ORIGINAL ARTICLE

Role of Percutaneous Bone Marrow Injection in Non Union of Fractures

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ABSTRACT

Introduction: In hypertrophic non union rigid fixation is needed, in atrophic non union of bone biological solution is needed either bone graft, bone growth factors, stem cells, demineralised bone matrix etc. We preferred to do bone marrow injection as it will be cost effective without donor site morbidity.

Methodology: We included 30 patients of non union of long bones presented to MIMER medical college from April 2012 to March 2016 were selected for prospective study. Bone marrow injection of 20 ml to 40 ml was aspirated from iliac crest and injected with aseptic precaution under C-arm guidance. We followed them for the period of 6 months.

Results: 17 males and 11 females, mean age was 37.2 years. Union was achieved in 22 of 28 patients were treated by bone marrow injection.

Conclusion: Bone marrow injection treatment is relatively less invasive and cheaper than bone grafting procedure.

Keywords: Non union, delayed union, Bone marrow injection, fractures

INTRODUCTION

There are basically two types of non union of fractures, hypertrophic and atrophic . In hypertrophic non union there is attempt at union taking place and there is exuberant callus formation but lack of stability of bone fragments needed for union.[1] Here mechanical intervention like changing the implant with more rigid ones may help in union, however when there is paucity of callus formation and bone ends are not showing any attempt at union (sclerosed bone ends , occluded bone marrow cavity) i.e. in atrophic non unions of bone. Mechanical solution will not be helpful. Most of the times biological solution is needed.[2] It can either be bone grafts, natural or synthetic bone growth factors, platelets rich plasma with it's platelet derived and other growth factors, stem cells from mesenchymal cells collected from bone marrow, demineralised bone matrix etc.[3]However due to easy and cheap availability and consistent results most of the times bone grafts are preferred.[4] However it has its own disadvantages. In addition to donor site morbidity, there is need to open the non union fracture site. This can cause devascularization of fracture ends and entail additional trauma.[4,5] Cells aspirated from bone marrow provide osteogenic stimulus for union of fracturres.[5,6] Hence we decided to aspirate bone marrow by bone marrow aspiration needle from iliac crest and inject it percutaneously at the non union site . This causes less trauma to patient fulfilling our aim of induction of osteosynthesis theoretically.[2,7] Hence we decided to carry out this study. Also this will save open risk introduction and will be cost effective.

METHODOLOGY

We excluded infected and paediatric patients (less than 18 years), non union cases with significant (more than 1 cm) gap non union. 30 cases of non union of long bones who presented to MIMER Medical College Hospital from April 2012 to March 2016 were selected for prospective follow up study. Local ethical committee approval was obtained and patients informed written consent was obtained on a form. However 2 patients were lost to follow up during the study. Bone marrow was aspirated from the iliac crest with the help of bone marrow aspiration needle. Then it was injected under aseptic precau-

tions in the operation theatre at non union site under C arm guidance without centrifugaton. In non union of metacarpal fractures bone marrow injection was given (20ml). In other long bones 40 ml of bone marrow was injected under aseptic precautions and sedation I.V. and local anaesthesia. We did follow up of cases on opd basis after 6 wks. At the follow up in addition to clinical examination for fracture mobility and tenderness we did x rays AP and Lateral views. We did not repeat bone marrow injections at all. We used 16 gauge bone marrow aspiration needle for bone marrow aspiration from iliac crest (anterior portion) and used 16 gauge standard disposable needle for injection of bone marrow at nonunion site under C arm guidance in O.T.

RESULTS

There were 17 males and 11 female patients. Mean age of patients was 37.2 yrs.

All 5 patients with nonunion of femur united within 6 months. Also patient with nonunion of radius and ulna and 2 with nonunion of metacarpals united.

Table 1: Bones affected

Bones	Frequency (%)
Femur	5 (17.86)
Tibia	20 (71.43)
Radius & Ulna	1 (3.57)
Metacarpal	2 (7.14)

Table 2: Types of Fixation

Types of Fixation	Frequency (%)
Intramedullary Naling	16 (57.14)
Open reduction and plating	4 (14.29)
K wiring	2 (7.14)
Plaster Cast	6 (21.43)

Table 3: Union or Nonunion after bone marrow injection

Bone	Union	Non union
Femur	5	0
Tibia	14	6
Radius & Ulna	1	0
Metacarpal	2	0

Table 4: Cases classified as per Judet Muller Weber, Cech classification

Type	Nonunited fractures	Fractures united after bone marrow injection (%)
Hypertrophic	20	16 (80)
Atrophic	8	6 (75)

Out of 20 tibia cases 6 patients failed to unite even after 6 months. Of these 2 patients were nailed earlier and 2 patients were plated earlier and 2 patients had under gone casting earlier.

Mean time for union was 12.2 +_ 4.2 weeks. Mean time for radiological union was 15.1 +_ 6.3 weeks. Union was achieved in 22 out of 28 patients i.e. 78%. Out of 28 patients 20 had non union of tibia, 5 had non union of femur and one patient had non union of radius and ulna and 2 non union of metacarpals. All five patients with non union of femur were treated with exchange nailing with larger size nail and bone marrow injection. Out of 20 patients of non union of tibia six patients were treated with plaster cast and rest 14 were operated, 10 with intramedullary nailing and 4 with plating. Earlier in these cases we just did bone marrow injection except those cases in whom Implants had broken (2 nails and 2 plates) In broken implants after removal of implants, appropriate Implants were used in addition. One patient with nonunion of radius and ulna had undue square nailing elsewhere and were not changed. Two cases of non union of metacarpals had not united despite k wire insertion.

DISCUSSION

In our study 6 patients of fracture tibia could not unite despite bone marrow injection. This were open fractures initially which had poor soft tissue coverage and blood supply in general. Autologous bone grafting has two rules 1) osteoinduction (that is stimulating bone formation) 2) osteoconduction (that is structural framework for union) .

However bone marrow Injection though is rich in cells stimulating unionis not giving osteoconduction advantage. Hence we excluded cases with significant bone gap prior to our study.[8,10] Amount of bone marrow aspirated and injected is matter of controversy but it has been shown by others that efficacy of injected marrow is directly related to number of progenitor cells. It has been shown that increasing concentration of bone marrow by centrifugation is helpful to increase its osteogenic potential.[9] We injected about 40 ml marrow , as we feel that most of the cases can accommodate 50 ml marrow , only as in many cases space is relatively small and we did not want to inject different amount of bone marrow in different patients and create bias in study , also we decided to inject only once as we feel that if treatment fail once there is no justification in trying same treatment again. In metacarpals space was so less so we decided to inject 20 ml only. We did not do centrifugation of bone marrow to keep our procedure easy and not spent time for process, as we want to inject freshly aspirated marrow only as soon as possible after aspiration. It has been argued that ideal

time for bone marrow injection should be after initial inflammatory period of fracture repair has been subsided (6-12 week s) however this situation exists only in delayed union cases and will be preventive rather that therapeutic modality of treatment.[8]Hence we choose onlynon union cases (after 9 months of fracture without clinical and radiological sign of Union).In our study 22 out of 28 patients united, thus result was fairly good and comparable to other studies(75% to 95%).Also wedid not not counter major complication like infection etc.[11]In same cases some pain at iliac crest was there for few days but subsided with simple NSAIDS only. In some studies bone marrow aspiration has been used in combination with osteoconductive materials for gap nonunion but we excluded such patients and cannot conclusion about them.[12,13]Out of 20 cases of hypertrophic non-union16 united after bone marrow injection and out of 8 cases of atrophic non-union 6 united after bone marrow injection. Thus bone marrow injection is helpful in treatment of both types of non union classified according to Judet Muller Weber, Cech.[14]

CONCLUSION

Bone marrow injection treatment is relatively less invasive and cheaper than bone grafting procedure with same osteoinduction properties with less comorbidity and complications. Hence it can be tried in nonunion cases without large gap.

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