folia medica

Folia Medica 64(6):938-944
DOI: 10.3897/folmed.64.e64542

Original Article

Comparison of Shear Bond Strength of Rebonded Brackets Prepared with Different Methods of Resin Removal: an In Vitro Study

Farhad Sobouti[1], Ardavan Etemadi[2], Sara Seifi[3], Maryam Bakhshi[4], Nasim Chiniforush[5], Sepideh Dadgar[1]

[1] *Department of Orthodontics, Dental Faculty, Mazandaran University of Medical Sciences, Sari, Iran.*

[2] *Department of Periodontics, Faculty of Dentistry, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran*

[3] *Department of Orthodontics, Dental Faculty, Tabriz University of Medical Sciences, Tabriz, Iran*

[4] *General Dentist, Tehran, Iran*

[5] *Dental Implant Research Center, Dentistry Research Institute, Tehran University of Medical Sciences, Tehran, Iran*

Corresponding author: Sepideh Dadgar, Department of Orthodontics, Dental Faculty, Mazandaran University of Medical Sciences, Sari, Iran; Email: dadgar_sepideh@yahoo.com; Tel.: 00989123226518

Received: 17 Feb 2021 ♦ **Accepted:** 15 July 2021 ♦ **Published:** 31 Dec 2022

Citation: Sobouti F, Etemadi A, Seifi S, Bakhshi M, Chiniforush N, Dadgar S. Comparison of shear bond strength of rebonded brackets prepared with different methods of resin removal: an in vitro study. Folia Med (Plovdiv) 2022;64(6):938-944. doi: 10.3897/folmed.64.e64542.

Abstract

Aim: Clinicians and researchers have always made every effort to achieve proper bonding between the surface of the tooth and the re-bonded orthodontic brackets in order to prevent the re-fracture failure of orthodontic pressures throughout treatment. The aim of this study was to determine the bond strength of rebonded brackets by four adhesive removal methods.

Materials and methods: Seventy-five orthodontic brackets were bonded to the extracted first premolar teeth and then debonded. Fifteen of these teeth were rebonded to new brackets after adhesive removal and were named as the control group. Sixty debonded brackets were divided into four groups by means of resin-removal: laser, burr, sandblast, and direct flame. These recycled brackets were re-bonded to the teeth with the same basic bonding methods. The shear bond strength (SBS) was measured at the speed of 0.5 mm/min and the data were analyzed using ANOVA and post hoc tests (α=0.05).

Results: SBS was significantly different in all four groups compared to the control group ($p<0.05$). The burr and sandblast groups had the lowest levels of SBS. Although the laser and flame groups had the highest levels of SBS, they did not show a significant difference ($p=0.99$).

Conclusions: 5W Er:YAG irradiation and direct flame due to relatively good bond strength can be recommended as proposed methods for orthodontic brackets recycling.

Keywords

burr, Er:YAG laser, recycled brackets, shear bond strength, sandblast

INTRODUCTION

Orthodontic treatments include direct bonding of orthodontic brackets to the tooth surface. This bonding should be strong enough to withstand the forces applied to the bracket during treatment. The appropriate bond force ranges from 5.88 to 7.85 MPa.[1]

One of the problems that may occur during orthodontic treatment is the loss of the bracket bond at the enamel junction.[2] Loss of bracket bonds in clinical treatments has been reported on average by 4.7% when using light cured adhesives and 6% when using chemical cured types.[3] The rate of bracket bond loss is related to several factors, including the type of bracket used, the type of tooth bonded to the bracket, the bracket design, and the occlusal forces.[4]

In order to reduce the cost of treatment, the surface of the debonded brackets is modified so that the adhesive material used in previous times should be removed from the surface of the bracket. Otherwise the shear bond strength (SBS) of the bracket reduces and it can lead to re-debonded brackets. There are various methods for removing adhesive materials and remodeling the surface of the bracket, such as using laser, sandblast grinding, and thermal and chemical methods.[5,6]

Studies on SBS of debonded brackets show different results.[7,8] If the SBS of the debonded brackets is not large enough to withstand occlusal forces, the bond failure will occur. Regular visits to rebond a debonded bracket are time-consuming and may sometimes cost more than replacing a debonded bracket with a new one. For this reason, SBS of brackets need to be compared with each other by different methods so the best one could be selected.

Modifying the surface of debonded brackets by laser is a new method. This method is useful for clearing adhesive material from the surface of brackets and providing high SBS.[5]

AIM

In this study we aimed to compare SBS of debonded and recycled brackets by four different adhesive removal methods.

MATERIALS AND METHODS

The protocol of this study was approved by the Ethics Committee of Dental School of Mazandaran University of Medical Sciences, Sari, Iran (IR.MAZUMS.REC.1396.427). In this study, 75 caries-free extracted human first upper premolars were collected from the orthodontic clinics in Sari, Iran, in which patients had to have their first upper premolars extracted according to their orthodontic treatment plan. Then the teeth were cleaned using pumice and rubber caps.

All 75 teeth were bonded with metal orthodontic brackets (Victory series, 0.022*0.028-in brackets; 3M Unitek, Monrovia, Calif) by a general dentist with a fixed pressure under the supervision of an orthodontist. The cross-sectional area of all brackets was 12.68 mm^2.

Fifteen teeth were randomly selected as the control group. The bonding procedure was performed on the surface of all 75 teeth as described below.

To prepare the buccal surface of enamel, it was etched using 37% phosphoric acid gel (Morva Etch, Iran) for 30 seconds and then the teeth were washed for 10 seconds. After drying the teeth by a gentle-air source, Light cure adhesive primer (3M, Unitek, Monrovia, USA) was applied to the surface of the teeth as a bonding agent, and the samples were exposed to LED (DENTAMERICA, LITEX 680A) for 10 seconds. The light cure Transbond XT adhesive paste (3M, Unitek, Monrovia, USA) was placed on the base of the brackets which were placed on the teeth; then the adhesive additions were removed from the tooth surface with an explorer and each bracket was cured by a light cure device for 40 seconds.[9] The curing process included 10 seconds at the occlusal side, 10 seconds at the gingival side, 10 seconds at the mesial side, and 10 seconds at the distal side.[2] Immediately after the bracket bonding process to the control group teeth, shear bond strength testing was performed by Universal Testing Machine (Roll Zwick-Germany) to evaluate the primary bond strength. Another 60 teeth were prepared in the same way and the brackets were bonded to them. After 24 h of sample storage in distilled water at 37°C and then thermocycling for 1000 cycles between 5°C and 55°C using a dwell time of 30 s, the samples were fixed in special jigs and the debonding was performed and measured by Zwick Roell material testing machine (Zwick GmbH, Ulm, Germany) at a head speed of 0.5 mm/min.

Then the process of removing the brackets from the surface of the teeth was carried out by an orthodontic pliers. In order to clear the remaining resin from the surface of the brackets, these 60 extruded brackets were randomly divided into 4 groups of 15 in each. In the first group, the surface of the brackets was cleaned by direct heat using a medium heat torch at 1 cm from the surface of the samples. The brackets were heated for 5 seconds to create a red appearance. Then the adhesive additions were removed by a dental explorer.[4] In the second group, the surface of the brackets was prepared using Er:YAG laser (Pluser, Doctor smile, Italy) at a wavelength of 2940 nm, power of 5 W, and frequency of 50 Hz for 15 sec with sweeping motions and beam profile of Guassian with pulse duration of 100 μsec.[10] The tip diameter was 600 μm with a distance of 1 mm above the surface. 55% water – 65% air were sprayed during the irradiation. In the third group, the resin was removed from the surface of the brackets by abrasion and the round diamond burr in a high-speed handpiece. In the fourth group, sandblasting was performed with a 50-μm aluminum oxide particle at 5 mm for 5 seconds using a sandblasting machine (RONVIG-Denmark) to remove the bracket resin.

After cleaning the surface of the deposited brackets, the enamel surface of all teeth was also cleaned by tungsten carbide burr in a contra-angle handpiece at approximately 30000 rpm to remove residual resin without damage to the enamel. Then 60 recycled brackets were re-bonded to the cleaned teeth. The process of re-bonding the brackets to the surface of the teeth was similar to the first bonding.

Fifteen new brackets were bonded to the cleaned surface of the teeth of the control group. Then the shear bond strength test of all 75 brackets bonded to the teeth was performed by Universal Testing Machine (Roll Zwick-Germany). In order to measure the SBS, the samples were subjected to shear force with blade force of 0.5 mm/min. At the end of the test, results were calculated in megapascals per area unit with the device. The bond failure force was measured by observing the number recorded in the computer software of the device that records the maximum force at breakpoint in Newton (numerical and diagrams).

RESULTS

Shear bond strength values of individual metal brackets to the surface of teeth with various surface cleaning methods including diamond burr, sandblasting, direct heat, and Er:YAG laser irradiation at 5 W are presented **(Table 1) (Fig. 1)**.

Mean ± standard deviation of shear bond strength values of metal brackets to enamel surface in recycling of bracket with direct heat application was 9.3±1.5 MPa, while in recycling with Er:YAG laser at 5 W, it was 9.4±0.8 MPa, in recycling with sandblast with aluminum oxide particles, it was 4.8±0.7 MPa, and in recycling with diamond burr – 6±0.8 MPa **(Table 2) (Fig. 2)**. This value was 13.3±0.7 for the control group where the new bracket was bonded to the cleaned tooth and 14.6±1.9 in the first bonding of the brackets to the enamel **(Table 3)**.

On the other hand, Dunnett's binary comparison test results showed a significant difference between binary comparison of groups with each other and with group control in terms of shear bond strength values of the metal brackets to the enamel surface (all $p<0.001$). There was no significant difference between the two groups of direct heat and Er:YAG laser ($p=0.99$). According to Dunnett's test, the first bond and second bond groups also showed a statistically significant difference ($p=0.04$).

Table 1. Numerical results of Universal Testing Machine in MPa

	Flame	Laser	Sandblast	Burr	New bracket
1	8.70	8.50	4.00	7.20	13.40
2	8.40	9.00	4.30	5.50	13.80
3	11.00	9.20	5.20	5.80	12.00
4	10.70	10.00	5.70	6.90	12.70
5	7.00	10.50	4.60	5.00	14.00
6	9.30	9.40	4.10	4.30	12.10
7	12.50	9.00	5.50	6.30	13.80
8	7.30	9.80	5.50	6.00	14.50
9	11.40	10.70	5.00	6.00	13.50
10	9.60	7.90	4.90	7.00	13.90
11	9.00	8.60	5.90	7.10	14.20
12	8.30	8.90	3.70	5.20	12.90
13	8.50	9.90	3.80	5.90	13.00
14	10.20	10.30	5.40	6.30	13.30
15	9.00	10.70	4.70	6.70	12.70

Table 2. Central Dispersion Indicators Bond strength of metal brackets to enamel surface with laser, flame, burr, sandblast and control group

Group	Number	Mean	Standard deviation	Maximum	Minimum
Flame	15	9.3933	1.52478	12.50	7.00
Laser	15	9.4933	0.85979	10.70	7.90
Sandblast	15	4.8200	0.71734	5.90	3.70
Burr	15	6.0800	0.83939	7.20	4.30
New bracket	15	13.3200	0.74374	14.50	12.00

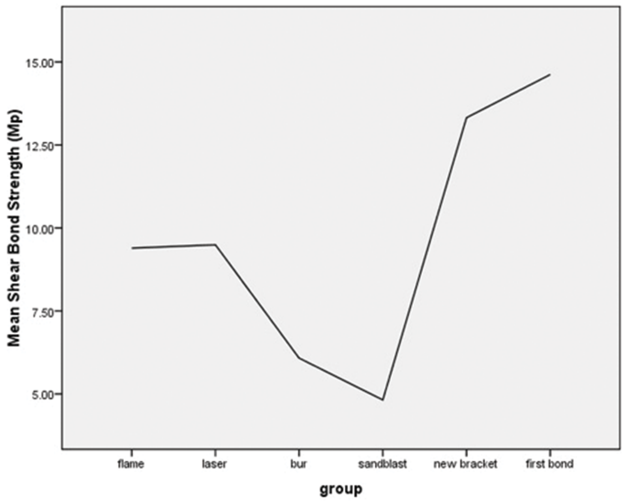

Figure 1. Mean SBS values of individual metal brackets to the surface of teeth with various surface cleaning methods.

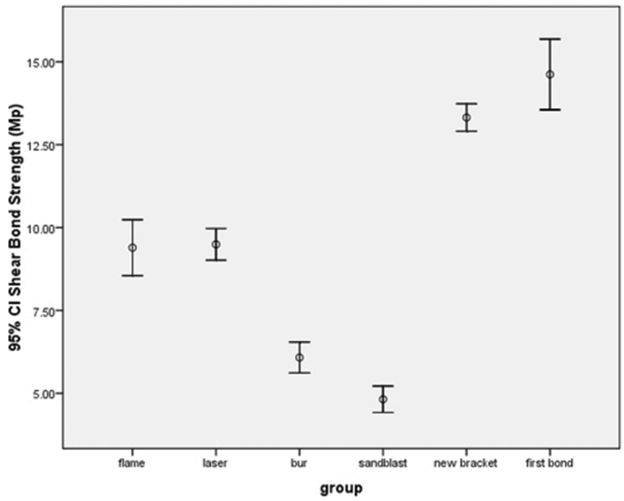

Figure 2. Average shear bond strength of groups.

Table 3. Central Dispersion Indicators Bond strength of metal brackets to enamel surface in comparison of first bond and second bond

Group	Number	Mean	Standard deviation	Minimum	Maximum
First bond	15	14.6200	1.92398	11.00	17.10
New bracket (second bond)	15	13.3200	0.74374	12.00	14.50

DISCUSSION

Achieving proper bonding between the surface of the tooth and the re-bonded orthodontic brackets to address the re-fracture failure of orthodontic forces during treatment has always been the focus of clinicians and researchers. The purpose of re-using debonded brackets is to reduce the cost of treatment for patients and orthodontic offices.[1] Therefore, appropriate methods for cleaning the bracket are needed to completely remove the adhesive material from the bracket surface without damaging the bracket structure, yet the shear bond strength of the re-bonded bracket should be as high as possible to overcome the occlusal and orthodontic forces during treatment.[11] Different techniques have been introduced to recycle de-bonded brackets. Comparing industrial techniques with clinical resin removal techniques, it could be said that industrial techniques require more time and cost. Clinical methods suggested in previous studies that such methods as direct heat, burr, and sandblasting may damage the bracket structure and cause inability to remove the resin completely. There are also conflicting reports on the usefulness or harmfulness of these methods.[2] Therefore, the search for appropriate surface treatments such as different laser irradiation power or different types of laser has been suggested.[4] In the present study, the effects of 5 W Er:YAG laser irradiation on shear bond strength of recycled metal brackets to the tooth surface was compared with direct heat, burr, and sandblasting methods.

As shown in this study, the values of bracket bond strength to the enamel surface in the first bond were statistically different from the amount of bracket bond strength in the second bond to the same tooth. This may be due to the resin remaining on the cleaned enamel surface or due to damage to the enamel tissue during the bracket removal process or removal of the adhesive material. In a study by Eminkahyagila et al., it was concluded that damage to the enamel during the resin removal process was inevitable. This may be due to the difference in the bond strength of the bracket following the first bond and the second bond from the cleaned enamel surface.[12]

According to the results of this study, cleaning the resin from the surface of the bracket with an Er:YAG laser of 5 W provides more bond strength to re-bond the bracket to the surface of the tooth than sandblasting and milling methods and is similar to direct heat treatment. In a similar study by Yassaei et al., they investigated the bond strength of brackets recovered by 4 different resin removal methods. The results showed that acceptable bond strength was obtained using Er:YAG and sandblasting methods in comparison with the control group; however, the extent of the damage to the surface of the bracket was lower in Er:YAG laser compared to sandblasting, based on scanning electron microscope (SEM) images.[4]

In a study by Manuela et al., they performed on 80 samples of orthodontic brackets, the bond strength of brackets recovered by sandblasting and other industrial methods were examined. The results showed that there was no significant difference in the bond strength of the four groups after the first bond. But after three times the success of industrial method was higher than sandblasting. Also, the bond strength of the brackets decreased as a result of the increased size of the aluminum oxide particles in the sandblasting method.[2] In a study by Wu et al., they evaluated the effect of different resin removal methods on bracket bond strength. Contrary to the results of this study, they reported significantly lower bond strength in direct heating method than other methods and there was no significant difference between abrasion and sandblasting methods.[13] This contradiction seems to be due to the intensity of heat applied to the sample and the distance of the heat source from the back surface of the bracket.

Comparison of the results of different studies in this field shows some contradictions. The differences in the methods of studies appear to be the cause of these differences and contradictory findings. It has been reported that the structural changes of the samples following laser irradiation depend on the intensity of the laser energy, the duration of the irradiation, and the distance of the source of irradiation to the sample surface.[14]

Also, according to the results of the study by Han et al. on 105 orthodontic brackets, the heating method caused structural discoloration and structural damage in brackets' bases. The shear bond strength caused by sandblasting decreased in comparison with the control group. However, the Er:YAG laser irradiation neither significantly reduced the bond strength nor damaged the bracket structure. Here, too, Er:YAG laser irradiation provided higher shear bond strength of recycled brackets than other groups, which is consistent with the present results.[10] Also, the esthetic problem caused by the darkening of the heated brackets makes it difficult to use this method to recycle the brackets in the exposed areas of the mouth.

In a study by Ishida et al, a total of 76 orthodontic brackets were examined. The results showed that the bond strength of the brackets recovered by the three groups (Er,Cr:YSGG laser, sandblasting, Er,Cr:YSGG laser + sandblasting) did not differ significantly, but the bond strength of these three groups was significantly higher than that in the control group, indicating the importance of removing the adhesive material from the surface of the brackets when reusing the same brackets.[15]

In a study with similar results by Chacke et al. on 80 orthodontic brackets, it was found that the brackets recycled with the Er:YAG laser had the highest bond strength in the groups, and other groups, including heat, tungsten carbide burr, and sandblasting, did not provide optimal clinical bond strength.[16]

Kachui et al. conducted a study comparing the bond strength of brackets recycled with sandblasting method and CO_2 laser techniques in repeated rebondings. According to the results of this study, the bond strength of the brackets after sandblasting and laser recycling was not significantly different, and in both groups, the optimal clinically favorable bond strength was obtained. But in re-recycling, brackets recycled by sandblasting provided better bond strength than the laser group.[9]

Some discrepancies are observed in bracket recovery using the sandblast method. In some studies, because of the increase in shear bond strength due to sandblasting, the presence of aluminum oxide particles at the bracket surface has been mentioned which can increase the bond strength. Sandblasting also creates a new surface that has high surface energy and therefore a high potential for absorbing other chemical particles and bonding. On the other hand, the same reasons have been mentioned in studies that bond strength decreases after sandblasting. Aluminum oxide particles remain in the bracket mesh, disrupting bonding, or making the high surface energy susceptible to contamination and interference.[17] Therefore, further studies are needed to obtain clear results in this area. Numerous studies have used different bond strength tests to measure the values of bond strengths, such as shear, tensile, micro and push-out tests, which may also be one of the possible reasons for these differences in results, although all of these strength tests are based on the force applied until the failure occurs. In addition, the storage time of the samples in distilled water at standard temperature prior to bond strength testing and how the thermal cycling process is performed, all influence the bond strength values. Also, in some cases, the laser irradiation process occurs after preparation in the usual way, either before it or alone, all of which are influential in recent results.[18]

The bond strength tests which are usually performed are shear and tensile. Of course, torsional tests have also been used in some cases. Both shear and tensile methods are valid and applicable for evaluating bond strength.[19] However, in order to calculate interfacial failure stress accurately, the design of the method must be such as to create uniform stress distribution at the surface. The present study is an in vitro study and its results should be interpreted according to the limitations of this kind of studies. In vitro, the forces applied to the brackets differ from those in the clinical setting. In the mouth, the brackets are affected by a variety of tensile, shear, rotational, and combined forces, and the forces used to remove the brackets in the clinic are different from the shear force that is gradually introduced into the vitro. In addition, there are a variety of stresses in the oral cavity, including temperature, humidity, and acidity, as well as microbial plaques that are difficult to simulate in vitro.[20,21] Despite these limitations, the use of vitro methods before the application of different materials in clinical conditions is the best and most appropriate option.

CONCLUSIONS

Considering the results of this study, we conclude that:

- According to relatively high shear bond strength obtained by 5 W Er:YAG laser irradiation and direct heat methods, these two methods can be recommended for recycling orthodontic brackets.
- Using burrs for recycling orthodontic brackets is

considered as the next option, regarding the medium bond strength it provided. But sandblasting is not recommended because of its low bond strength.
- The values of bond strength between bracket and enamel decreases after debonding and rebonding process.

Acknowledgments

The authors would like to thank the Research Committee of Mazandaran University of Medical Sciences (2593) and the Laser Research Center of Tehran University of Medical Sciences for the preparation of this review.

Funding

The authors have no funding and support to report.

Competing Interests

The authors have declared that no competing interests exist.

REFERENCES

1. Al Maaitah EF, Alomari S, Alhaija SA, et al. The effect of different bracket base cleaning method on shear bond strength of rebonded brackets. J Contemp Dent Pract 2013; 14(5):866–70.
2. Montero MM, Vicente A, Alfonso-Hernandez N, et al. Comparison of shear bond strength of brackets recycled using micro sandblasting and industrial methods. Angle Orthod 2015; 85(3):461–7.
3. Wendl B, Muchitsch P, Pichelmayer M, et al. Comparative bond strength of new and reconditioned brackets and assessment of residual adhesive by light and electron microscopy. Eur J Orthod 2011; 33(3):288–92.
4. Yassaei S, Aghili H, KhanPayeh E, et al. Comparison of shear bond strength of rebonded brackets with four methods of adhesive removal. Lasers Med Sci 2014; 29(5):1563–8.
5. Bahnasi FI, Abd-Rahman AN, Abu-Hassan MI. Effects of recycling and bonding agent application on bond strength of stainless steel orthodontic brackets. J Clin Exp Dent 2013; 5(4):e197–202.
6. Karimi A, Sobouti F, Torabi S, et al. Comparison of carbon dioxide laser with surgical blade for removal of epulis fissuratum. A randomized clinical trial. J Lasers Med Sci 2016; 7(3):201–4.
7. Aksu M, Kocadereli I. Influence of two different bracket base cleaning procedures on shear bond strength reliability. J Contemp Dent Pract 2013; 14(2):250–4.
8. Regan D, van Noort R, O'Keeffe C. The effects of recycling on the tensile bond strength of new and clinically used stainless steel orthodontic brackets: an in vitro study. Br J Orthod 1990; 17(2):137–45.
9. Kachoei M, Mohammadi A, Esmaili Moghaddam M, et al. Comparison of multiple rebond shear strengths of debonded brackets after preparation with sandblasting and CO_2 laser. J Dent Res Dent Clin Dent Prospects 2016; 10(3):148–54.
10. Han RQ, Yang K, Ji LF, et al. Analysis of shear bond strength and morphology of Er:Yag laser-recycled ceramic orthodontic brackets. BioMed research international 2016; 2016:7276287.
11. Reynolds IR. A review of direct orthodontic bonding. Br J Orthod 1975; 2(3):171–8.
12. Campbell PM. Re: Effect of resin-removal methods on enamel and shear bond strength of rebonded brackets. Angle Orthod 2006; 76(6):i-author.
13. Wu HM, Zhao BJ, Chen D. [Effects of different resin removal methods on shear bond strength of rebonded orthodontic brackets]. Shanghai kou qiang yi xue. 2015;24(3):307-10 [Chinese].
14. Viazis AD. Direct bonding of orthodontic brackets. J Pedod 1986; 11(1):1–23.
15. Ishida K, Endo T, Shinkai K, et al. Shear bond strength of rebonded brackets after removal of adhesives with Er,Cr:YSGG laser. Odontology 2011; 99(2):129–34.
16. Chacko PK, Kodoth J, John J, et al. Recycling stainless steel orthodontic brackets with Er:YAG laser - an environmental scanning electron microscope and shear bond strength study. J Orthod Sci 2013; 2(3):87–94.
17. Nishigawa G, Maruo Y, Irie M, et al. Various effects of sandblasting of dental restorative materials. PloS one 2016; 11(1):e0147077.
18. Alavi S, Hoorfar A. Evaluation of porcelain preparation procedures on shear bond strength of steel brackets. J Islam Dent Assoc Iran (JIDA) 2010; 22(1):49–59.
19. Valletta R, Prisco D, De Santis R, et al. Evaluation of the debonding strength of orthodontic brackets using three different bonding systems. Eur J Orthod 2007; 29(6):571–7.
20. Ersu B, Yuzugullu B, Ruya Yazici A, et al. Surface roughness and bond strengths of glass-infiltrated alumina-ceramics prepared using various surface treatments. J Dent 2009; 37(11):848–56.
21. Sinha PK, Nanda RS, Duncanson MG, et al. Bond strengths and remnant adhesive resin on debonding for orthodontic bonding techniques. Am J Orthod Dentofacial Orthop 1995; 108(3):302–7.

Сравнение прочности соединения при сдвиге переклеенных брекетов, изготовленных с использованием различных методов удаления смолы: исследование *in vitro*

Фархад Собоути[1], Ардаван Етемади[2], Сара Сеифи[3], Мариям Бакши[4], Насим Чинифоруш[5], Сепидех Дадгар[1]

[1] *Кафедра ортодонтии, Стоматологический факультет, Мазандаранский университет медицинских наук, Сари, Иран.*

[2] *Кафедра пародонтологии, Факультет дентальной медицины, Тегеранский мецицинский филиал, Исламский университет Азад, Тегеран, Иран*

[3] *Кафедра ортодонтии, Стоматологический факультет, Тебризкий университет медицинских наук,, Тебриз, Иран*

[4] *Стоматолог общей практики, Тегеран, Иран*

[5] *Исследовательский центр зубных имплантов, Исследовательский институт дентальной медицины, Тегеранский университет медицинских наук, Тегеран, Иран*

Адрес для корреспонденции: Сепидех Дадгар, Кафедра ортодонтии, Стоматологический факультет, Мазандаранский университет медицинских наук, Сари, Иран; E-mail: dadgar_sepideh@yahoo.com; Тел.: 00989123226518

Дата получения: 17 февраля 2021 ♦ **Дата приемки:** 15 июля 2021♦ **Дата публикации:** 31 декабря 2022

Образец цитирования: Sobouti F, Etemadi A, Seifi S, Bakhshi M, Chiniforush N, Dadgar S. Comparison of shear bond strength of rebonded brackets prepared with different methods of resin removal: an in vitro study. Folia Med (Plovdiv) 2022;64(6):938-944. doi: 10.3897/folmed.64.e64542.

Резюме

Цель: Клиницисты и исследователи всегда прилагали все усилия для достижения надлежащего сцепления между поверхностью зуба и переклеенными ортодонтическими брекетами, чтобы предотвратить повторный перелом из-за ортодонтического давления на протяжении всего лечения. Целью данного исследования было определение силы сцепления переклеенных брекетов с помощью четырёх методов удаления адгезива.

Материалы и методы: Семьдесят пять ортодонтических брекетов были зафиксированы на удалённых первых премолярах, а затем отсоединены. Пятнадцать из этих зубов были переклеены на новые брекеты после удаления адгезива и были названы контрольной группой. Шестьдесят снятых брекетов были разделены на четыре группы по способу удаления смолы: лазер, бор, пескоструй и прямое пламя. Эти переработанные брекеты были повторно прикреплены к зубам с использованием тех же основных методов фиксации. Прочность связи при сдвиге (SBS) измеряли при скорости 0.5 мм/мин, а данные анализировали с использованием ANOVA и апостериорных тестов ($\alpha=0.05$).

Результаты: SBS значительно отличался во всех четырёх группах по сравнению с контрольной группой ($p<0.05$). Группы с обработкой бором и пескоструйной обработкой имели самые низкие уровни SBS. Хотя группы с лазером и пламенем имели самые высокие уровни SBS, они не показали существенной разницы ($p=0.99$).

Заключение: Облучение Er:YAG мощностью 5 W и прямое пламя из-за относительно хорошей прочности сцепления могут быть рекомендованы в качестве предлагаемых методов переработки ортодонтических брекетов.

Ключевые слова

бор, лазер Er:YAG, переработанные брекеты, прочность на сдвиг, пескоструйная обработка