

Comparative Clinical Evaluation of Effectiveness of Subepithelial Connective Tissue Graft and Acellular Dermal Matrix Allograft (Alloderm®) in Combination with Coronally Positioned Flap in the Treatment of Gingival Class I or Class II Recession

Ridhima Sood^{1*} Suman Shergill² Jyotsana Singh³ Jaidev Dhillon⁴ Raman Gambhir⁵

¹Senior Lecturer, Department of Periodontology and Implantology, Rayat Bahra Dental College and Hospital, Rayat Bahra University, Mohali, Punjab, India.

²Senior Lecturer, Department of Periodontology and Implantology, Rayat Bahra Dental College and Hospital, Rayat Bahra University, Mohali, Punjab, India.

³Senior Lecturer, Department of Public Health Dentistry, Rayat Bahra Dental College and Hospital, Rayat Bahra University, Mohali, Punjab, India.

⁴Principal, Professor and Head, Department of Conservative Dentistry and Endodontics, Rayat Bahra Dental College and Hospital, Rayat Bahra University, Mohali, Punjab, India.

⁵Professor and Head, Department of Public Health Dentistry, Rayat Bahra Dental College and Hospital, Rayat Bahra University, Mohali, Punjab, India.

ABSTRACT

Background: The present randomized control was conducted clinically to evaluate the effectiveness of Acellular Dermal Matrix Allograft (ADMA) and Subepithelial Connective Tissue Graft (SCTG) in combination with Coronally Positioned Flap (CPF) in the treatment of Miller's class I and II multiple gingival recession in aesthetic areas.

Material and Methods: A total of 20 patients aged between 18 to 40 years were selected for this study, meeting all the criteria for inclusion. 10 patients were treated with ADMA and 10 patients with SCTG in combination with CPF. Various clinical parameters were assessed viz. probing pocket depth (PPD), clinical attachment level (CAL), gingival recession height (RH), width of keratinized gingiva (WKG) at baseline and 6 months after surgery.

Results: The mean RH at baseline in control and test group was 3.05 ± 0.55 (mean $\pm$ SD) and 2.60 ± 0.99 respectively. At 3 months the mean RH was found to be 1.60 ± 0.74 and 1.05 ± 0.60 in the control and test group respectively. The mean percentage of root coverage (MRC%) at 6 months in control and test group was 65.69 ± 26.52 (mean $\pm$ SD) and 65.54 ± 9.16 respectively but no statistically significant difference was seen between the two groups.

Conclusion: The results of the study suggest that the combination of both subepithelial connective tissue graft and acellular dermal matrix graft with a coronally positioned flap can produce equivalent amount esthetic root coverage.

Keywords: Gingival recession; Acellular dermal matrix allograft; Subepithelial connective tissue graft.

INTRODUCTION

The progression of recession defects warrants an investigation of the etiologic factors and their elimination. The consideration of therapeutic

actions is directed at minimizing the apical movement of the gingival margins. At the same time, achieving predictable and esthetic root

Received: Feb. 1, 2021; Accepted: Mar. 9, 2021

*Correspondence Dr. Ridhima Sood.

Department of Periodontology and Implantology, Rayat Bahra Dental College and Hospital, Mohali, Punjab, India.

Email: soodyv@icloud.com

coverage is the main objective of periodontal plastic surgery. The subepithelial connective tissue graft (SCTG) has been viewed as an effective and predictable method of achieving the coverage of denuded root surface in Miller's class I and class II gingival recession. Langer and Calagnain 1980 gave the technique of subepithelial connective tissue graft (SCTG) and later it was modified in 1985 by Langer and Langer. Since then various modifications have been made in the incisions and designs of this technique to make it a treatment of choice for achieving predictable root coverage and aesthetics.^{1,2} The subepithelial connective tissue graft is considered as a gold standard² in the treatment of gingival recession due its high predictability for root coverage and increase in the width of keratinized tissue. However, the main limitation of this technique is the need of a second surgical site. Besides this, the donor tissue from the palatal region may be insufficient for treatment of multiple recession sites and the patient may be subjected to multiple surgeries just to harvest the donor graft tissue.² These limitations led to the development of newer techniques which can achieve predictable root coverage with good esthetics. Recently, the use of an ADMG called as Alloderm® has become increasingly popular technique as a substitute for connective tissue graft.^{3,4} Acellular dermal matrix is obtained from a human donor skin tissue, processed that removes its cell component while preserving the remaining bioactive components, which is subsequently freeze dried. The preparation of this dermal allograft involves cell component removal and preservation of the ultrastructural integrity, which if damaged would induce an inflammatory response.⁵⁻⁷ ADM was originally utilized for use in plastic surgery for the treatment of full thickness burn wounds.⁸ A periodontal plastic surgical procedure using ADM offers the advantage of avoiding the need of second surgical palatal donor site thereby offering the clinician the tissue thickness similar to that of an autogenous connective tissue graft.^{9,10} The aim of present randomized clinical trial was to evaluate the effectiveness of ADMA and SCTG in combination with coronally advanced flap in the treatment of Miller's class I or class II gingival recession.

MATERIALS & METHODS

Twenty systemically healthy patients aged between 18 to 40 years were selected from the Outpatient, Department of Periodontics, I.T.S Centre for Dental Studies and Research. The following patients were included in the study that were systemically healthy, non smokers and had Miller's Class I or II recession defects on maxillary incisors, canines or premolars. Exclusion Criteria were as follows supra-erupted tooth, non vital tooth, subjects who have taken antibiotics in past 3 months, are on immune suppressant drugs or any medication known to cause gingival enlargement, with active infectious diseases (hepatitis, tuberculosis, HIV infection etc), with active caries or restoration on the root surface of the concerned tooth, pregnant and lactating mothers, high frenal attachment and who have previously undergone any type of periodontal surgical procedure or regenerative therapy in the past one year. The surgeries were performed from October 2013 to January 2014.

Standardized Clinical Parameters

The following clinical parameters were measured for assessment of the results in all the selected cases: plaque index (PI),¹¹ Gingival index (GI),¹² probing pocket depth (PPD), clinical attachment level (CAL), recession height (RH) and width of keratinized gingiva (WKG)¹³ by using UNC-15 periodontal probe. All the probing measurements were recorded (Mid-buccally per tooth) at baseline, 3 months and 6 months. The clinical parameters were measured using a UNC-15 probe. Reproducible alignments of the probe were provided by custom made self cure acrylic stents grooved in an occlusoapical direction corresponding to the inter-proximal area.¹⁴

Presurgical Management

Prior to the surgery, all the patients received thorough supragingival and subgingival scaling and root planing and oral hygiene instructions were given to the patient. Patients were evaluated for optimal oral hygiene at the end of 2 weeks. Every effort was made to modify the habits that contributed to the recession defects.

Occlusal analysis was within the normal limits in all the cases included in the study and no occlusal therapy was performed in any case.

Surgical Procedure

After local anesthesia, the exposed root surface was planed with hand & ultrasonic instruments. The recipient site was prepared by giving intrasulcular incision at the labial aspect of the involved teeth. Two horizontal papilla sparing incisions were made at right angles to the adjacent interdental papillae at the level of CEJ without interfering with the gingival margin of the neighbouring teeth. Two oblique vertical incisions were extended, beyond the mucogingival junction and mucoperiosteal flap was raised, up to the mucogingival junction. After this point, a split thickness flap was extended apically, releasing the tension and favouring the coronal positioning of the flap.¹⁵ (FIG 1,2) The epithelium on the adjacent papillae was deepithelised. The exposed root surfaces were planed with Gracey curettes (3/4) and conditioned with 24% EDTA gel for 2 minutes to remove the smear layer followed by subsequent rinsing with sterile saline solution to obtain a surface devoid of organic debris and gently air dried. A SCTG in a proper dimension was harvested from the palate by trap door technique and trimmed as necessary.¹⁶ (FIG 3,4) The graft was placed at the CEJ level and 2-3mm beyond to margin of alveolar bone covering the entire defect and stabilized by using 4-0 resorbable sutures and then sutured to the neighbouring mucosa. (FIG 5) Flap was then coronally positioned with margins located on the coronal to the cement-enamel junction. It was secured in position by horizontal suspensory sutures through an orthodontic bracket placed at the mid buccal portion of the crown.¹⁷ (FIG 6) Additional lateral interrupted sutures were placed to close the wound of the releasing incisions. In the test group ADMA to be adapted after being aseptically rehydrated in sterile saline according to the manufacturer's instruction. The graft was trimmed in such a way that coronally it was at CEJ and apically it covered the alveolar bone up to at least 2 to 3 mm. The connective tissue side was placed adjacent to the bone and basement membrane side was placed facing the flap.¹⁸ The coronal and

lateral border of ADMA was sutured to lingual gingival tissue with resorbable sutures. The flap was then coronally positioned and sutured to cover the ADMA. Subsequently periodontal dressing was placed over the surgical site in both the groups. (FIG 7-13)



Fig 1: Preoperative view of the recession defect (control group).



Fig 2: Root biomodification with 24% edta gel (control group).

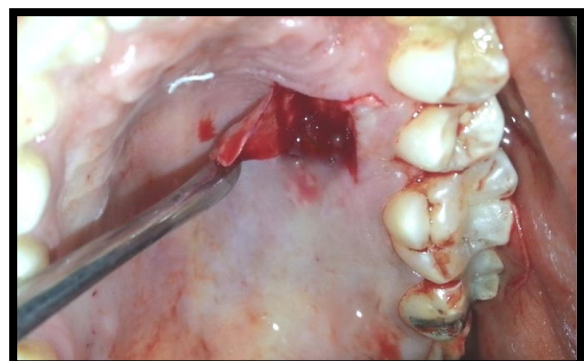


Fig 3: Palatal donor site with trap-door flap design,



Fig 4: subepithelial connective tissue graft obtained from palate and palatal site sutured with non-resorbable sutures.

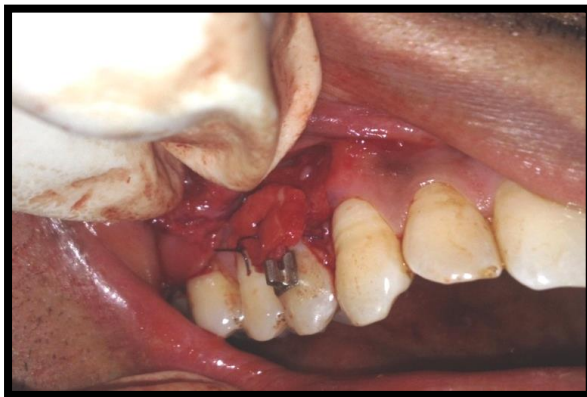


Fig 5: Subepithelial connective tissue graft secured at the recipient bed.



Fig 6: Flap Sutured Over the Subepithelial Connective Tissue Graft.



Fig 7: Postoperative view at 6 months (control group).



Fig 8: Preoperative View of The Recession Defect (Test Group).



Fig 9: Root biomodification with 24% edta gel (test group).



Fig 10: Coronal positioning of flap (test group).

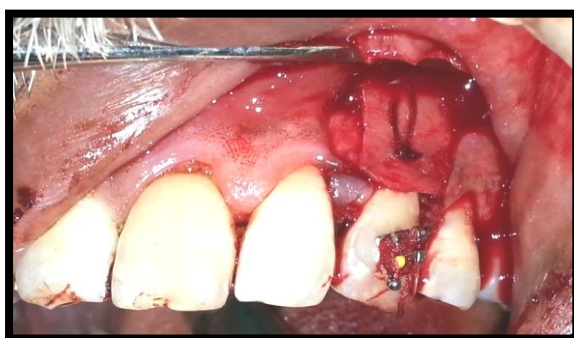


Fig 11: Acellular dermal matrix allograft (alloderm®) placement and stabilized with resorbable sutures.



Fig 12: Flap sutured over the acellular dermal matrix allograft (alloderm®).



Fig 13: Postoperative view at 6 months (test group).

Postoperative Care

Postoperative medications included a single standard regimen of oral administration of Amoxicillin 500 mg thrice daily for 5 days, and Ibuprofen 400mg + Paracetamol 325mg thrice daily for 5 days, along with 10 ml of 0.2% chlorhexidine gluconate rinse twice daily for a period of 2 weeks. The patients were asked to resume mechanical tooth brushing one month of the treated area using roll technique with a soft toothbrush.¹⁹ Patients were called after 2 weeks for periodontal dressing and suture removal.

Statistical Analysis

The software used for the statistical analysis were SPSS (statistical package for social sciences) version 21.0 and Epi-info version 3.0. The values were represented in Number (n), Percentage (%) and Mean ($\bar{x}$). The statistical tests used were Unpaired or independent samples t-test is used for comparison of mean value between test and control groups (Intergroup comparison) A one way ANOVA (Analysis of Variance) test, post hoc –Bonferroni multiple test and paired t –test were used to evaluate the statistical significance of differences at different time intervals(baseline , 3 months and 6 months) respectively. The p-value was taken significant when less than 0.05 ($p < 0.05$) and confidence interval of 95% was taken.

RESULTS

In the present study, 20 patients (18 males and 2 females) with age ranging from 20-45 years (mean age 29.75 ± 4.35), fulfilling the inclusion and exclusion criteria contributing to a total of 20 recession defects were recruited. The recession defects were located in 9 canines, 4 premolars, 2 central and 5 lateral incisors. The mean CAL at baseline in control and test group was 4.80 ± 0.63 (mean $\pm$ SD) and 4.00 ± 1.20 respectively. The mean CAL at 6 months for the control group was 2.12 ± 0.91 and 1.93 ± 0.84 for the test group respectively. The independent t-test (intergroup comparison) was used to compare the mean CAL between the groups and the difference between the groups was found to be statistically non-significant at baseline, 3

months and 6 months respectively. (TABLE 1,2) Similarly the mean change in the CAL between the groups when compared from baseline to 6 months was also statistically non-significant ($p>0.05$). (TABLE 3) The post hoc comparison (intergroup comparison) of the scores showed that the mean CAL reduced significantly ($p<0.05$) from baseline to 3 months and baseline to 6 months respectively in both the control as well as test groups but no statistically significant difference was seen at 3 months to 6 months in both the groups. (TABLE 4) The approximate size of recession defects in both the groups were nearly similar and there was no statistically significant difference in the mean preoperative gingival RH. The mean RH at baseline in control and test group was 3.05 ± 0.55 (mean $\pm$ SD) and 2.60 ± 0.99 respectively. The mean RH at 6 months for the control group was 1.14 ± 1.00 and 0.90 ± 0.46 for the test group respectively. (TABLE 1,2) The mean change in the RH between the groups when compared from baseline to 6 months was also statistically non-significant ($p>0.05$). (TABLE 3) The post hoc comparison of the scores showed that the mean RH from baseline to 3 months and baseline to 6 months reduced significantly ($p<0.05$) in both the control as well as test groups but no statistically significant difference was seen at 3 months to 6 months in both the groups. (TABLE 4) The mean WKG scores at baseline in control and test group was 3.80 ± 0.63 (mean $\pm$ SD) and 4.05 ± 0.86 respectively. The mean WKG at 6 months for the control group was 4.45 ± 0.50 and 4.80 ± 0.59 for the test group. (TABLE 1,2) The mean change in the WKG between the groups

when compared from baseline to 6 months was statistically nonsignificant ($p>0.05$). (TABLE 3) On intragroup comparison at 3 time point intervals, the mean WKG reduced significantly at 3 months and 6 months. The post hoc comparison of the scores showed that the mean WKG reduced significantly ($p<0.05$) from baseline to 3 months and baseline to 6 months in the control group but showed statistically non-significant difference at 3 months to 6 months. ($p>0.05$) The test group showed statistically non-significant difference at baseline to 3 months and 3 months to 6 months ($p>0.05$) but statistically significant difference at baseline to 6 months. (TABLE 4)

The mean percentage of root coverage (MRC%) at 6 months in control and test group was 65.69 ± 26.52 (mean $\pm$ SD) and 65.54 ± 9.16 respectively but no statistically significant difference was seen between the two groups (TABLE 5). Two of the sites in the control group showed 90% of root coverage, four of the sites showed 83.3% of the root coverage at 6 months whereas one of the site showed 66.7% of root coverage. The test group showed 80% of the root coverage at 2 sites and 8 sites showed 66.7% of the root coverage at 6 months. The patients were satisfied with the root coverage and colour match in both the treatment groups but minimal discomfort was reported by the patients in the test group when compared with the control group because of the postoperative morbidity due to the involvement of the second surgical site.

Table 1: Comparison of clinical parameters (unpaired t-test) between the study groups at baseline

Baseline(Clinical Parameters)	Groups	Mean	S.D.	t-test value	p-value	Mean Difference
PI	Control	0.48	0.14	0.849	0.407	0.05
	Test	0.43	0.12	0.849	0.408	0.05
GI	Control	0.65	0.13	1.342	0.196	0.08
	Test	0.58	0.12	1.342	0.196	0.08
PD	Control	1.75	0.49	1.561	0.136	0.35
	Test	1.40	0.52	1.561	0.136	0.35
CAL	Control	4.80	0.63	1.863	0.079	0.80
	Test	4.00	1.20	1.863	0.084	0.80
WKG	Control	3.80	0.63	-0.738	0.470	-0.25
	Test	4.05	0.86	-0.738	0.471	-0.25
RH	Control	3.05	0.55	1.252	0.227	0.45
	Test	2.60	0.99	1.252	0.231	0.45

Table 2: Comparison of clinical parameters (unpaired t-test) between the study groups at 6 months.

6 Months (Clinical Parameters)	Groups	Mean	S.D.	t-test value	p-value	Mean Difference
PI	Control	0.28	0.08	0.000*	1.000	0.00
	Test	0.28	0.08			
GI	Control	0.33	0.12	-0.447	0.660	-0.03
	Test	0.35	0.13			
PD	Control	0.98	0.24	-0.257	0.800	-0.05
	Test	1.03	0.57			
CAL	Control	2.12	0.91	0.485	0.634	0.19
	Test	1.93	0.84			
WKG	Control	4.45	0.50	-1.028	0.170	-0.35
	Test	4.80	0.59			
RH	Control	1.14	1.00	0.687	0.501	0.24
	Test	0.90	0.46			

Table 3: comparison of the clinical parameters between the the study groups from baseline to 6 months (unpaired t test).

Clinical Parameters	Groups	Mean	S.D.	t-test value	p-value	Mean Difference
GI	Control	0.33	0.12	2.191	0.042*	0.10
	Test	0.23	0.08			
PI	Control	0.20	0.11	0.949	0.355	0.05
	Test	0.15	0.13			
PD	Control	0.77	0.37	2.569	0.019*	0.40
	Test	0.37	0.32			
CAL	Control	2.68	0.72	2.052	0.055	0.61
	Test	2.07	0.60			
WKG	Control	-0.65	0.47	0.466	0.647	0.10
	Test	-0.75	0.49			
RH	Control	1.91	0.67	0.720	0.481	0.21
	Test	1.70	0.63			

Table 4: Comparison of clinical parameters (post-hoc bonferonni multiple comparison test) within the study groups at various time intervals.

Dependant variables		CONTROL		TEST	
Time Interval(I)	Time interval(J)	Mean Difference	p-value	Mean Difference	p-value
PI	Baseline to 3 months	0.18	0.004*	0.15	0.015*
	Baseline to 6 months	0.20	0.001*	0.15	0.015*
	3 months to 6 months	0.03	1.000	0.00	1.000
GI	Baseline to 3 months	0.28	0.000*	0.23	0.000*
	Baseline to 6 months	0.33	0.000*	0.23	0.000*
	3 months to 6 months	0.05	0.504	0.00	1.000
PD	Baseline to 3 months	0.72	0.000	0.25	0.157
	Baseline to 6 months	0.77	0.000	0.37	0.016*
	3 months to 6 months	0.05	0.532	0.12	0.312
CAL	Baseline to 3 months	2.17	0.000*	1.80	0.000*
	Baseline to 6 months	2.68	0.000*	2.07	0.000*
	3 months to 6 months	0.51	0.074	0.27	0.145

WKG	Baseline to 3months	-0.60	0.003*	-0.45	0.284
	Baseline to 6 months	-0.65	0.006*	-0.65	0.035*
	3 months to 6 months	-0.05	1.000	-0.30	0.085
RH	Baseline to 3months	1.45	0.000*	1.55	0.000*
	Baseline to 6 months	1.91	0.000*	1.70	0.000*
	3 months to 6 months	0.46	0.064	0.15	0.580

Table 5: Comparision of % root coverage (unpaired t-test) in both the study groups at the 6 months.

Groups	RH Baseline		RH 3 months		RH 6 months		%RC					Frequency of root coverage		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	Mean Diff.	S.D.	t-test value	p-value	0-30 %	30-60%	70-90%
Control	3.05	0.55	1.60	0.74	1.14	1.00	65.69	0.15	26.52	0.017	0.987	2	1	7
Test	2.60	0.99	1.05	0.60	0.90	0.46	65.54		9.16			-	8	2

DISCUSSION

The most common problem encountered by a clinician in his day-to-day practice is exposed root surface or a tooth getting long commonly reported by the patient. So the clinicians are faced with the challenge of not only addressing the biological and functional problems present in the periodontium but also fulfil the main indication for root coverage procedures that is the esthetics and/or cosmetic demands followed by the management of root hypersensitivity, root caries or when it hampers proper plaque removal.²⁰ The purpose of this present randomized controlled clinical trial was to compare the clinical outcomes of traditional SCTG versus ADMA in combination with coronally advanced flap for the treatment of isolated Miller's Class I and Class II gingival recession. There was no sign of allergy, infection or any other complications during the course of the study and all the patients tolerated the procedures well. The reduction in the plaque index and gingival index remained constant throughout the study period. In the present study, when the teeth were compared to the adjacent non treated teeth there was no visual detectable increase in the plaque accumulation. This suggested that patients were well motivated to maintain good oral hygiene postoperatively. This finding was an agreement with Chen et al in 1995.²¹ There was a slightly

greater reduction in the probing depth in the control group when compared with the test group. The mean difference between the groups from baseline to 6 months was also statistically significant. However, within the control group and the test group there was statistically significant decrease in the probing depth scores from baseline to 3 months and 6 months. These results are in agreement with the study conducted by Harris in 2000⁹ in which he reported mean reduction of 1.2mm in the control group and 0.7mm in the test group respectively. The mean reduction in the recession height in both the control (1.91) and the test group (1.70) was nearly the same. Both the groups showed statistically significant decrease in the recession height at baseline to 3 months and 6 months' time intervals. In the present study, reduction in the recession height in the test group could be attributed to the coronal movement of the gingival margin on the denuded roots following tissue grafts. Creeping attachment starting at one month after graft up to one year, has been referred in several studies. Harris in 2000⁹ referred to 0.85 mm creeping attachment through SCTG following one year and Piniprato et al ²²referred to 0.43 mm through the coronally advanced flap. In the present study both the groups showed increase in the width of keratinized gingiva. But the ADMA group showed slightly greater increase in width of keratinized gingiva (4.80±0.59), as

compared to SCTG group (4.50 ± 0.58 mm) at 6 months. Both the groups showed statistically significant increase in the width of keratinized gingiva at 3 months and 6 months time intervals. However, the mean difference in the width of keratinized gingiva between the group at baseline to 6 months was statistically non significant. Tal et al¹⁰ reported an increase of 2.0 mm in keratinized tissue when the basement membrane side of the acellular dermal matrix graft was placed facing the flap's connective tissue. In the present study the basement membrane side of ADM was placed facing the flap and this could attribute to the slight increase in the width of keratinized gingiva in test group when compared with the control group. One feature of this material is that it has 2 surfaces: one has characteristics of the basement membrane and the other of the connective tissue with collagen and elastic fibers. This non inert structure acts as a biologically compatible framework into which fibroblasts, keratinocytes and epithelial cells can migrate and adhere thus repopulating and incorporating the material into the newly formed tissue.²³ The control group showed a greater CAL gain when compared with the test group. Both the groups showed statistically significant increase in the clinical attachment level at 3 months and 6 months time intervals. However the mean difference in the CAL gain between the groups at baseline to 6 months was statistically non significant. This finding is in accordance to the results obtained in studies conducted by Novaes et al²⁴ and Paolantonio et al²⁵ who reported no statistically significant difference in the CAL gain between the SCTG and ADMA groups. Harris et al stated that clinical gain in the attachment level may be due to combination of new connective tissue attachment in the apical half of the defect and the presence of long junctional epithelial attachment in the coronal half.²⁶ The mean percentage of root coverage was same in both the groups. But there was no statistically significant difference seen between the two groups indicating that both the groups were found equally effective in the treatment of gingival recession and achieving adequate root coverage as well as esthetics. The results in the control group are in accordance with the study

conducted by Bouchard et al in which he reported a mean root coverage of 69.2% in the subepithelial connective tissue group.²⁷ In the present study the results in the test group are nearly similar and in accordance with the study conducted by Aichelmann-Reidy et al who also reported a mean percentage of root coverage 65.9% with acellular dermal matrix graft.²⁸

CONCLUSION

The subepithelial connective tissue graft (SCTG) is a predictable and versatile technique in which a bilaminar vascular environment is created to nourish the graft. However, harvesting the palatal area increases postoperative morbidity and is time consuming. In the current era that focuses on minimally invasive techniques, the use of allograft contributed to a significant reduction in the patient morbidity and surgical risks. In addition, it provides an unlimited supply of graft material thus permitting multiple site root coverage that can be extended for a sextant, quadrant, or even a full mouth arch at one time. The results provided by both the groups SCTG as well as ADMG were nearly equivalent and equally effective thereby suggesting that both the treatment modalities are feasible options for esthetics root coverage. However long term clinical trials with larger sample size are recommended to evaluate the stability of the root coverage procedures.

ACKNOWLEDGMENT

I express my sincere and heartfelt thanks to Dr Jaidev Dhillon, Principal, for his constant encouragement and guidance throughout this clinical study.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

REFERENCES

1. Langer B, Calagna L. The subepithelial connective graft. J Prosthet Dent 1980;44:363-7.

2. Langer B, Langer L. Subepithelial connective tissue graft technique for root coverage. *J Periodontol* 1985;56:715-20
3. Gartell JR, Mathews DP. Gingival recession the condition, process and treatment. *Dent Clin North M* 1976;20:199-213.
4. Rahmani ME, Lades MA. Comparative clinical evaluation of Acellular Dermal Matrix Allograft and connective tissue graft for the treatment of gingival recession. *J Contem Dental Prac*, 2006;7(2):63-70.
5. Wainwright D, Madden M, Luteman A. Clinical evaluation of an acellular allograft dermal matrix in full thickness burns. *J Burn Care Rehabil* 1996;17:124-6.
6. Rhee PH, Freidman CD, Ridge JA, Kusiak J. The use of processed allograft matrix for intraoral resurfacing: An alternative to split thickness skin grafts. *Arch Otolaryngeal Head Neck Surgery* 1998;124:1201-4.
7. Livesey S, Herndon D, Hollyoak M, Atkinson Y, Nag A. Transplanted acellular allograft dermal matrix. *Transplantation* 1995;60:1-9.
8. Wainwright DJ. Use of an acellular allograft dermal matrix (Alloderm) in the management of full thickness burns. *Burns* 1995;21:243-8.
9. Harris RJ. A comparative study of root coverage obtained with an acellular dermal matrix versus connective tissue graft :Results of 107 recession defects in 50 consecutively treated patients. *Int J Periodontics Restorative Dent* 2000;20:51-9.
10. Tal H. Subgingival acellular dermal matrix allograft for the treatment of gingival recession: A case report. *J Periodontol* 1999;70:1118-24.
11. Turesky S, Gilmore ND, Glickman I. Reduced plaque formation by the chloromethylene analogue of vitamin C. *J Periodontol* 1970;41(1):41-3.
12. Loe H, Silness J. Periodontal disease in pregnancy. I. Prevalence and severity. *Acta Odontol Scand* 1963;21:533-51.
13. Arlin LM. The periodontal examination and consultation: the diagnostic components. *Oral Health* 1986;76:37-41.
14. Silvertson JF, Burgett FG. Probing of pockets related to the attachment level. *J Periodontol*. 1976;47(5):281-6.
15. Pini Prato G, Pagliaro U, Baldi C, Nieri M, Saletta D, Cairo F, Cortellini P. Coronally advanced flap procedure for root coverage. Flap with tension versus flap without tension: a randomized controlled clinical study. *J Periodontol* 2000;71:188-201.
16. Harris RJ. The connective tissue and partial thickness double pedicle graft: A predictable method of obtaining root coverage. *J Periodontol* 1992;63:477-86.
17. Henderson RD, Greenwell H, Drisko C. Predictable multiple site root coverage using an acellular dermal matrix allograft. *J Periodontol* 2001;72:571-82.
18. Stahl S, Froum S. Human suprabony healing responses following root demineralization and coronal flap anchorage. Histologic responses in 7 Sites. *J Clin Periodontol* 1991;18:685-89.
19. Moslemi N, Jazi MM, Haghighati F, Morovati SP, Jamali R. Acellular dermal matrix allograft versus subepithelial connective tissue graft in treatment of gingival recessions: A 5-year randomized clinical study. *J Clin Periodontol* 2011;38:1122-9.
20. Miller PD. Regenerative and Reconstructive periodontal plastic surgery. *Dent Clin North Am* 1988;32:287-306.
21. Chen CC, Wang HL, Smith F, Glickman J, Shyr Y, Neal BB. Evaluation of an absorbable collagen membrane with or without bone grafts in treating periodontal intrabony defects. *J Periodontol* 1995;66:838-47.
22. Pini Prato GP, Baldi C, Pagliaro U, Nieri M, Saletta D, Rotundo R, Cortellini P. Coronally

- advanced flap procedure for root coverage. Treatment of root surface: root planning versus polishing. J Periodontol 1999;70:1064-76.
23. Nyman S, Lindhe J, Rosling B. Periodontal surgery in plaque-infected dentitions. J Clin Periodontol 1977;4:240-9.
 24. Novaes AB, Grisi DC, Molina GO, Souza SLS, Taba M Jr, Grisi MFM. Comparative 6-Month Clinical Study of a Subepithelial Connective Tissue Graft and Acellular Dermal Matrix Graft for the Treatment of Gingival Recession. J Periodontol 2001;72(11):1477-84.
 25. Paolantonio M, Dolci M, Esposito P. Subpedicle acellular dermal matrix graft and autogenous connective tissue graft in the treatment of gingival recessions: A comparative 1-year clinical study. J Periodontol 2002;73:1299-1307.
 26. Harris RJ. The connective tissue with partial thickness double pedicle graft: The results of 100 consecutively treated defects. J Periodontol 1994;65:448-61.
 27. Bouchard P, Etienne D, Ouhayoun JP, Nilveusf R. Subepithelial Connective Tissue Grafts in the Treatment of Gingival Recessions. A Comparative Study of 2 procedures. J Periodontol 1994;65(10):929-36.
 28. Reidy MEA, Yukna RA, Evans GH, Nasr HF, Mayer ET. Clinical evaluation of Acellular Dermis Allograft for the treatment of Gingival recession. J Periodontol 2001;72:998-1005.