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RESEARCH ARTICLE

A COMPARATIVE EVALUATION OF SOCKET PRESERVATION USING BONE GRAFT PLUG (SYBOGRAF-T)^{R} COMBINED WITH PLATELET RICH FIBRIN AND EXTRACTION ALONE – A CLINICO-RADIOGRAPHIC STUDY

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ABSTRACT

Aim: the present study was done to compare the efficacy of beta tricalcium phosphate bone graft plug (SYBOGRAF-T)R along with PRF membrane for purpose of post extraction socket preservation.
Materials and methods: this was a randomized controlled trial done in total of 34 sites with class II extraction sockets in 33 patients. In Test group, beta tricalcium phosphate bone graft plug along with PRF membrane was used whereas Control group consisted of extraction alone sites.
Results: Test group sites showed significant reduction in bone loss after extraction and socket preservation when compared with extraction alone sites.
Conclusion: Results of this study indicate that alveolar bone resorption following tooth extraction may be prevented or reduced by the use of β-TCP plug (SYBOGRAF-T)^{R} with PRF membrane.

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INTRODUCTION

Alveolar bone loss leading to compromised ridge dimensions after tooth extraction is a common phenomenon occurring due to variety of reasons (Irinakis, 2006). During the first 6 months after extraction, there may be as much as 40% of the alveolar height loss and 60% of alveolar width loss followed by a gradual modeling and remodeling of the remaining bone (Lekovic *et al.,* 1998). Different methods proposed initially for prevention of ridge resorption included modification of prosthesis, sulcus extension, repositioning of nerve and soft tissue grafts (Fickl *et al.,* 2008). The concept of vital root retention was initially proposed because bone resorption did not occur around retained teeth but was later abandoned due to soft tissue complications (Smukler *et al.,* 1999; Garver and Fenster, 1980). Socket augmentation at the time of tooth extraction is attempted to reduce crestal bone dehiscences, encourage socket fill and improve bone quality prior to implant placement thus ensuring better primary stability (Buser *et al.,* 2008). Various regenerative techniquesusing bone graftslike autografts, allografts, xenografts, and alloplasts or in combination with absorbable or non-absorbable membranes have been described by authors for socket preservation (Garver and Fenster, 1980; Orgeas *et al.,* 2013).

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The alloplastic materials available today can be categorized into three groups: calcium phosphates, bioactive glasses, and polymers. Hydroxyapatite and β-tricalcium phosphate (β-TCP) are the most intensively studied forms of calcium phosphates because of their composition, which closely resembles the inorganic phase of bone (Bohner, 2000). Both HA and β-TCP demonstrate osteoconductive properties while the latter shows faster resorption rate. In protected bone defects, TCP-based bone substitute materials show faster bone healing than HA-based materials. The explanation for this is that calcium and phosphate ions are released from the TCP material during the degradation process and are used as "raw material" for new bone formation. In addition, the resorption of TCP makes space for the healing bone through the process of creeping substitution (Von Arx *et al.,* 2001). These alloplasts are available in different forms such as particulate form, putty form and plug form. Many authors have used root shaped cones and particles placed into extraction sites for preserving the dimensions of the post extraction socket (Quinn *et al.,* 1984). Platelet rich fibrin (PRF) is a concentrated suspension of the growth factors in platelets. These growth factors are involved in wound healing and promote tissue engineering. It induces the proliferation of various cells in vitro with the strongest induction effect on osteoblasts.PRF appears to provide added benefit in socket preservation (Sharma *et al.,* 2011). To date, it is still uncertain as to which socket preservation technique is most predictable (Fickl *et al.,* 2008).

Collagen membrane in combination with allografts and alloplasts has been used with varied success (Garver and Fenster, 1980). PRF membrane because of its beneficial effects on healing has been used with different bone grafts. However, clinical data on the use of β-TCP with PRF membrane for socket preservation is still lacking. The present study attempts to compare the efficacy of beta tricalcium phosphate bone graft plug (SYBOGRAF-T)[R] along with PRF membrane for purpose of post extraction socket preservation.

MATERIALS AND METHODS

A total of 34 sites with class II extraction sockets in 33 patients (24 males, 9 females) were selected based on the following inclusion criterias:

- Non-restorable, single, non-molar tooth with hopeless prognosis per quadrant with adjacent teeth present
- Male and female subjects of 18 years of age and above
- Subjects with good general health and good oral hygiene 4.Subjects with freshly extracted sockets.

Exclusion criterias were:

- Patient on medication affecting bone metabolism and platelet function
- Patients with bleeding disorders
- Patients with generalized periodontitis
- Pregnant and lactating mothers
- Patient on chemotherapy in the last twelve months or with history of radiation therapy
- Current smokers or previous smokers
- Ankylosed tooth.

The selected sites were randomly assigned into: **Control group (CG**)- 19 extraction sites were allowed to heal by natural process, and into **Test Group (TG)-** 15 extraction sites, socket preservation was done using beta tricalcium phosphate bone graft plug (SYBOGRAF-T)[R] and Platelet Rich Fibrin membrane.Four sites in the control group were lost to follow up hence only 15 sites in the control group were considered for statistical analysis.

Following clinical parameters were assessed at baseline and at 6 months follow up: Width of keratinized tissue (WKT), Thickness of keratinized tissue (TKT).

Surgical procedure

The surgical site was prepared with adequate anaesthesia using 2% lignocaine hydrochloride containing adrenaline in concentration of 1:80,000.

Step I: A no 15 blade was used to initiate the preparation of the flap design by placing sulcular incision around the tooth to be extracted. The incision was extended one tooth mesially and one tooth distally.

Step II: A full thickness flap was reflected using periosteal elevator.

Step III: Periotomes were used to resect the periodontal fibers around the tooth.

Step IV: Extraction forceps were used to remove the tooth atraumatically.

Step V: Bone curette and Gracey curettes were used to debride the extraction socket.

In the test group

After debridement of the extraction socket, β-tricalcium phosphate bone graft plug was inserted up to the level of the bone crest in the extraction socket and was covered by a Platelet Rich Fibrin membrane and sutured into position by giving horizontal mattress sutures.

In the control group

After debridement of the extraction socket, the site was only sutured by giving horizontal mattress sutures.

Evaluation of radiographs

Baseline CBCT scans were taken just after the tooth extraction. The patients were scanned with a high-resolution CBCT scanner (Cerastream 9300 D, Atlanta, Georgia, USA), with exposure parameters of 70kVp at 5 mA and voxel size of 180 mm at FOV of 5x5 cm. The images were then reconstructed in a three-dimensional dataset using a modification of the original cone-beam algorithm developed by Feldkamp et al.[12,13] For every patient, the baseline CBCT scan was standardized by measuring the Mesio-distal length of the socket and dividing it into 1 mm slices. The middle section was noted in which the marker was visible and the same section was used to make measurements at the follow up visit. A line perpendicular to the reference marker was drawn and vertical measurements were made from that line. For measuring the width of the ridge at crest at baseline, a line was drawn connecting the crest of buccal and palatal/lingual socket wall and its distance from the fixed reference point was taken. Then a line was drawn from the crest which corresponded to 3 mm and 6 mm distance from crest and measurements were done. All the vertical measurements were done in sagittal section and the horizontal measurements were done in the axial section.

Following radiographic parameters were assessed utilizing a radiopaque marker as a fixed reference point at baseline and 6 months follow up:

- Height of buccal and palatal/lingual socket wall was measured as the vertical distance from the crest of buccal plate to the reference point.
- Socket fill was assessed indirectly by noting the change in distance from the reference point to the mid-point of the socket at baseline and then at follow up. Subtracting the baseline value from the follow up value gave the length of the socket which was filled.
- Width of alveolar ridge was measured as the Bucco-lingual distance at the middle of the socket crest, at 3mm apical to crest and at 6 mm apical to crest. All measurements were done using the same axial section.
- Thickness of buccal and palatal/lingual cortical plate was assessed in the axial section at the mid-palatal/lingual and mid buccal point as the width of the cortical plate.

Statistical analysis

All the data recorded were subjected to statistical analysis using the SPSS software. The results were averaged (mean ±

standard deviation) for each parameter and are presented in tables and figures. The following methods of statistical analysis have been used in the study:-

- Any difference in age and gender distribution between test group and control group was calculated by Chi square test.
- Pair wise and intergroup comparisons for the rest of the parameters were done by Paired t-test.

Level of significance for the study was 0.05.

RESULTS

The present study consisted of 30 extraction sites in 30 patients divided into Control and Test groups equally. All the procedures were well tolerated by all patients and none reported with any post-operative complications.

Evaluation of Width of keratinized tissue (WKT) at baseline and at 6 month follow up: The width of the keratinized tissue was measured using a UNC 15 periodontal probe. At baseline the mean WKT In the **CG**, was 3.86 mm and at 6 months was 3.3 mm.

Table 1. Comparison of mean width and thickness of keratinized tissue (wkt, tkt) at baseline and 6 months

Group			N	Mean	SD	Min.	Max.	't' value	'p' value
	WKT	Baseline	15	3.867	0.7188	3.0	5.0		
		6 months	15	3.300	0.5916	2.5	4.5	5.558	*0.026**
	TKT	Baseline	15	3.333	0.4880	2.5	4.0		
Control		6 months	15	3.200	0.8409	2.0	4.5	0.282	0.600
	WKT	Baseline	15	3.933	0.7287	3.0	5.5		
		6 months	15	3.300	0.4928	2.5	4.0	7.775	*0.009**
	TKT	Baseline	15	3.200	0.6492	2.0	4.0		
Test		6 months	15	3.067	0.7037	2.0	4.0	0.291	0.594

Table 2. Intergroup radiographic comparison of mean valuesat baseline and 6 months

	Group	Measurement	Mean	SD	t Value	p Value
Height of buccal socket wall	Control	Baseline	7.513	1.5537	11.100	*0.002**
		6 Months	9.493	1.6981		
	Test	Baseline	8.960	2.5230	0.488	0.491
		6 Months	9.613	2.5983		
Height of palatal/lingual socket wall	Control	Baseline	6.733	2.0756	7.577	*0.010**
		6 Months	8.913	2.2583		
	Test	Baseline	9.400	2.1902	0.339	0.565
		6 Months	9.873	2.2594		
Width of socket at crest	Control	Baseline	7.753	.9211	53.332	*<0.001**
		6 Months	5.340	.8887		
	Test	Baseline	8.573	1.0984	1.770	0.565
		6 Months	8.000	1.2564		
Width of socket at 3 mm apical to crest	Control	Baseline	8.793	1.5586	7.291	*0.012**
		6 Months	6.980	2.0823		
	Test	Baseline	9.113	1.0947	2.432	0.130
		6 Months	8.500	1.0590		
Width of socket at 6 mm apical to crest	Control	Baseline	9.647	1.6353	2.497	0.125
		6 Months	8.720	1.5763		
	Test	Baseline	9.660	1.0322	1.766	0.195
		6 Months	9.133	1.1362		
Thickness of buccal cortical plate	Control	Baseline	0.860	0.1882	28.125	*<0.001**
		6 Months	0.560	0.1121		
	Test	Baseline	0.860	0.1454	8.733	*0.006**
		6 Months	0.707	0.1387		
Thickness of palatal/lingual cortical plate	Control	Baseline	1.153	0.2774	21.643	*<0.001**
		6 Months	0.767	0.1633		
	Test	Baseline	0.900	0.1648	10.803	*0.003**
		6 Months	0.713	0.1457		

Table 3. Intergroup radiographic comparison of mean values at baseline and 6 months

	Group	N	Mean	SD	Min	Max	t Value	p Value
Height of buccal socket wall	Control	15	1.980	0.6570	1.1	3.1	47.270	*<0.001**
	Test	15	0.680	0.3234	.2	1.6		
Height of palatal/lingual socket wall	Control	15	2.180	0.4411	1.4	2.8	129.204	*<0.001**
	Test	15	0.647	0.2800	.3	1.3		
Width of socket at crest	Control	15	2.440	.4925	1.6	3.1	140.254	*<0.001**
	Test	15	0.580	.3570	-.1	1.4		
Width of socket at 3 mm apical to crest	Control	15	1.413	.5630	0.8	2.8	21.151	*<0.001**
	Test	15	0.653	.3044	0.1	1.2		
Width of socket at 6 mm apical to crest	Control	15	0.927	0.3770	0.3	1.7	7.858	*0.009**
	Test	15	0.620	0.1935	0.3	1.0		
Thickness of buccal cortical plate	Control	15	0.300	0.1363	0.1	0.5	12.642	*0.001**
	Test	15	0.153	0.0834	0.0	0.3		
Thickness of palatal/lingual cortical plate	Control	15	0.387	0.1642	0.1	0.7	19.442	*0.001**
	Test	15	0.180	0.0775	0.1	0.3		
Socket Fill	Control	15	8.200	1.3049	5.0	10.3	7.583	*0.010**
	Test	15	9.260	.7209	7.7	10.3		

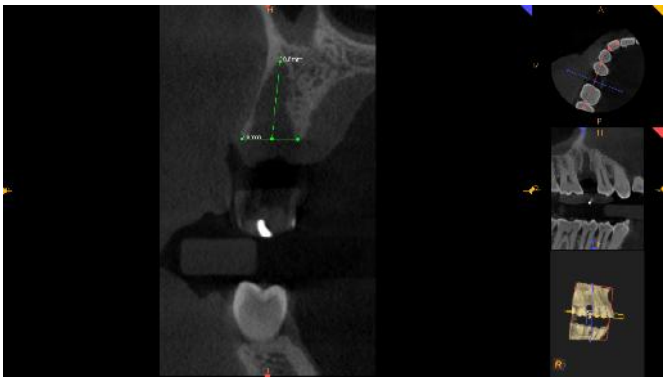

Fig 1. Length of the socket

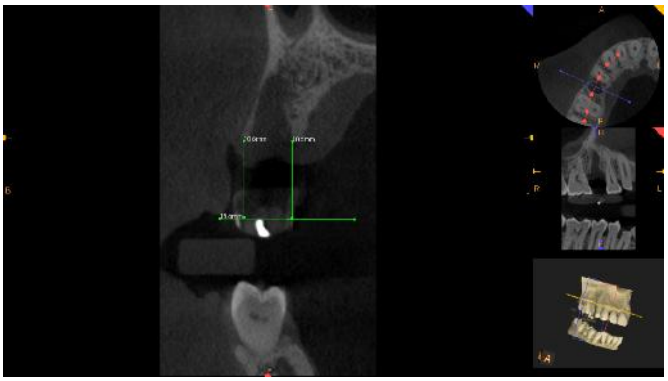

Fig 2. Height of buccal and palatal socket wall from reference

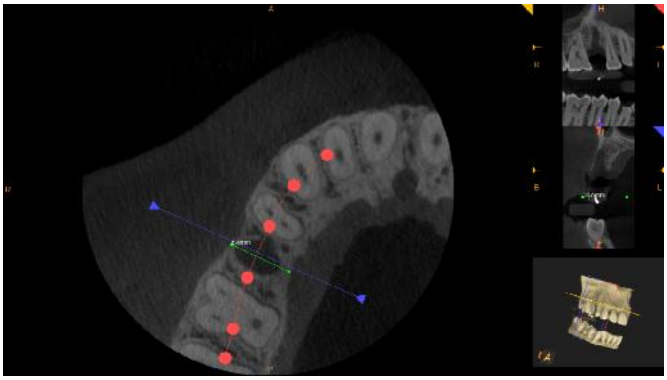

Fig 3. Width of the alveolar ridge at crest

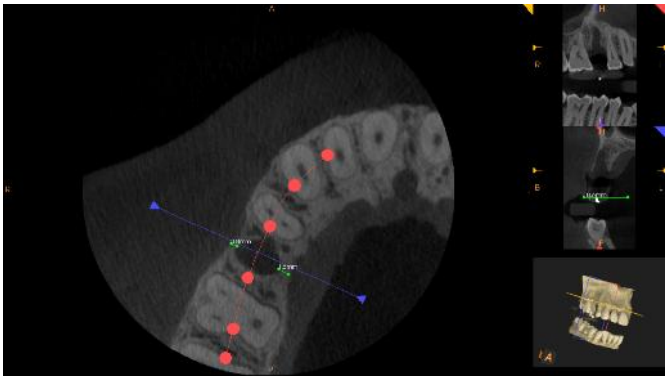

Fig 4. Thickness of buccal and palatal cortical plate at crest

This difference was statistically significant (p=0.026). In the **TG**, the mean WKT at baseline was 3.93 mm and was 3.3 mm at 6 months with statistical significance of p= 0.009. Between the groups, at baseline and 6 months, there was no statistically significant difference (p=1.00).

Evaluation of Thickness of keratinized tissue (TKT) at baseline and at 6 month follow up

The TKT was assessed using an endodontic K-file with a rubber stopper. At baseline the mean TKT in the **CG**, was 3.33 mm and at 6 months was 3.2 mm. This difference was not statistically significant (p=0.600). In the **TG**, the mean TKT at baseline was 3.2 mm and was 3.06 mm at 6 months with no statistically significant difference of p= 0.594. Between the groups, at baseline and 6 months, there was no statistically significant difference (p=0.641).

Evaluation of alveolar ridge dimensions with CBCT at baseline and at 6 months follow up

All the vertical measurements were done in the middle slice of the sagittal section and the horizontal measurements were done in the middle slice of the axial section with a fixed radiopaque reference point.

Evaluation of Height of buccal socket wall was done at baseline by measuring the vertical distance from the midpoint of the crest to the reference point and at 6 months follow up as the vertical distance from the crest of alveolar ridge buccally to the reference point. At baseline, mean height was 7.5 ± 1.55 mm in **CG** and was 9.4 ± 1.6 mm at 6 months. The change in height was statistically significant (p=0.002). In the **TG**, mean height was 8.9 ± 2.52 mm at baseline and 9.6 ± 2.5 mm at 6 months. This change in the height was not significant (p= 0.491).

Between the groups, the loss in height of buccal socket wall at baseline and 6 months was significantly more in **CG** (p<0.001). Evaluation of Height of palatal/lingual socket wall was done at baseline by measuring the vertical distance from the crest of palatal/lingual socket wall to the reference point and at 6 months, it was measured as the vertical distance from the crest of alveolar ridge palatally/lingually to the reference point.At baseline, mean height was 7.67 ± 2.07 mm in **CG** and was 8.9 ± 2.2 mm at 6 months. This change was statistically significant with p=0.010. In the **TG**, mean height was 9.4 ± 2.19 mm at baseline and 9.8 ± 2.25 mm at 6 months. This change was not significant (p>0.05).Between the groups, the loss in height of buccal socket wall at 6 months and baseline was significantly more in **CG** (p<0.001).

Assessment of Socket fill was done by subtracting the distance between base of socket to the reference point at baseline and the distance from the reference point to the crest of alveolar ridge at 6 months. At baseline, the mean distance of the base of socket from reference point in **CG** was 17.19 mm ± 2.58 mm and was 8.98mm ± 2.23 mm at 6 months. The mean socket fill was 8.2 mm ± 1.30 mm.In **TG**, the mean distance of the base of socket from reference point at baseline was 18.3 mm ± 3.24 mm and was 9.02 mm ± 2.86 mm at 6 months. The mean socket fill was 9.26 mm ± 0.72 mm. The socket fill was significantly more in **TG** (p= 0.010).

Width of alveolar ridge was recorded asthe distance between the outer borders of buccal and lingual cortical plate at three locations, i.e. at crest, at 3 mm and 6 mm apical to crest. In the **CG**, the baseline and 6 months mean ridge width at crest was 7.75 mm ± 0.92 mm, 5.3 ± 0.88 mm respectively; at 3 mm apical to crest, it was 8.79 mm ±1.55 mm, 6.98 mm ± 2.08 mm respectively and at 6 mm apical to crest, it was 9.64 mm ± 1.63 mm, 8.72 mm ± 1.57 mm respectively. These changes were

statistically significant at crest and at 3 mm apical to crest ($p<0.001$) but was not statistically significant at 6 mm apical to crest ($p=0.125$). In the TG, the baseline and 6 months mean ridge width at crest was 8.57 mm ± 1.09 mm, 8.00 mm ± 1.25 mm respectively; at 3 mm apical to crest, it was 9.11 mm ± 1.09 mm, 8.50 mm ± 1.05 mm respectively and at 6 mm apical to crest, it was 9.66 mm ± 1.03 mm, 9.13 mm ± 1.13 mm respectively. These changes were not statistically significant ($p>0.05$). Between the groups**,** the decrease in width of alveolar ridge at all levels was significantly lower in the **TG (**$p< 0.050$).

Evaluation of Buccal Cortical Plate thickness was done on the axial scans at the midpoint of the crest of the ridge both at baseline and at 6 months. At baseline, the mean width in the **CG** measured was 0.86 mm ± 0.18 mm and was 0.56 mm ± 0.11 mm at 6 months. The change in thickness was statistically significant ($p<0.001$). In the **TG**, the mean width measured was 0.86 mm ± 0.14 mm at baseline and 0.70 mm ± 0.13 mm at 6 months. The change in thickness was significant ($p=0.006$). Between the groups, the decrease in thickness of buccal cortical plate was significantly less in the **TG**. ($p=0.001$)

Evaluation of Palatal/Lingual Cortical Plate thickness was done in the axial scans at the midpoint of the crest of the ridge both at baseline and at 6 months and the difference was calculated. In the CG, the mean width measured was 1.15 mm ± 0.27 mm at baseline and 0.76 mm ± 0.16 mm at 6 months. This change was statistically significant ($p<0.001$). In the TG, the mean width measured was 0.90 mm ± 0.16 mm at baseline and 0.71 mm ± 0.14 mm at 6 months. This change was statistically significant ($p=0.003$).The decrease in thickness in cortical plate thickness was significantly lower in the TG ($p=0.001$).

DISCUSSION

Most of the time clinicians face a challenge in providing prosthetic treatment to the patient when there is deficient soft tissue and ridge volume (Lekovic *et al.,* 1998; Lekovic *et al.,* 1997; Araujo and Lindhe, 2005). Socket augmentation procedures at the time of extraction are aimed at reducing crestal bone dehiscences or facial undercut, encouraging socket fill and improving bone quality prior to implant placement thus ensuring better primary stability (Buser *et al.,* 2008). A systematic review on effect of socket preservation therapies following tooth extraction in non-molar regions in humans concluded that socket preservation technique may aid in reducing the bone dimensional changes following tooth extraction (Ten Heggeler *et al.,* 2011). The bone graft used in the present study was a sterile synthetic nanocrystalline β-Tricalciumphosphate plug (SYBOGRAF-T)^{R}of size of 25 X 8 mm. β-TCP is a 3-dimensional macroporousalloplast, containing spaces into which bone ingrowth can occur Porosity of β-TCP both microscopic and macroscopic is designed to maximize blood clot stability during early healing (Epstein, 2006). The material has no organic components and hence no chance of antigenicity or allergic reactions.The efficacy of β-TCP in socket preservation has also been reported by Horowitz *et al.,* 2009; Triveni *et al.,* 2012 and Bhatt *et al.,* 2015. Platelet derivatives like PRF have been found to regulate and accelerate surgical wound healing and osseous regeneration. The efficacy of PRF membrane in socket preservation has been demonstrated by Triveni *et al.,* 2012; Suttapreyasri *et al.,* 2013. PRF unlike other platelet concentrates is able to progressively release cytokines during fibrin matrix remodeling which is imperative for regeneration and is currently considered the leader in fibrin technology (Sharma *et al.,* 2011). In our study, the width and thickness of keratinized tissue were decreased at follow up after 6 months as compared to baseline values in both Control and Test groups. Thickness of keratinized tissue did not show a significant decrease in either Control group ($p= 0.600$) or Test group ($p= 0.594$). Width of keratinized tissue significantly decreased from baseline to follow up in both Control group ($p= 0.026$) and in Test group ($p= 0.009$). These results were in agreement with previous studies done by Kesteren *et al.,* 2010. However they observed non-significant decrease in thickness and width of the keratinized tissue. Contrary to our findings, Gustavo *et al.,* 2014 have shown an increased width of keratinized tissue in their study which was not statistically significant.

The reason may be because in our study the PRF membrane was placed only to cover the bone graft plug occlusally and no attempt was made to extend it over buccal or lingual/palatal socket wall whereas Gustavo et al placed a collagen membrane after overbuilding the buccal socket wall with allograft and PTFE membrane. Although histologic evaluation is most accurate for assessing bone regeneration, but due to ethical concerns, in our study only clinical and radiographic parameters were evaluated. CBCT scans were taken at baseline and were repeated 6 months post-operatively. In the present study when clinical parameters were assessed with radiographic parameters at baseline, no significant difference was found. In accordance with Duggan et al[24], the present study thus indicates that CBCT can be considered as a useful diagnostic tool as it compares well to clinical assessment of socket healing. In our study, CBCT recorded the mean socket length as 10.27 ± 0.61 in control group and 10.3 ± 0.60 mm in test group and the mean socket fill obtained forcontrol group was 8.2 ± 1.30 mm and 9.2 ± 0.72 mm intest group. There was a significantly higher socket fill obtained in test group than control group at 6 months ($p=0.010$) which was in agreement with previous studies done by Horowitz *et al.,* 2009; Triveni *et al.,* 2012; Iasella *et al.,* 2003. In our study, CBCT assessment showed that height of buccal socket wall in control group decreased significantly on an average by 1.98 ± 0.65 mm between baseline and 6 months ($p=0.002$). In Test group the height of buccal socket wall showed a mean decrease of 0.68 ± 0.32 mm which was not significant ($p=0.491$). Intergroup comparison revealed significantly more loss of vertical height in control group as compared to test group ($p<0.001$). Our results were similar to studies done by Lekovic *et al.,* 1989; Camargo *et al.,* 2000; Fiorellini *et al.,* 2005 and Barone *et al.,* 2008.

Contrary to our results, Serino *et al.,* 2009 have shown an increase in height in the buccal socket wall in test group which was treated using polylactide-polyglycolide sponge. The difference can be explained based on their study design which included higher percentage of mandibular sites in test group as compared to control group. Buccal bone walls are much thinner and less corticalizedin the upper compared to the lower jaw, so the sockets in the lower jaw may have a higher potential to regenerate the missing wall. In the present study, CBCT analysis showed a significant loss in height of palatal/lingual socket wall in control group between baseline and 6 months ($p=0.010$).The mean loss in Control group was 2.1 ± 0.44 mm. In test group a mean loss of 0.64 ± 0.28 mm

was observed between baseline and 6 months but this was not statistically significant (p=0.565). Intergroup comparison revealed that control group significantly lost more height of palatal/lingual socket wall when compared to Test group (p<0.001) and was in accordance with studies done by Fiorelliniet al., 2005; Iasella *et al.,* 2005; Barone *et al.,* 2008. In our study, CBCT measurements at 6 months when compared with baseline values, in control group showed a statistically significant loss of alveolar ridge width at crest (p< 0.001) and in Test group exhibited a loss of alveolar ridge width at crest but this was not statistically significant (p= 0.565). Loss of alveolar ridge width was significantly more in the control group as compared to test group (p<0.05). Our results were in agreement with studies done by Horowitz *et al.,* 2009; Lekovic *et al.,* 1998; Camargo *et al.,* 2000; Iasella *et al.,* 2003; Barone *et al.,* 2008. In contrary to our results, Brownfield *et al.,* 2012 found no significant difference in loss of width between test group and control group. This may be due to intact socket walls were included in their study and other reasons could be the different bone graft used which was demineralized bone matrix with cancellous bone chips and flapless extractions were performed.

In the present study, CBCT recorded loss of width in control group at 3 mm apical to crest which was statistically significant (p= 0.0012) and at 6 mm apical to crest which was not significant (p=0.125). In Test group loss of alveolar ridge width was not significant at either 3 mm or 6 mm apical to crest (p>0.05). Our results were in agreement with Brownfield *et al.,* 2012 who have reported that loss of alveolar ridge is less at 6 mm apical to crest and is maximum at 3 mm apical to crest. In our study, CBCT analysis compared at 6 months with baseline for both Control and Test groups showed decreased buccal and palatal/lingual cortical plate thickness at crest. The mean loss of thickness in buccal cortical plate and palatal/lingual cortical plate in Control group was 0.3± 0.13 mm and 0.38 ± 0.16 mm respectively. Test group patients revealed a mean loss of 0.15±0.08 mm and 0.18 ± 0.07 mm in buccal and palatal/lingual cortical plate thickness. Intragroup comparison showed that there was significantly more loss of thickness of palatal/lingual cortical plates at crest in Control group as compared to Test group (p=0.001). This result was in agreement with previous studies by Eskowet al., 2014 Brownfield *et al.,* 2012; Lekovic *et al.,* 1998. There are very few studies in literature which have attempted to evaluate the effect of β-TCP in plug form with PRF membrane in socket preservation. Results obtained in our study, are in general, comparable to most authors who have used collagen membranes with either allografts or alloplasts. The plug form of the β-TCP is effective in confirming to the shape of the extraction socket with deficient walls as compared to particulate form. Also, there are very less chances for losing bone graft plug from the extraction sockets as compared to the particle forms. In our study, clinical measurements were done only at baseline and were not carried out after 6 months because surgical re-entry was not performed at follow up. Furthermore, histologic analysis would have given an assessment of the quality of bone formed in the grafted sites. Although no attempts were made to augment the soft tissue in the present study, it did not lead to any compromised results. Studies on a larger sample population and histologic assessment may further help in establishing the effectiveness of β-TCP plug and PRF membrane as biomaterials for socket preservation.

Conclusion

The present study demonstrated successful results utilizing socket preservation procedures. The results of this study indicate that alveolar bone resorption following tooth extraction may be prevented or reduced by the use of β-TCP plug (SYBOGRAF-T)[R] with PRF membrane.Even though such approach increased the total treatment time, it decreases need for additional treatments such as bone augmentation procedures for prosthetic purpose. Also, this approach is cost effective with no associated complications. The use of β-TCP plug (SYBOGRAF-T)[R] with PRF membrane did not reveal any added benefit on the soft tissue profile.

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