

The Effect of Polishing Technics on Surface Smoothness and Plaque Accumulation on Stainless Steel Crowns

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Abstract

The purpose of this study was to evaluate the surface produced when stainless steel crowns were polished by several technics and to compare the ability of the various polished surfaces to resist bacterial plaque accumulation.

*Twenty-one Unitek and twenty-one Ion primary molar stainless steel crowns were divided into several groups containing three crowns each. Each group was polished with a different procedure. The crowns were suspended in culture medium and inoculated with *Streptococcus mutans*. Plaque accumulation on each crown was scored by visual assessment. One crown from each group was prepared for SEM evaluation.*

There were no significant differences in the plaque accumulation on the two types of crowns or in the ability of the various polishing procedures to retard the formation of bacterial plaque. The SEM revealed irregular shaped gouges, scratches, and protuberances on all crowns polished with rotary instruments. The smoothest surface was noted on the crowns polished in an acid passivator.

Introduction

Inflammation of the surrounding gingival tissue is a problem frequently associated with stainless steel crowns. The incidence of gingivitis has been reported to be higher around poorly fitting crowns than around crowns considered to be well adapted.¹⁻³ Gingivitis adjacent to restorative materials is likely to be the result

of bacterial plaque rather than direct mechanical irritation from the material.⁴

The polished surface of a stainless steel crown may be an important factor influencing the amount of plaque accumulation. Polishing stainless steel crowns with various combinations of abrasive wheels has been recommended.⁵⁻⁹ The scanning electron microscope (SEM) has revealed that stainless steel crown margins polished with an abrasive wheel are rougher than the unpolished margin of the original crown.¹⁰

The purpose of this study was to evaluate the surface produced when stainless steel crowns were polished by several technics and to compare the ability of the various polished surfaces to resist bacterial plaque accumulation.

Methods and Materials

Twenty-one Unitek* and twenty-one Ion** first and second primary molar crowns were divided into seven groups, each containing three crowns. The seven groups for each crown type were polished in the following manner:

Group 1 — Controls. No polishing procedures.

Group 2 — Cervical margins trimmed with scissors to approximate the length usually required for restoration of a primary

molar and contoured with a contouring plier.*

- Group 3 — Same as Group 2 plus gingival crimping with a crimping plier.**
- Group 4 — Same as Group 3 plus polished with a green stone in a handpiece.
- Group 5 — Same as Group 4 plus polished with a burlew wheel in a handpiece.
- Group 6 — Same as Group 5 plus polished with a felt wheel and rouge in a handpiece.
- Group 7 — Same as Group 5 plus polished for one minute in an acid passivator-polisher.***

The polishing was carried out until the crowns visually appeared as smooth as possible with the procedure. The test specimens were prepared by welding a four inch piece of 0.025 stainless steel orthodontic wire inside each crown. The free end of the wire was inserted in a rubber stopper. Each specimen was assigned a random number for identification.

The specimens were cleaned in an ultrasonic cleaner, rinsed and dried. The test specimens were carefully handled by the rubber stoppers and suspended in culture tubes for autoclaving.

In vitro plaque formation was carried out by the method of McCabe et al.¹¹ using the medium of Jordan et al.¹² supplemented with 5% sucrose. The tubes containing the medium and suspended crowns were inoculated with 0.1 ml of an 18 hour culture of *Streptococcus mutans* 6715 and incubated in an

atmosphere of 95% N₂-5% CO₂ at 37°C.

After one week of incubation the crowns were transferred to a tube containing sterile saline and assessed visually for plaque formation. The crowns were divided into cervical one-third and occlusal two-thirds for scoring. Plaque accumulation was rated on a scale of non — 0, slight — 1, moderate — 2, or heavy — 3.¹² The plaque accumulation was rated by two examiners and a single score for each surface determined.

In test 1, the crowns were suspended so that the cervical portion of the crown was superior. The crown position was reversed in test 2 so that the cervical portion of the crown was inferior. The specimens were thoroughly scrubbed and cleaned in an ultrasonic cleaner and sterilized between tests. The data was analyzed using an analysis of variance procedure.¹³

One of each brand of crown polished by each of the technics was subjected to SEM evaluation. A section was cut from the buccal surface of each crown and positioned on an aluminum stub with cotton pliers using colloidal silver as a cementing medium. Mounted samples were placed in an AMR 1000A scanning electron microscope and examined at a magnification of 500 times.

Results

The mean plaque score for each type of crown and polishing procedure is shown in Table 1.

Plaque accumulation was apparent regardless of the crown type or the polishing procedure. Of 168 observations on 42 crowns, only two were visually judged to be plaque free. There were no significant main effects due to crown type, polishing procedure, test conditions, or location.

*ill4, Rocky Mountain, Denver, Colorado.

**800-417, Unitek Corporation, Monrovia, California.

***J723, Rocky Mountain, Denver, Colorado

Table 1. Mean plaque scores following one week incubation.

Group	CROWN A*				Mean Plaque Score/ Polish Procedure	CROWN B**				Mean Plaque Score/ Polish Procedure
	Cervical One-Third		Occlusal Two-Thirds			Cervical One-Third		Occlusal Two-Thirds		
	Test 1	Test 2	Test 1	Test 2		Test 1	Test 2	Test 1	Test 2	
1	0.33	1.66	2.00	2.00	1.49	0.33	1.66	1.66	2.33	1.49
2	3.00	1.33	1.33	3.00	2.16	3.00	1.66	1.66	2.66	2.24
3	2.66	1.33	1.66	2.33	1.99	2.00	1.66	2.00	2.00	1.91
4	2.66	2.33	1.66	2.33	2.24	3.00	2.00	2.00	2.66	2.41
5	2.66	1.33	1.33	2.66	1.99	2.00	1.66	1.66	3.00	2.08
6	3.00	1.33	1.33	2.33	1.99	3.00	1.33	1.66	2.66	2.16
7	2.66	1.33	2.00	2.66	2.16	2.33	1.33	1.33	2.66	1.91
MEAN PLAQUE SCORE/TEST	2.42	1.52	1.61	2.52		2.23	1.61	1.71	2.56	

*Unitek **lon

A significant interaction between location and test conditions was noted indicating that the superior portion of the suspended crowns showed a greater tendency for plaque accumulation than did the inferior portion ($P < 0.001$, Figure 1).

The 3-way interaction between polish, test and location was also significant ($P < 0.001$), but the F value was much less than for the test X location interaction (Table 2).

The SEM evaluation revealed irregular shaped gouges, scratches and protuberances on all crown surfaces polished with rotary instruments (Figure 2).

The crowns which received their final polish with a stone showed particularly deep grooves extending throughout the length of the field (Figures 2C and 2D). The crowns finished with a burlew wheel also displayed scratch lines typical of a rotary instrument (Figures 2E and 2F). The surface of the crowns finished with rouge and a felt wheel appeared slightly less rough (Figures 2G and 2H). The smoothest surfaces were observed on the crowns polished in the acid passivator polisher (Figures 2I and 2J).

Discussion

Although each type of crown studied contains a different metal alloy, this study demonstrates that plaque will readily colonize on the surface of either type of crown, *in vitro*, regardless of the polishing technic employed. None of the polishing procedures evaluated appeared to produce a plaque resistant sur-

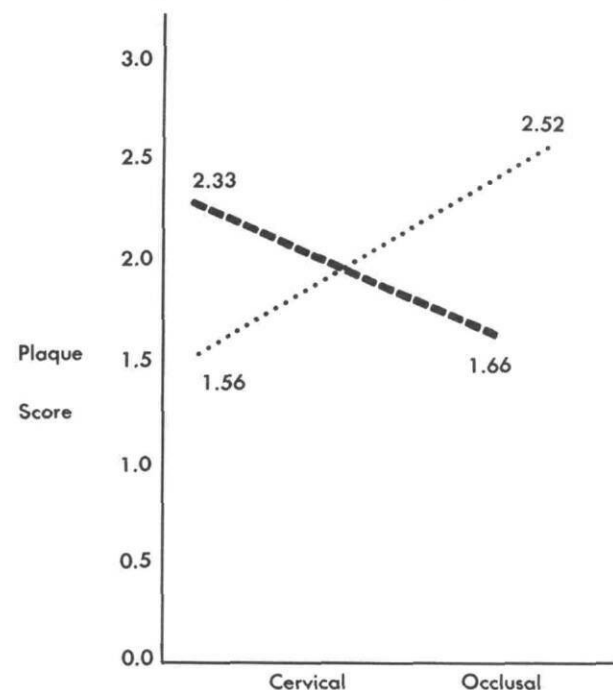


FIGURE 1. Means of both types of crowns combined showing interaction between location and time. (Test 1 = ---; Test 2 =)

Table 2. Sources. T = time, L = location (cervical vs occlusal); P = polish technic

Results of Selected Portions of Analysis of Variance		
SOURCE	F	P
P	3.0600	0.025
P x L	2.6588	0.050
L x T	128.9421	0.001
P x L x T	10.6225	0.001

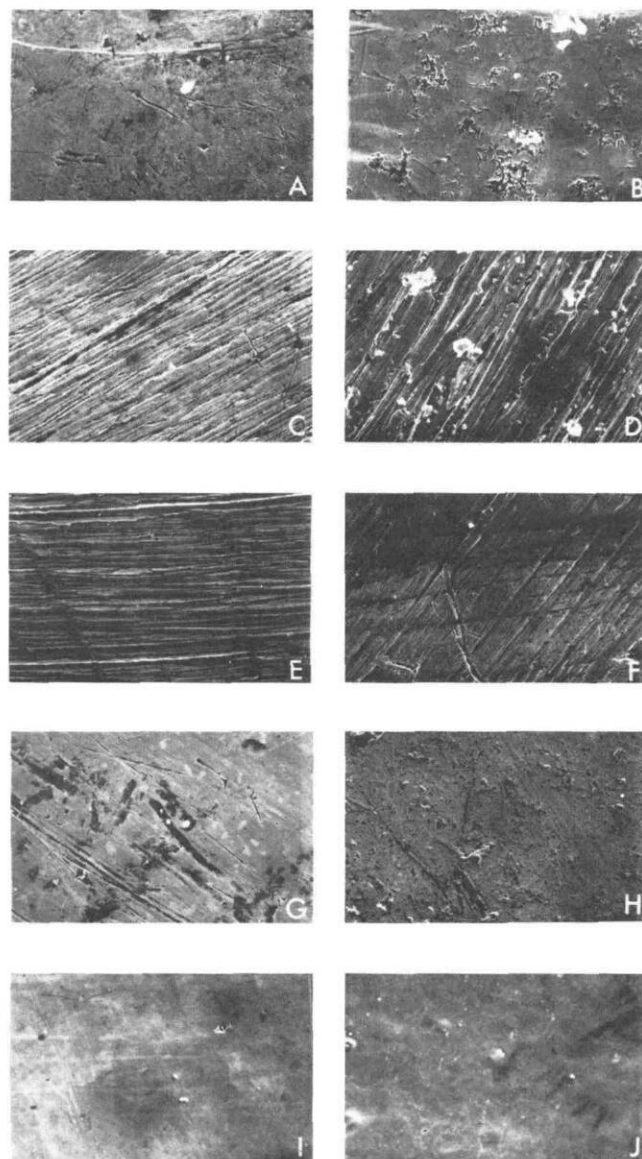


FIGURE 2. A. Unitek - original surface B. Ion - original surface
 C. Unitek - stone polish D. Ion - stone polish
 E. Unitek - burlew polish F. Ion - burlew polish
 G. Unitek - rouge polish H. Ion - rouge polish
 I. Unitek - acid reducer polish J. Ion - acide reducer polish
 (All photographs taken at 500X)

face. This finding is in agreement with that reported for other metal restorative surfaces.¹⁴ The significance of the significant interaction between location and test condition is unknown.

The SEM observations confirm previously reported work, by Peterson et al., that polishing with a rotary instrument produces a surface that is rougher than the original unpolished crown.¹⁰ The smoothest surface resulted when the crown was polished in the acid passivator. However, this surface did not prevent accumulation from occurring.

While both crown types are supplied by the manufacturer in precontoured, or precimped form, the fact remains that placement of the stainless steel crowns requires trimming and contouring to achieve a satisfactory fit. Manufacturers should be encouraged to produce crowns nearer the correct length and contour to minimize the need for modification, thus preserving the original crown surface.

This study demonstrates that plaque will readily form *in vitro* on stainless steel crowns regardless of the polishing procedure employed. Stainless steel crowns should be carefully fitted to avoid mechanical irritation to the gingiva, and oral hygiene procedures emphasized to minimize the accumulation of bacterial plaque.

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References

1. Goto, G., Imanishi, T. and Machida, Y.: "Clinical Evaluation of Preformed Crowns for Deciduous Teeth", *Bull Tokyo Dent Coll*, 11:169-176, 1970.
2. Henderson, H. Z.: "Evaluation of the preformed stainless steel crown", *J Dent Child*, 40:353-358, 1973.
3. Myers, D. R.: "A clinical study of the response of the gingival tissues surrounding stainless steel crowns" *J Dent Child*, 42:281-284, 1975.
4. Waerhaug, J.: "Historical considerations which govern where the margins of restorations should be located in relation to the gingival", *Dent Clin N Amer*, March, 1960, pp. 161-176.
5. Finn, G.: *Clinical Pedodontics*, Philadelphia: W. B. Saunders, Co., 1973, p. 164.
6. McDonald R. E.: *Dentistry for the Child and Adolescent*, St. Louis: C. V. Mosby Co., 1974, pp. 206-209.
7. Rapp, R.: "A simplified yet precise technique for the placement of stainless steel crowns on primary teeth", *J Dent Child*, 33:101-109, 1966.
8. Mink, J. R. and Bennett, I. C.: "The stainless steel crown", *J Dent Child*, 35:186-196, 1968.
9. Myers, D. R.: "The restoration of primary molars with stainless steel crowns", *J Dent Child*, 43:406-409, 1976.
10. Peterson, D. S., Fubach, T., and Katora, M.: "Scanning electron microscope study of stainless steel crown margins", *J Dent Child*, 45:376-380, 1978.
11. McCabe, R. M., Keyes, P. H., and Howell, A.: "An in vitro method for assessing the plaque forming ability of oral bacteria", *Archs Oral Biol*, 12:1653-1656, 1967.
12. Jordon, H. V., Fitzgerald, R. D., and Bowler, A. E.: "Incubation of experimental caries by sodium metabisulfite and its effect on the growth and metabolism of selected bacteria", *J Dent Res*, 39:116-123, 1960.
13. Gardner, P. L.: "Scales and Statistics: Review of educational Research", 45:43-57, 1975.
14. Giddenhuyse, R. R. and Stallard, R. E.: "Comparison of plaque accumulation on metal restoration surfaces", *Dental Survey*, 51:56-59, 1975.