Gingival Changes Following Scaling, Root Planing and Oral Hygiene

A Biometric Evaluation*

by

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THE POSITIONAL CHANGES that may occur in the gingiva following scaling, root planing, and oral hygiene (such as recession, reattachment, and variations in gingival width, pocket depth, and location of the mucogingival junction) have not been studied systematically. However, it is generally assumed that some gingival recession and/or some change in crevice or pocket depth may occur after scaling and root planing and that there is no change in the position of the mucogingival junction.

The location of the free gingival margin, the crevice depth, and the position of the mucogingival junction can be determined accurately with the cementoenamel junction as a fixed reference point.[1-5] Thus, it is possible to evaluate clinically any biometric changes in the relationships between these structures before and after scaling, root planing and oral hygiene.

Recent reports indicate a tendency for the width of the attached gingiva to increase with age.[6, 7] Teeth in labial version and teeth with adjacent muscle attachment and/or frenum involvement of the attached gingiva, generally have a narrow zone of attached gingiva.[8] With orthodontic hypereruption of teeth, the width of the attached gingiva may be increased with no change in the position of the mucogingival junction.[9, 10] Various mucogingival surgical procedures,[11-21] may also increase the width of the attached gingiva, changing the position of the mucogingival junction. The effects of other periodontal procedures on the width of attached gingiva and mucogingival junction are not known.

The purpose of the present study was to assess certain clinical changes that will occur in the gingiva after scaling, root planing, and oral hygiene in areas of advanced or severe gingival inflammation. The parameters studied were location of the mucogingival junction, crevice depth, attachment level, height of the gingival margin, and width of the keratinized gingiva.

MATERIALS AND METHODS

Fifteen patients at the University of Michigan School of Dentistry (6 females and 9 males) ranging in age from 23 to 77 years (mean 44 ± 14.2) participated in the study. The experimental sample consisted of 61 teeth with labial or buccal inflammation extending well into the attached gingiva, preferably to or beyond the mucogingival junction. Clinical measurements and scores were taken on these teeth during the three experimental sessions using the following indices and measurements.

A. Inflammation Index

The extent or degree of inflammation on the facial aspect of the tooth was clinically classified as:

GV I: Inflammation extending well into the attached gingiva but not to the mucogingival junction.

GV II: Inflammation extending to the mucogingival junction.

GV III: Inflammation extending beyond the mucogingival junction into the alveolar mucosa.

B. Dental Plaque Score

The amount of dental plaque on the facial surface of the tooth was evaluated using the Kobayashi-Ash Plaque Score[22] based on the following criteria for classification:

Pl 0: Absence of dental plaque

Pl 1: Dental plaque on one of the interproximal surfaces or on the middle of the facial gingival margin aspect of the tooth and not covering more than one-third of the gingival one-half of the facial surface.

Pl 2: Dental plaque on two interproximal surfaces, or any two gingival margin surfaces but not covering more than one-third of the gingival one-half of the facial surface of the crown of the tooth.

Pl 3: Dental plaque extending from the mesial to distal and not covering more than one-third of the gingival one-half of the facial surface of the crown of a tooth.

Pl 4: Dental plaque covering one-third to one-half of the gingival one-half of the facial surface of the crown of the tooth.

Pl 5: Dental plaque covering two-thirds or more of the gingival one-half of the facial surface of the crown of the tooth.

Subjects were grouped as to whether there was (a) total plaque improvement (achieving a plaque score of 0 or 1); or (b) partial plaque improvement (plaque score of 2 or greater)

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C. Clinical Measurements

All clincal measurements were taken with a Marquis S-4 periodontal probe, calibrated in 3-mm segments which are color coded. Measurements were read at two locations on the facial aspect of the tooth: (1) at the midline of the tooth (for the molars, at the midline of the mesial root); and (2) at the mesial interproximal line angle.

The measurements recorded were (1) the distance from the cementoenamel junction to the gingival margin; (2) the crevice or pocket depth; and (3) the width of keratinized gingiva (including the free and attached gingiva) from the gingival margin to the mucogingival junction (Fig. 1).

To help locate the mucogingival junction when it was not readily apparent, Schiller's IKI solution[23, 24] was used.

D. Presence of Bone

After the gingiva at the facial aspect of the tooth had been infiltrated with local anesthetic, the presence of alveolar bone underlying the mucogingival junction was determined by penetrating the gingiva at this level with a sharp No. 3 explorer. If bone was felt, a "Yes" designation was recorded; if penetration extended to the root surface, a "No" response was noted. This determination was performed only at the initial experimental procedure.

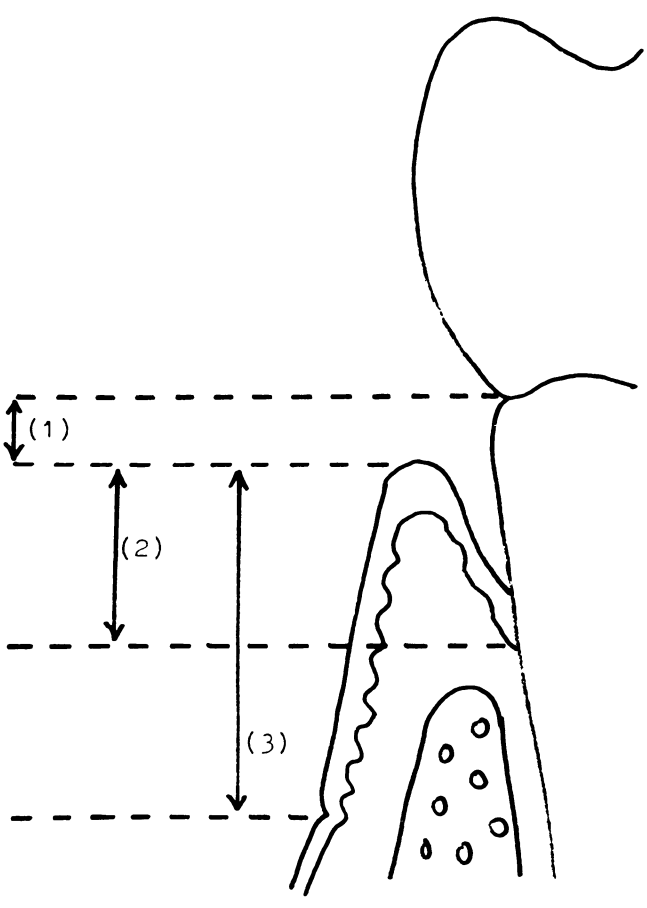


FIGURE 1. *A diagram illustrating the clinical measurements. See text for explanation.*

Experimental Procedures

The research project was composed of three experimental sessions. (1) At the initial appointment prior to scaling and root planing of the teeth, all clinical measurements and scores were obtained and the subject received instruction in toothbrushing and dental flossing. The selected teeth then were scaled, root planed and polished to remove all supragingival and subgingival plaque, calculus and root surface roughness. (2) One week after scaling and root planing the clinical measurements and scores were repeated. (3) After 1 month they were recorded again.

Statistical Analysis

All data obtained were analyzed statistically to determine the significance of the results. Each of the five parameters (location of the mucogingival junction, crevice depth, attachment level, height of the gingival margin, and width of the keratinized gingiva) was tested statistically against the following variables: anterior vs. posterior teeth, presence or absence of bone underlying the mucogingival junction, initial pocket depth within the attached gingiva or extending to or beyond the mucogingival junction, total or partial plaque improvement, and classification of the initial inflammation.

The parameters were tested against the variables separately for both the midline of the tooth and the mesial interproximal area.

The statistical tests used were the Fisher's Exact Test and the Chi-Square Test for association in $r \times c$ contingency tables at the 5% level of significance.

Clinical Calibration

Since all clinical scoring was performed by one examiner (T.P.H.), only the intraexaminer variation had to be determined. In order to assess the investigator's reproducibility, two randomly selected teeth on each of five human subjects with various degrees of periodontal disease were scored three times each, not consecutively, for inflammation, plaque and clinical measurements. Mean values for the inflammation score, the plaque score and the clinical measurements were computed and an analysis of variance between the three episodes of examination was performed. The results showed a very low scorer error and a high degree of reproducibility, at the 5% level of significance.

RESULTS

Changes in the *location of the mucogingival junction* 1 month after scaling are represented on Table 1. No changes were significant at the 5% level of confidence.

Table 2 shows changes in *crevice depth* 1 month after scaling. A decrease in the cervice depth of 1 to 2 mm

TABLE 1. *Changes in the Location of the Mucogingival Junction 1 Month after Scaling*

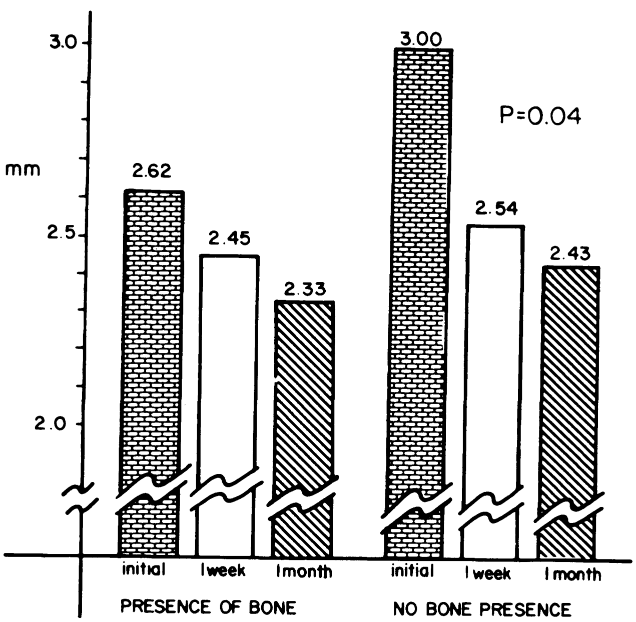
	No change	1 mm Coronally	1 mm Apically
Midline	58 (95%)	2 (3.3%)	1 (1.7%)
Mesial	59 (96.7%)	2 (3.3%)	0
Total	117 (95.9%)	4 (3.3%)	1 (0.8%)

TABLE 2. *Changes in the Crevice Depth 1 Month after Scaling*

	No change	1 mm Decrease	2 mm Decrease
Midline	36 (59%)	23 (37.7%)	2 (3.3%)
Mesial	30 (49.2%)	28 (45.9%)	3 (4.9%)
Total	66 (54.1%)	51 (41.8%)	5 (4.1%)

TABLE 3. *Changes in the Midline Crevice Depth in Relation to the Presence of Bone Underlying the Mucogingival Junction*

	No change	1–2 mm Decrease
Bone present	18 (75%)	6 (25%)
No bone present	18 (48.6%)	19 (51.4%)
Total	36	25



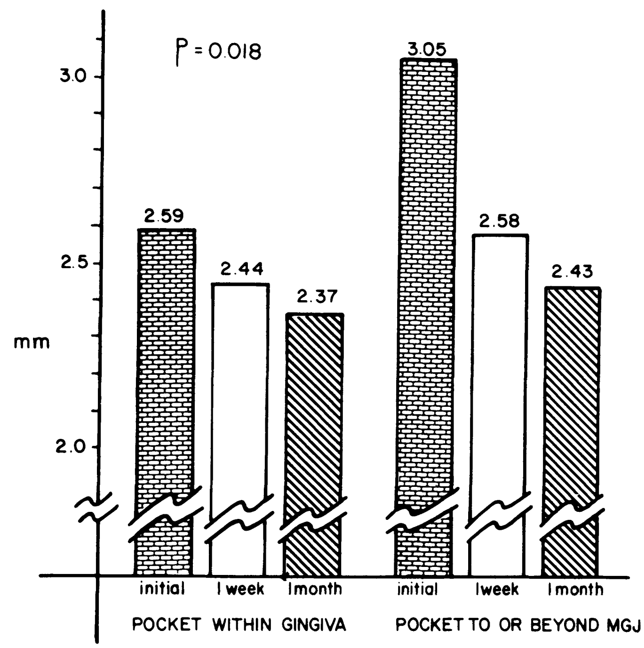
GRAPH 1. *Mean changes of the midline crevice depth in relation to the presence of bone underlying the MGJ.*

occurred in almost one-half of the cases. Two of the variables tested showed statistically significant results. Table 3 and Graft 1 show the changes in the midline crevice depth in relation to the presence or absence of bone underlying the mucogingival junction. Where no bone was present underlying the mucogingival junction, there was a greater tendency for a decrease in the midline crevice depth. Table 4 and Graph 2 compare the changes in midline crevice depth in relation to the location of the bottom of the initial pocket. When the bottom of the initial midline pocket extended to or beyond the mucogingival junction, there was a greater tendency for a decrease in the crevice depth.

Changes in the *attachment level* 1 month after scaling are indicated in Table 5. In approximately one-fifth of the cases, 1 mm of new attachment was gained. The only variable tested in relation to the attachment level to show statistical significance ($P < 0.05$) was initial mesial pocket depth (Table 6 and Graph 3). When the bottom of the interproximal pocket extended to or beyond the mucogingival junction, there was a greater tendency for gain of clinical attachment.

TABLE 4. *Changes in the Midline Crevice Depth in Relation to the Location of the Bottom of the Initial Pocket*

	No change	1–2 mm Decrease
Bottom of pocket within attached gingiva	20 (74.1%)	7 (25.9%)
Bottom of pocket extending to or beyond the mucogingival junction	15 (44.1%)	19 (55.9%)
Total	35	26



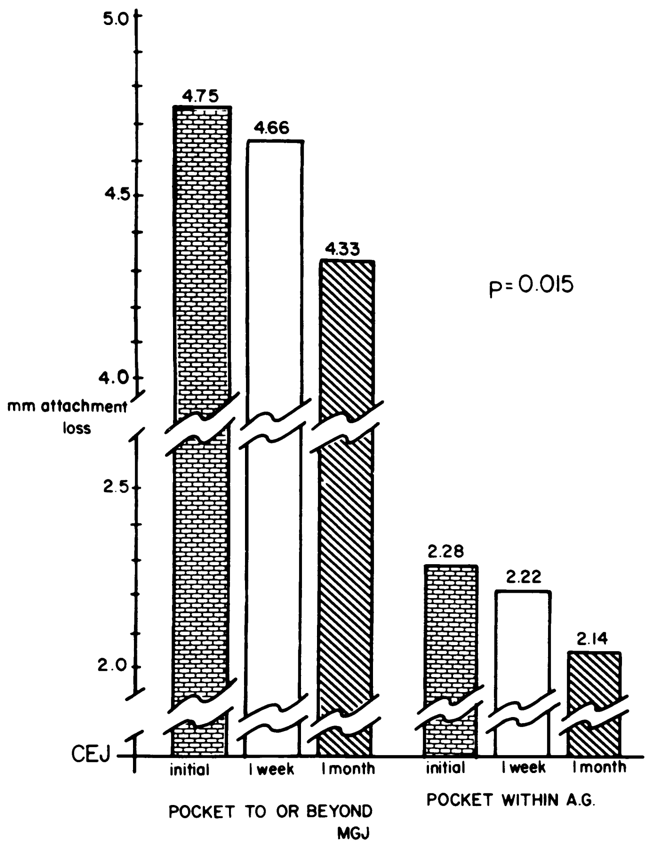
GRAPH 2. *Mean changes of the midline crevice depth in relation to location of the bottom of initial pocket.*

TABLE 5. *Changes in the Attachment Level 1 Month after Scaling*

	No change	1 mm Gain	1 mm Loss
Midline	48 (78.6%)	12 (19.7%)	1 (1.7%)
Mesial	47 (77%)	13 (21.3%)	1 (1.7%)
Total	95 (77.9%)	25 (20.5%)	2 (1.7%)

TABLE 6. *Changes in the Mesial Attachment Level in Relation to the Location of the Bottom of the Initial Mesial Pocket*

	No change	1 mm Gain	1 mm Loss
Bottom of pocket within attached gingiva	41 (83.6%)	7 (14.3%)	1 (0.1%)
Bottom of pocket extending to or beyond the mucogingival junction	6 (50%)	6 (50%)	0
Total	47	13	1



GRAPH 3. *Mean changes of the mesial attachment level from the CEJ in relation to the location of the bottom of the initial mesial pocket.*

Table 7 shows changes in the *height of the gingival margin* 1 month after scaling. One millimeter of gingival recession occurred in about one-fourth of all cases. Table 8 and Graph 4 represent the changes of the location of the mesial gingival margin in relation to the severity of the initial inflammation, which is the only variable showing statistical significance ($P < 0.05$). With increasing severity of the initial inflammation, there was a greater tendency for recession of the mesial gingival margin after scaling.

Changes in width of the keratinized gingiva 1 month after scaling are depicted in Table 9. In approximately one-fifth of all cases, the width of the keratinized tissue decreased by 1 mm. Table 10 and Graph 5 represent the changes in the mesial width of the keratinized gingival tissue in relation to the severity of the initial inflammation, which is the only variable that showed statistical significance ($P < 0.05$). When the initial inflammation extended to or beyond the mucogingival junction (Class II or III), there was a greater tendency for a decrease in the width of the interproximal keratinized gingiva after scaling.

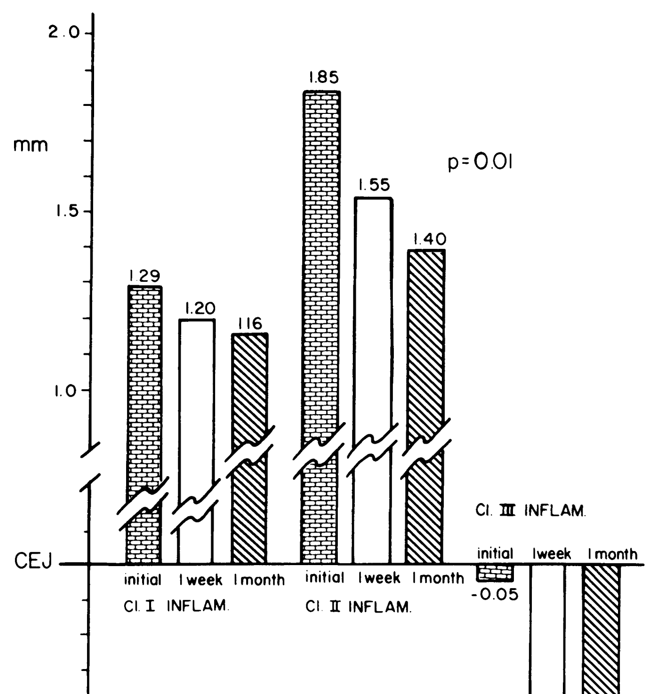
Tables 11a and b show the *effects of plaque improvement* upon tissue response. Of the 61 units evaluated in the study, 50 showed total plaque improvement,

TABLE 7. *Changes in the Location of the Gingival Margin 1 Month after Scaling*

	No change	1 mm Recession
Midline	49 (80.3%)	12 (19.7%)
Mesial	43 (70.5%)	18 (29.5%)
Total	92 (75.4%)	30 (25.6%)

TABLE 8. *Changes in the Location of the Mesial Gingival Margin in Relation to the Severity of the Initial Inflammation*

	No change	1 mm Recession
Class I inflammation	22 (91.7%)	2 (8.3%)
Class II inflammation	11 (55%)	9 (45%)
Class III inflammation	10 (58.8%)	7 (41.2%)
Total	43	18



GRAPH 4. *Mean changes in the height of mesial gingival margin in relation to the severity of the initial inflammation.*

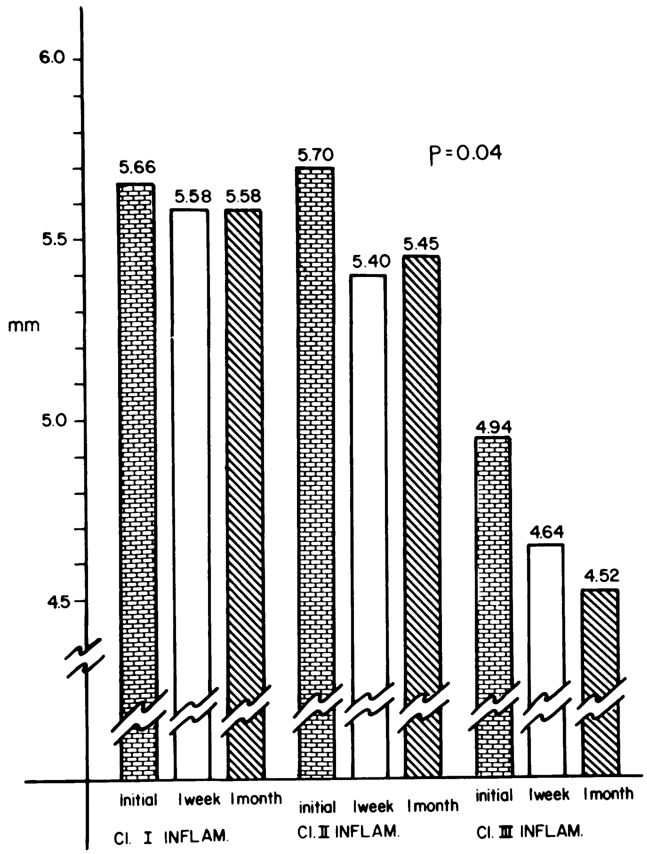
whereas 11 showed partial plaque improvement. When these two groups were tested against the five parameters evaluated, no stastically significant differences were found in any of them ($P > 0.05$). This means that the degree of plaque improvement did not significantly influence any of the changes found in the location of the mucogingival junction, crevice depth, attachment level, height of the gingival margin or width of the keratinized gingiva.

TABLE 9. *Changes in the Width of the Keratinized Tissue 1 Month after Scaling*

	No change	1 mm Decrease	1 mm Increase
Midline	50 (82%)	11 (18%)	0
Mesial	45 (73.7%)	15 (24.6%)	1 (1.7%)
Total	95 (77.9%)	26 (21.3%)	1 (0.8%)

TABLE 10. *Changes in the Width of the Mesial Keratinized Tissue in Relation to the Severity of the Initial Inflammation*

	No change	1 mm Decrease	1 mm Increase
Class I inflammation	22 (91.7%)	2 (8.3%)	0
Class II inflammation	13 (65%)	6 (30%)	1 (5%)
Class III inflammation	10 (58.8%)	7 (41.2%)	0
Total	45	15	1



GRAPH 5. *Mean changes in mesial width of keratinized tissue in relation to severity of initial inflammation.*

TABLE 11a

Effect of Oral Hygiene Upon the Different Parameters Considered

	Midline Muco-Gingival Junction		Mesial Muco-Gingival Junction		Midline Sulcus Depth		Mesial Sulcus Depth		Midline Attachment Level	
	No Change	Increased	No Change	Increased	No Change	Reduced	No Change	Reduced	No Change	Gained
Total Plaque Improvement	47	2	48	2	29	21	23	27	38	11
Partial Plaque Improvement	11	0	11	0	7	4	6	5	10	1
P	N.S. (0.6644)*		N.S. (0.6693)*		N.S. (0.5032)*		N.S. (0.4274)*		N.S. (0.2040)*	

* Fisher's exact test

TABLE 11b

Effect of Oral Hygiene Upon the Different Parameters Considered

	Mesial Attachment Level		Midline Gingival Margin		Mesial Gingival Margin		Midline Width of Keratinized Tissue		Mesial Width of Keratinized Tissue	
	No Change	Gained	No Change	Recession	No Change	Recession	No Change	Reduced	No Change	Reduced
Total Plaque Improvement	39	10	40	10	35	15	39	10	40	10
Partial Plaque Improvement	8	3	9	2	7	4	7	4	9	2
P	N.S. (0.4426)*		N.S. (0.6298)*		N.S. (0.4669)*		N.S. (0.2248)*		N.S. (0.6298)*	

* Fisher's exact test

Discussion

The results of this study are in agreement with the findings of others[6–10] that the mucogingival junction maintains a relatively constant position. After routine scaling and root planing of teeth, there was no significant change in location of the mucogingival junction for either the midline or the interproximal areas evaluated. This finding agrees with the observations of Smith[25, 26] and Karring[27, 28] that the particular type of underlying connective tissue genetically determines the specificity of the overlying mucosa. In routine scaling and root planing, the subepithelial connective tissue is left intact and no change in the location of the mucogingival junction should be anticipated.

One month after scaling and root planing there was a 1 to 2 mm decrease in crevice depth in 41% of the midline areas and 51% of the interproximal sites. This can be accounted for by the gingival recession and/or the gain in clinical attachment or tight adaptation that occurred after scaling and resolution of the gingival inflammation. The decrease in crevice depth occurred regardless of the severity of the initial inflammation, whether it was an anterior or posterior tooth, or whether there was total or partial plaque improvement in that particular area. The presence or absence of bone underlying the mucogingival junction and the location of the bottom of the initial pocket did not appear to influence the mesial interproximal crevice depth. However, there was a greater tendency for the midline crevice depth to decrease when no bone was present under the mucogingival junction. This possibly may be explained by a greater tendency for gingival recession and/or reattachment or readaptation of the soft tissues to the tooth with no bone underlying the gingiva and the mucogingival junction. Coronal support of the gingiva is dependent on connective tissue attachment to cementum as well as on support from adjacent tissues, but above all on the integrity of its dense connective tissue core, which will act as a scaffold to maintain gingival architecture and adaptation to the tooth. If some attachment to the root surface has been lost and a pocket has formed, and if the connective tissue integrity has been altered by inflammation, enhanced shrinkage of the gingiva may occur after scaling and root planing when bony support is lacking. After treatment, a certain amount of "creeping reattachment"[29] also may occur at the midline area of the tooth. Such new attachment may account for the observed decrease in midline crevice depth.

When the bottom of the initial midline pocket extended to or beyond the mucogingival junction, there was a greater tendency for a decrease in the crevice depth 1 month after scaling. This may have been due to a greater tendency for gingival recession and/or reattachment or tight readaptation. Thorough scaling and root planing of the tooth promotes resolution of the gingival inflammation, permitting shrinkage and recession of the "unattached" gingiva. Gingival and mucosal tissues adapt closely to the midline of a clean and smooth root surface, creating a condition conducive to reattachment or tight readaptation. The potential for a "creeping" reattachment should also be considered. Either gingival recession and/or reattachment or tight readaptation could account for the decrease in the crevice depth.

A gain of 1 mm in the attachment level was observed in about 20% of both the midline and mesial crevicular areas 1 month after the scaling. This gain was independent of the severity of the initial inflammation, the presence or absence of bone underlying the mucogingival junction, whether it was an anterior or posterior tooth or whether there was total or partial plaque improvement in the treated areas. The location of the bottom of the initial pocket did not appear to influence the midline attachment level. However, it was significantly related to the mesial interproximal gain in attachment. When the bottom of the mesial pocket extended to or beyond the mucogingival junction, there was a greater tendency for a gain in the mesial attachment level. The mean depth of the treated mesial pockets extending to or beyond the mucogingival junction initially was 2.5 mm greater than the mesial pockets confined within the attached gingiva. This finding suggests that there was a greater tendency for reattachment or tight readaptation in the apical portion of deep rather than shallow interproximal pockets. A high percentage of the mesial interproximal pockets that extended to or beyond the mucogingival junction also might have been associated with interproximal infrabony defects. Thorough scaling and root planing of such areas might have created a situation conducive to reattachment or readaptation.

One millimeter of gingival recession occurred in 20% of the midline areas and 30% of the mesial interproximal sites 1 month after scaling. Gingival recession was independent of the location of the bottom of the initial pocket, the presence or absence of bone underlying the mucogingival junction, whether it was an anterior or posterior tooth or whether there was total or partial plaque improvement on that particular tooth. The severity of the initial inflammation did not appear to influence the midline location of the gingival margin after scaling. However, the degree of initial inflammation was significantly related to the degree of mesial interproximal gingival recession. With increasing severity of the inflammation, there was a greater tendency for gingival recession because of the increased amount of edema associated with the enlargement and distention of the tissue commonly seen in severe gingivitis. The gingiva of the interproximal area consists of a soft tissue papilla occupying all or a portion of the embrasure space and is the area most frequently affected by gingival inflammation. It is logical, therefore, that this region displays most gingival recession following elimination of the inflammation.

There was a 1 mm decrease in the width of the keratinized gingival tissue in 18% of the midline areas and 25% of the interproximal sites 1 month after scaling. The decrease in width of the keratinized gingival tissue can be accounted for by the gingival recession alone since there was no change in the location of the mucogingival junction. The decrease in width of the keratinized gingival tissue occurred independent of the location of the bottom of the initial pocket, the presence or absence of bone underlying the mucogingival junction, whether it was an anterior or posterior tooth or whether there was total or partial plaque reduction on the treated teeth. The severity of the initial inflammation did not appear to influence the changes in the midline width of the keratinized gingival tissue. However, with increasing severity of the initial inflammation, there was a greater tendency for a decrease in the width of keratinized mesial gingival tissue after scaling. This trend is similar to that observed for gingival recession, suggesting that shrinkage is responsible for the loss of keratinized gingival tissue.

Clinical Significance

The findings of this study indicate that thorough scaling, root planing and oral hygiene of teeth with severe inflammation of the gingiva is commonly followed within 1 week to 1 month after scaling by a decrease in the crevice depth, a gain in attachment level, gingival recession, and a decrease in width of the keratinized tissue.

A decrease of 1 mm in crevice depth that frequently occurs after scaling and root planing, due either to a 1 mm gain in the attachment level or 1 mm of gingival recession, could negate the need for further periodontal treatment, or influence the need for mucogingival surgery. In areas in which initially there is a minimal width of keratinized gingival tissue, a 1 mm decrease after scaling and root planing could result in an inadequate width of attached gingiva for maintenance of periodontal health. Since no change occurred in the location of the mucogingival junction a widening of the zone of keratinized gingiva cannot be anticipated. On the other hand, in areas in which initially there appears to be an inadequate width of attached gingiva on the basis of probing, the reattachment or tight adaptation that occurs after scaling and root planing may increase the width of the attached gingiva enough to maintain periodontal health.

The degree of plaque control on the treated teeth had no influence on the changes in gingival position and attachment levels. Teeth associated with total plaque elimination responded similarly to teeth with partial plaque reduction for up to 1 month after scaling. This observation suggests that instrumentation of the root surface was the primary cause of the positional gingival changes.

Summary

Variations in the attached gingiva after scaling, root planing and oral hygiene were studied. The midline and mesial interproximal areas of the facial aspect of 61 teeth were evaluated. A plaque score, an inflammation score and clinical measurements of the gingiva and attachment level were obtained before and after treatment. An initial determination of the presence of bone underlying the mucogingival junction also was made. All data were analyzed statistically. The results were:

1. A decrease in crevice depth, most often in the midline area when no bone was present underlying the mucogingival junction or when the bottom of the initial pocket extended to or beyond the mucogingival junction.
2. A gain in the attachment level, most often in the interproximal areas when the bottom of the initial pocket extended to or beyond the mucogingival junction.
3. Gingival recession, most often in the interproximal areas with inflammation extending to or beyond the mucogingival junction.
4. A decrease in width of the keratinized gingiva, most often in the interproximal areas with the inflammation extending to or beyond the mucogingival junction.
5. Any one or combination of all the above gingival changes occurred at 1 month following scaling and root planing.
6. The gingival changes occurred independent of the location of the tooth in the arch.
7. The gingival changes occurred independent of the degree of plaque improvement on the corresponding tooth surface.
8. No change in the location of the mucogingival junction occurred after scaling and root planing.

Conclusions

1. The relationship of the bottom of a pocket to the mucogingival line may change during the hygienic phase of periodontal therapy.
2. The position of the mucogingival line related to the cementoenamel junction will not change during initial therapy.

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Abstracts

The Regulation of the Jaw Bite Force in Man

Hannam, A. G.
Arch Oral Biol **21:** 641, No. 11, 1976.

Little is known about the ability of human subjects to estimate the intensity of their biting forces and to provide different levels of biting force under conditions of reinforced and nonreinforced perceptual references. In 12 adult subjects with intact dentitions, short isometric clenches were produced in response to a series of numbers called by the investigator. A linear transducer was used to measure bite force on a scale of 1 to 10, where maximum comfortable bite was considered 10. The subjects were tested by calling out the numbers in random order and also sequenced with maximum measured bite between each integer as a reference. The mean maximum comfortable bite force for the group was 8.9 kg SD ± 2.6. The mean maximum discrimination for the group without use of the reinforcing reference was five levels out of 10 requested. Inclusion of the periodic reference value of "10" as a perceptual guidepost between called integers improved the mean score of the group to six levels of bite force when attempting 10. *Department of Oral Biology, Faculty of Dentistry, University of British Columbia, Vancouver V6T 1W5, British Columbia, Canada*

Dr. Harvey Green

The Effect of Age and Sex on the Relationship between Crevicular Fluid Flow and Gingival Inflammation in Humans

Borden, S. M., Golub, L. M., and Kleinberg, I.
J Periodont Res **12:** 160, May, 1977.

Using a filter paper strip inserted into the gingival crevice of 120 patients, half male and half female, ages 12 to 69 years, it was shown that there were no differences in crevicular fluid flow and gingival inflammation related to a patient's age or sex. The patients were also tested for crevicular fluid pH, urea content, urea concentration, and crevice depth. The results exhibited an increase of crevicular depth, fluid flow, urea content, and pH with an increase of gingival inflammation. The only definable variation showed a slightly deeper pocket depth in males and a higher crevicular pH at most levels of inflammation possibly due to poorer personal plaque control by males. It was shown that the crevicular fluid flow – inflammatory tissue response is an objective solution of monitoring gingival inflammation since there is a constant relationship which is substantiated in both sexes of all ages. *Faculty of Dentistry, University of Manitoba, 780 Bannatyne Avenue, Winnipeg R3EOW3 Canada*

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