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ORIGINAL ARTICLE

A STUDY OF EXCHANGE OF FAILED IMPLANT WITH INTRAMEDULLARY INTERLOCKING NAIL IN FRACTURES OF FEMUR AND TIBIA

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ABSTRACT: The aim of the fracture treatment is to achieve union with timely functional recovery. Internal fixation with adherence to strict biomechanical principles is often required to achieve this. However, a fixation device may fail to hold a reduced fracture until union, giving rise to non-union or delayed union with implant failure. The aim of this study was to see the efficacy of exchange of failed implant with an intra-medullary interlocking nail. **PATIENTS AND METHODS:** 18 cases of long bone fractures (Femur and Tibia), who had the problem of poor fracture healing because of the fracture pattern or the implant were studied. Their failed implants were exchanged with an intra-medullary interlocking nail. **RESULTS:** In our study 89 percent were males and majority of the patients were in the age group of 18-35 years. Femur (11 cases) was more frequently involved than Tibia (7cases). Dynamic compression plates were exchanged in 2 cases, external fixator of Tibia was exchanged with interlocking nail of Tibia (secondary interlocking nailing) in 4 cases, 1 External Fixator of Femur was exchanged with Interlocking nail Femur. Mean duration of hospital stay was 25 days. Overall Functional Result was Excellent in 33.33%, good in 55.55% and Poor in 11.11% of cases. **CONCLUSION:** In case of an earlier implant failure, intramedullary interlocking nail is a better choice for fixation of fractures in long bones. Thorough reaming of the medullary canal should be done to remove endosteal fibrous tissue in all cases of exchange nailing. In properly selected cases, bone grafting is not necessary akin to our series as the endosteal reamings provide sufficient osteogenic material. Exchange nailing is an excellent choice for aseptic nonunions of non- comminuted diaphyseal femoral and tibial fractures.

KEYWORDS: Long bone fracture, Implant failure, Intra-medullary Interlocking Nail, Exchange nailing, Fracture healing.
MESH: Implant failure, Exchange nailing

INTRODUCTION: The long bones normally must sustain huge loads of axial compression, bending, and torsion during daily activities. Particularly in the lower extremities, the top loads may be as high as 3 to 5 times the body weight. Therefore, once a long bone is fractured, the ability of movement may be lost immediately. In every case, the utmost speed of repair of a fracture is required.[1] Implant failures arise mainly from loosening or breakage of the internal fixation devices. Because bones are more flexible than metal plates, screwing a metallic plate to bone stiffens it and produces ''stress riser'' at each end of the plate. In the absence of union, even the strongest metal plates and screws will eventually break or pull out of the bone.[2]

Mechanical failure of implants fall into 3 categories: Plastic, Brittle and Fatigue failure. Plastic failure is one in which the device failed to maintain its original shape resulting in a clinical failure. Brittle failure, an unusual type of implant failure, is caused by defect in design or metallurgy.

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Fatigue failure occurs as a result of repetitive loading on a device. Therefore, with insertion of an implant, race between fatigue of the implant and healing of the fracture begins.[2]

Nomenclature: Exchange of failed implant with an intramedullary interlocking nail may be **secondary interlocking nailing** – If a failed metallic plate (DCP) is exchanged with an Interlocking nail.[3,4]

Delayed interlocking Nailing: If an External fixator applied to an open fracture is exchanged with an Interlocking nail because of non-union or as a definitive procedure, after soft tissues have healed.[3,5,6,7]

Exchange interlocking Nailing: If a failed intramedullary nail is exchanged with an another intramedullary Interlocking nail.[8]

Principles of Exchange Nailing:

- Accurate diagnosis and typing of implant Failure.
- Analysis of the underlying cause of implant failure and correction of the underlying pathology by appropriate and effective means.

These principles have to be adhered with in dealing with functional implant failures such as delayed unions and non-unions and mechanical/material implant failure with broken in-situ implants.

Intramedullary interlocking nail offers the best biomechanical environment for fracture healing through reaming of the medullary canal and the stability in the form of near rigid fixation and prevention of rotational torque.[1,2,8]

AIMS AND OBJECTIVES: The aim of this study is to see the efficacy of exchange of failed implant with an intramedullary interlocking nail and thereby facilitating early fracture union and to allow early ambulation.

MATERIAL AND METHODS: This study comprises of 18 cases of long bone fractures- Femur and Tibia, who presented at the outpatient department of our hospital, who had the problem of poor fracture healing because of the fracture pattern or the implant. Their failed implants were exchanged with an intra-medullary interlocking nail. In cases where surface plating has failed, excision of the non-union was carried out and fresh bleeding bony edges are opposed to have sufficient native bone contact. In most of the cases of implant failure with nailing closed procedure was adapted wherein the medullary canal was reamed to a next higher diameter and length as permitted. In few cases open procedure as done for failed plating was contemplated.

Post-operative Care: Intravenous Antibiotics (I.V) for initial 3-4 days and oral antibiotics for an average period of 10 days in un-complicated cases. Prolonged I.V Antibiotics were given in cases with suspicion of subclinical infection with no proven evidence of infection, difficult cases. On the average, suture removal was done on 10th post-operative day. Regular physiotherapy for Knee range of motion (ROM) was advised. Mean duration of hospital stay was 25 days with an average from 10 days to 90 days. Patients were asked to come at monthly intervals, and assessed clinically and radiologically for fracture union. Partial weight bearing was allowed after an average of 6 weeks. Complete weight bearing was allowed only after radiographs showed good callus formation. Mean follow up was 10 months with a range from 4 months to 18 months.

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Table 1: The Functional Outcome of the Present Study was evaluated after 6 Months of Surgery by Using the Following Criteria.

GRADE	CRITERIA
EXCELLENT	< 1cm shortening >100deg of knee flexion no infection anatomical alignment of medullary canal absence of pain unrestricted activity Radiological callus formation <12 weeks
GOOD	<90deg of flexion and >45deg of knee flexion superficial infection <3deg of angulatory deformity of medullary canal occasional dull aching pain radiological callus formation 12-24 weeks
POOR	Knee joint stiffness ROM <45 deg deep infection debilitating pain radiological callus formation >30 weeks

Table 1: "criteria for evaluation of outcome"

RESULTS: 89 percent were Males, 11 percent were females (FIG.1). Majority of the patients were in the age group of 18-35 years (67%). Tibia was involved in 7 cases and Femur in 11 cases (FIG.2). DCP was exchanged in 2 cases for Interlocking nail Femur, External Fixator Tibia was exchanged with interlocking nail Tibia (secondary interlocking nailing) in 4 cases, 1 External Fixator for Femur was exchanged with Interlocking nail Femur. (FIG.3).

Intra-Medullary Nails Exchanged Were: Broken interlocking nails - 2 in Tibia, 1 Broken Retrograde Interlocking nail femur, 1 case of Ender's nail Femur with non-union, 3 Kuntscher's nails Femur with Hypertrophic non-union 2 cases of Interlocking nail Femur with gap non-union, 1 case of Failed Proximal Femoral Nail. (FIG.4)

Only 4 cases required open method of exchange with interlocking nail, and 2 cases required bone grafting, 1 case required 2nd procedure of exchange nailing for infective non-union Tibia.

Complication encountered were superficial infection in 3 cases (16.6%), deep infection in 2 cases (11.11%) and joint stiffness was significant in 38.8% (FIG.5) Mean duration of hospital stay was 25 days with a range from 10 days to 90 days.

Overall Functional Result: Excellent: 33.33%., Good: 55.55%., Poor: 11.11 %(FIG.6).

DISCUSSION: There is ample evidence in literature that intramedullary interlocking nail offers the best biomechanical environment for fracture healing through reaming of the medullary canal and the stability in the form of near rigid fixation and prevention of rotational torque, especially in implant failure scenario.[1,2,8]

Exchange nailing is reported to be an excellent choice for aseptic nonunions of non-comminuted diaphyseal femoral fractures, with union rates reported to range from 72% to 100%[6]

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and non-comminuted diaphyseal tibial fractures, with union rates reported to range from 76% to 96%.[9] Exchange with an interlocking nail provides biological and mechanical effects that promote osseous healing. The biological effects resulting from reaming of the medullary canal, and the mechanical effects resulting from the use of a larger-diameter intramedullary nail ensures good fracture healing when the principles of exchange nailing are appropriately addressed.[10]

Open fractures with unstable fracture pattern which were stabilized initially with external fixator should be stabilized with an intramedullary interlocking nail after removal of external fixator and at least 19 days of time should be allowed for the pin tracts to heal, or else infection is a major complication.[6] Whenever an intramedullary nail or any failed implant is being exchanged with an interlocking nail, thorough reaming of medullary canal should be done to remove endosteal fibrous tissue until bone is seen on the end of the reamer and more reaming was required if the diameter of the nail removed was inadequately small.[8]

Bone grafting was not necessary in all cases of exchange with interlocking nail especially non-infected hyper trophic non-unions. The exchange nail should be at least 1mm larger in diameter than the nail being removed, and it has been recommended that it may be up to 4 mm larger when the nail being removed was greatly undersized. Canal reaming should progress until osseous tissue is observed in the reaming flutes.[10]

These principles have to be adhered to, when dealing with functional implant failures such as delayed unions, non-unions and mechanical/material implant failure with broken in-situ implants. Strict adherence to the treatment protocol as set in the beginning is the cornerstone for appreciable functional outcome in our study.

CONCLUSIONS: Intramedullary interlocking nail is a better choice of fixation for fractures in long bones with previous implant failure as interlocking nail provides the best biological and mechanical support in fracture healing. It is an excellent choice for aseptic non-unions of non- comminuted diaphyseal femoral and tibial fractures in an implant failure scenario. Proper analysis of the cause of implant failure is very much essential for successful outcome. Excision of non-union, native bone to bone apposition in cases treated with open technique and adequate reaming of the medullary canal, proper selection and fixation of the nail in both open and closed techniques are crucial for improved outcome.

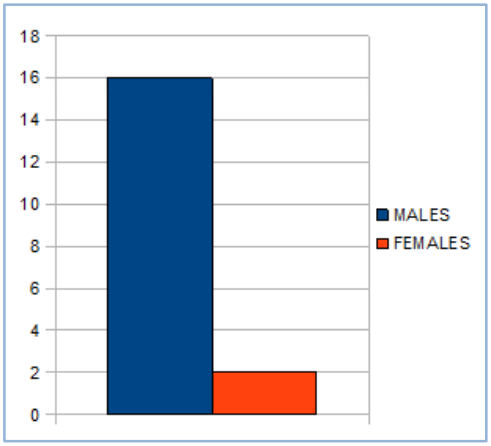

Fig. 1: Sex Ratio

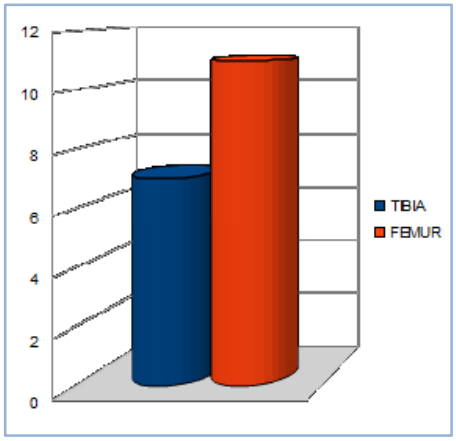

Fig. 2: Bone Involved

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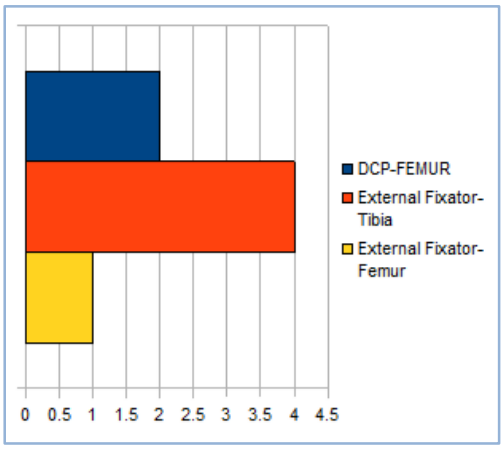

Fig. 3: Extramedullary Device Exchanged

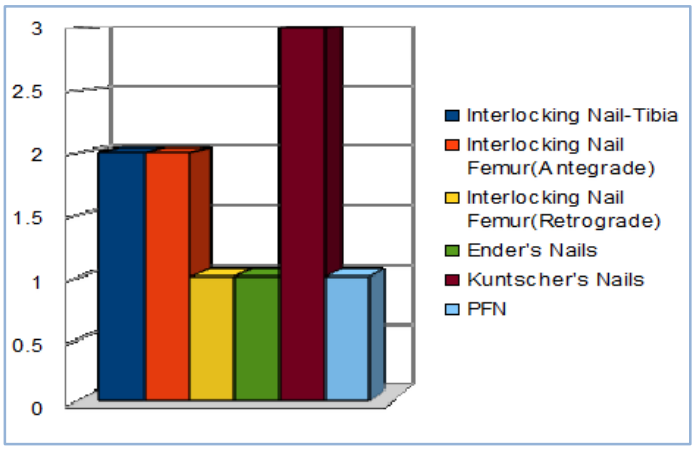

Fig. 4: Intramedullary Device Exchanged

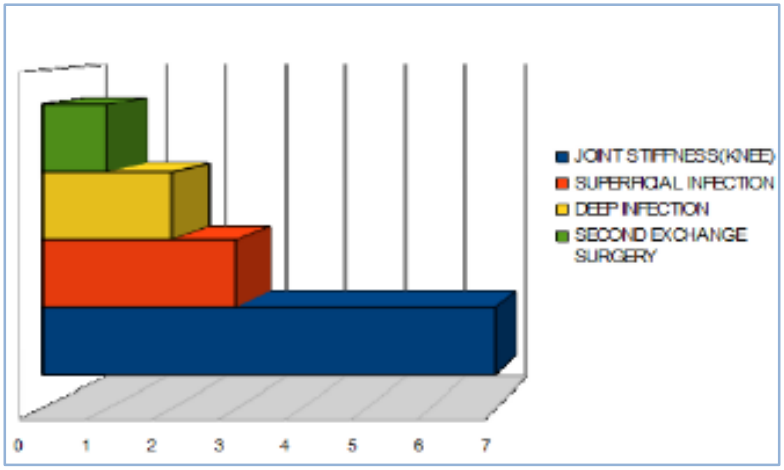

Fig. 5: Complications

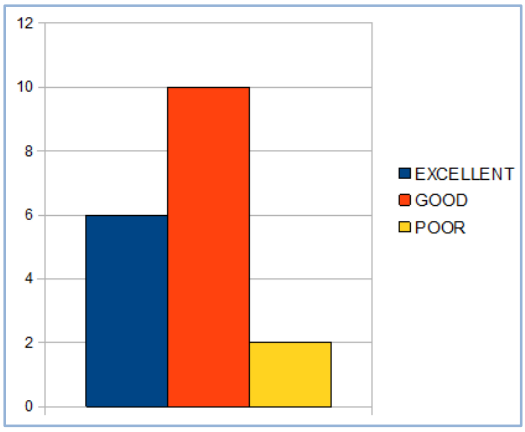

Fig. 6: Overall Functional Result of the Study

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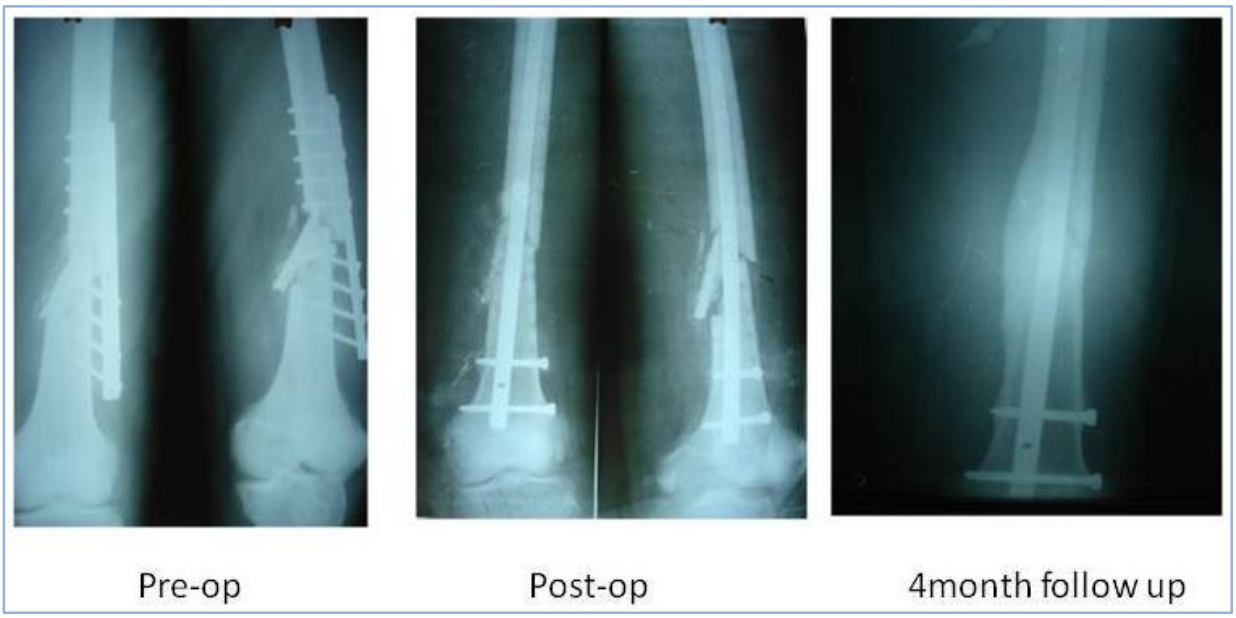

X-rays 1

X-rays 2

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X-rays 3

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