

Comparative evaluation of coronally advanced flap using bilayer bioresorbable collagen membrane and platelet rich fibrin membrane in the treatment of gingival recession: A randomized clinical study

¹Dr. Aradhana Sharma, Post Graduate Student, Department of Periodontology, Sri Guru Ram Das Institute of Dental Sciences and Research Sri Amritsar, Punjab, India

²Dr. Vandana Sarangal, Professor and Head, Department of Periodontology, Sri Guru Ram Das Institute of Dental Sciences and Research Sri Amritsar, Punjab, India

³Dr. Sahib Tej Singh, Reader, Department of Periodontology, Sri Guru Ram Das Institute of Dental Sciences and Research Sri Amritsar, Punjab, India.

⁴Dr. Supreet Kaur, Associate Professor, Department of Periodontology, Sri Guru Ram Das Institute of Dental Sciences and Research Sri Amritsar, Punjab, India

⁵Dr. Karandeep Kaur, Post Graduate Student, Department of Periodontology, Sri Guru Ram Das Institute of Dental Sciences and Research Sri Amritsar, Punjab, India

⁶Dr. Gurprabjit Kaur, Post Graduate Student, Department of Periodontology, Sri Guru Ram Das Institute of Dental Sciences and Research Sri Amritsar, Punjab, India

⁷Dr. Pallavi Prashar, Post Graduate Student, Department of Periodontology, Sri Guru Ram Das Institute of Dental Sciences and Research Sri Amritsar, Punjab, India

Corresponding Author: Dr. Aradhana Sharma, Post Graduate Student, Department of Periodontology, Sri Guru Ram Das Institute of Dental Sciences and Research Sri Amritsar, Punjab, India.

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Abstract

Background: Gingival recession is an undesirable condition resulting in root sensitivity, aesthetic concerns and predilection of caries. Various materials for root coverage include growth factors, bioresorbable membranes and combined procedures involving coronally

advanced flap (CAF) with barrier interposed between flap and root surface. Use of platelet-rich fibrin (PRF) and porcine derived bioresorbable bilayer collagen membrane (Bio-Gide®) offers advantages of preventing second surgical procedure for barrier removal.

Aim: To clinically compare and evaluate the efficacy of bioresorbable collagen membrane and PRF in combination with CAF in the treatment of buccal gingival recession defects.

Materials and Methods: 15 patients having bilateral Miller's Class I or Class II buccal gingival recession defects were randomly divided using split mouth design and assigned to Group A: 15 sites with Miller's Class I or Class II recession defects were treated with (CAF+Bio-Gide®) and Group B: 15 sites with Miller's Class I or Class II recession defects were treated with (CAF+PRF). Plaque and gingival indices, pocket depth, relative attachment level, gingival recession depth, width of recession defect, width of keratinized gingiva were determined at baseline, 1, 3 and 6 months postoperatively. Percentage of root coverage was determined at 1, 3 and 6 months postoperatively.

Results: There was a significant improvement in the periodontal parameters in both group A and B whereas statistically non-significant differences were found when intergroup comparison was done. Conclusion: CAF in conjunction with Bio-Gide® or PRF membrane is a highly predictable procedure for the treatment of Miller's Class I or Class II recessions defects.

Keywords: Collagen membrane, gingival recession, guided tissue regeneration, platelet-rich fibrin

Introduction

Gingival recession refers to "the exposure of the tooth by the apical migration of gingiva".[1] It is a characteristic clinical finding in periodontal disease associated with root caries, tooth hypersensitivity and pulp hyperemia. The etiological factors of recession include tooth malpositioning, bone dehiscence, thin marginal soft tissue, high frenulum attachment, tooth brush trauma, inflammation due to plaque and calculus accumulation.[2] Gingival recession defects were classified by Miller in

1983, based on the involvement of periodontal tissues. During the last decade, various periodontal plastic procedures have been performed with variant degree of success for obtaining root coverage. Presenting an edge, Pini Prato et al. (1993) devised the term coronally advanced flap (CAF) as one of the most widely used surgical technique indicated for the treatment of Miller's Class I and Class II gingival recession defects.[3] Some of the materials used in these techniques are autogenous connective tissue grafts, platelet rich fibrin (PRF) and bioresorbable membranes. Limited supply and difficulty in procuring sufficient tissue for multiple recessions is marked as a disadvantage of using connective tissue autografts.[4] Owing to this, Tinti and Vincenzi in 1990 used the principles of guided tissue regeneration (GTR) to obtain coverage of the denuded root surfaces, ensuring space provision by preventing a collapse of the mucoperiosteal flap, along with regeneration of the entire attachment apparatus.[5] The introduction of bioresorbable membranes made from collagen eliminated the requirement for a second surgical intervention along with possible infection due to membrane exposure, in gingival recession depth coverage.[6] These absorbable membranes can be classified as collagen and non-collagen membranes. Amongst the absorbable barriers, collagen membranes play a pivotal role in improving cell adhesion thereby achieving the growth rate using mineralised cellulose matrices. They possess additional advantages including hemostasis, chemotaxis for periodontal ligament and gingival fibroblasts, easy manipulation and ability to augment tissue thickness.[7] Hence, collagen material appears to be an ideal choice for an absorbable GTR barrier. Bio-Gide® Geistlich Pharma AG, Wolhusen, Switzerland, is a pure non-cross linked bilayer collagen composed of porcine type I and III collagen fibres without any organic components and/or

chemicals. It is composed of compact and porous layers, the compact layer has a smooth cell occlusal surface which is turned towards soft tissue, whereas porous layer stabilizes the blood clot and encourages the integration of bone forming cells and is turned towards the bone. It is biocompatible which might augment tissue volume as it is absorbed and replaced by host tissue.[8] A recent innovation in dentistry, derived from patients own blood is termed as platelet-rich fibrin (PRF). It was first described by Choukroun et al. (2001) in France. PRF is composed of various growth factors like platelet derived growth factors, insulin like growth factor, transforming growth factor- β , vascular endothelial growth factor etc. which are involved in wound healing and are postulated as promoters of tissue regeneration.[9] Platelets play a vital role in periodontal regeneration due to the presence of growth factors and cytokines, that are essential for maturation of soft tissue and regeneration of bone. It is a novel treatment option available for various mucogingival defects. Keeping in mind, the regenerative potential of porcine-derived bioresorbable collagen membrane and PRF, the present study was aimed to clinically compare and evaluate the efficacy of bioresorbable collagen membrane and PRF in combination with coronally advanced flap in the treatment of buccal gingival recession defects.

Materials and Methods

A randomized clinical study was conducted on 15 systemically healthy patients, each having bilateral Miller's Class I or Class II buccal gingival recession defects visiting the Department of Periodontology and Oral Implantology, Sri Guru Ram Das Institute of Dental Sciences and Research, Sri Amritsar.

The research protocol was initially submitted to the institutional ethical committee. After ethical approval, all patients were verbally informed and written consent was taken from all the patients before inclusion in the study.

Inclusion criteria

1. Systemically healthy patients.
2. Patients aged between 18 and 45 years.
3. Patients having bilateral Miller's Class I or Class II buccal gingival recession defects ≥ 3 mm.

Exclusion criteria

1. Patients with history of periodontal therapy in past six months.
2. Alcoholics, smokers, tobacco chewers, drug addicts.
3. Pregnant women and lactating mothers.
4. Inability to complete the trial.

Materials

1. Commercially available porcine-derived bilayer bioresorbable collagen membrane registered as Bio-Gide[®], (Geistlich Pharma AG, Wolhusen, Switzerland).
2. Platelet-rich fibrin (PRF) membrane.
3. 17% Ethylenediaminetetraacetic acid (EDTA).

Methods

Prior to surgery, initial therapy consisted of scaling, root planing and occlusal adjustments as indicated. Routine blood investigations were carried out and the patients were instructed to adopt meticulous home care measures to control dental plaque. The selected participants were randomly divided into two groups viz group A and group B each.

Group A: 15 sites with Miller's Class I or Class II buccal gingival recession defects were treated with Bio-Gide[®] along with coronally advanced flap.

Group B: 15 sites with Miller's Class I or Class II buccal gingival recession defects were treated with platelet-rich fibrin membrane (PRF) along with coronally advanced flap.

A custom-made acrylic stent and a William's periodontal probe were used to standardize the measurement of clinical parameters.

Clinical parameters evaluated

1. Plaque Index (Silness and Loe, 1964)
2. Gingival Index (Loe and Silness, 1963)
3. Probing Pocket Depth (PPD)
4. Relative Attachment Level (RAL)
5. Gingival Recession Depth (GRD)
6. Width of Recession Defect (WRD)
7. Width of Keratinized Gingiva (WKG)
8. Percentage of root coverage (% RC)

All the above mentioned clinical parameters were evaluated at baseline and re-evaluated at an interval of 1, 3 and 6 months in both the groups postoperatively.

Preparation of platelet rich fibrin membrane

Preoperatively, 10 ml of patient's blood was taken and collected in a syringe, later transferred into the test tube and centrifuged immediately without the addition of anticoagulant at 3000 revolutions per minute for 10 minutes.

The resultant product consists of three layers:

- i) Top most layer consisting acellular plasma.
- ii) Platelet Rich Fibrin (PRF) clot in the middle.
- iii) Red blood cells at the bottom.

Top most layer was discarded. Middle layer consisting of PRF clot was separated from the red blood cell layer. The PRF clot was squeezed on a sterile gauze to form a PRF membrane. After the procurement of PRF membrane, it was immediately transferred to the prepared surgical site.

Surgical Procedure

The area to undergo surgery was anaesthetized with lignocaine hydrochloride 2% with adrenaline 1:2,00,000. On the facial aspect, horizontal incision at the level of

cemento-enamel junction was placed and two diverging vertical incisions 1-2 mm away from gingival margin of the adjoining teeth beyond the mucogingival junction were placed. A full thickness flap was raised till the mucogingival junction and a partial thickness flap beyond it. In the adjoining interdental papillae, de-epithelialization was done. The exposed root surface was thoroughly planed using curettes and root conditioning was done with 17% Ethylenediaminetetraacetic acid (EDTA).

Group A: The commercially available bilayer bioresorbable collagen membrane (Bio-Gide)[®] was then cut to cover atleast 1 mm of surrounding tissue along the entire recession defect area. The internal porous layer of the membrane was placed towards the root surface. The flap was then coronally positioned. The flap was approximated with 3-0 absorbable (synthetic) surgical suture [TRUGLYDE[™]] using coronal sling suture technique and the surgical area was covered using periodontal dressing (Coe- Pak[®]).

Group B: In group B, the surgical sites were prepared in the similar way as that of group A sites and the previously prepared PRF membrane was placed over the denuded root surface just coronal to the CEJ and sutured in the same position. Routine postoperative instructions and medications were given to the patients. The same clinical parameters as recorded preoperatively were again recorded at 1, 3 and 6 months postoperatively.

Observations and Results

The data thus compiled were analysed statistically to arrive at the results. The mean values, standard deviation and percentage change in the values of periodontal parameters were analysed using t-test. Paired t-test was applied to compare within groups and unpaired t-test was applied to compare group A (CAF+Bio-Gide[®]) and group B (CAF+PRF) from baseline to 1, 3 and 6 months

postoperatively. A total of 15 subjects were recruited for this study of the 15 subjects, 9 were males and 6 were females.

Discussion

The success criteria for root coverage procedures include objective outcomes such as percent root coverage (RC) and also subjective outcomes- patient's aesthetic satisfaction in terms of colour match and intra- and postoperative discomfort. Surgical techniques aim at increased predictability of RC, reduced number of surgical sites and improved patient comfort, aesthetics, and reconstruction of the lost periodontal tissues. A variety of resorbable guided tissue regenerative materials such as collagen membranes, growth factors, and combined procedures involving coronally advanced flap (CAF) with barrier interposed between flap and the root surface were evaluated and were preferred over non-resorbable membranes in order to circumvent the need for second surgery.[10] Collagen is one of the predominant structural proteins in alveolar bone and periodontal connective tissues. It is biocompatible and has got a hemostatic function (aggregates platelets) facilitating early clot formation and wound stabilization. It provides a collagenous scaffold for tissue repair as well as augmenting the gingival tissue thickness. Being semi-permeable, it permits gaseous exchange and nutrient passage to ensure better flap healing.[11] Type I and III porcine derived bioresorbable bilayered collagen membrane Bio-Gide® is easy to manipulate, biocompatible. The natural bilayer structure promotes reliable bone regeneration and excellent tissue integration on account of optimal barrier duration. The soft tissue heals without scarring and largely without complications.[12] Platelet Rich Fibrin (PRF) represents a new revolutionary step in tissue engineering field. It is used worldwide by clinicians as an adjunctive autologous

biomaterial to promote bone and soft tissue healing and regeneration. PRF technology has grabbed the attention of clinicians because this biomaterial is derived from the patients' own blood; is readily available; easy to prepare; can be produced immediately at chair-side; easy to use; and widely applicable in dentistry, whilst being financially realistic for the patient and the clinician, and with virtually no risk of a rejection reaction (foreign body response).[9] The present study was carried out to clinically compare and evaluate the efficacy of bioresorbable collagen membrane and PRF in combination with coronally advanced flap in the treatment of buccal gingival recession defects. In our study, on intra-group comparison the clinical parameters showed significant improvement in both Group A and Group B from baseline to 1, 3 and 6 months. Also, inter-group comparison showed statistical non-significant differences in Group A (CAF+BIO-GIDE®) in comparison to Group B (CAF + PRF). In both Group A and B, the mean reduction in scores of plaque and gingival indices showed significant improvement from baseline postoperatively. This might be attributed to the reinforcement of oral hygiene and regular monitoring of the patients undergoing periodontal therapy.[13] A statistically non-significant difference was observed between 1 to 3 months and 3 to 6 months in both the groups A and B postoperatively. Thus, suggesting that both the biomaterials (Bio-Gide® and PRF membrane) were well tolerated by the tissues and did not enhance gingival inflammation. These findings concur with the findings of Blumenthal NM (1993)[14] who reported no untoward reaction with collagen membrane. A statistically significant reduction in probing pocket depth and gain in relative attachment level was observed from baseline to 1, 3 and 6 months in both group A and B postoperatively. This may be attributed to minimal probing depth and good oral gingival health due to meticulous plaque control,

education and motivation of patient in preoperative phase of therapy. Also, one of the reasons could be that in group A, Bio-Gide® provided an inherent space making potential since the blood clot formed beneath the collagen membrane in recession defects is sufficient for the regeneration of cementum, periodontal ligament and bone.[15] The results were in accordance with the studies conducted by Rocuzzo et al. (1996),[16] , Vieira TR et al. (2017)[17] On the other hand, in Group B, possess three main platelet cytokines particularly platelet-derived growth factors [PDGFs], transforming growth factor- β (TGF- β) and Insulin like growth factor-1 (IGF- 1) play a fundamental role in initial healing mechanisms owing to their capacity to stimulate cell migration and proliferation and induce fibrin matrix remodeling as well as secretion of a cicatricial collagen matrix by TGF- β .²⁶ The results were in accordance with Thamaraiselvan M et al. (2015)[13], Alabood O et al. (2020)[18] Reduction in gingival recession depth and width of recession defect was shown from baseline to 1, 3 and 6 months in both the groups A and B postoperatively, which was statistically significant. A statistically non-significant difference was observed between both the groups A and B from 1 to 3 months whereas statistically significant difference was observed from 3 to 6 months postoperatively. In Group A, Bio-Gide® as a GTR membrane in combination with coronally advanced flap (CAF) displaced the epithelial attachment at a more coronal position than before treatment, allowing progenitor cells from periodontal ligament and bone to repopulate the coronal root surface and to form a new periodontal attachment attributing its wonderfabulous role in gingival recession coverage. 101 The results were in concordance with Castro Y et al. (2014)[19], Bali D et al. (2020)[20] In Group B, PRF when used as a membrane for guided tissue regeneration as a grafting material created an improved spacemaking

effect which facilitated cell events that are favorable for periodontal regeneration leading to mineralized tissue formation.¹⁸⁴ The results are in accordance with Rodas MA et al. (2020)[21] The study showed significant increase in width of keratinized gingiva from baseline to 1, 3 and 6 months in both group A and B postoperatively. A statistically non-significant increase in width of keratinized gingiva was observed between both group A and B from 1 to 6 months postoperatively. The plausible reason could be that- In Group A, Bio-Gide® successfully acted as a barrier device in guided tissue regeneration based root coverage procedure. In addition collagen is resorbed in tissues through catabolic processes and may eventually be replaced by new collagen, suggesting that a collagen membrane can act not as a collagen barrier for GTR but also may add to the volume of collagenous tissue present at the surgical site. The results were in accordance with Romagna Genon C (2001)[22], Pini Prato et al. (2005)[23] In Group B, PRF increased width of keratinized gingiva equivalent to gold standard connective tissue graft (CTG) and this may be explained by the proliferation of gingival or periodontal fibroblasts under the influence of the growth factors released from platelets entrapped in fibrin clot. The results were in accordance with study conducted by Gupta et al. (2015)[24] The results also showed significant improvement in percentage of root coverage (% RC) in both group A and B from baseline to 1, 3 and 6 months postoperatively. The mean percentage of root coverage in group A (CAF+Bio-Gide®) was marginally higher than group B (CAF+PRF) which was found to be statistically non-significant. This might be attributed to the resulting trapezoidal flap elevation with a split full split approach in the coronal-apical direction. de Sanctis et al. (1996) and Zucchelli et al. (2000) suggested that the split thickness elevation at the level of the surgical papilla guarantees anchorage and

blood supply in the interproximal areas mesial and distal to the root exposure; the full thickness portion, by including the periosteum, confers more thickness and thus better opportunity to achieve root coverage. The other reasons might be that- In group A, Bio-Gide® mimicked as a natural hemostatic agent due to its ability to promote platelet aggregation, thereby facilitating early wound stabilization and maturation thus resulting in mean root coverage.[22] The results were in accordance with Pini Prato et al. (2005)[23], Harinath et al. (2008)[25] In Group B, PRF as a healing material stimulates the gingival connective tissue on its whole surface with growth factors. Moreover, the fibrin matrix itself shows mechanical adhesive properties and biologic functions like fibrin glue, which maintains the flap in a high and stable position, enhances neo- angiogenesis, reduced necrosis, resulting in maximum recession coverage. As an interpositional matrix, PRF layers prevent the early invagination of gingival epithelium.[26] The results were in accordance with the studies conducted by Gupta et al. (2015)[24], Reddy S et al. (2018)[27] Bio-Gide® being a bilayer membrane possess excellent uniform thickness, malleability, ease of placement, pre-fabricated and pre-sterilized whereas on the other side PRF being a patient's own blood derived autologous material might possess regenerative capabilities as well as resorption potential thus warranting the routine clinical application of these materials.

Conclusion

Within the limits of the present study and in the light of above findings, it can be safely concluded that CAF in conjunction with Bio-Gide® or PRF membrane is a highly predictable procedure for the treatment of Miller's Class I and Class II recessions defects. Nevertheless, both Bio-Gide® and PRF seem to be suitable as scaffold materials for guided tissue regeneration indicating the regenerative

capacity in gingival augmentation. However, further studies with large sample size and subsequent longer follow-up periods along with histologic evidence might be needed to shed light on the use of Bio-Gide® and PRF along with coronally advanced flap in recession defects.

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Legend Tables and Figures

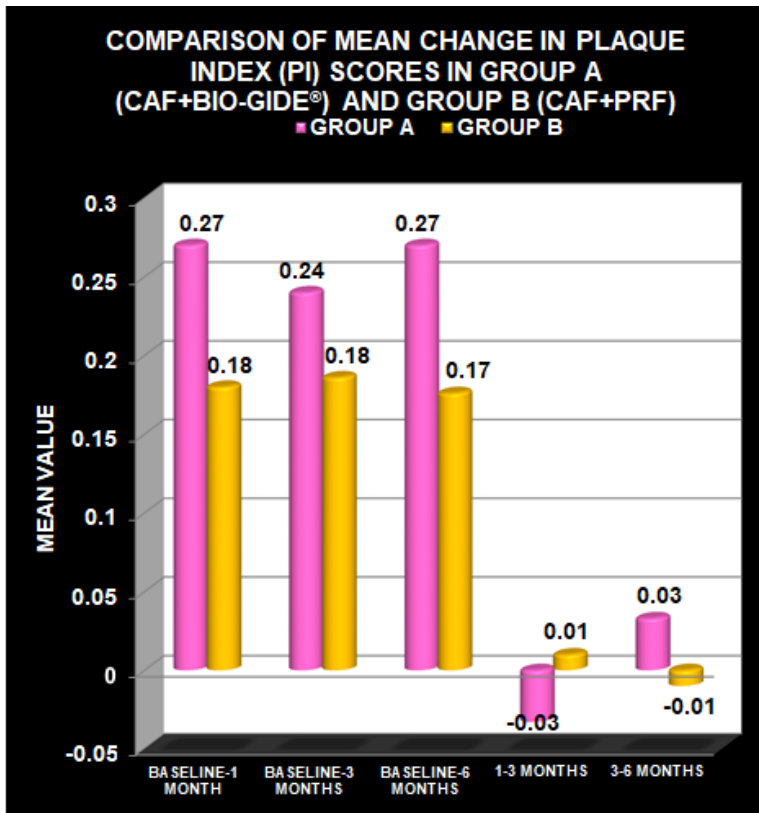
Table 1

COMPARISON OF DIFFERENT CLINICAL PARAMETERS BETWEEN GROUP A AND GROUP B AT VARIOUS TIME INTERVALS

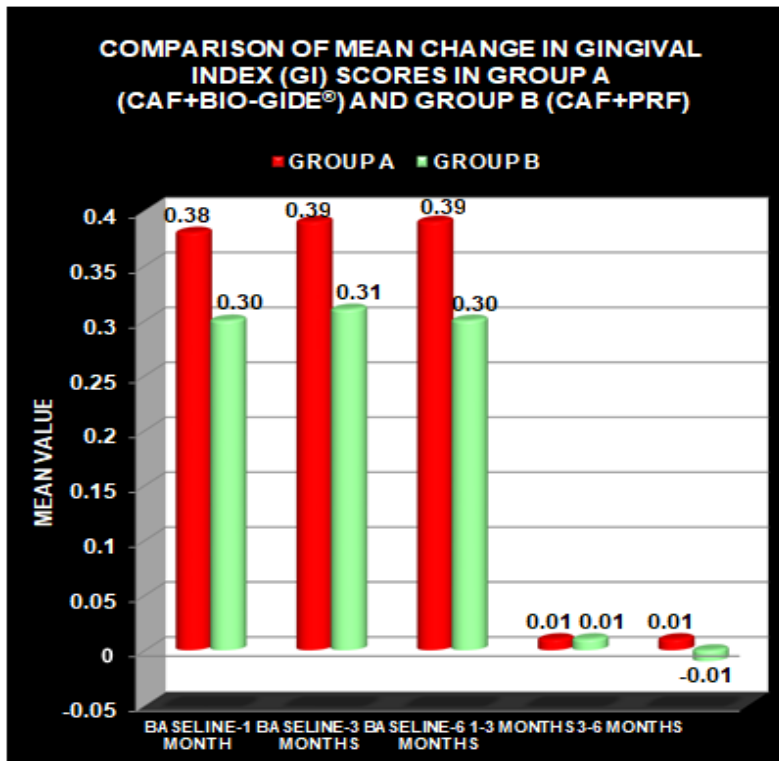
	TIME INTERVALS	GROUP A	GROUP B	P-VALUE
PLAQUE INDEX	BASELINE	1.28 ± 0.15	1.19 ± 0.12	0.07 ^{NS}
	1 MONTH	1.01 ± 0.02	1.01 ± 0.03	0.52 ^{NS}
	3 MONTHS	1.04 ± 0.15	1.01 ± 0.02	0.39 ^{NS}
	6 MONTHS	1.01 ± 0.02	1.02 ± 0.06	0.65 ^{NS}
GINGIVAL INDEX	BASELINE	1.41 ± 0.17	1.33 ± 0.22	0.25 ^{NS}
	1 MONTH	1.03 ± 0.05	1.03 ± 0.04	0.37 ^{NS}
	3 MONTHS	1.02 ± 0.05	1.02 ± 0.06	0.76 ^{NS}
	6 MONTHS	1.02 ± 0.05	1.03 ± 0.07	0.62 ^{NS}
POCKET DEPTH	BASELINE	1.86 ± 0.63	2.20 ± 0.41	0.09 ^{NS}
	1 MONTH	1.06 ± 0.25	1.40 ± 0.50	0.07 ^{NS}
	3 MONTHS	1.00 ± 0.00	1.33 ± 0.48	0.06 ^{NS}
	6 MONTHS	1.00 ± 0.00	1.26 ± 0.45	0.19 ^{NS}
RELATIVE ATTACHMENT LEVEL	BASELINE	6.93 ± 0.88	7.33 ± 0.61	0.25 ^{NS}
	1 MONTH	1.80 ± 0.67	2.33 ± 0.81	0.09 ^{NS}
	3 MONTHS	1.86 ± 0.74	2.40 ± 0.73	0.10 ^{NS}
	6 MONTHS	2.26 ± 0.70	2.86 ± 0.51	0.04*
GINGIVAL RECESSION DEPTH	BASELINE	5.06 ± 0.79	5.13 ± 0.51	0.83 ^{NS}
	1 MONTH	0.80 ± 0.67	1.00 ± 0.75	0.49 ^{NS}
	3 MONTHS	0.80 ± 0.67	1.00 ± 0.65	0.51 ^{NS}
	6 MONTHS	1.20 ± 0.67	1.60 ± 0.50	0.14 ^{NS}
WIDTH OF RECESSION DEFECT	BASELINE	4.33 ± 0.61	4.26 ± 0.70	0.77 ^{NS}
	1 MONTH	3.60 ± 0.63	3.46 ± 0.74	0.58 ^{NS}
	3 MONTHS	3.26 ± 0.45	3.33 ± 0.48	0.75 ^{NS}
	6 MONTHS	3.20 ± 0.41	3.26 ± 0.45	0.72 ^{NS}
WIDTH OF KERATINIZED GINGIVA	BASELINE	2.93 ± 0.70	2.80 ± 1.01	0.71 ^{NS}
	1 MONTH	2.93 ± 0.70	2.80 ± 1.01	0.71 ^{NS}
	3 MONTHS	3.33 ± 0.97	3.20 ± 0.86	0.71 ^{NS}
	6 MONTHS	3.73 ± 0.96	3.60 ± 0.91	0.73 ^{NS}
% ROOT COVERAGE	1 MONTH	85.06 ± 11.64	80.73 ± 13.45	0.35 ^{NS}
	3 MONTHS	85.06 ± 11.64	81.06 ± 11.06	0.42 ^{NS}
	6 MONTHS	76.80 ± 11.58	68.73 ± 10.36	0.09 ^{NS}

** P<0.001: Highly Significant, * P<0.05 Significant, NS: P> 0.05; Non significant

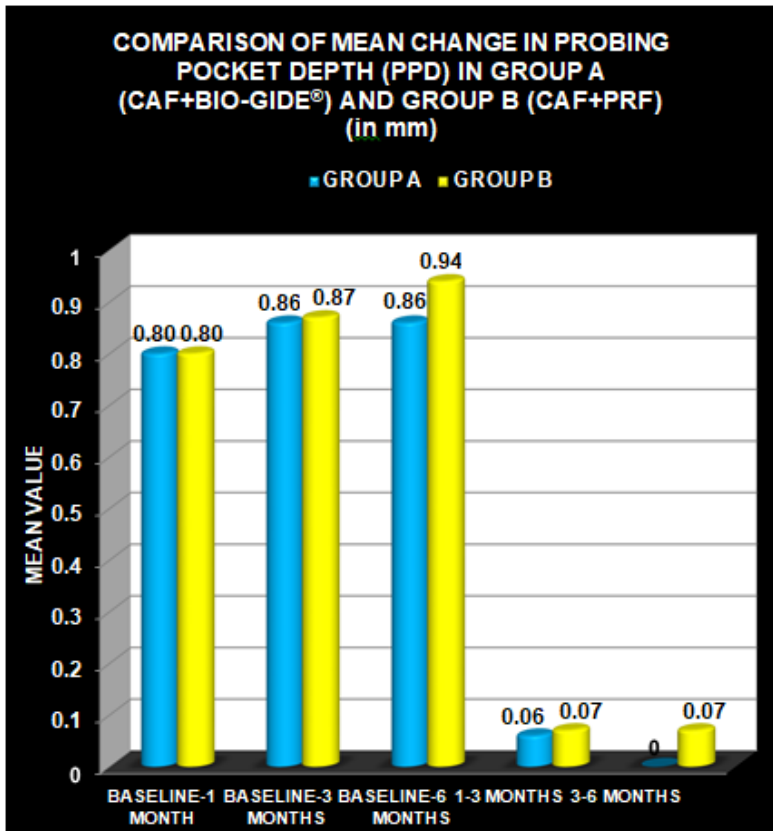
Graph 1: Comparison of Mean Change In Plaque Index (PI) Scores In Group A (CAF+BIO-GIDE®) AND GROUP B (CAF+PRF)



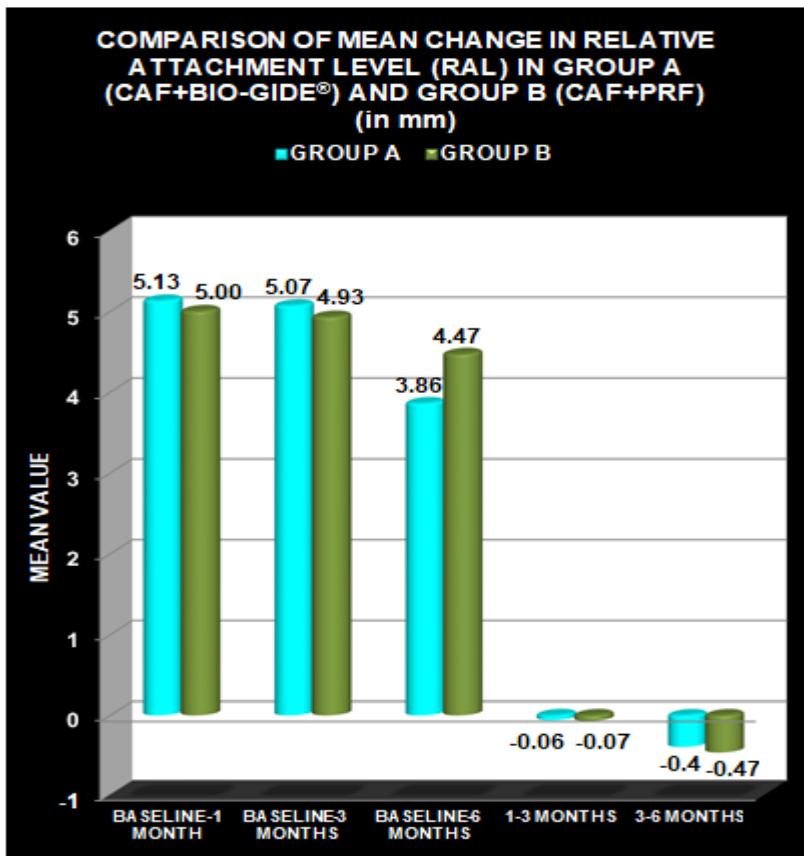
Graph 2: Comparison of Mean Change in Gingival Index Scores in Group A (CAF+BIO-GIDE®) AND GROUP B (CAF+PRF)



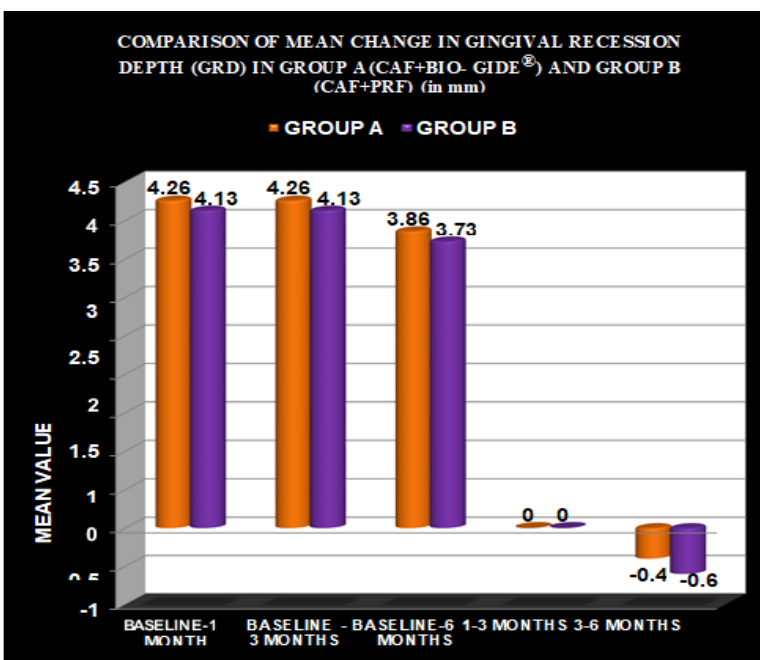
Graph 3: Comparison of Mean Change in Probing Pocket Depth (PPD) In Group A (CAF+BIO-GIDE®) AND GROUP B (CAF+PRF) (in mm)



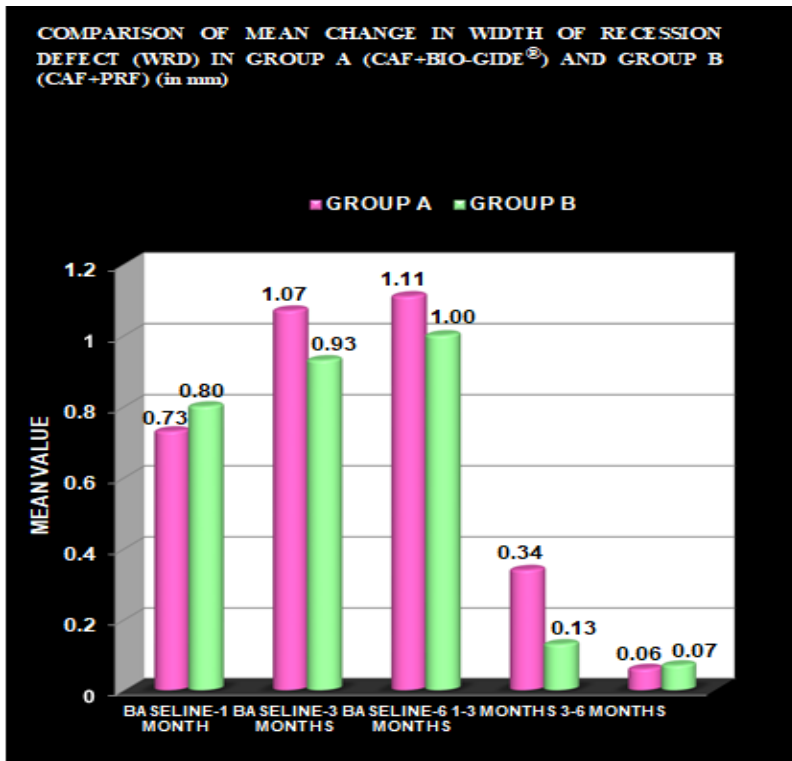
Graph 4: Comparison of mean change in relative attachment level (RAL) In group a (CAF+BIO-GIDE®) AND GROUP B (CAF+PRF) (in mm)



Graph 5: Comparison of Mean Change in Gingival Recession Depth (GRD) In Group A (CAF+BIO-GIDE®) AND GROUP B (CAF+PRF) (in mm)



Graph 6: Comparison of Mean Change in Width of Recession Defect (WRD) In Group A (CAF+BIO-GIDE®) AND GROUP B (CAF+PRF) (in mm)



Graph 7: Comparison of Mean Change in Width of Keratinized Gingiva (WKG) In Group A (CAF+BIO-GIDE®) and Group B (CAF+PRF) (in mm)

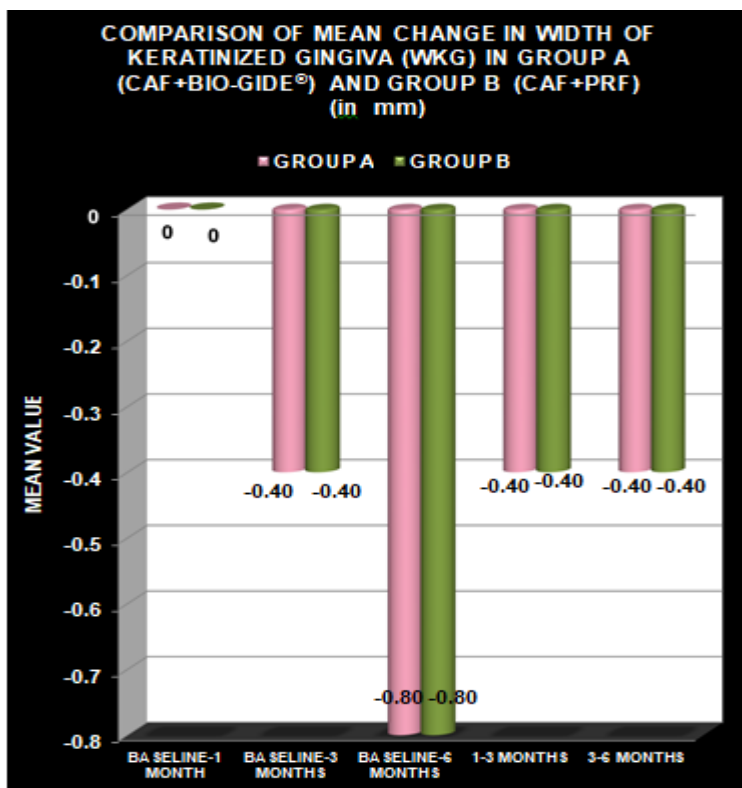




Figure 1: Preoperative View (Group A)



Figure 2: Preoperative View (Group B)

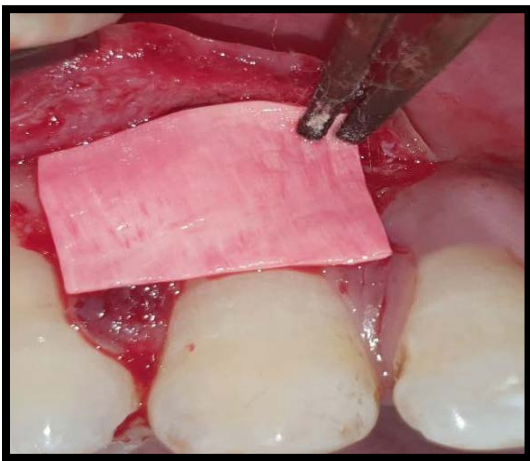


Figure 3: Flap Reflection Followed By Placement of Bio-Gide® Membrane

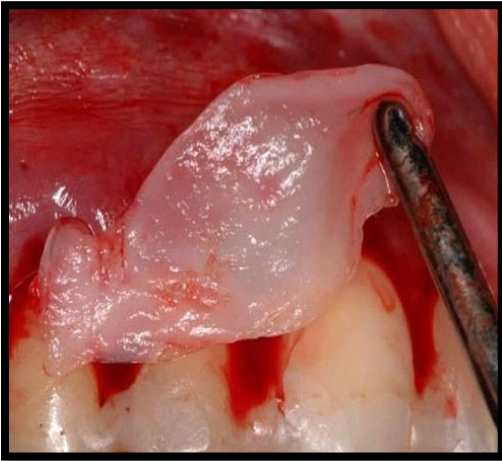


Figure 4: Flap Reflection Followed By Placement Of Prf Membrane

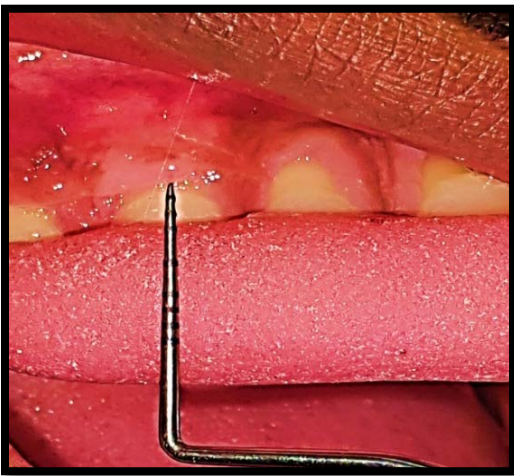


Figure 5: Postoperative View After Six Months (Group A)



Figure 6: Postoperative View After Six Months (Group B)