A Longitudinal Study Comparing Apically Repositioned Flaps, with and without Osseous Surgery*

Prior to the first in a series of several articles published by Ramfjord and co-workers, very little had been published comparing any of the available surgical procedures. Their studies compared closed curettage, the modified Widman procedure (i.e., open curettage) and pocket elimination surgery. The results indicated that: 1. In areas that had initial pocket depths of 4-6 mm, there were no significant differences in attachment when the modified Widman was compared to pocket elimination surgery. 2. These same areas had the greatest pocket depth reduction with the pocket elimination surgery and the modified Widman, both being superior in this regard to closed curettage. 3. Pockets that were initially 4-6 mm were reduced an average of 2 mm by both surgical procedures.

Lindhe, Nyman and Rosling have done studies that indicate equal success with several types of surgical therapy, provided that the patient's oral hygiene is optimal. Zander also found that, although better gingival contours were produced with osseous recontouring, and pocket reduction was improved, all three types of surgery investigated were successful, given optimum plaque control.

Yukna evaluated the excisional new attachment procedures (i.e., open curettage) on rhesus monkeys and humans at three and five years postoperatively and found an overall mean decrease in the amount of previously gained new attachment and an overall increase in sulcus depth over the period of the study.

It is the intent of this study to further evaluate the differences between flap curettage with no osseous therapy and flap surgery with recontouring for moderate periodontal disease, to provide clarification of the indications for and advantages of one versus the other. This is the second in a series of longitudinal reports on the data from a clinical research study initiated by Drs. D. H. Smith and W. F. Ammons. The study compares postoperative clinical results in segments treated with flap curettage and osseous recontouring surgery in eight human subjects. This paper reports data five years postoperatively.

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*This paper was partial fulfillment for a Master's Degree in Periodontics at the University of Washington, School of Dentistry.

** 15604 Bel Red Road, Bellevue, Washington 98007

*** Associate Professor, Department of Periodontics, University of Washington, Seattle, Washington 98105

**** Professor, Department of Biostatistics, University of Washington, Seattle, Washington 98105

*The International Journal of Periodontics and Restorative Dentistry* 4:4 1984
Figs. 1 and 2. Intracoronal defects at the time of surgery. These clinical photographs demonstrate the character of the osseous defects for the group of patients. Note the generalized interproximal cratering of 1-3 mm and the reversed architecture created by the defects. These represent the types of attachment loss that were to be treated with either osseous recontouring surgery or a flap curettage approach.

Methods and Materials

The experimental design for this study was reported in the publication reporting six month results. In review, an original sample of 12 patients had bilaterally symmetrical moderate periodontal disease and intact dentitions in the areas to be treated. Preoperative pocket depths for these patients ranged from 4 to 8 mm. The character of the osseous defects is best shown in Figs. 1 and 2 which represent quadrants as they appeared following incisions, flap reflection, and debridement, but prior to any osseous recontouring. Figures 3 to 5 are radiographs showing the extent of pretreatment interproximal cratering.

Cure related therapy was completed for each patient. This included oral hygiene instruction, scaling and root planing, and occlusal adjustment. Baseline data was collected after these steps were completed. Split-mouth surgery was then done with posterior sextants being randomly assigned (in a cross-arch fashion), either an osseous recontouring or a flap curettage procedure. Each patient thus had equal numbers of quadrants of the two modalities, one of each type per arch.

Osseous recontouring surgery involved apically repositioned flaps after reshaping of alveolar bone to eliminate interproximal craterations. Figures 6a, 7a, and 8a show pre-osseous defects. Figures 6b, 7b, and 8b show osseous contours after defects are eliminated and scalloped architecture is reestablished.

The flaps were designed with internal bevel incisions which included thinning and scalloping of the gingiva to
Figures 3 to 5. These radiographs demonstrate the extent of the interproximal cortication for the根治 of periodontitis. Note the degree of attachment loss on all of the posterior teeth. It is generated horizontal bone loss of 1-2 mm with interproximal cortication of 1-2 mm. This is typical of the type of defect which would then receive further ostectomy recession surgery or flap coverage surgery.
Fig. 6 to 8: The clinical slides demonstrate the pre-assessment defects (6a, 7a, and 8a) and the defects eliminated (6b, 7b, and 8b) after assisted recontouring surgery. Note the reestablishment of slightly scalloped positive bony architecture post-assessment surgery. The objective is to eliminate the microstructural defects and reestablish bony architecture which represents the pre-disease normal situation.

Figure 6a
Figure 6b

Figure 7a
Figure 7b

Figure 8a
Figure 8b

create a soft tissue complex which could then be adapted to the osseous contours. Flap curettage surgery also involved the same flap design and apical repositioning. However, all bony defects were left unaltered in areas treated with flap curettage. Both types of surgery involved thorough debridement of root surfaces and removal of granulomatous material from intraosseous defects. Following the 24 week data collection appointment, the patients were placed on six-month recalls for two years, and subsequently on a recall program of three month intervals. This change was necessary for the maintenance of the periodontal health of these patients, as plaque and inflammation levels had increased after six months.

The recall itinerary included a health history review, photographs, oral inspection, data collection, curettage, polishing, fluoride treatment, evaluation of occlusion, and any special needs including bitewing radiographs and oral hygiene review. The sequence for data collection was: (1) plaque index, (2) gingival inflammation index, (3) tooth mobility index, (4) gingival width index, (5) pocket depth index, (6) level of the gingival margin and gingival attachment index, (7) sounding index, and (8) replicate measurements using the same five gram probing force and protocol as the original study.14

Pocket depth measurements were taken from the soft tissue attachment to the free gingival margin, whereas the level of the gingival attachment (L.G.A.) was taken from the soft tissue attachment to a standard reference point, which was the CEJ. Sounding was taken by probing to crestal bone and measuring to the CEJ. Since this sample contained no severe infrabony defects, sounding was a measurement of the deepest part of the interproximal crater preoperatively and the most apical extent of mid-interproximal bone postoperatively.

The length of the soft tissue attachment was calculated by taking the level of the bone minus L.G.A. The level of the gingival margin was taken from the gingival margin to the CEJ. A gingival width measurement was taken from the free gingival margin to the mucogingival junction, and attached gingival width was derived using that measurement minus pocket depth. The remainder of the gingiva will be referenced to as free gingival width.

The data was averaged for like tooth surfaces, sextants, arches, and segments (i.e., total patient osseous or flap curettage scores). Mean values were obtained for each patient and the differences between the two surgical procedures were computed. A mean number, the standard deviation, and the standard error were established for the differences between flap curettage and osseous recon- tounding surgery. A student's t-test was utilized to determine any sig- nificant differences between the two surgical modalities and to identify any differences between different time intervals (i.e., comparison of one time interval versus another). These mean values included surfaces which had 1–3 mm pockets as well as 4–8 mm pockets. Values which represent all interproximal surfaces pool both normal and abnormal pocket depths. In addition, areas that preoperatively had greater attachment loss (i.e., level of the gingival attachment greater than or equal to 4 mm), as well as the areas which at five years had pocket depth greater than or equal to 4 mm, were evaluated as separate pools of data. Therefore, when interpreting the data, it must be taken into consideration that the effect of pooling data for all surfaces is that the mean numbers are the middle values between, for example, greatest pocket depths (i.e., 6–8 mm) and least pocket depths (1–3 mm). Mean values for data pooled separately are thus greater than those values for all surfaces.
Chart 1. Plaque and gingival inflammation plotted from time zero to five years.

Note: Both osseous recontouring surgery and flap curettage surgery reduced plaque and gingival inflammation following surgery. Over the course of five years post-surgery, the plaque score returned to preoperative levels. Gingival inflammation remained reduced at the six-month postsurgical level. The findings show there were no differences between flap curettage and osseous recontouring in regard to plaque or bleeding when all surfaces are evaluated.
Results

Plaque and Gingival Inflammation

Plaque scores at five years, identical to those at three years, are significantly greater at interproximal surfaces than buccal and lingual surfaces. The mean values on buccal and lingual surfaces were 0.6 (osseous recontouring surgery) and 0.5 (flap curettage surgery) versus interproximal surface score of 1.7 (osseous recontouring surgery) and 1.8 (flap curettage surgery). Gingival inflammation was also significantly greater for interproximal surfaces than for buccal and lingual surfaces.

Comparing plaque and inflammation levels from time zero (preoperative level) to five years (Chart 1), it is clear that both were significantly reduced six months after surgery and there were no differences between the two types of surgery in this regard. Over the course of the five year recall program, plaque scores returned to their presurgical levels. However, gingival inflammation remained reduced at the same six month postoperative level. These findings were essentially identical in areas treated with either type of surgery when all surfaces were averaged.

Gingival Components

Total gingival width (i.e., free gingival width plus attached gingiva) has remained greater in flap curettage sextants after 5.0 years, and the mean values have remained stable over the entire course of the study. Mean gingival values at interproximal surfaces were greater in areas treated with flap curettage 12% of the time. This is an apparent trend. This difference was not statistically significant (with a broad range of values for this sample), but has remained a trend in the study for all time intervals after six months.

Attached gingival width (Table 1) is evaluated for these same interproximal surfaces, one will observe that the values are essentially the same. Mean values were 3.4 mm at three years and 3.3 mm at five years for both surgical procedures, indicating no difference between the two therapeutic modalities. Both types of surgery resulted in greater gingival width as compared to preoperative values.

The level of the gingival margin (Table 2) remains more apical in osseous recontouring surgery than in flap curettage surgery at all time intervals and at a statistically significant level when all surfaces are averaged. This was true for interproximal as well as buccal and lingual surfaces. The position of the gingival attachment (Table 3) also remained more apical in osseous recontouring surgery at all time intervals, and this was significant. This position of the gingival margin in osseous recontouring areas was consistently more apical to a greater extent on buccal and lingual surfaces than on interproximal surfaces.

The mean value for the height of the interproximal tissue in flap curettage surgery at five years indicated that the average interdental papilla was 0.2 mm apical to the CEJ, whereas the interproximal tissue was on average of 0.8 mm apical to the CEJ in areas treated with osseous recontouring surgery. On the buccal/lingual surfaces, the tissue in osseous recontouring surgery was an average 1.7 mm apical to the CEJ, compared to 1.1 mm in segments treated with flap curettage.

Table 1: Attached Gingival Width: Interproximals

<table>
<thead>
<tr>
<th>Time</th>
<th>Osseous (x)</th>
<th>Flap Curettage (x)</th>
<th>d</th>
<th>S.D. (of d)</th>
<th>p</th>
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<td>0.6</td>
<td>NSD</td>
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</tbody>
</table>

* Non-significant data.

Note: There is no difference in the amount of attached gingiva for areas treated with flap curettage surgery as compared to those treated with osseous recontouring surgery.
Table 2 Gingival Margins: Interproximals

<table>
<thead>
<tr>
<th>Time</th>
<th>Osseous (X)</th>
<th>Flap Curettage (X)</th>
<th>d</th>
<th>S.D. (of d)</th>
<th>p</th>
</tr>
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<tbody>
<tr>
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<td>0.6</td>
<td>0.3</td>
<td>&lt; 0.01*</td>
</tr>
</tbody>
</table>

* Significant difference.

Note: The position of the free gingival margin relative to the CEJ remains significantly more apical in cases treated with osseous recontouring surgery as contrasted to those areas which received flap curettage surgery.

Table 3 Gingival Attachment Level: Interproximals

<table>
<thead>
<tr>
<th>Time</th>
<th>Osseous (X)</th>
<th>Flap Curettage (X)</th>
<th>d</th>
<th>S.D. (of d)</th>
<th>p</th>
</tr>
</thead>
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<td>3.4</td>
<td>0.5</td>
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<td>&lt; 0.01*</td>
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<tr>
<td>5.0</td>
<td>3.9</td>
<td>3.5</td>
<td>0.4</td>
<td>0.2</td>
<td>&lt; 0.01*</td>
</tr>
</tbody>
</table>

* Significant difference.

Note: The position of the soft tissue attachment relative to the CEJ remains more apical in osseous recontouring surgery areas than in areas treated with flap curettage surgery at both three and five years if one looks at all interproximal surfaces.

Pocket Depth

Mean values for pocket depth for all interproximal surfaces, at both three and five years postoperative, demonstrate less pocket depth in areas treated with osseous recontouring surgery than in those treated with flap curettage surgery (Chart II). At five years this finding was statistically significant with a minimal standard deviation of 1.8 and standard error of 0.06, indicating that this greater pocket depth in flap curettage surgery areas is consistently true for this sample.

In contrast to this information, pocket depths on buccal and lingual surfaces averaged 2.0 mm for both types of surgery.

Data for interproximal pocket depths plotted from time zero (preoperative) to five years postoperative (Chart III) show that both types of surgery significantly reduced pocket depths six months postoperative. At six months, interproximal pocket depths were a mean 2.3 mm (osseous recontouring surgery) and 2.5 mm (flap curettage surgery). These values increased to 2.9 mm by 1.5 years (both surgeries) and increased to the mean 3.1 mm (osseous recontouring surgery) and 3.4 mm (flap curettage surgery) by five years (statistically significant difference at a p value of < 0.01).

At five years, mean interproximal pocket depth is nearly equal to preoperative values in areas treated with flap curettage surgery (3.5 mm at five years compared to 3.4 mm preoperative). In contrast, the 3.1 mm mean value in areas treated with osseous recontouring surgery remains reduced compared to the 3.4% preoperative mean. This differ-

ence is statistically significant at the $p < .01$ level.

If the data pool is narrowed in a more specific way and one looks only at surfaces that have pocket depths which are 4 mm or greater at five years, it is notable that there are 2.3 times as many bleeding 4+ mm pockets in areas treated with flap curettage surgery as there are areas treated with osseous recontouring surgery. The areas treated with flap curettage surgery had 42% bleeding pockets (4+ mm), while those treated with osseous recontouring surgery had 18% (Chart IV). When these bleeding sites were evaluated for the presence of plaque, a 91% correlation between the presence of plaque and bleeding was found.

Of these 4+ mm pockets, lingual interproximals accounted for 77% of the total 147 buccal interproximals for 65% of them, and only five total pockets were either on the straight buccal or lingual surfaces.

Chart V represents data which evaluates the effectiveness of pocket reduction for both types of surgery, comparing the pocket depths at five years to their preoperative values for the same sites. The data is subdivided into four groups: preoperative pockets of 1-3 mm, preoperative pockets of 4 mm in depth, those which were 5 mm before surgery, and those which were 6-8 mm before either type of surgery was done. Pockets that were 1-3 mm before surgery were 1-3 mm after surgery in both areas of flap curettage and osseous recontouring surgery. However, if one looks at 4 mm pockets, osseous recontouring surgery reduced these by 37% mm 80% at the 5 years, as compared to 65% reduction in areas treated with flap curettage.

Chart IV. The mean values for interproximal pocket depth at three and five years. Note: The average pocket depths for all interproximal surfaces at both three and five years postsurgery are greater in flap curettage sites (shown as red bars) than in those areas treated with osseous recontouring surgery (blue bars). This finding was consistently true for every patient, as evidenced by the small standard deviation for the sample, and it was a statistically significant difference between the two types of surgery ($p < .01$).
Chart III: The mean values for interproximal pocket depths from time zero to five years.

Note. This graph represents mean pocket depth values for all interproximal surfaces from time zero (preoperative) to five years postoperative. Over the course of five years, pocket depths in areas treated with osseous recontouring surgery and flap coverage surgery both showed increases. However, this increase occurred at a statistically significant level in areas treated with flap coverage surgery as compared to areas treated with osseous recontouring surgery. After five years, the mean values for flap coverage surgery areas were not statistically different from preoperative values. Mean values for areas treated with osseous recontouring surgery remained reduced from the preoperative values at a statistically significant level. By five years, interproximal pocket depths in areas treated with flap coverage were significantly deeper than the corresponding pockets in areas treated with osseous recontouring.
ous recontouring surgery. This was true for all surfaces, as well as data collected at interproximal surfaces (Table 4).

**Bone**

Osseous recontouring surgery resulted in bone levels on buccal and lingual surfaces which at six months were significantly more apical than the bone in flap curettage sextants (which showed no change post-operatively when compared to preoperative values). At five years the mean values for buccal and lingual surfaces indicate that the bone is apical in the areas treated with osseous recontouring surgery as compared to those treated with flap curettage surgery at only a borderline level of significance ($p < .05$).

An evaluation of the interproximal bone position indicates that virtually no changes have occurred. Values five years are similar to values at previous time intervals. It is noteworthy however, that the mean values for osseous recontouring surgery and flap curettage surgery are not significantly different, although at all time intervals the osseous recontouring surgery values are greater (indicating a more apical level). This can be partially attributed to a broad range of values and a small sample size.

**Chart V.** The frequency of the effectiveness of pocket reduction at five years.

Note: This graph represents data which compares preoperative pocket depths to pocket depths at the same site at five years. Pockets that were 1-3 mm preoperative were not reduced by either flap curettage surgery or osseous recontouring surgery. Pockets that were 4 mm preoperative were reduced 4 mm of the time in flap curettage surgery areas as compared to 10% return in areas treated with osseous recontouring surgery. Eighty-five percent of the time, areas that were 4 mm preoperative were reduced 1-3 mm in osseous recontouring surgery areas, versus 65% reduction in flap curettage surgery areas. Pockets that were 5 mm preoperative were reduced 5 mm of the time in osseous recontouring surgery areas. Osseous recontouring surgery reduced these 5 mm pockets 2-3 mm 85% of the time, versus 65% reduction in flap curettage surgery areas.

In the 6-8 mm pocket area, 30% returned to preoperative depths when treated with flap curettage surgery, versus 5% return in osseous recontouring surgery areas. Ninety percent of the time, osseous recontouring surgery reduced these pockets 2-4 mm, versus 95% reduction in flap curettage surgery areas.

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Table 4  Gingival Attachment Length: Interproximals

<table>
<thead>
<tr>
<th>Time</th>
<th>Osseous (%)</th>
<th>Flap Curettage (%)</th>
<th>d</th>
<th>S.D. (of d)</th>
<th>p</th>
</tr>
</thead>
<tbody>
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<td>0.6</td>
<td>NSD*</td>
</tr>
<tr>
<td>5.0</td>
<td>1.4</td>
<td>1.3</td>
<td>0.1</td>
<td>0.3</td>
<td>NSD</td>
</tr>
</tbody>
</table>

* Non-significant data.

Note: The dimension of the soft tissue attachment shows no differences when the two types of surgical procedures are compared at three and five years on interproximal surfaces.
Interproximal bone/gingival components 5 years

Gingival margins
S.D. = 0.3

Gingival attachments
S.D. = 0.7

Bone
S.D. = 0.4

--- Flap curettage
--- Osseous recontouring

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Areas of Preoperative Attachment Loss Greater Than or Equal to 4 mm

If the data pool is narrowed to include only areas that initially had greater loss of attachment, similar results are seen to those for all interproximal surfaces. Pocket depth in areas of greater attachment loss are identical for osseous recontouring surgery (i.e., 3.1 mm) but slightly greater in the flap curettage surgery (3.5 mm) than the values computed for all interproximal surfaces (Chart VI).

The level of the gingival margin remains more apical in areas treated with osseous recontouring surgery, but the level of attachment is not significantly more apical, which is a difference not seen in the mean values for all interproximal surfaces. The interproximal surface values for the level of gingival attachment are greater in areas of initially greater attachment loss for both types of surgery than the values for all interproximal surfaces. The difference between the two groups of data is greater in the flap curettage surgery areas (1.42 mm increase versus 0.26 mm increase in osseous areas). This indicates a more apical attachment position in areas where osseous defects exist.

Sounding interproximal bone results in mean values that are greater than those values for all surfaces. The values are border-line greater (i.e., more apical) in terms of significance of difference in areas treated with osseous surgery than with flap curettage (p = .05). These findings are identical to those at three years.

Discussion

The five year results of this study demonstrate that flap surgery with the elimination of osseous defects by osseous recontouring surgery is more effective in pocket reduction when treating 4-5 mm pockets than flap curettage surgery that is performed without osseous recontouring.

Pocket Depth

Both types of surgery reduced pocket depth initially. At five years, however, pocket depth at interproximal surfaces in areas treated with flap curettage surgery had returned to preoperative levels. In contrast, pocket depths in areas treated with osseous recontouring surgery remained reduced (compared to preoperative values) at a statistically significant level. Figures 9, 10, and 11 show some of these pocket depths, comparing preoperative depths with those at six months and five years for six different sextants. Other investigators who have evaluated apically repositioned flap procedures have also noticed effective pocket reduction (Zancher, 1975). Likewise, the recurrence of pocket depth in areas with the modified Widman procedure has been demonstrated previously (Pihlstrom et al., 1981). Data from this study also demonstrate that the deeper the pocket is preoperatively, the more effective osseous recontouring surgery is at reducing and maintaining pocket depth.
Figs. 9 to 11: These figures demonstrate pocket depths in posterior patients treated with flap curettage and osseous recontouring surgery. Pocket depths in black are presurgery, pocket depths in green are six months post surgery, and pocket depths in purple are data five years postoperatively. Bleeding pockets are indicated by red dots over the millimeter recording. Note the greater pocket depths and greater frequency of bleeding sites in the flap curettage areas. Statistically, there were two to three times as many bleeding, 4 mm or greater pocket depths in flap curettage areas as there were in areas treated with osseous recontouring at five years.

Figs. 12 and 13. These figures demonstrate the differences in the apical position of the free gingival margins, as well as pocket depths, in areas treated with osseous recontouring surgery (Figs. 12a to 12d) versus flap coverage areas (Figs. 12e, 12b, and 12g). Note the more apical position of tissues in areas treated with osseous recontouring surgery, as well as the reduced pocket depths as compared to the preoperative (black) and six months post-surgery (green) recordings. Tissues in flap coverage sites demonstrated rebound over the course of five years and greater concurrent pocket depths.
Soft Tissue Behavior

The free gingival margin in areas treated with flap curettage surgery is more coronal than it is in areas treated with osseous recontouring surgery. This is in spite of the fact that tissues were apically repositioned in both types of surgical areas. We have chosen to describe this as a rebound of the soft tissues which obviously contributes to the greater pocket depths. Figures 12 and 13 demonstrate the more apical soft tissues in osseous recontouring surgery sextants compared to those treated with flap curettage surgery. Also noteworthy are the corresponding pocket depths for these areas. This has not been evaluated in other studies.

An important question is: How do attachment levels compare between the two procedures and over the duration of the data collection? Data collected in this study indicates that when areas that were diseased to begin with (i.e., areas of initially greater attachment loss) are evaluated, gingival margins are significantly more apical in osseous recontouring surgery, but the attachment levels are not significantly different when compared to areas treated with flap curettage surgery. It is noteworthy that the initial "gain" in attachment reported in the six month paper for flap curettage surgery was lost by 1.5 years. This lack of a permanent connective tissue attachment has been noted in other studies.10,13,16

Bone

Areas with the greatest attachment loss cooperatively are only borderline more apical in areas treated with osseous recontouring surgery than in those treated with flap curettage surgery. Interproximal bone levels are only borderline more apical even though bone was removed in those areas. This is not a surprising finding, since these were areas where bone loss had occurred to begin with and when flap curettage surgery was utilized as the surgical procedure, the defects in bone were not eliminated. Where bone was recontoured to eliminate the interproximal defects, the amount removed at the interproximal surfaces was apparently minimal, and thus the lack of significant difference between the two surgical treatments in terms of bone levels. This minimal amount of bone removed during osseous recontouring surgery has also been noted in another study.17

The increase in pocket depth observed in the areas of greater attachment loss as compared to the means for the pooled data from all areas can thus be attributed not to rebound of interproximal tissue, but also to a soft and hard tissue attachment positioned nearly as apical as that in the areas treated with osseous recontouring surgery.

This information is very relevant since the involved pockets of 4-6 mm post surgically have a tendency to be inflamed (as demonstrated by bleeding). The pockets in the flap curettage surgery treated to a greater extent than in the osseous recontouring surgery areas and the amount of attachment loss is a direct result of eliminating the osseous defects is minimal. Other studies which have evaluated surgical periodontal procedures have not reported this particular data.

Another important finding in this current data is that there was no dem-

Implications for Therapy

There are some aspects of this study which are unique when compared to other studies which have evaluated surgical modalities as part of periodontal therapy, it is hoped that these unique factors have sound clinical implications.

First, only moderate disease was treated with the two types of surgery in this study, whereas all others included areas of advanced attachment loss in their data pool. Second, the types of surgery utilized in this study are unique and those in other studies in that we set out specifically to evaluate the impact of eliminating defects by recontouring alveolar bone as compared with the same flap management without any osseous recontouring. In other words, flap design and postsurgical positioning were identical, flaps in areas treated with either osseous recontouring surgery or flap curettage surgery were apically repositioned before suturing. This achieves initial soft tissue pocket reduction for both surgical modalities. Another unique aspect of this study is that the actual techniques of the two
procedures have been clearly de-


nished in the text and the clinical
photographs. In contrast, the other
studies which have evaluated
periodontal surgical techniques have
been vague as to exactly what is
meant by pocket elimination surgery
and flap curettage. Our intent was to
provide the clinician with a clear idea
of what was done and how the vari-
ous clinical variables were influ-
enced.

Thus, the long-term follow-up truly
evaluates the effect of the presence
or absence of intrasulcular defects
on soft tissue behavior and pocket
depth. The proliferation of interprox-
imal tissues that we noted in this study
seems to indicate that more coronal
heights of bone and the embrasure
form influence soft tissue height into
embrasures. That is, the buccal and
lingual crater walls and root proxim-
ity as they define embrasure form
may play an important role in terms of
soft tissue rebound.

It is also noteworthy that areas of
greater depth postsurgically showed
greater inflammation (as measured
by bleeding). This finding, in addition
to that of greater pocket recurrence
in areas treated with flap curettage
surgery, and the fact that the amount
of bone removed in areas treated
with osseous recontouring surgery is
minimal, might lead one to the con-
clusion that the end result after osse-
ous recontouring surgery is superior
to that achieved after flap curettage
surgery if interproximal pocket depth
and inflammation are important clin-
icall parameters. One might also
conclude that the "price paid" for
this result was of little biologic con-
sequence.

It is thus quite clear that if minimal
pocket depth is a clinical objective of
a surgical treatment, then osseous
recontouring is the procedure of
choice, since flap curettage surgery
is not an effective means of eliminat-
ing interproximal pockets. The con-
cept of utilizing reshaping of alveolar
bone to effect postsurgical pocket
depth is not new.28-30 (This study sup-
ports that concept. It is not possible
to reach a total conclusion in this
paper because of limited sample
size.) It must be emphasized that
these cases are moderately involved
and that the study covers only five
years. Therefore, these conclusions
can only be applied therapeutically
to cases of similar degree of involve-
ment and utilizing these particular
surgical techniques. For patients with
advanced periodontal disease, the
conclusions would likely be different.

A summary of indications for flap
curettage has appeared in the litera-
ture by Ammons et al.31

The areas of increased pocket depth
appear to be a problem in terms of
maintaining gingival health, and this
finding tends to support the conclu-
sions of Waerhaug.32-34 Waerhaug
found that once subgingival plaque
had formed, plaque in pockets of
greater than 3 mm was not effec-
tively removed by closed curettage.
Robbani et al.24 evaluated the effec-
tiveness of subgingival scaling and
root planing and found that closed
curettage is not very effective in
pockets greater than 3 mm.

This information may be very val-
uable in terms of the rationale for
one type of procedure versus another.
It appears that the greater defects
have more significant recurrence of
pocket depth with only an early tem-
porary gain in attachment when flap
curettage is the surgical modality.
This loss of attachment, plus coronal
tissue proliferation, has resulted in
pocket depth that shows signs of
being more difficult to maintain even
with close intervals of curettage. Ti-
sues remain more apical in the areas
of osseous recontouring with less
pocket depth, which seem to be
more accessible for the patient's
plaque removal attempts as well as
for the therapist's use of a curette.
Summary Statements

1) Although both flap curettage surgery and osseous recontouring surgery resulted in significant pocket reduction at six months postoperative, over the course of the five years of follow-up, pocket depths in areas treated with flap curettage surgery have returned to their preoperative values, whereas pocket depths in areas treated with osseous recontouring surgery have remained significantly reduced as compared to their preoperative values.

2) By five years, there are 2.3 times as many bleeding 4+ mm pockets in areas treated with flap curettage surgery as in areas which received osseous recontouring surgery.

3) When one looks at areas that had greater loss of attachment before treatment, pocket depths are even greater in areas treated with flap curettage surgery than for all interproximal surfaces and the level of the attachment is not significantly more apical than in areas treated with osseous recontouring surgery. Likewise, the level of bone is only borderline more apical in areas treated with osseous recontouring surgery. There was also no gain of attachment noted in this study.

4) The position of the free gingival margin relative to the CEJ remains significantly more apical in areas treated with osseous recontouring surgery than in those treated with flap curettage surgery. This is true for all interproximal surfaces, as well as areas which preoperatively had greater loss of attachment.

5) Clearly, when one compares preoperative pocket depth at a specific site with pocket depth at five years at that same site, osseous recontouring surgery is much more effective at pocket reduction than is flap curettage surgery. This is especially true for pockets that were in the range of 5–8 mm preoperatively.
Conclusions

1. Osseous recontouring surgery allows more apical repositioning of the soft tissue complex than does flap curetage surgery. Minimal amounts of bone are removed to facilitate the reestablishment of the scalloped contours found in the healthy periodontum. This repositioning of the soft tissue complex to reduce pocket depth holds over the course of five years of follow-up.

2. The data from this study clearly show greater return of preoperative pocket depths in areas treated with flap curetage surgery. This pocket depth is accounted for in greater coronal height of the free gingival margin and a level of attachment position in flap curetage area that is as apical as it is in osseous recontouring surgery; areas where bone purposely was removed and soft tissues positioned as apical as possible to eliminate pockets. These pockets also tended to be inflamed.

3. Therefore, if reduction in pocket and control of inflammation are agreed-to objectives of periodontal surgery, osseous recontouring surgery is clearly more effective in achieving those objectives in cases which have preoperative pocket depths of 5–8 mm.

Acknowledgment

We wish to acknowledge the special and unique guidance of our mentor, Dr. Saul Schluger, in this project.
References