

## Adhesive Removal In Orthodontics - A Literature Review

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### ABSTRACT

Inadequate removal of adhesive remnants after orthodontic debonding may result in heightened enamel roughness, potential staining from white spot lesions, and increased vulnerability to plaque accumulation. Furthermore, it may result in iatrogenic enamel damage, including scratches or more severe harm due to improper instrument utilization. Numerous techniques for the removal of adhesive remnants have been documented in the available literature. Therefore, it is essential for the orthodontist to possess extensive knowledge of adhesive remnant scoring techniques, identification methods, and removal procedures. Comprehending the advantages and disadvantages of each method is essential for achieving optimal clinical outcomes and patient satisfaction.

**KEYWORDS:** Scoring system for Adhesive remnants, Adhesive remnant identification techniques

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### INTRODUCTION

Orthodontic debonding is a pivotal phase in orthodontic treatment, involving the removal of brackets and residual adhesive resin from the enamel surface. Following debonding and subsequent removal of all adhesive residues leads to structural abnormalities in the tooth. Enamel loss due to etching, white spot lesions, microcracks, and scratches resulting from cleaning processes are frequently observed structural problems. Additionally, surface change may occur due to decalcification resulting from plaque collection around orthodontic brackets during treatment and around remaining adhesive post-debonding, which presents a significant problem. (Figure 1) 1-11



Figure 1; Examples of composite resin remnants on canines and incisors after bracket removal in young adults often show color alteration and increased surface roughness. In Figure A, composite resin remnants, surface wear, and scratches on the enamel – likely caused by a rotary instrument such as a diamond bur – are evident. Figures B and C show color alteration due to residual composite resin

Earlier, adhesive removal techniques were rudimentary, depending on manual scraping or basic rotary instruments. These procedures often resulted in iatrogenic injury due to excessive force or inadequate precision. Technological advancements have led to the development of advanced instruments, such as tungsten carbide burs, diamond burs, and polishing discs. While mechanical techniques like tungsten carbide burs are widely used for their effectiveness and affordability, laser-assisted and light-assisted methods offer innovative alternatives with promising results. However, financial limitations and training requirements may impede their widespread adoption. 4,5,12

Given the importance of the procedure, the present review aims to provide comprehensive data regarding the methods of adhesive remnant scoring, adhesive remnant identification methods, and adhesive removal methods. Additionally, the aim is to enumerate each method's advantages and disadvantages as it is critical to ensure optimal clinical outcomes and patient satisfaction.

### SCORING SYSTEM FOR ADHESIVE REMNANTS:

Several scoring systems for assessing adhesive remnants after orthodontic bracket removal have been reported in the literature (see Table 1). Establishing standardized methods to score residual adhesive is crucial for achieving consistent and reliable evaluations in dentistry following bracket debonding.

**Table 1; Scoring system for Adhesive remnants**

Sno	Author name/ scoring system	Scores
1	Scoring system by Zachrisson and Arthur <sup>2</sup> 1979	0 = Perfect surface, 1 = satisfactory, 2 = surface acceptable, 3 = imperfect surface, 4 = unacceptable surface.
2	Adhesive Remnant Index (ARI) used by Artun and Bergland et al. <sup>14</sup> 1984	A. Score 0- no composite resin left on the tooth; B. Score 1- less than half of composite resin left on the tooth C. Score 2- more than half of composite resin left on the tooth D. Score 3-All composite resin left on the tooth with a distinct impression of the bracket base.
3	Adhesive Remnant scoring system used by Bishara et al. <sup>4</sup>	A. Score 5: meaning that there is no composite left on the enamel. B. Score 4: less than 10% of the composite is left on the tooth surface.
		C. Score 3: more than 10% but less than 90% of composite left on the tooth. D. Score 2: more than 90% of the composite is left on the tooth. E. Score 1: 100% of the composite left on the tooth, along with the impression of the bracket base.
4	Modified Adhesive Remnant Index <sup>15</sup>	A. Score 5: 100% of adhesive left on the enamel. B. Score 4: 75%-100% of the adhesive is left on the tooth surface. C. Score 3: 50%-75% of adhesive left on the tooth. D. Score 2: 25%-50% of the adhesive is left on the tooth. E. Score 1: less than 25% of adhesives left on the bracket F. Score 0- No Adhesive left on the bracket

In 1979, Zachrisson and Arthur<sup>2</sup> examined enamel surfaces post-debonding using stereomicroscopy and scanning electron microscopy. They tested cleaning tools such as thin diamond burs, coarse strips, medium and fine sandpaper, green rubber tips, and tungsten carbide drills, assigning qualitative scores from 0 to 4 based on observed enamel quality. Later, Artun and Bergland in 1984 introduced the Adhesive Remnant Index (ARI) as a scoring system. 14 Bishara et al (1990)<sup>4</sup> proposed a method to score adhesive remnants based on the percentage of adhesive remaining on the tooth surface.

### ADHESIVE REMNANT IDENTIFICATION TECHNIQUES

Several adhesive remnant identification methods have been utilized to identify adhesive remnants clearly and efficiently. Thereby facilitating safer and faster removal of adhesive residue by visually distinguishing it from tooth tissue.

A. Ultraviolet light: It is a non-invasive method that depends on the fluorescence of dental materials and tissue. In teeth with dental caries, the loss of biological content and the decalcification of dental structures make it harder for light to pass through, which makes the image appear radiolucent. 16 The composite resins and resinous materials do not glow in the same way as tooth structure. As a result, this makes it easier to visualise the material while adhesive removal. 17–19 (figure 2A)



Figure 2; Adhesive remnant identification techniques

B. Fluorescence-aided identification method: The fluorescence-aided identification technology makes it easier to see the difference in fluorescence between tooth features and restorative materials. 18, 20,16 (figure 2B)



(figure 2B) Fluorescence-aided identification method

C. Dyes and stains: The enamel and composite surfaces exhibit varying affinities for different hydrophobic dyes, which can serve as a revealing agent for residual composite. Abdallah et al. (2014)<sup>21</sup> found that several hydrophobic dyes—such as turmeric solution, paprika solution, oil red, methylene blue, and acid fuchsin—could stain both enamel and composite resin surfaces. Using X-ray photoelectron spectroscopy, they demonstrated that these surfaces contained relatively high levels of hydrocarbons. Their study also highlighted that methylene blue and turmeric, in particular, were effective at staining both enamel and composite materials.

### ADHESIVE REMOVAL TECHNIQUES

Literature reveals the utilisation of different methods for adhesive removal. They can be grouped into; a) Materials used for remanent adhesive removal; b) Materials used for adhesive removal and enamel polishing; and c) Materials used for enamel polishing. (Table 2)

Table 2; Adhesive removal techniques

Sno	Adhesive removal techniques
1	<p>Materials used for remanent adhesive removal</p> <ul style="list-style-type: none"> <li>A. Greenstone, Whitestone</li> <li>B. Green rubber wheel</li> <li>C. Sandpaper disks</li> <li>D. Finishing and acrylic burs</li> <li>E. Air-abrasion</li> <li>F. Ultrasonic and scalers</li> <li>G. Lasers used for adhesive removal                             <ul style="list-style-type: none"> <li>a. CO2 laser</li> <li>b. Er: YAG laser</li> </ul> </li> <li>H. The 8-fluted tapered tungsten carbide burs</li> <li>I. The 12-fluted tapered TC burs</li> <li>J. The 30-fluted tapered TC burs</li> </ul>
2	<p>Materials used for adhesive removal and enamel polishing</p>
	<ul style="list-style-type: none"> <li>A. Sof-Lex discs</li> <li>B. Sof-Lex spiral wheels</li> <li>C. Super-Snap discs</li> <li>D. Zirconia Debonding Bur</li> <li>E. Stain buster</li> </ul>
3	<p>Materials used for enamel polishing</p> <ul style="list-style-type: none"> <li>A. One Gloss polisher</li> <li>B. PoGo Polishers</li> <li>C. Opti Shine</li> <li>D. Porte polisher</li> <li>E. Engine-driven polishers</li> <li>F. Pumice</li> <li>G. Diamond polishing paste</li> </ul>

**Materials used for remanent adhesive removal**

**I. Greenstone, and Whitestone**

The use of green and white stones has been reported as effective for removing residual adhesive.<sup>19</sup> However, Sugsompian et

al.22 observed that polishing with white stone burs often resulted in fine scratches, fracture lines, and in some cases, deep grooves aligned with the bur movement. In contrast, Morado Pinho et al. 23 demonstrated that Arkansas stones used at low rotational speeds caused comparatively less surface damage to enamel.

## II. Green rubber wheel.

Green rubber wheels provide another option, ranging in abrasiveness from pumice-based formulations to aluminum oxide (moderate) and silicon carbide (highly abrasive). They are useful for reducing bulk adhesive or abrading remnants but require continuous air cooling due to heat generation. 24 According to Zachrisson et al. 2, the enamel surface after treatment with green rubber wheels appears smooth and glossy, although with scratches similar to those caused by medium-grit sandpaper discs.

## III. Sand paper disks

Sandpaper discs, particularly the medium grades, were found to be slow and inefficient in removing thick resin remnants. While producing a visible polish, they often caused enamel loss, surface faceting, and persistent scratches. Smaller-grit discs reduced scratching but could not fully overcome these drawbacks. 24

## IV. Finishing and Acrylic Burs

Finishing and acrylic burs have demonstrated effectiveness in removing different types of resin. Their cutting efficiency increases at higher speeds (over 20,000 rpm), but this is accompanied by greater enamel loss. High-speed tungsten carbide burs, in particular, remove material faster but are more aggressive than low-speed steel burs. 24

## V. Air-abrasion

Air-abrasion with alumina represents a minimally invasive method in which abrasive particles are propelled by compressed air against the tooth surface. This technique targets resin more effectively than sound enamel and can therefore be utilized for adhesive removal. However, scanning electron microscopy has revealed the presence of roughened surfaces, shallow pits, and short microscopic scratches after treatment.25,26

Johnson et al. compared sodium bicarbonate and bioactive glass powders in air-abrasion polishing. Both produced enamel loss similar to untreated enamel, but bioactive glass was superior in removing stains compared with sodium bicarbonate. 8

## VI. Ultrasonic and scalers

The rotary instrument is a modern technique for removing adhesives. Mechanical removal of tooth-coloured adhesives is connected with enamel surface damage. Using ultrasonic hand scalers or low-speed handpieces the abrasive removal results in noticeable surface roughness, and is proved inefficient in adhesive removal, requiring substantially more time and enormous operator pressure. These two characteristics, together with the Ultrasonic's vibratory nature, could explain the significant amount of damage caused, particularly to demineralized enamel. 29

Bishara et al.4 (2008) investigated the correlation of mechanical bonding with the ultrasonic and ETD methods and concluded that the conventional method resulted in significantly higher bracket failure, despite the fact that the ultrasonic method took significantly longer to debond than the mechanical and ETD methods.

## VII. Lasers

"Lasers have been explored as a method for adhesive removal, particularly for detaching ceramic brackets by softening the bonding resin through ablation and photoablation. Different laser systems—including diodes, CO<sub>2</sub>, Nd:YAG, Er:YAG, Tm:YAP, and ytterbium lasers—have been investigated, each offering specific benefits and limitations. Although many authors suggest that lasers are associated with less pain, reduced risk, and minimal enamel damage, their high cost and the lack of standardized operating parameters limit routine clinical use. Further research is still required to establish reliable protocols. 34

Smith et al. 35 reported localized areas of enamel alteration following exposure to various laser pulses. Crater formation correlated with the pulse duration, with larger and deeper craters and occasional surface fissures observed at higher energies. In contrast, shorter pulses and lower intensities produced less marked effects, and in some cases, no cratering at all. (Figure 3A)



(Figure 3A) Laser assisted orthodontic debonding;

### VIII. The (8/12/30) fluted tapered tungsten carbide burs

For mechanical removal, tungsten carbide burs are widely employed. Eight-fluted burs are commonly used for initial adhesive remnants; their design, with auxiliary blades reinforcing the main blade, helps minimize vibration. Larger fluted burs with 12 or 30 blades are typically applied for more effective removal of residual bonding material, followed by polishing to restore an acceptable enamel surface.(Figure 3B)



(Figure 3B)fluted tapered tungsten carbide burs

Ryf et al. compared five different polishing techniques on 75 extracted human molars after adhesive removal with tungsten carbide burs and found no significant differences among them. They concluded that selecting an appropriate polishing system used in conjunction with carbide burs can help achieve optimal enamel appearance while facilitating appliance removal. 38.

Despite their common use, Elizabeth Melvin et al. highlighted a lack of consensus regarding several aspects of adhesive removal: the ideal number of flutes in carbide burs, whether pumice is essential for polishing, the most effective bur type, and whether polishing is best performed under wet or dry conditions. Further evidence is therefore needed to guide standardized clinical practice. 11

## MATERIALS USED FOR ADHESIVE REMOVAL AND ENAMEL POLISHING

### A. Sof-Lex discs (3M ESPE, St Paul, Minn)

"The Sof-Lex finishing and polishing discs are made of urethane-coated paper, which provides flexibility and adaptability to different tooth surfaces. This multi-step system includes four grades of aluminum oxide abrasives—coarse, medium, fine, and superfine—distinguished by their color and particle size (Table 3).<sup>24</sup> In clinical use, bulk and medium-grit Sof-Lex discs are typically applied with light pressure for removing adhesive remnants, followed by fine and superfine discs for about 20 seconds of polishing.<sup>23,31,41</sup> In a study involving 80 extracted premolars, Eminkahyagil et al. (2006) 15 compared tungsten carbide burs, Sof-Lex discs, and a microetcher for adhesive removal. While the tungsten carbide bur was the fastest, it caused considerable enamel loss. Sof-Lex discs were gentler, though more time-consuming, and often left behind residual resin.

Table 3; Colour and particle sizes of various soflex disc

Disc type	Color	Particle size
Coarse	Dark orange	100µm
Medium	Orange	40 µm
Fine	Light orange	25 µm
Superfine	Yellow	8 µm

### B. Sof-Lex spiral wheels

The Sof-Lex spiral wheels are designed with flexible spiral “fingers” that contour to both anterior and posterior surfaces, including convex and concave regions. However, applying excessive pressure or contacting sharp edges can limit their lifespan or even detach the spiral from the mandrel. <sup>23,31,41</sup>

### C. Super-Snap discs

The Super-Snap disc system (Shofu, Kyoto, Japan) is available in three abrasive grades. The medium (purple) disc is used to eliminate larger adhesive remnants, followed in sequence by the fine (green) and superfine (red) discs. Sequential use of this system has been shown to produce smooth, highly polished enamel surfaces with minimal scratching.<sup>24</sup>

### D. Stain buster

These are fiber-reinforced composite burs in which abrasive fibers are distributed throughout the working surface. As the resin matrix wears down during use, new fibers are exposed, giving the bur self-sharpening properties and ensuring consistent cutting efficiency. According to research by Shah et al., Stain Buster burs not only achieve effective surface cleaning but also result in one of the smoothest enamel finishes observed, confirming both their qualitative and quantitative effectiveness.<sup>16</sup>

## MATERIALS USED FOR ENAMEL POLISHING

### A. One Gloss polisher

One Gloss is an aluminum oxide–based finishing and polishing system that provides a high-quality surface finish for a wide range of composite and cement restorations. It is also effective in removing stains or excess resin cement from tooth surfaces without damaging enamel, making it particularly useful in orthodontic procedures and for post-scaling polishing, while helping reduce chairside time. <sup>24</sup>

### B. PoGo Polishers

More recently, diamond- and silicon carbide–coated polishers have been developed to further shorten clinical time. Among these, the single-step PoGo polishers—available as discs, cups, or points—are disposable, diamond-impregnated devices designed for final polishing of composite restorations without the need for water. Some studies have evaluated the use of PoGo micro-polishers directly on composite surfaces without pretreatment. While small residues, possibly fine diamond particles, were noted on enamel surfaces, these one-step micro-polishers consistently provided superior surface smoothness with minimal scratches. <sup>24,39</sup>

### C. Engine-driven polishers

Engine-driven polishers are widely preferred by clinicians for their reliability and efficiency. These devices typically employ straight or contra-angled shanks attached to a prophylaxis handpiece and function at a controlled slow speed of about 2500–3000 rpm. <sup>24</sup> Clinical data indicate that dental hygienists often use a mean rotational speed of 2500 rpm, with an optimal applied pressure of around 20 psi.<sup>34,24</sup> Most surfaces can be effectively polished within 2–5 seconds using a light, tapping motion, and clinical observations have shown that each tooth surface generally requires about 4–5 seconds of contact with the rubber cup. However, excessive polishing time, higher rotational speeds, or increased cup pressure can generate frictional heat and lead to undesirable abrasion of the tooth surface. <sup>34,41,24</sup>

### D. Pumice

Pumice, a light grey volcanic material rich in silica, is commonly used in a finely ground form known as pumice flour. It is applied for polishing enamel, gold foil, amalgam restorations, and acrylic resins. Compared to pumice, chalk (calcium carbonate) is less abrasive and produces a smooth, reflective surface with minimal scratching. Research indicates that pumice achieves moderate enamel polishing with a noticeable abrasive effect, whereas calcium carbonate offers a glossy finish with very limited surface damage. <sup>42, 43</sup>

### E. Diamond polishing paste

Diamond polishing pastes, on the other hand, contain diamond particles ranging from 1–6 µm along with fine oxides such as titanium dioxide, aluminum oxide, zinc oxide, and silica from pumice. These pastes are usually applied using plastic or rubber cones in combination with a soft bristle instrument, such as the Super Snap Buff Disk, to achieve an enhanced final polish. <sup>41,44</sup> Complications associated with adhesive removal

1. Enamel damage
2. Inadequate removal of adhesive residues can promote plaque buildup and the development of carious lesions, which may cause discoloration and negatively affect dental aesthetics.
3. Hypersensitivity after debonding may develop.<sup>34</sup>
4. Thermal pulpal damage

## CONCLUSION

The techniques currently used for adhesive removal and enamel polishing inevitably alter the surface texture and roughness of enamel to some degree. Although advances in bracket bonding have greatly improved the predictability and efficiency of orthodontic treatment, the process of debonding continues to present clinical challenges. Preserving enamel integrity while removing orthodontic appliances swiftly and effectively remains a critical aspect for the long-term success and wider acceptance of orthodontic care.

## REFERENCES

1. Gorassini F., Fiorillo L., Marrapodi MM., et al., "Debonding issues in orthodontics: an RCTs systematic review," *Explor Med.* 2024;5:477–91.
2. Zachrisson BU., Årthun J., "Enamel surface appearance after various debonding techniques," *Am J Orthod.* 1979;75(2):121–137.
3. Fitzpatrick DA., Way DC., "Enamel loss caused by orthodontic bonding," *Am J Orthod.* 1977;72(6):671–681.
4. Bishara SE., Trulove TS., "Comparative evaluation of debonding techniques," *Angle Orthod.* 1990;60(3):267–272.
5. Oliver RG., Griffiths J., "Different operator effects on adhesive removal times," *Br J Orthod.* 1992;19(1):47–54.
6. Ijaz U, Haroon K, Haroon S, Khan T, Yasmin R, Mehmood R. Enamel surface roughness assessment after debonding, employing three different removal methods. *Professional Med J* 2019; 26(9):1511-1517.DOI: 10.29309/TPMJ/2019.26.09.3841

7. de Alcântara Cury-Saramago A, Coimbra PR, de Moraes Izquierdo A, Elias CN, de Oliveira Ruellas AC, Sant'Anna EF. Ceramic surface polishing techniques after removal of orthodontic adhesive. *The Angle Orthodontist*. 2009 Jul 1;79(4):790-5.
8. Poothong, P., Teerakanok, S., & Chanmanee, P. (2024). The Effect of Alternative Technique using Hydro Air Abrasion on Enamel Surface Roughness during Orthodontic Adhesive Removal. *Procedia of Multidisciplinary Research*, 2(9), 28
9. Bora N. An Sem Study of Enamel Surface Damage During Debonding of Ceramic Brackets Using Different Debonding Techniques—An in Vitro Study (Master's thesis, Rajiv Gandhi University of Health Sciences (India)).
10. Sanacore M. Examination of Enamel Surface with a Scanning Electron Microscope After Orthodontic Bracket Removal (Master's thesis, State University of New York at Stony Brook).
11. Melvin EA, Yu Q, Xu X, Laird CG, Armbruster PC, Ballard RW. A comparison of traditional orthodontic polishing systems with composite polishing systems following orthodontic debonding. *The Saudi Dental Journal*. 2021 Dec 1;33(8):747-83.
12. Villalobos-Tinoco J, Andretti F, Conner C, Rojas-Rueda S, Fischer NG, Pagan-Banchs M, Jurado CA. A Narrative Review and Clinical Study on Er: YAG Laser Debonding of Ceramic and Composite Veneers. *Biomimetics*. 2025 May 6;10(5):295.
13. Ghaleb L, Al-Worafi NA, Thawaba A, Abdulqader AA, Alkamel A, Abdo Y, Yang Z, Noman N, Al-Aroomi MA, Yulou T. Evaluation of enamel surface integrity after orthodontic bracket debonding: comparison of three different system. *BMC Oral Health*. 2024 Mar 20;24(1):358. doi: 10.1186/s12903-024-04138-4. PMID: 38509532; PMCID: PMC10953161.
14. Özer T, Başaran G, Kama JD. Surface roughness of the restored enamel after orthodontic treatment. *Am J Orthod Dentofac Orthop*. 2010;137(3):368
15. Eminkahyagil N, Arman A, Cetinşahin A, Karabulut E. Effect of resin-removal methods on enamel and shear bond strength of rebonded brackets. *Angle Orthod*. 2006;76:314–21.
16. Shah P, Sharma P, Goje SK, Kanzariya N, Parikh M. Comparative evaluation of enamel surface roughness after debonding using four finishing and polishing systems for residual resin removal—an in vitro study. *Progress in orthodontics*. 2019 Dec;20:1-0.
17. Wang F, Su C, Yang C, Von den Hoff JW, Bian Z, Meng L. Validity of near-infrared light transillumination for the assessment of proximal caries in permanent teeth. *Australian Dental Journal*. 2022 Mar;67(1):46-54.
18. Moecke SE, Barros PC, Andrade AC, Borges AB, Pucci CR, Torres CR. Efficacy of bracket adhesive remnant removal by a fluorescence-aided identification technique with a UV light handpiece: in vitro study. *International Journal of Dentistry*. 2022;2022(1):4821021.
19. Ribeiro AA, Almeida LF, Martins LP, Martins RP. Assessing adhesive remnant removal and enamel damage with ultraviolet light: An in-vitro study. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2017 Feb 1;151(2):292-6.
20. Raticová D, Koťová M, Bezrouk A, Sala L, Křížová P, Leger A, Urbanová W. Enamel surface roughness after orthodontic adhesive removal: an in vitro study comparing four clearance methods. *Eur Oral Res* 2024; 58(3): 145-151.
21. Abdallah MN, Light N, Amin WM, Retrouvey JM, Cerruti M, Tamimi F. Development of a composite resin disclosing agent based on the understanding of tooth staining mechanisms. *J Dent* 2014;42:697-708.
22. Sugsompian K, Tansalarak R, Piyapattamin T. Comparison of the Enamel Surface Roughness from Different Polishing Methods: Scanning Electron Microscopy and Atomic Force Microscopy Investigation. *Euro J Dent*. 2020;14(02):299-305. <https://doi.org/10.1055/s-0040-1709945>
23. Pinho MM, Pinto GF, Mesquita P, Silva FS, Souza J, Ferreira AP, Henriques BA. Damage on tooth enamel after removal of orthodontic adhesive by Arkansas' stone and tungsten carbide burs. *Rev port estomatol med dent cir maxilofac* . 2017; 58(1): 32-38. 10.24873/j.rpemd.2017.05.011
24. Kandikatla, P., Polinetti, P., Ushasree, R. Chiluvuri, P. K. . Materials and methods used for adhesive remnant removal and polishing of enamel after orthodontic treatment: a review. *International Journal of Dental Materials*, 2022; 4(3), 62–68. <https://doi.org/10.37983/IJDM.2022.4303>
25. Sivakumar P, Sharma S. Use of various disclosing dyes to differentiate composite from tooth structure. *Drug Invention Today* 2020;13:32-7.
26. Grünheid T, Sudit GN, Larson BE. Debonding and adhesive remnant cleanup: an in vitro comparison of bond quality, adhesive remnant cleanup, and orthodontic acceptance of a flash-free product. *European journal of orthodontics*. 2014 Dec 29;37(5):497-502.
27. Lai C, Bush PJ, Warunek S, Covell Jr DA, Al-Jewair T. An in vitro comparison of ultraviolet versus white light in the detection of adhesive remnants during orthodontic debonding. *The Angle Orthodontist*. 2019 May 1;89(3):438-45.
28. Eram A, Vinay Kr R, K N C, Keni LG, Shetty DD, Zuber M, Kumar S, S P. Air-Abrasion in Dentistry: A Short Review of the Materials and Performance Parameters. *J Biomed Phys Eng*. 2024 Feb 1;14(1):99-110. doi: 10.31661/jbpe.v0i0.2310-1670.
29. Degrazia FW, Genari B, Ferrazzo VA, Santos-Pinto AD, Grehs RA. Enamel roughness changes after removal of orthodontic adhesive. *Dentistry journal*. 2018 Aug 6;6(3):39.
30. Krell KV, Courey JM, Bishara SE. Orthodontic bracket removal using conventional and ultrasonic debonding techniques, enamel loss, and time requirements. *American Journal of Orthodontics and Dentofacial Orthopedics*. 1993 Mar 1;103(3):258-66.
31. Yassaei S, Joshan N, Abdolahy S, Abadi AHR. Comparative evaluation of three methods of adhesive remnant removal after orthodontic bracket debonding. *Dental Press J Orthod*. 2022;27(6):e2220352.
32. Cesur E, Arslan C, Orhan AI, Bilecenoğlu B, Orhan K. Effect of different resin removal methods on enamel after metal

- and ceramic bracket debonding: An in vitro micro-computed tomography study. *Journal of Orofacial Orthopedics/Fortschritte der Kieferorthopädie*. 2022 May;83(3):157-71.
33. Agrawal S, Jain M, Chachada A. Comparative evaluation of the differential staining ability of carbol fuchsin, methylene blue, and turmeric GC-MI paste between enamel and adhesive composite remnant after orthodontic debonding using a spectrophotometer. *J Oral Res Rev* 2024;16:97-102.
  34. Christensen RP, Bangerter VW. Determination of rpm, time, and load used in oral prophylaxis polishing in vivo. *J Dent Res* 1984;63(12):1376-82. <https://doi.org/10.1177/0022034584063012070137>
  35. Smith SC, Walsh LJ, Taverne AA. Removal of orthodontic bonding resin residues by CO2 laser radiation: surface effects. *J Clin Laser Med Surg*. 1999;17(1):13-8. <https://doi.org/10.1089/clm.1999.17.1315>.
  36. Palmer JA, Mang T, Tabbaa S, Al-Jewair T. Analysis of enamel surface roughness after different adhesive removal techniques for orthodontic bracket debonding. *Lasers in Dental Science*. 2018 Jun;2:95-101.
  37. Marchi RD, Marchi LM, Terada RS, Terada HH. Comparison between two methods for resin removing after bracket debonding. *Dental Press Journal of Orthodontics*. 2012;17:130-6.
  38. Ryf S, Flury S, Palaniappan S, Lussi A, Van Meerbeek B, Zimmerli B. Enamel loss and adhesive remnants following bracket removal and various clean-up procedures in vitro. *The European Journal of Orthodontics*. 2012 Feb 1;34(1):25-32
  39. Melvin EA, Yu Q, Xu X, Laird CG, Armbruster PC, Ballard RW. A comparison of traditional orthodontic polishing systems with composite polishing systems following orthodontic debonding. *The Saudi Dental Journal*. 2021 Dec 1;33(8):747-83.
  40. Cardoso LAM, Valdrighi HC, Vedovello Filho M, Correr AB. Effect of adhesive remnant removal on enamel topography after bracket debonding. *Dental Press J Orthod*. 2014 Nov-Dec;19(6):105-12. DOI: <http://dx.doi.org/10.1590/2176-9451.19.6.105-112.oar>
  41. Fu JH, Wong LB, Tong HJ, Sim YF. Conventional versus comprehensive dental prophylaxis: comparing the clinical outcomes between rubber cup and air polishing and the importance of plaque disclosure. *Quintessence Int*. 2021;52(3):264-274. doi: 10.3290/j.qi.a45602. PMID: 33491396.
  42. Dovgan JS, Walton RE, Bishara SE. Electrothermal debracketing: patient acceptance and effects on the dental pulp. *American Journal of Orthodontics and Dentofacial Orthopedics*. 1995 Sep 1;108(3):249-55.
  43. Erdur EA, Akın M, Cime L, İleri Z. Evaluation of enamel surface roughness after various finishing techniques for debonding of orthodontic brackets. *Turkish Journal of Orthodontics*. 2016 Mar;29(1):1.
  44. Eliades T, Gioka C, Eliades G, Makou M. Enamel surface roughness following debonding using two resin grinding methods. *The European journal of orthodontics*. 2004 Jun 1;26(3):333-8.
  45. Engeler O, Stadler O, Horn S, Dettwiler C, Connert T, Verna C, Kanavakis G. Fluorescence-Aided Identification Technique (FIT) Improves Tooth Surface Clean-Up after Debonding of Buccal and Lingual Orthodontic Appliances. *J Clin Med*. 2021 Dec 31;11(1):213. doi: 10.3390/jcm11010213.