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# Bond Strength of New Fiber Post-system (Rebilda GT)

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**Abstract**

**AIM:** The aim of this *in vitro* study is to determine the push-out bond strength of bundle glass fiber post (Rebilda GT) and tapered glass fiber post (Rebilda fiber post).

**MATERIALS AND METHODS:** Twenty freshly extracted human single rooted premolar teeth were used, all teeth were endodontically treated, after 24 h from obturation the gutta-percha removed leaving 5 mm apically to ensure clinically acceptable apical seal. Finally, all canals were flushed with 2 ml NaOcl 5.25% and 2 ml distilled water, respectively, then the canals were dried using paper points. The roots were divided randomly into two sets with ten roots for each group according to post-type. Group A: Rebilda fiber posts were used. Group B: Rebilda GT bundle fiber posts were used. The posts were inserted into the canals according to the manufacturer instructions. All specimens were stored for 72 h in an incubator. Slices of 2 mm thickness were cut from the roots at different levels (cervical, middle, and apical thirds), bond strength was determined using universal testing machine at a speed of 0.5 mm/min.

**RESULTS:** One-way analysis of variance and Tukey HSD tests showed that the (bundle fiber) Rebilda GT fiber post had bond strength higher than that of the Rebilda fiber post in all regions. ($p < 0.05$), also the cervical area showed higher bond strength in both groups than the middle and the apical areas, respectively.

**CONCLUSIONS:** The bundle glass fiber post (Rebilda GT) showed bond strength higher than the taper glass fiber (Rebilda fiber) post in all regions (apical, middle, and cervical). The cervical region showed higher bond strength than the middle and the apical thirds.

## Introduction

Root canal treatment often weakens the coronal tooth structure and this may necessitate the use of additional retention means (intra canal post) to restore the core of the final restoration [1]. Due to shortcomings of the metal posts, fiber post to be used as an alternative to restore the endodontically treated teeth [2]. The color and elastic modulus of the fiber posts (which are close to dentin) has led to the more popularity of its usage in the past years [3].

The fiber posts can be cemented into the root canal walls passively without friction so this will reduce the risk of root fractures during application; if the tooth is subjected to heavy occlusal or lateral force, the fracture will occur within the fiber post without root deterioration [3], [4].

Several methods are used for restoration of weakened tooth structure, such as the usage of accessory fiber posts or a novel approach such as bundle posts, these posts will occupy the space inside the canals without the need for more dentin removal and the thickness of luting cement will be decreased to obtain well-fitting posts [1], [5].

The manufacturers try to modify the fiber posts shape and components to achieve better adhesion to root canal dentin and long survival restoration [6].

Rebilda GT is a new glass fiber post, it is not like previous designs of posts that come in a single tapered post, this type of post is basically a group of bundled thin posts attached together with a plastic sleeve, once the dentist removes this sleeve, the posts spread inside the canal and can be adapted optimally inside any root canal anatomy so this will reduce the cement thickness inside the canal [7], [8], [9].

The aim of this *in vitro* study is to determine the bond strength of two types of glass fiber posts: A bundle (Rebilda GT) and a tapered (Rebilda fiber post). The hypothesis of this study is that the new bundle fiber post has at least equal bond strength to the tapered post.

## Materials and Methods

This *in vitro* study used 20 single rooted mandibular first premolars that were collected from the orthodontic department university of Mosul.

The selected teeth were carefully checked to exclude any cracks or external resorption in the roots. In addition, radiographs for all teeth in buccolingual and mesiodistal directions were taken and any root abnormalities (calcification and internal resorption) were excluded from the study.

All the selected teeth were kept at room temperature in 0.1% thymol solution.

All roots were cut at the level of cementoenamel junction using slow-speed handpiece with water cooling diamond disc to adjust roots at lengths of 12 mm [8], [9].

The working lengths of all canals were determined using size 10 K file (Dentsply, Malifer, Switzerland) inside the root canals, once the tip of the file just becomes visible at the apical foramen under dental loupes ×3.5 magnification the working length should be 1 mm less than that of the measured length. Root canal preparations were done using rotary file (protaper next), all canals were enlarged to size ×3 file (Dentsply, Malifer, Switzerland). During preparation, 17% EDTA solution (i-EDTA, Lituania) was used to facilitate preparation, after that irrigation with 2 ml of distilled water then 2 ml of 5.25% sodium hypochlorite was done. To remove any remnants of irrigation materials, all canals were rinsed with 10 ml distilled water [9].

All canals were dried with paper points, then the canals were filled with bioceramic sealer (Total fill BC sealer) (FKG swiss endo) and single cone size ×3 guttapercha. After that, the access of gutta-percha was cut and vertically condensed using hand plugger. The cervical openings for all canals were closed with glass ionomer cement (Tokuso ionomer, Japan) and stored inside the incubator for 24 h at 37°C to permit the sealer to set completely [9].

### *Fiber post procedure*

After removing the glass ionomer, the gutta-percha was removed with peeso reamer number 1 to number 3 leaving 5 mm apically to ensure apical seal.

The canals were cleaned and disinfected by 2 ml 5.25% NaOcl, then 2 ml distilled water, later the canals were desiccated using paper points.

The roots were assigned randomly into two groups with ten roots for each group according to the post-type used for filling:

Group A: Rebilda fiber post (1.2 mm in diameter tapered posts) (Voco Cuxhaven, Germany).

Group B: Rebilda GT bundle fiber post (1.2 mm in diameter bundle posts) (Voco Cuxhaven, Germany) (Figure 1).

Figure 1: Rebilda GT fiber post-kit

Fiber posts were disinfected, air-dried, and cemented in the prepared canal space according to the manufacturer instructions.

Silane coupling agent (ceramic bond voco) was applied to the posts and left to dry for one minute, after that bonding agent (Futurabond U Voco Cuxhaven,Germany) which is dual cure self-etching bond was applied and dried, subsequently (Rebilda DC, VOCO Germany) cement was injected inside the root canals for all specimens.

The posts were placed in the roots with slight finger pressure. The excess resin cement was removed using probe after light curing for 3 s. The resin was then light-cured for 40 s in the occlusal direction using a (Dia-lux, Dia Dent Korea) device with 1600 $mW/mm_2$ power, the intensity of the light cure was confirmed by radiometer and rechecked after each curing. All specimens were sealed then stored for 72 h in the incubator at 37°C and 100% humidity [9], [10].

### *Sectioning of the roots*

The roots were sectioned using diamond-coated blades 0.3 mm in thickness (Micra Cut, Metkon, Turkey) making 2 mm thick slices for each: Cervical, middle, and apical thirds of the fiber posts. For each group, 30 test specimens were prepared (Figure 2).

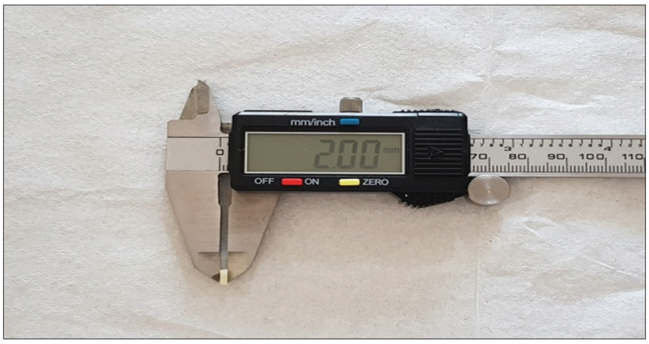


Figure 2: Slice of root with fiber post after section

The slices were marked and labeled to ensure that the load will be applied apicocervically [11].

### *Push-out test procedure*

Push-out bond strength was done using universal testing machine (Figure 3).

The roots sections were loaded from apical to cervical.

The pin of the device was situated to be in contact with the post, and 0.5mm/min speed was applied until the post-section was displaced from the root slice as manifested by the complete extrusion of the post-section from the root slice. At this time, the score of the de-bonded force backed to zero, as seen on a computer screen (Figure 4).

Statistical analyses were done using SPSS (version 25) program. The data were analyzed using

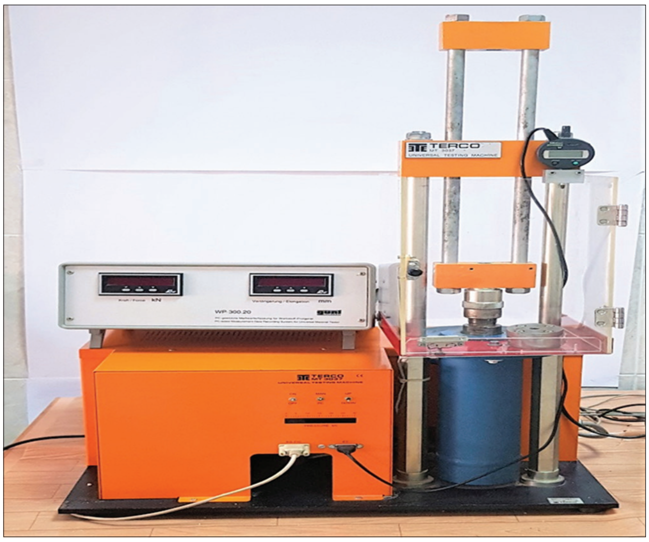


*Figure 3: Universal testing machine (TERCO, MT 3037, Sweden)*

one-way analysis of variance (ANOVA) test and *post hoc* Tukey HSD test.

*Figure 4: Specimen under load*

## Results

Means and standard deviations of bond strength for all groups are shown in Table 1.

We can see that the Rebilda GT fiber post shows bond strength higher than that of the Rebilda fiber post in all regions, also the cervical areas revealed higher bond strength in both groups than middle and apical areas, respectively.

ANOVA test was conducted to identify the existence of statistically significant difference for the mean push-out bond strength among different regions within the posts. The results showed statistically significant differences among sections for all the posts as their $p < 0.05$.

One-way ANOVA test was used to show the differences in the mean values of the push-out bond strengths between the three different canal regions of the Rebilda fiber post (Table 2).

**Table 2: One-way ANOVA test of the Rebilda fiber post**

| | Sum of squares | DF | Mean of square | F | Sig. |
|---|---|---|---|---|---|
| Between groups | 371.138 | 2 | 185.569 | 147.759 | 0.000 |
| Within groups | 33.909 | 27 | 1.256 | | |
| Total | 405.047 | 29 | | | |

The mean difference is significant at the 0.05 level.

Tukey HSD test was used to investigate the differences in the push-out bond strengths present between each pair of the three regions of the root canals for Ribilda fiber post (Table 3).

**Table 3: Tukey HSD for Rebilda fiber post**

| Variable | Mean difference | SD | Sig. | 95% Confidence interval | |
|---|---|---|---|---|---|
| | | | | Lower bound | Upper bound |
| Cervical-middle | 6.070 | 0.501 | 0.000 | 4.83 | 7.31 |
| Cervical-apical | 8.33 | 0.501 | 0.000 | 7.09 | 9.57 |
| Middle-apical | 2.26 | 0.501 | 0.000 | 1.02 | 3.5 |

The mean difference is significant at the 0.05 level.

One-way ANOVA test was used to show the differences in the mean values of the push-out bond strengths between the three different canal regions of the Rebilda GT fiber post (Table 4).

**Table 4: One-way ANOVA test of the Rebilda GT fiber post**

| | Sum of squares | DF | Mean of square | F | Sig. |
|---|---|---|---|---|---|
| Between groups | 932.850 | 2 | 466.425 | 276.871 | 0.000 |
| Within groups | 45.485 | 27 | 1.685 | | |
| Total | 978.335 | 29 | | | |

The mean difference is significant at the 0.05 level.

Tukey HSD test was used to investigate the differences in the push-out bond strengths present between each pair of the three regions of the root canals for Ribilda GT fiber post (Table 5).

**Table 5: Tukey HSD for Rebilda GT fiber post**

| Variable | Mean difference | SE | Sig. | 95% Confidence interval | |
|---|---|---|---|---|---|
| | | | | Lower bound | Upper bound |
| Cervical-middle | 4.95 | 0.580 | 0.000 | 3.51 | 6.39 |
| Cervical-apical | 13.5 | 0.580 | 0.000 | 12.06 | 14.94 |
| Middle-apical | 8.55 | 0.580 | 0.000 | 7.11 | 9.99 |

*The mean difference is significant at the 0.05 level.

**Table 1: Descriptive statistics of push out bond strength values for both types of posts in MPa**

| | N | Mean | SD | SE | 95% Confidence interval for mean | | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lower bound | Upper bound | | |
| Rebilda fiber post | | | | | | | | |
| Cervical | 10 | 14.91 | 1.595 | 0.504 | 13.77 | 16.05 | 13 | 17 |
| Middle | 10 | 8.84 | 0.973 | 0.308 | 8.14 | 9.54 | 8 | 10 |
| Apical | 10 | 6.58 | 0.527 | 0.167 | 6.20 | 6.96 | 6 | 7 |
| Total | 30 | 10.11 | 3.737 | 0.682 | 8.71 | 11.51 | 6 | 17 |
| Rebilda GT fiber post | | | | | | | | |
| Cervical | 10 | 21.10 | 1.820 | 0.575 | 19.8 | 22.4 | 19 | 24 |
| Middle | 10 | 16.15 | 10.15 | 0.321 | 15.42 | 16.88 | 15 | 18 |
| Apical | 10 | 7.6 | 0.845 | 0.267 | 7 | 8.2 | 6 | 9 |
| Total | 30 | 14.95 | 5.808 | 1.060 | 12.78 | 17.12 | 6 | 24 |

## Discussion

Glass fiber post is frequently used in strengthening weakened teeth, because these posts exhibit high fatigue and tensile strength, and a modulus of elasticity closer to dentin, and has the ability to bond to the tooth structure [12], [13].

Rebilda GT post is composed of bundles of glass fiber posts, instead of a single post that is present in the Rebilda post [12], [13], [14], [15].

In this study, Rebilda GT (1.2 mm diameter) which is composed of nine individual thin posts held together with a plastic sleeve, unfold, and expand in fine distinct posts within the whole space of the root canal, so it adjusts to fit any root canal configurations. Therefore, this post can be used in conditions of elliptical or curved root canals [8].

The highest mean value of push-out bond strength was recorded for (Rebilda GT) post in all regions. Because of the greater number of posts within this post, the surface area of the cement has increased which led to improved distribution of force.

Rebilda GT post with its unique design has a greater width and diameter than the other post because it expands to fill the space inside the canal that will give better adaptation to the root canal walls and a thinner cement thickness than in the single post, these results coincide with [Egilmez *et al*., 2013], who asserted that increasing in post diameter will decrease the thickness of the cement and increases the bond strength [16].

Furthermore, (Kremeier *et al*., 2008) shows that there is a negative linkage between bond strength and luting cement thickness [17].

Rebilda GT results can be attributed to the lower resin cement thickness because thinner cement means that strain and stress shrinkage which developed at the adhesive interface would be reduced [18].

The presence of bundle posts allowed for minimizing the cement layer, similar findings were found in the study of (Latempa *et al*., 2015), who concluded that bond strength to dentin could be enhanced using accessory posts [15].

The results of this study showed that push-out bond strength varied among the cervical, middle, and apical regions in the tested groups, highest values were obtained in the cervical followed by the middle and apical areas for all post-types. This can be explained by the reduction in the dentinal tubules number and size going down from the cervical to the apical thirds of the root, that causes reduction in adhesive infiltration into the dentinal tubules leading to reduction in resin tags formation in the apical parts. This coincides with (Desai *et al*., 2016) they specified that the cervical section shows strongest adhesion because of greater dentinal tubules number per square millimeter [1], [16].

The cervical portion of the canal is an easily manageable position of the root making it less cumbersome in acid etching and bonding application than deeper parts of the root canal [16].

Apical root dentin is less favorable for bonding agents because of the difficulties in acid etching and bonding application that results in a decrease in resin tags formation [19].

## Conclusions

From the results of this *in vitro* study, the following conclusions could be drawn:

The bundle glass fiber posts (Rebilda GT) showed higher bond strength than taper post (Rebilda fiber post) in all regions (apical, middle, and cervical). The bond strength at cervical region is higher than middle and apical regions.

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