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IZVORNI ZNANSTVENI RAD
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Smična čvrstoća ortodontskih bravica vezanih na cirkonij-oksidne krunice

Shear Bond Strength of Orthodontic Brackets Bonded to Zirconium Crowns

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Sažetak

Sve češća potražnja za estetskim restauracijama rezultirala je povećanim korištenjem potpuno keramičkih dentalnih nadomjestaka, primjerice onih od cirkonijeva oksida. Time se pojavljuje izazov osiguravanja vezne čvrstoće ortodontskih bravica na različite keramičke materijale. Na snagu veze može utjecati vrsta bravice, odnosno materijal od kojega je izrađena i površina njezine baze ili način retencije. **Svrha rada:** Željela se provesti komparativna analiza posmične čvrstoće metalnih i keramičkih ortodontskih bravica zalijepljenih na cirkonij-oksidnu keramičku površinu kakva se nalazi na protetičkim nadomjestcima, te procijeniti način loma tih dviju vrsta ortodontskih bravica. **Materijali i metode:** Pripremljeno je 20 uzoraka/polukrunica od keramike na koje su zalijepljene ortodontske bravice – 10 metalnih i 10 keramičkih. Posmični test obavljen je u univerzalnoj kidalici s opterećenjem uzrokovanim klipom oštrog vrha koji se kretao pri fiksnoj brzini od 1 mm/min do loma. Sila potrebna za odljepljivanje bravica bilježena je u Newtonima, nakon čega je posmična čvrstoća izračunata u MP-ima. Osim toga, uzorci su analizirani pod digitalnim mikroskopom kako bi se ustanovio indeks ostatka ljepila (ARI). Statistički podatci obrađeni su t-testom, a razina značajnosti postavljena je na $\alpha = 0,05$. **Rezultati:** Pokazali su da je vezna čvrstoća metalnih bravica vezanih na cirkonij-oksidne krunice veća u usporedbi s keramičkim bravicama sa statistički značajnom razlikom. Tijekom istraživanja dvije keramičke bravice su djelomično ili potpuno oštećene. **Zaključak:** Čini se da metalne bravice u usporedbi s keramičkima stvaraju jaču vezu s cirkonij-oksidnim površinama zbog boljeg načina retencije. Keramičke bravice su i krhkije tijekom uklanjanja.

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Ključne riječi
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Uvod

Sve veći estetski zahtjevi rezultirali su povećanim korištenjem potpuno keramičkih nadomjestaka. Danas se koristimo različitim vrstama keramika, kao što je cirkonijev oksid (1). Kako se broj odraslih koji traže ortodontsku terapiju povećava, kliničari često moraju ortodontske bravice lijepiti na zube s različitim vrstama keramičkih nadomjestaka. Zbog češćeg neuspjeha u odnosu na lijepljenje na caklinu, u ortodonciji za odrasle postoje veći izazovi (2, 3). Uglavnom se to odnosi na vrstu keramike, površinsko kondicioniranje, materijal bravica i način retencije, svojstva ljepila, izvor svjetlosne polimerizacije te na vještinu kliničara (3, 4)

Nakon strelovita razvoja CAD/CAM tehnologije, cirkonijev oksid postao je jedan od najzanimljivijih materijala te je predmet mnogobrojnih istraživanja i naširoko se koristi (5, 6). Cirkonijev oksid najčešće se odabire za izradu jezgre pot-

Introduction

The demand for esthetic restorations has resulted in an increased use of all-ceramic restorations. Today, various types of all-ceramic crowns are in use such as zirconium crowns.(1) As the number of adults seeking orthodontic treatment is increasing, clinicians often have to bond orthodontic brackets to teeth that have different types of porcelain restorations. As a result, there is a higher degree of failure compared to bonding to enamel, and different challenges in adult orthodontics. (2, 3). Bond strength is mostly affected by the porcelain type, surface conditioning, bracket material and retention mode, properties of the bonding adhesive, the light-curing source, as well as the skill of the clinician (3, 4).

After the huge development of the CAD/CAM technology, zirconium has become one of the most interesting materials to be examined and used in almost entire dental field.(5,

puno keramičkih krunica zbog velike čvrstoće i bolje estetike u odnosu na metal. Konačna estetika postiže se nanošenjem obložne keramike na cirkonij-oksidnu jezgru. Budući da je lom obložne keramike česta komplikacija na stražnjim zubima zbog snažnih sila žvakanja (7, 8), potiče se češća uporaba monolitnih krunica bez obložne keramike (9, 10). Ortodontskim pacijentima s monolitnim cirkonij-oksidnim krunicama, ortodontske bravice lijepe se izravno na cirkonij-oksidnu površinu (11).

Različite vrste keramike, uz jetkanje cakline, zahtijevaju različite mehaničke ili kemijske metode pripreme za adhezijsku vezu kako bi se izbjegle poteškoće u liječenju odraslih osoba fiksnim ortodontskim aparatima. Preporučuju se metode koje osiguravaju adekvatnu snagu veze bez uzrokovanja prekomjerne hrapavosti kako bi se izbjegle mikropukotine keramičkih površina (11 – 15). Također treba uzeti u obzir veliku opasnost pri rukovanju fluorovodičnom kiselinom jer može znatno oštetiti gingivu i druga mekana tkiva te može brzo oštetiti rožnicu oka (15, 16).

Drugi čimbenik koji utječe na veznu čvrstoću može biti materijal od kojega je izrađena bravica i njezina osnovna površinska struktura ili način retencije. Prema različitim istraživanjima čini se da je vezna čvrstoća keramičkih bravica veća u usporedbi s metalnima zbog bolje adhezije. Drugi razlog za veću veznu čvrstoću keramičkih bravica može biti njihova propusnost svjetlosti, što omogućuje bolju fotopolimerizaciju i smanjenje naprezanja na sučelju ljepila i bravice (12, 15 – 19). Dakle, postavlja se pitanje koje se bravice bolje vežu za površinu cirkonij-oksidne keramike, s obzirom na to da se vrlo malo istraživanja bavilo tom problematikom uzimajući u obzir vrstu materijala i način njihove retencije.

Cilj ovog istraživanja bila je komparativna analiza posmične čvrstoće metalnih i keramičkih ortodontskih bravica vezanih na cirkonij-oksidne keramičke površine kakve se nalaze na protetičkim nadomjestcima, kako bi se ispitali učinci materijala od kojeg su bravice izrađene i način njihove retencije ili strukture površine. Dodatni je cilj bio procijeniti način frakture ovih dviju vrsta ortodontskih bravica.

Materijali i metode

Za istraživanje je pripremljeno 20 uzoraka/keramičkih polukrunica (Copran Zr-i Monolith, White Peaks Dental Solutions GmbH & Co.KG, Wesel, Essen, Njemačka) na koje su zalijepljene ortodontske bravice –10 metalnih (Mini 2000 Ormco Corp., Glendora, Kalifornija, SAD) i 10 keramičkih (Glam Forestadent, Bernhard Forster GmbH, Pforzheim, Njemačka).

Kako se ne bi utjecalo na učinkovitost površinske strukture ili osnovne retencije ortodontskih bravica (slika 1.), adhezivni protokol je pojednostavnjen. Nije primijenjeno nikakvo mehaničko hrapavljenje ili jetkanje fluorovodičnom kiselinom, niti je primijenjen silan ili drugi primeri. Prije li-

6) Zirconium is a widely used core for all-ceramic crowns due to its high strength and esthetic appearance. This is accomplished when a veneer is layered with ceramic powder onto the zirconium core. Since fracturing of the veneer is frequently reported in the posterior teeth, because of the strong masticator forces (7, 8), an increased use of monolithic zirconium crowns without veneers is encouraged.(9, 10) In orthodontic patients with monolithic zirconium crowns, the orthodontic bracket should be bonded directly onto the zirconium surface(11).

Various mechanical or chemical methods other than etching protocol on the enamel must be followed in different types of ceramics, as well as in zirconium, in order to avoid difficulties in treating adults with fixed orthodontic appliances. It has been recommended that methods that provide proper bond strength with less roughening should be used in order to avoid micro-cracks of ceramic surfaces(11-15). There is an extreme danger in handling with hydrofluoric acid (HFA), which should be considered, because it can be very noxious to gums and other soft tissues and it can quickly destroy the corneas of the eyes(15, 16).

Another factor affecting the bond strength can be the material that brackets are made of, and their base surface design or retention mode. According to various studies, the bond strength of ceramic brackets seems to be higher than that of metallic brackets because of the stronger adhesion they obtain. Another reason for the higher bond strength of ceramic brackets can be due to their light transmittance allowing better photo-polymerization and reduced stresses in adhesive-bracket interface. (12, 15-19) Consequently, the question arises which brackets are more adequate for bonding them to full-zirconium ceramic surfaces, taking into consideration that few studies have examined the bond strength between orthodontic brackets and zirconium prostheses, and the effects of bracket material and their retention mode.

The objective of this study was to perform a comparative analysis of the shear bond strength (SBS) of metallic and ceramic orthodontic brackets bonded to all-zirconium ceramic surfaces used for prosthetic restorations, in order to examine the effect of the material that brackets are made of and their retention mode or base surface design. Also, our aim was to evaluate the fracture mode of these two types of orthodontic brackets.

Material and methods

Twenty samples/semi-crowns of all-zirconium ceramic (Copran Zr-i Monolith, White Peaks Dental Solutions GmbH&Co.KG, Wesel, Essen, Germany), on which orthodontic brackets were bonded, 10 metallic (Mini 2000 Ormco Corp., Glendora, California, USA) and 10 ceramic polycrystalline brackets (Glam Forestadent, Bernhard Forster GmbH, Pforzheim, Germany) were prepared for this research.

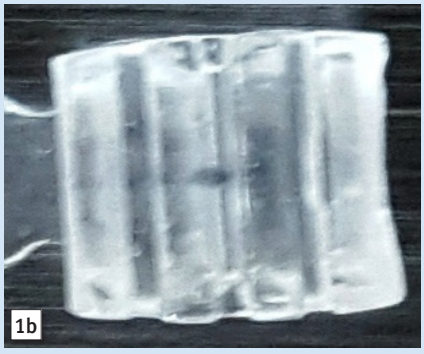
In order not to affect the effectiveness of the base surface design or retention mode of orthodontic brackets (Figure 1), the bonding protocol was simplified. No mechanical roughening or hydrofluoric acid was applied, neither silane

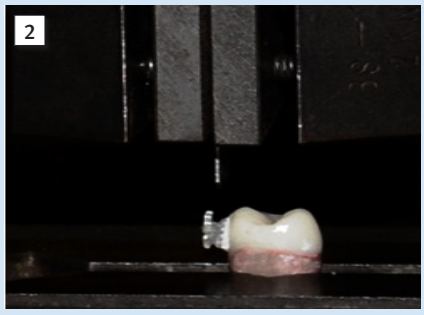
jepljenja samo je obavljeno jetkanje ortofosfornom kiselinom i to 120 sekundi. Sve bravice lijepio je isti istraživač koristeći se dvokomponentnim (primer i adheziv) cementnim sustavom na bazi kompozitne smole (Tranbond XT, 3M/Unitek, Monrovia, CA, SAD). Ljepilo je osvijetljeno 40 sekundi LED lampom (Ledition, Ivoclar Vivadent AG, Schaan, Lihtenštajn). Nakon polimerizacije uzorci su stavljeni 24 sata u vodenu kupelj.

Kao što je prikazano na slici 2., test posmične čvrstoće obavljen je u univerzalnoj kidalici (Erichsen 0-2000 N, ISO 7500-1: 1, AM Erichsen GmbH & Co.KG, Hemer-Sundwig, Njemačka) s opterećenjem primijenjenim paralelno s bukalnom plohom krunice s pomoću klipa oštrog vrha koji se kretao stalnom brzinom od 1 mm/min do loma. Sila potrebna za odljepljivanje bravice zabilježena je u Newtonima, a zatim je posmična čvrstoća izračunata u MP-ima.

nor other primers. Bonding was conducted only after application of phosphoric acid for 120 seconds. All brackets were bonded by the same operator with a two-component (primer and adhesive) composite resin-based bonding system (Tranbond XT, 3M/Unitek, Monrovia, CA, USA). The adhesive was light cured for 40s, using light-emitting diode (Ledition, Ivoclar Vivadent AG, Schaan, Lichtenstein). After polymerization, the specimens were put in water bath for 24 hours.

As presented in Figure 2, SBS has been tested using Universal Testing Machine (Erichsen 0-2000 N, ISO 7500-1:1, AM Erichsen GmbH&Co.KG, Hemer-Sundwig, Germany), with a load applied parallel to the buccal surface of the restoration, using knife edged rod moving at fixed rate of 1 mm/min, until failure occurred. The force required to debond the brackets was recorded in Newton, subsequently, SBS was calculated to MPa.





Slika 1. Površina baze ili retencijski oblik ortodontskih bravica: a. – metalnih i b. – keramičkih
Figure 1 Base surface design or retention mode of orthodontic brackets: a) metallic and b) ceramic
Slika 2. Posmični test na ortodontskim bravicama zalijepljenim na cirkonij-oksidnu keramiku
Figure 2 SBS testing of orthodontic brackets bonded to zirconium

Da bi se procijenila vrsta loma na veznom sučelju u svakoj ispitnoj skupini, uzorci su analizirani digitalnim mikroskopom (Dino-Lite, ANMO Electronics Corp., Taipei City, Tajvan) kako bi se utvrdio indeks ostataka ljepila (ARI) (19, 20). Korištene su ocjene od 1 do 5:

1 - sve ljepilo ostalo je na površini keramičke krunice s otiskom baze bravice
2 - više od 90 % ljepila ostalo je na površini keramičke krunice
3 - manje od 90 %, ali više od 10 % ljepila ostalo je na površini keramičke krunice
4 - manje od 10 % ljepila ostalo je na površini keramičke krunice
5 - nije ostalo ljepila na površini keramičke krunice.

Ovo istraživanje provedeno je kao pilot-istraživanje na Stomatološkom fakultetu i u Laboratoriju za ispitivanje mehaničkih svojstava Fakulteta strojarstva i brodogradnje Sveučilišta u Zagrebu, Hrvatska.

In order to evaluate the type of bond failure at the bracket-adhesive interface in each test group, the samples were analyzed using a Digital Microscope (Dino-Lite, ANMO Electronics Corp., Taipei City, Taiwan), to determine Adhesive Remnant Index (19, 20) . The measurements were conducted, using scores from 1 to 5:

1 - All adhesive remaining on the ceramic crown surface with the impression of the bracket base;
2 - More than 90% of the adhesive remaining on the ceramic crown surface;
3 - Less than 90%, but more than 10% of the adhesive remaining on the surface;
4 - Less than 10% of the adhesive remaining on the ceramic crown surface;
5 - No adhesive remaining on the ceramic crown surface.

This research was conducted as a pilot study at the School of Dental Medicine and at the Faculty of Mechanical Engineering and Naval Architecture, Laboratory for testing mechanical properties, University of Zagreb, Croatia.

Statistička analiza

Provjera normalnosti distribucije vrijednosti posmične čvrstoće provedena je Kolmogorov-Smirnovljevim testom. Hipoteza jednakosti prosječne posmične čvrstoće prema vrsti bravice ispitana je t-testom za neovisne uzorke. Zbog malog uzorka Kolmogorov-Smirnovljev test ima tendenciju prihvatiti hipotezu normalnosti, pa je ispitivanje hipoteze jednakosti prosječnih vrijednosti pomične čvrstoće prema vrsti bravica provedeno i Mann-Whitneyjevim testom za neovisne uzorke. Razina značenja postavljena je na $\alpha = 0,05$. Statistička obrada obavljena je u softveru Statistica 10.

Rezultati

Rezultati pokazuju da su brojčane vrijednosti sile potrebne za odljepljivanje metalnih bravica (zbroj 10 testiranja = 707,97N) s cirkonij-oksidnih krunica veće u usporedbi s keramičkim bravicama (zbroj 10 testova = 597,70N), sa statistički značajnom razlikom.

Procjene parametara posmične čvrstoće prema vrsti bravica navedene su u tablici 1. i prikazane na slikama 3. i 4. Za metalne bravice vrijednosti posmične čvrstoće kretale su se u rasponu od 3,26 do 13,90, s prosjekom od 7,35 i standardnom devijacijom od 3,41 MP-a. Za keramičke bravice te vrijednosti bile su od 2,34 do 7,5, 4,66 i 1,78 MP-a.

Statistical analysis

The Kolmogorov-Smirnov test was applied to ascertain that the data had a normal distribution of SBS. The hypothesis of equality of the average of SBS by the type of braces was tested by t-test for independent samples (Independent Samples Test). Because of the small sample, the Kolmogorov-Smirnov test tends to accept the hypothesis of normality, test of the hypothesis of equality of the average of SBS by the type of braces has also been processed by applying the Mann-Whitney test for independent samples (Mann-Whitney test). The level of significance was set at $\alpha = 0.05$. Data processing was carried out using the software package Statistica 10.

Results

The results of the study showed that numerical values of the force necessary to debond metallic brackets (sum of 10 tests = 707,97N) of the zirconium crowns were higher than those of ceramic brackets (sum of 10 tests = 597,70N), with a significant difference.

The estimates of parameters of SBS by type brackets are listed in Table 1 and shown in Figure 3 and 4. For metal brackets, SBS is in the range from 3.26 to 13.90, with a mean of 7.35 and standard deviation of 3:41 MPa. For ceramic brackets, these values are respectively 2:34 to 7:15, 4.66 and 1.78 MPa.

Tablica 1. Deskriptivna statistika posmične čvrstoće prema vrsti bravice (MP-a)
Table 1 Descriptive statistics of SBS by the type of bracket (MPa)

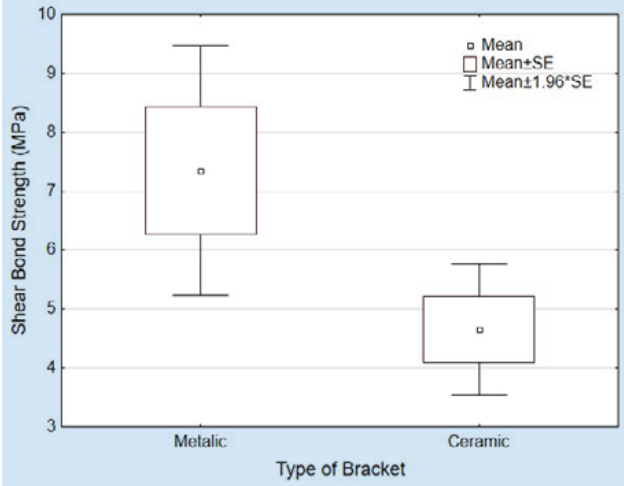
Vrsta bravice • Type of bracket	N	Prosječna vrijednost • Mean	Standardna devijacija • Standard Deviation	Min	Max
Metalna • Metalic	10	7.35	3.41	3.26	13.90
Keramička • Ceramic	10	4.66	1.78	2.34	7.15

Prema Kolmogorov-Smirnovljevu testu, vrijednosti posmične čvrstoće normalno su distribuirane (Z = 0,898, p = 0,395). Leveneov test jednakosti varijance (F = 1,73, p = 0,205) potvrdio je homogenost vrijednosti posmične čvrstoće za metalne i keramičke bravice, što je preduvjet za ispitivanje hipoteze o jednakosti posmične čvrstoće prema vrsti bravica. Rezultat t-testa za neovisne uzorke omogućuje prihvaćanje alternativne hipoteze (t = 2,22, df = 18, p = 0,040), što potvrđuje statistički značajno veću vrijednost posmične čvrstoće za metalne bravice u usporedbi s keramičkima. S obzirom na mali broj uzoraka, normalnost distribucije vrijednosti posmične čvrstoće prema Kolmogorov-Smirnovljevu testu može se dovesti u pitanje. Testiranje hipoteze jednakosti prosječnih vrijednosti posmične čvrstoće prema vrsti bravica potvrđeno je i neparametrijskim Mann-Whitneyjevim testom, a rezultati (U = 25,00, p = 0,059) također potvrđuju rezultate t-testa, ali za 0,9 posto više od potrebne pogreške od 5 posto. Gootovo beznačajno odstupanje od navedene pogreške omogućuje tvrdnju da je posmična čvrstoća metalnih bravica znatno veća u usporedbi s keramičkima.

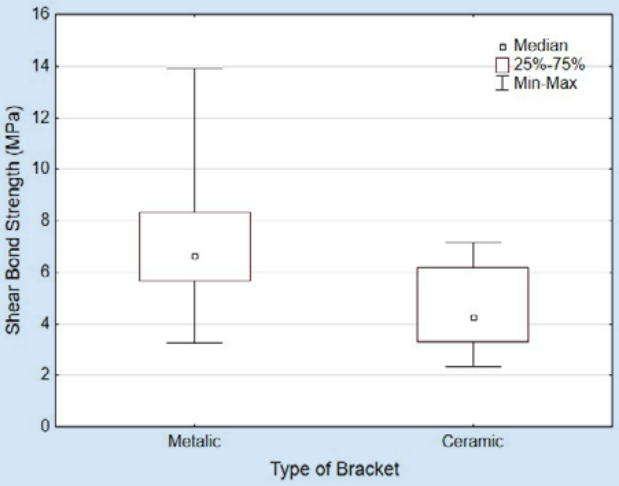
Distribucija ARI-ja prema vrsti bravice prikazana je na slici 5. – uočava se da je distribucija gotovo identična: razlika je samo u četvrtoj kategoriji i za jedan slučaj u petoj.

According to Kolmogorov-Smirnov test, the shear bond strength (SBS) is in normal distribution (Kolmogorov-Smirnov Z = 0.898, p = 0.395). The Levene's test for equality of variances (F = 1.73, p = 0.205) confirmed the homogeneity of variances for the SBS of metallic and ceramic brackets, which is a prerequisite to test the hypothesis for equality of means for the SBS according to type of bracket. The result of t-test for independent samples (t-test for equality of means) allows acceptance of the alternative hypothesis (t = 2.22, df = 18, p = 0.040), which in turn confirms the significantly higher value for the SBS of metallic brackets then of ceramic brackets. The acceptance of the normality of distribution for the SBS according to the Kolmogorov-Smirnov test can be queried. Testing of the hypothesis for equality of means for the SBS according to the type of brackets, was confirmed with the nonparametric Mann-Whitney test and the results (U = 25.00, p = 0.059) also confirmed the results of t-test, but with 0.9% higher than the required error of 5%. In addition, practically insignificant deviation from the stated mistake, it is possible to argue that SBS of metallic brackets is significantly higher than that of ceramic polycrystalline brackets.

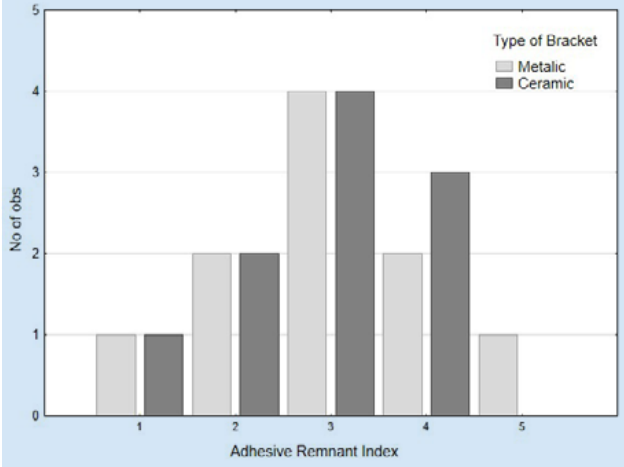
ARI distribution by type of brackets is shown in Figure 5, as it is evident that distributions are almost identical: the



Slika 3. Prosječne vrijednosti, aritmetičke sredine (SE) i 95-postotni interval pouzdanosti posmične čvrstoće prema vrsti bravice
Figure 3 Means, standard errors (SE) and 95% confidence interval SBS-a by the type of bracket



Slika 4. Medijan, interkvartilni raspon i raspon vrijednosti posmične čvrstoće prema vrsti bravice
Figure 4 Median, interquartile range and range of SBS-a by the type of bracket



Slika 5. Distribucija ARI-ja prema vrsti bravica
Figure 5 ARI distributions by type of brackets

Tijekom testa dvije su keramičke bravice djelomično ili potpuno oštećene.

Rasprava

Prema mnogobrojnim studijama vezna čvrstoća keramičkih bravica čini se većom u odnosu na metalne zbog bolje adhezije na keramiku i propuštanja svjetlosti, što rezultira većim stupnjem polimerizacije i smanjenjem naprezanja na spoju ljepila i bravice (12, 17). No naše istraživanje pokazuje da to nije slučaj kod ortodontskih bravica vezanih za cirkonij-oksidne krunice. Čini se da je mehanička veza jača od kemijske kada se bravice lijepe na cirkonijev oksid, a površina baze ili način retencije ortodontskih bravica važni su u postizanju čvrstoće veze.

U ovom istraživanju vrijednosti ARI-ja pokazuju da je u objema skupinama postojala kombinirana učestalost lomova na sučelju bravice i adheziva, ali i adheziva i keramike. Razlika je samo u 4. kategoriji i za jedan slučaj u 5. kategoriji.

Tijekom testa, dvije keramičke bravice djelomično su ili potpuno oštećene.

difference is only in the 4th category and for one case in the 5th category

During the test, two of the ceramic brackets were partially or totally damaged.

Discussion

According to numerous studies, the bond strength of ceramic brackets seems to be higher compared to the strength of metallic brackets due to a stronger adhesion to ceramics and light transmission, which leads to a higher degree of polymerization and stress reduction on the adhesive-bracket joint.(12, 17) However, our study shows that this is not the case for orthodontic brackets bonded to zirconium ceramic crowns. It seems that mechanical coupling is greater than chemical coupling of the brackets with zircon ceramic surface, and the base surface design or retention mode of orthodontic brackets plays a determinant role in their bond strength.

In this research, ARI scores indicated that, in both groups, there was a combined frequency of bond failure at the brack-

mike. Ti rezultati slični su drugim objavljenim rezultatima (12, 15).

Procjena načina loma dvaju tipova ortodontskih bravica u skladu je s drugim istraživanjima, pri čemu su keramičke bravice bile krhkije tijekom uklanjanja.

Usto valja uzeti u obzir da postoje ograničenja u istraživanju *in vitro* i da mogu postojati razlike između *in vivo* i *in vitro* rezultata zbog složenosti usne šupljine. Potrebna su daljnja istraživanja s različitim kombinacijama utjecajnih čimbenika.

Zaključak

Prema rezultatima dobivenima u ovom istraživanju zaključujemo da metalne bravice u usporedbi s keramičkima stvaraju jaču vezu s cirkonij-oksidnom površinom zbog povoljnije bazne površine ili načina retencije. Keramičke bravice također su krhkije tijekom uklanjanja.

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Sukob interesa

Nema sukoba interesa.

et-adhesive interface and at the adhesive-ceramic interface. These results are similar to other reported findings(12, 15).

The evaluation of the fracture mode of the two types of orthodontic brackets is in accordance with other studies, which confirmed the fact that ceramic brackets show higher fragility during debonding.

In addition, it should be considered that there are limitations of *in vitro studies*, and that there can be differences among *in vivo* and *in vitro* results due to the complexity of the oral cavity. Further research using different combinations of influencing factors is needed.

Conclusion

According to the results obtained from this research, we conclude that metallic brackets compared with ceramic polycrystalline brackets, seem to create stronger adhesion with all-zirconium surfaces due to their better base surface design or retention mode. Also, ceramic brackets show higher fragility during debonding.

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Conflict of Interest

There are no conflicts of interest to declare.

Abstract

An increasing demand for esthetic restorations has resulted in an increased use of all-ceramic restorations, such as zirconium. However, one of the challenges the orthodontist must be willing to face is how to increase bond strength between the brackets and various ceramic restorations. Bond strength can be affected by bracket type, by the material that brackets are made of, and their base surface design or retention mode. **The aim** of this study was to perform a comparative analysis of the shear bond strength (SBS) of metallic and ceramic orthodontic brackets bonded to all-zirconium ceramic surfaces used for prosthetic restorations, and also to evaluate the fracture mode of these two types of orthodontic brackets. **Material and methods**: Twenty samples/semi-crowns of all-zirconium ceramic, on which orthodontic brackets were bonded, 10 metallic and 10 ceramic polycrystalline brackets, were prepared for this research. SBS has been tested by Universal Testing Machine, with a load applied using a knife edged rod moving at a fixed rate of 1 mm/min, until failure occurred. The force required to debond the brackets was recorded in Newton, then SBS was calculated to MPa. In addition, the samples were analyzed using a digital camera magnifier to determine Adhesive Remnant Index (ARI). Statistical data were processed using t-test, and the level of significance was set at $\alpha = 0.05$. **Results:** Higher shear bond strength values were observed in metallic brackets bonded to zirconium crowns compared to those of ceramic brackets, with a significant difference. During the test, two of the ceramic brackets were partially or totally damaged. **Conclusion:** Metallic brackets, compared to ceramic polycrystalline brackets, seemed to create stronger adhesion with all-zirconium surfaces due to their better retention mode. Also, ceramic brackets showed higher fragility during debonding.

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Shear Bond Strength; Orthodontic Brackets; Dental Debonding

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