Effects of Various Stripping Techniques on Surface Enamel

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A great deal of clinical evidence and reported data suggest that the burs used to reduce interproximal enamel create furrows and scratches that can lead to carious lesions, periodontal disease, and oversensitivity to extreme temperatures.[1] Studies conducted on fragments of intraoral enamel have shown that the size and particularly the depth of these furrows can have a significant effect on remineralization and thus on the formation of demineralizing lesions.[2] The more numerous and deep the lesions, the higher the risk that they will be carious.

The present study was intended to assess surface changes in enamel caused by treatment with various stripping and finishing techniques.

Materials and Methods

Thirty permanent teeth were extracted from non-bruxing, healthy patients (mean age: 32 years) for orthodontic and surgical reasons. No teeth with white spots, caries, or changes in the morphology and structure of interproximal enamel were selected. The teeth were stored in a saline solution for a maximum of seven days.

After being fixed to semi-elastic supports, the teeth were randomly divided into three groups: A, B, and C. These were further divided into two subgroups each, depending on the type of interproximal enamel stripping and finishing, as follows.

Group A1: Stripping with No. 699L tungsten carbide bur.*
Group A2: Stripping with No. 699L tungsten carbide bur and finishing with No. 862 ultrafine diamond bur.**
Group B1: Stripping with No. 699L tungsten carbide bur.
Group B2: Stripping with No. 699L tungsten carbide bur and finishing with 20 polishings using Sof-Lex medium, fine, and superfine discs.***
Group C1: Stripping with No. H135 tungsten carbide bur.†
Group C2: Stripping with No. H135 tungsten carbide bur and finishing with 20 polishings using Sof-Lex medium, fine, and superfine discs.

To ensure comparability of results, all treatments were performed by a mechanical device that applied pressure evenly and removed the

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**No. 862.314.014 EF, Komet, Via Marco Aurelio, 8, 20127 Milan, Italy.
***Sof-Lex Contouring and Polishing Discs, Nos. 2382M, 2382F, and 2382SF, 3M Dental Products, P.O. Box 33600, St. Paul, MN 55133.
†No. H135.314.014, Komet, Via Marco Aurelio, 8, 20127 Milan, Italy.

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same thickness of enamel from each tooth.

After completion of the stripping and polishing procedures, the teeth were removed from their supports. A low-speed diamond bur was used to cut a section along the major axis of each tooth, separating the mesial and distal surfaces for the study. Only the distal surfaces were treated because the distal enamel is significantly thicker than the mesial enamel in all lower posterior teeth except the second premolars.[3]

Each fragment was washed with deionized water and blown dry. Each sample was then mounted on metallic supports, dehydrated, and gold-coated (thickness: 30 nanometers; time: 2 minutes; current: 25mA) for observation under a scanning electron microscope.‡

The degree of roughness and the characteristics of furrows created by the burs were analyzed on the SEM images using a double-blind method; in other words, the evaluator was unaware of which group an image belonged to.

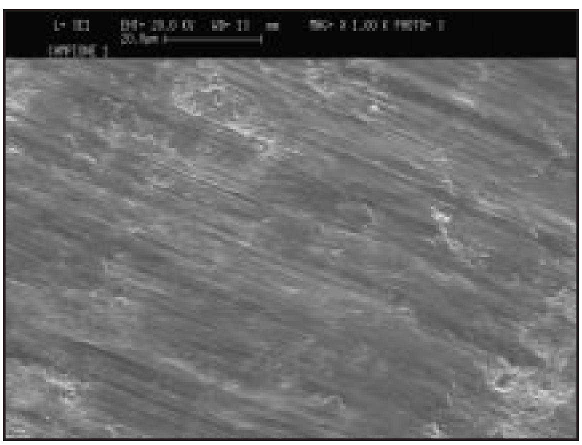

Fig. 1 SEM image (×1000) from Group A1 (stripped with No. 699L tungsten carbide bur), showing small number of furrows distributed over entire surface and interspersed with rough areas.

Results

Group A1: The No. 699L tungsten carbide bur created a small number of furrows distributed over the entire surface and interspersed with rough areas (Fig. 1).

Group A2: The No. 699L tungsten carbide bur and No. 862 ultrafine diamond bur produced deep furrows distributed regularly and evenly over the entire surface (Fig. 2).

Group B1: These samples were not evaluated

‡Cambridge Scientific Products, Cambridge, MA.

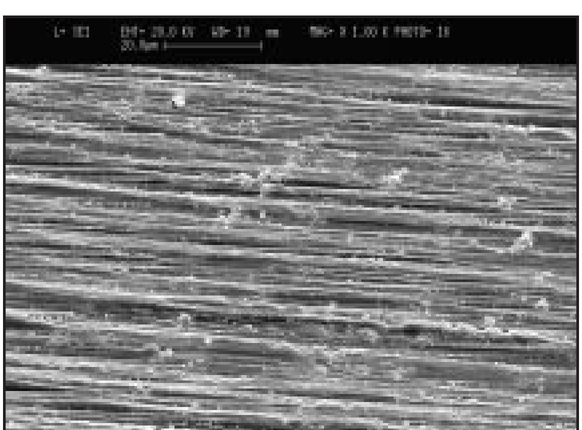

Fig. 2 SEM image (×1000) from Group A2 (stripped with No. 699L tungsten carbide bur and finished with No. 862 ultrafine diamond bur), showing deep furrows distributed regularly and evenly over entire surface.

Fig. 3 SEM image (×1000) from Group B2 (stripped with No. 699L tungsten carbide bur and finished with Sof-Lex discs), showing fine, irregular furrows left by stripping bur.

separately, since the technique was the same as in Group A1.

Group B2: Disc polishing produced a somewhat smoother surface than in Group A2 (Fig. 3). The furrows remaining from the stripping bur were irregular, but fairly fine and uniform.

Group C1: The No. H135 tungsten carbide bur created furrows that were distributed irregularly over the entire surface and interspersed with notably rough areas (Fig. 4).

Group C2: The polishing discs were reasonably effective in smoothing out the irregular furrows left by the stripping bur (Fig. 5).

Two digitally processed algorithms were used for objective analysis of the various stripping techniques: the roughness index (RI), to measure surface roughness, and the Hough Transform (Fig. 6), to identify linear structures with the linear structure index (LSI). Roberts Filters were applied to areas of the SEM images for further clarification of linear structures (Fig. 7).

RI and LSI values for each sample and the mean for each group were plotted on a graph (Fig. 8). Group C2 was closest to zero, indicating the smoothest surfaces. While Group A2 was highly rough and furrowed, Group B2 was furrowed, but markedly less rough.

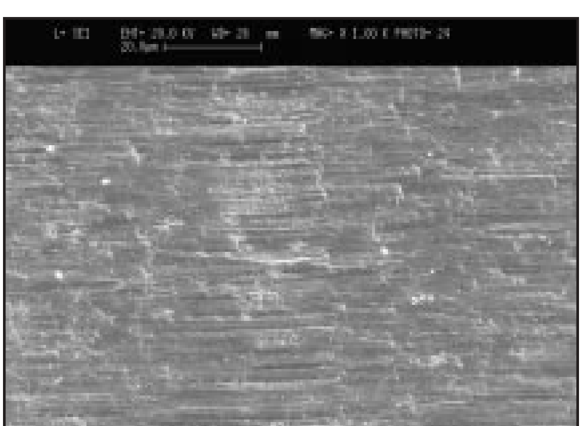

Fig. 4 SEM image (×1000) from Group C1 (stripped with No. H135 tungsten carbide bur), showing furrows distributed irregularly over entire surface and interspersed with notably rough areas.

Discussion

Studies have demonstrated that a 50% reduction in interproximal enamel can increase the available space by as much as 6.4mm when only the first molars and premolars are stripped,[4] by 8.9mm when the anterior teeth are added,[5,6] and by 9.8mm when the second molars are added.[3]

Clinicians have found stripping to be an attractive alternative to transverse or anteroposterior expansion and to extractions.[7-12] A number of other situations are also highly amenable to treatment with stripping[13,14]:

- Reducing a Bolton disharmony to improve intermaxillary occlusion (stripping anterior teeth to improve the overjet-overbite relation, thus improving function and protecting a natural occlusion).
- Prevention and treatment of interdental gingival recession in association with periodontal treatment of adults.
- Controlling relapse after treatment.
- Redesigning dental morphology for esthetic purposes.
- Removal of cracked enamel after treatment.

In this study, SEM evaluation demonstrated that finishing with a fine diamond bur (Group

Fig. 5 SEM image (×1000) from Group C2 (stripped with No. H135 tungsten carbide bur and finished with Sof-Lex discs), showing smoothing of irregular furrows left by first bur.

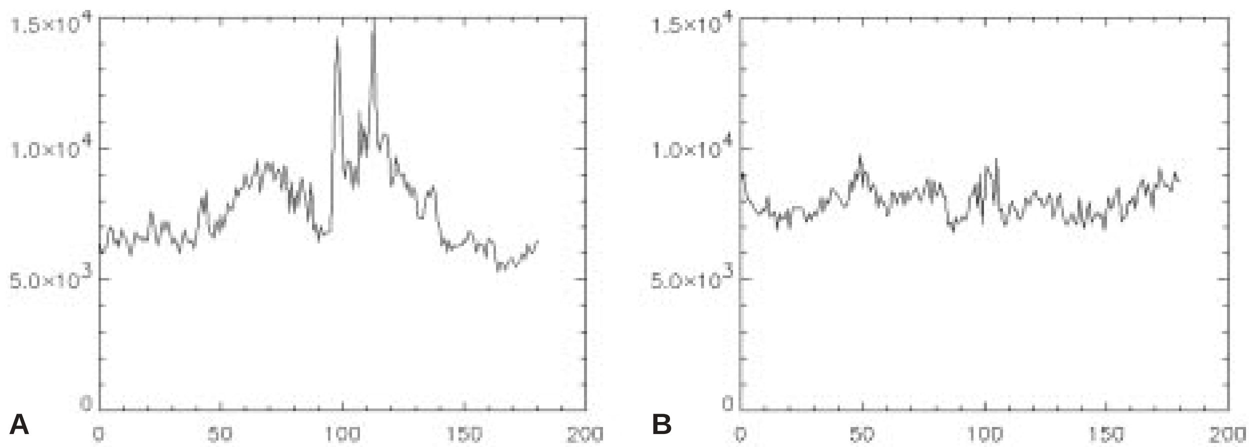

Fig. 6 A. Angular diagram of Hough Transform applied to Group B2, indicating two marked theta LSI high-value peaks (98° and 112°). B. Angular diagram of Hough Transform applied to Group C1 shows no peaks, with similar LSI values for all angles.

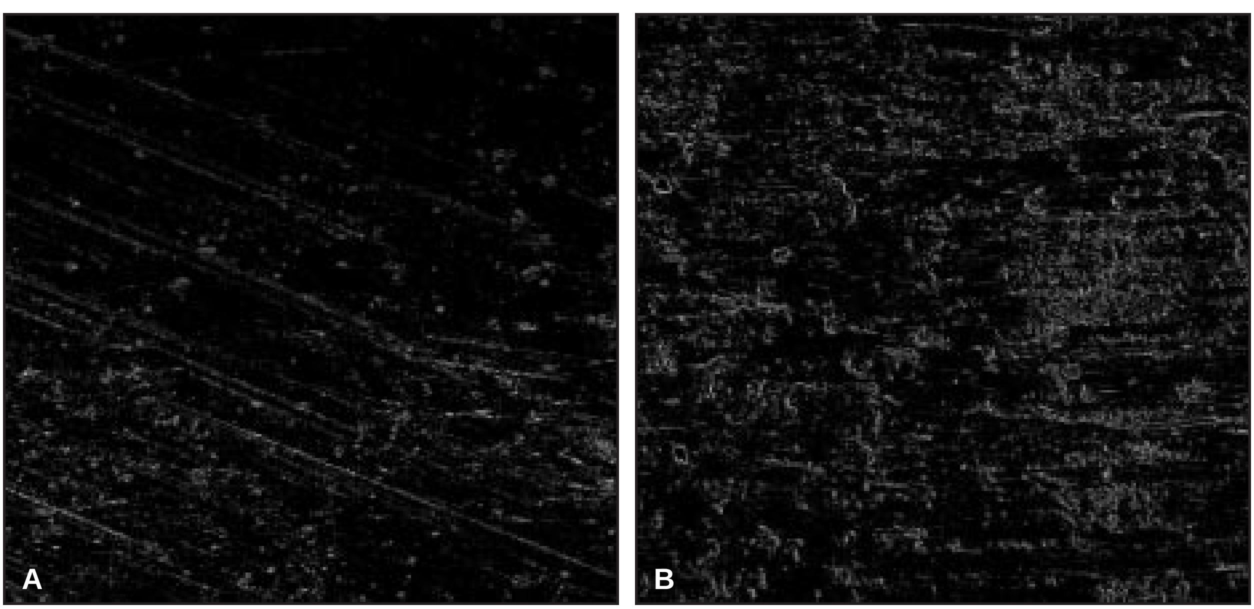

Fig. 7 Roberts Filters applied to areas of SEM images (light areas indicate high-contrast pixels). A. Figure 3 (Group B2) shows linear structures in two directions. B. No linear structures are apparent in Figure 4 (Group C1).

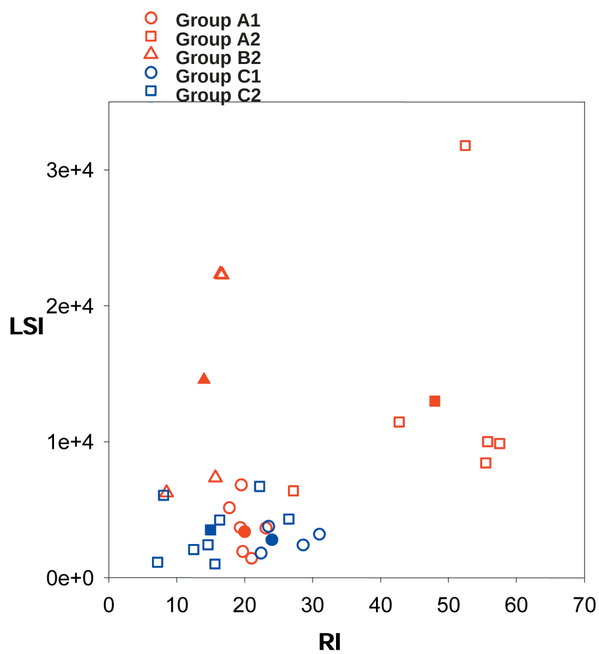

Fig. 8 Distribution of roughness index (RI) and linear structure index (LSI) values of analyzed samples (empty symbols represent single images; filled-in symbols indicate mean values of each group).

A2) could not smooth out the rough areas left by a stripping bur (Group A1). Twenty polishings with medium, fine, and superfine Sof-Lex discs (Group B2) made the stripped enamel visibly smoother. The SEM assessment also showed good results on surfaces polished with medium, fine, and superfine Sof-Lex discs (Group C2) after stripping with a tungsten carbide bur (Group C1).

Digital analysis of the SEM images confirmed that the technique producing the least roughness involved the use of a tungsten carbide bur (Group C1) to strip interproximal enamel, followed by finishing with medium, fine, and superfine Sof-Lex discs (Group C2).

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