

# The Relationship Between the Location of Subgingival Crown Margins and Gingival Inflammation

by

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SOME DENTAL PROCEDURES can lead to periodontal disease. When the margin of a dental restoration is located within the gingival crevice, gingival inflammation is likely to occur.<sup>1-4</sup> This principle was illustrated with telling effect by Silness.<sup>5</sup> He found that the gingivae around crowns with subgingival margins were more inflamed than the gingivae around crowns with supragingival margins. Consequently, we are often advised to "avoid the gingival third" when undertaking crown preparations.

By contrast, when it is necessary to create a subgingival margin for reasons of appearance, high caries rate, or a short clinical crown, there is considerable controversy over the best position to finish the preparation. Confronted by a confusing array of recommendations, we are told to place the crown margin right at the gingival crest,<sup>6,7</sup> or extend 0.5 mm,<sup>8</sup> 0.5 to 1.0 mm,<sup>9</sup> or 1.0 to 1.5 mm<sup>10</sup> into the crevice. Other recommended locations for the crown margin are right at the base of the gingival crevice,<sup>11,12</sup> and midway between this point and the gingival crest.<sup>13</sup> However, there seems to be little scientific evidence to support some of these statements.

Just where should one place a subgingival margin? In an attempt to answer this question, a survey was designed to investigate the degree of gingival inflammation associated with subgingival crown margins located at different levels within the gingival crevice.

## MATERIALS AND METHODS

59 patients (age range 19-53 years, mean 30.7 years) provided the study population and 75 anterior veneer crowns with subgingival labial margins were examined. The crowns had all been constructed by final year dental students over a period of fifteen months before the examination date.

This study was carried out at the Faculty of Dental Science, University of Western Australia, Perth, Western Australia. Present address of author—Dental Department, Royal Adelaide Hospital, Adelaide, South Australia.

Nine crowns were considered to have defective labial margins and/or overcontoured labial surfaces, when compared with their contralateral teeth, and these were eliminated from the survey. The final sample consisted of 66 crowns of an average age of 8.23 months. Thirty-four were porcelain jacket crowns and 32 were porcelain bonded to gold crowns.

At the midpoint of the labial aspect of these crowns an assessment was made of the degree of gingival inflammation, using the Gingival Index<sup>14</sup> conceived by Löe and Silness. The amount of dental plaque present was measured using the Plaque Index<sup>14</sup> developed by the same authors. With the aid of a pair of 2 x magnifying glasses and an accurately calibrated periodontal probe, the depth of the gingival crevice, and the distance between the gingival crest and the subgingival crown margin were measured to the nearest 0.25 mm. Then, the latter measurement was subtracted from the crevice depth measurement to give the distance of the crown margin from the base of the crevice. Gingival and Plaque Indices and a crevice depth measurement were then taken at the midpoint of the labial aspect of the uncrowned contralateral tooth which acted as a control.

Before the start of the investigation another group of 20 patients was examined twice to determine the precision of the recording procedure. This was found to be high; the differences between the paired index scores or measurements were not significant. No systematic error was apparent, and the data accumulated were not used subsequently.

## RESULTS

The teeth with subgingival crown margins displayed significantly higher labial Gingival Indices and crevice depths than their uncrowned control teeth (Table 1). However, the plaque scores as measured by the Plaque Index were significantly lower for the crowned teeth.

The crowned teeth and their control teeth were divided into groups based on the distance of the crown margin from the base of the crevice (CM-BC). Four groups resulted:

- Group 1 CM-BC = 0.25 mm. (15 Crowns)
- Group 2 CM-BC = 0.5 mm. (23 Crowns)
- Group 3 CM-BC = 0.75 mm. (24 Crowns)
- Group 4 CM-BC = 1.0 mm. (4 Crowns)

Table 2 sets out the mean Plaque and Gingival Indices of the crowned and control teeth in each of these four groups. Non parametric statistical methods were used to analyse the data because of the nature of the scores.

Except for Group 4, the crowned teeth in each group had a significantly lower mean Plaque Index than their

TABLE 1  
Mean labial Plaque and Gingival Indices, and mean labial crevice depths of crowned teeth and control teeth.

|                          | <i>Crowned Teeth</i> | <i>Control Teeth</i> | <i>Significance</i> |   |
|--------------------------|----------------------|----------------------|---------------------|---|
| Mean Plaque Index        | 0.14 ( $\pm$ 0.043)  | 0.65 ( $\pm$ 0.098)  | P < 0.001           | † |
| Mean Gingival Index      | 1.23 ( $\pm$ 0.094)  | 0.33 ( $\pm$ 0.066)  | P < 0.001           | † |
| Mean crevice depth (mm.) | 1.01 ( $\pm$ 0.112)  | 0.91 ( $\pm$ 0.097)  | P < 0.001           | * |

Statistical Analysis:

† Wilcoxon Matched—Pairs Signed Ranks Test

\* Students 't' Test for paired samples

control teeth. However, the mean Plaque Indices for the crowned or control teeth did not differ significantly between the four groups.

Except for Group 4, the crowned teeth in each group had a significantly higher mean Gingival Index than the control teeth. There was no significant difference between the mean Gingival Indices of control teeth in the four groups. By contrast, there was a highly significant difference between the mean Gingival Indices of the four groups of crowned teeth; Group 1 teeth having the greatest inflammation and Group 4 having the least.

Crowned teeth in Groups 1 and 2 had significantly greater mean crevice depths than their control teeth. There was no significant difference in crevice depth between crowned teeth or control teeth in Groups 3 and 4 (Table 3).

In order to further examine the relationship between the crown margin position and gingival inflammation, the crowned teeth *only* were divided into groups based on their observed labial Gingival Index (Table 4). It was clear that as the observed degree of inflammation

increased so did the crevice depth and the distance of the crown margin below the gingival margin (GM-CM). However, the distance between the crown margin and the base of the crevice (CM-BC) tended to be less with increasing gingival inflammation. Correlation coefficients prepared using the ungrouped data (Table 4) showed that there was a positive correlation between the degree of gingival inflammation and the crevice depth ( $p < 0.01$ ). There was also a relatively strong positive correlation between gingival inflammation and the distance of the crown margin below the gingival crest ( $p < 0.001$ ). Finally, there was a very strong *negative* correlation between gingival inflammation and the distance of the crown margin from the base of the crevice ( $p < 0.001$ ).

#### DISCUSSION

Tables 1 and 2 confirm previous reports<sup>1-5</sup> which indicate that teeth with crowns having subgingival margins are associated with increased gingival inflammation. It is interesting to note that the crowned teeth have significantly lower Plaque Indices than the uncrowned teeth.

TABLE 2  
Mean Plaque and Gingival Indices of crowned and control teeth for different crown margin to base of gingival crevice distances (CM-BC).

|   | <i>Crowned Teeth</i> |                     | <i>Control Teeth</i> |                     | <i>Significance of Differences within groups*</i> |           |
|---|----------------------|---------------------|----------------------|---------------------|---|-----------|
|   | <i>PII</i>           | <i>GI</i>           | <i>PII</i>           | <i>GI</i>           | <i>PII</i>  | <i>GI</i> |
| Group 1<br>CM-BC 0.25 mm.                   | 0.27 ( $\pm$ 0.118)  | 2.27 ( $\pm$ 0.115) | 0.80 ( $\pm$ 0.200)  | 0.46 ( $\pm$ 0.165) | P < 0.05  | P < 0.001 |
| Group 2<br>CM-BC 0.50 mm.                   | 0.13 ( $\pm$ 0.072)  | 1.23 ( $\pm$ 0.037) | 0.65 ( $\pm$ 0.173)  | 0.26 ( $\pm$ 0.094) | P < 0.02  | P < 0.001 |
| Group 3<br>CM-BC 0.75 mm.                   | 0.13 ( $\pm$ 0.069)  | 0.79 ( $\pm$ 0.085) | 0.67 ( $\pm$ 0.167)  | 0.33 ( $\pm$ 0.115) | P < 0.01  | P < 0.01  |
| Group 4<br>CM-BC 1.00 mm.                   | 0 —                  | 0 —                 | 0.25 ( $\pm$ 0.250)  | 0 —                 | N.S.  | N.S.      |
| Significance of differences between groups† | N.S.                 | P < 0.001           | N.S.                 | N.S.                |   |           |

Statistical Analysis:

\* Wilcoxon Matched—Pairs Signed Ranks Test

† Kruskal Wallis Test

N.S. Not Significant.

TABLE 3  
Mean labial crevice depths in millimeters of crowned and control teeth for different crown margin to base of crevice distances (CM-BC).

|                        | <i>Crowned Teeth</i> | <i>Control Teeth</i> | <i>Significance*</i> |
|------------------------|----------------------|----------------------|----------------------|
| Group 1 CM-BC 0.25 mm. | 1.25 (± 0.106)       | 0.97 (± 0.060)       | P < 0.01             |
| Group 2 CM-BC 0.50 mm. | 0.97 (± 0.055)       | 0.88 (± 0.063)       | P < 0.05             |
| Group 3 CM-BC 0.75 mm. | 0.91 (± 0.033)       | 0.88 (± 0.042)       | N.S.                 |
| Group 4 CM-BC 1.0 mm.  | 1.06 (± 0.062)       | 1.06 (± 0.062)       | N.S.                 |

\* Students 't' Test for paired samples.  
N.S. Not Significant.

Clinical observation and some experimental evidence<sup>15</sup> has shown that plaque does not accumulate easily on the surface of dental porcelain. In the case of teeth with full crown coverage, the plaque bacteria are retained in the niche between the restoration and the tooth where they would not be measured by the Plaque Index.

It is clear that the greatest gingival inflammation is seen when the crown margin is located close to the base of the gingival crevice. The significant increase in inflammation as the crown margin approached the base of the crevice was not apparent in the intact control teeth (Table 2). Marcum<sup>6</sup> showed that when dogs' teeth were fitted with gold crowns finished at the gingival crest, less inflammation was observed than when the crowns were extended to the base of the crevice. Likewise, Silness<sup>16</sup> noted, that while bridge retainer margins both at and below the gingival crest interfered with gingival health, the most harmful effects seemed to be produced by retainer margins located sub-gingivally.

There is a positive correlation between gingival inflammation and the distance of the crown margin below the gingival crest. However, this relationship is slightly distorted by the obvious correlation between inflammation and crevice depth. Anything more than a minor gingivitis will cause edema and gingival enlargement. Not only will this cause teeth with deep subgingival crown margins to have increased crevice depths (Table 3) but it will also alter the original relationship between

the crown margin and the gingival crest. Nevertheless, the results of this study indicate that if one is unable to avoid a subgingival margin, the preparation should not be extended more than a short distance into the crevice.

One objection to finishing the preparation just below the gingival crest, is that passive eruption may soon lead to the exposure of the crown margin.<sup>13</sup> There is strong evidence to suggest that continuous passive eruption in adults is pathological, and that it will not occur in the absence of inflammation.<sup>17-19</sup> If this is so, a crown margin should be placed in the position least likely to create gingival inflammation, that is, as far from the base of the crevice as possible. This would slow, or at best stop completely, the process of pathological passive eruption.

It is possible that a small part of the increase in crevice depth adjacent to the crowns has resulted from apical migration of the junctional epithelium, that is, true pocketing. The strong correlation between gingival inflammation and the distance of the crown margin from the base of the crevice shows that, if there has been loss of attachment, the epithelial cuff has moved to a position where the irritation was less, allowing the inflammation to subside.

#### SUMMARY AND CONCLUSIONS

The degree of gingival inflammation on the labial

TABLE 4

The relationship between the Gingival Index and the mean crevice depth, the mean distance between the gingival margin and the crown margin (GM-CM), and the mean distance of the crown margin from the base of the gingival crevice (CM-BC).

|                          | <i>Gingival Index</i> |                |                |                | <i>Correlation Coefficient (r) and Significance</i> |
|--------------------------|-----------------------|----------------|----------------|----------------|---|
|                          | <i>0</i>              | <i>1</i>       | <i>2</i>       | <i>3</i>       |   |
| Number                   | 9                     | 37             | 16             | 4              |   |
| Mean crevice depth (mm.) | 0.94 (± 0.055)        | 0.90 (± 0.038) | 1.22 (± 0.085) | 1.31 (± 0.277) | + 0.4419 (P < 0.01 )                                |
| Mean GM-CM (mm.)         | 0.08 (± 0.042)        | 0.28 (± 0.034) | 0.86 (± 0.085) | 1.06 (± 0.277) | + 0.7412 (P < 0.001)                                |
| Mean CM-BC (mm.)         | 0.86 (± 0.044)        | 0.63 (± 0.021) | 0.33 (± 0.030) | 0.25 —         | - 0.8221 (P < 0.001)                                |

aspect of 66 anterior veneer crowns, with subgingival margins in varying positions, was compared with that on the labial aspect of the 66 uncrowned contralateral teeth. The inflammation score was then correlated with the location of the crown margin in the gingival crevice.

There was a very strong negative correlation between gingival inflammation and the distance of the crown margin from the base of the crevice. The strong positive correlation between gingival inflammation and the distance of the crown margin below the gingival crest, was distorted slightly by the effect inflammation has on crevice depth.

The nearer a subgingival crown margin approaches the base of the gingival crevice, the more likely it is that severe gingival inflammation will occur. The least inflammation is observed when subgingival crown margins are placed at the gingival crest or just into the gingival crevice.

#### REFERENCES

1. Bergman, B., Hugoson, A., and Olsson, C.: Periodontal and Prosthetic Conditions in Patients Treated with Removable Partial Dentures and Artificial Crowns. *Acta Odontol. Scand.*, 29:621, 1971.
2. Karlsen, K.: Gingival Reactions to Restorations. *Acta Odontol. Scand.*, 28:895, 1970.
3. Alexander, A. G.: Periodontal Aspects of Conservative Dentistry. *Brit. Dent. J.*, 125:111, 1968.
4. Waerhaug, J.: Histological Considerations Which Govern Where the Margins of Restorations Should be Located in Relation to the Gingiva. *Dent. Clin. North Am.*, pp. 161-176, March 1960.
5. Silness, J.: Periodontal Conditions in Patients Treated with Dental Bridges. II. The Influence of Full and Partial Crowns on Plaque Accumulation, Development of Gingivitis and Pocket Formation. *J. Periodont. Res.*, 5:219, 1970.
6. Marcum, J. S.: The Effect of Crown Margin Depth on Gingival Tissues. *J. Prosthet. Dent.*, 17:479, 1967.
7. Pini, C. E.: Co-Report: Hygienic Considerations in Crown and Bridge Prosthesis. *Int. Dent. J.*, 8:357, 1958.
8. Johnston, J. F., Phillips, R. W., and Dykema, R. W.: *Modern Practice in Crown and Bridge Prosthodontics*, 3rd ed., p. 451, Philadelphia, W. B. Saunders Co., 1971.
9. Minkler, J. S.: Simplified Full Coverage Preparations. *Dent. Clin. North Am.*, pp 355-372, July 1965.
10. Fairley, J. M. and Deubert, L. W.: Preparation of a Maxillary Central Incisor for a Porcelain Jacket Restoration. *Brit. Dent. J.*, 104:208, 1958.
11. Glickman, I.: *Clinical Periodontology*, 4th ed., p. 895, Philadelphia, W. B. Saunders Co., 1972.
12. Wagman, S. S.: Tissue Management for Full Cast Veneer Crowns. *J. Prosthet. Dent.*, 15:106, 1965.
13. Tylman, S. D.: *The Theory and Practice of Crown and Fixed Partial Prosthodontics (Bridge)*, 6th ed., p. 94, St. Louis, The C. V. Mosby Co., 1970.
14. Löe, H.: The Gingival Index, the Plaque Index, and the Retention Index Systems. *J. Periodontol.*, 38:610, 1967.
15. Kaqueler, J. C. and Weiss, M. B.: Plaque Accumulation on Dental Restorative Materials. Abstr. 615, I.A.D.R. Programme and Abstr. of Papers, March 16-19, 1970.
16. Silness, J.: Periodontal Conditions in Patients Treated with Dental Bridges. III. The Relationship Between the Crown Margin and the Periodontal Condition. *J. Periodont. Res.*, 5:225, 1970.
17. Williams, C. M. H.: Investigation Concerning the Dentition of the Eskimos of Canada's Eastern Arctic. *J. Periodontol.*, 14:34, 1943.
18. Löe, H.: In Goldman, H. M. and Cohen, D. W.: *Periodontal Therapy*. 4th ed., p. 35-39, St. Louis, The C. V. Mosby Co., 1968.
19. Manson, J. D.: Passive Eruption. *Dent. Practit. Dent. Rec.*, 14:2, 1963.

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