

## Dentascan an excellent tool for assessment of variations in the management of periodontal defects

### ABSTRACT

**Background:** The purpose of the present study was to envisage the effectiveness of demineralized freeze-dried bone allograft (DFDBA) and bovine bone graft (BBG) for promoting defect fill in periodontal intrabony defects using dentascan.

**Materials and Methods:** A total of 13 subjects (15 intrabony defects) aged between 24 and 56 years affected by moderate to severe periodontitis were randomly divided into Control (CG) and Test groups (TG1 and TG2). In CG only debridement, TG1 debridement plus DFDBA, and TG2 debridement plus BBG were performed. The clinical parameters probing pocket depth (PPD), clinical attachment level (CAL) was used. The radiological analysis was done by dentascan, which is a single-slice spiral computed tomographic scanner. Six months after, regenerative treatment clinical measurements were recorded. The bone fill was assessed using Dentascan as previously mentioned.

**Results:** PPD reduction and CAL gain were significant in all the groups after 6 months whereas, on intergroup comparisons, insignificant finding was observed both at baseline and after 6 months. Coronoapical bone status decreased significantly in all groups, buccolingual measurements decreased significantly in TG1 and TG2, but no such trend was seen in CG. Significant reduction in mesiodistal bone status was noticed only in TG1 whereas insignificant on intergroup comparisons.

**Conclusion:** Dentascan-based analysis attested that DFDBA was superior to BBG.

**Keywords:** Bovine bone graft, dentascan, demineralized freeze-dried bone allograft, osseous regeneration

### INTRODUCTION

Recently, dental computed tomographic (CT) reformatting programs that use thin transverse images of the jaw to reformat multiple panoramic and cross-sectional views were developed. Since images are reformatted, streak artifacts that degrade bone visualization at direct coronal CT are projected over the crowns of the teeth, permitting optimal viewing of bone. As a result, these programs have been successfully used to evaluate implants, cysts, tumors, and surgical procedures. The developments of dental CT reformatting programs, however, have completely revolutionized and changed the fashion, in which we radiographically evaluate the jaw today.<sup>[1]</sup> The programs are useful because they provide accurate information about the height and width of the jaws as well as information about the location of vital structures.

The technique of dental CT, also called Dentascan, was developed by<sup>[2]</sup> Schwarz *et al.* in 1987. They first used curved multiplaner reconstruction of the jaw.

Periodontal therapy involves the elimination of bacterial plaque and the correction of anatomical defects produced by disease process. Both nonsurgical and surgical treatment

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modalities have been used to manage periodontal diseases. It is assumed that the application of bone grafts would potentially manipulate the biological response into a regenerative rather than a predominantly reparative pattern of periodontal healing.<sup>[3]</sup> The use of bone grafts for reconstruction of osseous defects produced by periodontal diseases dates back to 1923 by<sup>[4]</sup> Hegedus and was popularized by<sup>[5]</sup> Nabers and O'leary in 1965. Many osseous grafting materials have been used toward the goal of obtaining periodontal regeneration, for example, autografts, allografts, heterografts (or xenografts), and alloplastic materials. These various grafting materials may produce radiographic evidence of bone fill and clinical evidence of improvement in probing depth and clinical attachment level (CAL).<sup>[6]</sup> Schwartz *et al.* 1998 reported that variations in the amount of bone formation induced by demineralized freeze-dried bone allograft (DFDBA) were related to the source and processing of the bone. In addition to processing variations, it has been demonstrated that young donor bone results in significantly greater quantities of bone morphogenetic proteins (BMPs) retained in the bone allograft matrix compared with older donor bone. On the other hand, bovine bone grafts (BBGs) have long been used in the treatment of periodontal bone defects because of their potential for periodontal regeneration.<sup>[7]</sup>

Due to a paucity of literature on the role of Dentascan in periodontics, the purpose of the present study was to envisage the effectiveness of DFDBA and BBG for promoting defect fill in periodontal intrabony defects using Dentascan.

## MATERIALS AND METHODS

A cross-sectional study was conducted in the Department of Periodontology, faculty of dental sciences, K. G. Medical University, Lucknow. A total sample size was 13 subjects (with 15 intrabony defects) out of 9 males and 4 females with age group 24–56 year (mean 40 years) affected by moderate to severe periodontitis were recruited from the outpatient.

### Inclusion criteria

- No contributory medical history
- At least  $\geq 5$  mm of probing pocket depth (PPD) of the test tooth
- Radiographically detectable intrabony defects and presence of two wall intraosseous defects was confirmed during surgery
- Ability to control oral hygiene
- Good cooperation.

### Exclusion criteria

- Subjects on medications for the past 6 months
- Three walls or one wall intraosseous defects

- Smokers
- Tobacco chewers
- Grade three mobility of the test tooth with intrabony defects.

### Study design

Fifteen intrabony defects were randomly divided into two groups; control and test group based on the assigned treatment. Control group (CG) ( $n = 5$ ): Only debridement. Test groups: Group-I (TG1) ( $n = 5$ ): assigned treatment with DFDBA, granules size:  $> 1040 \mu$ .

Group-II (TG2) ( $n = 5$ ): assigned treatment with BBG, granules size: 1000–2000  $\mu$ .

### Presurgical management

For all subjects, general, oral, and full-mouth periodontal examination was carried out, and informed consent was obtained from the subjects after explanation of the procedure. Basic periodontal therapy was performed with detailed instructions in self-plaque control measures. Full mouth scaling and root planing and occlusal adjustments if necessary were done. The baseline examination was performed 4 weeks after the completion of initial therapy and achievement of low plaque index (15%).<sup>[8]</sup> Subjects evaluation was followed by impressions for fabrication of acrylic stent required for the measurements of clinical parameters in control and test groups during the study.

### Clinical measurements

#### Soft-tissue measurements

Included PPD and CAL using UNC-15 probe (Hu-friedy).

All measurements were performed by

- PPD - Distance measured from free gingival margin to the base of the periodontal pocket
- CAL - When the gingival margin is coronal to the cemento-enamel junction (CEJ), the CAL is calculated by subtracting the gingival margin level to CEJ from the probing depths. When recession is present, the CAL is calculated by adding the probing depth to the gingival margin level from CEJ.

### Radiological examination

Coronoapical, mesiodistal, and buccolingual measurements of intrabony defect were measured using Dentascan, which is a single-slice spiral CT scanner. Dentascan produces 1 mm thick slice interval, and all axial images acquired 12.5 cm field of view. Dentascan was operated at 120–140 kV and 100–200 mA which varied from subject to subject.

### Analysis

The acquired images were transferred to workstation and reformatted into axial sections, sagittal sections, and CT orthopantomographs. The buccolingual and mesiodistal measurements were taken using computer software placing caliper at widest point of bone loss. The coronoapical measurements were taken manually using CT orthopantomographs and sagittal reformatted images of individual tooth, using measurement scales provided along with the printed images.

### Statistical analysis

It was performed using two-way analysis of variance (ANOVA) which is an extension to the one-way ANOVA. There are two independent variables (hence the name two-way). After ANOVA, Newman–Keuls test was used to calculate difference between the means of all groups.  $P < 0.05$  was considered as a statistically significant.

### Surgical procedure

All instruments to be used in the surgery were sterilized by autoclaving (temperature 121°C at 15 psi for 15 min). The facial skin all around the oral cavity was scrubbed with povidone-iodine solution and subjects were asked to rinse with 0.2% chlorhexidine.

After obtaining the local anesthesia (2% xylocaine with 1:80,000 adrenaline), crevicular incision with blade number 15 was given at the test site. Full thickness mucoperiosteal flap was reflected on facial/buccal and lingual/palatal exposing crestal bone using periosteal elevator to expose the test area. The vertical releasing incision was given when needed for better access. Papilla preservation flap was performed where interproximal spaces were available to ensure maximum closure and graft coverage postsurgically. The exposed intraosseous defect was debrided of granulation tissue using hand curettes. Adjacent tooth surfaces were planed with area specific curettes. The defect area was irrigated with sterilized saline to get rid off the residual debris. Osseous grafts (DFDBA or BBG) were placed in the defects as assigned. Flaps were repositioned, and complete closure was achieved. Interrupted or horizontal mattress sutures (3-0) were used and periodontal dressing was applied over the surgical site.

After surgery, subjects were prescribed amoxicillin with clavulanic acid (625 mg) TDS, anti-inflammatory (Ibugesic 400 mg) three times per day and B-complex 1 capsule daily for 5 days. Subjects were instructed to rinse twice daily with 0.2% chlorhexidine and not to brush in the treated area for the first 2 weeks. One week after surgery sutures and periodontal dressing were removed. The site was cleaned,

and the periodontal dressing was replaced if needed. The subjects were recalled every 4 weeks for 6 months for oral hygiene evaluation and prophylaxis. After 6 months PPD and CAL were measured, and bone fill was assessed using Dentascan as previously mentioned.

### RESULTS

The results obtained through the study are summarized in Tables 1–4 and Figures 1-7. The maximum reduction in PPD was 3.80 mm (45.2%) in the TG1 and minimum reduction 2.80 mm (32.6%) in CG. The maximum gain of CAL 3.80 mm (50%) was observed in TG1 followed by 3.00 mm (38.5%) in TG2 and 2.80 mm (35.9%) in CG [Table 1]. On intergroup comparison [Table 2] PPD and CAL at baseline and after 6 months showed nonsignificant difference ( $P > 0.05$ ).

Alterations in hard tissue (bone status) using Dentascan [Table 3] depicts reduction in coronoapical bone status 3.00 mm (50%) in TG1 followed by 2.40 mm (41.4%) in TG2 and least 0.80 mm (14.3%) reduction was seen in CG. Reduction in buccolingual bone status in CG, TG1, TG2 was 0.40 mm (5.7%), 2.20 mm (30.6%) and 1.40 mm (18.9%) respectively. The mesiodistal bone status was 0.80 mm (26.7%) in TG1 followed by 0.60 mm (21.4%) in TG2 and 0.40 mm (14.3%) in CG.

On intergroup comparison at baseline coronoapical bone status did not differ significantly ( $P > 0.05$ ) [Table 4]. On the contrary at 6 months significant reduction ( $P < 0.01$ ) in coronoapical bone status was seen in CG versus TG1; ( $P < 0.05$ ) in CG versus TG2 and nonsignificant difference ( $P > 0.05$ ) in TG1 versus TG2. Although the reduction of mesiodistal bone status between the CG versus TG1 is twice, i.e., 0.40 mm [Table 3] but difference was



Figure 1: Pretreatment radiological measurement of coronoapical bone loss





Figure 2: Pretreatment radiological measurement of mesiodistal and buccolingual bone loss

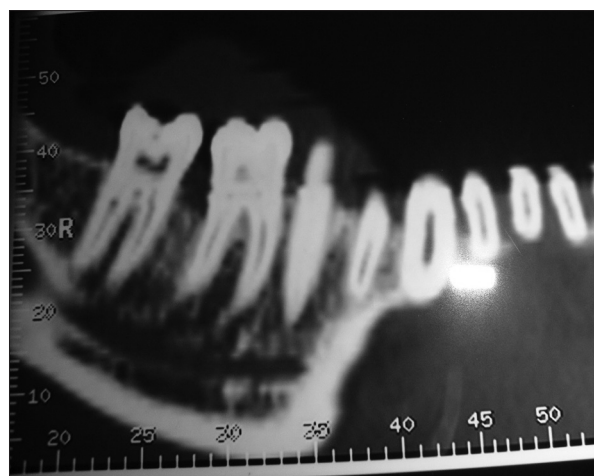


Figure 3: Radiological measurement of coronoapical bone loss at 6 months after treatment

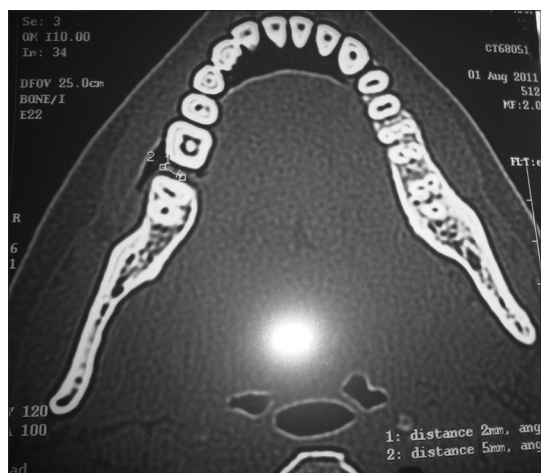


Figure 4: Radiological measurement of mesiodistal and buccolingual bone loss at 6 months after treatment



Figure 5: Placement of bone graft in the defect

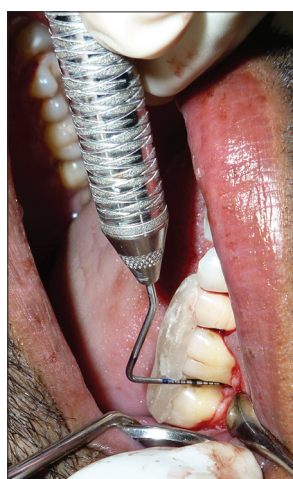


Figure 6: Clinical measurement of coronoapical bone loss at the time of surgery



Figure 7: Clinical measurement of coronoapical bone loss at 6 months after treatment without exposure of the defect

statistically nonsignificant ( $P > 0.05$ ). The Same trend of the nonsignificance was observed in CG versus TG2 and in

between the two test groups. On intergroup comparison insignificant ( $P > 0.05$ ) reduction of buccolingual bone status was observed.

**Table 1: Change in probing pocket depth and clinical attachment level (mm) at 6 month interval in control and test groups**

Treatment groups	PPD			CAL		
	Base line	Post (6 months)	Reduction (%)	Base line	Post (6 months)	Gain (%)
CG	8.60±0.89	5.80±0.84	32.60	7.80±0.84	5.00±1.00	35.90
TG1	8.40±1.14	4.60±0.89	45.20	7.60±0.55	3.80±0.84	50.00
TG2	8.80±1.30	5.20±1.30	40.00	7.80±0.84	4.80±0.45	38.50

PPD: Probing pocket depth, CAL: Clinical attachment level, CG: Control group, TG: Test group

**Table 2: Comparison of mean probing pocket depth (mm) and clinical attachment level (mm) between the groups**

Treatment comparisons	PPD		CAL	
	Base line	Post (6 months)	Base line	Post (6 months)
CG versus TG1	0.77	0.22	0.91	0.06
CG versus TG2	0.77	0.39	1.00	0.69
TG1 versus TG2	0.83	0.39	0.69	0.06

PPD: Probing pocket depth, CAL: Clinical attachment level, CG: Control group, TG: Test group

**Table 3: Change in coronaoapical, mesiodistal, and buccolingual bone status (mm) at 6 month interval in control and test groups**

Treatment groups	Bone status	Baseline	Post (6 months)	Reduction (%)
CG	Coronoapical	5.60±0.55	4.80±0.45	14.3
	Mesiodistal	2.80±1.10	2.40±0.89	14.3
	Buccolingual	7.00±1.30	6.60±1.34	5.7
TG1	Coronoapical	6.00±1.22	3.00±1.00	50
	Mesiodistal	3.00±0.71	2.20±0.45	26.7
	Buccolingual	7.20±0.84	5.00±0.71	30.6
TG2	Coronoapical	5.80±0.84	3.40±0.55	41.4
	Mesiodistal	2.80±0.84	2.20±0.45	21.4
	Buccolingual	7.40±1.67	6.00±1.73	18.9

CG: Control group, TG: Test group

## DISCUSSION

The present study was designed to compare the role of DFDBA and BBG for the treatment of intrabony periodontal defects. Test and control intrabony defect groups were homogeneous at baseline, and each subject participating in the study showed good oral hygiene level and a healthy gingival status. Among all the bone graft materials being developed, DFDBA has been shown in clinical trials, controlled studies, and human histological evaluations to be a highly efficacious materials for the reconstruction of periodontal osseous defects and the regeneration of the periodontium.<sup>[9,10]</sup> BBG has recently been shown to have the potential for periodontal regeneration.<sup>[7]</sup>

Although, there is no denying fact that the most reliable method to assess the amount of bone fill is surgical reentry, yet in this study second surgical procedure was not performed. Trejo *et al.* 1998<sup>[11]</sup> emphasized that second surgical trauma to the subjects add to the disruption of the

attachment apparatus and may account for the resultant significant loss of attachment and bone fill.

Clinical examination and periapical radiographs are generally sufficient in the pre- and postoperative hard tissue measurements. Usually, these are affected by common errors such as angulations and distortion. Even with the best-standardized technique, the radiograph does not show the entire topography of the area before or after treatment.

A comparative study of pretreatment bone levels and posttherapy bone gains shows that linear radiographic analysis significantly underestimates pretreatment bone loss and posttreatment bone fill.<sup>[12]</sup> Therefore, in the present study Dentascan, a unique new computer software program which provides CT imaging was used. It offers significant potential for identifying mineralized structures and enhances the usefulness of radiographic evaluation by measuring coronaoapical, mesiodistal and buccolingual bone loss/fill.

The particle size of DFDBA and BBG used in this study was >1040 μ and 1000–2000 μ, respectively. Fucini *et al.* 1993<sup>[13]</sup> however concluded that there is no statistic significant difference between defects grafted with different particle sizes of DFDBA when used in humans. At 6 months postsurgically, the percentage reduction of PPD in TG1 was 45.2%, 40.9% in TG2, and 32.6% in the CG [Table 1]. Highly significant ( $P < 0.001$ ) reduction of PPD was obtained both with TG1 and TG2 when compared with CG. Comparable PPD reduction was reported by<sup>[14]</sup> Scheyer *et al.* 2002.

Percentage gain in CAL after 6 months was 50% in TG1 whereas very little differences of 38.5% were observed in TG2 and 35.9% in the CG [Table 1]. In contrast to our study,<sup>[15]</sup> Richardson *et al.* 1999 reported a gain of  $2.6 \pm 1.6$  mm and  $3.6 \pm 1.9$  mm with DFDBA and BBG, respectively. Rummelhart *et al.* 1989 documented a gain of 1.7 mm in CAL with DFDBA.

After 6 months, posttreatment coronaoapical bone status decreased in all groups. The improvement was highest in TG1 (50%) followed by TG2 (41.4%) and least for CG (14.3%) [Table 3]. On intragroup comparisons, significant ( $P < 0.01$  or  $P < 0.001$ ) reduction in coronaoapical bone status was noted in all the groups. When compared to control

**Table 4: Comparisons of mean coronaoapical, mesiodistal and buccolingual bone status (mm) between the groups**

Comparisons	Bone status					
	Coronoapical		Mesiodistal		Buccolingual	
	Base line	Post (6 months)	Base line	Post (6 months)	Base line	Post (6 months)
CG versus TG1	0.72	0.01	0.69	0.69	0.81	0.17
CG versus TG2	0.70	0.02	1.00	0.91	0.88	0.49
TG1 versus TG2	0.70	0.45	0.91	1.00	0.81	0.25

CG: Control group, TG: Test group 1

significant coronaoapical bone level reduction of 2.20 mm (3.5 fold) and 1.60 mm (2.9 fold) was noted in TG1 and TG2, respectively. Masters *et al.* 1996<sup>[16]</sup> also reported similar results of 2.20 mm bone fill with DFDBA.

According to the results, DFDBA (TG1) appeared to be a favorable graft material. Dissimilar results between our study and other studies can be attributed to the variation in the degree of DFDBA demineralization between the tissue banks, which might have an effect on bone fill.

With the use of Dentscan in the present study, it was possible to record two more measurements buccolingual and mesiodistal. The findings of our study demonstrated that TG1 and TG2 led to substantial improvement buccolingually when compared to nongrafted CG. Reduction in buccolingual bone status with TG1 (30.6%) was 5.3 and with TG2 (18.9%) 3.3 fold higher than the CG (5.7%). While in buccolingual measurements, no significant difference ( $P > 0.05$ ) was present when TG1, TG2, and CG were compared at 6 months from baseline. Bone status mesiodistally showed significant reduction ( $P < 0.05$ ) only in TG1 at 6 months when compared to baseline. Nonsignificant difference ( $P > 0.05$ ) was noted in TG2 and CG at 6 months period [Table 4].

It was interesting to note that TG1 (DFDBA) maintained consistency in reducing all the three bony parameters, thus proving a better treatment choice for the management of two wall intrabony defects. Appreciable results of DFDBA (TG1) might be attributed to the exposure of BMPs on demineralization which subsequently stimulated new bone formation.

Within the limits of the present study, it can be concluded that at 6 months after surgery both the grafts resulted in significant PPD reduction and CAL gain. Although significant improvement was noted in bone fill and percentage gain with both the materials DFDBA (TG1) and BBG (TG2), there was no significant difference between the two. However, DFDBA was found to be superior to BBG. Further longitudinal studies with larger sample size and use of barrier membranes should be undertaken to substantiate the osteogenic potential of DFDBA and BBG.

## CONCLUSION

DFDBA is better treatment choice in compare to BBG for the management of two wall intrabony defects.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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