



## STUDY OF TREATMENT OF DELAYED UNION WITH AUTOLOGUS BONE MARROW INJECTION

### Orthopaedics

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### ABSTRACT

The technique of percutaneous autologus bone marrow injection (ABI) has been used for the management of fractures with delayed and non unions since a long period of time. From September 2015 to December 2017, 18 patients were treated with ABI. Among the 18 patients, fracture humerus-2, fracture both bones forearm-6, fracture femur-4 and fracture tibia-6 cases. The time of presentation to hospital after injury was from 2 weeks to 10 weeks (Average 8 weeks). Depending on the fracture pattern, duration of previous definitive internal fixation and conservative treatment duration, all the patients suspected to be cases of delayed union were given ABI. The average time of bone union after ABI was 6 to 16 weeks depends on age, habits, fracture pattern, simple/compound fractures and duration of fracture. All the patients were evaluated during the study period and found sound bony union in 14 cases without any complications. Two cases of fracture Tibia G-A type II were not united with ABI and open cancellous bone grafting done.

### KEYWORDS

Delayed/non Union Of Fracture Long Bones, Autologus Bone Marrow Injection, Bony Union.

### INTRODUCTION

Late presentation is common in developing countries like India due to poor socio economic status and certain miss-beliefs in rural areas. Most of the patients first go to local bone setters for bandages with leaf juices and egg yolk results in loss of precious time and not consulting ortho surgeons in time. These patients expect speedy recovery and early return to work after treatment. So, in the prevailing circumstances author planned to give ABI to all the late presentation patients after treatment of fractures either with fixation or plaster immobilization. The open bone grafting technique was not done in this study group.

Bone marrow contains osteo progenitor cells, which are shown to provide stimulus for osteogenesis. These precursor cells capable of differentiating into osteoblasts, chondroblasts, adipocytes and muscle cells. Bone marrow stem cells develop into haematopoietic and marrow stromal cells, which are progenitors of bone and cartilage. The autologus bone graft taken from iliac crest is the most common procedure to treat delayed/non union of fractures and occasionally for fresh fractures with bone defects. This additional procedure results in pain and morbidity in working group people. Most of the patients are not willing for this additional surgery at iliac crest for fear of incision near abdomen. Alternatively allografts, synthetic bone substitutes,

autologus bone marrow injections and recently recombinant human bone morphogenetic Protein-2(RhBMP-2) are advisable to these patients.

### MATERIAL AND METHODS

Among the 18 patients 1 was female, 17 were male patients selected for this procedure from the patients attending our hospital OPD from September, 2015 to December, 2017. All the patients were either late presentations or comminuted fractures who require open bone grafting. The average age of the patients were 34 years (range 23 to 48). As per the initial injury the following were fracture patterns; humoral shaft fractures were 2 and one comminuted, fracture both bones forearm were 6, 2 were segmental fractures of radius/ulna, 2 cases of fracture ulna were compound and 2 cases were simple fractures. All four fractures of femur were closed fractures. The fracture tibia cases were 6, 4 cases were Gustilo-Anderson type I, 2 cases were type-II. The details of surgical fixation, conservative treatment and external fixation are given in the table. The ABI was given after two weeks of injury which is sufficient for inflammation to subside in suspected cases going for delayed/non union. Among 16 patients 12 were given single dose of ABI, 4 patients were given 2 doses at two weeks intervals.

**TABLE 1: The Details Of Fracture Pattern, Different Methods Of Treatment And Union Time After ABI**

| S. No | Age, Sex | Fracture                         | Open/Closed, comminuted   | Initial treatment                | ABI                    | Union time                  |
|-------|----------|----------------------------------|---------------------------|----------------------------------|------------------------|-----------------------------|
| 1.    | 58 M     | Humoral shaft                    | Closed comminuted         | ORIF plating                     | 3 weeks                | 12 weeks                    |
| 2.    | 45 F     | Humoral shaft                    | Closed                    | Functional POP cast              | 4 weeks                | 8 weeks                     |
| 3.    | 16 M     | #B.B. fore arm                   | Closed                    | MR POP                           | 4 weeks                | 12 weeks                    |
| 4.    | 22 M     | #B.B. fore arm                   | Closed comminuted-Radius  | ORIF plating                     | 4 weeks                | 12 weeks                    |
| 5.    | 24 M     | #B.B. fore arm                   | Segmental# radius, closed | ORIF plating                     | 4 weeks                | 14 weeks                    |
| 6.    | 29 M     | #B.B. fore arm                   | Closed Ulna open#         | ORIF plating                     | 4 weeks                | 14 weeks                    |
| 7.    | 42 M     | #B.B. fore arm                   | Closed Ulna open#         | ORIF plating                     | 4 weeks                | 14 weeks                    |
| 8.    | 54 M     | #B.B. fore arm                   | Closed                    | ORIF plating                     | 4 weeks                | 16 weeks                    |
| 9.    | 40 M     | #Shaft femur                     | Closed                    | ORIF plating                     | 2 weeks                | 12 weeks                    |
| 10.   | 36 M     | #Shaft femur                     | Closed                    | IM nailing                       | 2 weeks                | 12 weeks                    |
| 11.   | 34 M     | #Shaft femur                     | Closed comminuted         | IL nailing                       | 2 weeks                | 13 weeks                    |
| 12.   | 45 M     | #Shaft femur                     | Closed                    | OR IL nailing                    | 2 weeks                | 14 weeks                    |
| 13.   | 22 M     | #Lower 1/3 <sup>rd</sup> BB leg  | G-A type-I                | ORIF plating                     | 4 weeks (2 injections) | 16 weeks                    |
| 14.   | 28 M     | #Middle 1/3 <sup>rd</sup> BB leg | G-A type-I                | POP cast + Functional cast brace | 4 weeks (2 injections) | 18 weeks                    |
| 15.   | 26 M     | #Middle 1/3 <sup>rd</sup> BB leg | G-A type-I                | POP cast + Functional cast brace | 4 weeks                | 18 weeks                    |
| 16.   | 30 M     | #Middle 1/3 <sup>rd</sup> BB leg | G-A type-I                | ORIF plating                     | 4 weeks                | 16 weeks                    |
| 17.   | 45 M     | #Lower 1/3 <sup>rd</sup> BB leg  | G-A type-II               | Interlocking nailing             | 4 weeks (2 injections) | 18 weeks<br>Open graft done |
| 18.   | 44 M     | #Lower 1/3 <sup>rd</sup> BB leg  | G-A type-II               | Interlocking nailing             | 4 weeks (2 injections) | 18 weeks<br>Open graft done |

## PROCEDURE

For all the patients the bone marrow was aspirated with 16G bone marrow aspiration needle under local anesthesia from the iliac crest. The aspirated marrow was directly injected into the fracture site with 16G disposable needle. Image intensifier was used to locate the fracture site except in the cases of fracture tibia where fracture site is easily palpable. The volume of bone marrow injected was 50 to 60 ml in femur and tibia and 10 to 15 ml in ulna and radius. Compression bandage was applied for 1 week in all the patients and POP cast reapplied in patients treated conservatively. The patients were followed up once in 4 weeks and assessed for bony union clinically and radiologically.

## RESULTS

Among the total 18 patients included in the study, 16 patients had bony union at 12 to 18 weeks after ABI. The fracture shaft humerus, closed type treated conservatively with plaster cast and united in 8 weeks. All the other patients had bony union from 12 to 18 weeks. Early bony union occurred with the younger age group, closed fractures and location of fracture. The comminuted fracture both bones forearm, fracture femur cases united in 12 to 16 weeks. In the fracture both bones leg among 6 patients, 4 got bony union from 16 to 18 weeks and 2 doses of ABI was given to these patients. In 2 patients with Gustilo-Anderson type II lower 1/3 fracture tibia had not shown any callus after two injections of ABI and open cancellous bone grafting done. These two patients got union after 8 weeks. The lower 1/3 of tibia is more prone for non union. So, the ABI did not work in these 2 cases in this study.

## DISCUSSION

The method of autologous cancellous bone grafting to stimulate union in fractured bones is present from phemister (Ref.13) and improvements in surgical techniques are evolved. These procedures are having many complications like, donor site morbidity and necessity to open the non union/delayed union fracture site with risks of infection and additional damage to fracture biology. The main advantages of ABI are it can be performed in patients who are not fit for second surgery. In this procedure the most osteogenic cells can be injected at the fracture site and not the devitalized bone.

The majority of cases in our study are delayed union patients who had good potential for healing as per the type of fracture and these were failed to unite in the expected time period. Connolly et al., (Ref 17) stated that ABI has been the most useful method for prevention of delayed union. He also stated that ideal time for injection is 6 to 12 weeks and should be after the initial inflammation and osteoclastic resorption period of fracture repair was subsided.

In our study the quantity of bone marrow injected is 50 to 60 ml in femur and tibia, in ulna and humerus it is 10 to 15 ml. Healey (Ref.19) in his study injected 50 ml and half of his cases were given 2nd injection. Connolly et al., (Ref. 17) injected 100 to 150 ml in all cases and only one injection was given. Garg et al., (Ref.20) in their study injected 15 to 20 ml of bone marrow at the fracture site twice at 3 weekly intervals. In some of these studies the bone marrow is centrifuged and concentrated liquid is injected in the cases of radius and ulna.

## CONCLUSION

- It is safe and day care procedure done under local anaesthesia and can be repeated if necessary.
- It is cost effective and can be given in fractures which are going to delayed/non union and the process of union is accelerated.
- The ABI is an acceptable procedure in patients with co-morbidities who are not fit for open grafting.

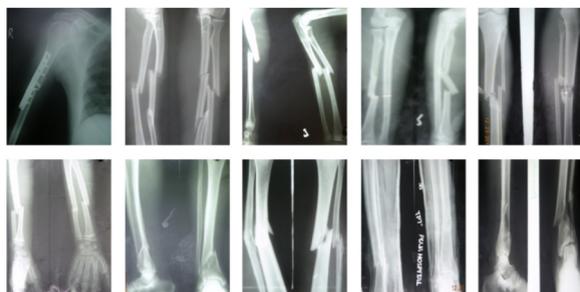


FIGURE 1: Radiographs before bone marrow injection



FIGURE 2: Radiographs after bone marrow injection

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