# Tensile Bond Strength of Two Luting Agents on Customized Cast Post and Core

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## ABSTRACT

**Introduction.** Post and core usually used on tooth that have lost a lot of coronal tissue. Custom-made cast post and core have the advantage that the post and core parts are cast together which consists of the same material so as to produce the best connection between the post and core parts, also fill the root canal space more accurately than prefabricated one. **Methods.** Eight maxillary central insisivus were extracted than endodotically treated. Customized post and core were made with inlay resin pattern than cast with chromium cobalt alloy. Specimens were divided into two groups. The cast post and core in group one (n=4) were cemented using glass ionomer cement and in group two (n=4) cemented using self-adhesive resin cement. Tensile bond strength was measured in a universal testing machine. The results (N) were statistically analyzed by ANOVA (α=.05). **Results.** The ANOVA indicated that there were no significant differences among the groups tested. Tensile bond strength mean between glass ionomer and self adhesive resin cement was statistically similar. The mean value of group 1 (glass ionomer) adhesion strength is 209,292 N, and group 2 (self-adhesive resin) is 196,190 N. **Discussion:** Factors can effect tensile strength of luting cement such as composition of sealer and surface roughing. **Conclusion.** Customized cast post and core cemented with glass ionomer and self-adhesive resin cement had similar mean tensile bond strength.

**Keywords:** Tensile strength, cast post and core, glass ionomer cement, self adhesive resin cement.

## Introduction.

Tooth that has been treated with endodontic treatment require specific restorations to return to their maximum function and can act as abutment tooth for fixed or removable prostheses.[1–3] Intraradicular post usually used to restore endodontically treated tooth, so the tooth can provide adequate support and retention for restoration.[4–6]

Ceramic crowns supported by metal posts and cores have the potential to be more resistant to failure and show greater integrity compared to Fiber Reinforced Composite (FRC) posts.[7] From several previous studies, the results of tooth restored with cast metal posts have higher fracture resistance compared to FRC posts.[7]

Custom-made cast post and core have the advantage that the post and core parts are cast together which consists of the same material so as to produce the best connection between the post and core parts, besides that custom-made post and core can also fill the root canal space more accurately than prefabricated post core.[8] Torbjoner[9] states that custom-made post cores are often used on weak tooth structures.[9,10]

Sorensen and Mertinoff[10] revealed in their study that 8.6% failure resulted from of post loss, root fracture, and post perforation on the prefabricated post and cast post and core. After ten years or more, post-insertion failure was also reported as 6.5% [11], the success rate in anterior tooth was 82% and decementation was the most commonly found form of post failure.[12]

Cobalt-cromium alloy (Co-Cr) is an alloy commonly used for the manufacture of fixed restorations. Co-Cr Alloy is a material that is more economical, very hard, has good biocompatibility, and have high corrosion resistance.[13,14] Types of cements, including zinc phosphate, glass ionomer, and resin composites have been used to cement post and core restoration. The retention of this post and core varies depending on the type of cement, its mechanical properties, and dentin structure.[15] Many in vitro studies on the tensile bond strengths of various cements used to retain post and core have reported conflicting results. This study was to compared the tensile bond strength of customized cast post and core cemented with glass ionomer type 1 and self adhesive resin cement.

**Methods**

This research type is experimental laboratories. The subject was eight maxillary central incisors. The cast post and core, cemented with two different types of cement, will then be processed to a universal testing machine to measure the tensile strength. The data obtained will be processed using ANOVA statistical test followed by a t-test.

Eight samples were selected from several maxillary first incisor tooth that had been collected from various practice sites and dental clinics in the city of Bandung (Ethical clearance number: 563/UN6.KEP/EC/2018), then from the tooth that had been collected were examined and the population was taken with criteria such as visually similar size (root length $12.5 \pm 1.6$ mm[1]), no restoration, no caries, no root canal treatment, and no fracture or cracks.

The exclusion factor is a tooth with dental caries, tooth with a bent root, and a tooth with flat root in the mesiodistal area. Examination of fractures or cracks was done using a magnifying glass. Samples were divided into two groups; each group contained four samples. Posts and cores in group 1 (n=4) were cemented using glass ionomer cement, and in group 2 (n=4), they were cemented using self-adhesive resin cement. Using a calliper run, all tooth were measured for their root length from the apex to the centre of the labial point at the cementoenamel junction. All tooth were cut, leaving 2 mm of crown tissue from the cementoenamel junction

The tooth were prepared into the pulp chamber using round diamond burs. Root canal preparation for all tooth was done using stepback preparation techniques with K-File hand use. Irrigation uses 2.5% Sodium Hypochlorite solution and distilled water during the root canal preparation procedure. The filling of the root canal using AHseal paste (Dentsply) as a sealer was then carried out by filling the root canal using guttapercha. AHseal paste was used

in this study because eugenol-free epoxy-amine sealer did not influence adhesion ability by inhibition of eugenol. Root canal preparation was carried out with a peaso reamer with a diameter of 1.5 mm to leave guttapercha in the root canal as much as 4-5 mm. Root canal impression was done using an inlay resin pattern (Duralay), and then the core with a ferrule design is formed 2.5 cm long to buried into the resin.

Each tooth in each group was mounted in an iron tube-shaped resin mould of the same size. The tube has been given a hole at the end. The hole is clogged with wax first, then the tube is filled with resin. The samples were positioned so that it was ocated in the centre of the tube that has been filled with resin and then waited until the hardening process is complete (Fig 1).[3]

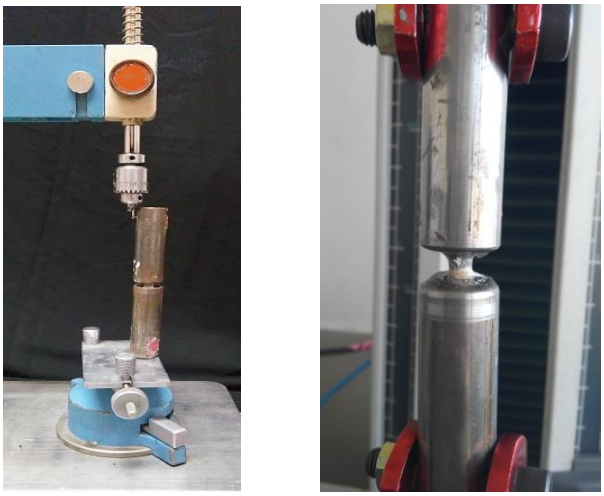

**Figure 1.** The process of mounting the tooth in the holder tube.

The cast post and core in group 1 were cemented with glass ionomer cement (Luting Cement, GC), cast post core in group 2 cemented with self-adhesive resin cement (Rely X U200, 3M). Before cementing the dental sample was placed on the sample holder tube which was previously prepared and then placed because the resin hardening reaction that produces heat was feared to affect the cement strength of the cement. The cement was stirred according to the manufacturer's instructions and then inserted into the root canal by applying it to the surface of the core. All cast post and core was inserted into the root canal using the hands, then the remaining excess cement was cleaned.

Manipulation of glass ionomer cement that is carried out is a comparison of powder with liquid, a scoop of cement powder with two drops of liquid placed on the pad provided. Mix the powder into the liquid using a plastic spatula with a folding motion for 20 seconds then cement it on the surface of the post and place it on the root canal wall. This process must be completed within 2 minutes and excess cement was cleaned.

The first cementation step with self-adhesive resin cement was to clean the root canal, cast post and core with distilled water and dry them. Manipulate resin cement self-adhesive, place cement on the glass pad, stir with a spatula, place the postcore into the root canal, and then clean the excess cement.

Samples embedded in the resin are installed in an additional tool explicitly made for this study. Then the attachment is attached to the Instron machine clamping device located at the base and the upper arm of the sample holder (Fig 2). Adhesion strength was applied at a 0.5 mm/minute speed at 100 kgf cell load. The test apparatus is activated, and the upper part will move up giving continuous pressure until the cast post and core are apart from the root canal wall, and the results are recorded. The test result is the amount of tensile force in Newton's units. The tensile strength that causes the cast post and core release from the root canal wall is recorded and then analyzed statistically.

**Figure 2.** Samples are ready for tensile testing on Instron machines.

**Result**

Table 1 showed the average adhesion strength value of cast post-core cemented with glass ionomer cement and self-adhesive resin cement, of which 209.29 N used glass ionomer cement and 196.19 N used self-adhesive resin cement. From the results of the t-test analysis (Table 2) obtained p-value of glass ionomer cement when compared with self adhesive resin cement was 0.7240. With p value 0,7240 which > 0,05, there is no significant difference between the adhesive strength of glass ionomer cement and self-adhesive resin cement.

**Table 1.** The average value of the adhesion strength of glass ionomer cement and self-adhesive resin cement as postcore cementation material in Newton units.

| Cement | Samples | Standard Deviation (SD) | Mean |
|---|---|---|---|
| Glass Ionomer | 4 | 29,788 | 209,292 |
| Resin *Self Adhesive* | 4 | 64,228 | 196,190 |
| Total | 8 | 47,008 | 202,741 |

**Table 2.** Analisis post hoc (2-tail p-values for pairwise independent groups t-tests)

| | | Glass Ionomer | Resin |
|---|---|---|---|
| | **Mean** | 209,292 | 196,190 |
| **Glass Ionomer** | 209,292 | | ,7240 |
| **Resin** | 196,190 | | |

**Discussion**

For luting agent to function rather than the primary element of retention, there should be an optimum fit between post, core, and the root canal. Most of the studies that tested intraradicular post retention were carried out shortly after cementation, without the actual type of simulated conditions in the mouth. However, clinically, loss of cast post core restoration usually occurs after several years of use by the patient as a result of stress factors experienced by the post, such as changes in mechanical temperature and pressure.[15] Therefore, in vitro tests are needed to evaluate the retention of cast core posts should aim to simulate clinical conditions by using artificial maturation processes to predict actual clinical behaviour. This study carried out the ripening process using an incubator machine with 100% humidity and 37ºC temperature for at least 72 hours.

The results of the study illustrate that the adhesive strength of glass ionomer cement is higher than that of self-adhesive resin cement. The binding strength of glass ionomer cement to the tooth surface is the same as composite adhesion to the dentin surface with the help of third-generation dentin adhesives.[16] As is well known, root canal sealers containing eugenol inhibit the polymerization of resin cement. Therefore, eugenol-free epoxy-amine sealers were used in this study to supplement endodontic treatment.[17] Cementing with self-adhesive resin cement is a sensitive technique, and studies have reported difficulties in manipulating self-adhesive resin cement in vitro.[18] In a study of dowel retention under adhesion strength, Mendoza and Eakle[19] observed no significant difference between cement which did not contain resins and cement containing resin but mentioned difficulties in manipulating resin cement, resin cement was more affected by poor root canal preparation than other cement.[19,20]

Premature resin polymerisation causes cast post core not to sit correctly in the root canal, therefore when cementing with self adhesive resin cement is not carried out with a lentulo needle.[18] Serafino et al.[21] reported that the use of a reamer machine to remove guttaperçha can produce a smear layer containing many remnants of endodontic and guttapercha sealers, which become plastic because of the heat produced. This smear layer is not beneficial and can damage the binding strength of resin cement.[21]

Balbosh et al.[15] stated in their research that cast post and core cemented with resin cement accompanied by treated surface with roughing root canal with bur showed the greatest adhesive strength compared to other cement. The reason for this increase in retention is the mechanical interlock between the luting agent and the rough dentinal wall. The operator did not carry out roughing process of root canal with bur in this study, so this factor might have caused a different strength of adhesive between lower self-adhesive resin cement compared to glass ionomer cement.

## Conclusion

From the results of this study, it can be concluded that there is a difference in the strength of the adhesive between glass ionomer cement and self-adhesive resin cement in numerical data, although the difference is not statistically significant.

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