Study Of Healing In Diaphyseal Fractures Of Adult Long Bones Fixed Without Bone Grafting

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ABSTRACT

Background: Diaphyseal fractures of long bones are the commonest fractures of the limbs because of a sharp increase of mechanized transport, particularly motorcycles, in developing countries. Many of these injuries present late as a result of delay in transporting victims to hospitals. **Objective:** We conducted a study of healing in diaphyseal fractures of adult long bones fixed without bone grafting, radiologically in terms of visible callus, cortical continuity and fracture gap and decide the role / necessity of bone grafting in delayed / non-unions. **Method:** This study was conducted in the Department of Orthopaedics at S.P. Medical College & Associated group of Hospitals, Bikaner on patients treated during August 2013 to December 2015. The study included 25 cases of diaphyseal fractures of all long bones fixed late by nailing or plating without bone grafting. **Results:** Of the total 25 patients 19(76%) had closed type of fracture while 6(24%) had open type of fracture. Most common pattern was transverse 16(64%), followed by oblique 4(16%), communited 3(12%), segmental and segmental + communited 1(4%) each respectively. **Conclusion:** Bone grafts should be used where absolutely indicated like in bone gaps and not just because of fear of failure. Healing definitely occurs without bone grafting if proper surgical technique is followed.

Keywords: Diaphyseal Fractures, Long Bones, fixed, Communited, Nonunion.

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INTRODUCTION

In adults, non-operative treatment predominates in fractures of the humeral and tibial shaft, while plate osteosynthesis in fractures of the forearm and intramedullary nailing in fractures of the femoral shaft are commonly used. Whatever the plan of treatment is, union may not always be early and successful.

Healing occurs by callus or by direct cortical healing depending upon the type and rigidity of fixation[1].

Indirect healing consists of the sequential steps of tissue differentiation, resorption of the surfaces of the fracture and uniting of the fracture fragments by callus. Finally, the fracture undergoes long-lasting internal remodeling[2]. This is the pattern of healing without stabilisation, with stabilisation by an external or internal fixator[3] and with flexible internal fixation[4].

Direct healing follows stable fixation and compression; the bone heals without apparent callus (soudure autogène[5], primary healing[6]). It skips the intermediate steps of tissue differentiation and resorption of the bone surface and progresses directly, although not necessarily more quickly, to the final internal remodeling of the Haversian system.

If any of the factors persist for a prolonged duration then the sequence of union cycle is interrupted and the situation

ends up in non-union. Healing problems are basically categorized in two types:

1. Delayed union, which implies that union will ultimately occur but over a longer period when detrimental factors are removed.
2. Non-Union, which is complete suspension of the healing process and the fracture will not unite without surgical treatment.

The use of the term bone "grafting" is inaccurate since histologic sections of such bone reveal empty lacunae, indicating necrosis of osteocytes and matrix.

In present scenario it is seen that many surgeons go for bone grafting in delayed fixation of fractures just to decrease the risk of failure; without definite indication or policy for the same[7].

We have been fixing ununited fractures without bone grafting keeping soft tissue/ periosteal preservation on priority, exposing only as much surface of the bone as necessary for implant placement, avoiding circumferencial denuding and use of bone clamps. Bone grafts were used only for defects as fillers.

AIMS & OBJECTIVE

To study healing in diaphyseal fractures of adult long bones fixed without bone grafting, radiologically in terms of visible callus, cortical continuity and fracture gap and decide the role / necessity of bone grafting in delayed / non-unions.

MATERIAL & METHODS

This study was conducted in the Department of Orthopaedics at S.P. Medical College, Bikaner on patients treated during August 2013 to December 2015. The study included 25 cases of diaphyseal fractures of all long bones fixed late by nailing or plating without bone grafting. Patients who attended hospital in OPD and casualty with fracture diaphyseal region of all long bones were admitted in orthopaedic ward. Patients were thoroughly evaluated and all vitals were monitored. Detailed evaluation was done regarding the injured limb and general condition of the patient. Detailed history was taken about age, sex, occupation, mode of injury, past history and associated medical illness. General condition, orthopaedic and other systemic injuries were assessed and managed accordingly. X-rays of the affected part were taken in two planes- anteroposterior and lateral view, including x-ray of ipsilateral proximal and distal joints of affected long bones.

X-Ray Analysis Details

X Ray analysis was done on the basis of type of fractures like oblique, spiral, transverse, simple and comminuted, displaced and undisplaced and level of fractures like mid shaft, upper 1/3rd, lower 1/3rd. Then analysis was also done on the basis of bone quality like porotic and nonporotic, union status and duration of fracture (delayed or non-union) with visible callus or not

Surgical procedure

The optimal location of the incision was determined by evaluating the pre-operative radiographs.

Incision was planned in such a manner that subcutaneous part of bone was not directly exposed. As a policy only the needed circumference of the bone was exposed for plating. Direct incision over scars were avoided. If open nailing was planned then limited exposure was done. Only the fracture ends were exposed so that the medullary canal could be aligned. Small or large displaced or detached splinters but with adherent periosteum and soft-tissue were not brought into accurate alignment. The dissection preceded either in a osteoperiosteal or musculoperi-osteal plane. At the time of surgery we observed for vascularity, soft tissue cover, fibrous tissue and necrotic or non-viable bone. Fracture ends were cleared till vascular ends were visible. Total taken down of the fracture site was not done. All surgeries

were performed on an elective basis under standard aseptic precautions. Surgery was performed under spinal, general or regional anaesthesia.

Choice of Implant: -

Choice of implant depended on the type of fracture, duration of fracture and history of previous surgery like failed implant with refracture/broken implant in situ.

Postoperative Management

Postoperative radiographs were taken in AP and Lateral views for the operated site on 2nd post-operative day.

Postoperative plaster

Postoperative slab was kept for a minimum of 6 weeks, or further till union in selected cases, in upper and lower limbs both.

Follow up:-

The patients were asked to come for first follow up at four, eight and twelve weeks. Patients were instructed not to bear weight on the affected extremity. Full range of motion and muscle strengthening exercises were allowed only after confirmation of complete union. Mobilization was not done at the cost of risking fixation.

1. Excellent healing- homo-genous callus formation and obliterated fracture line.
2. Good healing – Massive bone trabeculae crossing fracture line with barely discernible fracture line.
3. Fair healing- Apparent Bridging callus and discernible fracture line. Grading of final result Excellent/ good/fair

RESULTS

Out of the total 25 patients 19(76%) had closed type of fracture while 6(24%) had open type of fracture. Most common pattern was transverse 16(64%), followed by oblique 4(16%), communited 3 (12%), segmental and segmental +communited 1(4%) each.

Table 1
Distribution of cases according to fracture type

Type of Fracture	Frequency	%
Closed	19	76.0
Open	6	24.0
Total	25	100

Table 2
Distribution of cases according to Pattern of Fracture

Pattern of Fracture	Frequency	%
Transverse	16	64.0
Oblique	4	16.0
Communited	3	12.0
Segmental	1	4.0
Segmental+ Communited	1	4.0
Total	25	100

Table 3
Distribution of cases according to radiologic Bone Gap

Bone Gap	Frequency	Percent
<2mm	3	12.0
2-5mm	15	60.0
>5mm	7	28.0
Total	25	100

Bone gap of 2-5mm was seen in 15 (60%), >5mm in 7 (28%), and <2mm in 3 (12%) of cases respectively. 18 (72%) patients were previously managed conservatively, 4(16%) patients treated with external fixator while 1(4%) patient each had I/L nail femur surgery, I/L Nail femur Surgery then leaf plate fixation with bone grafting for 2 consecutive times and K wire. Compression was most commonly used in 20(80%) of cases.

DISCUSSION

In the present study correlation was found between closed fractures and excellent union and correlation was also found between previous conservative treatment and excellent union.

Table 4
Distribution of cases according to Previous Treatment

Previous Treatment	Frequency	%
Conservative	18	72.0
External Fixator	4	16.0
I/L Nail Surgery	1	4.0
I/L Nail Surgery, Then Leaf plate fixation for 2 times with bone grafting	1	4.0
K Wire	1	4.0
Total	25	100

Table 4
Distribution of cases according to Previous Treatment

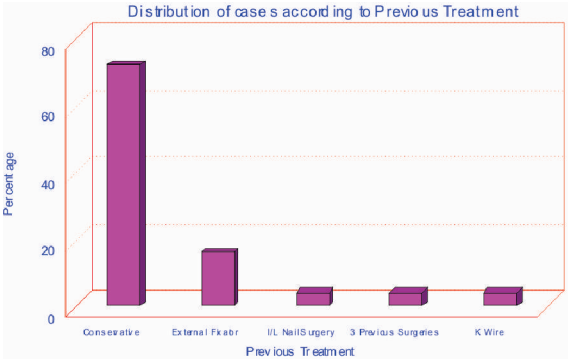
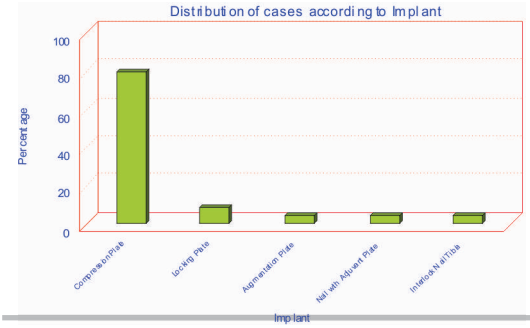


Table 5
Distribution of cases according to Implant

Implant	Frequency	%
Compression Plate	20	80.0
Locking Plate	2	8.0
Augmentation Plate	1	4.0
Nail with Adjuvant Plate	1	4.0
Interlock Nail Tibia	1	4.0
Total	25	100



According to Rockwood and Green[8], surgical exposure of a fracture site can interfere with healing. The fracture hematoma is disrupted, the blood supply to the fracture site and the surrounding soft tissue may be damaged and opening a closed fracture may lead to infection.

According to Ramoutar et al[13] in general, the area at the non union site was not removed if it was hypertrophic unless deformity correction was also required. The non-union was fixed in situ with compression. The exception to this was highly mobile non-unions with a transverse fracture pattern where osteotomy was performed with resection of the fracture site. In our study the most common fracture pattern (56%) was transverse like Chacha[9] who had (47%) transverse fractures in his study.

In our study the most frequent (72%) previous treatment was conservative i.e 18 out of 25, which is similar to Livani et al[10] where they observed (80%) of patients conservatively treated.

According to vascular status of the fracture, most fracture ends were found to have good vascularity (84%) like Livani et al[10] who also observed 80% of the fracture ends with good vascularity. They concluded that a well vascularised non-union usually occurs after the failure of conservative treatment and conventional osteosynthesis performed with a straight plate and compression alone was enough for union. Case No. 20 (Fig. 1 & 2)

Figure 1: Fracture right humerus mid shaft presented with an open injury, definitive surgery was done when wound healed completely

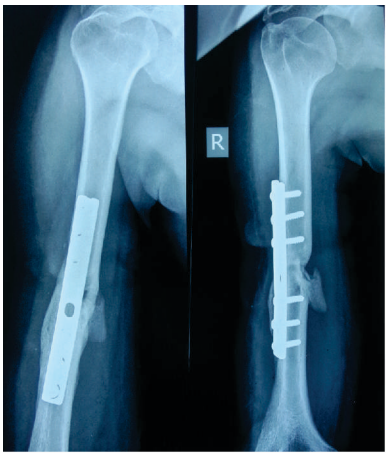


Figure 2 : Large splinter present medially was not separated from soft tissues, plate applied and compression achieved. X-ray shows good union at 3 months follow up with bridging callus and incorporation of the splinter

We used the technique of periosteal preservation by working in an osteo-periosteal plane like Ramoutar et al[11] who used the technique of elevating small petals of sub-perisoteal bone together with attached periosteum and soft tissue. We exposed only up to 50% of the bone circumference leaving soft tissue attached to the far cortex and creating a vascular osteo-periosteal bed. Case No. 10 (Figure 3-5). Cases with a large bone gap, because of bone loss at the fracture site, were not included in our study.

Figure 3: Fracture left leg bone segmental. Large splinter present over medial aspect.

Figure 4: Ultimately good union achieved at 5 month follow up Whatever the fracture gap found was due to initial displacement, communition and attrition at the fracture site. Case No. 21 : (Figure 6-8)

Figure 6 : Fracture left leg bone lower third X-ray showing bone gap at fracture site because of attrition of fracture ends and united fibula

Oh et al[12] showed that a bone gap of up to 5mm with intervening fibro-cartilage tissue could be safely compressed. Court-Brown et al stated that bone loss of more than 2cm and 50% of the circumference almost always required open bone grafting. In this study most of the patients (60%) had a bone gap between 2-5mm.

Figure 7 : Fracture fixed with locking plate still showing fracture line and fibular osteotomy was done

Figure 8 : Ultimately bridging callus seen and good union achieved at follow up 5 months

In this study, 76% fractures were closed and most of these were previously managed by conservative treatment (72%). Most frequent fracture pattern was transverse (56%) in our study. 15 out of 25 (60%) cases had fracture gap of 2-5 mm. Compressive plating was the modality used for fixation in maximum patients i.e. 20 out of 25 (80%). Case No. 1 : (Figure 9-11).

Figure 9 : Fracture right humerus mid shaft showing good amount of callus medially

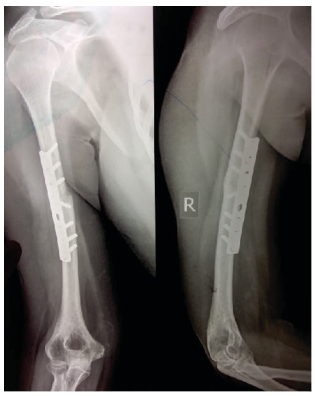


Figure 10 : Plate was placed over antrolateral aspect without touching the large callus over medial site compression was achieved by lag scres

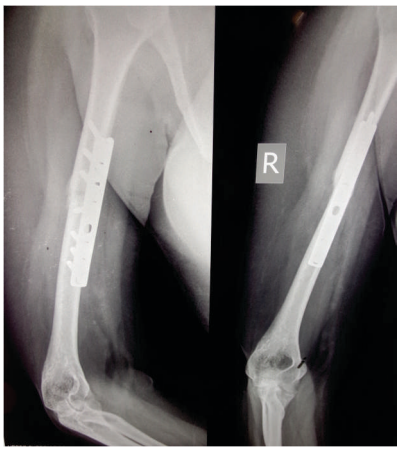


Figure 11 : Ultimately good union achieved at two month follow up

CONCLUSION

Bone grafting in ununited fractures is not an essential procedure. Bone grafts should be used where absolutely indicated like in bone gaps and not just because of fear of failure. Besides having a potential for complications, bone grafting also enhances the propensity for infection liability in terms of fracture types (old infected healed nonunions), patient hygiene, and OT environment. Healing definitely occurs without bone grafting if proper surgical technique is followed, without which union can still fail despite

presence of grafts. Proper technique should be considered to preserve vascularity of the fracture ends. Whenever in doubt do not hesitate with plaster immobilization specially, considering the poor educational background of patients in developing countries.

Conflict of Interest: None.
Source of Funding: Nil.

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