



ISSN 2278 – 0211 (Online)

Manual vs. Air Rotor Stripping “Just Do It with Care”- SEM Evaluation

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Abstract:

Grinding interproximal tooth surfaces to reduce tooth size is a common procedure in orthodontics. Several procedures are used in daily orthodontic to perform precise interdental stripping as part of the treatment plan. Reduction of enamel can be achieved with hand-held or motor-driven abrasive strips but also with disks or burs mounted on a hand piece nowadays ARS (AIROTOR STRIPPING) are most commonly used. 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. So in this vitro study we compared manual and ARS stripping technique to find out which technique is less damage to the enamel surface with SEM evaluation. The purpose of this SEM investigation was to evaluate the morphologic effects of different enamel stripping techniques--and of various polishing procedures.

1. Introduction

- Grinding interproximal tooth surfaces to reduce tooth size is a common procedure in orthodontics. The indications for interproximal enamel reduction are lack of space, Bolton tooth-size discrepancy, correction of morphologic anomalies, tooth reshaping, and reduction of interdental gingival papilla retraction¹. Interproximal enamel reduction is also known as interdental stripping, enamel approximation, or slenderizing².
- Crowding can be defined as a quantitative discrepancy between the clinical length of the dental arch and the sum of the mesiodistal widths of the teeth. While crowding may occur in the anterior or posterior areas of either arch, adults are most likely to have crowding in the mandibular anterior area. Geiger note that 40-50% of adult patients display crowding, and that many of them reported having previous treatment³⁻⁴.
- interproximal enamel reduction is an alternative to extraction of permanent teeth or expansion of the dental arches in cases of mild to moderate crowding, with arch-length discrepancies of 4-8mm. The technique of air-rotor stripping, as described by Sheridan, was made possible by the introduction of direct bonding, which leaves the proximal surfaces accessible during any phase of treatment⁵⁻⁷.
- Several procedures are used in daily orthodontic to perform precise interdental stripping as part of the treatment plan. Reduction of enamel can be achieved with hand-held or motor-driven abrasive strips but also with disks or burs mounted on a hand piece nowadays ARS (AIROTOR STRIPPING) are most commonly used⁸⁻⁹.
- 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. 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. The more numerous and deep the lesions, the higher the risk that they will be carious¹⁰.
- So in this vitro study we compared manual and ARS stripping technique to find out which technique is less damage to the enamel surface with SEM evaluation. The purpose of this SEM investigation was to evaluate the morphologic effects of different enamel stripping techniques--and of various polishing procedures.^{11b}

2. Source of Data

- a) Study duration - 3 mnths
- b) Study design - In-vitro study
- c) Sampling - Purposive Sampling

3. Method of Collection of Data

3.1. Sample Size

24 human permanent extracted human teeth (12 incisors and 12 premolars) due to Periodontitis or ortho extraction will be used for the present study and stored in distilled water (5 per each group)

3.2. Inclusion Criteria

- a) Non-carious permanent teeth
- b) Sound undamaged buccal surfaces

3.3. Exclusion Criteria

- a) Grossly destructed teeth
- b) Teeth with enamel hypoplasia
- c) Abraded teeth.
- d) Teeth with cervical caries.
- e) No enamel cracks on the proximal surface
- f) No restoration of any surfaces

3.4. Sample Size

Group I – stripping with AUF 199010 diamond bur (denticon dental) (fig 1)

Group II – stripping with REF 166010M tungstone carbide bur (desire dental) (fig 2)

Group III- stripping with hand pulled strips (libral traders) (fig 3)

Group IV- stripping with perforated diamond coated disk (ortho technology germany) (fig 4)

Polishing with Sof-Lex XT fine and ultrafine disks (fig 5)

4. Methodology

- The teeth were randomly assigned to four groups, each containing three subgroups of two incisors and two premolars.
- The samples were stored in .1% thymol before and after removal of the attached soft tissue from the root surfaces. The teeth were then mounted in Frasaco model bases, and each model was mounted in a phantom head to simulate clinical conditions. Before and after stripping, the mesiodistal diameter of each tooth was measured with a sliding digital caliper.
- Premolar enamel was reduced by .5mm per surface, and incisor enamel by .3mm. The enamel reduction was performed with a [foot]diamond-coated bur[/foot] at 4,000-6,000 rpm and a [foot]perforated diamond-coated disk[/foot] in either a conventional contra-angle handpiece or an oscillating handpiece.
- The latter has the advantage that it will not injure the soft tissues when operated at speed setting 4 of the micro motor (Figure 5).
- The ground enamel surfaces were polished with Sof-Lex XT fine and ultrafine disks ([img=2]Figure 2[/img]) at 200-400 rpm (Figure 5), or fine and ultrafine oscillating Elastrips at 4,000-6,000 rpm, all with adequate water spray.
- In two of the groups, the polishing time for each step was 40 seconds; in the third and fourth group no polishing has been done (Table 1).
- Replicas were made for SEM evaluation of each sample after stripping and again after polishing. Organic surface debris was removed with 5% hypochloride, and the tooth was then rinsed with distilled water and dried with compressed air. Impressions were taken with an injection-type vinyl polysiloxane material, rinsed with alcohol, poured with epoxy resin, and sputter-coated with gold for two minutes at 25 mA. A 20kV scanning electron microscope was used at various magnifications to compare the effects of the different stripping and polishing methods with untreated enamel surfaces (Figure 6).

5. Results

- Enamel surfaces were rougher after stripping with the diamond-coated bur, tungsten carbide bur, hand pulled strips than after dinking. In ARS cases, the enamel roughness produced by stripping was almost totally eliminated by using the fine and ultrafine Sof-Lex XT disks for 40 seconds each.
- The surface gloss appeared to increase with polishing time, and the polished surfaces were smoother than untreated enamel.
- surface after stripping with diamond bur: furrows uniformly distributed over (fig 7), enamel surface after stripping with tungsten carbide bur: showing small number of furrows distributed over entire surface and interspersed with rough area (fig 8), enamel surface after stripping with single sided hand pulled strips: showing deep furrows distributed irregularly and evenly over entire surface (fig 9), enamel surface after stripping with oscillating perforated diamond coated disk: grooves small and uniformly disturbed (fig 10)
- enamel surface after stripping with diamond bur and tungsten carbide bur and polishing with fine and ultrafine sof-lex xt disks for 40 seconds each : surface smoother than untreated enamel (fig 11)

- so stripping with oscillating perforated diamond coated disk which showed less damage to the enamel surface and stripping with single sided hand pulled strips showed more damage to the enamel surface.

6. Discussion

- Studies by Piacentini and Sfondrini¹² and Puigdollers¹³ have shown that the deep furrows produced by coarse diamond-coated strips could not be eliminated by polishing, and that they promoted the adherence of bacteria and thus increased the risk of caries. Radlanski and colleagues found that "artificially produced furrows were still clearly visible" one year after enamel reduction.¹⁴ We therefore feel it is of the utmost importance to polish to the smoothest possible surface after stripping. In the current study, grinding with a diamond-coated bur or disk caused extensive enamel roughness, making subsequent finishing and polishing mandatory.^{13,15}
- A combined mechanical and chemical technique, as advocated by Joseph and colleagues, appears unnecessary.¹⁶ Although these authors suggested the application of fluoride solutions after stripping, etched enamel is susceptible to demineralization and rapid plaque accumulation, which could result in greater exposure to carious agents. Sheridan and LeDoux proposed the application of a sealant,¹⁷ but this raises questions such as how long the sealant would remain, what condition the enamel would be in once the sealant had dissipated, how a dry working field could be achieved next to the gingiva, and how contact could be avoided between the gingiva and a potentially cytotoxic sealant.¹⁸
- Radlanski and colleagues found enamel surfaces with deep scratches after polishing with hand-held Sof-Lex strips that were moved back and forth 20 times.¹⁰ On the other hand, Hein and Jost-Brinkmann demonstrated smooth surfaces after 60 seconds of polishing with Sof-Lex disks or strips in a motor-driven handpiece.¹⁵ In this study, we found that the surfaces treated for 40 seconds with rotating polishing instruments were smoother than those which were not polished
- Hein and Jost-Brinkmann showed that polishing with three Sof-Lex disks (medium, fine, and ultrafine) produced surfaces smoother than untreated enamel.¹⁵ In the present study, the furrows from stripping were almost totally eliminated by only two Sof-Lex XT disks (fine and ultrafine) operated at 200-400 rpm for 40 seconds each. Even the steps and waves produced by grinding with a diamond-coated bur were found to be well polished. A new set of disks should be used for every tooth, however, because the surface structure of a Sof-Lex disk deteriorates rapidly.⁷
- The amount of enamel that can be safely removed remains a controversial question.^{19,20} Based on a minimum enamel thickness of .36mm for the mandibular anterior teeth, Hudson suggested a maximum removal of .25mm per surface from the incisors and .3mm from the canines,²¹ while Barrer allowed as much as .5mm per surface to be stripped from the mandibular incisors.²² On the other hand, Fillion warned against removing more than .2mm of enamel.¹⁹ While the smallest-diameter bur he advocated for stripping was .18mm, the disks used in our study measure only .15mm. We found an additional enamel reduction of .05-.1mm after polishing with Sof-Lex XT disks and of .1-.15mm after using the three tungsten carbide burs. Therefore, it appears safer to remove enamel with disks than with burs.

7. Conclusion

- Interproximal enamel reduction has been widely accepted by clinicians and researchers.^{3,4,15,17,19} The present study demonstrates that even smoother enamel can be achieved than has been shown in previous studies.^{10,19} The SEM evaluation demonstrates satisfactory results using oscillating perforated diamond-coated disks for stripping and fine and ultrafine Sof-Lex XT disks for polishing. We believe even larger-diameter Sof-Lex disks would reach the cervical areas more easily and thus produce optimal results. This method is simple and clinically expedient, involving only three steps. However, stripping must be also be comfortable for the patient. The perforated diamond-coated disk in an oscillating handpiece at moderate speed oscillates only about 60°, making injuries unlikely and eliminating the need for lip and cheek protectors

FIGURE

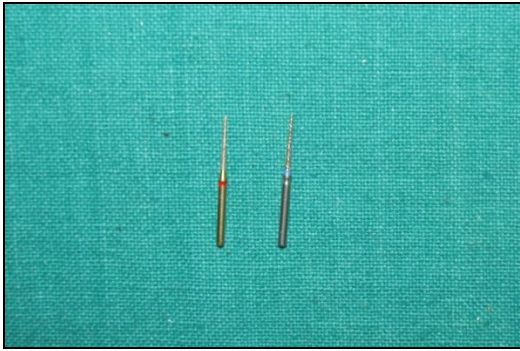


Figure 1: AUF 199010 diamond bur



Figure 2: REF 166010M tungstone carbide bur

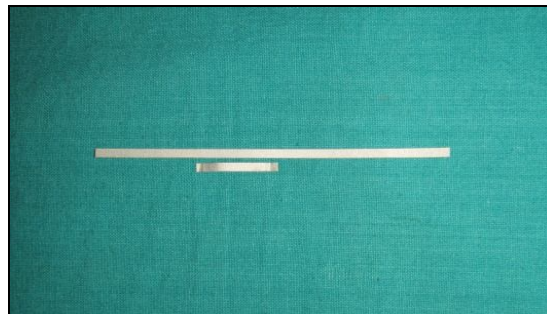


Figure 3: single sided hand pulled strips



A

Figure 4: A perforated diamond coated disk



B

B.in oscillating handpiece, disk oscillates only about 60°

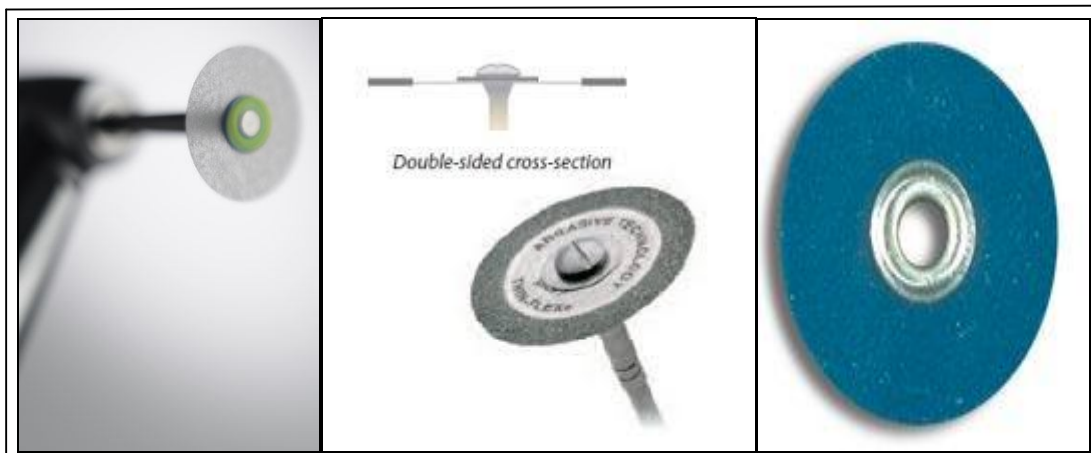


Figure 5: sof-lex xt disks fine and ultrafine use for polishing

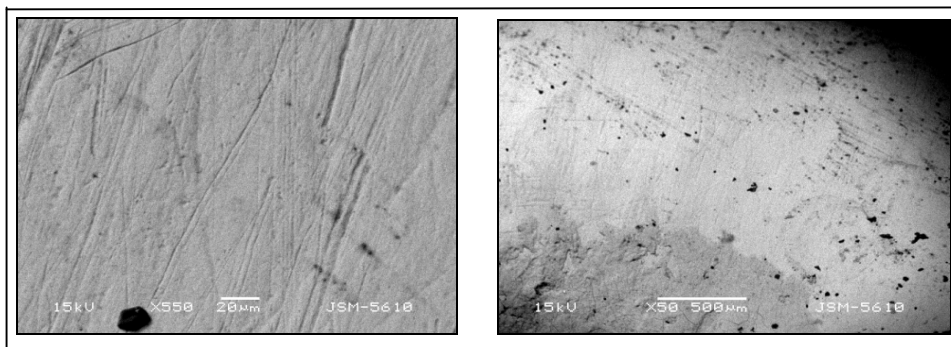


Figure 6: untreated enamel surface

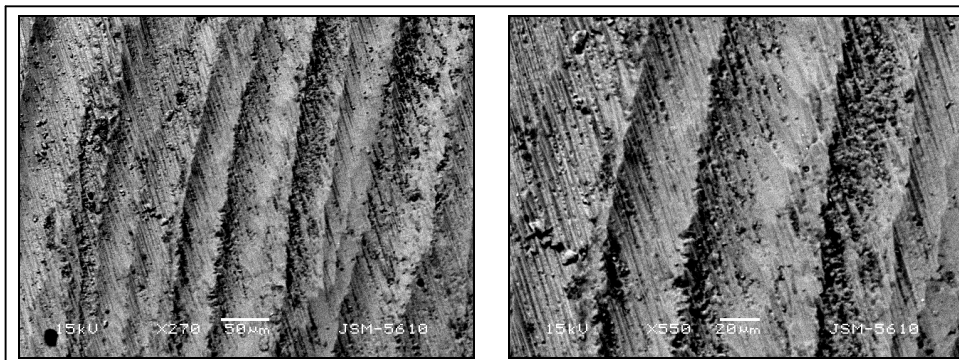


Figure7: enamel surface after stripping with diamond bur: furrows uniformly distributed over

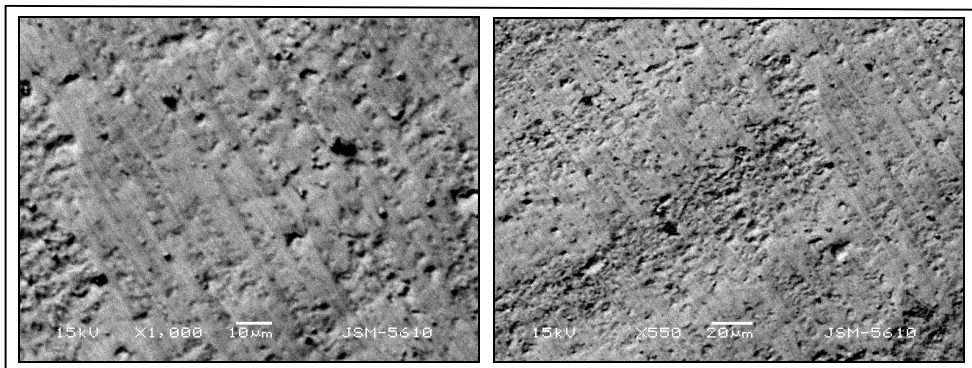


Figure 8: enamel surface after stripping with tungsten carbide bur: showing small number of furrows distributed over entire surface and interspersed with rough area

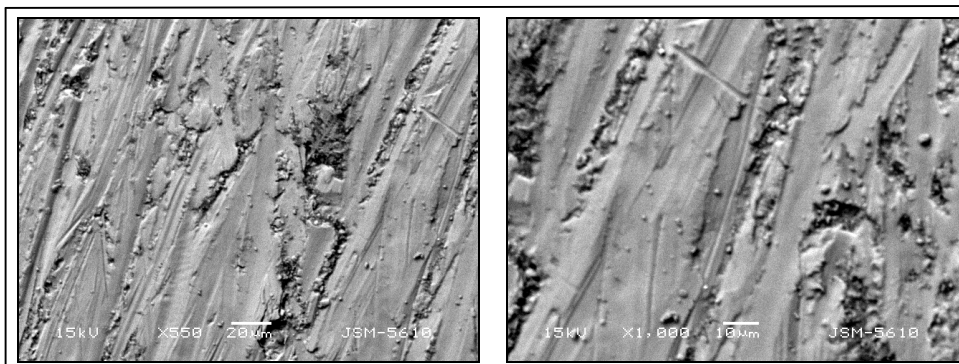


Figure 9: enamel surface after stripping with single sided hand puled strips: showing deep furrows distributed irregularly and evenly over entire surface

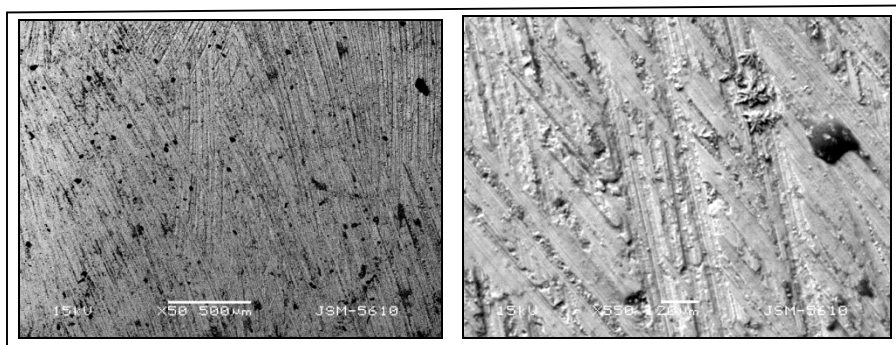


Figure 10: enamel surface after stripping with oscillating perforated diamond coated disk: grooves small and uniformly disturbed

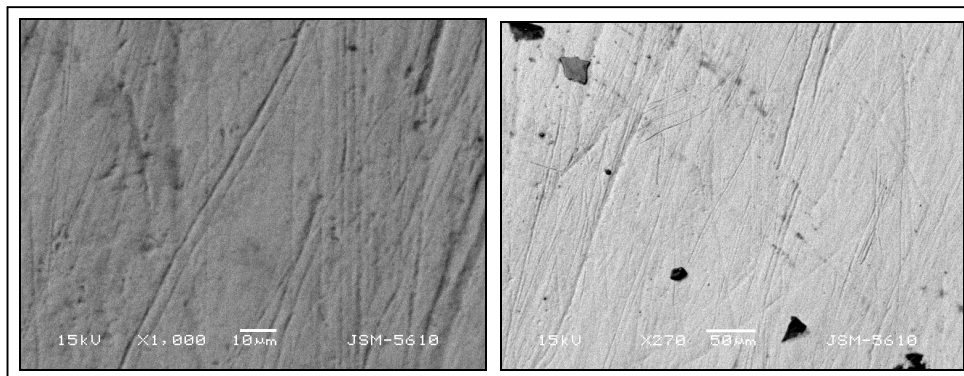


Figure 11: enamel surface after stripping with diamond bur and tungsten carbide bur and polishing with fine and ultrafine sof-lex xt Disks for 40 seconds each: surface smoother than untreated enamel

Group	Stripping	Polishing	Time
A	AUFG 199010 diamond bur (denticon dental)	SOF-LEX XT disks (fine and ultrafine)	40 sec
B	Group II – stripping with REF 166010M tungstone carbide bur (desire dental)	SOF-LEX XT disks (fine and ultrafine)	40 sec
C	Group III- stripping with hand pulled strips (libral traders)	-----	-----
D	Group IV- stripping with perforated diamond coated disk(ortho technology germony)	-----	-----

Table 1: Instruments and methods

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