# Enamel Polishing after Orthodontic Bracket Debonding using two Different Protocols and two Different Adhesives

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**Abstract**

Many techniques were developed for enamel polishing after orthodontic bracket debonding to keep the enamel surface as smooth as possible to pretreatment condition, in addition to many bracket adhesives used for orthodontic brackets bonding. This study aimed to compare the effect of two different adhesive materials and polishing protocols on enamel surface roughness after debonding of orthodontic brackets. Forty maxillary premolars were divided into four groups, orthodontic brackets were bonded using two different adhesive materials (Resilience LC Orthodontic Adhesive from Orthotechnology and Bisco Ortho bracket paste LC from Bisco). After brackets debonding adhesive remnants were removed using carbide bur followed by either Enhance Finishing tip then Prisma Gloss Polishing Cup with Prisma Gloss Polishing Paste or High Shine Enamel Polisher and Astropol green polishing cups. Then Atomic force microscope was used to evaluate surface roughness parameters among groups. The roughness data were statistically analyzed with Tukey post hoc test. Results showed significantly lower surface roughness parameters with Bisco Ortho bracket paste group compared with Resilience LC Orthodontic Adhesive group when both were polished with Enhance Finishing tip and Prisma Gloss Polishing Paste. Additionally, significantly lower Sz (Ten points height) value was seen with Bisco Ortho bracket paste group polished with Enhance Finishing tip and Prisma Gloss Polishing Paste in comparison with Resilience LC Orthodontic Adhesive polished with High Shine Enamel Polisher and Astropol green polishing cups. Pre-mounted, aluminum oxide impregnated, cured urethane dimethacrylate resin finishers tips (Enhance finishing tips) with a fine-grit aluminum-oxide polishing paste (Prisma Gloss Polishing Paste) could produce smoother enamel surface than 5 micron diamond grit suspended in resilient silicone tip (high shine enamel polisher) followed by Multiple-use polishing cups consist of silicone rubber and silicon carbide particles (Astropol green polishing cups) when Bisco Ortho bracket paste LC used.

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## Introduction

The restoration of enamel surface after orthodontic treatment to the pretreatment condition is a major concern when removing orthodontic brackets [1], because the presence of resin remnants left on enamel surface facilitates plaque accumulation which could lead to decalcification and subsequent carious lesions development [2]. Accordingly, different resin removal and polishing protocols introduced by many authors such as tungsten carbide bur, band-removing plier, Sof-Lex discs or scaler [3 4 5 6].

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Additionally, previous studies investigated the influence of air abrasion techniques with aluminum oxide particles on enamel surface roughness [7 8]. While others found that the bonding resin was degraded with laser energy that reduce the bracket removal force needed [9 10]. On the other hand some studies used ultrafine diamond burs or Er:YAG laser, but others believe that these protocols may result in irreversibly damaged enamel surface [1 10]. Furthermore many less aggressive techniques have been developed such as new composite burs, silicone or diamond coated polishers, disks and stone burs [11 12].

Tungsten carbide burs have been used as an efficient and fast way for removal of the adhesive remnants in either a high-speed or low-

speed hand piece and considered as a method of choice by many studies [11 13 14].

The widely used protocol is the use of a suitable bur then a polishing disc followed with a polishing paste [15]. After achieving normal enamel and complete removal of adhesive the polishing with pumice or prophylaxis paste may be optional [16]. Scanning electron microscopy (SEM) used for qualitative assessment of different rotary instruments effect on enamel surface [14 17 18]. However qualitative evaluation of enamel surface cannot be performed with SEM in addition to comparative assessment that make this technique to be considered subjective and unreliable [16]. Furthermore the possible assessment and comparison of enamel damage resulted from various instruments enhances the choice of the most efficient protocol [19]. An alternative assessment technique to SEM is the Atomic force microscopy (AFM) which is highly recommended for the analysis of surfaces with nanoscale irregularities such as enamel surface through high resolution multiple mechanical scans [20].

AFM is considered as a scanning probe that has a biologic applications. It can measure the force between the sample and the tip with a flexible cantilever spring. Many advantages were found in AFM like the production of several 2-dimensional and 3-dimensional high-resolution scans, sample reevaluation possibility and minimal sample preparation [21 22].

Furthermore better resin removal and less enamel damage can be achieved through the use of a dental loupe that can affect the debonding procedure quality [23].

Different orthodontic brackets adhesives and protocols were used by Iraqi orthodontists. The present study chose the most frequently used adhesives, burs and polishing kits that are available in Iraqi dental markets.

## Materials and methods

A total of 72 extracted first or second premolar for orthodontic purposes were collected. Forty premolars were selected with inclusion criteria that teeth should be free from cracks, caries and enamel hypoplasia when inspected visually. The teeth were stored in plastic containers filled with distilled water [16].

Any remnants of soft tissue were removed and the roots were separated from crowns leaving 2 mm below the cemento-enamel junction. The pulp tissue in the sectioned crowns was manually removed using a dental explorer, plastic molds of 20 mm height and 25 mm width loaded with light-curing acrylic resin were used for investing the crowns from all surfaces except the buccal that would be about 1-2 mm above the mold rim. Following light curing process acrylic blocks were stored in plastic containers filled with distilled water at room temperature to avoid dehydration [10].

The teeth were randomly divided into four groups according to the type of bonding material and adhesive removal protocol. Each group consists of 10 numbered samples:

1. Group A brackets were bonded with Resilience LC Orthodontic Adhesive (Orthotechnology, Florida, USA) and polished with Debonding Carbide Burs (Orthotechnology, Florida, USA) followed by Enhance Finishing System Kit then Prisma Gloss Polishing cups and paste (Dentsply, North Carolina, USA)

2. Group B brackets were bonded with Resilience LC Orthodontic Adhesive (Orthotechnology, Florida, USA) and polished with Debonding Carbide Burs (Orthotechnology, Florida, USA) followed by High Shine Enamel Polisher (Orthotechnology, Florida, USA) and Astropol green polishing cups (Ivoclar Vivadent, Schaan, Liechtenstein).

3. Group C brackets were bonded with Bisco Ortho bracket paste LC (Bisco, Chicago, USA) and polished with Debonding Carbide Burs (Orthotechnology, Florida, USA) followed by Enhance Finishing System Kit then Prisma Gloss polishing cups and paste (Dentsply, North Carolina, USA)

4. Group D brackets were bonded with Bisco Ortho bracket paste LC (Bisco, Chicago, USA) and polished with Debonding Carbide Burs (Orthotechnology, Florida, USA) followed by High Shine Enamel Polisher (Orthotechnology, Florida, USA) and Astropol green polishing cups (Ivoclar Vivadent, Schaan, Liechtenstein).

Enamel surfaces were prepared for 10 seconds using low rotation rubber cup with water and pumice then washed with distilled water for

10 seconds and dried with oil free air at 5 cm distance for additional 10 seconds. Acid etch (Meta, Korea) was applied for 15 seconds then subsequently washed with distilled water for 10 seconds and dried for 10 seconds. Then the etched enamel was subjected to bonding agent application, while the brackets basis of the 1st premolar (Equilibrium 2, Dentaurum, Germany) were loaded with composite resin according to the sample grouping then centered mesiodistally along the crown long axis with enough manual pressure using bracket placing forceps (Dentaurum, Germany); before light curing of orthodontic adhesive, excess material around the bracket base was removed using a dental explorer [13].

All samples were stored for 24 hours in water at room temperature then brackets were debonded from crowns with a bracket removal plier (Dentaurum, Germany) while the remaining residual adhesive was removed using different protocols as follow:

1. Debonding Carbide Burs – 12 Fluted Long Taper (Orthotechnology) – High Speed with water cooling then followed by Enhance Finishing tips (Pre-mounted, aluminum oxide impregnated, cured urethane dimethacrylate resin finishers tips), then Prisma Gloss Polishing cups and paste (fine-grit aluminum-oxide polishing paste) (Dentsply, Germany).

2. Debonding Carbide Burs – 12 Fluted Long Taper– High Speed with water cooling then followed by high shine enamel polisher (5 micron diamond grit suspended in resilient silicone tip, 2.35 mm head length) (Orthotechnology, Florida, USA) and Astropol green polishing cups (Multiple-use polishing cups consist of silicone rubber and silicon carbide particles) (Ivoclar Vivadent, Schaan, Liechtenstein).

The burs, tips and cups used for adhesive removal procedures were discarded after every five samples polishing [13.] The polished tooth surface was examined under the operative lamp light with naked eye to ensure composite free and smooth enamel surface [11].

A surface probe/atomic force microscope (SPM/AFM) (Digital Instruments MMAFM-2/1700EXL, Calif) was used for initial evaluation of samples surface roughness. Topographic images of selected surface areas were obtained when the contact mode was operated in the AFM by the aid of built-in scanner that has a maximum range of 125 µm X 125 µm X 5 µm in x, y, and z directions, respectively with a scan rate of 2.03 Hz and 5-mm scan sizes. The roughness of three different points on the surface center was measured by moving the device tip across the enamel surface. The average roughness of these three readings was calculated. A no platform (NP) probe type was used at 12 to 40 kHz with applied force of 1026 N and the bending constant was set to normal (0.06 to 0.58 N/m). Each measurement consisted of 512 scans and provide many parameters for surface roughness, among these parameters three were selected [16]:

- Average roughness value (Sa).
- Root mean square roughness (Sq).
- Ten points height (Sz).

Kolmogorov Smirnov statistical test was used to investigate normality of distribution, then parametric tests such as 1-way analysis of variance (ANOVA) and the Tukey post hoc test were used to statistically analyze the roughness data values using SPSS software, release 10.0. The level of significance was set at 0.05 [10 16].

## Results

Results for surface roughness parameters (Sa, Sq and Sz) were summarized in figure 1 and table 1. One way ANOVA revealed a significant difference between groups in all surface roughness parameters. Multiple comparison using Tukey Post hoc test showed significantly lower surface roughness parameters (Sa, Sq and Sz) in group C which was bonded with Bisco Ortho bracket paste LC polished with Enhance Finishing System Kit then Prisma Gloss polishing cups and paste when compared with group A which was bonded with Resilience LC Orthodontic Adhesive and polished with Enhance Finishing System Kit then Prisma Gloss Polishing cups and paste. Additionally regarding Sz parameter a significantly lower finding was found in group C when compared with group B which was bonded with Resilience LC Orthodontic Adhesive and polished with High Shine Enamel Polisher followed by Astropol green polishing cups. On the other hand no statistically significant differences were found among other groups (Table 1) (Figure 1). Differences between

surfaces roughness of the four groups' samples are in accordance with AFM scans as shown in figure 2.

| variable | Group A Mean ± SD | Group B Mean ± SD | Group C Mean ± SD | Group D Mean ± SD | P-value |
|---|---|---|---|---|---|
| Sa | 141 ± 39 | 106 ± 17 | 102 ± 21 | 109 ± 23 | 0.03 |
| Sq | 168 ± 47 | 126 ± 21 | 122 ± 24 | 130 ± 25 | 0.03 |
| Sz | 728 ± 124 | 519 ± 101 | 508 ± 102 | 586 ± 148 | 0.003 |

**Table 1.** Results of Surface Roughness Measurement for Each Group (in nm).

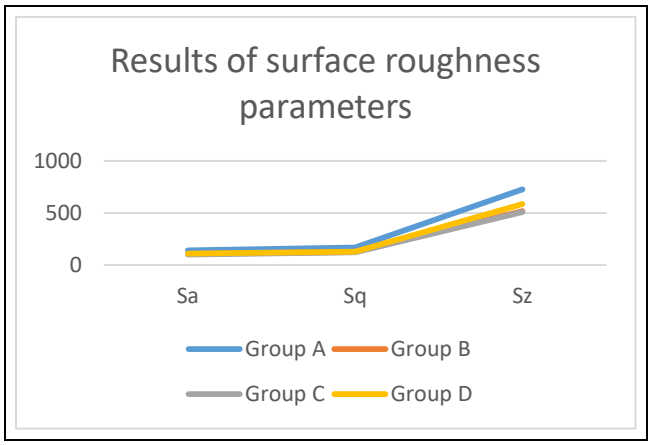


**Figure 1.** Results of surface roughness parameters.

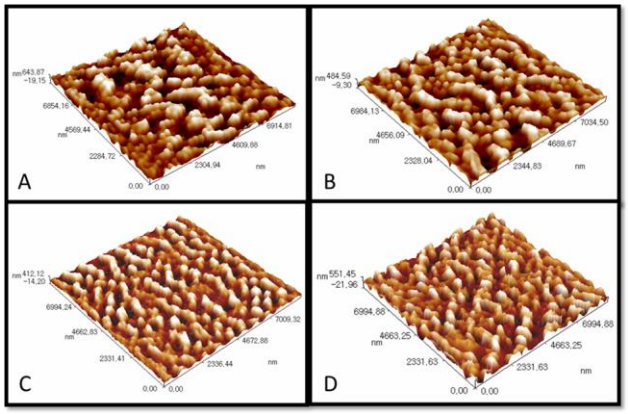


**Figure 2.** AFM scan of A) group A (LC Orthodontic Adhesive polished with Enhance Finishing System then Prisma Gloss Polishing Cups and Paste). B) Group B (LC Orthodontic Adhesive polished with High Shine Enamel Polisher and Astropol green polishing cups). C) Group C (Bisco Ortho bracket paste LC polished with Enhance Finishing System then Prisma Gloss Polishing Cups and Paste). D) Group D (Bisco Ortho bracket paste polished with High Shine Enamel Polisher and Astropol green polishing cups).

## Discussion

Results showed significantly lower surface roughness parameters when teeth were bonded with Bisco Ortho bracket paste LC and polished with Enhance Finishing tips then Prisma Gloss Polishing Cups with Prisma Gloss Polishing Paste in comparison with teeth that were bonded with Resilience LC Orthodontic Adhesive and polished with the same protocol of group A, this could be attributed to the difference in adhesive materials properties like the shear bond strength which when increased can cause failure at the interface between bracket base and adhesive that results in large amounts of firmly attached adhesive remnants on enamel surface that when removed can damage enamel surface [24 25 26].

Results also showed a significant difference between group C and group B which was bonded with Resilience LC Orthodontic Adhesive and polished with High Shine Enamel Polisher and Astropol green polishing cups. This difference could also be related to the difference in adhesive material properties used in addition to the polishing protocol especially the use of enhance finishing tips which was supported by the findings of many studies as these molded tips contain aluminum oxide and glycerin and used in removal of gross scaring and found to be useful in developmental grooves [5 13 27].

The smoothest surfaces obtained with Enhance polishing system could be attributed to many factors such as Aluminum oxide impregnated polishing points, prisma gloss, aluminum oxide pastes. The aluminum oxide paste causes finer abrasion in comparison to impregnated disks or points used alone additionally polishing with aspropol cups could results in higher RA values due to the presence of coarser abrasive particles [27 28].

The results of this study came in disagreement with Campbell [5] who found that the green polishing cups provide high polishing clinically, and porcelain polishing paste was also effective clinically but shows some scratches microscopically due to the presence of diatomaceous earth particles. Additionally, the study results were in disagreement with Zarrinnia et al [29] who found higher surface roughness when adhesive remnants were removed with Enhance tips. These differences could be attributed to the difference in sample preparation and the techniques used to measure enamel roughness

like light microscope and magnification in Zarrinnia et al [29] or SEM in Campbell [5].

## Conclusions

Enamel surface bonded with Bisco Ortho bracket paste LC could be smoother than those bonded with Resilience LC Orthodontic Adhesive when polished with Pre-mounted, aluminum oxide impregnated, cured urethane dimethacrylate resin finishers tips (Enhance finishing tips) followed by a fine-grit aluminum-oxide polishing paste (Prisma Gloss Polishing Paste).

Enamel surface bonded with Bisco Ortho bracket paste LC then polished with Enhance finishing tips followed by Prisma Gloss Polishing Paste could be smoother than those bonded with Resilience LC Orthodontic Adhesive when polished with 5 micron diamond grit suspended in resilient silicone tip (high shine enamel polisher) followed by Multiple-use polishing cups consist of silicone rubber and silicon carbide particles (Astropol green polishing cups).

## Declaration of Interest

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## References

1. Pont HB, Ozcan M, Bagis B, Ren Y. Loss of surface enamel after bracket debonding: an in-vivo and ex-vivo evaluation. Am J Orthod Dentofacial Orthop. 2010;138(4):387.e1-387.e9.
2. Gwinnett AJ, Gorelick L. Microscopic evaluation of enamel after debonding: Clinical application. Am J Orthod. 1977;71:651-65.
3. Rouleau BD Jr, Marshall GW Jr, Cooley RO. Enamel surface evaluations after clinical treatment and removal of orthodontic brackets. Am J Orthod. 1982;81: 423–426.
4. Howell S, Weekes WT. An electron microscopic evaluation of the enamel surface subsequent to various debonding procedures. Aust Dent J. 1990;35:245–252.
5. Campbell PM. Enamel surfaces after orthodontic bracket debonding. Angle Orthod. 1995;65:103–110.
6. Hong YH, Lew KK. Quantitative and qualitative assessment of enamel surface following five composite removal methods after bracket debonding. Eur J Orthod. 1995;17: 121–128.
7. Krell KV, Courey JM, Bishara SE. Orthodontic bracket removal using conventional and ultrasonic debonding techniques, enamel loss, and time requirements. Am J Orthod Dentofacial Orthop. 1993;103:258–266.
8. Kim SS, Park WK, Son WS, Ahn HS, Ro JH, Kime YD. Enamel surface evaluation after removal of orthodontic composite remnants by intraoral sandblasting: a 3-dimensional surface profilometry study. Am J Orthod Dentofacial Orthop. 2007;132:71–76.
9. Thomas BW, Hook CR, Draughn RA. Laser-aided degradation of composite resin. Angle Orthod. 1996;66:281–286.
10. Ahrari F, Akbari M, Akbari J, Dabiri GH. Enamel surface roughness after debonding of orthodontic brackets and various clean-up techniques. J Dent (Tehran). 2013;10(1):82-93.
11. Ulusoy C. Comparison of finishing and polishing systems for residual resin removal after debonding. J Appl Oral Sci. 2009;17:209-15.
12. Radlanski RJ. A new carbide finishing bur for bracket debonding. J Orofac Orthop. 2001;62:296-304.
13. Vidor MM, Felix RP, Marchioro EM, Hahn L. Enamel surface evaluation after bracket debonding and different resin removal methods. Dental Press J Orthod. 2015;20:61-7.
14. Eliades T, Gioka C, Eliades G, Makou M. Enamel surface roughness following debonding using two resin grinding methods. Eur J Orthod. 2004;26(3):333-8.
15. Zachrisson BU, Arthun J. Enamel surface appearance after various debonding techniques. Am J Orthod. 1979;75: 121–137.
16. Karan S, Kircelli BH, Tasdelen B. Enamel surface roughness after debonding. Angle Orthod. 2010;80(6):1081-8.
17. Maciesky K, Rocha R, Locks A, Ribeiro GU. Effects evaluation of remaining resin removal (three modes) on enamel surface after bracket debonding. Dental Press J Orthod. 2011;16:146-54.
18. Faria-Junior EM, Guiraldo RD, Berger SB, Correr AB, Correr-Sobrinho L, Contreras EF, Lopes MB. In-vivo evaluation of the surface roughness and morphology of enamel after bracket removal and polishing by different techniques. Am J Orthod Dentofacial Orthop. 2015;147:324-9.
19. Mohebi S, Shafiee HA, Ameli N. Evaluation of enamel surface roughness after orthodontic bracket debonding with atomic force microscopy. Am J Orthod Dentofac Orthop. 2017;151(3):521–527.
20. Kakaboura A, Fragouli M, Rahiotis C, Silikas N. Evaluation of surface characteristics of dental composites using profilometry, scanning electron, atomic force microscopy and gloss-meter. J Mater Sci Mater Med. 2007;18:155–163.
21. Tholt de Vasconcellos B, Miranda-Junior WG, Prioli R, Thompson J, Oda M. Surface roughness in ceramics with different finishing techniques using atomic force microscope and profilometer. Oper Dent. 2006;31:442-9.
22. Karan S, Toroglu MS. Porcelain refinishing with two different polishing systems after orthodontic debonding. Angle Orthod. 2008;78:947-53.
23. Baumann DF, Brauchli L, van Waes H. The influence of dental loupes on the quality of adhesive removal in orthodontic debonding. J Orofac Orthop. 2011;72:125-32.
24. O'Brien KD, Watts DC, Read MJF. Residual debris and bond strength—is there a relationship? Am J Orthod Dentofacial Orthop. 1988;94:222-30.
25. Vicente, A. , L. A. Bravo , M. Romero , A. J. Ortiz , and M. Canteras . A comparison of the shear bond strength of a resin cement and two orthodontic resin adhesive systems. Angle Orthod. 2005;75:109–113.
26. Dilip, S., Srinivas, S., Mohammed Noufal, M. N., Ravi, K., Krishnaraj, R., & Charles, A. Comparison of surface roughness of enamel and shear bond strength, between conventional acid etching and erbium, chromium-doped: Yttrium scandium-gallium-garnet laser etching - An in vitro study. Dent Res J (Isfahan). 2018;15(4):248-255.
27. Hassan AM, Nabih SM, Mossa HM, Baroudi K. The effect of three polishing systems on surface roughness of flowable, microhybrid, and packable resin composites. J Int Soc Prev Community Dent. 2015;5(3):242–247. doi:10.4103/2231-0762.159965
28. Paravina RD, Roeder L, Lu H, Vogel K, Powers JM. Effect of finishing and polishing procedures on surface roughness, gloss and color of resin-based composites. Am J Dent. 2004;17:262-6.
29. Zarrinnia, K. et al. The effect different debonding techniques on the enamel surface: an in vitro qualitative study. Am J Orthod Dentofacial Orthop. 1995;108(3):284-93.