Fracture Resistance of New Fiber Post System (Rebilda GT)

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Abstract

Background and Aims: Evaluate and compare the fracture resistance of endodontically treated teeth restored with bundle glass fiber post and tapered glass fiber post, at 45 degree oblique load.

Materials and Method: Thirty newly extracted single rooted mandibular first premolars were chosen, and after root canal preparation and obturation, post spaces were prepared. Then the samples were separated into three groups (n = 10) dependent on the type of restorative method used: group A restored with Rebilda fiber post [tapered glass fiber post], group B restored with Rebilda post GT post system (bundle glass fiber post), and group C restored with direct composite resin restoration without a post (control). Using a universal testing machine with speed of 0.5 mm/minute at 45 degree sloping load which was applied to the restored teeth, fracture resistance was recorded in Newton.

Results: The results showed that the fracture resistance significantly affected by different post systems ($p < 0.05$). The bundle glass fiber post (rebilda Gt) showed highest fracture resistance than the other groups.

Conclusion: Rebilda GT post (bundle glass fiber system) showed higher fracture resistance than the Rebilda fiber post (tapered glass fiber post) and control group respectively.

Keywords: *Fracture resistance, Rebilda GT post, Rebilda fiber post.*

Introduction

The restoration of root canal treated teeth is difficult to clinicians particularly when there is moderate to sever tooth loss, in such cases, the final restoration can be well retained only by means of a post and core system. The preference of suitable restoration for these teeth is affected by strength and esthetics.[1,2]

Prefabricated posts have become prevalent because of the wide assortment systems are available like: tapered, parallel sided, smooth or serrated, cemented, threaded or combination of these, the prefabricated metal posts have been used for many years to restoring endodontically treated teeth; However, the roots restored with metal posts are subjected to fracture because of the high elastic modulus of metals which is very high compared with that of dentin so any force specially lateral force will cause concentrated stress on the root and fracture. [3]

Fiber reinforced composite post was used as a substitute to metal cast post and cores and metal post, the first fiber post was introduced in the late of 1989 to restore endodontically treated teeth with an excessive loss of tooth structure, the priority of these posts can be basically attributed to that these posts has modulus of elasticity closer to that of dentin with good esthetic specially when all ceramic crowns are done, other advantages of fiber posts was decrease the hazard of root fracture because it enabling soft cementation without friction with root canal walls. [4-7]

Glass fiber posts have an elastic modulus comparable to that of dentin and can be bonded to the tooth structure which allows more homogeneous stress absorption and force distribution on the residual root consequently reinforcing the tooth structure, this property has been reported to reduce catastrophic fracture of the root and offer better distributions of the stress; Glass fiber post provides excellent esthetic and light transmission results, it require less dentin removal, and can be bonded to dentin.[8-11]

Furthermore the glass fiber posts are unaffected by corrosion; also these posts have tensile strength comparable to dentine; they are high retentive because of their matching and bonded to tooth structure also have revealed appropriate results comparative to root fracture and more convenient fracture modes.[8,9]

Other advantages of glass fiber posts are that they allow preparing the intra canal post preparation and fulfilling post cementation in a single clinical visit, because these procedures don't required laboratory work, so that decreasing the working time, cost effective and decrease the risk of root canal contamination.[8,9]

A new glass fiber post developed by German company this post is basically a bundled post this post is radiopaque, translucent and exhibits dentine like elasticity. Each post composed of many of fine individual posts (0.3 mm in diameter) in varying numbers fixed together with color coded sleeve. In this system once remove the sleeve the bundles spread and are spread into the entire root canal, which can be adapted to any root canal anatomy. In contrast to conventional root posts, this provides uniform strengthening of the entire core buildup.

The purpose of this in vitro study was to estimate the fracture resistance of endodontically treated teeth restored with a bundle glass fiber post (rebilda GT) and tapered glass fiber post (Rebilda fiber post) at 45 degree oblique load.

The null hypothesis test was that the bundle fiber post will show superior fracture resistance than the tapered post.

Materials and Method

Thirty freshly extracted human single rooted lower first premolar teeth extracted for orthodontic reasons were selected for this study the teeth collected from young patient's age between 18-25 years old.

The selected teeth with absence of cracks or caries, no posts or crowns, no external resorption, with anatomically similar roots were selected. Radiographs for all teeth were taken and examined to exclude any teeth with canal calcifications, abnormalities, and/or signs of internal resorption.

The extracted teeth stored in 0.1% thymol solution at room temperature.

During preparation of the specimen, the root surfaces were cleaned from soft tissue with a periodontal curette (LM- Ergomax, Finland). Before preparation of the root canal, the crowns of all teeth were sectioned at the level of the cement-enamel junction (CEJ) using diamond disc (komet, Germany) adjusted to a slow-speed hand piece, with continuous water coolant, the roots were adjusted to 12 mm in length, any root that not 12mm length after section was excluded, and the working length was measured 1 mm shorter from the apex.[11]

All the root canals were instrumented by using pro-taper next rotary files driven at 250 rpm with 2N/cm torque (x smart pluse, Dentsply, Maillefer).

Each instrument was used for five canals up to size X3 (30/0.07) during preparation EDTA cream (SURE-PREP, SURE ENDO, korea) used inside canal to enhance instrumentation and 2ml of distilled water and 2ml of 5.25% sodium hypochlorite (NaOCl) irrigation were used between each file size, there after each canal received a final irrigation of 3 ml EDTA solution to remove the smear layer then 3 ml of NaOCl after washing the EDTA with 2ml of distilled water, then the canals flushed with 10 ml distilled water to remove any remnant of irrigation materials. [12]

After drying with paper points the canals were obturated with single cone using size X3 guttapercha cone which was fitted at the working length with slight resistance [tug back] effect, in conjunction with endodontic sealer (AD SEAL) (META BIOMED CO.LTD, Korea).

Then access gutta-percha was removed and condensed vertically with hand plugger after the ending of the endodontic treatment, temporary filling material MD Temp (META BIOMED, Korea) used to close the opening of the canals. Then the teeth stored inside incubator at 37^{o}c with 100% humidity for one week.

Fiber Post Procedure: After one week of incubation the temporary filling removed and peeso reamer size 3 was used to remove the gutta-percha to a depth of8 mm leaving 4mm of endodontic filling at the apex to ensure a clinically acceptable apical seal. As manufacturer instructions the Rebilda GT post system come without drills and this post well-matched with all drill systems.

Ultimately the canals flushed with 2ml NaOcl 5.25% and 2ml distilled water respectively to remove the debris then dried with paper points.

Then the roots were arbitrarily divided into three groups with regard to the post type:

Group A: 10 roots filled with Rebilda fiber post (1.2 mm in diameter tapered posts) (Voco Cuxhaven, Germany) (Figure 1).

Group B: 10 roots filled with Rebilda GT bundle fiber post (1.2 mm in diameter bundle posts) (Voco Cuxhaven, Germany) (Figure 2,3).

Group C: 10 roots restored with direct composite resin restoration without a post (control).

Before cementation, as manufacturer's instructions all posts were disinfected with alcohol, then silane coupling agent was applied to the post and allowed to dry for 1 minute as manufacturer instructions, after that bonding agent (Futurabond U Voco Cuxhaven,Germany) which is self-etching and dual cure were applied inside the root canals and dried with gentle air without light cure as manufacture instructions then the core-built-up composite (Rebilda DC, VOCO Germany) inserted in the canal using special application tip for the groups: Rebilda post and Rebilda GT post. Following placement of the posts with slight finger pressure, the excess resin was removed after light curing for 3 seconds with the probe. Then the resin was light-cured with light curing device with 1600mW/mm^2 intensity for 40 seconds (Da-lux, Dia Dent Korea) in the occlusal direction; the intensity of light cure had been checked before using with a radiometer and rechecked after each curing. [12, 13]

The core build-ups with composite resin which were standardized using the same size of a cellulite core-forming matrices to ensure the uniformity of the specimens. Then all the specimens were maintained in 100% humidity, for 24 hours, at 37°C.

Fracture Resistance test was done by applying the load using the Instron Universal Testing Machine (TERCO, MT 3037, Sweden).

A 45-degree oblique load was applied at speed of 0.5 mm/minute until fracture occure, and the fracture loads were registered and the fracture was observed by visual inspection with the aid of transillumination and by return-back de-bonded force score to zero, as shown on a computer screen.

Statistical analysis was done using Statistical Package for the Social Science software, version 17.

Descriptive statistics were expressed as means and standard deviation (SD) for each group (Tables 1). The effect of different posts types on the fracture resistance of the tooth was assessed by comparison of groups using ANOVA test and post hoc Tukey HSD test (Tables 2 and 3). In the above tests, $p \leq 0.05$ was taken to be statistically significant.

Results

The mean and standard deviation of fracture resistance for each experimental condition are presented in table 1.

Statistical analysis of data by using the analysis of variance ANOVA test and post hoc Tukey HSD test (Tables 2 and 3). The tables showed, that group B (Rebilda GT post) had the highest average fracture resistance, compared to group A (Rebilda fiber post) and group C (control group) respectively. Consistent with the finding, the null hypothesis was accepted as the bundle post restorations show higher fracture resistance than other groups.

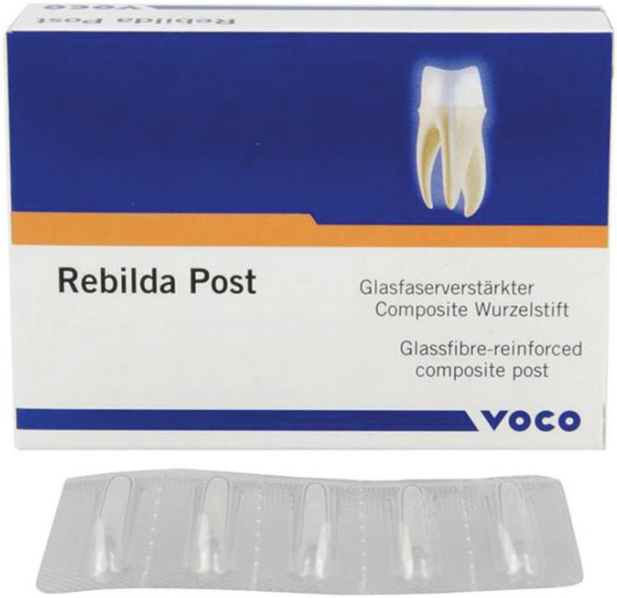

Figure (1): Rebilda post

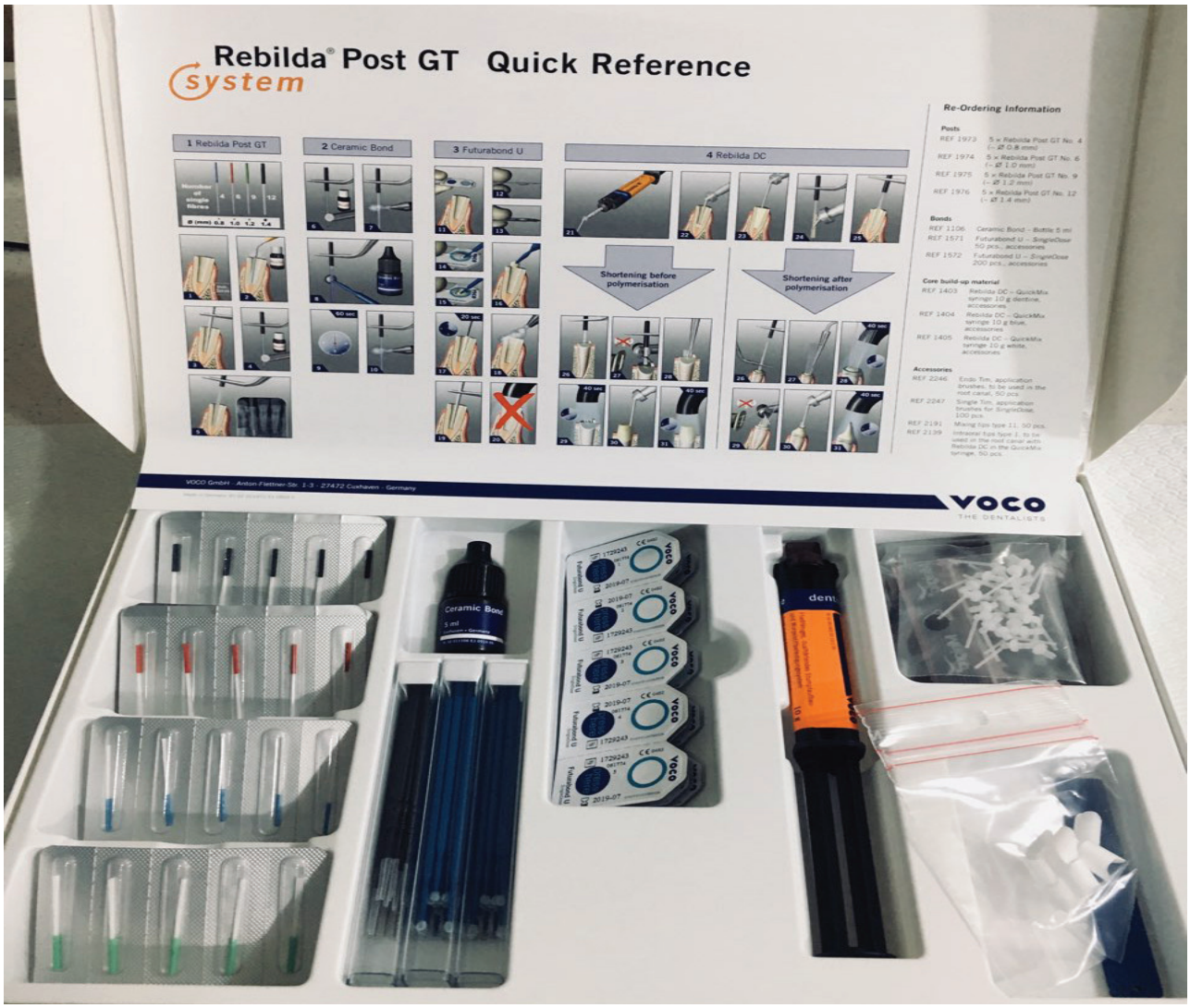

Figure (2): Rebilda GT post kit.

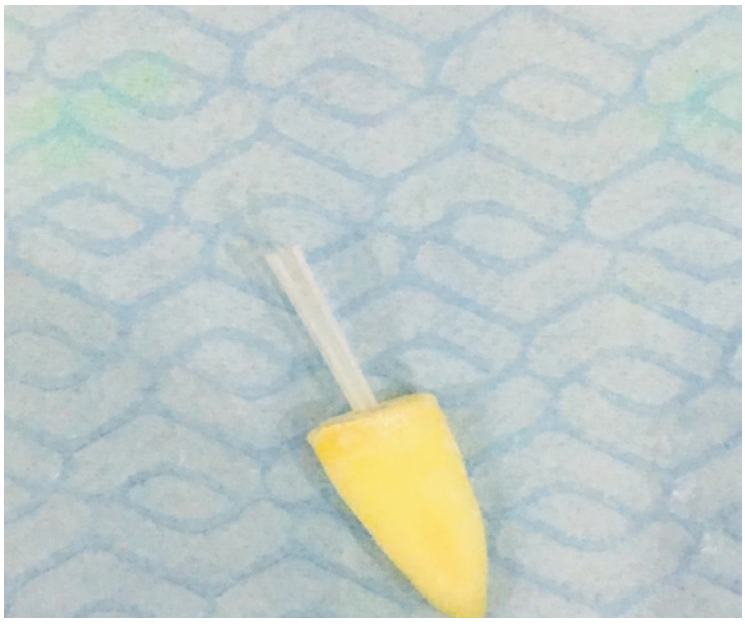

Figure (3): Fiber post inside the specimen.

Table (1): Descriptive statistics show the fracture resistance in Newton.

Groups	N	Mean	Std.deviation	Std. Error	Minimum	Maximum
Rebilda fiber post	10	222	12.74	4.03	200	240
Rebilda GT post	10	284	12.79	4.04	265	310
Control	10	80	7.05	2.23	70	90
Total	**30**	**195**	**87.7**	**16.02**	**70**	**310**

Table (2): ANOVA test between the groups.

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	219901.66	2	109950.833	877.527	0.000
Within Groups	3383.000	27	125.296		
Total	223284.667	29			

P value less than that of 0.05 indicates significance of difference

Table (3): Tukey HSD test to evaluate the significance of differences.

		Mean difference [I –J]	Std. error	p value
Rebilda fiber post	Rebilda Gt post	-62.000	5.006	0.000
Rebilda fiber post	Control	142.000	5.006	0.000
Rebilda Gt post	Rebilda fiber post	62.000	5.006	0.000
Rebilda Gt post	Control	204.000	5.006	0.000
Control	Rebilda fiber post	-142.000	5.006	0.000
Control	Rebilda Gt post	-204.000	5.006	0.000

The mean difference is significant at the p value less than or equal to 0.05 level.

Discussion

Restoration of endodontically treated teeth is a pivotal subject in restorative and prosthetic dentistry intra-radicular posts used extensively to restore root canal treated teeth with enormous loss of coronal structure, glass fiber post have elastic modulus similar, near to that of dentin which allows more harmonized stress distribution, force absorption inside root structure this posts are capable to bond to dentin so that it restore the function, esthetic and strengthening the remaining dental structure.[14,15] Fiber-reinforced composite resin posts differ in conditions of design, shape and properties, the bonding of fiber reinforced composite resin posts to dentin is affected by many factors such as the post material, the shape of post tapered or parallel and the luting material; the thickness of the luting materials around the post play an important role in the bonding strength. The posts absorb the applied stresses and dispense this force along the entire post channel.[16] Sorensen et al. showed that fracture resistance increased when the post adapted closely to the canal walls.[17] Rebilda GT is a new type of glass fiber dental posts, which is composed of a bundled of glass fiber-reinforced composite post, this post different from conventional posts because once open the sleeve it will occupied the canal space and adapted well to the canal walls also the thickness of cement will be less there for it show higher resistance to fracture than the single post. Rebilda GT can diffuse in the fine individual posts that are dispense in the entire root canal, this post fitted optimally to any root canal configuration; consequently, this oncoming can be used in conditions where strongly curved root canals or oval and pearl shape root cross sections and marked conicity occur.[11] An 45 degree oblique load to the long axis of the tooth was applied to the tested specimens which appear to be the worst condition in terms of the fracture resistance this correspond to a worst occlusal loading for teeth.[18] The results of this study revealed that the

Rebilda GT post (group B) system showed significantly higher resistance against oblique load than the Rebilda post (group A), and the control group (group C) showed the least fracture resistance, this could be attributed to a better chemical bond between the glass fiber and the resin matrix, however increase in the number of fibers in the coronal aspect leads to better adaptation and bonding to the walls of the canal and to the core respectively and thus better stress distribution than of the single post this bundle posts can be used to strengthening of the weak tooth specially the large canals because it can occupy the canal space with least amount of cement thickness which give more strength to the canal walls. This result agrees with Maceri et al. showed that a multi-post system may lead to superior adaptation to the tooth.[19]

Conclusion

Rebilda GT post (bundle glass fiber system) showed higher fracture resistance than the Rebilda fiber post (tapered glass fiber post) and control group respectively so that this post (rebilda GT) can be strengthen the weak tooth structure better than tapered post.

Financial Disclosure: There is no financial disclosure.

Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under the University of Mosul and all experiments were carried out in accordance with approved guidelines.

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