

Clinical Trial of Ionizing Radiated Bone Allograft Combined with Autologous Red Bone Marrow for the Treatment of Bone Defects.

*Ahsan K,¹ Hossain SN,² Mahmud SA³

To evaluate the effect of ionizing radiated bone allograft combined with autologous red bone marrow on bone defects, 54 cases (15 cases of chronic osteomyelitis with bone loss, 14 cases of old fracture non union, 12 cases of simple bone cyst, 04 patients of aneurismal bone cyst and 9 cases of Giant cell tumour) bone defects were treated with curettage operation and post curettage bone defects were filled with ionizing radiated bone allograft combined with autologous red bone marrow in Orthopaedic Department of Dinajpur Medical College Hospital, Dinajpur and local private clinics in Dinajpur. The result showed that all got bony healing within 9 months (7 months in average) and 46 patients became totally cured (85%) & 8 patients (15%) became not cured. So it is suggested that ionizing radiated bone allograft combined with autologous red bone marrow is a simple, cost effective and minimally invasive procedure for the treatment of bone defects.

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Key words: bone allograft, autologous red bone marrow, delayed union, non union, giant cell tumour, aneurismal bone cyst.

Introduction

To stimulate the process of bone healing, several methods have been so far suggested. These modalities include use of ultrasound, electrical stimulation, exposure of electromagnetic field, bone grafting, interporous hydroxyapatite (as a bone graft substitute) etc. All of these methods are rather time consuming and require special instruments and may need second incision (fig. 1).⁵ Cancellous iliac crest autograft has remained the gold standard for bone grafting due to its being osteoconductive, osteogenic and osteoinductive properties (fig. 2).

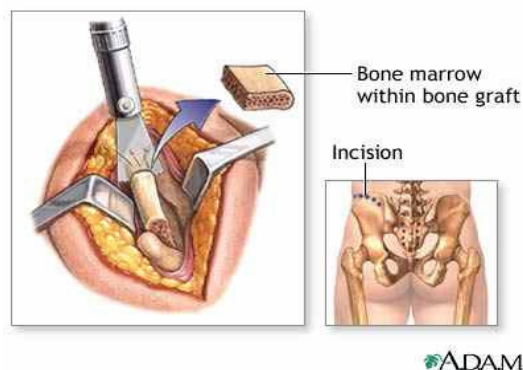


Figure 1. Iliac crest autograft

1. *Dr Kamrul Ahsan, Assistant Professor, Department of Orthopaedics & Traumatology, Dinajpur Medical College and Hospital, Dinajpur.
2. Dr Syed Nadir Hossain, Medical Officer, Department of Orthopaedics & Traumatology, Dinajpur Medical College and Hospital, Dinajpur
3. Dr Sayeed Al Mahmud, Indoor Medical Officer, Department of Orthopaedics & Traumatology, Dinajpur Medical College and Hospital, Dinajpur.

*For correspondence

There are numerous approaches being applied to reduce or eliminate the dependence on autologous bone graft in orthopaedic procedures due to its morbidity, time and cost concern and need of second incision. The ability of red marrow to form new bone was first suggested by Goujon in 1869.¹ Burwell placed bone marrow in a paravertebral muscle pouch and observed bone formation. All these reports suggest that bone marrow might be a logical graft material.²



Figure 2. Incision margin for iliac crest autograft. So, the present study was aimed to present the use of composite graft materials of allogenic cancellous graft combined with autologous red bone marrow is safe, less invasive, inexpensive and effective for fracture healing and filling bone defects.

Methods

This prospective study on 54 patients had been carried out at the Department of Orthopaedics & Traumatology, Dinajpur Medical College Hospital and local private clinics at Dinajpur from February 2008 to February 2010. Radiation sterilized bone allograft were collected from local Center for Nuclear Medicine & Ultrasound Center (CNMU), Dinajpur. Pre-anaesthetic evaluation included a complete physical checkup and laboratory tests done. All patients were informed about the planned operative procedure and written consent taken.

Bone marrow aspirate was collected from posterior iliac crest and tibial condyle of the patients (fig. 3).



Figure 3. Aspiration of bone marrow

After deep insertion of a beveled needle 6 – 8 cm long and 1.5 mm in internal diameter into spongy part of bone then marrow was aspirated in to a 10 ml disposable plastic syringe (fig. 4).⁴

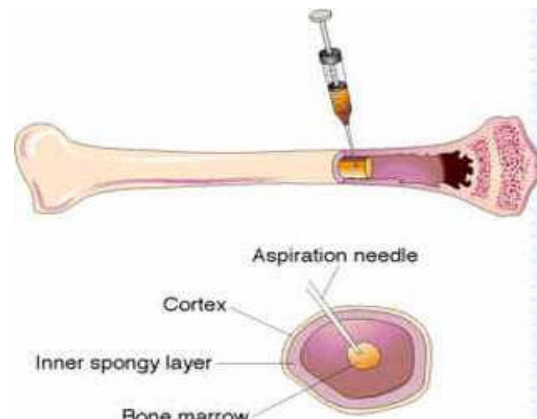


Figure 4. Diagrammatic presentation of collection of bone marrow

Bone marrow aspirate mixed with radiation sterilized bone allograft collected from CNMU, Dinajpur. Then the patients were treated with curettage operation & post-curettage bone defects were filled with radiation sterilized bone allograft combined with autogenic red bone marrow.

Results

From February 2008 to February 2010, 54 consecutive cases of bone defects were treated by bone allograft combined

with autogenic red bone marrow in Orthopaedic & Traumatology Department, Dinajpur Medical College Hospital, Dinajpur and local clinics, Dinajpur. Patients' age ranged from 12 years to 67 years. There were 14 children, 15 female and 25 male patients.

Among 54 patients there were 15 patients of chronic osteomyelitis with bone loss, 14 patients of old fracture non-union, 12 patients of simple bone cyst, 4 patients of aneurismal bone cyst and 9 patients of Giant Cell Tumour (GCT). Under this study, 54 patients were followed by taking X ray radiography at 1 month interval for first three month then every 3 months in the period of one year. The result showed that all got bony healing within 9 months (7 months in average) and 46 patients became totally cured (85%) and 8 patients (15%) became not cured.

Analysis

Healing Rate – results were presented here according to patient cure rate. Fifteen patients of chronic osteomyelitis with bone loss were treated by ionizing radiated bone graft combined with autologous red bone marrow – among them 13 patients (87%) cured but 2 patients (13%) became not cured (table I).

Table I: Cure rate

Clinical outcome	Number of patients (n=15)	Percentage (%)
Healed	13	87
Not healed	02	13
Total	15	100

Fourteen patients of old fracture non union were treated with ionizing radiated bone allograft combined with autologous red bone marrow – among them 10

patients (72%) became cured and remaining 4 patients (28%) became not cured (table II).

Table II: Healing rate of old fracture

Clinical outcome	Number of patients (n=14)	Percentage (%)
Healed	10	72
Not healed	04	28
total	14	100

Twelve patients of simple bone cyst were treated with ionizing radiated bone allograft combined with autologous red bone marrow – among them 11 patients (92%) became cured and remaining 1 patient (8%) became not cured (table III).

Table III: Healing rate of bone cyst

Clinical outcome	Number of patients (n=12)	Percentage (%)
Healed	11	92
Not healed	01	08
Total	12	100

Four patients of aneurismal bone cyst were treated with ionizing radiated bone allograft combined with autologous red bone marrow – among them all patients (100%) became cured (table IV).

Table IV: Healing rate of aneurismal bone cyst

Clinical outcome	Number of patients (n=04)	Percentage (%)
Healed	04	100
Not healed	00	--
Total	04	100

Nine patients of Giant Cell Tumour of bone were treated with ionizing radiated bone allograft combined with autologous red bone marrow – among them 08

patients (89%) became cured and remaining 1 patient (11%) became not cured (table V).

Table V: Healing rate of giant cell tumour

Clinical outcome	Number of patients (n=09)	Percentage (%)
Healed	08	89
Not healed	01	11
Total	09	100

So, in this study – out of 54 patients of above mentioned diseases 46 patients became totally cured (85%) and 8 patients (15%) became not cured.

Healing time – results were presented here according to the time (in month) for complete bone healing.

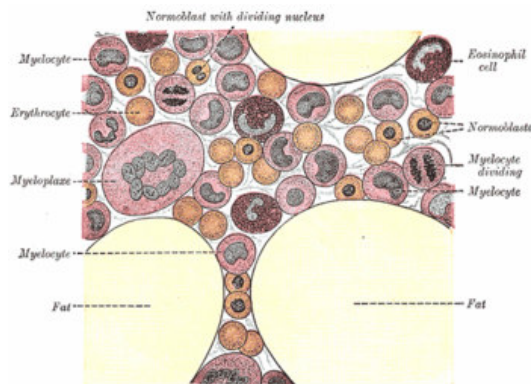


Figure 5. Cells of bone marrow

So in this study, out of 54 patients of above mentioned diseases – 46 patients showed good bony healing within 9 months (7 months in average) (table VI).

Discussion

In children if bone grafting is indicated then the availability of autograft bone is a great problem, because all the donor sites like iliac crest, tibial condyles are






mostly cartilagenous. So enough autogenous bones could not be found. Not only in children in case of adult if the bony cavity is large enough autogenous bone might not be available.⁶

Autograft has all three properties of bone graft such as osteogenesis, osteoconduction and osteoinduction. But allograft has only osteoconduction and osteoinduction, lack of osteogenesis property.⁹ So it is much inferior to autograft. On the other hand, bone marrow aspirate has osteogenesis property that means it provides stem cells with osteogenic potential which directly lay down new bones to the recipient area.⁷ So if allograft is admixed with bone marrow aspirate then it provides osteogenic property to the allograft. This mixture or composite graft then would have all three properties of bone graft as good as autograft.

Bone marrow aspirate is a simple and safe procedure, can be easily done in both children and adult. It has a little risk or morbidity. On the other hand, collection of autograft requires second operation which has a lot of complications like haemorrhage, pain, infection etc and also cost effective.⁴

In this situation, ionized radiated bone allograft combined with autologous red bone marrow for the treatment of bone defect and fracture healing is a very good and effective alternative to bone autograft collected by surgical intervention. This procedure of collection of bone marrow autograft and admixing with radiation sterilized bone allograft can be done in any ordinary operation theatre and does not require much expertise, with minimal risk and very much cost effective.⁸

Table VI: Healing time of different disease

X ray Images of diseases.	Name of disease	Number of healed patients	Average time (in month) for bony healing.
	Chronic osteomyelitis with bone loss	13	9 to 10 months
	Old fracture non union	10	9 to 10 months
	Simple bone cyst	11	7 to 8 months
	Aneurismal bone cyst	04	7 to 8 months
	Giant cell Tumour of bone.	08	7 to 9 months

Success rate of ionizing radiated bone allograft combined with autologous red bone marrow for the treatment of bone defects is very encouraging and is more or less same as with other studies like that of Datta et al.⁹

Table VII: Properties of various types of bone graft sources⁴

Bone Graft	Osteoconductive	Osteoinductive	Osteogenic
Allograft	+	+/-	-
Autograft	+	+	+

Conclusion

Bone marrow aspirate is a validated biological driver of bone formation. So bone marrow aspirate mixed with the optimum osteoconductive scaffold performs equivalent to autograft. Radiation sterilized bone allograft is available in all Nuclear Medicine Centers in Bangladesh. The procedure of using ionized radiated bone allograft combined with autologous red bone marrow is relatively simple, cost effective and in general well accepted by the patients.

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