Prediction of Gingival Recession after Flap Surgery in Patients with Chronic and Aggressive Periodontitis with Horizontal or Vertical Bone Loss

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ABSTRACT

BACKGROUND

The sites with deeper periodontal pockets showed greater postoperative gingival recession. The purpose of this study was to correlate the gingival recession following the periodontal flap surgery with the amount of bone loss at the treated site and to propose a prediction chart of post-operative gingival recession based on certain clinical parameters.

METHODS

A total of 120 sites in patients with chronic and aggressive periodontitis were treated with flap surgery. Clinical parameters such as probing pocket depth (PPD), recession depth (RD) and clinical attachment level (CAL) were recorded at baseline, 1 month, 3 months and 6 months post-surgery. The extent of bone loss in the surgical site was measured in digital radiographs (RVG) at baseline. The prediction chart for post-operative recession depth was proposed based on the amount of bone loss in surgical site and the clinical parameters.

RESULTS

The difference in mean PPD, CAL and gingival recession depth from baseline to 1 month, 3 month and 6 months was statistically significant. Out of 120 sites, 38 sites with the bone loss of 3-5 mm showed increase in gingival recession from baseline ($0.89 \text{ mm} \pm 0.924 \text{ mm}$) to 6 months ($1.47 \text{ mm} \pm 0.979$) post-surgery. The difference was statistically significant ($p < 0.05$). The mean gingival recession was increased from baseline ($1.46 \text{ mm} \pm 1.58 \text{ mm}$) to 1 month ($2.80 \text{ mm} \pm 1.54 \text{ mm}$), 3 months ($2.93 \text{ mm} \pm 1.465 \text{ mm}$) and 6 months ($2.98 \text{ mm} \pm 1.49 \text{ mm}$) after surgery in 54 sites with the bone loss of 5-10 mm. The difference was statistically significant ($p < 0.001$).

CONCLUSIONS

In our study, it was concluded that gingival recession following flap surgery correlates with the bone loss at the surgical site and sites with greater bone loss showed increased postoperative recession.

KEY WORDS

Chronic Periodontitis, Aggressive Periodontitis, Flap Surgery, Gingival Recession, Bone Loss, Prediction.

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BACKGROUND

Gingival recession (GR) is the term that describes the exposure of the root surface of teeth due to the migration of gingival margin apical to the cementoenamel junction (CEJ), which can be either localized or generalized.^{1,2} Recession is a prevalent and unwanted condition of the gingiva and is often accompanied with clinical problems such as plaque retention, root surface hypersensitivity, root caries, cervical root abrasions, erosions, and aesthetic dis-satisfaction.^{3,4}

The aetiology of gingival recession consists of various factors such as, improper tooth brushing, tooth malposition, smoking, destructive periodontal disease, alveolar bone dehiscence, occlusal trauma, high muscle attachment, aberrant frenal pull and iatrogenic factors such as prosthetic, orthodontic, restorative and periodontal therapy.⁵

Previous studies found that recession occurred following both nonsurgical and surgical periodontal therapy, which led to various sensitivity and aesthetic problems.^{6,7} Surgical debridement is a standard procedure to treat deep periodontal pockets in chronic and aggressive periodontitis patients with vertical or horizontal bone loss. Post-operatively, surgical debridement and flap repositioning might result in notable gingival recession.⁸ This post-operative recession was found to correspond with initial

probing depth, i.e., it was considerably higher in sites with deeper periodontal pockets.⁹ Several explanations have been suggested for the postoperative recession including the thin gingival tissue with limited blood supply, lack of bone support for the flap, and postoperative shrinkage of the flap.^{9,10}

According to our knowledge there are no studies in the literature to correlate the postoperative gingival recession with the amount of bone loss in the surgical site.

Based on the aforementioned findings the purpose of the present study was to correlate the gingival recession following the periodontal flap surgery with the amount of bone loss at the treated site and to propose a prediction chart of post-operative gingival recession based on certain clinical parameters.

METHODS

A longitudinal study wherein a total of 120 sites in 80 patients with chronic and aggressive periodontitis were randomly selected from the Outpatient Department of Periodontology, Rajarajeswari Dental College and Hospital, Bangalore.

The sample size was estimated using the GPower software v. 3.1.9.4 [Franz Faul, Universität Kiel, Germany]. The research protocol was approved by institutional ethical committee and was registered under Clinical Trials Registry-India (CTRI/2018/08/015327-Reg no). This was a clinical study carried out for a period of 6 months (from May 2019 to November 2019). The purpose and procedure of the study was described to patients and an informed consent was obtained.

The chronic and aggressive periodontitis patients with PPD > 6mm, CAL > 3mm and gingival recession depth of < 1mm with the radiographic horizontal or vertical bone loss, patients in the age group of 25-60years were included in the study.

The patients who had undertaken periodontal treatment in the past six months and those with history of known systemic diseases, smokers, pregnant and lactating women were excluded from the study.

Clinical parameters such as probing pocket depth, recession depth and clinical attachment level were recorded using graduated Williams periodontal probe at baseline, 1month, 3 months and 6 months post-surgery. The extent of bone loss in the surgical site was measured from a fixed reference point (i.e., cemento-enamel junction) to the alveolar crest in digital radiographs (RVG) at baseline. The measurements were made in millimetres with the help of a ruler in the Kodak dental imaging software version 6.12.10.0. The prediction chart for post-operative recession depth was proposed based on the amount of bone loss in the site of surgery and the clinical parameters such as PPD and CAL.

All the clinical parameters were assessed by the single examiner. The periodontal flap surgeries were carried out by the postgraduates under the guidance of an experienced periodontal faculty in the Department of Periodontology, Rajarajeswari Dental College and Hospital. The features of the surgery comprised of the flap being elevated with crevicular incision; no osseous surgery was done. The flap was positioned back without any displacement. All patients received oral hygiene instructions following the procedure.

Statistical Analysis

The data collected was submitted in Microsoft Excel and statistical analyses were performed using the Statistical Package for Social Science (SPSS version 18.5) software. The comparison between the groups was carried out using non parametric test such as Mann Whitney U test, Kruskal Wallis test and one-way analysis of variance (ANOVA). For all the statistical tests, $p < 0.05$ was considered statistically significant.

RESULTS

Probing Pocket Depth

The mean probing depth at baseline, 1 month, 3 months and 6 months post-surgery was 8.38 ± 2.257 mm, 3.06 ± 0.853 mm, 2.70 ± 0.656 mm, 2.61 ± 0.523 mm, respectively. The reduction in probing depth was continued from baseline to 6 months after the surgery. The difference in mean probing

pocket depth from baseline to 1 month, 3 months and 6 months was statistically significant as shown in Table 1

Clinical Attachment Level

There was an increase in the clinical attachment level after surgical therapy. At baseline the mean clinical attachment was 9.56 ± 2.834 mm, while at 1 month, 3 months and 6 months post-surgery was 5.17 ± 1.939 mm, 4.88 ± 1.735 mm, 4.81 ± 1.682 mm, respectively. The difference in mean clinical attachment level from baseline to 1 month, 3 months and 6 months post-surgery was statistically significant (Table 1)

Gingival Recession Depth (Measured from CEJ to Gingival Margin)

The mean gingival recession depth at baseline was 1.16 ± 1.264 mm. 1month, 3 months and 6 months post-surgery the recession depth was increased to 2.11 ± 1.483 mm, 2.18 ± 1.472 mm, 2.20 ± 1.493 mm, respectively. The difference in mean gingival recession depth from baseline to 1 month, 3 months, 6 months was statistically significant as shown in Table 1.

The Amount of Bone Loss at Surgical Site (Measured from CEJ to Crest of the Alveolar Bone)

At baseline the mean amount of bone loss in 120 surgical sites was 6.173 ± 2.5029 mm. Among 120 surgical sites, 17 sites (14.2%) had < 3 mm of bone loss, 38 sites (31.7%) had 3-5 mm of bone loss, 54 sites (45%) had 5-10 mm of bone loss, 11 sites (9.2%) had > 10 mm of bone loss. (Table 2).

Correlation of Gingival Recession Depth with the Amount of Bone Loss at the Surgical Site

17 sites with < 3 mm of bone loss showed no difference in the mean gingival recession from baseline (0.71 ± 0.470 mm) to 1 month, 3 months, 6 months after the flap surgery. The mean gingival recession was increased from baseline (0.89 mm $\pm$ 0.924 mm) to 6 months (1.47 mm $\pm$ 0.979) post-surgery in 38 sites with the bone loss of 3-5 mm. The difference was statistically significant ($p < 0.05$). 54 sites with the bone loss of 5-10 mm had increase in mean gingival recession from baseline (1.46 mm $\pm$ 1.58 mm) to 1 month (2.80 mm $\pm$ 1.54 m), 3 months (2.93 mm $\pm$ 1.465 mm) and 6 months (2.98 mm $\pm$ 1.49 mm) after the surgery. The difference was statistically significant ($p < 0.001$).

There was increase in the mean gingival recession from baseline (1.27 ± 1.009), to 1 month (3.09 mm $\pm$ 1.044 mm), 3 months (3.27 mm $\pm$ 0.786 mm), 6 months (3.18 mm $\pm$ 0.751 mm) at 11 sites with > 10 mm of bone loss ($p < 0.001$). (Table 3).

The pair wise comparison between the visits showed statistically significant increase in recession depth from baseline to 1 month, 3 months and 6 months post-surgery in sites with >3 mm of bone loss. (Table 4).

Prediction Chart for the Post-operative Gingival Recession

Table 5 shows the predicted depth of postsurgical recession for various PPD, CAL and radiographic bone loss at the surgical site.

	Visit	N	Mean	SD	Median	Min.	Max.	Q1	Q2	Q3	Chi-square*	P value
CEJ-Gingival margin	Baseline	120	1.16	1.264	1.00	0	4	0.00	1.00	2.00	44.954	<0.001
	Month 1	120	2.11	1.483	2.00	0	6	1.00	2.00	3.00		
	Month 3	120	2.18	1.472	2.00	0	6	1.00	2.00	3.00		
	Month 6	120	2.20	1.493	2.00	0	6	1.00	2.00	3.00		
Probing depth	Baseline	120	8.38	2.257	8.00	5	13	6.00	8.00	10.00	301.481	<0.001
	Month 1	120	3.06	0.853	3.00	2	5	2.00	3.00	4.00		
	Month 3	120	2.70	0.656	3.00	2	4	2.00	3.00	3.00		
	Month 6	120	2.61	0.523	3.00	2	4	2.00	3.00	3.00		
CAL	Baseline	120	9.56	2.834	9.50	6	16	6.00	8.00	10.00	200.059	<0.001
	Month 1	120	5.17	1.939	5.00	2	10	2.00	3.00	4.00		
	Month 3	120	4.88	1.735	5.00	2	9	2.00	3.00	3.00		
	Month 6	120	4.81	1.682	5.00	2	9	2.00	3.00	3.00		

Table 1. Clinical Parameters Recorded at Different Time Points

CEJ: Cemento-enamel junction, CAL: Clinical attachment level, N: Number, SD: Standard deviation

Visit	Bone loss	Frequency	Percent
Baseline	<3 mm	17	14.2
	3-5 mm	38	31.7
	5-10 mm	54	45.0
	>10 mm	11	9.2
	Total	120	100.0

Table 2. The Amount of Bone Loss at Surgical Site (Measured from CEJ to crest of the alveolar bone)

Bone Loss	Visit	N	Mean	SD	Min.	Max.	Q1	Q2	Q3	Chi-square*	P value
<3	Baseline	17	0.71	0.470	0	1	0.00	1.00	1.00	0.000	1.000
	Month 1	17	0.71	0.470	0	1	0.00	1.00	1.00		
	Month 3	17	0.71	0.470	0	1	0.00	1.00	1.00		
	Month 6	17	0.71	0.470	0	1	0.00	1.00	1.00		
3-5	Baseline	38	0.89	0.924	0	2	0.00	1.00	2.00	8.804	0.032
	Month 1	38	1.47	0.979	0	3	0.00	1.00	2.00		
	Month 3	38	1.47	0.979	0	3	0.00	1.00	2.00		
	Month 6	38	1.47	0.979	0	3	0.00	1.00	2.00		
5-10	Baseline	54	1.46	1.587	0	4	0.00	1.00	3.00	28.449	<0.001
	Month 1	54	2.80	1.547	0	6	0.00	2.50	4.00		
	Month 3	54	2.93	1.465	1	6	0.00	2.50	4.00		
	Month 6	54	2.98	1.498	1	6	0.00	2.50	4.00		
>10	Baseline	11	1.27	1.009	0	2	0.00	2.00	2.00	19.148	<0.001
	Month 1	11	1.27	1.009	0	2	0.00	2.00	2.00		

Table 3. Correlation of Gingival Recession Depth with the Amount of Bone Loss at the Surgical Site

N: Number, SD: Standard deviation

Bone Loss	Baseline vs Month 1	Baseline vs Month 3	Baseline vs Month 6	Month 1 vs Month 3	Month 1 vs Month 6	Month 3 vs Month 6
<3 mm	1.000	1.000	1.000	1.000	1.000	1.000
3-5 mm	0.016	0.016	0.016	1.000	1.000	1.000
5-10 mm	<0.001	<0.001	<0.001	0.733	0.612	0.877
>10 mm	0.001	0.001	0.001	0.660	0.748	0.797

Table 4. Pairwise Comparison of Gingival Recession at Different Time Points

Bone Loss	PPD	CAL	Recession
<3 mm	6 mm	6-7 mm	< 1 mm
3-5 mm	6-8 mm	6-10 mm	1 – 2 mm
5-10 mm	8-10 mm	10- 12 mm	2 – 3 mm
> 10 mm	>12 mm	12-14 mm	>3 mm

Table 5. Prediction Chart for the Post-operative Gingival Recession

PPD: Probing pocket depth, CAL: Clinical attachment level

DISCUSSION

Many studies have come to the conclusion that periodontal surgical procedures resulted in postoperative recession.^{9,11,12} Isidor et al. in a study compared the clinical results of root planning, reverse bevelled flap without osseous surgery and modified Widman flap. It showed that surgical procedures resulted in statistically significant reduction in clinical attachment level gain and probing depth at 3- and 6-months examination. In spite of that, the surgical procedures resulted in a significant recession compared to baseline. (2.2 mm for modified Widman flap and 1.8 mm for root planning).¹¹

In a recent study, Becker et al. estimated the clinical outcomes of scaling, osseous surgery and modified Widman procedures, found an improvement in clinical attachment level and a significant reduction in probing depth, but with a significant post-surgical gingival recession after 5 years (mean of 1.28 mm, 2.18 mm, 1.70 mm).⁹ Kaldahl et al. also reported that statistically significant recession occurs for several surgical techniques such as flap debridement, osseous surgery and root planning (mean of 1.2 mm, 1.5 mm and 0.8mm, respectively).¹²

The clinical outcome of present study coincided with the results of preceding studies that flap surgery induced considerable improvement in probing depth and clinical attachment level, but significant gingival recession at 1 month, 3 month and 6 months after examination.

The postoperative recession was found to correspond with initial probing depth; i.e., it was more pronounced at sites with deeper periodontal pockets. Various explanations have been suggested for postoperative recession including thin gingival tissue with limited blood supply, lack of bone support for the flap and postoperative shrinkage of the flap.^{9,10}

According to our knowledge this is a novel study conducted to correlate the postoperative recession with the amount of bone loss at the surgical site. The changes in the recession of gingival margin were recorded from baseline to six months after therapy as studies have shown that the major changes resulting from active therapy occur within the first six months following therapy i.e., the healing phase.¹³ In another study, following flap surgery, the apical shift of gingival margin position was appreciated in 29% of sites from baseline to six months post treatment. The apical shift was highly significant ($P < 0.001$).¹⁴

Gingival recession was also found to correlate with age and bone loss. A statistically significant difference was found in the correlation between bone loss and gingival recession when comparing dehiscence/fenestration sites and non-dehiscence / fenestration sites. Lost studied a correlation between gingival recession and alveolar bone loss.¹⁵ Periodontal flap surgeries of 50 recessions areas which included 113 affected teeth were done on 27 patients with an average age of 25.6 years. They assessed dehiscence defects and gingival recession of 113 teeth in vivo and found the average bone dehiscence depth to be 5.4 mm and average soft tissue recession depth of 2.7 mm.¹⁶ In contrast, results of the present study showed that sites with the bone loss of 5-10 mm had mean gingival recession of 1.46 mm at baseline which was increased to 2.93 mm at 6 months after the flap surgery. The result from this study, that is, increased bone

loss corresponds with increased recession is in agreement with Lost's study, which found gingival recession to correlate, on average, to underlying buccal bone loss. But literature lacks studies that could help to compare the results of the present study.

This study indicates that the amount of bone loss at the surgical site can be a strong predictor for the postoperative recession depth following flap surgery. It is important for a clinician to predict the post-operative recession that can occur for the particular amount of bone loss at the surgical site following periodontal therapy. This knowledge helps the clinician to convey the realistic expectations about surgical outcome to the patients in day-to-day practice.

CONCLUSIONS

Clinical inference of this study includes the validations that gingival recession following flap surgery correlates with the bone loss at the surgical site and sites with greater bone loss showed increased postoperative recession.

Data sharing statement provided by the authors is available with the full text of this article at jemds.com.

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