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Research Article

COMPARATIVE ASSESSMENT OF SOCKET PRESERVATION USING AUTOGENOUS DENTIN GRAFT OR ALLOGENIC BONE GRAFT– A 1 YEAR CLINIC-RADIOGRAPHIC ANALYSIS

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ABSTRACT

Alveolar ridge preservation following tooth extraction is an important aspect in modern treatment planning. Aim of this current study was to evaluate and compare the efficacy of autogenous tooth dentin block graft with allogenic bone graft block in preserving alveolar ridge dimension after tooth extraction at 12 months. 20 subjects require at least three teeth extraction were selected and divided into 3 groups - group I: autogenous tooth block with PRF membrane placement, group II: DFDBA block with PRF membrane placement, group III: Control group i.e., socket left ungrafted. CBCT analysis was done immediately after extraction and at 12th month. At 12 month group I and II showed comparable socket preservation compared to group III. Dentin graft can be a good alternative for socket preservation.

INTRODUCTION

Alveolar ridge preservation following tooth extraction is an important aspect in modern treatment planning. Following extraction of a tooth, dimensional changes of the residual alveolar ridge are inevitable. At the time of tooth extraction, pre-existing pathologies such as periodontal disease and periapical lesions hasten the process of bone resorption. First six months following extraction is very crucial for ridge loss. Alveolar ridge loses its height and width by ≥50% in this time period.[1] Thus, to maintain the bone volume necessary for optimal functional and aesthetic outcome of a dental implant, ridge preservation is required. Preservation of existing ridge before resorption is much easier and predictable than regenerating a lost ridge.[2] Placement of various bone or bone substitute graft materials into extracted socket is thus advocated and medically termed as ridge preservation technique. Commercially available bone substitute grafts like allogenic grafts, xenografts or alloplasts have mainly osteoconduction property. Autogenous bone possesses osteogenic properties and considered as the gold standard. However, the risk of infection at the donor site surgery, limited availability and early resorption are few shortcomings of autogenous bone grafting.

While considering mineralized structure, i.e., tooth in its organic parts have dentin and cementum. It possess type I collagens and also has various growth factors such as bone morphogenic proteins (BMPs). Type I collagen occupies about 90% of the organic parts of tissues, rest 10% are non-collagenous proteins (NCP), biopolymers, glycoprotein, citrate, lactate etc. NCPs include phosphophoryn, sialoprotein, glycoprotein, proteoglycan, osteopontin (OPN), osteocalcin, dentin matrix protein 1, osterix and Runx2. These proteins present both in dentin and bone are known to trigger the bone resorption and generation processes.[3] Based on the potentials of osteoconduction, osteoinduction and osteogenesis through the growth factors between tooth and bone, a novel bone graft material has been developed utilizing the organic and inorganic components of an extracted tooth. Non-restorable tooth, periodontally compromised tooth or a third molar indicated for extraction are potential sources of tooth graft. Autogenous dentin graft was developed and clinically applied in South Korea since 2008 and showed good clinical and histological outcome. In addition, dentin contains growth factors: insulin-like growth factor (IGF)-II, BMP-2 and transforming growth factor (TGF) -β.[4] Hence the aim of this study was to evaluate and compare the efficacy of Autogenous tooth Dentin block graft with Allogenic bone graft block in preserving alveolar ridge dimension after tooth extraction at 12 months.

MATERIALS AND METHOD

The present in-vivo, clinico-radiographic prospective study was conducted with 20 subjects having minimum three teeth indicated for extraction. Subjects were selected from the Out Patient Department. Inclusion criteria's included - Systemically healthy subjects, age ranging between 20 to 60 years, Subjects with at least three teeth indicated for

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extraction, Extraction socket with at least two walls present, Socket depth ≥5mm and width ≥3mm present after extraction and at least half of the buccal wall should be present in the socket. Exclusion Criteria's were pregnant or lactating women, Subjects with substance abuse or tobacco use, periapical infection, history of drug allergy and subjects on bisphosphonate therapy or any other drug that modify bone metabolism. A comprehensive medical and dental history was recorded. Subjects willing to participate in the study were explained about the potential benefits and risk of the study procedures and an informed consent was obtained. Both the study protocol and inform consent form was approved by institutional ethical board after rigorous evaluation.

Surgical procedure

After achieving adequate anaesthesia in the surgical area using 2% lignocaine hydrochloride and adrenaline (1:100,000), a minimally traumatic extraction of the indicated teeth was carried out using laxator or forceps as required. Sockets were curetted and irrigated with normal saline solution. (Figure 1)

Clinical measurements

The socket depth and width was then measured using UNC-15 periodontal probe. From highest point on the buccal/lingual bone to base of the socket was measured as height and distance between bucco-lingual plates was measured as width.

Radiographic assessment

Socket dimensions were also measured by cone beam computed topography (CBCT). Data was acquired using 14s scanning time at 88 KVp and 8 mAs exposure, with voxel size of 200 µm. The bucco-lingual width and depth of socket was measured immediately after tooth extraction and at 12^{th} month post-operatively using CBCT. The crestal bone loss for each socket was evaluated by subtracting immediate post-extraction dimension i.e. on the day of operation with 12^{th} month post-operative dimensions.

Sockets were randomly assigned into 3 groups: Group I: Autogenous tooth block with PRF membrane (Figure 2)

Group II: DFDBA block with PRF membrane (Figure 3)

Group III: Control group i.e., socket left ungrafted and healed with clot formation. (Figure 4)

Preparation method of tooth block graft for group I: it has phase preparation dentin graft preparation and i-PRF preparation.

Autogenous tooth Dentin Graft Preparation - The extracted tooth was scaled, caries were removed if present, using a round tungsten carbide bur. Enamel and cementum were removed using bur. The tooth was powdered using a conventional grinder having motor rating 2000 W and speed of 700 - 1000 rpm. The crushed granules were passed through autoclaved stainless steel sieves to obtain graft with particle size between 500-1000 µm. To achieve graft sterilization, the graft particles were immersed in 1 N lactic acid for 15–20 min to partially decalcify them. Subsequently, graft particles were thoroughly washed with sterile normal saline for 60 sec to remove any residual traces of lactic acid. (Figure 5). i-PRF Preparation: 5 ml of whole venous blood was collected from the median cubital vein which was transferred in a test tube. The test tube was then transferred to the centrifugation machine and then centrifuged at 3000 rpm for 3 minutes for obtaining i-PRF. This prepared i-PRF was mixed with prepared tooth graft to make the block graft. (Figure 6) I-PRF was stirred gently for approximately 10 seconds while shaping it into desired form. Fibrinogen clots into fibrin within some minutes and traps the biomaterial to form a PRF block.[5] Tooth block graft was procured and placed into the extraction socket and sutured. (Figure 8). Preparation method of allograft block for group II: Commercially available DFDBA particulate graft (particle size of 500-1000 µm) was procured and was mixed with i-PRF. It was stirred gently for approximately 10 seconds while shaping it into desired form. (Figure 7) Similar to group I a block was formed with DFDBA. It was then placed in to the socket and sutured. (Figure 8). Post-operatively 10 ml of 0.2% Chlorhexidine Gluconate mouth rinse twice daily for 2 weeks were advised and analgesic were prescribed as required. CBCT analysis of socket dimension was performed for group I, II, III was performed immediately after tooth extraction and at 12^{th} month. (Figure 9,10,11)

Statistical analysis

All the descriptive data that include mean and standard deviation were determined. The data derived for each group was analysed by independent t test and paired t test. The inter-group comparison between all the three groups was done using analysis of ANOVA test. For all tests, a p value of ≤0.05 was considered significant and p value of ≤0.001 was considered highly significant.

RESULTS

Intra-group comparison of socket size (socket width × socket height): Mean socket size for group I was found 33.270 ± 18.515 mm^2 at baseline and 25.358 ± 16.635 mm^2 socket fill was seen 12 month post operatively. The mean difference was found to be 7.913 mm^2. The value of socket fill was statistically significant with a p value of 0.006 (Table I). The mean socket size for group II was found 53.250 ± 28.509 mm^2 at baseline and socket fill was 41.875 ± 25.248 mm^2 at 12 month post operatively. The mean difference was 11.375 mm^2. The value of socket fill was statistically significant with a p value of 0.007 (Table I). The mean socket size for group III was found 43.483 ± 28.734 mm^2 at baseline and socket fill was 15.063 ± 9.942 mm^2 at 12 month post operatively. The mean difference was 28.420 mm^2. The value of socket fill was statistically non-significant with a p value of 0.079 (Table 1).

Inter-group comparison

1. Socket size: On inter-group comparison of socket size using ANOVA test between all the three groups, the values were found to be statistically non-significant both at baseline and at 12 month post-operatively (Table II).
2. Crestal bone loss: The crestal bone loss was 0.975 ± 0.263 mm, 1.075 ± 0.299 mm and 2.925 ± 2.516 mm for for Group I, II and III respectively (Table III). Highest crestal bone loss was seen in Group III and lowest for Group I. On intergroup comparison, using unpaired t test, between all the three groups, the values were found to be statistically non-significant (p value=0.16)
3. Socket fill percentage: The mean percentage socket fill was found to be 80.01%, 76.13% and 34.03% for group I, II and III respectively (Table IV). More amount of socket fill was found in Group I and II when compared to Group III.

Table I Intra group comparison of socket size

Groups	Baseline socket size (mm2)	Groups I year socket size (mm2)	Mean difference (mm2)	P value
Group I	33.270±18.515	25.358±16.635	7.913	0.006(S)
Group II	53.250±28.509	41.875±25.248	11.375	0.007(S)
Group III	43.483±28.734	15.063±9.942	28.420	0.079(NS)

Table II Intergroup comparison of socket size

		Sum of Squares	Mean Square	Sig.
Baseline Socket size	Between Groups	798.533	399.266	0.567(NS)
	Within Groups	5943.726	660.414	
	Total	6742.259		
1 year Socket size	Between Groups	1463.633	731.817	0.170(NS)
	Within Groups	3039.083	337.676	
	Total	4502.716		

Table III Intergroup comparison of Crestal bone loss

Groups	Crestal bone loss (mm)	Standard deviation	P value
Group I	0.975	0.263	0.16 NS
Group II	1.075	0.299	
Group III	2.925 2.516	2.925 2.516	

Table IV Intergroup comparison of Socket fill percentage

Groups	Socket fill %	P value
Group I	80.01	0.000 HS
Group II	76.13	
Group III	34.03	

Figure 1 Pre-operative view of mandibular anterior teeth with periodontitis

Figure 2 Immediately after teeth extraction – socket measurement with UNC-15 Periodontal probe of Group I

Figure 3 Immediately after teeth extraction – socket measurement with UNC-15 Periodontal probe of Group II

	**Figure 4** Immediately after teeth extraction – socket measurement with UNC-15 Periodontal probe of Group III
	**Figure 5** Preparation of dentin particulate graft and decontaminated with lactic acid
	**Figure 6** Dentin graft mixed with i-PRF to prepare Dentin block graft
	**Figure 7** Commercially available DFDBA mixed with i-PRF to prepare DFDBA block graft
	**Figure 8** Site I and II were filled with designate draft materials and site III was left without any graft.

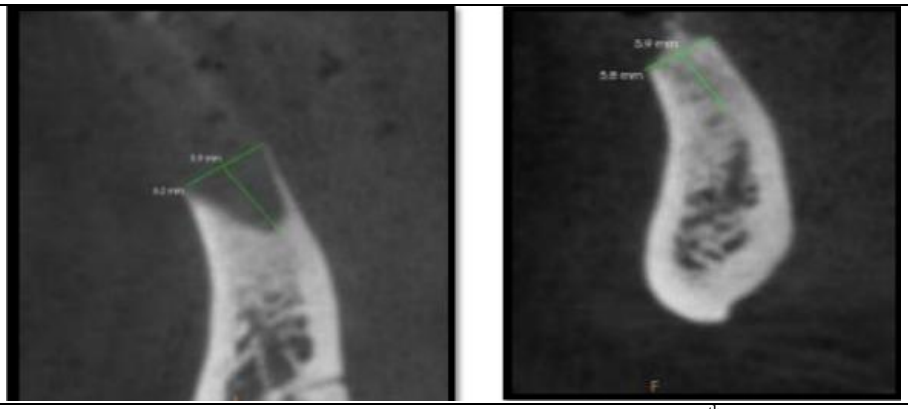

Figure 9 Socket measurement immediately after extraction and at 12th month using CBCT analysis – group I

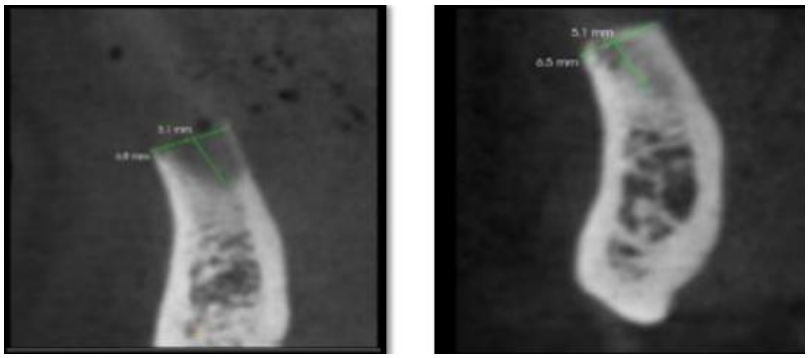

Figure 10 Socket measurement immediately after extraction and at 12th month using CBCT analysis – group II

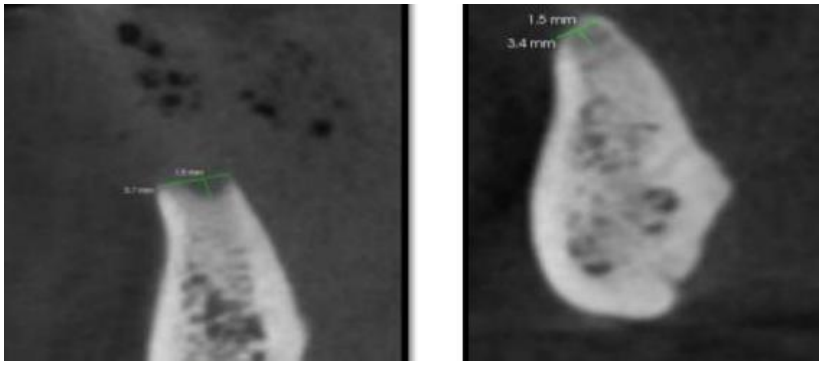

Figure 11 Socket measurement immediately after extraction and at 12th month using CBCT analysis – group III

DISCUSSION

Ridge preservation technique is performed to maintain the bone volume for optimum functional and esthetic outcome for dental implants. Tooth extraction is yet one of the most widely performed procedures in dentistry and it has been well documented that this procedure may induce significant dimensional reduction of the alveolar ridge which further can be a considerable obstacle to the esthetic, phonetic and functional results, during rehabilitation. Extracted teeth are generally considered clinical waste and, therefore, are simply discarded. The use of extracted tooth as an autogenous graft is one of the proposed method to procure autogenous graft. The extracted teeth that were discarded, are now being introduced as a novel graft material for bone regeneration. Dentin include type I collagens and various growth factors like bone morphogenic proteins (BMPs). Type I collagen occupies about 90% of the organic parts of tissues, rest being made up of non-collagenous proteins (NCP), biopolymers, glycoprotein, regeneration processes. Based on the potentials of osteoconduction, osteoinduction and osteogenesis through the growth factors in tooth and similar histogenesis between tooth and bone, a novel bone graft material has been developed utilizing the organic and inorganic components of an extracted tooth. With fabrication and demineralization process, autogenous dentin graft material is made from the extracted tooth that is grafted back in the same patient whenever regeneration is necessary in dental surgeries. With successful extraction of growth factors and bone morphogenic protein (BMPs) from the mammalian teeth, many researchers support the development of a bone substitute using dentin derived grafting. Mineralized dentin particles have the advantage to maintain its mechanical stability, allowing early loading after grafting in fresh sockets and bone defects.[6] Moreover, in spite of delayed inductive properties, the mineralized dentin is firmly integrated with newly formed bone, creating a solid site for anchorage of dental implants. It is very slowly remodelled

in comparison to cortical bone or most biomaterials. The aesthetic and structure pattern of the alveolar crest and mucoperiosteum is maintained for years. DFDBA has been widely used in periodontal therapy and is proven to be safe, and it can induce the formation of new bone. DFDBA has both the properties of osteoconduction and osteoinduction. Similarly another noble bio-material, PRF has been used extensively in dentistry in the past few decades providing good results.[7] The use of PRF has been most frequently utilized for the management of extraction sockets. Hence this current research i-PRF was mixed with DFDBA and with dentin graft to make block graft. Block graft was mouldable and easy to place and secure into the socket. Murata *et al.*[6] in the first clinical case of sinus augmentation using auto-dentin as a bone graft material stated that dentin particles have the same composition as bone and helps in maintaining the mechanical stability. Recently a study conducted by Nampo *et al.*[8] suggested that material made from extracted teeth may have potential as a bone graft material.

Kim Y *et al.*[9] evaluated the clinical use of demineralized dentin matrix scaffolds to repair alveolar bone defects. The result suggested that demineralized dentin matrix acts as a scaffold for osteoblast differentiation which helps in formation of new bone.

Shapoff *et al.*[10] in a study reported that the particle size of graft materials influenced later bone formation. Bhaskar *et al.* [11] reported that the ideal particle size of the bone graft material is 500 µm and that the between particle distance is 150 µm. Koga T *et al.* [12] concluded that the larger particle size of partially demineralized dentin graft induced prominent bone regeneration. Our current study had a particle size between 500-1000 µm in both dentin graft and DFDBA. study by Gomes MF. [13] concluded that the radiographic bone density of the dental sockets treated with autogenous demineralized dentin matrix (ADDM) was similar to that of the surrounding normal bone on the 90th day.

In the present study, maximum crestal bone loss was seen in Group III, and the least amount of crestal bone loss was seen in group I which is in accordance with the study conducted by Binderman *et al.* [14]

Radiographic parameters like buccolingual width and socket height were recorded at baseline and at 1- year postoperatively using cone beam computed tomography. All the pre-operative and post-operative radiographic data was subjected to statistical analysis. The following conclusions were drawn from the findings over a period of 1-year: Significant amount of radiographic socket fill was appreciated over a period of 1-year in all the three groups. The percentage socket fill in Group I was 80.01% and Group II was 76.13% and the difference between them was statistically non-significant.
Further long term studies with a larger sample size needs to be carried out to evaluate and compare the efficacy of autogenous dentin block graft in various regenerative procedures.

CONCLUSION

Both DFDBA and dentin graft can be used successfully to fill the extraction socket. Processing of dentin graft is important and it can be a viable option as graft material.

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