

# In-Vitro Effect of Effectively of G-Bond and Z-Prime Plus in Prevention of Fracture of Prefabricated Zirconia Posts Bonded to Root Canal Walls

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## ABSTRACT

**Background and Aim:** The purpose of this research was to examine the influence of Z-Prime Plus and G-Bond on zirconia posts fracture resistance affixed to the walls of root canals.

**Place of Study:** Avicenna Medical College Lahore

**Study Duration:** March 2021 to April 2022

**Materials and Methods:** In this in-vitro experimental study, the diameter and length of each of the 20 mandibular premolars used were identical. This assured that the study's findings were comparable. Once a cut was made at the cemento-enamel junction (CEJ) to prepare the teeth for root canal therapy, the teeth were randomly assigned to one of two groups (n=11) with the same number of teeth in each group. In the experiment, a single tooth from each group was chosen at random to serve as the control. A post space of approximately 10 millimeters in length was established in the remaining teeth. The following process involved etching the intracanal dentin, followed by rinsing and drying the material. The technique involved filling the canal with Panavia F2 resin cement. After applying G-Bond and Z-Prime Plus to the zirconia posts in respectively, groups 1 and 2, the placement of post was done in the canals and subsequently cemented. The photo core resin composite material was utilized in the fabrication of the cores. The longitudinal axis of the teeth was compressed by a force application to the core of central fossa o at a crosshead speed of 0.5 millimeters per minute. This was accomplished with a crosshead speed of 0.5 mm/min. The load that caused the fracture was measured and documented. To analyze the data, a t-test was conducted, and a normal distribution was also taken into account.

**Result:** The results indicated that the average fracture resistance of G-Bond was 1088.1±330 while the average fracture resistance of Z-Prime Plus was 898.4±369 however, the difference was not statistically significant (P=0.3).

**Practical Implication:** The influence of Z-Prime Plus and G-Bond on zirconia posts fracture resistance affixed to the walls of root canals

**Conclusion:** There was no significant difference between the fracture resistance of zirconia posts bound with G-Bond and Z-Prime Plus to root canal walls. In contrast, G-Bond is highly advised for usage in this application due to its decreased coefficient of variation (CV) and significantly increased fracture resistance. This makes it a great option for the current endeavor.

**Keywords:** Primer; resin composite; shear bond strength; zirconia ceramic, G-Bond, Post and Core Technique, Z-Prime Plus

## INTRODUCTION

When it comes to the endodontically treated teeth rehabilitation that lost a large amount of coronal structure, the fracture resistance of the dental roots is one of the most critical elements to consider. This is because the stability of the tooth is directly related to the fracture resistance of the dental roots. It is normal practice to place intracanal posts into a tooth that has undergone endodontic treatment in order to provide more consistent load distribution<sup>1</sup>. This is done for the safety of the patient. Teeth that have been treated endodontically, frequently have larger missing portion of their tooth structure and are more susceptible to fracture. This puts the tooth at risk of becoming dislodged. During space preparation on such teeth, the tooth's structure may experience further damage, which is linked with an increased risk of perforation and microfracture. The non-metallic posts bond strength to the walls of root canal is an important aspect to consider when selecting the procedure that will result in the most successful restoration of endodontically treated teeth that have lost the majority of their coronal structure<sup>2,3</sup>. To achieve optimal adhesion, zirconia posts are routinely bent and maybe abraded with airborne particles. Due to this, the surface of zirconia ceramics can sometimes get deformed, which has an effect on the material's mechanical properties. When subjected to the identical loads, it has been demonstrated that teeth with fiber posts have a considerably higher risk of fracture than teeth with zirconia posts. A research comparing the resistance to fracture of intracanal posts bonded with different bonding agents generations resulted that saline may be essential to improve the binding of fiber posts cemented using resin cements. Based on the results of a study that examined the fracture resistance of intracanal posts bonded with different generations of bonding agents, this was determined. In another study that evaluated the influence of primers on the surface

treatment with various primers, the researchers discovered no significant differences between the primers in terms of the tensile bond strength between zirconia ceramic and composite resins<sup>5</sup>. This study examined the impact of primers on the tensile binding strength of zirconia ceramic and composite resins. G-Bond is an adhesive composed of a resin that is strong, dimethacrylates, urethane dimethacrylate (UDMA), acidic resins, phosphoric acid ester monomers and 4-Methacryloxyethyl trimellitic anhydride (4-MET). These constituents are combined to create G-Bond. It represents the seventh generation of bonding agents. In the process of bonding repairs, which is now ongoing, it has demonstrated some encouraging effects. It is packaged in a a bottle and has no requirement of any extra etching on its own. It forms a thin, void-free coating that covers the entire surface and can even be utilised in somewhat shallow cavities. This layer might completely cover the surface. The polymerization procedure leaves no trace once it has been completed. Due to the absence of 2-Hydroxyethyl methacrylate (HEMA) in the most recent version of G-Bond, there will be no water absorption or change in colour. It is biocompatible and capable of withstanding the harsh conditions present in the mouth. It can be used to treat the surfaces of zirconia posts because it is simple to apply, it forms a strong bond, it consists of a single component, it is not overly sensitive to technical errors, it does not require a separate etching step, and it reduces the time necessary for the procedure (30 seconds). Bisco's Z-Prime Plus is a primer that requires only one component to achieve its intended function<sup>6,8,10</sup>. In order to attain optimal results, it is utilized to reinforce the existing linkages between indirect restorative components and composite resin cements. Because of its unique chemical makeup, it is suitable for treating the surface of zirconia, alumina, metal, and composite posts. Moreover, it is good for treating composite posts. Owing to the fact

that this primer was developed specifically for the process of curing bonds, the bond will be strong regardless of how it is cured. Moreover, it is easy to use, has a good durability rating, and is compatible with both self-curing and light-curing resin cements. These are but a few of its characteristics. As zirconia posts are not fixed in place with resin cements, it is essential to prepare the surface of the zirconia posts to create a strong bond<sup>9</sup>. The objective of this study was to compare and contrast the effects of Z-Prime Plus and G-Bond on the resistance of fracture of zirconia posts bonded to the walls of root canals. Due to the paucity of knowledge regarding the Z-Prime Plus and G-Bond for zirconia after bonding, it was necessary to conduct this study.

## MATERIALS AND METHODS

In this laboratory-based investigation, 20 previously extracted mandibular premolars were evaluated. There were no lesions that were carious, root splits, or external and internal root resorption on any of the teeth, and the length and size of each tooth was the same. Before beginning the procedure, the patients were requested for permission to pull some of their teeth so that the orthodontic issues could be handled more successfully. Once completion, the teeth were discarded in the trash. Owing to the absence of names associated with the teeth, it was hard to ascertain who exactly they belonged to. The teeth were chosen using a method of sampling known as convenience sampling. Following the extraction procedure, they were sterilized by soaking in a 0.5% chloramine-T solution. Then, until the experiment, they were maintained in saline at 37 degrees Celsius. One tooth from each set was chosen at random to serve as the experiment's control. The canals were cleaned with a 5.25 percent concentration of sodium hypochlorite (NaOCl) solution. Each canal received a master apical file (MAF) with the identifier number 45. Thereafter, the step-back procedure was utilized to flare each canal to a maximum of in any way (no post surface treatment). To remove the crowns from the remaining teeth, a metal disc with a thickness of 0.2 millimeters was attached on a high-speed handpiece and operated under surplus amounts of irrigation via water. This was accomplished while the working area was irrigated with an excessive amount of water. This resulted in effectively achieving a residual root length of 14 millimeters. To estimate the working length, radiographic measurements were taken using a Dentsply/Maillefer #35 K- sixty degrees (25 mm file length). The canals could be dried out by introducing paper points into them. In declining order of size, the root canal was then filled with a 35 master cone and 15 auxiliary cones. Following cleaning and preparing the root canals of the teeth, gutta-percha and AH-26 sealer were packed using lateral compaction. This alteration was done prior to the start of the trial. After teeth obstruction, they were separated randomly into groups of two that included ten samples each and then treated with Z-Prime Plus or G-Bond. The characteristics of the two teeth that acted as controls in this investigation are outlined below. Group 1 (n=11): the supplied universal drill was used to complete post space preparation. The post space in the canals measured 10 millimeters in length and was positioned between 3 and 4 millimeters from the canal's apex. The third completing drill was then utilised as a component of the concluding preparation. Using a rubber stop, the length of the preparation was measured in accordance with the radiograph. This served as a measuring guide for the length of the dish. Once the post area was prepared, it was sprayed with oil-free water and air to initiate the cleaning procedure. The posts, which are manufactured by Ice light and have their headquarters in Danville, United States, were subjected to a number of tests in the canals to ensure that their installation is simple and that they fit well. The coronal piece of each post needed to be cut with a 008 fissure diamond bur such that the length of each post precisely measured 14 millimeters. With the aid of paper points, The post space was cleaned and allowed to dry prior to being reused. The canals were then treated for 15 seconds with 37% phosphoric acid. This procedure was carried out three times. Microbrushes were used to

apply Panavia F2 resin cement, to the canal after the canal was built according to the manufacturer's instructions. After passing that period of time, the air performed a thorough job of drying it out. To eliminate the leftover cement, a paper point was utilized. After that, Z-Prime Plus was mixed in accordance with the manufacturer's guidelines, applied to the post surface, and allowed to cure for the proper amount of time. After mixing pastes A and B from Panasonic F2 and Kuraray, Japan, in a ratio of 1:1, they were then applied uniformly across the surface of the post. After that, zirconia posts were inserted into the canals, and finger pressure was applied to them in order to compress them. A microbrush was utilized in order to remove extra cement. For a duration of one minute and sixty seconds, a light-curing equipment was utilized to accelerate the curing of the cement. The opening was entirely surrounded by Oxyguard gel, which stayed in place for three minutes to guarantee that the cement thoroughly hardened. This was accomplished by leaving the gel in place. The length of each zirconia-coated fiber-reinforced composite, also known as FRC, post was precisely 14 millimeters. The entire length of the posts was divided as follows: ten millimeters were placed within the canal region, and the remaining four millimeters were kept outside the canal for core retention. The final step involved producing the core with Photo Core composite resin as the principal ingredient. Following the placement of prefabricated polyester crowns on the coronal portion of the posts, the coronal voids of these crowns were subsequently filled with photo core composite resin. To guarantee that the core thickness was uniform throughout all of the teeth, the cores were cured for forty seconds at a power density of 750 milliwatts per square centimeter from each of the four directions. This was done to ensure that the cores were adequately cured. Group 2 (n=10): After being prepared according to group 1's procedures, both the post space and the canal were engraved. Using a microbrush, G-Bond was applied to the canal in line with the techniques provided in the manufacturer's product instructions. The manufacturer has given these instructions. After a thirty-second delay, it was meticulously air-dried using an air spray, and then paper points were utilized to remove any excess bonding agent. Thereafter, pastes A and B from the Japanese Panavia F2 plant and the Japanese Kuraray manufacture were combined and put to the surface of the post. Following the insertion of the post into the canal, the canal was squeezed for between five and ten seconds using finger pressure. After removing any excess cement with a microbrush, the surface underwent sixty seconds of gentle drying before being left to air dry. Oxyguard was used for a total of three minutes in order to ensure that the cement set fully. The ensuing procedures were identical to those performed for group 1. The n = 2 teeth that comprised the control group were not subjected to any surface treatment. After being prepared according to group 1's procedures, both the post space and the canal were engraved. After removing any excess cement with a microbrush, the surface underwent sixty seconds of gentle drying before being left to air dry. Oxyguard was used for a total of three minutes in order to ensure that the cement set fully. The ensuing procedures were identical to those performed for group 1. The Instron machine then applied a compressive force to the central fossa of each tooth's core at a crosshead speed of 0.5 millimeters per minute. This force was given at a 90-degree angle relative to the longitudinal axes of the teeth.

## RESULTS

This study was conducted on a total of 20 premolars, of which ten were treated with G-Bond, ten were treated with Z-Prime Plus, and two served as controls by not receiving any surface treatment. According to the calculations, the estimated average resistance to fracture of the control samples was 429.1 N. In Table 1, the average fracture resistance, designated by "N" and the coefficient of variation, denoted by "CV," for the two separate groups are shown. As a direct result, there was no statistically significant difference between the two groups' fracture resistance levels (P=0.3).

Table 1. Fracture resistance (N) of the two groups

Group	Fracture Resistance	Maximum	Minimum	CV
Z-Prime Plus	898.4±369	1648.7	290.3	41
G-Bond	1088.1±330	1499.8	612.5	20
Control	479.020	541.4	429.1	
Test result P=0.3				

## DISCUSSION

While choosing the most successful technique for rebuilding endodontically treated teeth that have lost a considerable portion of their coronal structure, it is essential to take into account the fracture resistance of the dental roots. This is due to the fact that the optimal strategy will be selected while the fracture resistance of the tooth roots is being evaluated. With the aid of intracanal posts, steady stress distribution in endodontically treated teeth has been accomplished for a very long time<sup>12</sup>. Several factors can influence the fracture resistance of teeth that has been treated endodontically, including the amount of surviving dentin, the kind of cement employed, the method used to apply the cement, the design and material of the core, the crown design, and the post biocompatibility. The diameter of the post, its length, its design, and its adaptability are other factors that can influence its fracture resistance. The goal of this research was to determine the effect of Z-Prime Plus and G-Bond on the fracture resistance of root canal-bound, zirconia posts that were prefabricated. The data demonstrated that there was no noteworthy difference between Z-Prime Plus and G-Bond in terms of the fracture resistance of zirconia posts after they were attached to canal walls. Despite the fact that each of the other options was suitable for glueing zirconia posts to dentin, G-Bond offered marginally (but not considerably) greater fracture resistance than the other two options. Hence, it is possible to attach zirconia posts to radicular dentin using either technique effectively in clinical settings<sup>13,14,15</sup>. This is the purpose for which both were created. Even while G-Bond had slightly higher retention, the fact that it had a decreased coefficient of variation (CV) and a smaller standard deviation (SD) was a significant finding of our research. Thus, it is anticipated that G-Bond will demonstrate a more predictable clinical behaviour than Z-Prime Plus. As a result, it has the potential to be more effective in clinical settings than Z-Prime Plus. Kivanc and Gorgul conducted an experiment to determine the fracture resistance of teeth repaired with various posts and new bonding agents. They discovered that the repaired teeth had dramatically enhanced fracture resistance. Based on their findings, they concluded that saline is required for enhancing the binding of fiber posts bonded using resin cements. The fact that silane is necessary for strengthening the binding between fiber posts led to this conclusion. The findings of their investigation were consistent with our own. Sanohkan and colleagues conducted an experiment to determine the effect of utilizing a variety of primers on the tensile bond strength of zirconia ceramic to composites. They came to the conclusion that treatment of surfaces with primers had nil discernible effect on bond strength. In contrast, the results of our investigation indicated that Z-Prime Plus and G-Bond noteworthy improved fracture resistance. Maleki zadeh et al. investigated influence of various surface treatments on the modulus of elasticity and flexural strength of FRC posts. They made a conclusion that the treating the surface of quartz fiber and glass fiber posts with 10% hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) and laser had no noteworthy results on the flexural strength or modulus of elasticity of FRC posts. In contrast, the fracture resistance of zirconia posts was enhanced by applying a surface treatment comprised of G-Bond and Z-Prime Plus. Our investigation resulted to this conclusion. Habibzadeh and colleagues studied the zirconia fracture

resistance, FRC post systems and cast nickel-chromium (Ni-Cr) beneath all ceramic crowns in a previous study<sup>16,17,18</sup>. They discovered that zirconia posts had significantly less fracture resistance (435.34 N) and irreparable fractures than the other two post systems. These results remain consistent along with outcomes of the recently concluded study. A study carried out recently depicted that the fracture resistance of prefabricated zirconia posts is stronger than that of carbon fiber posts<sup>19,20</sup>. The comparison between the two types of posts was made. This study contains several errors that required correction. Our sample population was modest due to the difficulties in acquiring teeth of same length and thickness. Obtaining teeth of uniform length and width in future research, it will be necessary to analyze a larger sample size of teeth of the same age and size, as doing so will increase the validity of the findings. This will be done in order to apply the findings to clinical practice.

## CONCLUSION

Regarding the attachment of zirconia posts in case of endodontically treated teeth, there was no discernible difference among G-Bond and Z-Prime Plus with respect to their bonding abilities. This conclusion was made possible by the in-vitro nature of the study. G-Bond, on the other hand, possesses a slightly higher fracture resistance and a lower coefficient of variation, making it a potentially preferable option for bonding zirconia posts in clinical environments.

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