

A comparison of different techniques for finishing and polishing amalgam

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Three different methods for finishing and polishing amalgam surfaces were studied by determining the roughness (R_a) of specimens at different stages of the procedures. Method I consisted of green stone, followed in sequence by finishing bur and pastes of pumice, powdered chalk, and SnO_2 . Method II was similar to method I but included brown and green Shofu polishers after the finishing bur. In method III medium and fine sandpaper and fine cuttle-paper discs were used before the pastes. A dramatic decrease in the R_a values was observed after the specimens had been ground with green stones, finishing burs, and sandpaper discs. Pumice resulted in a further reduction in R_a values. However, no significant differences in R_a values were found between the brown Shofu polisher, the fine cuttle-paper disc, and the different pastes. The lowest R_a value—that is, the highest smoothness—was obtained with green Shofu polisher. □ *Dental materials; in vitro study; operative dentistry*

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Finishing and polishing amalgam restorations have been regarded as necessary steps in restorative dentistry. Svärdröm (1) describes finishing as involving removal of material and polishing as surface treatment. These procedures enable adjustment of contour and occlusion, and it has been claimed that they provide a better marginal adaptation by removing excess of amalgam at the margins that could otherwise fracture and leave a ditch between the tooth and the filling (2, 3). Finishing and polishing may also lead to increased resistance to tarnish and corrosion and thus to better esthetics (1, 4). Polishing leads to less retention of plaque, with a supposedly reduced irritation of the gingival tissues (1, 4-6). In addition, it is easier to evaluate the quality of the amalgams when the fillings have been polished (1).

Various procedures have been outlined to attain a smooth amalgam surface. The traditional methods have been the use of diamonds, finishing burs, and abrasive discs for contouring, followed by polishing strips, various brushes and rubber cups with a selection of polishing pastes (1-3, 7). In the past decade the introduction of rubber pol-

ishing points and wheels has led to modifications in these procedures (1, 4); some authors, however, dismiss the need to go beyond the use of finishing burs (8, 9).

The aim of the present investigation was to study the effect of different finishing and polishing techniques on dental amalgam specimens, taking into account time consumption and cost. Three techniques were selected to represent treatment of smooth surface fillings (paper discs) and occlusal restorations (polishers and pastes). Since measurement of roughness seems to be an ideal method to characterize the surface of amalgam restorations (10), this technique was used to obtain a measure of the effect of different techniques.

Materials and methods

A non-gamma 2 dispersion type amalgam (NG2®, AB Ardent, Sweden, batch no. 8401.12), in capsule form, was used in the investigation. Trituration was done with an amalgamator (Silamat, Vivadent, Liechtenstein) for the time suggested by the manufacturer.

Thirty-nine amalgam specimens were made by condensing amalgam into a cylindrical steel mold with a diameter of 4 mm. The condensation was carried out in accordance with ADA specification no. 1, but, to imitate the clinical situation, a sharp Nyström no. 2 carver was used to cut off the specimens when removing the excess material. After condensation the specimens were stored for 1 week at 37°C. They were then embedded in resin blocks (Acryfix, Struers, Denmark), four to five specimens in each block, with the circular experimental surface exposed.

The specimens were finished and polished with a slow-speed handpiece. The following instruments were used:

A) Green stone (Viking no. 17A, Hallvard Foss & Co. A/S, Fetsund, Norway), 10 sec at 24,000 rpm.

B) Finishing bur (Round no. 5, which had been used for 30 sec on a steel plate to simulate wear), 60 sec at 24,000 rpm in reversed direction of rotation.

C) Coarse rubber point (Brownie, Shofu Dental Corp., Japan), 30 sec at 24,000 rpm.

D) Fine rubber point (Greenie, Shofu Dental Corp., Japan), 30 sec at 24,000 rpm.

E) Medium-grit sandpaper disc (S. S. White Ltd., England), 10 sec at 6000 rpm.

F) Fine-grit sandpaper disc, as E.

G) Fine-grit cuttle disc, as E.

H) Pumice, 2 g of powder mixed with 1 ml of glycerol and applied with a rubber cup, 30 sec at 6000 rpm.

I) Powdered chalk, 1 g of powder mixed with 1 ml of water and applied with a rubber cup, 30 sec at 6000 rpm.

J) SnO₂, 1.5 g of powder mixed with 1 ml of water and applied with a rubber cup, 15 sec at 6000 rpm.

New finishing burs and paper discs were used for all specimens. The stones, burs, and rubber points were used with copious water-cooling. Between each finishing and polishing step the specimens were cleansed first in running water and then in an ultrasonic bath, rinsed in alcohol, and dried in a blast of warm air. The time needed to obtain the optimal effect from each instrument, on the basis of visual evaluation, was selected as the experimental working period. The blocks

were divided into three groups in accordance with the following finishing and polishing procedure:

Group I: A-B-H-I-J (15 specimens)

Group II: A-B-C-D-H-I-J (14 specimens)

Group III: E-F-G-H-I-J (10 specimens)

Roughness determination

At the start of each series, and after each step, the surface roughness, R_a , was determined with a roughness measuring instrument (Petrohometer W5A, Perthen, FRG) (10), which was calibrated against a standard. The instrument was mounted in a profile projector (Nikon Profile Projector, Japan), so that the path of the profile trace could be chosen. Seven parallel scans, 1.5 mm long and separated by a distance of 0.1 mm, were made, with another 7 parallel scans at right angles to the first—altogether 14 scans. This gave a total scan length of 21 mm for each specimen. To minimize the effect of the curvature of the surface, a filtration was used corresponding to a cut-off value of 0.25 mm (10). The analysis of the data is based on the mean value for each specimen.

Statistical evaluation

Differences between mean values of series to be compared were evaluated by Student's *t* test (two-sided).

Results

The R_a values for the different groups are shown in Figs. 1–3. The corresponding levels of significance are shown in Table 1. A marked decrease in the R_a values was observed after the specimens had been ground with green stones and finishing burs (Figs. 1 and 2). Pumice gave a further significant reduction of the R_a values, which remained at the same level after polishing with powdered chalk and SnO₂.

The use of both types of polishers after stone and finishing bur resulted in significant reductions in the R_a values (Fig. 2). On the other hand, the step from fine polisher to

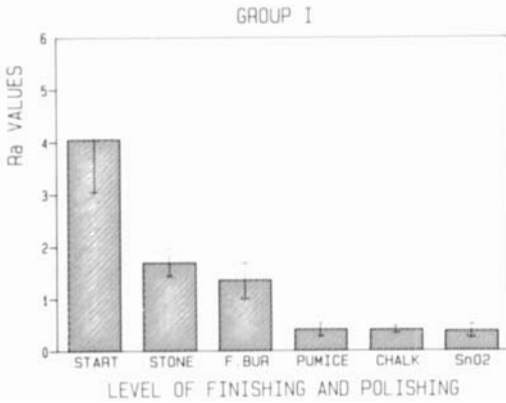


Fig. 1. Levels of roughness (R_a) of amalgam after sequential use of green stone, finishing (F.) bur, pumice, chalk, and SnO₂.

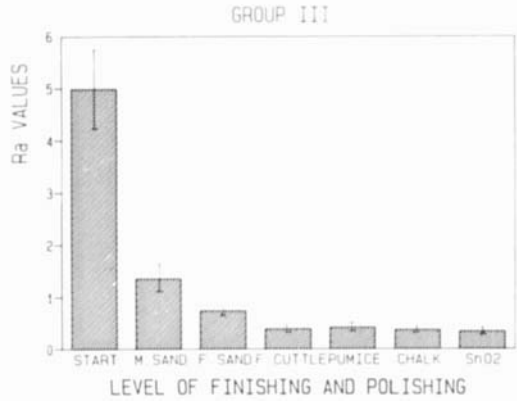


Fig. 3. Levels of roughness (R_a) of amalgam after sequential use of medium sandpaper disc (M. SAND), fine sandpaper disc (F. SAND), fine cuttle disc (F. CUTTLE), pumice, chalk, and SnO₂.

pumice gave a significant increase in the value of R_a . In this group the powdered chalk after pumice gave a significant reduction in the R_a value. No further change in the R_a values was seen after the use of SnO₂.

A significant decrease in the R_a values was registered after paper discs had been used, compared with the initial roughness. Pumice, powdered chalk, and SnO₂ after the fine-grit cuttle disc did not reduce the R_a values significantly (Fig. 3). The R_a levels of green-stone- and finishing-bur-treated specimens were compared in group I and group II: no significant differences were found (Table 1).

Specimens in all groups which had been treated with pumice showed similar R_a values. On the other hand, a significant difference was found between powdered chalk-treated specimens of group II and group I, whereas no significant difference was found between specimens in the other groups. The situation was the same for SnO₂-treated specimens.

Table 1. Significance levels (p) for change in surface roughness between sequential steps in three different polishing procedures

Level of polishing	Group I	Group II	Group III
Start	} $p < 0.001$	} $p < 0.001$	
Green stone			
Finishing bur	} $p < 0.01$	} $p < 0.01$	} $p < 0.001$
Medium sandpaper			
Fine sandpaper			
Fine cuttle	} $p < 0.001$	} $p < 0.001$	} $p < 0.001$
Coarse polisher			
Fine polisher	} $p < 0.001$	} $p < 0.001$	
Pumice			
Powdered chalk	} NS	} $p < 0.01$	} NS
SnO ₂			

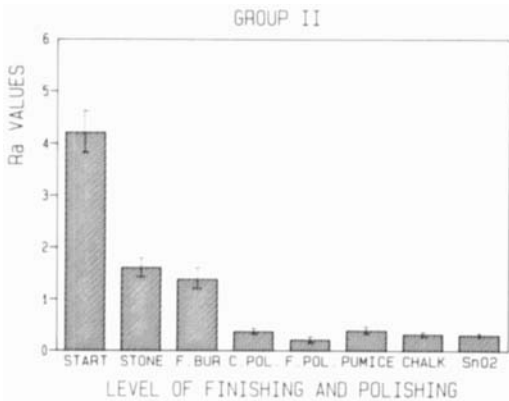


Fig. 2. Levels of roughness (R_a) of amalgam after sequential use of green stone, finishing (F.) bur, coarse polisher (C. POL.), fine polisher (F. POL.), pumice, chalk, and SnO₂.

No significant difference in roughness was found whether the specimens had been treated with fine cuttle disc (group III), pumice (groups I and II), or coarse rubber polisher (group II). However, a significant decrease in R_a values was noted after treatment with fine rubber polisher (Fig. 2).

Discussion

Svärdström (1) has recommended a procedure for finishing and polishing dental amalgam fillings which consists of five steps, including diamonds, finishing burs, rubber points, and coarse and fine polishing pastes. Similar stepwise procedures have been advocated by many institutions and are widely used by dental practitioners. It is obvious that such a scheme is time-consuming and therefore costly, and one of the aims of the present study was to evaluate whether a rationalization would be possible.

The findings indicate that a simplification of the polishing procedure is feasible. The use of fine cuttle discs, coarse rubber points, and both coarse and fine pastes resulted in the same surface roughness. It was unexpected that the use of fine pastes did not reduce the R_a value further in two of the three groups. Since pumice and amalgam have the same relative hardness on the Mohs scale, pumice will abrade amalgam. On the other hand, chalk and SnO_2 are placed lower than amalgam on the scale and are less abrasive (1). Only the use of green Shofu polishers resulted in a lower R_a value. Consequently, the use of pastes after coarse polishers appears to be a superfluous step in the polishing procedure, and after using fine cuttle discs when these are indicated, no further improvement is obtained with coarse polishers or pastes. If the highest level of polish is desirable, then the procedure should end with the green Shofu polisher, which gave the lowest R_a level.

With regard to time consumption, the results indicate that polishing discs give the highest effect in the shortest time. Coarse rubber points and pumice gave results similar to those with polishing discs, with three times longer working period.

Polishing points are fairly expensive and wear easily. Scruggs & Wilder (11) have recommended dry polishing points used with a light, intermittent pressure, since this leads to less wear of the points. They maintain that this represents no danger of overheating, but admit that this procedure leads to a considerable increase in polishing time. Pumice, on the other hand, is inexpensive and easily available and can readily be made into a paste of the desired consistency.

In the teaching of dental students, finishing and polishing of dental restorations have always been regarded as necessary steps, and much emphasis has been placed on achieving the highest possible level of smoothness. However, the rationale for this requirement is not clear, and can be questioned.

There is some controversy as to the need for a high polish from a periodontal point of view. Some authors (1, 4–6) advocate an extensive polishing to reduce the retention of plaque, and thereby minimize gingival inflammation. It has, however, been claimed that merely contouring of restorations and removal of marginal overhangs are sufficient to retain gingival health (8, 9, 12).

Several studies have shown that secondary caries is the major cause for replacing amalgam fillings (13–16). It seems reasonable that a well-polished amalgam filling will retain less plaque than a rough amalgam surface and thereby reduce the cariogenic challenge. Furthermore, the esthetic value of a well-shaped and well-polished amalgam filling and its reflection on the self-esteem of the practitioner should not be underestimated.

Corrosion of amalgam is a rather complex subject. Ideally, the corrosion subsides with the developing film of corrosion products. However, the maintainance of such a film is dependent on many factors. A rough surface represents, of course, an increased surface area with a correspondingly increased corrosion. It is impossible to maintain a stable passive surface film due to the chemical conditions in crevices and porosities and beneath plaque (17). Polishing of amalgam fillings should therefore lead to less corrosion both through decreased surface area and through reduced plaque retention.

All therapy requires a continuous control of quality, and polishing is a necessary step for evaluating the quality of amalgam fillings. The porosity level reflects the composition of the amalgam and the handling of the material and can only be judged after a proper finishing and polishing procedure. Moreover, such a procedure will make it easier to assess the fillings later.

In conclusion, this study shows that a cost/benefit-effective regimen for finishing and polishing amalgam fillings should include, in sequential order, green stones, finishing burs, and pumice or coarse rubber polishers. This procedure could be supplemented with paper discs for special locations. If the highest possible polish is desired, a fine rubber polisher could be added to the regimen.

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