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Original Research Article

Non union long bones treated with rigid fixation and autogenous bone grafting. A Series of 50 Cases

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Abstract

Introduction: The surgical treatment of aseptic nonunion often represents a more challenging situation for the orthopaedic surgeon than treatment of the primary fracture. In fact, it may be necessary not only to "rivitalize" the nonunion area, but also to exchange the bone fixationdevices and to place some refill material in the bone gap.
Objective: To study the Non-union long bones treated with rigid fixation and autogenous bone grafting.
Materials and methods: We present the results of 50 cases of long bone nonunion that have been treated in a period of 3 years (2011–2013) by open approach to the nonunion site with autologous bone graft interposition. The site 11humerus, 9 forearms, 12 femurs, 18 tibias and the type of nonunion (42 atrophic, 8 hypertrophic) was considered in the surgical planning as were the mechanic and biological problems. Newosteosynthesis was performed in50 cases: with plate and screws in 29 cases, with intramedullary nails in 16 cases, with external fixators in 2 cases and with only bone grafting in 3 cases. Bone graft, always autologous from the iliac crest was used in 48 cases and fibula with iliac graft was used in 2 cases.
Result: Healing of the nonunion was successful in 49cases in a mean time of 9.8 weeks with few complications which was easily manageable and did not hinder the functional result.
Conclusion: Autogenous Cortico-Cancellous Bone graft & Rigid Fixation still Gold Standard Treatment for Non-Unions in the era of Vascularised Bone Grafts.
Keywords: Nonunion, Bone graft, Long bones, Rigid Fixation.

1. Introduction

Long bone fractures are the commonest orthopedic trauma and therefore need to follow all principles of fixation for union. Through advancements of modern medicine and technology, many excellent techniques and devices are continually being invented. Currently, the success rates of treatment have markedly increased while complication rates have been great lowered. Even so, complications of failed fracture treatment still occasionally occur. Non union can occur mainly due to insufficient mechanical stablizitation of a fracture or failure of biological process which control the biosynthesis of the repair tissue.[1]

So we decided the treatment of nonunion by: provide mechanical stability to the fracture and favour biological appositional activity of osteogenic cells. In the case of a mechanical problem, the stability at the nonunion site has tobe corrected and this can be achieved by new osteosynthesis or by the change of the bone fixation devices.[3,11]

In case of nonunion with a previous satisfactory osteosynthesis, it is enough to add a biological supplement of vital osteogenic cells (bone graft) or factors stimulating differentiation of cells of the osteoblastic line.[12] The bone graft interposition acts as a gap filler, which also has osteoinductive and osteoconductive properties. [13]

Taking this into consideration we did a study on Non-union long bones treated with internal fixation and autogenous bone grafting

2. Materials and Methods

This was a prospective study of fifty patients (38 males and 12 females) presenting to Department of Orthopaedics from May 2012 to March 2014 with non union of long bone and fractures were called non union if they met following criteria :

- Abnormal mobility at Fracture site
- Radiological cortical discontinuity
- Implant breakage and no radiological consolidation at Facture site

2.1 Inclusion Criteria

- Cases Treated conservatively by
  a) Natives

b) Quacks

- Those presented with Implant failure

2.2 Exclusion Criteria

- Children below 16 yrs
- Infected non-unions
- Uncontrolled Co morbidities

Al Patients were followed for a period of 6 months. Pre-operative assessment was made by clinical examination and X ray including boyh AP and Lateral view

Surgical procedure

- Position and anesthesia of the patient was decieded according to the fracture non union being operated.
- Open reduction and internal fixation/external fixation was done
- Autogenous Iliac Crest/ Iliac Crest + Fibular graft used
- Graft was taken only After Internal Fixation & Immediately Placed At the Fracture site
- In all cases shingling of fracture ends was done
- Post OP IV Antibiotic, Dressings done as per our Protocol
- Range of motion Started Immediate post op(day 1)
- Clinico-radiological follow-up was done at 4^{th} week, 8^{th} week, 12^{th} week, 16^{th} week

In Case of neglected Non-unions & those Treated by Quacks:

- Freshening of Fracture site was done
- Any Soft tissue interposition was removed
- Graft was placed in compressive mode at fracture site
- Autogenous Blood from Graft site was Placed at Fracture site before closure

In Case of Implant Failures:

Along with the above Protocol the choice of implant was changed

➢ Irrespective of hypertrophic or atrophic non-union we have done Internal fixation and bone grafting

We confirmed union with plane radiographs, AP and Lateral view. Cortical continuity in cortices, medullary cavity reconstitution, no increase in fracture line gap in consecutive radiographs, and a non tender fracture site clinically were considered evidence of union at fracture site

3. Results

The mean time between primary fracture treatment and surgical correction of the non union was 7.8 months (range 3-36 months). Out of 50 cases 76 % of cases are males and age distribution of cases (Table 1). In our study we found that most of the non union cases are of lower limb viz femur in large number 36 % (Table 2). Since most of the cases in our study belong to low socioeconomic status the cause for non union in most cases was native treatment 74%. It is found that atrophic type of non union is more common. All the fifty cases had been treated with open surgical technique, removal of fibrous tissueand necrotic bone tissue from the non union site, new osteosynthesis or substitution with different fixation devices (Table 3).

New osteosynthesis had been performed in 47 cases (94%): with plate and screws in 29 cases, with intramedullary nails in 16 cases, with external fixators in 2 cases. Only bone grafting was used in 3 cases. Cancellous or corticocancellous autologous bone graft from iliac crest had been used in 48 cases (96%) and in 2 cases (4%) iliac graft with fibula graft is used (one in humerus and one tibia (Table 4). All the cases (Attained Both Clinical and Radiological Union and the mean time for union was 9.8 weeks (range 8- 16 weeks) (Table 5).

Complications

- In one case, of Non- union Supracondylar humerus – Olecranon Osteotomy site went in to non-union For which Tension Band Wiring was Revised with k-wires & Bone grafting Which got united. (Fig. 3E and Fig. 3F)
- In Two Cases Superficial wound infection occured which resolved with IV Antibiotics
- In one case bone graft Site (iliac crest) got infected which was treated with Debrid ment& IV Antibiotics

Figure 1: A and B shows humerus and tibia non union treated with both fibular and iliac bone grafting.

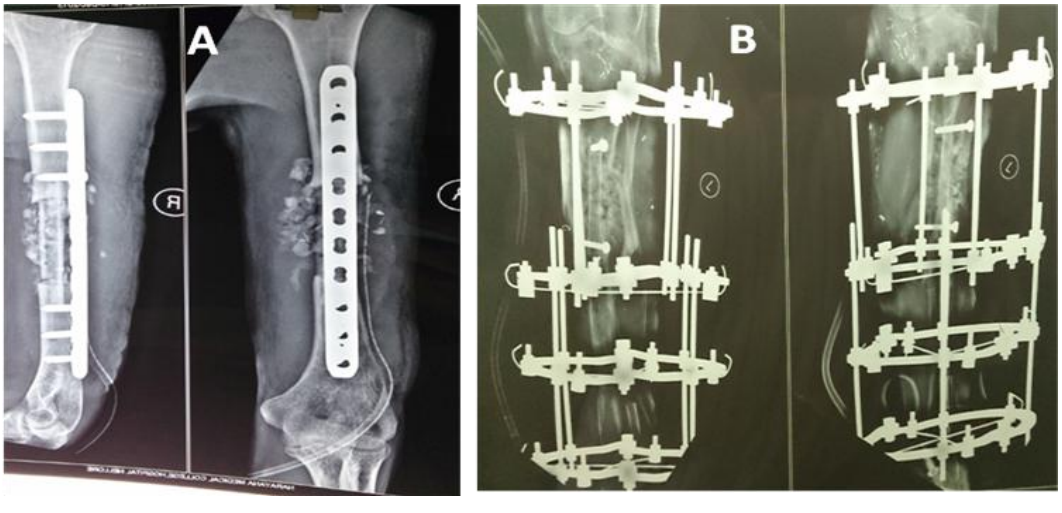

Figure 2: A shows subtrochanteric femur non union treated with Dynamic condyle system (DCS) with bone grafting. B shows subtrochanteric femur non union treated with proximal femoral locking plate (PFLP) with bone grafting. C shows subtrochanteric femur non union treated with proximal femoral Nail (PFN) with bone grafting.

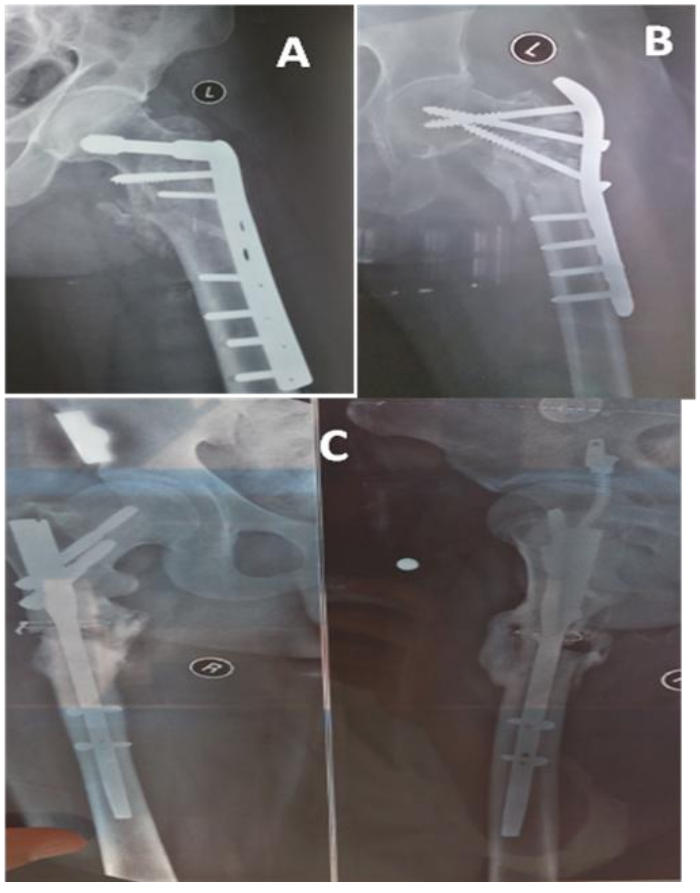

Figure 3: A and B shows preoperative radiograph AP and Lateral view showing non union of supracondylar humerus. C shows intraoperative fixation. D and E shows postoperative radiograph AP and Lateral view showing 90-90 plate fixation of non union of supracondylar humerus with iliac bone grafting and chevron osteotomy. F shows union of supracondylar nonunion at 16 weeks with non union of chevron osteotomy treated with TBW.

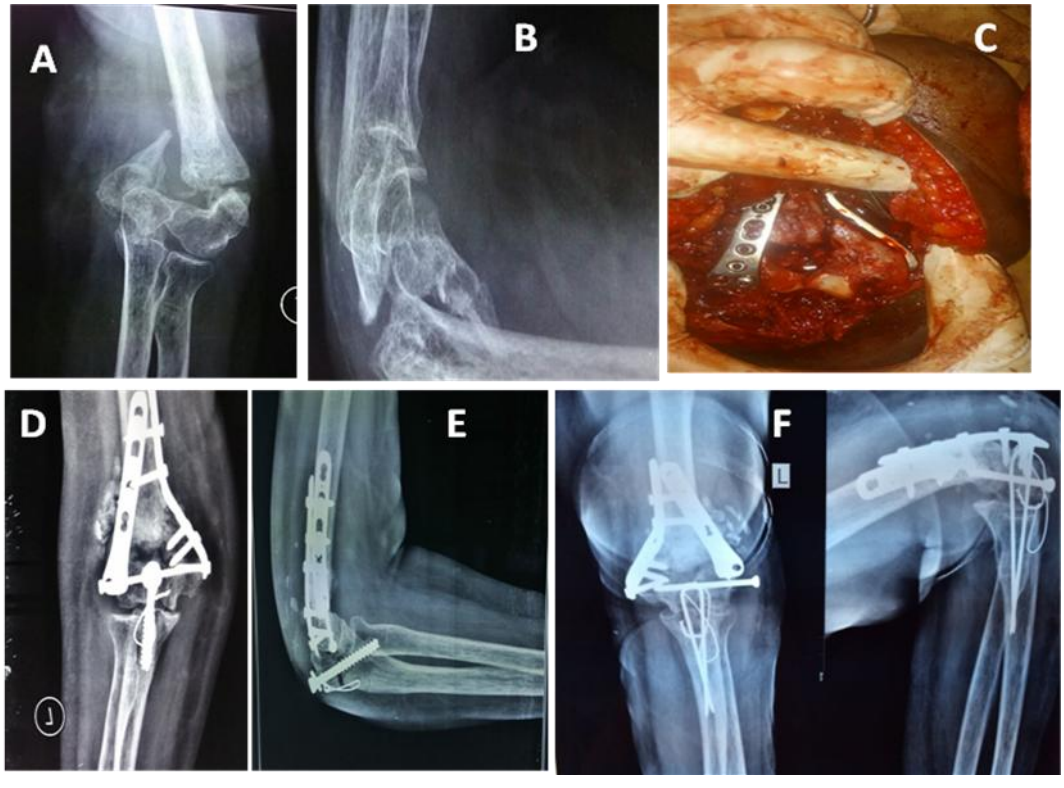

Figure 4: A show implant failure of distal femur done with interlocking nail. B shows Distal femoral nail with bone grafting. C shows union after 12 weeks in distal femur with Distal femoral nail.

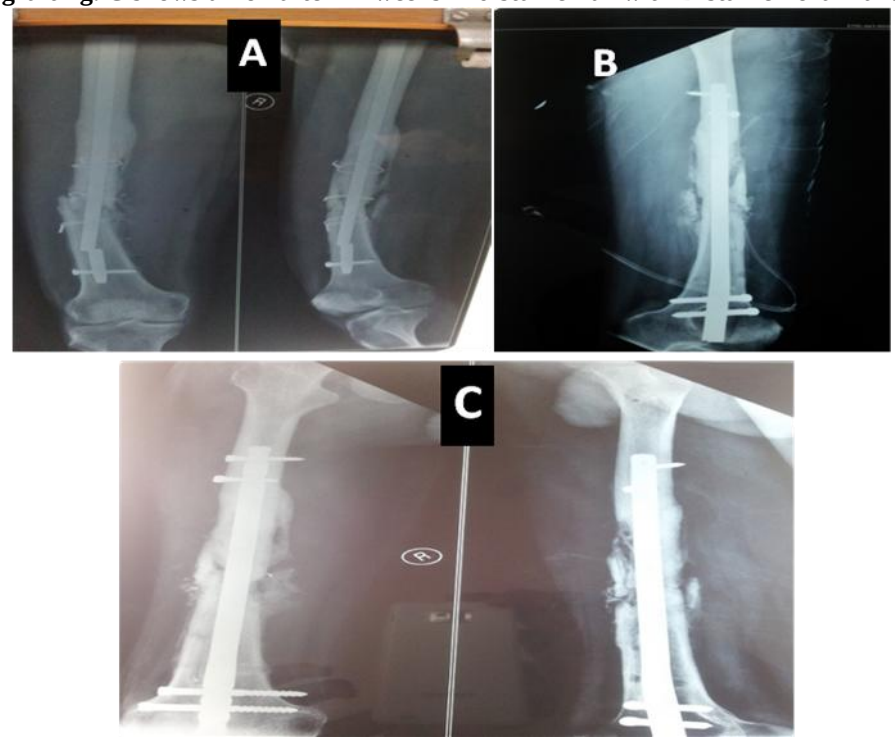

Figure 5: A and B shows AP and Lateral view non union of distal femur with Distal femoral locking plate implant failure. C shows implant removed. D shows intraoperative fixation. E shows AP and Lateral view showing Distal femoral nail fixation of non union site with bone grafting.

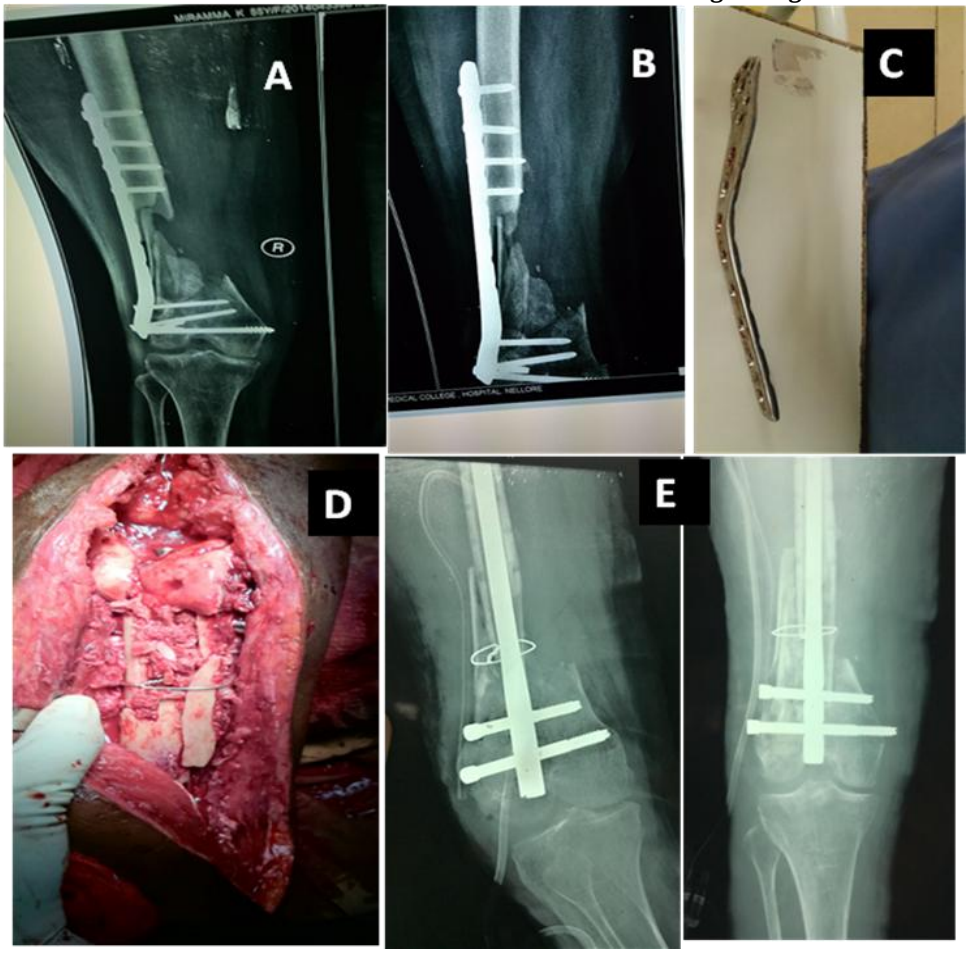

Table 1: Age Distribution

Age (years)	No of cases	Percentage (%)
0-20	5	10
20-40	24	48
40-60	14	28
>60	7	14

Table 2: Site Distribution

Site	No of cases	Percentage (%)
Humerus	9	18
Forearm	11	22
Tibia	12	24
Femur	18	36

Table 3: Type of implant

Type of implant	No of cases	Percentage (%)
Plating	29	58
Nailing	16	32
Ilizarov	2	4
Only Grafting	3	6

Table 4: Type of graft

Type of graft	No of cases	Percentage (%)
Iliac graft	48	96
Fibula + Iliac Graft	2	4

Table 5: Time For union

Time for union	No of cases	Percentage (%)
8 weeks	12	24
12 weeks	23	46
16 weeks	15	30

4. Discussion

Nonunion is defined as a fracture that has not healed after 1 year of treatment, or repeated surgeries must be performed to achieve union.[14,15] A union is defined as clinically having no pain, no tenderness, and no need of assistance for movement; and radiographically as trabeculae having passed through the fracture gap or the solid cortical callus having bridged both fragments.[14,15] In practice, nonunions are divided into atrophic or hypertrophic types according to the convenience of treatment.[16]

Atrophic nonunions are caused by loss of osteogenic power, such as a large fracture defect, severe vascular destruction around the fracture site, and infection. Hypertrophic nonunions are caused by insufficient stability. Therefore, if adequate treatment focuses on the actual mechanism causing the nonunion, the success rate can be markedly elevated. When nonunions are noted, a septic or aseptic cause should be carefully determined. Clinical and laboratory information must be checked and then adequate treatment methods designed.

In our study we only took the aseptic non union cases. Associated shortening must concomitantly be considered when treatment methods are designed.[17] as in our study we got 2 cases with excessive shortening which we managed by taking both fibular as well as iliac crest graft Figure 1a and 1b.

Although nonoperative methods such as electrical stimulation, ultrasound, or shock waves, may be effective, the success rate is generally lower than with operative methods.[18-21] Therefore, patient selection is important.

In the literature, regardless of whether atrophic or hypertrophic nonunions are treated surgically, cancellous bone grafting to elevate the union rate is recommended.[22] Similarly in our study we have done cancellous bone grafting in all the cases irrespective of atrophic or hypertrophic non union to revitalize the tissue and to assure the union of the site.

a. Humeral nonunions

For aseptic nonunions, plating and locked nailing have similar success rates in our study.

b. Femoral nonunions

The first choice for treatment of aseptic shaft nonunions is intramedullary nails. Sometimes, plate augmentation may be useful near the metaphysic.[23] Nonunion sometimes may be combined with shortening of more than 2 cm. For such nonunions, 1-stage or gradual lengthening should be performed (Fig. 4).[17,24] similarly in our study for shaft nonunion we have done nailing and for metaphyseal plating (Fig 2.A & Fig 2.B) but in some sub trochanteric non union we have done PFN.(Fig 2.C)

c. Tibialnonunions

For aseptic shaft nonunions, intramedullary nails should be considered a priority.[25] In our study we have done nailing for shaft and plating for metaphyseal region.[26]

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 3~5 times the body weight.[27,28] Therefore, fracture stabilization must strictly abide by biomechanical principles, or implants can easily fail. If acute fractures are not successfully treated, nonunion will occur like in our study most of our cases belong to low socioeconomic status who still go to bone setters for treatment. This makes the treatment for each complication become much more complex than the primary treatment. Moreover, the final results may be discouraging. Therefore, fractures always need careful treatment from the initial stage.

In this article, principles of treatment of long-bone fractures, nonunions are clarified. Factors favoring fracture repair are a minimal gap, adequate stability, and sufficient nutrition supply.[29] Lack of any of these 3 factors will cause anonunion. To reduce fracture fragments and minimize the fracture gap, either an open or closed reduction may be chosen.

In our study, we open all the non union sites to remove soft tissue interposition, opening the medullary cavity, freshening the edges till it bleeds, done shingling then fix the non union site and then compactly packed the site with graft (freshly harvested).

This paper describes a series of 50 patients with non

union of long bones. The study is limited in the fact there is no control group and therefore it provides no basis for firm conclusions, or statistical analysis. However the study does demonstrate that rigid stabilization along with autogenous bone grafting has remained the standard treatment for the non union.

5. Conclusion

Autogenous Cortico-Cancellous Bone graft & Rigid Fixation still Gold Standard Treatment for Non-Unions in the era of Vascularised Bone Grafts.

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