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EFFECT OF LIGHT TRANSMITTING ABILITY OF FIBER POST ON BOND STRENGTH OF SELF-ADHESIVE RESIN CEMENT TO RADICULAR DENTINE

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Abstract

Aim: to investigate the effect of different light transmitting ability of two fiber posts systems on bond strength to the root canal dentine using dual cure self-adhesive resin cement.

Materials and methods: 24 freshly extracted human premolars were decoronated and endodontically treated. Post spaces were prepared to a depth of 8 mm and width of 1.3 mm using manufacture's supplied drills. Teeth were randomly classified into two main groups (n= 12) according to fiber post light transmission ability; group I; non-light transmitting fiber posts (NLT) (Reforpost, Angelus), group II; light transmitting fiber post (LT) (Exacto, Angelus). Both groups were cemented using self-adhesive resin cement (SpeedCEM, Ivoclar Vivadent). Using low speed saw (IsoMet, Buehler), a 2 mm thickness coronal, middle and apical sections were obtained from each sample. Then they were subjected to push out test using Instron machine (Lloyd Instruments Ltd) until failure. Data was collected and statistically analyzed.

Results: the highest means in the coronal and middle parts was found, when using light transmitting fiber post, which scored (11.75, 10.30 MPa) compared with (6.51, 6.98 MPa) when using non-light transmitting group. One-way ANOVA among the groups revealed a significant difference between non-light and light transmitting fiber post. However, there is no significant difference on the middle and the coronal parts.
Conclusions: There was no significant difference between non-light and light transmitting fiber post when all sections were added together. There is a reasonable doubt regarding the ability of light to reach more than 4 mm depth.

Keywords: Push-out test, Non-light transmitting fiber post, Light transmitting fiber post, Self-adhesive and resin cement

Introduction

Endodontically treated teeth with extensive loss of coronal structure present a dilemma to the restorative dentist (Yasa, et al, 2015). They may often require posts and cores to retain the final restorations. Recently, due to the increased demand for aesthetic and tooth colored restorations, the use of non-metallic posts has increased in popularity (Naumann , et al. 2015 and Ferrari, et al. 2000). The aesthetic posts exhibit not only aesthetic results, but also good mechanical properties justifying their clinical usage. (Akkayan, et al. 2002)

Nowadays, many prefabricated posts are available in the market with different composition and shapes. Basically fiber posts contain high volume of reinforcing fibers, which are embedded in a matrix of resin (Kumar, et al., 2015, Pereira, et al., 2015 and Novais, et al. 2009). These fibers reinforce the composite posts and some of them allow intraradicular light transmission. The use of light-transmitting posts was suggested to allow polymerization along the entire depth of the post holes (Chandu, et al. 2015 and Lui 1994). However, impairment of resin polymerization at increased depths has been reported (Sigemori, et al 2005 and Yap, 2000). A study suggested that inadequate polymerization of the resin composite was found surrounding the post at the middle-apical levels of simulated root canals, when evaluating the Knop Hardness bottom/top cure ratio (Roberts, et al. 2004).

Fiber posts are passively retained inside the root canals, so that it needs a strong adhesive cement. Resin-based luting agents are materials of choice that are indicated for their superior retention (D'Arcangelo, et al. 2008, Bitter, et al. 2006 and Qualtrough and Mannocci, 2003). They are more effective for post cementation compared with the other cements, they were claimed to strengthen and reinforce the tooth (Pest, et al., 2002). Few years ago, self-adhesive resin cement was introduced, these cements reduced the number of application steps, and application time compared with total-etch and self-etch bonding protocols. It eliminated etch and rinse steps in total-etch, which may significantly reduce the technique sensitivity (Skupien, et al., 2015).

Understanding different post systems in the market along with proper choice of adhesive system are paramount on achieving longevity and clinical success (Parisi, et al., 2015 and Sandhyarani, et al., 2015). It was advisable not to use light curing resin cements because of the post space depth that cannot be entirely reached by light. However, the use of self-cured resin can be a problem due to the insufficient available working time (edreira, et al., 2009).

As a result, dual-cured resin cements have been advised to overcome unfavorable characteristics of self-cured and light-cured resin cements. Nevertheless, when dual-cured resin is not exposed to light, it had been shown to decrease the degree of conversion (DC) (Faria, et al., 2007). An insufficient DC of a resin may lead to unfavorable solubility and permeability of resin cement layer and consequently microleakage. There are a lot of light-transmitting fiber posts in the market. The true value and justification of using light transmitting fiber post is surrounded by debate. That what urged the authors to lay down this study investigating the immediate effect of light on the bond strength of dual-cured resin cement. The null hypothesis of this research that; there will be significant difference between the two fiber posts used.

Materials and Methods

Twenty-four freshly extracted human mandibular second premolars characterized by single canal and straight roots of approximate sizes were collected. The teeth were cleaned and sterilized in an autoclave at 121°C, 15 Psi for 40 minutes. They were then mounted 2mm below the cement-enamel junction in an auto-polymerized acrylic resin (Vertex- Dental B.V.) blocks with a size of 10mm x 10mm x 20 mm. The clinical crowns were amputated horizontally close to the CEJ. Root canals were manually instrumented using K-files (Dentsply Maillefer) with #40 master apical file using step-back technique. The irrigation solution used was 2.5% sodium hypochlorite followed by a final irrigation with 2ml of distilled water, the canals were then aspirated and finally dried using absorbent paper points (Dentsply Maillefer). They were obturated with gutta-percha points (Dentsply Maillefer) and endodontic sealer (AH Plus, Dentsply, DeTrey) using lateral condensation technique. Specimens were placed in distilled water at room temperature for 72 hours. Roots were embedded in 10 x 10 x 20 mm resin blocks (Vertex-Dental) for easy handling. (Fig 1)

Fig.1: Amputated teeth in resin blocks

Samples were divided into two groups according to the type of fiber post used; group I: non-light transmitting fiber post (NLT) and group II: light transmitting fiber post (LT). Post space preparation was initiated by the removal of 8 mm of gutta-percha with Gates Glidden #1 drills (Dentsply Maillefer) then followed using Peeso reamers (Largo, Dentsply Maillefer) and completed by the corresponding post drill (1.3 mm in diameter). Fiber posts were tried for proper length, and then they were cleaned using alcohol and dried with blasts of oil-free air. All fiber post surfaces were treated with Monobond Plus silane (Ivoclar Vivadent; Liechtenstein). Speed CEM cement (Fig 2) was injected in an apical-coronal direction (to prevent any void formation). Then the silanated (Ultradent, Products,Inc.) & length-adjusted post was inserted into the canal. Excess material was removed immediately using micro brush (Microbrush, Grafton). Then the fiber post was held under pressure for10 sec under LED curing light tip (Elipar S10, 3M ESPE).

Fig.2: Speed CEM cement

Using low speed IsoMet saw (Buehler Worldwide Headquarters), three post/dentin sections (coronal, middle and apical) was obtained from each sample (Fig 3), with a thickness of 2 mm.

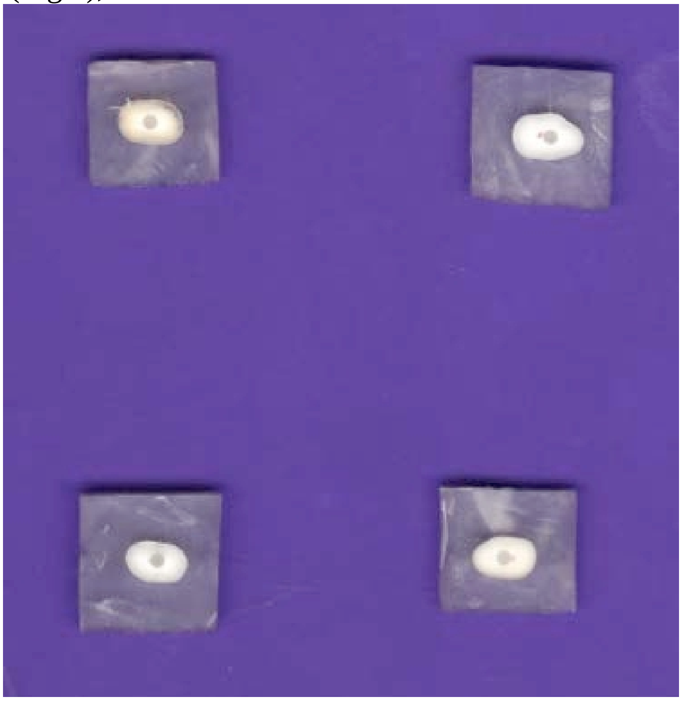

Fig.3: Sectioned samples

Samples were submitted to a push-out test using a using universal LRX-plus testing machine (Lloyd Instruments Ltd.) at a crosshead speed of 0.5 mm/min (Fig 4). The specimens were fixed in the frame cell. The fracture was confirmed by sudden drop in force measurements in the testing machine. (Fig.4) The maximum failure load was recorded in N and converted into MPa, by computed surface area measurements and using the following formula: Bond = F/A [A = (π h (r1+r2)], Where π is the constant 3.14, r1 apical radius, r2 coronal one, and h is the thickness of the sample in mm.

The data recorded was coded, entered using the statistical package SPSS version 15 and summarized using descriptive statistics such as: mean, standard deviation values for quantitative variables. Statistical differences between groups were tested using one-way ANOVA quantitative. P- values less than or equal to 0.05 were considered statistically significant.

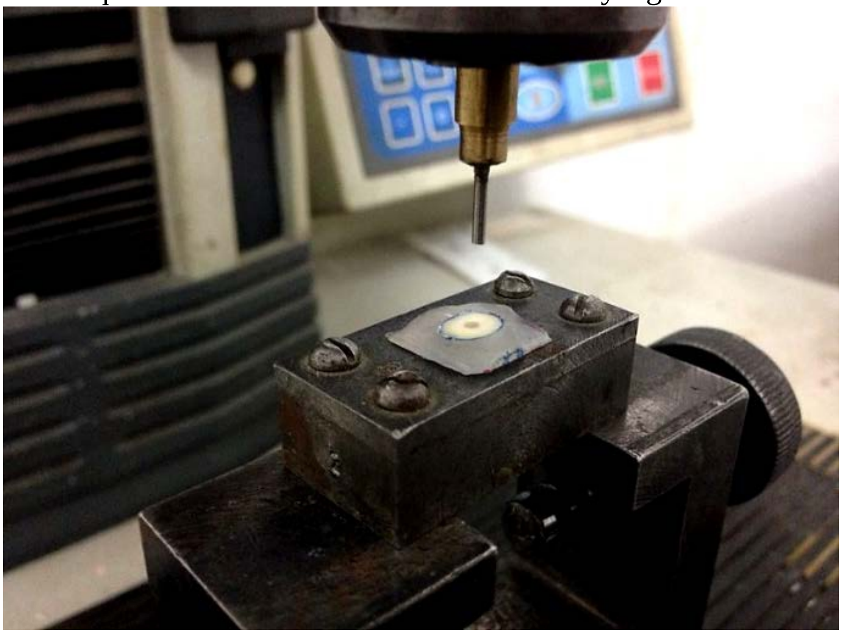

Fig.4: Samples mounted for push-out test

Results

Failure was recorded when the bonded post part was forcibly removed from its corresponding root. The means and standard deviation comparing the non-light and light transmitting post in each part (coronal-middle-apical) are listed in (table 1 & chart1):

Table 1: Mean and standard deviation values of tested groups

Type of cement	Part	Type of post	Mean	Std. Dev
Self-adhesive cement	coronal	Non-light transmitting	6.51	**2.93**
		Light transmitting	11.75	**3.66**
	middle	Non-light transmitting	6.98	**3.90**
		Light transmitting	10.30	**4.61**
	apical	Non-light transmitting	4.45	**1.99**
		Light transmitting	4.39	**2.10**

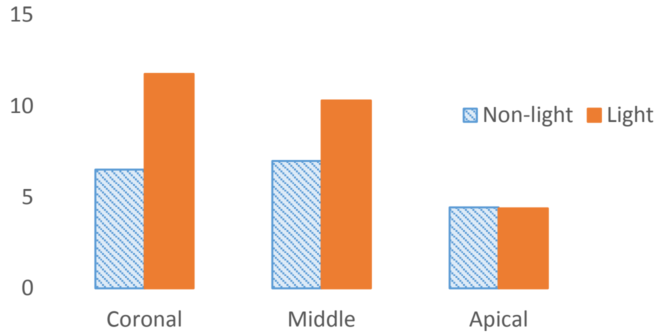

Chart 1: mean values measured in MPa

Comparing the mean values of each root section in both groups:

The results showed that, the highest means where found in light transmitting fiber post, in the coronal and middle parts (11.75, 10.30 MPa) compared with (6.51, 6.98 MPa) when using non-light transmitting post.

One-way ANOVA among the groups revealed that; in the coronal part, a p-value of 0.0041 indicates a significant difference between non-light and light transmitting fiber post. However, there is no significant difference on the middle and the apical parts

Comparing the mean values of each root section in the same group

In non-light transmitting group the results showed that, the highest bonding value was 6.98 MPa in the middle part, compared with 6.51 MPa in the coronal and 4.45 MPa in the apical parts. A P-value of 0.22 indicated that there was no significant difference between the three root sections in the non-light transmitting group.

Regarding the light transmitting fiber post, the highest values scored were the coronal part. A p-value of 0.002 indicated that there was a significant different between middle and apical parts, also a p-value of 0.0002 confirmed that there was significant difference between coronal and apical parts

The means and standard deviation of the of the added root sections of each post are displayed on table (4) and chart (2)

Table 4: added parts mean and standard deviation values

Type of post	Mean	Std. Dev
Non-light transmitting	6.98	3.15
Light transmitting	10.30	4.75

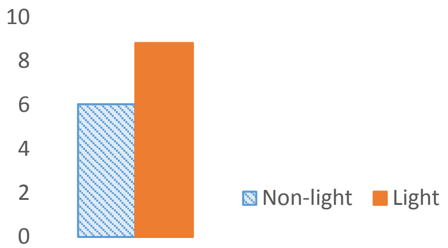

Chart 2: added parts mean values measured in MPa

Comparing the results of entire root of all subgroups, it was found that mean value in non-light transmitting group, which scored 6.04 MPa, lower than the light-transmitting group which scored 10.3 MPa.

However, a P-value of 0.0961 confirmed that there was no significant difference between the entire root between light and non-light transmitting posts.

Discussion

This study, investigated the effect of light transmitting ability of fiber post on bond strength of self-adhesive resin cement to radicular dentine. There are many types of prefabricated posts available with different light transmitting abilities. Materials used for fabrication of fiber post, the fibers/resin matrix ratio, the direction of the fibers and its dimension; all these factors contribute to the light transmitting ability of the post. Also we should keep in consideration that the post-hole is different than coronal cavities. A vitro study reported lower bond strengths found in the radicular dentine when compared to coronal dentine (Bouillaguet, et al. 2003). There are conflicting reports about the ability of light to reach the apical portion of the post. A study (ZhiGang, et al. 2010) concluded that the light even if we use a light transmitting post would only penetrate 2-3 mm radicularly. Also the root canal environment is subjected to a number of variables that may directly affect bond strength (Boff, et al. 2007). Variables should be taken into consideration when comparing intraradicular results to the intra-coronal ones.

Results of this study revealed that the mean values of coronal and middle parts of the light transmitting fiber post scored higher than that of Non-light transmitting group. On the other hand both groups had close values in the apical part. This might suggest that the LT ability of the post might affect the bonding strength. As well as the gradually decreased values in apical direction might be due to the decreased light transmission, and the approximate scores that were recorded on the apical part, might due to that the light can only reach the intra-radicular coronal and middle parts.

Regarding NLT group, the middle part scored slightly higher values than the coronal part, but there is no significant difference between them, this might due to the adequate film thickness on the middle part. A study (Özcan, et al. 2013) investigated the effect of the resin cement thickness on bond strength of fiber posts found that, when the cement thickness is excessive, the bonding strength decreases. On top of that, high wall-to-wall contraction shrinkage may occur because thin resin films generate high shrinkage stress during polymerization, which may influence the bonding ability.

When comparing the mean values of radicular part of the LT group it was found to be higher than the NLT group. But there was no significant difference between both of them.

Our findings are consistent with previous literature (Zamboni et al. 2014, Urapepon, 2014 and dos Santos, et al. 2008),, they showed that there was a significant reduction of the quantity of light transmitted as the depth increased and the light might not reach the apical third. Also the fiber post translucency might increase the bond strength on the coronal and middle thirds with no significant difference when comparing the added parts of LT or NLT fiber posts together.

The null hypothesis of this study was fulfilled there was no significant difference between the two fiber posts used.

Conclusion

Within the limitations of this study it could be concluded that

- There is no significant difference between non-light and light transmitting fiber post when all sections were added together.
- The light decreases gradually in apical direction.
- There is a reasonable doubt regarding the ability of light to reach more than 4 mm depth.

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