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Original Article

Comparative evaluation of surgical modalities for coverage of gingival recession: An Armed Forces Medical College perspective

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ABSTRACT

Background: Esthetics represents an inseparable part of today's oral therapy, and several procedures have been proposed to preserve or enhance it. Gingival recessions may cause hypersensitivity, impaired esthetics and root caries. Keeping in mind patient's desire for improved esthetics and other related problems, every effort should be made to achieve complete root coverage.

Methods: Different types of modalities have been introduced to treat gingival recession including displaced flaps, free gingival graft, connective tissue graft, different type of barrier membranes and combination of different techniques. The aim of this study was to compare the commonly used techniques for gingival recession coverage and evaluate the results obtained. 73 subjects were selected for the present study who were randomly divided into four groups and were followed at baseline and 180 days where following parameters were recorded: (a) Assessment of gingival recession depth (RD); (b) Assessment of pocket depth (PD); (c) Assessment of clinical attachment level (CAL) and (d) Assessment of width of attached gingiva (WAG).

Results: Results of this study showed statistically significant reduction of gingival recession, with concomitant attachment gain, following treatment with all tested surgical techniques. However, SCTG with CAF technique showed the highest percentage gain in coverage of recession depth as well as gain in keratinized gingiva. Similar results were obtained with CAF alone. The use of GTR and other techniques showed less predictable coverage and gain in keratinized gingiva.

Conclusion: Connective tissue grafts were statistically significantly superior to guided tissue regeneration for improvement in gingival recession reduction.

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Introduction

One of the commonest esthetic complaints of a patient reporting to dental surgery is loss of gum over root surfaces leading to unsightly defects and/or hypersensitivity. "Gingival recession is defined as the displacement of the soft tissue margin apical to the cemento-enamel junction (CEJ)".¹ Gingival recessions are predominantly found on buccal root prominences, especially canine and premolar sites, where bone dehiscences and fenestrations are common.² Surgical coverage of recessions is mainly indicated for esthetic improvement rather than functional aspects.³ Success of mucogingival surgical interventions may depend on several factors, (i) bacterial contamination (ii) local factors;- defect morphology, tooth position, tooth surface characteristics (iii) surgical technique.⁴ Benefits of microsurgical approaches in addition to conventional periodontal therapy have also been described for a better treatment outcome.

Materials & methods

The study population comprised of 73 patients who reported at Dept of Dental Surgery AFMC between 01 Jan 2005 to 31 Dec 2008. 27 female and 46 male patients who all desired coverage of their single gingival recessions for esthetic reasons were recruited. Inclusion criteria were (1) good systemic health, (2) non-smokers, (3) no medication intake affecting the periodontal tissues, (4) absence of periodontal diseases, and (5) presence of root denudations of Class I or II (Miller 1985).⁵ An informed consent was obtained and patients were allotted to 4 study groups as follows:

Group A – coronally advanced flap alone (17 cases).

Group B – coronally advanced flap with subepithelial connective tissue graft (20 cases).

Group C – guided tissue regeneration using resorbable collagen membrane (15 cases).

Group D – other procedures (21 cases).

Presurgical phase I therapy consisted of scaling and root planning, restoration of carious lesions/endodontic therapy, occlusal correction followed by maintenance therapy consisting of follow up appointments at biweekly intervals.

Surgical phase

Periodontal plastic surgery for all selected cases was carried out using modalities as described below:

Group A – coronally advanced flap alone (Fig. 1).

Group B – coronally advanced flap with subepithelial connective tissue graft (Figs. 2 and 3).

Group C – guided tissue regeneration using resorbable fish collagen membrane (Fig. 4).

Group D – other procedures including laterally displaced flap (Fig. 5), double papilla flap, free gingival graft and adjunctive procedures for root biomodification namely, platelet-rich plasma and tetracycline prior to periodontal plastic surgical procedures.

Baseline measurements were taken for probing depth (PBD), clinical attachment level (CAL), recession depth at mid

Fig. 1 – Coronally advanced flap.

buccal region (RD), recession width at cemento-enamel junction (RW), width of attached gingiva (WAG), plaque index and gingival index scores were taken. Same measurements were repeated at 6 month intervals postoperatively.

Results

A total of 73 subjects were selected for the present study who were randomly divided into four groups (Group A, B, C and D) as described above and were followed at baseline and 180 days where following parameters were recorded:

- Assessment of gingival recession depth (RD).
- Assessment of pocket depth (PD).
- Assessment of clinical attachment level (CAL).
- Assessment of width of attached gingiva (WAG).

Patient selection

Group A comprised of 17 cases, Group B consisted of 20 patients, Group C consisted of 15 cases, whereas Group D comprised of 21 subjects. Cases were selected randomly in each clinical grouping to rule out any selection bias.

Fig. 2 – Subepithelial connective tissue graft.

Fig. 3 – Harvesting of subepithelial connective tissue graft from palate.

Gender distribution

There were 46 male and 27 female patients in the study. Statistical analysis (paired t-test) was carried out. The analysis revealed no statistically significant difference ('p' value = 0.053) among the groups.

Age distribution

Group A patients age were ranging from 22 to 41 years and the mean age of the patients involved was $32.95 (\pm 6.02)$. Group B patients' age were ranging from 20 to 42 years and the mean age was $31.60 (\pm 8.14)$. Group C patients' age were ranging from 22 to 53 years and the mean age was $36.10 (\pm 12.2)$, while Group D patients' age were ranging from 22 to 55 years and the mean age was $37.50 (\pm 7.04)$. There was no statistically significant difference ('p' value = 0.555) between mean age of subjects in the Groups.

Baseline comparison of all measurements

Baseline comparison of all parameters between Groups was statistically insignificant ($p > 0.05$).

Fig. 4 – GTR using resorbable collagen membrane.

Fig. 5 – Lateral sliding flap.

Gingival recession depth (RD)

Group A subjects presented with vertical gingival recession with a mean value of 3.941 ± 1.088 , Group B patients were having preoperative mean of 4.40 ± 1.429 , Group C patients were having preoperative mean of 3.4 ± 0.986 , while Group D patients were having preoperative mean of 3.10 ± 0.944 (Table 1). Mean reduction in gingival recession in Group A at 180 days postoperatively was 2.353 ± 1.618 . The observed baselines to postoperative difference in gingival recession depth in Group A at 180 days were statistically highly significant with the 'p' value 0.000. Similarly Group B at 180 days interval presented a mean value of 3.250 ± 1.44 . The results were statistically highly significant ('p' = 0.000). Similar results were observed in Groups C and D (Tables 1 and 2). In the intergroup comparison of gingival recession depth revealed that at baseline and 180 days the results were clinically insignificant ('p' value > 0.05) (Table 3).

Percentage of gingival recession coverage

A comparison between baseline to 180 days has been done between the groups to assess the percentage of gingival recession coverage. At 180 days, Group A showed root coverage of 76.8%, Group B it was 84.5%, Group C it was 72.1% whereas in Group D it was 66.5% which was statistically insignificant ('p' = 0.129). Clinically Group B cases showed better percentage of root coverage.

Probing pocket depth (PD)

While probing the gingival sulcus, a similar probing depth was noticed in all group subjects. Group A subjects were having a preoperative mean value of 2.59 ± 2.265 , Group B patients were 1.45 ± 0.605 , Group C patients were 1.33 ± 0.488 , while Group D patients were having preoperative mean of 1.76 ± 0.539 (Table 1). In Group A subjects, there was reduction in probing depth at 180 days postoperatively with a mean value of 1.412 ± 1.734 . The changes from baseline to 180 days for Group A were statistically significant. Similar significant changes were observed in the other groups (Tables 1 and 2).

Table 1 – Pre and postoperative measurements.

Tech	No of Pt	Baseline	6 months postop	Diff	p value
<i>Recession depth</i>					
Group A	17	3.941 ± 1.088	1.59 ± 1.460	2.353 ± 1.618	0
Group B	20	4.40 ± 1.429	1.15 ± 0.933	3.250 ± 1.44	0
Group C	15	3.4 ± 0.986	1.00 ± 1.195	2.400 ± 0.986	0
Group D	21	3.10 ± 0.944	1.29 ± 1.231	1.810 ± 0.873	0
<i>Probing depth</i>					
Group A	17	2.59 ± 2.265	1.18 ± 0.809	1.412 ± 1.734	0.004
Group B	20	1.45 ± 0.605	1.10 ± 0.308	0.350 ± 0.587	0.015
Group C	15	1.33 ± 0.488	1.07 ± 0.258	0.267 ± 0.458	0.041
Group D	21	1.76 ± 0.539	1.33 ± 0.483	0.429 ± 0.507	0.001
<i>CAL</i>					
Group A	17	6.59 ± 1.906	2.65 ± 1.766	3.941 ± 1.983	0
Group B	20	5.8 ± 1.609	1.85 ± 1.348	3.950 ± 1.638	0
Group C	15	4.73 ± 1.223	2.07 ± 1.163	2.667 ± 1.113	0
Group D	21	5.33 ± 1.518	2.62 ± 1.396	2.714 ± 1.102	0
<i>Width of attached gingiva</i>					
Group A	17	0.58 ± 0.870	2.00 ± 0.612	–1.412 ± 1.121	0
Group B	20	0.60 ± 0.754	2.15 ± 0.489	–1.550 ± 0.759	0
Group C	15	1.20 ± 0.676	2.53 ± 0.516	–1.333 ± 0.724	0
Group D	21	1.86 ± 1.062	2.71 ± 0.717	–0.857 ± 0.727	0

Intergroup comparison showed statistically insignificant change at baseline and postoperatively ('p' value >0.05) (Table 3).

Clinical attachment level (CAL)

At baseline mean clinical attachment level for Group A subjects was 6.59 ± 1.906 , Group B mean CAL was 5.8 ± 1.609 , Group C mean CAL was 4.73 ± 1.223 , while Group D had a mean CAL of 5.33 ± 1.518 (Table 1). In Group A mean CAL at 180 days postoperatively were 2.65 ± 1.766 . The changes observed were highly significant (Tables 1 and 2) with similar results for other groups. In the intergroup comparison regarding clinical attachment level, it is observed that at baseline and 180 days the results were statistically insignificant (Table 3).

Width of attached gingiva (WAG)

At baseline, Group A subjects presented with width of attached gingiva with a mean value of 0.58 ± 0.870 , Group B patients had a preoperative mean of 0.60 ± 0.754 , Group C had a preoperative mean of 1.20 ± 0.676 , while Group D patients had a preoperative mean of 1.86 ± 1.062 (Table 1). In Group A at 180 days postoperatively the mean width of keratinized gingiva was 2.00 ± 0.612 . There has been significant gain in the width of the keratinized gingiva at 180 days (Tables 1 and 2). Again significant changes were observed between preoperative and postoperative measurements in all other groups also. The intergroup comparison showed statistically insignificant change in width of keratinized gingiva at baseline and postoperatively ('p' value >0.05) (Table 3).

When the percentage gain in width of keratinized gingiva was assessed for all the groups it was observed that at 180 days Group A showed coverage of 70.6%, in Group B showed 72.1%, Group C showed 52.7% and Group D it was 31.6% which

was statistically significant ($p < 0.05$). Percentage gain in width of keratinized gingiva was more in Group B subjects.

Discussion

The main goal of periodontal therapy is to improve periodontal health and thereby to maintain a patient's functional dentition throughout life. However, esthetics represents an inseparable part of today's oral therapy, and several procedures have been proposed to preserve or enhance it. Primary causes of gingival recessions are faulty tooth brushing, abnormal frenum attachment, improper restorations, tooth malpositioning and aging. Gingival recessions may cause hypersensitivity, impaired esthetics and root caries. The above factors have favored the development of many surgical procedures that permit the coverage of exposed roots.⁶

The term 'periodontal plastic surgery' (PPS), first suggested by Miller (1988), was defined as 'surgical procedures performed to prevent or correct anatomical, development, traumatic or plaque disease-induced defects of the gingiva, alveolar mucosa, or bone' (The American Academy of Periodontology 1996). One of the most frequent indications of PPS is treatment of buccal gingival recessions. Surgical technique evolved to correct gingival recession using displaced flap was introduced by Norberg as early as in 1926.⁷ He used coronally advanced flap for gingival recession coverage. Later on different types of modalities were introduced to treat gingival recession including displaced flaps, free gingival graft, connective tissue graft, different type of barrier membranes and combination of different techniques.

First attempt to classify gingival recession according to its amenability of being covered using mucogingival surgical procedures was published by Sullivan and Atkins. The basis for their gingival recession classification was the depth and width

Table 2 – Comparison of parameters within the groups.

Parameter	Time of comparison	Mean	Std. Deviation	p value
Group A				
Recession depth	RD-B	3.4	0.985611	0.000
	RD-06	1	1.195229	
Pocket depth	PD-B	1.333333	0.48795	0.020
	PD-06	1.066667	0.258199	
CAL	C-B	4.733333	1.222799	0.000
	C6	2.066667	1.162919	
Width of attached gingiva	WAD-B	1.2	0.676123	0.000
	WAD-06	2.533333	0.516398	
Group B				
Recession depth	RD-B	4.380952	1.395571	0.00
	RD-06	1.095238	0.94365	
Pocket depth	PD-B	1.47619	0.601585	0.003
	PD-06	1.095238	0.300793	
CAL	C-B	5.857143	1.590148	0.000
	C6	1.809524	1.327368	
Width of attached gingiva	WAD-B	0.571429	0.74642	0.000
	WAD-06	2.190476	0.511766	
Group C				
Recession depth	RD-B	3.94	1.12	0.000
	RD-06	1.69	1.44	
Pocket depth	PD-B	2.625	2.334524	0.0028
	PD-06	1.1875	0.834166	
CAL	C-B	6.5625	1.965324	0.0000
	C6	2.75	1.770122	
Width of attached gingiva	WAD-B	0.625	0.885061	0.0001
	WAD-06	1.9375	0.57373	
Group D				
Recession depth	RD-B	3.095238	0.94365	0.000
	RD-06	1.285714	1.230563	
Pocket depth	PD-B	1.761905	0.538958	0.0004
	PD-06	1.333333	0.483046	
CAL	C-B	5.333333	1.527525	0.000
	C6	2.619048	1.395571	
Width of attached gingiva	WAD-B	1.857143	1.062342	0.000
	WAD-06	2.714286	0.717137	

of the defect. The implication was that the deep wide recession showed very limited potential for complete root coverage.⁸ Later, Miller proposed a classification scheme that is currently most commonly used by clinicians. He classified gingival recession according to the height of interproximal papillae adjacent to defect area. He specifically described height of interproximal gingivae as the single most important factor in determining likelihood of a successful root coverage outcome.⁵

The definition of successful “complete” root coverage became relevant after Miller’s initial classification because success of such surgical procedures involved other factors besides survival of grafted gingival tissue over a previously denuded root surface. In order to clarify his definition of complete root coverage, Miller included following additional criteria:

1. The soft tissue margin must be located at cemento-enamel junction.
2. There is clinical attachment to the root.

Table 3 – Paired ‘t’ test.

Table 3 – Paired 't' test.									
Group	Paired differences					t	df	Sig. (2-tailed)	
	Mean	Std. Deviation	Std. error mean	95% confidence interval of the difference					
				Lower	Upper				
A	Pair 1	RD_0 – RD_6	2.353	1.618	0.392	1.521	5.996	16	0.000
	Pair 2	PD_0 – PD_6	1.412	1.734	0.421	0.520	3.357	16	0.004
	Pair 3	CAL_0 – CAL_6	3.941	1.983	0.481	2.921	8.193	16	0.000
	Pair 4	WAG_0 – WAG_6	-1.412	1.121	0.272	-1.988	-5.191	16	0.000
B	Pair 1	CAL_0-CAL_6	3.250	1.446	0.323	2.573	10.049	19	0.000
	Pair 2	PD_0 – PD_6	0.350	0.587	0.131	0.075	2.666	19	0.015
	Pair 3	CAL_0 – CAL_6	3.950	1.638	0.366	3.184	10.787	19	0.000
	Pair 4	WAG_0 – WAG_6	-1.550	0.759	0.170	-1.905	-9.131	19	0.000
C	Pair 1	CAL_0-CAL_6	2.400	0.986	0.254	1.854	9.431	14	0.000
	Pair 2	PD_0 – PD_6	0.267	0.458	0.118	0.013	2.256	14	0.041
	Pair 3	CAL_0 – CAL_6	2.667	1.113	0.287	2.050	9.282	14	0.000
	Pair 4	WAG_0 – WAG_6	-1.333	0.724	0.187	-1.734	-7.135	14	0.000
D	Pair 1	CAL_0-CAL_6	1.810	0.873	0.190	1.412	9.500	20	0.000
	Pair 2	PD_0 – PD_6	0.429	0.507	0.111	0.198	3.873	20	0.001
	Pair 3	CAL_0 – CAL_6	2.714	1.102	0.240	2.213	11.288	20	0.000
	Pair 4	CAL_0-CAL_6	-0.857	0.727	0.159	-1.188	-5.403	20	0.000

3. Sulcus depth is no more than 2 mm.
4. There is no bleeding on probing.⁹

Treatment of gingival recessions with different surgical procedures depends on many factors, such as defect size, presence or absence of keratinized tissue adjacent to defect, and thickness of gingiva, which are related to the defect and/or patient.¹⁰ Keeping in mind patient's desire for improved esthetics and other related problems, every effort should be made to achieve complete root coverage.^{2,11}

Ultimate goal of a root coverage procedure is complete coverage of the recession defect with good appearance of adjacent soft tissues and minimal probing depth. Several surgical procedures such as pedicle flaps, free soft tissue grafts, combinations of pedicle flaps and grafts or barrier membranes may be indicated to improve the condition.¹² Harvey in 1965 introduced the coronally advanced flap (CAF) technique to cover the denuded area.⁷ Restrepo,¹³ Allen et al¹⁴ used a similar procedure for treating gingival recession. This technique does not involve a second surgical site for graft harvesting. The coronally advanced flap is the first choice surgical technique when there is adequate keratinized gingiva apical to the recession defect. Optimum root coverage results, good color blending of the treated area and recuperation of original morphology of the soft tissue margin can be predictably accomplished by this technique. Furthermore, the coronally advanced flap is very effective in treating multiple recession defects affecting adjacent teeth. This approach may be used alone or in combination with soft tissue grafts, barrier membrane, enamel matrix derivative, acellular dermal matrix, platelet-rich plasma and living tissue-engineered human fibroblast derived dermal substitute.¹⁵ This procedure is based on the coronal shift of the soft tissues on the exposed root surface.

Langer et al¹⁶ (1982) described "Subepithelial connective tissue graft" (SCTG) technique to augment edentulous ridge. Langer et al¹⁷ (1985) described the same technique in detail for covering gingival recessions on both single and multiple adjacent teeth. By incorporating the advantages of the pedicle graft such as double blood supply from the overlying flap and periosteal connective tissue bed coupled with the genetic potential of the connective tissue from palate, it was possible to maximize the graft survival which provided excellent esthetics. Although auto grafts have proven predictable when proper technique is used, they have their drawbacks. The donor tissue is usually harvested from hard palate which necessitates an additional surgical procedure. Use of connective tissue grafts in periodontal surgery has increased tremendously over the years. Originally, connective tissue grafts were used as replacements for autogenous masticatory mucosa grafts (free gingival grafts).¹⁸ The connective tissue grafts offered several advantages over free gingival grafts, probably the most important of which is fewer complications in the donor area. A connective tissue graft has also been shown to be effective in restoring deformed edentulous ridges. This can permit placement of more ideal prosthetic restorations. Another possible use of a connective tissue graft is for regenerative procedures. In recent case reports, human histological evaluation of the results revealed regeneration in a recession defect treated with a connective tissue graft.¹⁹ Sanctis et al²⁰ proposed a hypothesis in an attempt to

explain the increase of keratinized tissue after connective tissue graft and coronal advancement of flap based on Ainamo and Karring theory. As described by Ainamo, the mucogingival line always regains its original, "genetically determined" position.²¹ A possible benefit following root coverage procedures may be augmentation of keratinized tissue.

Although many comparisons have been made using different surgical approaches, of both CAF and the SCTG techniques for root coverage,²² literature lacks studies that directly compare these and other techniques. Comprehensive reviews between techniques clearly indicated that there were no significant differences in efficacy and reported results show a high variability. Reasons for this variability could depend on factors including selection of defects, magnitude of defects, location of recession, mean initial depth and operator skill.¹²

Results of this study showed statistically significant reduction of gingival recession, with concomitant attachment gain, following treatment with all tested surgical techniques. However, SCTG with CAF technique showed the highest percentage gain in coverage of recession depth as well as gain in keratinized gingiva. Similar results were obtained with CAF alone. The use of GTR and other techniques showed less predictable coverage and gain in keratinized gingiva as discussed.

Conclusion

On the basis of this study following conclusions were made:

1. All surgical techniques produced statistically significant improvements in gingival recession, clinical attachment level and width of attached gingiva.
2. Connective tissue grafts were statistically significantly superior to guided tissue regeneration for improvement in gingival recession reduction.
3. The use of barrier membranes did not statistically significantly enhance root coverage compared with coronally advanced flaps.

Only limited data exist for free gingival grafts and laterally positioned flaps. Predictability appears low for both methods. Data do not support the use of root modification agents to improve root coverage.

However, more research is needed to identify important factors associated with successful outcomes in relation to cost-benefit, patient, site, surgical technique and operator variability.

Conflicts of interest

All authors have none to declare.

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