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A NEW METHOD FOR FINISHING MINICAVITIES

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Abstract

Minicavities were prepared in 26 caries-free teeth. Cavity preparation and the finishing of the occlusal area and the gingival floor was done with diamond burs (diameter 1 mm, grain sizes 90 µm and 15 µm, respectively). For the finishing of the axial box margin and the proximo-cervical curved border, a new set was developed: It is composed of an EVA-system with the total amplitude reduced to 0.34 mm, and a highly flexible file (Cavishape, grain 15 µm). The shape of this file had to be modified in order to follow the proximo-cervical curvature. The efficiency of the new device was compared with the axial margin trimmer by means of scanning electron microscopy and a score system.

The new device allowed a significantly better finishing of the proximo-cervical curvature and of the axial box margin.

KEY WORDS: Minicavities, finishing of preparations, amalgam, diamond, EVA-system.

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Introduction

The prevalence of caries in Switzerland and other developed countries has been declining during the last decade (Marthaler 1977, 1979; Marthaler et al. 1982). This fact, combined with the more frequent recalls, has lead to the detection of caries in the earlier stages of development. Thus, Black's century-old principle that class 2 cavity preparations should extend beyond the carious lesion to prevent further decay is no longer valid (Bowen 1983). Many investigators (Markley 1951, Vale 1959, Nadal et al. 1961, Almquist et al. 1973, Jacobsen & Robinson 1980, Elderton 1984b) have suggested that smaller cavities (= "minicavities", Fig. 1) be prepared. Studies have shown clearly that the smaller cavities have a longer service life (Almquist et al. 1973, O'Hara & Clark 1984). The reasons are: 1) masticatory forces are borne by the tooth structure rather than the restoration; 2) the amalgam in the smaller cavities is less susceptible to fracture. Therefore, Elderton (1984a) suggested a cavity width of 1 mm and an amalgam margin angle of at least 70°.

Preparations of the minicavities and finishing of the occlusal area are easily accomplished with commercially available instruments. The finishing of the axial box margin and the proximo-cervical curved border is another matter. Instruments, such as paper disks and small burs, can be used only when the old principle of cavity extension is employed. The gingival cavity margin can be finished with the gingival margin trimmer. When the gingival floor was finished with a diamond bur (grain 15 µm), it was shown that an additional finishing with a gingival margin trimmer did not improve this margin (Lussi et al. 1987). An axial margin trimmer can be used to finish the axial box margin and the proximo-cervical curved border (Fig. 2). However, preliminary clinical studies with several general practitioners showed that this finishing was unsatisfactory because the margins were too rough (Buzzi, unpublished).

The aim of this study was, therefore, to develop a new instrument designed to satisfactorily finish the axial box margins and the proximo-cervical curved borders of small cavity preparations (= "minicavities"). The finishing done with this new instrument was compared with that done with the axial margin trimmer.

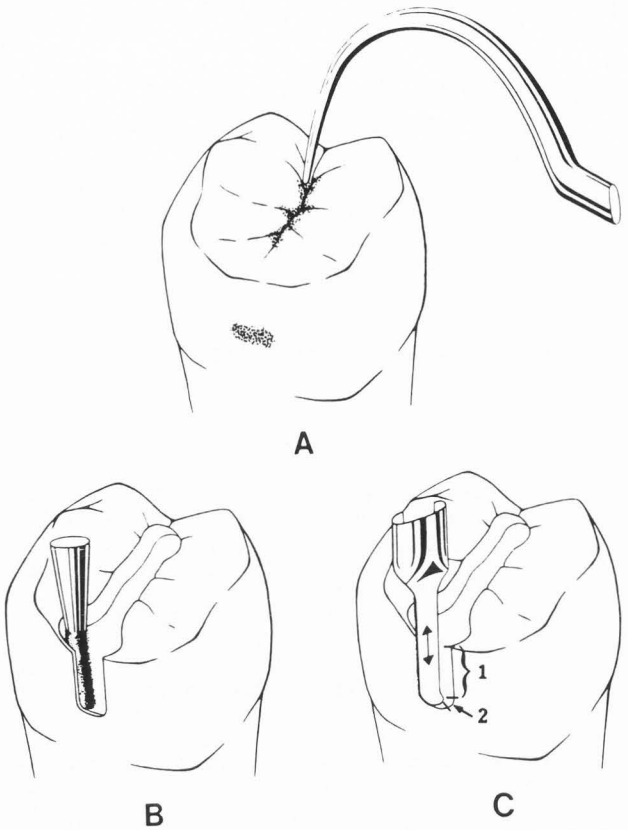

Fig. 1. A. Explorer locating caries on occlusal surface. Note lesion on proximal surface. B. Formation of enamel-lamella with diamond bur. C. Finishing with the new device. Note: curvature of file; 1 = axial box margin; 2 = proximo-cervical curvature.

Materials and Methods

Minicavities were prepared on 26 caries-free extracted human premolars and molars. To simulate the situation in the mouth, each tooth was embedded in a plaster block adjacent to another tooth. The cavity was prepared with a diamond bur (grain size 90 µm, diameter 1 mm, ISO). In order not to introduce a new variable only one investigator prepared the cavities.

In all 26 cavities, the occlusal area and the gingival floor were finished with the appropriate diamond bur (grain 15 µm, diameter 1 mm). To prevent damage to the adjacent tooth while drilling the cavity, the final enamel-lamella could not be removed fully (Fig. 1B). The remaining 52 unfinished vertical borders were divided randomly into two groups. In one group the axial box margin and the proximo-cervical curved borders were treated with an unused sharp axial margin trimmer (Fig. 2), (tungsten carbide; LM, Michel & Cie AG, Schanzenstrasse 1, CH-3008 Bern). In the second group the borders were finished with the new device. For further evaluations all margins were coded, so that the investigators did not know which instrument was used.

The new instrument is composed of an EVA-system (Lutz et al. 1981) technically modified so that the total amplitude of vibration was reduced from 1.5 mm to 0.34 mm (KaVo, Innovationsgesellschaft, 7950 Biberach, Germany). This reduction was necessary to prevent damage to the border. The original EVA-system with its rigid diamond file has been used to eliminate overhangs in restorations or to polish restorations (Small et al. 1987). The working surface of the original file was replaced with a highly flexible file that has a curved end (Cavishape, grain 15 µm, Intensiv S.A. Via Molinazzo 11, 6962 Viganello, Switzerland). The file was replaced so that the working surface conformed with the proximo-cervical curvature (Fig. 3).

In both groups, the margins studied were finished for 20 ± 2 seconds, cleaned with Tubulicid (Dental Therapeutics AB, Ektorpvägen 3,

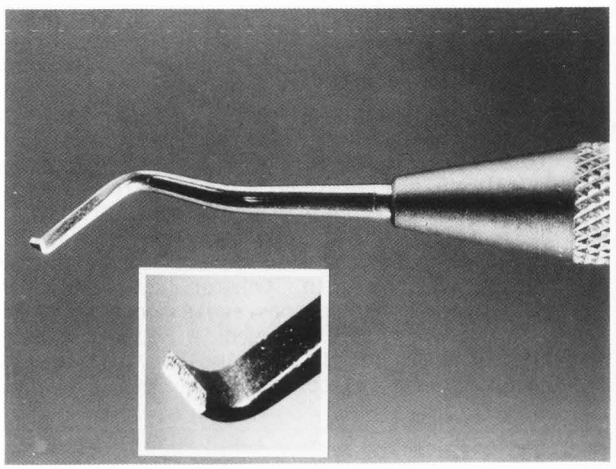

Fig. 2. The axial margin trimmer (tungsten carbide).

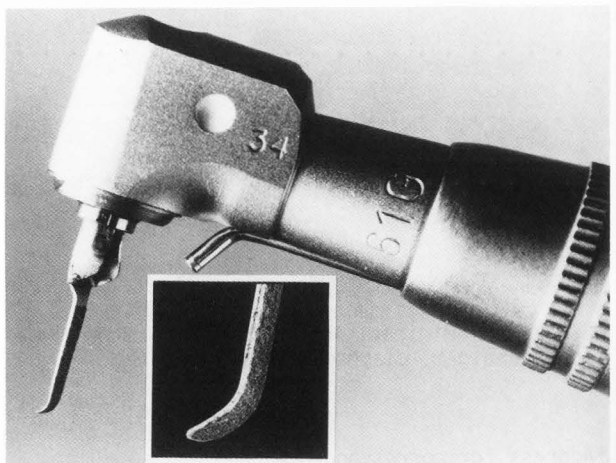

Fig. 3. The new device, a modified EVA-instrument (amplitude 0.34 mm) with a flexible file that is terminally curved.

13145 Nacka, Sweden), carefully washed with water and dried with air. Primary replicas were made with President light body (Coltène, 9450 Altstätten, Switzerland). Secondary replicas were made with an epoxy (Stycast; Emerson and Cuming, 2431 Westerlo-Oevel, Belgium), gold coated and evaluated using scanning electron micrographs (Cambridge, Stereoscan 200) and a score system. Prior to the study; it was found that independent scoring of margins by the investigators agreed in 95% of the cases. The scoring of the margins was done independently by two investigators (A.L and D.L) using a system slightly modified from that of Tronstad and Leidal (1974) and Leidal and Tronstad (1975).

Scores for the axial box margin

Score 0: no chips at the enamel margin, perfect margin (Fig. 4)
Score 1: few, isolated small chips at the enamel margin, imperfect margin (Fig. 5)
Score 2: large chips at the enamel margin, unacceptable margin (Fig. 6)

Scores for the proximo-cervical curvature

Score 0: no chips at the enamel margin, perfect margin (Fig. 7)
Score 1: few, isolated small chips at the enamel margin, imperfect margin (Fig. 8)
Score 2: large chips at the enamel margin, unacceptable margin (Fig. 9)

Statistical evaluation

The statistical significance of the differences between the methods was determined using the Chi-square test. A significance level of $P < 0.05$ was employed.

Results

Axial box margin (Table 1).

The margins of the axial box were significantly better, when finished with the modified EVA-instrument and the highly flexible file compared to the axial margin trimmer ($P < 0.05$). A zero score (0; indicating a perfect margin) was found more frequently (21 to 13) with the new device than with the hand instrument. Unacceptable margins (i.e., score 2) were recognized 5 times with the margin trimmer, while this occurred 3 times with the EVA-instrument.

Proximo-cervical curvature

Table 2 clearly shows the significant better finishing of the proximo-cervical curvature of the new device compared to the axial margin trimmer. The margin was perfect in 4 of the 26 cases using the trimmer, while this occurred in 17 of 26 cases using the new instrument. Imperfect and unacceptable margins were detected more than twice as often with the hand instrument as with the modified EVA-instrument.

Table 1 Grading of the axial box margin

Score	0	1	2	
EVA-instrument with file	21	2	3	*
Axial margin trimmer	13	8	5	

* = significant difference, $P < 0.05$

Table 2 Grading of the proximo-cervical curvature

Score	0	1	2	
EVA-instrument with file	17	5	4	*
Axial margin trimmer	4	13	9	

* = significant difference, $P < 0.05$

Discussion

Minipreparations of class 2 cavities often are not employed in daily practice mainly because adequate instruments for finishing the axial box margin and the proximo-cervical curvature were not available. Proper finishing of the proximo-cervical curvature is important because secondary caries often start at this site (Vale 1959). In small cavities, paper disks cannot be used because they are too large. Small burs can cause a slice in the preparation (e.g., a long gingival bevel) which is not desirable for amalgam restorations. The axial margin trimmer is small enough to finish the whole border. However, it leaves a rough margin. Additionally, in daily practice there is the problem of the axial margin trimmer becoming dull, the difficulty to sharpen it and the expense of replacing it (Buzzi, unpublished).

This study shows that the new device is clearly superior to the axial margin trimmer. In the proximo-cervical curvature the new device led to a perfect finishing more than four times as frequently as the axial margin trimmer. The large amount of enamel chips lost in the curvature when the axial margin trimmer is employed could be due to the higher force exerted by the operator to start movement in the curvature. The Cavishape-file, however, fits close to the whole margin causing a uniform application of force. Additionally, the small amplitude of the modified EVA-instrument (0.34 mm) and the flexible, curved file that fits well to the anatomy of the cavity are ideal for finishing the proximo-cervical curvature.

The new instrument was also superior to the axial margin trimmer in finishing the axial box margin. The modified EVA-instrument and the Cavishape-file produced perfect margins more than 1.5 times compared to the margin trimmer. Additionally, the new device is easier to use.

Further applications of the EVA instrument with the reduced amplitude and the high flexible file under study are in the preparation of inaccessible minislices and in the treatment of root surfaces.

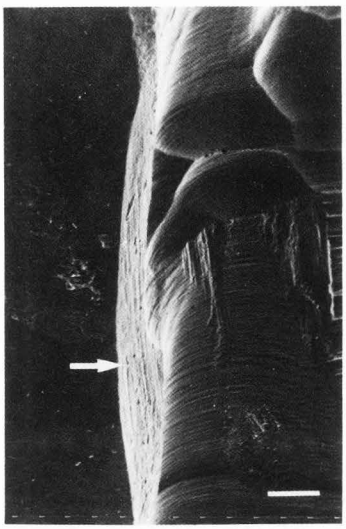

Fig. 4. Perfect axial box margin finished with the new instrument. No enamel chips can be found at the margin, arrow (Score = 0). Bar = 200 µm

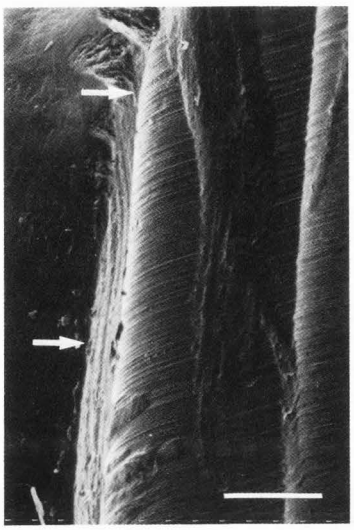

Fig. 5. Imperfect axial box margin finished with the new instrument. Few enamel chips can be found at the margin, arrow (Score = 1). Bar = 200 µm

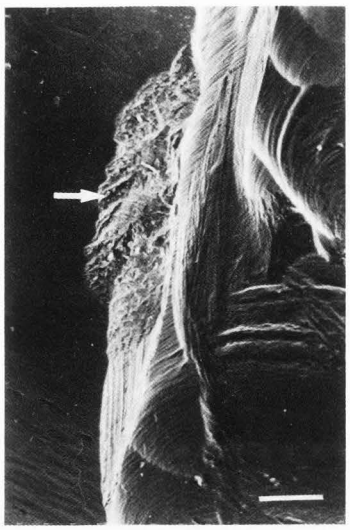

Fig. 6. Unacceptable axial box margin finished with the new instrument. Large chips can be found at the margin, arrow (Score = 2). Bar = 200 µm

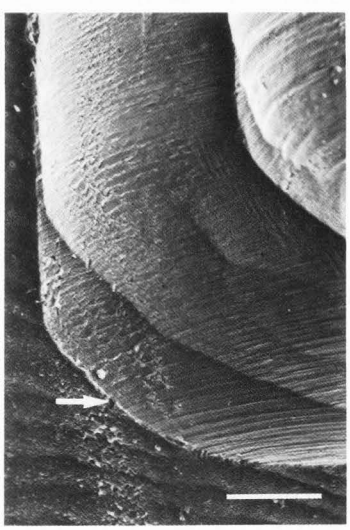

Fig. 7. Perfect proximo-cervical curvature finished with the axial margin trimmer. No enamel chips can be found at the margin, arrow (Score = 0). Bar = 200 µm

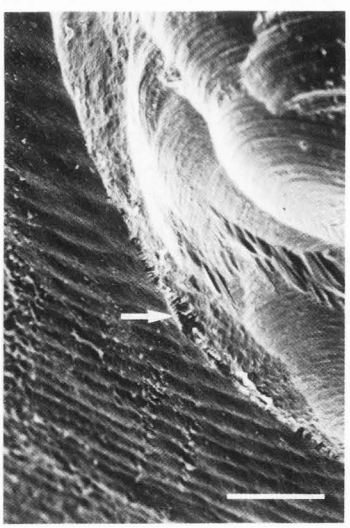

Fig. 8. Imperfect proximo-cervical curvature finished with the axial margin trimmer. Few enamel chips can be found at the margin, arrow (Score = 1). Bar = 200 µm

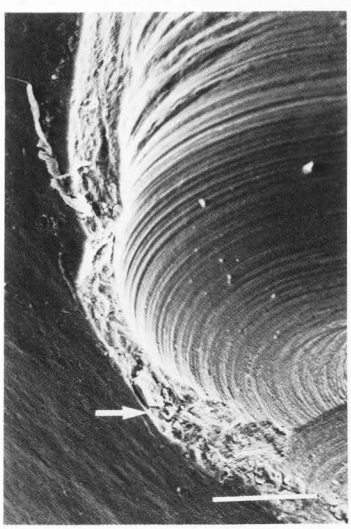

Fig. 9. Unacceptable proximo-cervical curvature finished with the axial margin trimmer. Large chips can be found at the margin, arrow (Score = 2). Bar = 200 µm

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Discussion with Reviewers

Reviewer IV: Do the authors feel that it would be possible to make some of these distinctions between the two techniques using a hand magnifier or the naked eye, or is this far too difficult to discern on a "white" colored tooth?
Authors: Sometimes, it was possible to distinguish grade 2 from grade 0 by a hand magnifier. However, the hand lens is not adequate for quantification with a score system.

Reviewer IV: Was a "fresh" axial margin trimmer used for each cavity? I'm sure that the authors would agree that dulling of the trimmer would influence the results if the same one was used throughout the study.
Authors: For all 26 margins the same file and the same margin trimmer (with two working sides) were used. It would be unusual in daily practice to sharpen the axial margin trimmer (tungsten carbide) after using it for only one margin or to replace the file after each margin finishing. It is our experience that the trimmer does not dull as easily as the reviewer suggests.

Reviewer IV: Since the two score systems are identical, it would be proper to combine them into one, i.e., there is no reason to repeat the same information twice.
Authors: The scoring system is repeated because of the need to refer to the micrographs. (see Figs. 4-9).

I.C. Punwani: Were minicavities prepared by only one investigator? How was the potential bias controlled in the use of hand instruments (margin trimmers)?
Reviewer IV: Since the authors comment in the Discussion on the operator variables that make the axial margin trimmer less efficient, it would be beneficial for them to explain why they did not compare the results from several operators in this study?
Authors: In this first report, all minicavities were prepared by one investigator. In our opinion, it is virtually impossible to eliminate operator bias because the devices are so different. However, we have been aware of this problem and therefore a study with different practitioners is in progress.