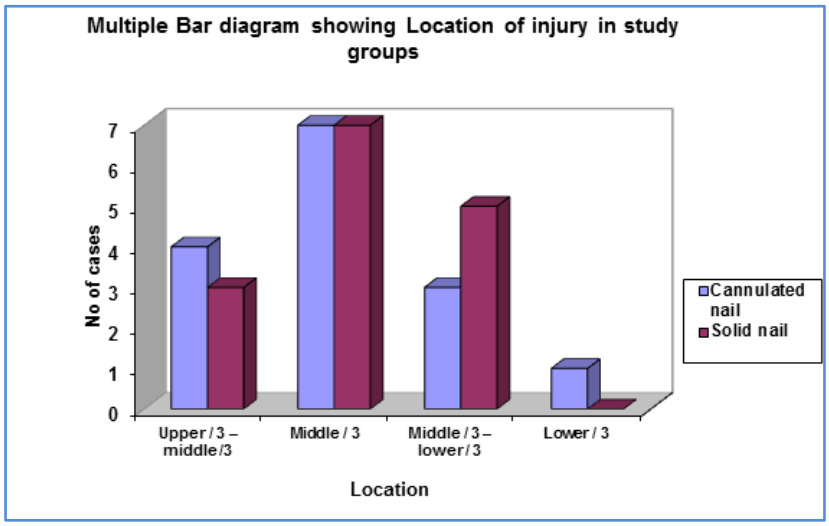
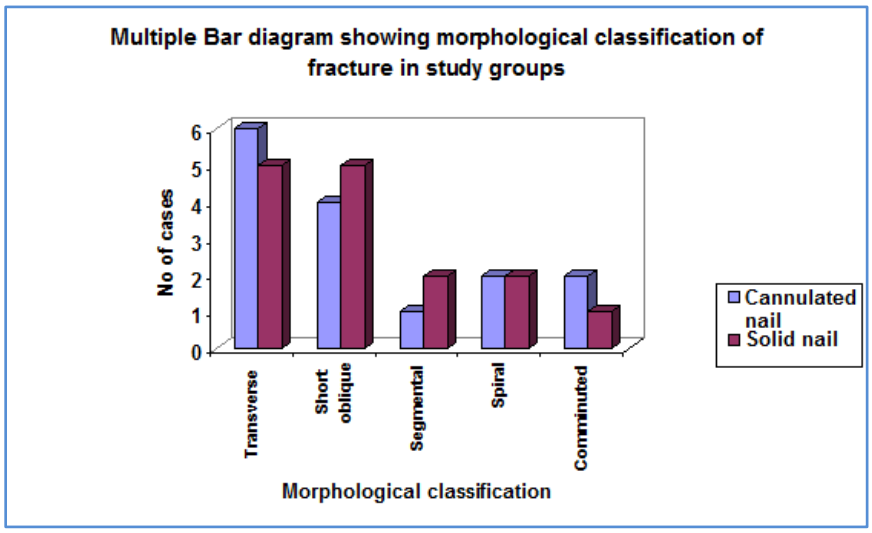


Type	Cannulated nail	Solid nail	Total
	No (%)	No (%)	No (%)
Transverse	6 (20)	5 (16.67)	11 (36.67)
oblique	4 (13.33)	5 (16.67)	9 (30)
Segmental	1 (3.33)	2 (16.67)	3 (10)
Spiral	2 (6.67)	2 (6.67)	4 (13.33)
Comminuted	2 (6.67)	1 (3.33)	3 (10)
Total	**15 (50)**	**15 (50)**	**30 (100)**

Table 6: Morphological classification of fractures in study groups

$\chi^2 = 0.87$, $P>0.05$.



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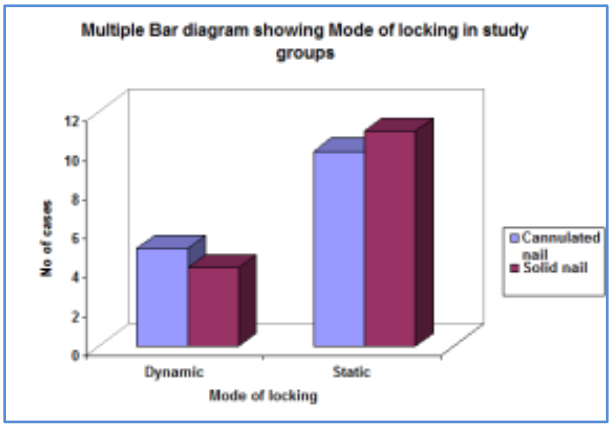
Mode of locking	Cannulated nail	Solid nail	Total
	No (%)	No (%)	No (%)
Dynamic	5 (16.67)	4 (13.33)	9 (30)
Static	10 (33.33)	11 (36.67)	21 (70)
Total	**15 (50)**	**15 (50)**	**30 (100)**

Table 7: Mode of locking in study groups

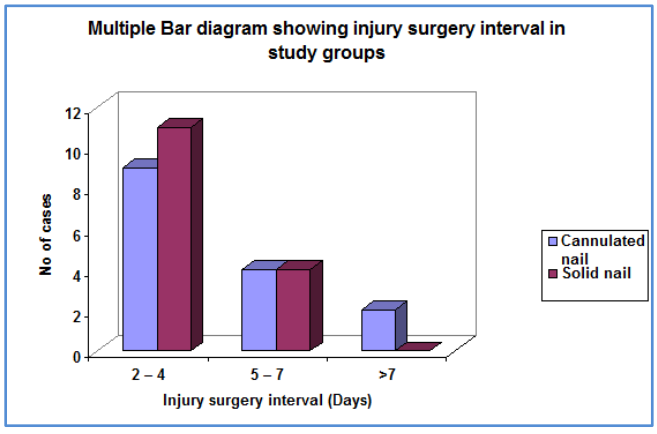
$\chi^2 = 0.28$, P>0.05



Injury surgery interval (Days)	Cannulated nail	Solid nail	Total
	No (%)	No (%)	No (%)
2 – 4	9 (30)	11 (36.67)	20 (66.67)
5 – 7	4 (13.33)	4 (13.33)	8 (26.66)
>7	2 (6.67)	0 (0)	2 (6.67)
Total	**15 (50)**	**15 (50)**	**30 (100)**

Table 8: Injury surgery interval in study groups

$\chi^2 = 2.2$, P>0.05



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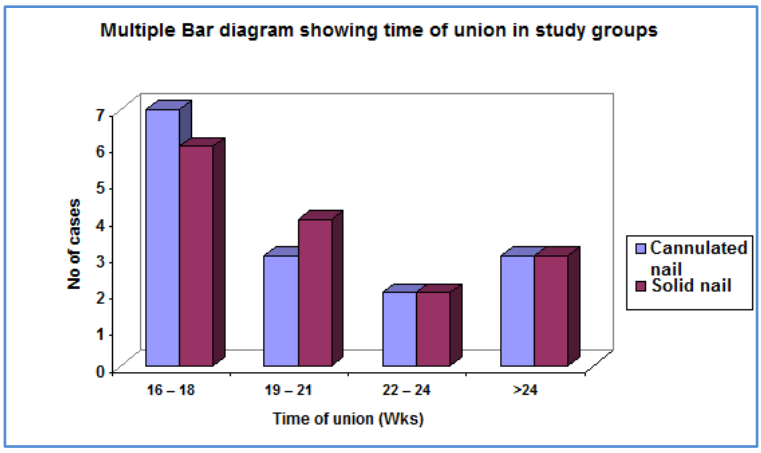
Injury surgery interval (Days)	Cannulated nail	Solid nail	T Value	P Value
	Mean ± SD (n=15)	Mean ± SD (n=15)		
	4.8 ± 2.51	4.07 ± 1.58	0.96	>0.05

Table 9: Injury surgery interval in study groups

Time of union (Wks)	Cannulated nail	Solid nail	Total
	No (%)	No (%)	No (%)
16 – 18	7 (23.33)	6 (20)	13 (43.33)
19 – 21	3 (10)	4 (13.33)	7 (23.33)
22 – 24	2 (6.67)	2 (6.67)	4 (13.34)
>24	3 (10)	3 (10)	6 (20)
Total	**15 (50)**	**15 (50)**	**30 (100)**

Table 10: Time of union in study groups

$\chi^2 = 0.22$, P>0.05



Time of Union (Wks)	Cannulated nail	Solid nail	T Value	P Value
	Mean ± SD (n=15)	Mean ± SD (n=15)		
	20.27 ± 3.67	20.53 ± 4.19	0.18	>0.05

Table 11: Time of union in study groups

Dynamiation	Cannulated nail	Solid nail	Total
	No (%)	No (%)	No (%)
Dynamed	2 (6.67)	2 (6.67)	4 (13.33)
No dynamed	13 (43.33)	13 (43.33)	26 (86.67)
Total	**15 (50)**	**15 (50)**	**30 (100)**

Table 13: Dynamiation in study groups

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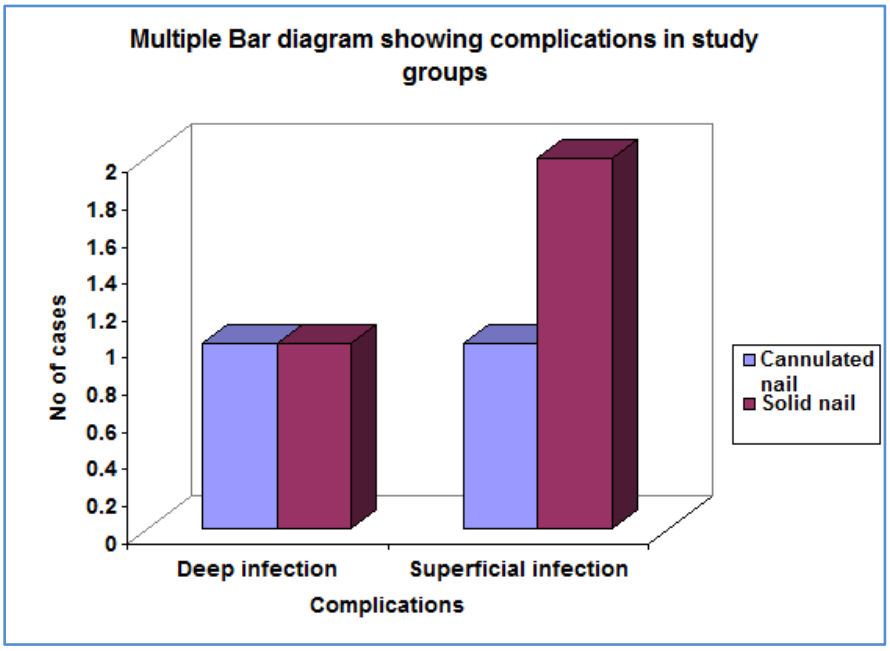
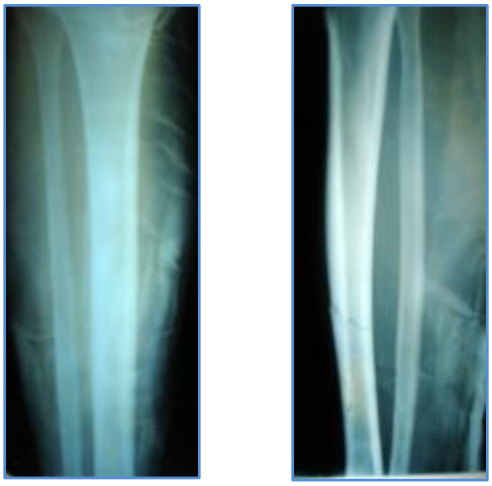
Complications	Cannulated Nail (n=15)	Solid nail (n=15)	T Value	P Value
	No (%)	No (%)		
Deep infection	1 (6.67)	1 (6.67)	0	>0.05
Superficial infection	1 (6.67)	2 (13.33)	0.61	>0.05

Table 14: Complications in study groups





Pre-operative X-ray

Immediate Post-operative X-ray

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3 Months Follow up

6 Months Follow up

Pre-operative X-ray

Immediate Post-operative X-ray

3 Months Post-operative

6 months Pre-operative

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