

Evaluation of enamel surface roughness after orthodontic bracket debonding with atomic force microscopy

Shadi Mohebi,^a Hassan-Ali Shafiee,^b and Nazila Ameli^c

Urmia, Tehran, and Semnan, Iran

Introduction: Achieving a smooth enamel surface after orthodontic bracket debonding is imperative. In this study, we sought to compare the enamel surface roughness values after orthodontic bracket debonding and resin removal using a white stone bur, a tungsten carbide bur, and a tungsten carbide bur under loupe magnification. **Methods:** Thirty sound premolars were randomly divided into 3 groups, and their buccal surfaces were subjected to atomic force microscopy to measure initial surface roughness. Brackets were bonded to the buccal surfaces and debonded after 24 hours. Resin remnants were removed using a white stone bur, a tungsten carbide bur, or a tungsten carbide bur under loupe magnification. The teeth were then subjected to atomic force microscopy again. The time required for composite removal was calculated. Data were analyzed using repeated-measures analysis of variance, 1-way analysis of variance, and the Tukey test. **Results:** Resin removal increased the enamel surface roughness compared with the initial values ($P < 0.001$); however, no significant differences were noted among the 3 groups in this respect after resin removal. The mean times required for smoothing by the tungsten carbide bur and the tungsten carbide bur with a dental loupe were similar ($P > 0.05$): significantly lower than the time with the white stone bur (both, $P < 0.001$). **Conclusions:** The tungsten carbide bur is still recommended for composite removal. (Am J Orthod Dentofacial Orthop 2017;151:521-7)

A major concern when removing orthodontic brackets is restoration of the enamel surface to the pretreatment condition.¹ The quest for an efficient method to remove adhesive resin after debonding of orthodontic brackets has led to the introduction of various techniques and instrumentations.^{1,2} Mechanical removal of composite resin includes scraping with a scaler and various burs, such as ultrafine diamond burs, but some believe that they can cause irreversible damage to the enamel.^{3,4} Other studies have shown that laser energy may be used for resin removal, since it degrades the resin and reduces the force needed to remove orthodontic attachments. However, the Er:YAG

laser also has been shown to cause irreversible enamel damage.³

Using different burs in conjunction with rubber cups and pumice paste seems to be appropriate for resin removal; however, there is a considerable lack of consensus regarding the most efficient route for this.^{5,6} Tungsten carbide burs in either a low-speed or a high-speed hand piece have been the method of choice for removing resin remnants.^{7,8} Techniques and new composite burs that are less aggressive to the enamel⁹ and new instruments such as stone burs, disks, and diamond or silicone coated polishers, also stated to be less aggressive, have been developed.⁸ The effect of various rotary instruments on the enamel surface has been assessed qualitatively with scanning electron microscopy.¹⁰⁻¹² However, using quantitative scales enhances the selection of the most efficient method because of the possibility of better assessing and comparing the damage caused by different instruments.^{13,14}

The atomic force microscope (AFM) is a scanning probe microscope with biologic applications. It uses a flexible cantilever as a type of spring to measure the force between the tip and the sample. The AFM analysis uses several high-resolution scans and is highly recommended for evaluation of the enamel

^aDepartment of Orthodontics, School of Dentistry, Urmia University of Medical Sciences, Urmia, Iran.

^bDepartment of Orthodontics, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

^cDepartment of Orthodontics, School of Dentistry, Semnan University of Medical Sciences, Semnan, Iran.

All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.

Address correspondence to: Nazila Ameli, Department of Orthodontics, School of Dentistry, Semnan University of Medical Sciences, 17th Shahrivar blv, Semnan, Iran; e-mail, Nazilaa.aameli@gmail.com.

Submitted, October 2015; revised and accepted, August 2016.

0889-5406/\$36.00

© 2016 by the American Association of Orthodontists. All rights reserved.

<http://dx.doi.org/10.1016/j.ajodo.2016.08.025>

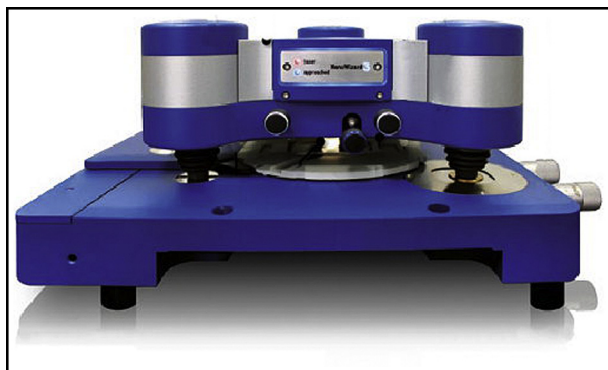


Fig 1. AFM core (Nano Wizard II; JPK Instruments, Berlin, Germany).

surface.^{15,16} Minimal sample preparation, obtaining 2-dimensional and 3-dimensional images simultaneously and the possibility of reevaluating the sample are among the advantages of this method.^{17,18} It has been stated that the use of a dental loupe by the practitioner may affect the quality of the debonding procedure, causing less enamel damage and better resin removal.¹⁹ To date, multiple modalities have been advocated and used to remove adhesive residues after debonding; a large disparity exists in the literature regarding the most efficient way to remove resin after orthodontic treatment. Therefore, we undertook this study to compare the effect of 3 resin removal methods (tungsten carbide bur, white stone bur, and tungsten carbide bur under loupe magnification) on enamel surface roughness assessed by AFM. The time taken for resin removal after bracket debonding was also evaluated.

MATERIAL AND METHODS

In this in-vitro experimental study, 30 freshly extracted (for orthodontic indications) intact premolars were obtained from 10- to 20-year-old patients. The teeth were stored in distilled water before they were sent to the laboratory and cleaned with a low-speed bristle brush. They were then rinsed with water for 10 seconds and dried with oil-free compressed air. The experimental teeth were mounted in acrylic blocks and stored in isotonic saline solution. The teeth were not sterilized (since sterilization could affect the quality of the bond).²⁰

The buccal surface roughness of each tooth was determined by AFM (NanoWizard II; JPK Instruments, Berlin, Germany; Fig 1), equipped with a scanner with a maximum range of $100 \times 100 \times 5 \mu\text{m}$ in the x, y, and z axes, respectively.



Fig 2. Mounted tooth in acrylic block after bonding.

To measure roughness values, the tip of a silicon probe (with a radius of less than 10 nm, height of 4–6 μm , and spring constant of 0.046 N/m) was moved across the middle third of the buccal surface of the samples in the contact mode with 10^{-6} N force. In the contact mode, the tip never left the surface. After obtaining 2 to 3 initial images ($20 \times 20 \times 5 \mu\text{m}$), 5 images of each specimen ($5 \times 5 \times 5 \mu\text{m}$) were extracted from the initial images via blind randomization. Then the teeth were etched for 30 seconds using 37% phosphoric acid gel, rinsed with water, and air dried. The brackets were bonded to the prepared enamel (Reliance Orthodontic Products, Itasca, Ill), excess adhesive was removed, and the resin was light-cured for 40 seconds (Fig 2). All samples were stored in isotonic saline solution at room temperature for 24 hours, and the brackets were debonded with a fine cutter using the peeling method. The teeth were randomly assigned to 3 equal groups with 10 teeth in each group. In the first group, removal of resin remnants was performed with a 12-bladed tungsten carbide bur (0197; D & Z, Frankfurt, Germany) and a low-speed hand piece.

In the second group, a dome-shaped white stone bur (Arkansas 661 DEF; D & Z) in a low-speed hand piece was used for resin removal.

In the third group, removal of resin remnants was performed with a 12-bladed tungsten carbide bur as in the first group, but during the debonding process the operator used a dental loupe (binocular loupe, HR 2.5 \times 420 mm; Heine, Dover, NH). All bonding and debonding processes were done by the same operator.

Download English Version:

<https://daneshyari.com/en/article/5637721>

Download Persian Version:

<https://daneshyari.com/article/5637721>

[Daneshyari.com](https://daneshyari.com)