ASSESMENT OF BONE GRAFT VIABILITY USING SCINTIGRAPHY

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ABSTRACT

The objective of the study was to evaluate autogenous bone graft viability in surgical bony defects using scintigraphy. The Study Design was case series. This case series was conducted in the department of Oral and Maxillofacial Surgery, de'Montmorency College of Dentistry / Punjab Dental Hospital, Lahore from January 2016 to January 2017. Non-probability purposive sampling was done. All patients between 18 to 50 years of age with jaw bone defect from 20 mm to 50 mm were included in the study and all medically unfit patients were excluded. Ten patients received autogenous bone graft into their bone defect. Bone scintigraphy was performed at one and three month intervals and bone formation was clinically correlated radiographically at 6 months. The uptake of radionuclide at the grafted area and uptake of frontal bone was quantified in counts / pixel and recorded as improvement ratio. The results showed that the postoperative course of the study patients was uneventful. There was highly increased uptake of radionuclide, when compared with frontal bone. The mean improvement ratio was 3.6 at one month interval and 3.78 at three month interval. It can be concluded that bone scintigraphy is an effective way to assess bone graft viability and osteoblastic activity can be quantified in terms of counts / pixel but it has to be correlated clinically and radiographiccally because of low specificity.

Key words: *Bone scintigraphy, Autogenous Bone Graft, Surgical bony defect, Radionucleotide. technetium-99m-labelled methylene diphosphonate*

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INTRODUCTION

Autogenous bone grafts is the gold standard for osseous defect regeneration in craniofacial region due to its osteogenicity, osteoinductivity, osteoconductivity and eventual replacement by natural bone.[1] The free bone grafts are associated with bone resorption, rejection and sinus formation. Therefore early assessment of the graft is vital for future prediction of graft status. One of the methods of graft monitoring is bone scintigraphy using technetium-99m-labelled methylene diphosphonate (TCMDP).[2]

Bone scintigraphy was first performed using Technetium-99m as a skeletal localizing agent in 1971.[3] After that a number human studies were conducted using bone scintigraphy to monitor bone graft viability.[4-6] In 1988, twenty four patients under went autogenous grafting procedure in partially resected mandible. The follow up bone scan with technicium-99-methylene diphosphate showed significantly greater tracer uptake in the grafted region was correlated with healing without complications while lower uptake of tracer lead to development of complication, thus concluding that bone scintigraphy is an effective and safe method to assess metabolic viability in a bone graft.5,6 Bone scan hot spot in the graft area signify blood supply and osteoblastic activity during this period and therefore provides functional information about graft incorporation that cannot be obtained with conventional radiography.[7,8] Bone graft viability has also been assessed by bone scintigraphy

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of grafts harvested from two different sites in 1991.[9] Berding et al. did bone scan to evaluate bone graft in mandidular reconstruction. Scintigraphy performed at one and three months interval post operatively showed significantly greater increase in tracer uptake of the grafted area having no complications. Therefore bone scintigraphy has a significant value if used for bone graft evaluation after mandibular reconstruction.[3,10] In 1997 a sequential bone scintigraphy to assess viability of onlay bone graft in an atrophic mandible, in the study forty six patients underwent surgery and results concluded that sequential bone scintigraphy provides very useful information about graft viability.[10,11] In 2007 a study was published that predicted graft retention by bone scintigraphy and results concluded that higher uptake of radionuclide is associated with graft retention. Hence, bone scintigraphy has shown to be an effective method to evaluate viability of bone.[12] In 2014, Costochondral Graft was used in the reconstruction of condyle in Temporomandibular Joint Ankylosis and the viability of the graft was assessed using bone scintigraphy. The results obtained showed that bone scintigraphy is an important tool for graft viability assessment. Vascular patent grafts characterized by higher tracer up take are viable grafts while the nonviable grafts with reduced vascularity showed deficient tracer uptake evidenced on the images obtained.[13,14]

It is extremely important to assess viability of bone after bone graft surgeries. Assessment of viability in maxillofacial bone grafts can be made via bone scintigraphy using Tc-99m methylenedisphosphonate which shows active (hot area) bone formation in the scan.[14] No active bone loss occurred as bone formation was confirmed with 6 months radiograph.

MATERIALS AND METHODS

This was conducted in the department of Oral and Maxillofacial Surgery, de'Montmorency College of Dentistry / Punjab Dental Hospital, Lahore from January 2016 to January 2017. Informed and written consent was taken from the patients. This research was conducted with personal funding. Non-probability purposive sampling was used to collect the sample. All patients between 18 to 50 years of age with jaw bone defect from 20 mm to 50 mm were included in the study and all medically unfit patients were excluded from the study. Screening for eligible subjects took place at the OPD of Oral and Maxillofacial Surgery Department. Potential eligible subjects were sent for radiographic evaluation and for baseline investigations such as CBC, INR and ALT. Then eligible patients were informed about the research project and were asked to give a written consent to take part in the research.

Demographic data of the patient, aetiology causing the jaw defect, type of defect were recorded preoperatively. Anterior posterior size of the defect was noted at the time of operation using a Vernier scale. Routine oral examination was performed and the state of the graft site (infection and dehiscence) was recorded after ten days.At one and three month intervals bone scintigraphy was performed. The radionulide uptake of the grafted area and frontal bone was recorded.

Patients were prepared for operation as per department protocol. Patients included in the study received autogenous bone into their bone defect as given in figure 1. Post-operatively, antibiotics and pain killers were prescribed for seven days. Routine oral examination was performed and the state of the graft site (infection and dehiscence) was recorded after ten days.

At one and three month intervals bone scintigraphy was performed and correlated clinically . The radionulide uptake of the grafted area and frontal bone was recorded in terms of counts/pixel and improvement ratio was noted. Bone formation was confirmed on 6 months follow up radiographs

All the data collected was entered in special package for social sciences (SPSS version 20.0) and results were analyzed accordingly. Mean + S.D was calculated for quantitative data (age, size, improvement ratio) whereas frequency (%) was calculated for qualitative data (gender, type of bone defect).

RESULTS

The data of all patients was collected and compiled well according to research protocol. After completion of follow up the results were depicted in tables, graphs and figures. Male to female ratio was 3:2. 70 % of the bone defects were marginal while 30% of the cases had segmental bone defects after removal of pathology. The defect measurement was from 2.1cm to 4.6cm with mean 3.19cm and defects were restored by corticoconcellous iliac bone. At one month post-operative bone scan, the mean counts/pixel at bone graft region (BGR) was 69.540. At three months post-operative bone scan, the mean counts/pixel was 71.130 as given in table 1. The improvement ratio was calculated at one month and three month interterval via bone graft scintigraphy using the formula;

$$improvement\ ratio = \frac{bone\ graft\ count\ per\ pixel}{Frontal\ bone\ count\ per\ pixel}$$

Total number of ten subjects with Etiology of Odontogenic Myxoma, Gun Shot, Radicular Cyst, Radicular cyst, Alveolar Cleft, Residual cyst, Solitary bone cyst and Ameloblastoma were operated. The mean value of count per pixel at one month bone graft scintigraphy was 69.54 count/pixel with standard deviation 5.94 and at three months it was 71.13 counts/pixel with

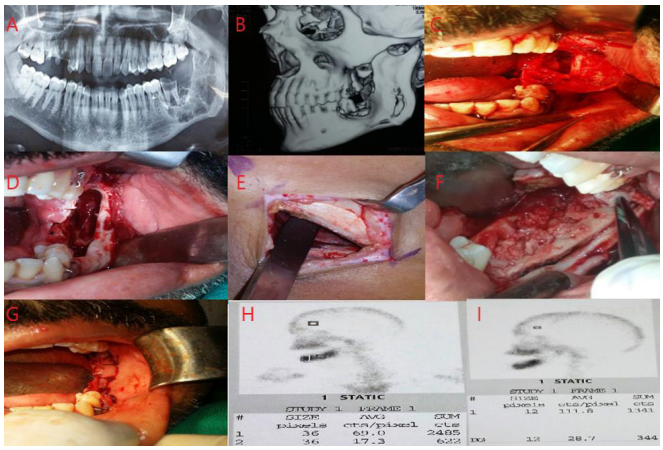

Fig 1: A,Odontogenic Myxoma on the left side mandibular angle area, B, CT scan showing bony distruction, C, Pathology removed, D, Host bed preparation ,E, Graft harvest from the illiac, F,Defect area filling with Autogenous iliac bone,G, Surgical site sutured, H and I, Show Scinitigraphic results at 1 month and 3 month

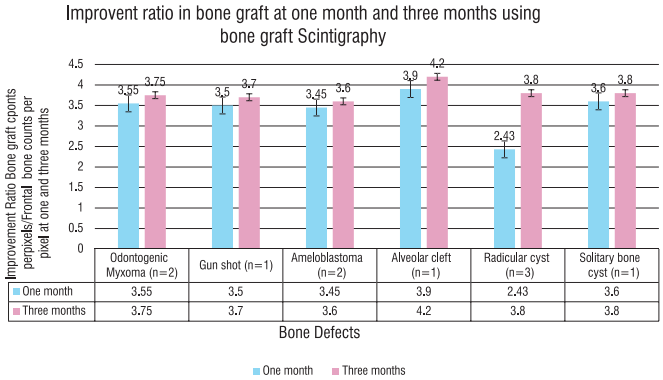

Fig 2: Improvement ratio in bone graft at one month and three months using bone Scintigraphy using technetium-99 methylene-diphosphate

TABLE 1: SHOWSMEAN COUNT/PIXEL FROM THE AT 1 MONTH AND 3 MONTHS

Bone Graft count/ pixel	N	Count/ pixel of	Standard Deviation
1 month bone Graft count/pixel	10	69.540	5.9422
3 month bone Graft count/pixel	10	71.130	5.6085

standard deviation 5.61. The calculated improvement ratio was assessed at one and three month interval as given in figure 2.

DISCUSSION

This study evaluates bone graft viability by a bone scintigraphy using Techncium-99-methylene-di-phosphate. In new bone formation Diphosphonates are chemosorbed on the surface of immature hydroxyapatite crystals with a large hydration shell. In the maturation phase tracer uptake reduces as the mineral phase becomes less available. Thus scintigraphy provides useful information about osteoblastic activity in avascular bone grafts and the degree of revascularization.[2,7,8,11]

In this study bone viability was slightly increased improvement ratio at third month when compared to the first month suggesting slight increase in osteoblastic activity. Osteoclastic activity was not predominant as it was confirmed clinically and radiographically at 6 months.

Similarly Berding et al. (1994) conducted a study to evaluate bone graft viability in mandibular reconstructions with follow up scingtigraphy at 1 and 3 months post operatively which showed significant increase in tracer uptake in grafts.[2] In a study conducted by Schliephake et al. (1997) on autogenous bone grafts of the jaw and sequential bone scintigraphy, the mean uptake of radionuclide at the graft area was similar to the uptake of the graft of our control group but at 5 months there was a slight decreased in the uptake of radionuclide suggesting that the grafts were going through maturation and decreased bone deposition by creeping substitution at 5 months.[11]

CONCLUSION

Bone rehabilitation has been attempted since long to repair bone loss in the Oral and Maxillofacial region. The free bone grafts of reasonable size are sometimes associated with bone resorption, rejection and sinus formation. . Therefore early assessment of viability in a bone graft is essential for future prediction of graft status. Bone scintigraphy using technetium-99m-labelled diphosphonate has been an effective tool for early assessment of bone graft but has to be correlated clinically and radiographically because of low specificity. This study also concluded that bone formation in a bone graft is slightly more at 3 month than at first month.

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4	**Muhammad Munaaf Hashim:**	Article Editing.
5	**Shahreen Zahid:**	Data acquisition/ analysis.
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