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Augmented plate osteosynthesis and bone grafting in aseptic non union femur with locked intramedullary nail

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Abstract

Intramedullary nails have been widely used to treat long bone fractures, most of which heal within the expected time. However, in some cases union fails to occur by the expected time due to various reasons. After treatment with intramedullary nails, fractures located at the metaphysis of long bones are especially prone for non union. The main reason for the non union is instability (rotational) at the fracture site.

Exchange Nailing With or Without Bone Grafting: It is the gold standard treatment in cases of non union in interlocked femur, but it has certain limitations. Plate augmentation with bone grafting eliminated the rotational instability at the fracture and additional bone grafting stimulated fracture healing. Plate augmentation and bone grafting without removing the nail had more advantages such as shorter operation time, less invasiveness and early weight bearing after surgery than plate fixation after removing the nail.

Materials and Method: Our study is a prospective study conducted from AUG 2008 to NOV 2012, involving 10 patients. All patients were primarily treated with closed intramedullary interlocking nailing for femoral shaft fractures. The mean interval between the primary interlocking nailing and the augmentative plating and bone grafting was 11 months. (Range from 6 months to 2 years).

Results: All cases were followed up every 4 weeks upto 4 month and then every two months upto 2 years. All cases started showing signs of healing from 6 weeks onwards and the fracture united radiologically at the end of 4 months without any serious complication except in one case with mild soft tissue infection which was treated with intravenous antibiotics.

Conclusion: Our study shows that augmentation plating with bone grafting gives excellent mechanical stability and improves the biology for fracture healing with less complications and less chances for resurgery

Keywords: Non union femur, delayed union, augmented plating, interlocking nail

Introduction

Intramedullary nails have been widely used to treat long bone fractures, most of which heal within the expected time. However, in some cases union fails to occur by the expected time due to various reasons. After treatment with intramedullary nails, fractures located at the metaphysis of long bones are especially prone for non union. The main reason for the non union is instability (rotational) at the fracture site.

Treatment Options

1. Dynamization
2. Bone grafting alone
3. Plate augmentation with bone grafting.
4. External fixation
5. Exchange nailing with or without bone grafting.

Dynamization

Dynamization is not applicable in all cases. For e.g., in a case of comminuted fracture, this may make the fracture site more unstable. Patient has to come for regular follow up, which is not possible in a country like ours.

It produces significant instability at the non union site and may also produce femoral shortening.

According to Wu *et al.* there is only 50% chance of union when dynamization is done in a case of non union femur.

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Bone Grafting Alone

It is not of much use when non union is due to rotational instability at the fracture site, which is the most important reason for non union.

Exchange nailing with or without bone grafting

It is the gold standard treatment in cases of non union in interlocked femur, but it has certain limitations.

Its use is questionable in cases of comminuted fractures and fractures occurring in distal one-thirds of femur, where it does not fully eliminate the rotational instability at the non union site. It is ideal in cases of transverse and non comminuted fractures.

Minimum of 2mm larger nail should be used when an exchange nailing is done.

Rate of union after exchange nailing

1st exchange-53%-78%

2nd exchange-87%-95%

Plate Augmentation

According to study reported by Johnston, the rotational stability of the interlocking nail was 3% of that of the normal femur. Rotation of 10-15 occurred at the fracture site without resistance in the femur with intramedullary fixation.

This means that there was some limitation in the rotational stability after interlocking intramedullary fixation.

In distal one-third femoral shaft fractures or in comminuted fractures, exchange nailing with a larger diameter could not eliminate the rotational instability completely.

Plate augmentation with bone grafting eliminated the rotational instability at the fracture and additional bone grafting stimulated fracture healing. Plate augmentation and bone grafting without removing the nail had more advantages such as shorter operation time, less invasiveness and early weight bearing after surgery than plate fixation after removing the nail.

Materials and Method

Our study is a prospective study conducted from AUG 2008 to NOV 2012, involving 10 patients.

All patients were primarily treated with closed intramedullary interlocking nailing for femoral shaft fractures.

The mean interval between the primary interlocking nailing and the augmentative plating and bone grafting was 11 months. (Range from 6 months to 2 years)

Operative Technique

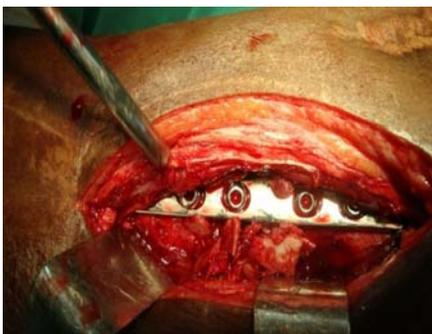
Through lateral approach, non union site was exposed.

Rotational instability at the non union site was visualized.

Femoral nail was retained in situ.

Bone graft was harvested from the ipsilateral iliac crest.

One 4.5mm broad dynamic compression plate was used with 4.5mm cortical screws.



If intramedullary nail was fixed in static mode it was changed to dynamic before augmentative plating. 6 cortical purchases (bicortical) were secured both proximal and distal to the non union site (bypassing the intramedullary nail).

Post-Operative Protocol

Knee bending exercises were started as soon as the pain subsided.

Patient was allowed partial weight bearing with crutches immediately after the pain subsided.

Sutures were removed on the 12th post op day.

Follow Up

All patients were followed once every 2 weeks in the first month, once a month thereafter.

Radiological and Functional evaluation was done at every visit.

Results

All cases were followed up every 4 weeks upto 4 month and then every two months upto 2 years. All cases started showing signs of healing from 6 weeks onwards and the fracture united radiologically at the end of 4 months without any serious complication except in one case with mild soft tissue infection which was treated with intravenous antibiotics.

Case 1

5 Months Post Operative X-Ray C/O pain on weight bearing

No evidence of any infection Oligotrophic non union.



Immediate Post Op X-Ray



At 6 Months Follow Up



Case 2

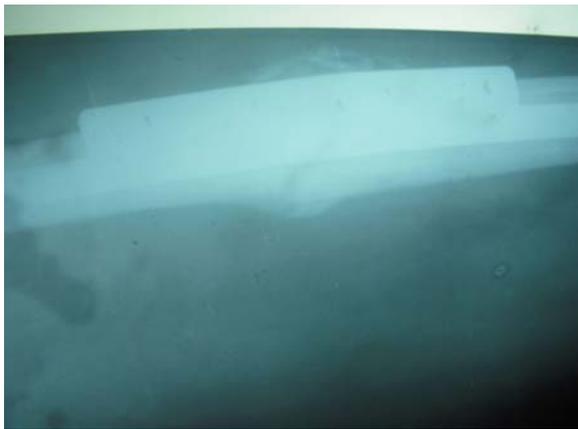
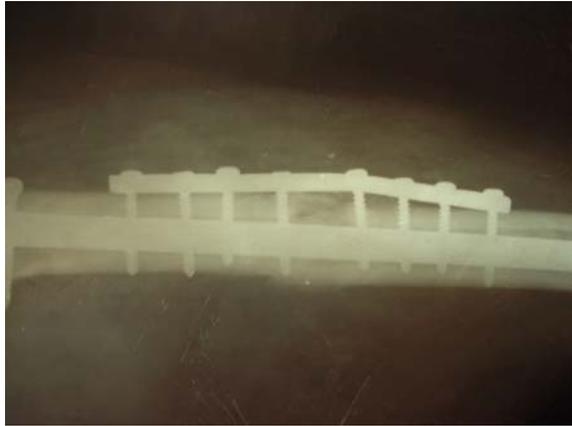
50 years old male sustained injury due to an RTA Underwent three surgeries-primary interlocking nailing and dynamization, bone grafting and exchange nailing.



Immediate post op
At 4 months follow up
Showing good healing response



8 Months Post Op



Immediate Post Op



10 Months post Op



Case 3

45 years male patient sustained injury due to an RTA
Closed interlocking nailing was done for # shaft of femur
10 months post operative x-ray



Case 4

Immediate post op x-ray



3 Months post op



Case 5

Immediate Post op



6 months post op



Discussion

Despite recent developments in fracture treatment, cases of non-unions of femoral shaft fractures following intramedullary nailing are still encountered. Reamed exchange nailing is most appropriate choice for aseptic, noncomminuted nonunions of the femoral diaphysis following prior intramedullary nailing.

In comminuted fractures the intramedullary nails are not canal filling which reduce stability in bending and rotation. The stability is further compromised in the distal third femoral shaft fractures because of the wide medullary canal.

The effectiveness of the exchange nailing in the treatment of nonunions following intramedullary nailing of comminuted fractures has been questioned. Weresh *et al.* 4 reported that only ten of nineteen femoral nonunions following locked intramedullary nailing of comminuted femoral fractures went to osseous union after exchange nailing. Similarly, Banaszkiwicz *et al.* 6 reported that only eleven of nineteen aseptic nonunions following locked intramedullary nailing of high energy, comminuted fractures went on to osseous union after treatment with exchange nailing alone.

Augmentative plate fixation in the presence of existing nail has been used for the management of femoral nonunions following intramedullary nailing. All previous studies have verified rotational instability of the fracture site during operation, which disappeared after plate augmentation. In all our cases there was visible motion at the fracture site which disappeared after plate augmentation.

Conclusion

Our study shows that augmentation plating with bone grafting gives excellent mechanical stability and improves the biology for fracture healing with less complications and less chances for resurgery.

Hence this is an excellent alternative to exchange nailing as a treatment for non union in interlocked femurs.

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