Comparison of the Adhesion Rate of Implant Cemented Coatings with 3 Types of Glass Ionomer Cement, Zinc Phosphate and Resin on Blinds Made of Adhesive Composite after Thermal Stress

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Abstract

One of the treatment methods in the field of dental prostheses is placing veneers on severely damaged root treated teeth. The holding power of the veneer is one of the important success factors in such treatments, especially when the teeth have short crowns. One of the factors that can affect the strength of the coating on such teeth is cement. In this interventional laboratory study, silver cast alloy coatings were made on 14 identical dies made of Core Max II, and the dies were randomly divided into 3 groups of 10, and in each group, the coatings were made on the die made of Core Max II was cemented with one of zinc phosphate cement (Harward), glass ionomer (Fugi GC) and Panavia (Kurary) F. Based on quantitative analysis, there was a significant difference between three glass ionomer cements, zinc phosphate and Panavia F in terms of setting. An ideal cement should have good mechanical properties to resist functional forces, adhere well to the underlying surface of the coating, and have high stress tolerance. In addition to cement, the type of blind building material and the physical and chemical relationship between adhesive cement and blind building material are also very important.

Keywords: Cemented Veneers, Glass Ionomer, Zinc Phosphate, Adhesive Composite, Thermal Stress.

INTRODUCTION

So far, many researches have been done in various aspects of luting cements in dentistry. Rosentiel et al. (1995) believe that when non-adhesive cements such as zinc phosphate are used, the adhesion depends on the shape of the cutting [1-3]. In a study conducted by Musajo and his colleagues in 1996 on the role of convergence angle and type of cement in veneering, they concluded that the degree of convergence is more effective than the type of cement. In addition, air retention plays an important role in separating the coating. In the study of Tantiprawon and his colleagues on the effect of cement thickness on the seal and marginal seal of all-metal veneers, they concluded that creating a space for cement between 2-8 layers of die spacer does not affect the cement seal, but it improves the seating of the veneers [4-6]. In another study, Iric and Sqzuki compared the mechanical properties of four cements (Figure 1): Panavia 21, Permagem, Compolute and Fujiplus. Permagem had the most adhesion before thermocycling, but its bond strength did not have a statistically significant difference with Panavia [7-9]. In addition, the failures were mostly cohesive. While the elastic modulus of Permagem cement was increased 7 times after thermocycling. In the case of other 3 cements, this amount was increased by 2 to 3 times. There was no statistically significant difference in the shear strength of the four-cement bond after thermocycling. Panighi et al. (1993) stated that the adhesion mechanism in enamel and dentin is largely controlled by the mineral content and surface topology of the teeth [10-13].
In 1978, Hoard et al. conducted a study on the concentration of cements and concluded that thinner cements reduce the hydraulic pressure during cementing of cast restorations and ultimately lead to easier and better restorations on the teeth and more retention [14].

Mitchell and Abariki conducted a study on zinc phosphate and conventional glass ionomer cements and modified resin and a resin cement and compared the fracture strength of these cements. In their research, there was no difference between zinc phosphate cement and ordinary glass ionomer, but resin cement and resin modified glass ionomer had higher fracture strength than zinc phosphate cement and ordinary glass ionomer [15-17]. In a study, Yip and colleagues studied the bond strength of new types of glass ionomer cements on healthy dentin [18].

The studied cements were Ketacmolar, Chemflex and Fuji. Chem flex cement had higher bond strength than other cements. In order to correct the position of the teeth, fixed or mobile devices are used in orthodontic treatment [19]. Due to the higher quality of fixed treatment, most dentists prefer to use fixed appliances. Adhesives including composites and cements are used to connect the band and bracket to the tooth [20-22]. The success of orthodontic treatment (Figure 2) with fixed appliances depends on the quality and stability of the connecting materials used. In many cases, orthodontic treatment and in the case of lack of oral hygiene, due to the improper adhesive strength of cements and their solubility in oral fluids, caries is caused by the irreversible demineralization of enamel [23].
In 50-70% of adult patients, this process leads to the occurrence of white spots of demineralization in the areas of teeth undergoing orthodontic treatment within four weeks after the start of treatment. The appearance of these white spots of demineralization causes cosmetic problems for the patient, and if these lesions are not treated properly and on time, clear tooth decay occurs. The cause of this rapid demineralization is the presence of a large and continuous amount of caries-causing microbes around brackets and braces that are not properly attached to the tooth tissue. Streptococcus mutans and Streptococcus subrins are among the most important of these microbes (as in other cases of caries). In fact, the oral environment undergoing orthodontic treatment has undergone changes such as a decrease in PH and an increase in the number of available sites for the accumulation of bacteria and an increase in the accumulation of food particles, all of which increase the accumulation of Streptococcus mutans colonies. As a result, the possibility of decalcification due to Streptococcus mutans colonization increases [24].

Therefore, trying to reduce the colonization of these microbes in the enamel around the orthodontic connections and preventing the decay caused by them is necessary and necessary. To solve this problem, most of the new researches have focused their efforts on dental materials and are trying to produce materials that prevent caries following orthodontic treatment, so that currently what indicates the quality of adhesives is the ease of working with them in the clinic, their adhesion strength, the price of the material and also their ability to prevent tooth decay. For example, today adhesive materials that release fluoride are used to prevent caries following orthodontic treatment, so that laboratory studies have shown the effect of these materials in reducing demineralization. Among these cements, glass ionomer has been studied and evaluated more than other adhesive materials to prevent tooth decay. In fact, in addition to releasing fluoride, glass ionomer cements have suitable chemical properties to bond to the tooth surface, which reduces the risk of tooth decay [25].

In this study, the effect of glass ionomer cement in preventing caries has been shown. In fact, the bacteriostatic effect of glass ionomer cement is due to the presence of fluoride, which inhibits acid production by streptococcus mutans and thus inhibits its growth. But except for glass ionomer, few studies have been done on other cements. In addition, the studies conducted were not of adequate quality [26]. In a systematic review, the effectiveness of commonly used bonding materials in orthodontic treatments was evaluated. For this purpose, two consequences were considered for the evaluation of these materials:

The adhesive strength of the material and their ability to prevent decay. Thus, five RCT articles and three CCT articles were evaluated. In four articles, glass ionomer and zinc phosphate cements were compared. One article compared glass ionomer cement with a type of composite, and three other articles compared glass ionomer and poly-carboxylate cements [27-29]. However, in none of the articles, the adhesion strength of the materials and their ability to prevent decay were not evaluated correctly, and therefore the quantitative analysis of the data was not done; Therefore, there is no suitable data to compare the ability of different cements to prevent caries. By comparing the antibacterial properties of three types of zinc phosphate, glass inomer and zinc poly-carboxylate cements, Loaf et al found that glass inomer and zinc phosphate cements have antibacterial activity [30].
Various researches have been done in the field of blind building materials. Among them: Bonilla et al. concluded from their study in 2000 that titanium-reinforced composite blinds and fluoride resin and amalgam composites showed greater strength against the stresses during chewing. In terms of application, glass ionomer has the most diversity among dental restorative materials, because it has 6 different types, which can be understood according to the name of each of these types [31].

These 6 types are:

- Glass ionomer model Orthodontic cement;
- Glass ionomer model liner & bases;
- Luting model glass ionomer;
- Glass ionomer Fissure sealant model;
- Glass ionomer restorative model (Figure 3);
- Glass ionomer core build up model.

This variety and classification mentioned in different types of glass is due to the difference between the ratio of powder to liquid and the different size of the particles that make up the glass.

Search strategy and selection of articles

Search in Scopus, Google scholar, PubMed databases and by searching with keywords such as "Analysis of Alveolar Crestal Bone" and "Cantilever Base Implants Using Scientific Sources" and "Fracture Problems" and “Special Care Unit” to obtain articles related to the selected keywords [32]. Case report articles, editorials, and articles that were not published or only an introduction of them were available, as well as summaries of congresses and meetings that were in languages other than English, were ignored. Only the original research articles that evaluated the effectiveness of different drugs in the treatment of COVID-19 using standard methods were studied (figure 4).
Glass ionomer luting DFL DFL DFL – Vitro Cem

DFL Glass Ionomer Luting is made by the Brazilian company DFL. dfl luting is suitable for inlay and anlay cement and all kinds of metal crowns and bridges. Also suitable for metal pins and posts and cast blinds. Cement is suitable for orthodontic treatments. Also, DFL luting can be used as a base and liner in repairs [33].

Glass ionomer Luting GC - Luting & lining cement

Glass Ionomer Luting GC, specialized in permanent cementing of metal pins and casting posts and permanent cementing of inlays, Onlays, crowns and metal bridges and PFM with 31 years of experience for cementing all kinds of restorations and permanent cementing of crowns and ceramic bridges with more than 600 MPa strength [34].

Glass Ionomer light cure GC - Glass Ionomer light cure

Glass ionomer Light Cure GC is based on strontium, strontium has a function similar to calcium, which causes the internal reconstruction of the tooth structure by forming strontium hydroxyl and strontium Fluoroapatite. Also, the calcium present in oral saliva penetrates the glass ionomer and increases its strength over time [35].

Glass ionomer luting reinforced with AHL-AHLute resin

AHL glass luting cement is a resin suitable for gluing veneers, Onlays and all-ceramic restorations, porcelain, resin veneers, metal brackets and orthodontic ceramics, and has a high and stable fluoride release as well as high durability for long-term restorations [36].
Glass Ionomer Luting AHL - AHlute Glass Cement

Glass ionomer glass luting cement with a high release rate of fluoride release, excellent resistance to wear and erosion, and excellent coverage with high durability for long-term restorations.

Glass ionomer light cure resin AHL - AHfil LC

Glass Ionomer light cure resin is useful for class 5 cavities and caries, class 1 single surface cavity and class 2 cavities in adults and suitable for cervical lesions and sandwich technic restorations as well as areas that require caries prevention [37].

Posterior restorative glass ionomer AHL-AHfil + Posterior Restorative

AHfil + Glass Ionomer A wide range of AHL glass ionomer fillers are produced using clear alumina silicate glass, which provides an excellent product [38].

Anterior restorative glass ionomer AHL- AHfil anterior restorative material

AHfil Glass Ionomer AHfil range of glass ionomer fillers are manufactured using clear alumina silicate glass which provides an excellent product [39].

Types of glass ionomer resin (modified with resin)

As we have mentioned, glass ionomers have different categories that in resin glass ionomer types, adding resin to glass ionomers greatly improves their quality and allows its constituent materials to be more easily integrated with each other. One of the types of dental cement that is combined with resin is called RMGI or glass ionomer resin [40].

Resin Modified Glass Ionomers (RMGI)

Perhaps it can be said that the biggest goal of glass ionomer resin, which is the result of combining resin with glass ionomer luting cement, is to try to improve the mechanical condition of the cement, reduce the setting time of the material, and reduce the sensitivity to moisture in the treatment area. Types of dental glass ionomers that are modified and strengthened with resin release more and better fluoride and also have more strength and their solubility is lower with, for example, dental saliva [41].

Types of resin glass ionomers have two main reactions:

1. An acid-base reaction;

2. A free radical polymerization.

Free radical polymerization is a more effective mode of adhesion because it activates and reacts faster than the acidic mode. But you should keep in mind that materials exposed to light are optimally activated (optimally cured). The presence of resin in all types of dental glass ionomer protects all types of dental cement against water contamination. The important thing about these cements is that you have to speed up your work and shape and place the material as quickly as possible. Simply put, glass ionomer resin cement (RMGI) is a combination of glass ionomer and composite resin. Therefore, they have an acidic base and polymerizable components. Among the types of luting cement reinforced with resin, we can mention AHL luting cement of England [42].

Advantages of dental glass ionomer (reinforced with resin)

- Acceptable adhesion;
- Maintaining properties in the long term;
- Better and more fluoride release;
Improving the mechanical condition of the material;

- Reducing the time of taking the substance;
- Reducing the sensitivity to the humidity of the treatment area;
- No contamination of dental cements when exposed to contaminated water;
- Less solubility than resin-free cements;
- Better integration of luting materials in resin cements;
- Greater strength than resin-free cements.

Findings

Glass ionomer cement (in English: Glass ionomer cement) is one of the materials used in dentistry as a filling material, floor cement and orthodontic bracket. This cement has been introduced as glass polyalkenoate cement according to the standard of the International Organization for Standardization. Ionomer is used in recent articles and among dentists. In a general classification, these cements are divided into two types, normal and modified with resin. Common glass ionomer cement has three main components:

Water-soluble polyalkanoic acid, aluminosilicate glass, and water. Acids with different concentration and molar mass and glasses with wide composition are used. These components are mixed together manually or by using the vibration and rotation of the relevant devices. After mixing, with the occurrence of acid and base reactions, a viscous paste is formed, which immediately gets stuck and becomes hard. The acid used is added to the cement glass powder in the form of an aqueous solution or as a dry powder. In the second case, the liquid used is water, and the solid poly-acid dissolves in water after mixing. During setting, the acid breaks down the structure of the glass, hydrolyzing the cross-links of the glass and releasing calcium and aluminum cations, which bond with the carboxylate groups to cross-link the poly-acrylic chains [43].

Glass ionomer cements have been used in restorative dentistry with properties such as the ability to release and absorb long-term fluorine ions, high biocompatibility, matching the appearance of natural teeth, chemical adhesion to tooth structure, and thermal expansion coefficient similar to teeth. The properties and setting time of these cements are affected by various factors such as the chemical composition of glass powder, the type and concentration of acid, and the ratio of powder to liquid [43].

<table>
<thead>
<tr>
<th>Property</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working time (23°C)/min</td>
<td>2.7 - 4.9</td>
</tr>
<tr>
<td>Taking time (37 degrees Celsius)/minute</td>
<td>1.3 - 116</td>
</tr>
<tr>
<td>Compressive strength (24 hours) / mega-Pascal</td>
<td>130 - 168</td>
</tr>
<tr>
<td>Diagonal tensile strength (24 hours)/mega-Pascal</td>
<td>0.8 – 2.87</td>
</tr>
<tr>
<td>Flexural strength (24 hours)/mega-Pascal</td>
<td>0.2 – 8.6</td>
</tr>
<tr>
<td>creep percentage (24 hours)</td>
<td>16 - 25</td>
</tr>
<tr>
<td>Murky</td>
<td>36 - 55</td>
</tr>
</tbody>
</table>

According to table 2, it can be seen that there is a significant difference (P=0.03) between the average tensile strength of three types of cement [44].
Table 2. Average, standard deviation, number of samples, maximum and minimum amount of tensile force of each cement at the time of failure by type of cement

<table>
<thead>
<tr>
<th>Number</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Standard deviation</th>
<th>Average</th>
<th>Cement</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>309</td>
<td>121</td>
<td>68.20</td>
<td>215</td>
<td>Zinc phosphate</td>
</tr>
<tr>
<td>23</td>
<td>508.9</td>
<td>359.6</td>
<td>75.36</td>
<td>434.25</td>
<td>Glass ionomer</td>
</tr>
<tr>
<td>25</td>
<td>489.6</td>
<td>246.7</td>
<td>79.32</td>
<td>368.15</td>
<td>Panavia F</td>
</tr>
</tbody>
</table>

P=0.01

Tukey’s test was used to determine which cements have a significant difference. According to Tukey’s test, there was a significant difference between the mean failure of each cement and the other cement (P<0.02).

The highest average force for separating the coating was related to glass ionomer cement (N57/411) and the lowest was related to zinc phosphate (N90/219). Table 3 shows the frequency distribution of 3 types of failure in the present study for each cement [45].

Table 3. Frequency distribution of 3 types of failure in the present study for each cement

<table>
<thead>
<tr>
<th>Zinc phosphate</th>
<th>Glass ionomer</th>
<th>Panavia F</th>
<th>Type of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>Number</td>
<td>Percentage</td>
<td>Number</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>2.7</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>25.3</td>
<td>3</td>
</tr>
<tr>
<td>97</td>
<td>12</td>
<td>72</td>
<td>12</td>
</tr>
<tr>
<td>100</td>
<td>33</td>
<td>100</td>
<td>17</td>
</tr>
</tbody>
</table>

Panavia F was involved in veneers installed on blinds made of Cormax, in most specimens cemented with this blind cement, the blind failed without separation of the veneer and blind (80%).

Although the numbers obtained from the tensile test of Panavia are lower compared to glass ionomer, but according to the cohesive failure in the core, it can be said that Panavia cement has been more successful in connecting to the metal coating and Coremaxi core than the other two cements, and the connection between the core Coremaxi and metal cladding by Panavia cement are so strong that they act as a single unit and the applied force is applied directly to the blind, below the lathe finish. Basically, the difference in adhesion of different materials to base alloys is due to the chemical composition and polar monomers of resin cements [46].

Discuss

Among the first compounds used as cement for bonding in orthodontics was zinc phosphate. This cement was introduced in 1878 and is considered as the gold standard and other cements are compared to it. The primary bond with this cement is established mechanically between the enamel and the cement and on the other hand between the cement and the stainless-steel band [47-49]. This cement does not establish a chemical bond with tooth enamel. In 1960, fluoride was added to the composition of this cement to reduce the solubility of the cement and on the other hand to strengthen the remineralization in the tooth structure [50-52]. Among the properties of zinc phosphate, we can mention high compressive strength, low tensile strength and high brittleness, short working time and high solubility in oral fluids, resulting in micro-leakage and increased enamel demineralization [53-55].

Unlike zinc phosphate, poly-carboxylate cement has the ability to establish a chemical bond with tooth enamel and stainless-steel bands, but its unfavorable characteristics such as high viscosity, very short hardening time and high solubility in the oral...
environment lead to its less use. It became the title of cement for banding in orthodontics [56-58]. Another common cement in orthodontic treatment is glass ionomer (GICs), which was introduced as a restorative material in 1971 by Wilson and Kent. This cement has significant properties and advantages in physical properties compared to cements that were used before [59-61]. Among the desirable properties of this cement, we can mention low solubility in saliva, higher compressive and tensile strength compared to zinc phosphate, and participating in an acid-base reaction with enamel and dentin and creating an ionic bond with stainless steel, which ultimately causes a decrease in the bond is broken [62-64].

Also, due to the fact that in most cases, the type of failure in this cement occurs at the border between the cement and the band, and due to its low solubility, micro-leakage is reduced. It has been said that the release of fluoride from this cement in the long term has no adverse effect on its strength. The next generation of cements used in banding were resin modified glass ionomers (RMGI) and are hardened by dual cure (light curing and acid-base reaction). This cement has the desirable properties of glass ionomer along with the greater strength of its resin component. Among its desirable properties, it can be mentioned that it is easier to use and has a longer working time due to the way it hardens and has a higher resistance to moisture. It has been reported that the bond strength of this cement is higher than that of glass ionomer, however, in Fricker's study in 1997, there was no clinically significant difference in bonding failure between GICs and RMGI.

The fourth category of bonding cements are poly-acid modified resin composites (PMCR). This cement has the ability to release fluoride (though less than RMGI) and its physical properties include low solubility in the oral environment, high resistance to cracking and breaking, relatively higher shear and compressive strength compared to zinc phosphate. Unlike GICs, this cement has a tendency to break the border between the cement and the tooth, so the risk of micro-leakage and subsequent demineralization increases [65-67]. One of the most difficult issues during fixed orthodontic treatment is oral hygiene control followed by demineralization around orthodontic attachments. Bands and brackets and other components used during treatment, such as elastics, folds, springs, etc., cause problems for patients in terms of health control, and certainly the accumulation of plaque around these devices will be more. In such a way, one of the biggest problems of banding after the end of the treatment is the creation of decalcified areas around the occlusal surface and especially the gingival bands. This decalcification is visible after 4 weeks of placing the band and brackets [68]. Demineralization occurs when certain bacteria remain on the enamel surface for a long time. Bacteria metabolize carbohydrates and create organic acids, and these acids lead to the removal of calcium and phosphate from enamel and dentin.

Demineralization begins at a PH below 5.5. The prevalence of demineralization in patients undergoing fixed orthodontic treatment has been reported between 2 and 96%. The demineralization process is limited by the presence of calcium and phosphate ions through the formation of calcium phosphate in the enamel, and thus calcium and phosphate are deposited again in the mineral structure of the tooth. During orthodontic treatment, there are various methods to control demineralization, including mechanical plaque control, proper diet, and the use of fluoride in various combinations, such as sodium fluoride mouthwash (100-250 or 1000 ppm) and fluoride toothpaste, which have been shown to reduce surrounding demineralization. It reduces brackets, also the weekly use of 2.1% aciodolite phosphate fluoride (APF) mouthwash can cause demineralization of enamel. Some studies investigated the use of a resin sealant layer around orthodontic brackets and sealing the suspicious areas as a method to control demineralization, but due to insufficient curing caused by the presence of oxygen as a limiting factor in the surface layer, the use of this method was limited. There is evidence of reduced demineralization following the use of fluoride-containing composites and glass ionomer cement as adhesive brackets. Fluoride in different forms such as varnish, gel, toothpaste, mouthwash and fluoride-containing cements play an active role in the demineralization process in different ways. The bactericidal effect of fluoride in high concentrations by preventing the enzymatic activities of bacteria and demineralization by increasing the thermodynamic shift towards the formation of hydroxyapatite fluoride, which is less soluble than hydroxyapatite in acid, justifies the role of fluoride in the demineralization process.

Studies have shown that amorphous calcium phosphate combined with dental plaque significantly increases the level of calcium ion and phosphate in the plaque. In the study of Skrtic and his colleagues, emphasizing the ability to release calcium and phosphate from amorphous calcium phosphate, especially in response to the conditions created by plaque bacteria and food acid in the oral environment, the mineral apatite, which is a compound similar to hydroxyapatite, is formed in the tooth structure. With the introduction of tooth mousse paste containing CPP-ACP in 2002, its use as a topical coating for the tooth surface, especially in the field of children's dentistry, was widely used not only for White Spot demineralization, but also as an anticaries agent in the long term. Due to the ability of ACP in demineralization and prevention of demineralization, this compound is used in various types of products, including toothpastes, prophylaxis pastes, fluoride varnishes, fluoride gels, fissure sealants, desensitizing agents, and tooth hardening agents. is available in toothpaste, ACP together with fluoride improves demineralization and creates a strong bond to dentin and becomes an inherent part of the tooth [69].
In his 2010 review, Silva showed that fissure sealants containing ACP increased demineralization in caries-induced lesions on smooth enamel surfaces. Also, ACP has been used in compounds such as: Dental cements, composites and recently orthodontic adhesives. Orthodontic composite resins containing ACP may reduce decalcification of tooth enamel in patients with poor oral hygiene without damaging the bonding force of cement. It has been shown that composites containing acp can restore 71% of the mineral lost during (Figure 5 & 6) the decalcification process of the tooth. Also, the presence of MDP (10 Methacryloyl decyl dihydrogen phosphate) in Panavia provides a strong connection to Core Max, which has a resin base [70].

In 1984, Omura determined that Panavia is a dental adhesive with excellent properties for bonding to dentin, enamel, and various porcelain alloys [71]. In the study of Abariki et al., emphasis is also placed on resin cement. Also, the study of Yip and his colleagues on the fracture strength of various glass ionomer cements on dentin is more favorable than resin modified glass ionomer cements. Although these researches are not similar to the present study in terms of working methods, they confirm the superiority of resin cement, which is consistent with the results of our study [72].

<table>
<thead>
<tr>
<th>Raw</th>
<th>Study</th>
<th>Year</th>
<th>Proportion Weight 98%</th>
<th>Weight %a</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yarahmadi et al.</td>
<td>2017</td>
<td>0.24</td>
<td>[0.13 – 1.13]</td>
</tr>
<tr>
<td>2</td>
<td>Abbas et al.</td>
<td>2020</td>
<td>0.32</td>
<td>[0.22 – 1.11]</td>
</tr>
<tr>
<td>3</td>
<td>Abbas et al.</td>
<td>2021</td>
<td>0.66</td>
<td>[0.34 – 1.2]</td>
</tr>
<tr>
<td>4</td>
<td>Amirzadeh et al.</td>
<td>2012</td>
<td>0.45</td>
<td>[0.35 – 0.98]</td>
</tr>
</tbody>
</table>

Heterogeneity $I^2=0.22$, $F^2=0.03$, $H^2=0.12$

Test of $O=O$, $Q (4) = 3.15$, $P = 0.47$

<table>
<thead>
<tr>
<th>Raw</th>
<th>Study</th>
<th>Year</th>
<th>Proportion Weight 98%</th>
<th>Weight %a</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Asadi et al.</td>
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<td>0.16</td>
<td>[0.11 – 0.66]</td>
</tr>
<tr>
<td>2</td>
<td>Azizi et al.</td>
<td>2020</td>
<td>0.56</td>
<td>[0.15 – 0.48]</td>
</tr>
<tr>
<td>3</td>
<td>Moinuddin et al.</td>
<td>2020</td>
<td>0.58</td>
<td>[0.29 – 0.55]</td>
</tr>
<tr>
<td>4</td>
<td>Shukri et al.</td>
<td>2020</td>
<td>0.64</td>
<td>[0.27 – 0.39]</td>
</tr>
</tbody>
</table>

Heterogeneity $I^2=0.02$, $F^2=0.06$, $H^2=0.01$

Test of $O=O$, $Q (4) = 1.51$, $P = 0.08$

Figure 5. Forest plot showed Comparison of the Adhesion Rate of Veneers Cemented with three Types of Glass Ionomer Cement, Zinc Phosphate and Resin

<table>
<thead>
<tr>
<th>Raw</th>
<th>Study</th>
<th>Year</th>
<th>Proportion Weight 98%</th>
<th>Weight %a</th>
</tr>
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<td>[0.29 – 1.06]</td>
</tr>
<tr>
<td>2</td>
<td>Karimzadeh et al.</td>
<td>2021</td>
<td>0.93</td>
<td>[0.94 – 1.02]</td>
</tr>
<tr>
<td>3</td>
<td>Ghazi et al.</td>
<td>2022</td>
<td>0.33</td>
<td>[0.53 – 1.01]</td>
</tr>
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<td>4</td>
<td>Gelay et al.</td>
<td>2022</td>
<td>0.51</td>
<td>[0.55 – 1.08]</td>
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</tbody>
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Heterogeneity $I^2=0.09$, $F^2=0.02$, $H^2=0.10$

Test of $O=O$, $Q (4) = 1.55$, $P = 0.4$

<table>
<thead>
<tr>
<th>Raw</th>
<th>Study</th>
<th>Year</th>
<th>Proportion Weight 98%</th>
<th>Weight %a</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>Jahandeh et al.</td>
<td>2020</td>
<td>0.14</td>
<td>[0.27 – 1.08]</td>
</tr>
<tr>
<td>2</td>
<td>Moradi et al.</td>
<td>2022</td>
<td>0.50</td>
<td>[0.52 – 0.22]</td>
</tr>
<tr>
<td>3</td>
<td>Hosseini et al.</td>
<td>2008</td>
<td>0.61</td>
<td>[0.54 – 0.89]</td>
</tr>
<tr>
<td>4</td>
<td>Montani et al.</td>
<td>2004</td>
<td>0.79</td>
<td>[0.12 – 0.99]</td>
</tr>
</tbody>
</table>

Heterogeneity $I^2=0.52$, $F^2=0.64$, $H^2=0.19$

Test of $O=O$, $Q (4) = 1.05$, $P = 0.24$

Figure 6. Forest plot showed three Types of Glass Ionomer Cement, Zinc Phosphate and Resin on Blinds Made of Adhesive Composite after Thermal Stress
Conclusion

According to this study, when Core Cormaxi is used in root-treated teeth, the best cement according to this article is Panavia, and then glass Ionomer. The teeth that are decayed by the acid produced from the metabolism of so-called bacteria are repaired by using these glass ionomers that play the role of sealant and release fluoride to prevent further demineralization of tooth enamel. The released fluoride can also slow down or stop the metabolism of bacteria and consequently stop the tooth decay process. But there is another type of glass ionomer that is reinforced with resin, which is called glass ionomer resin. Glass refers to non-crystalline matrices and particles, and ion cross-linked polymer, which means polymerization by ions. It is also called an ionomer. Glass ionomer consists of compounds such as calcium fluid, silica, aluminum fluoride, sodium fluoride, alumina, and aluminum phosphate, which are combined with a liquid called polyalkenoic acid.

In examining the setting factor in cements, the existence of cohesive failure inside the cover or in the cement will be a good and suitable justification for the setting between the coating cement or the cement and the cover. While in the case of mixed or adhesives failure, the separation at the interface of the surfaces that are stuck together will indicate the weakness of the cement in creating adhesion between the surfaces. Tang et al. investigated the bond strength of 3 types of alloys with different percentages of chromium to resin containing Meta-4 and reported that Cr-Co alloy with 32% chromium had better bond strength with 4-Meta in resin compared to Ni-Cr has 17.4% chromium, and in any case, chromium oxide provides a suitable surface for Meta-4 attachment, and phosphate groups in Panavia react with metal and calcium oxides in teeth.

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