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Original research article

Comparison of the adhesive performance of various composite materials used for clear aligner attachments

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Abstract

Objective: This study aims to investigate the impact of commonly consumed beverages in patients' daily diets on the bonding performance of composite attachments used in clear aligner treatments.

Materials and Methods: Extracted ninety premolar teeth were cleaned and polished. These premolar teeth were then used for attachment placement, utilizing three distinct types of composites and with an attachment template. To simulate the impact of beverages on bond strength during *in vitro* evaluation, the attachments were exposed to three different solutions: coffee, cola, and distilled water. The bonding force was quantified using the shear bond strength test, followed by an assessment of the Adhesive Remnant Index (ARI) scores to evaluate the remaining adhesive. Statistical analyses were done.

Results: The subgroups within the GC Aligner Connect showed statistically significant differences in shear bond strength ($p < 0.05$). Specifically, the cola group's shear bond strength values were significantly lower than the coffee and distilled water groups. Additionally, the shear bond strength values in the distilled water group were significantly higher than those observed in the coffee group ($p < 0.05$). Notably, the measured values for the cola solution exhibited a significant difference across the groups ($p < 0.05$).

Conclusions: The three composites immersed in acidic solutions of cola, coffee, and distilled water were affected to varying degrees, with Omnichroma being the least affected. Clinicians should emphasize to patients the significance of proper dietary rules and their compliance. Additionally, they should consider dietary habits when selecting suitable materials.

Keywords: Dental bonding; feeding behavior; orthodontic appliances, removable; shear strength

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[Abstract in Turkish is at the end of the manuscript]

Introduction

The foundational principles of clear aligner treatments were initially introduced by Kesling and revolutionized orthodontic treatment.[1] Following advancements, particularly the enhancement of Essix technology, plastic began to be used for teeth alignment.[2]

In 1999, Align Technology (Santa Clara, California, USA) introduced a pioneering computer-aided design-based virtual treatment planning system for tooth movement.[3] This system has continuously evolved and has become the dominant player in the market. In recent years, its popularity has increased, due to patients.[4-6] After these changes, clear aligner systems were modified to ensure optimal orthodontic tooth movement, involving the addition of attachments.

The clear aligner system typically begins with the use of traditional attachments that are ellipsoid or rectangular shaped. Among these, the conventional rectangular attachment holds a prominent role in supporting orthodontic tooth movement during virtual planning.[7] Virtually all contemporary aligner systems incorporate this attachment to ensure optimal control over tooth positioning.[8]

Crafted from resin composites, attachments adhere to tooth enamel through a bonding process. Failures in bonding or non-compliance with dietary guidelines can result in failure of attachments from the tooth surface. Loss of attachment presents a scenario that can increase the frequency and duration of clinical visits, extend treatment timelines, and potentially compromise

treatment success.[9-10] Different tooth positions exhibit different levels of attachment loss, which can be influenced by patient factors like eating habits, chewing behaviors, and aligner wear duration.[10]

An optimal protocol for attachment placement is still uncertain, leading to the use of different composite materials. Chen et al.[11] used Filtek Z350XT(3M ESPE, St Paul, MN, USA), Filtek Z350XT flow (3M ESPE, St Paul, MN, USA), and SonicFill (Kerr Corp, Orange,CA) resin composites for attachment design and compared them to operation time, shear bond strength, placement accuracy and wear volume loss. The flowable composites showed shorter operation times. The shear bond strength of SonicFill was higher than the others. The wear volume loss of Filtek Z350XT flow (3M ESPE, St Paul, MN, USA) was higher than others. Alsaud et al.[12] studied how surface preparation, bonding agents, and composite materials affect the surface texture and bonding strength of clear aligner composite attachments bonded to ceramic surfaces and found that the combination of air abrasion, assure Filtek Z350(3M ESPE, St Paul, MN, USA) yielded the highest bonding force. Jungbauer et al.[13] attached a cylindrical test specimen to the enamel using a mold filled with a chemically curing substance (Maximum Cure (Reliance Orthodontic Products, Itasca, IL), Transbond IDB Premix (3M ESPE, St Paul, MN, USA) or a dual-curing (Nexus NX3(Kerr Corp, Orange, CA), RelyX Unicem2 (3M ESPE, St Paul, MN, USA) attachment materials. They evaluated curvature, and the radius of curvature correlated positively with a shear bond straight. RelyX Unicem2 (3M ESPE, St Paul, MN, USA) showed higher values. To date, only a limited number of studies have investigated the shear bond strength of attachments.[11-13]

Considering this context, our study aims to assess the comparative efficacy of three different composites when clinicians apply three distinct clinical usage techniques. The null hypothesis posits that patient dietary habits, simulated *in vitro* through exposure to acidic drinks such as cola and coffee, will not have a detrimental effect on bond strength.

Materials and Method

The research protocol was approved by the Ethics Committee of Clinical Research of the Biruni University (Protocol Number: 2015-KAEK-74-23-02).

In this study, a total of 90 premolar human teeth (extracted premolar teeth for orthodontic treatment purposes, based on indications) were used, with a planned sample size of 10 teeth (n=10) per group. G Power 3.1.9.7 (Franz Faul, Germany) software was used to determine the required sample size for the study. The calculations were based on data from the study titled “Comparative study of three composite materials in bonding attachments for clear aligners” conducted by Chen et al.[11] According to the calculations with 90% power and 5% margin of error, a minimum of 90 samples was determined to be required. The study aims to evaluate the bonding force after attachment application and removal. Therefore, a sample size of 10 teeth per group has been determined for the study. The study conducted is a continuation of a color study previously done with the same solutions and composites.[14]

Exclusion criteria were teeth from patients with craniofacial anomalies or dental irregularities, presence of congenital enamel defects or hypomineralization, extensive buccal restorations, caries, cracks, restorations, or infections.

The specimens were kept in a 0.1% thymol solution in a refrigerator at +4 ℃ until utilization. Subsequently, all teeth were cleared of debris, calculus, and soft tissues through intraoral scaling, polished with paste, and thoroughly rinsed with water.

Preparation of models

Plaster models were meticulously crafted using silicone molds to replicate the precise dental arch shape, facilitating seamless scanning and the creation of attachment templates. These models underwent scanning using an iTero intraoral scanner (Align Technology, San Jose, California, USA), generating digital representations from the scanned images. Subsequently, digital models were fabricated and used to prepare attachment templates. In this investigation, vertical, rectangular attachments measuring 2 × 4 mm were meticulously planned. The templates were meticulously fashioned using a 0.6 mm Duran plate and a Biostar device (Scheu-Dental GMBH, Germany).

Placement of attachments

After applying 37% orthophosphoric acid to the middle third of each tooth for 30 seconds, the teeth were rinsed with water for 30 seconds and dried using an air syringe. A universal bonding agent (Adhese Universal, Ivoclar Vivadent, Ltd. São Paulo, Brazil) was applied with an applicator for 20 seconds to the demineralized areas. The adhesive was polymerized with a Bluephase light device (Ivoclar Vivadent, Ltd. São Paulo, Brazil) in PowerCure mode for 3 seconds (Table 1-2). Then the attachments were placed on the middle third of the buccal surfaces of the premolars.

Holding in Solutions Procedure

- The models were divided into subgroups and then held in three different solutions: coffee, cola, and distilled water (Figure 1).
- Group 1: Coffee (Nescafe Classic, Nestle, Switzerland) solution (pH = 5) A coffee solution was obtained by mixing one tablespoon of granulated coffee and 100 ml of boiled water
- Group 2: Cola (The Coca-Cola Company, Turkey) solution (pH = 3)
- Group 3: Distilled water (pH = 6)
- The solutions were replaced daily, and the specimens were stored in darkness in an oven at 37 ± 1 ℃ for 28 days.

Table 1. *Materials used in the study.*

Materials	Composition	Filler w/v%	Manufacturer
Omnichroma	UDMA, TEG-DMA, uniform size supra-nano spherical fillers (260 nm spherical SiO_2-ZrO_2)	79/68	Tokuyama Dental Corporation, Tokyo, Japan
GC Aligner Connect	Ocrahydro-4,7-methano-1H-indenedyl)bis(methylene) bismethacrylate; 1,3,5-Triazane-2,4,6-triamine-polymer with formaldehyde 2,2-ethylene dioxyethyl dimethacrylate; 2-(2H-benzotriazol-2-yl)-p-cresol; titanium dioxide; UDMA… (not all the contents were disclosed)	NA	GC Corporation, Tokyo, Japan
Tetric PowerFlow	Bis-GMA, Bis-EMA, UDMA, Bis-PMA, DCP, D3MA. Fillers: Barium glass, Ytterbium, Trifluoride, Copolymer, and Mixed Oxide (SiO2/ZrO2)	79/53–54	Ivoclar Vivadent Ltd., São Paulo, Brazil

UDMA: Urethane dimethacrylate
TEGDMA: Triethylene glycol dimethacrylate
SiO_2: Silicone dioxide
ZrO_2: Zirconium dioxide
Bis-GMA: Bisphenol A diglycidyl methacrylate
Bis-EMA: Ethoxylated bisphenol A dimethacrylate
Bis-PMA: Propoxylated bisphenol A dimethacrylate
DCP: Tricyclodecane dimethanol dimethacrylate
D3MA: Decandiol dimethacrylate

Table 2: *Polymerization of composites.*

Composite	Time/Procedure	Device
Omnichroma	5 seconds in Turbo mode (2000 mW/cm^2)	Bluephase Light Device
GC Aligner Connect	5 seconds in Turbo mode (2000 mW/cm^2)	Bluephase Light Device
Tetric PowerFlow	3 seconds in PowerCure mode (3000 mW/cm^2)	Bluephase Light Device

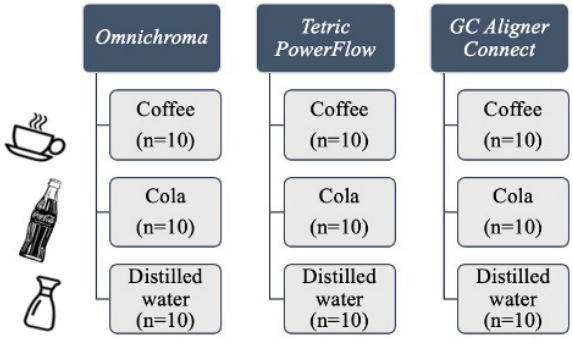

Figure 1. *Distribution of composite attachments into subgroups.*

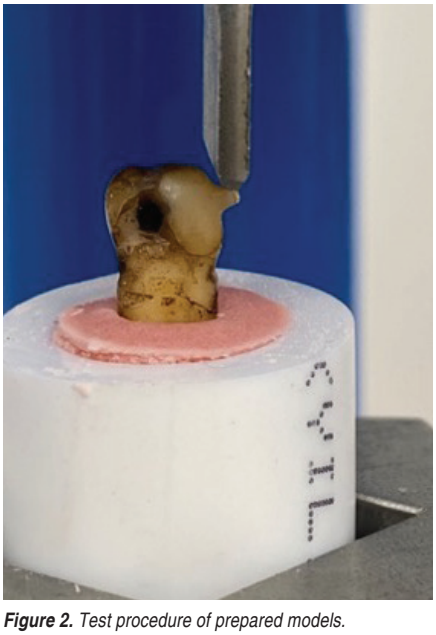

Figure 2. *Test procedure of prepared models.*

Test Procedure

The teeth were extracted from plaster models and secured in acrylic resin using plastic pipes with a diameter of 25 mm. Before testing, all models with composite attachments were subjected to 1000 thermal cycling (SALUBRIS, Boston, Massachusetts, USA). The shear bond strength test was conducted by the same operator using a universal testing machine (MOD Dental, Esetron Smart Robotechnologies, Turkey) at a speed of 0.5 mm/min (Figure 2). The initial failure load values (N) were recorded and converted into Megapascals (MPa) using a formula. Shear bond strength was then calculated using the following formula:

$$SBS = \frac{\text{Failure load}}{\text{A}}$$

A: The surfaces area of the attachment (2x4 mm= 8 mm^2).

Adhesive remnant Index (ARI) evaluation[15]:

The tooth surfaces were assessed for residual adhesive using the ARI on the enamel surface at magnifications of 10x, 30x, and 40x with a stereomicroscope (Nikon SMZ745T, Tokyo, Japan) and microscopic camera (Toupcam, Hangzhou ToupTek, Zhejiang, P.R.China) (Figure 3).

ARI was evaluated as follows;

- scale 0 represents 0% adhesive remnant on the enamel,
- scale 1 less than 50% adhesive remnant on the enamel,
- scale 2, over 50% adhesive remnant on the

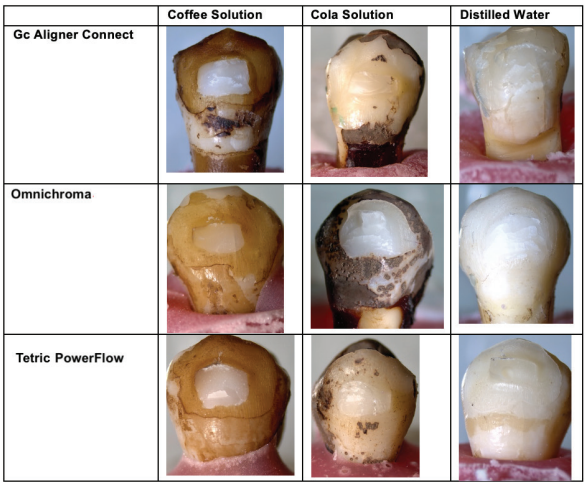

Figure 3: *Tooth surface at 10x magnification.*

enamel,

- scale 3, 100% adhesive remnant on the enamel.

ARI was scored by three authors, and a consensus method was used for statistical evaluation. The representation of the entire study procedure is shown in a flowchart (Figure 4).

Statistical analysis

The data obtained in this study were analyzed using the Statistical Package for the Social Sciences (SPSS) 22.0 package program (IBM Corporation, Armonk, NY, USA). Kruskal Wallis H test was used to compare between three or more groups in non-normally distributed data. The Chi-Square test was used to compare ARI measurements. $p < 0.05$ was used as the significance level.

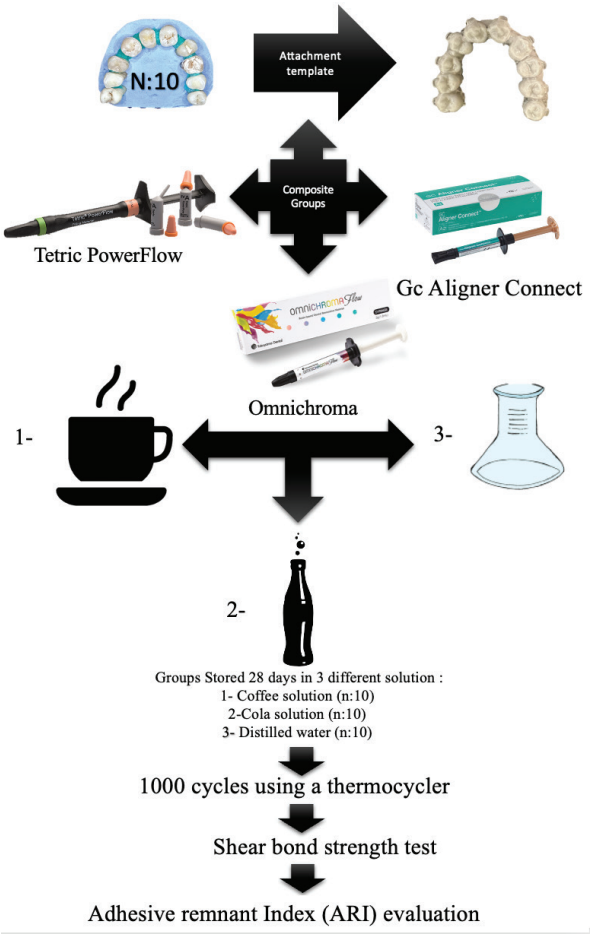

Figure 4. *The representation of the entire study procedure shown in a flowchart.*

Results

The shear bond test values of the materials according to the solutions are shown in Table 3.

The subgroups of GC Aligner Connect (GC Corporation, Tokyo, Japan) showed a statistically significant difference ($p < 0.05$) in shear bond strength. The values for the cola group were significantly lower than those for the coffee and distilled water groups, while the values for the distilled water group were significantly higher than those for the coffee group ($p < 0.05$).

When the values of the Omnichroma (Tokuyama Dental Corporation, Tokyo, Japan) and Tetric PowerFlow (Ivoclar Vivadent Ltd., São Paulo, Brazil) groups were evaluated separately, there was no statistically significant difference between subgroups, although the values for the coffee group were lower ($p > 0.05$).

There was no significant difference between the groups in terms of measured values for the coffee solution and distilled water when evaluated separately ($p > 0.05$), but the values for the Omnichroma group were higher.

The groups showed a significant difference in measured values for the cola solution ($p < 0.05$). The values for the Omnichroma (Tokuyama Dental Corporation, Tokyo, Japan) group were significantly higher than those for the Tetric PowerFlow (Ivoclar Vivadent Ltd., São Paulo, Brazil) and GC Aligner Connect (GC Corporation, Tokyo, Japan) groups.

Table 4 shows the ARI values. There was no significant difference or dependency between the subgroups of GC Aligner Connect (GC Corporation, Tokyo, Japan), Omnichroma (Tokuyama Dental Corporation, Tokyo, Japan), and Tetric PowerFlow (Ivoclar Vivadent Ltd., São Paulo, Brazil) for the ARI values for the coffee, cola, and distilled water groups, which were held on coffee solutions ($p > 0.05$).

However, the GC Aligner Connect (GC Corporation, Tokyo, Japan) group that was held on coffee had higher scores in the ARI. Both GC Aligner Connect GC Corporation, Tokyo, Japan) and Tetric PowerFlow (Ivoclar Vivadent Ltd., São Paulo, Brazil) groups held on coffee had higher scores in the ARI. Moreover, the Tetric PowerFlow(Ivoclar Vivadent Ltd., São Paulo, Brazil) group that was held on distilled water had higher scores in the ARI.

Table 3. *Shear bond strength test values shown as MPa.*

	Coffee Solution	Cola Solution	Distilled Water	Kruskal-Wallis H Test
Gc Aligner Connect	20.59 ± 5.23	16.12 ± 2.94	23.27 ± 5.64	0.011*
Omnichroma	24.63± 5.85	27.94 ± 2.86	29.77 ± 7.83	0.118^{NS}
Tetric Power Flow	21.82 ± 4.99	17.60 ± 7.01	22.46 ± 8.38	0.211 ^{NS}
Kruskal-Wallis H Test	0.254 ^{NS}	0.0001***	0.096 ^{NS}	

*NS: Non- significant. p<0.05 is statistically significant. *p<0.05; *** p<0.001.*

Table 4. *Measures of ARI.*

			Coffee Solution	Cola Solution	Distilled Water	Chi-Square
		ARI	**%**	**%**	**%**	**p**
Gc Aligner Connect	**Consensus**	**0**	0	0	0	
		<%50	30.0	10.0	50.0	
		>%50	40.0	80.0	40.0	0.228^{NS}
		%100	30.0	10.0	10.0	
		Total	100.0	100.0	100.0	
Omnichroma	**Consensus**	**0**	0	0	0	
		<%50	50.0	50.0	60.0	
		>%50	50.0	50.0	40.0	1 ^{NS}
		%100	0.0	0.0	0.0	
		Total	100.0	100.0	100.0	
Tetric PowerFlow	**Consensus**	**0**	0	0	0	
		<%50	40.0	10.0	10.0	
		>%50	60.0	80.0	80.0	0.397 ^{NS}
		%100	0.0	10.0	10.0	
		Total	100.0	100.0	100.0	
	Chi-Square	**p**	0.256 ^{NS}	0.168 ^{NS}	0.102 ^{NS}	

NS: Non- significant. P<0.05 is statistically significant.

Discussion

In recent years, there has been a growing demand for clear aligners, leading to systemic developments in the field. As a result, clinicians have started exploring appropriate composite materials to use with these aligner systems. However, studies investigating aligner attachment materials have been limited in number.[11-13]

This study aimed to evaluate the effectiveness of three composites in a clinical setting and determine if simulating a patient's acidic beverage consumption (such as cola and coffee) *in vitro* would impact bond strength. Patient cooperation is crucial for ensuring optimal treatment duration and outcomes, including the successful removal of braces or attachments.[15] Furthermore, soft drinks, including cola, have become a common element in the daily diets of children, teenagers, and occasionally adults.[17] Previous research has indicated that cola consumption may reduce the bonding forces of braces.[17-19] However, to our knowledge, this is the first study to examine the effect of acidic beverages on aligner attachments. The results of the current study rejected the null hypothesis that *in vitro* simulation of a patient's consumption of acidic drinks such as cola and coffee wouldn't negatively impact bond strength.

Clinicians may favor packable composites for their stronger bonding forces, but flowable composites are preferred for their easier application and quicker chair-side application.[11] Despite this, a paper by Park et al.[19] found no significant differences between Transbond XT, which is considered the gold standard for orthodontic bonding, and several flowable composites such as X-flow, Tetric Flow, Grandio Flow, and Filtek Z350. Moreover, the recommended bond strength values for bonding orthodontic brackets to natural teeth were established as 6-8 MPa.21 The flowable composite materials that were tested in the study by Park et al.[20] had higher bond strength, particularly Tetric PowerFlow, which was used in this study and showed a bond strength of 13 MPa. However, the high bond strength values of Tetric PowerFlow (22 MPa) may be related to the fact that it does not contain metal brackets or that different adhesives are used. In this study, when attachments made from Tetric PowerFlow were exposed to a cola solution, there was a noticeable decrease in the bond strength values.

According to a study reported in the literature, a comparison between flowable and packable composites, in conjunction with universal and assure bonding adhesives, demonstrated that the selection of an appropriate combination of adhesive and composite

material plays a significant role in achieving higher bonding forces for clear aligner attachments to ceramic materials.[12]

In the literature, it is reported that micro- and nano-hybrid composites generally demonstrate superior properties compared to flowable composites in all aspects.[22,23] Therefore, flowable composites, which are more durable compared to previous generations while providing time and application advantages, have been preferred.

This finding highlights the importance of considering both the adhesive and composite material when aiming for optimal bonding outcomes. Omnichroma is preferred by orthodontists for making attachments in aligner patients as it is a single-shade universal composite that does not require color selection and can be used on multiple teeth. The Tetric PowerFill composite is a bulk-fill composite that can be applied in a single layer up to 4mm thick, and it can be polymerized in 3 seconds with light-curing devices, offering a time-saving alternative in the clinic. GC Aligner Connect is a specific aligner attachment composite. In a study found in the literature, it was observed that the hardness value of Omnichroma decreased when exposed to citric acid compared to those kept in air and water.[25] However, the surface roughness did not change significantly.[24]

In terms of attachment construction, when the evaluation of two same composite flowable and packable forms was conducted, the packable form had significantly higher shear bond strength values.[11] The study selected three flowable composites to assess their clinical convenience and time-saving capabilities. The average bond strength values in the current study were comparable to or higher than those reported for packable composites in the previous study. Additionally, the bond strength values achieved in the current study were higher than those reported for the flowable composite, despite subjecting the attachments to an acidic solution.[11] These results suggested that the combination of adhesive and composite used in the current study may have contributed to the enhanced bond strength, even under acidic conditions. In the current study, the bond strength of GC Aligner Connect was significantly negatively affected compared to the group immersed in distilled water when exposed to coffee and cola solutions. While the Omnichroma and Tetric PowerFlow groups showed no significant differences, they exhibited lower values in acidic solutions. There was a significant difference among the three composite groups immersed in cola, with Omnichroma being the most resistant composite. This suggests that in individuals with high potential for acidic nutrition or reflux, or those who struggle with managing their dietary habits, this composite may serve as a good alternative. Nevertheless, when considering this suggestion, it is essential not to forget the need for clinical observation and evaluation, bearing in mind that it is an *in vitro* study.

In clinical practice, buccal attachments are generally used, but some patients may prefer not to have buccal attachments due to aesthetic concerns. Furthermore, certain biomechanical conditions require palatally positioned attachments. Although individual differences exist, especially on the palatal surfaces, when examined anatomically, these differences are usually less frequent on the buccal surfaces of the teeth.[25]

In their study, Kırçelli et al.[26] aimed to compare the bond strength values and manipulation times of five different composite materials. They obtained results of 21.0 ± 4.0 MPa for Tetric N-Flow and 17.4 ± 3.5 MPa for GC Aligner Connect, with the mean shear bond strength in the GC Aligner Connect group being significantly lower than in Tetric N-Flow. Additionally, the flowable composite demonstrated a significantly shorter manipulation time compared to the high viscous composite. In the current study, although no statistically significant differences were observed between the groups when the three materials were stored in distilled water, GC Aligner Connect exhibited a higher shear bond strength compared to Tetric PowerFlow. The reason for this difference could be attributed to the materials being kept in liquid or the use of different agents during bonding. Additionally, it is possible that the polymerization with a compatible light device for Tetric PowerFlow could have played a role in this disparity. Additionally, the flowable composite demonstrated a significantly shorter manipulation time compared to the high viscous composite.[26] We believe that selecting materials with a flowable consistency in our study will provide a clinical advantage by saving time.

Jungbauer et al.[13] examined curvature-dependent bonding forces on various attachment materials and found that there was a negative correlation between curvature and shear bond strength values. Given this information, we chose the relatively flat middle third of the buccal surface for attachment construction. After conducting the shear bond strength test, we evaluated the ARI scores and found them to be lower than those reported by Jungbauer et al.[13] This could be because we used a procedure to simulate the attachment template and chose direct bonding, whereas they chose indirect bonding and attachment construction through a disc covering the surface. If the composite stays on the enamel surface, this means that bonding forces are higher. Two enamel fractures were observed as a result of shear bond testing, suggesting that the use of rotary instruments might be more suitable for attachment removal.

Attachment loss can be attributed to various risk factors related to the clinician and the patient. Clinician-related factors include the bonding protocol and the choice of bonding materials. In our study, we followed the same bonding procedure; however, we experienced one bonding failure in the Tetric PowerFlow and

Omnichroma groups and four failures in the GC Aligner Connect group. The attachment loss can also be influenced by patient behaviors like how often aligners are removed, wear time, use of seaters, eating habits while wearing aligners, and chewing patterns. Although we were unable to simulate all these conditions, which represents a limitation of our study, we were able to simulate drinking habits[10], which provided valuable insights into the effect of acidic beverages on bond strength.

In this study, the ARI was modified to evaluate residual adhesive post-aligner attachment removal, which is usually used for post-brace removal.[15] Using an electron microscope is not necessary for the ARI assessment; an optical microscope provides sufficient detail for visualizing and evaluating adhesive remnants.[27] Typically, it is performed using magnifications ranging from 10x to 40x and is relatively easy to apply in a clinical setting.[27] In the study, three different observers scored at three different magnification levels(10x-30x-40x), and the mean values were calculated and subjected to statistical analysis. This approach aimed to eliminate differences arising from magnification variations, as mentioned in the literature.[27]

The ARI values for the coffee, cola, and distilled water groups were compared among the subgroups of GC Aligner Connect, Omnichroma, and Tetric PowerFlow; the results showed no significant difference. Rodríguez-Chavez et al.[27] reported that while the resin area increases, the debonding resistance also increases. The adhesion between orthodontic resin and enamel is intended to be temporary, yet it needs to be durable enough to withstand orthodontic forces.[27] The Tetric PowerFlow group had higher scores in the ARI and it is possible that the more composite was preserved, the less damage the mine would cause during attachment loss. The process of removing waste from the tooth can lead to physical changes in the enamel, ranging from a hard surface to microscopic fractures.[28] Therefore, from a clinical standpoint, composites that can adhere well to the enamel surface and can be removed in a controlled manner are preferred.

The current study had certain limitations; wear resistance was not measured, and simulations of chewing and brushing weren't included. *In vitro* studies cannot fully replicate the oral environment, lacking the complexity and dynamics of real oral conditions including factors like saliva, other oral fluids, bacterial influence, and chewing forces. Consequently, the outcomes of *in vitro* studies may not entirely reflect events under oral conditions, limiting direct applicability to clinical practice and requiring careful evaluation before implementation. Further research should aim to address these limitations and investigate other patient and clinician-related factors that may impact the success of composite attachments.

Conclusion

Indeed, the results of the study indicated that acidic beverages, particularly cola, had a detrimental effect on the bond strength values of the attachments. It is important to note that different materials may exhibit varying degrees of resistance to acidic beverages. Some materials may be more susceptible to the negative effects of acidic exposure, while others may demonstrate greater resistance. The three composites immersed in acidic solutions of cola, coffee, and distilled water were affected to varying degrees, with Omnichroma being the least affected.

Consequently, it is crucial to consider the specific material properties and their compatibility with acidic environments when selecting attachments or bonding materials for clinical applications.

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Şeffaf plak ataşmanı yapımında kullanılan çeşitli kompozit malzemelerin yapışma performansının karşılaştırılması

Özet

Amaç: Bu çalışma, günlük diyetlerinde sık tüketilen içeceklerin şeffaf plak tedavilerinde kullanılan kompozit ataşmanların yapışma performansı üzerindeki etkisini araştırmayı amaçlamaktadır.

Gereç ve Yöntem: Çekilmiş doksan adet premolar diş temizlendi ve cilalandı. Bu premolar dişler, üç farklı kompozit türü ve bir bağlantı şablonu kullanılarak ataşman yerleştirme işlemi yapıldı. *In vitro* değerlendirme sırasında bağlantıların yapışma dayanıklılığına içeceklerin etkisini simüle etmek için bağlantılar kahve, kola ve distile su içeren üç farklı çözeltiye maruz bırakıldı. Yapışma kuvveti, kesme bağlanma dayanıklılığı testi kullanılarak ölçüldü ve kalıcı yapışkanı değerlendirmek için Yapışkan Kalıntı İndeksi (ARI) skorlarına bakıldı. İstatistiksel analizler yapıldı.

Bulgular: GC Aligner Connect içindeki alt gruplar arasında kesme bağlanma dayanıklılığında istatistiksel olarak anlamlı farklılıklar bulundu ($p < 0.05$). Özellikle, kola grubundaki kesme bağlanma dayanıklılığı değerleri, kahve ve distile su gruplarına göre önemli ölçüde daha düşüktü. Ayrıca, distile su grubundaki kesme bağlanma dayanıklılığı değerleri, kahve grubunda gözlenen değerlerden önemli ölçüde daha yüksekti ($p < 0.05$). Özellikle, kola çözeltisi için ölçülen değerler gruplar arasında önemli farklılıklar gösterdi ($p < 0.05$).

Sonuç: Kola, kahve ve distile suda bekletilen üç kompozit belli oranlarda asidik solüsyonlardan etkilenmiş ancak en az etkilenen Omnichroma olmuştur. Klinisyenler, uygun diyet kurallarının ve uyumun önemini hastalara vurgulamalı ve uygun malzeme seçerken diyet alışkanlıklarını göz önünde bulundurmalıdır.

Anahtar Kelimeler: Beslenme davranışı; diş yapıştırma, hareketli, kayma mukavemeti; ortodontik aletler