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PULL-OUT STRENGTH OF FIBER POSTS LUTED WITH DIFFERENT SELF-ADHESIVES

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ABSTRACT

Introduction: Dislodging from the root canals is the most common failure of bonded fiber restorations. Self-adhesive system has the advantage of reduced cementation procedure. The aim of this study was to evaluate the bond strengths of fiber posts with three different self-adhesive/resin systems to coronal and apical thirds of the post space dentine

Materials and methods: Thirty freshly extracted single-root human teeth were selected for this study. The specimens were then randomly divided into 3 subgroups each containing 10 samples. Fiber posts (RelyX, 3M, ESPE, UK) were inserted into canals using RelyX Unicem 3M ESPE, St. Paul, MN, USA), G-Cem (GC Corporation, Tokyo, Japan) and Maxcem Elite (Kerr Hawe Neos Orange,CA, USA) adhesives. Two disc shaped sections perpendicular to the long axis of each root sample were obtained for push-out tests. Failure load value was recorded. Statistical analysis was performed using One-way ANOVA and Kruskall-Wallis tests.

Results: RelyX Unicem exhibited the highest mean push-out bond strength values at the coronal section of all samples. G-Cem exhibited higher push-out bond strength values at apical section The overall bonding data of RelyX Unicem was also observed to be the highest among groups.

Conclusion: Self-adhesive systems are of practical ways of intra-canal cementation. It does not require multiple steps for success. All the systems offered acceptable retention ability. Keywords: Self-adhesive systems, root-canal cementation, post-core

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ÖZET

Giriş: Bağlantı sonrası fiber restorasyonların kök kanallarından ayrılması en sık karşılaşılan başarısızlıktır. Self adeziv sistemler azaltılmış simantasyon prosedür avantajına sahiptir. Üç farklı self-adeziv rezin sistemin kullanıldığı bu çalışmanın amacı fiber postların koronal ve apikal üçlülerdeki bağlanma dayanımını değerlendirmektir.

Materyal ve metod: Bu çalışma için 30 adet yeni çekilmiş tek köklü insan dişi seçildi. Örnekler 10!arlı rasgele gruplandı. Fiber postlar (RelyX, 3M, ESPE, UK) RelyX Unicem (3M ESPE, St. Paul, MN, USA), G-Cem (GC Corporation, Tokyo, Japan) ve Maxcem Elite (Kerr Hawe Neos Orange,CA, USA) adezivler kullanılarak kanallara yerleştirildi. İtme testleri için örneklerden diş uzun eksenine dik ve birbirine paralel 2 disk şeklinde kesit alındı. İstatistiksel analizler için tek yönlü varyans analizi ve Kruskall-Wallis testleri kullanıldı.

Sonuçlar: RelyX Unicem tüm örneklerde koronal bölgede en yüksek itme değerleri ortaya çıkardı. G-Cem ise apikal bölgede en yüksek değerlere ulaştı. Tüm veriler değerlendirildiğinde RelyX-Unicem yine en yüksek değerleri verdi.

Karar: Kanal içi simantasyonunda self-adeziv sistemler pratik çözüm yoludur. Çoklu aşama gerektirmezler. Çalışmada kullanılan bütün sistemler kabul edilebilir bağlanma değerleri sunmaktadır.

Anahtar Kelimeler: *Self-adeziv sistemler, Kök-Kanal Simantasyonu, Post-Kor*

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INTRODUCTION

Root filled teeth with excessive loss of coronal tooth structure are frequently reconstructed with posts and cores[1]. Most clinical failures with endodontic post systems are related with the decementation of the post and/or root fractures[2, 3]. Conventional metal post restorations may result an unaesthetic gray discoloration when used with all-ceramic restorations. Besides, fiber posts have better vision and generally offer advantages about application over conventional cast posts or prefabricated metallic posts[4-6]. The most common failure of restorations bonded with fiber posts is dislodging of the posts from the root canals[7, 8]. Various luting agents and adhesive systems have been proposed for luting fiber posts to root canal dentine[9]. Contemporary resin cements, frequently used to lute fiber posts, may be divided into three subgroups according to the adhesive approach; etch-and-rinse adhesive systems, self-etching primers, self-adhesive cements[10]. The self-adhesive systems eliminate the need for separate etching, priming, and bonding steps in an attempt to simplify the cementation procedure[11]. However, information on fiber post cementation technique is still confusing and inadequate in the literature[10, 12]. Besides, as the number of dentine tubules decreases from coronal to the apical direction, the success of bonding to dentine may vary at these different regions of even the same root canal[9].

Therefore, the aim of this study was to evaluate the bond strengths of fiber posts with three different adhesive/resin systems to coronal and apical thirds of the post space dentine.

MATERIALS AND METHODS

Thirty freshly extracted single-root human teeth were selected for this study. Soft tissue and remnants were cleaned gently from the root surfaces. The crown of each tooth was removed with a diamond disc 1 mm apical from the cemento-enamel junction. After gently removing the pulpal residuals working length was determined as 1 mm shorter than the canal length. The canals were instrumented using a crown-down technique with rotary ProTaper instruments (Dentsply, Maillefer, Ballaigues, Switzerland) to size of finishing F3. The canals were irrigated with 2% sodium hypochlorite (NaOCl) among each file size and then the root canals were dried with #30 sterile paper points (Spident, Incheon, Korea). All root canals were obturated with lateral compaction technique. Single cone ProTaper Gutta-percha (#30) (F3) (Dentsply, Maillefer, Ballaigues, Switzerland) with AH-26 sealer was used as a master cone. The samples were then stored at 100 % humidity for 7 days at 37 ºC to allow complete setting of the sealers.

To prepare 8-mm-deep fiber post spaces ISO size-90 preparation instrument (Dentsply, Maillefer, Ballaigues, Switzerland) was used. Spaces were irrigated with 2% sodium hypochlorite solution and were dried with paper points. The specimens were then randomly divided into 3 subgroups each containing 10 samples. Fiber posts (RelyX, 3M, ESPE, UK) were inserted into canals using RelyX Unicem 3M ESPE, St. Paul, MN, USA), G-Cem (GC Corporation, Tokyo, Japan) and Maxcem Elite (Kerr Hawe Neos Orange,CA, USA) adhesives. All materials were used according to the manufacturers' recommendations. All the posts were then seated to full depth in the prepared spaces using finger pressure. The excess luting agent material was immediately removed with a small cotton brush. After initial setting, the resin luting cements were polymerized with a light cure for 40 s. Thirty minutes after the cementation procedures, all samples were stored in distilled water for 24 h. Two disc shaped sections perpendicular to the long axis of each root sample were obtained for push-out tests as shown in the figure 1. Using a low-speed saw (Micromet M; Remet S.p.A., Casalecchio di Reno, Italy).

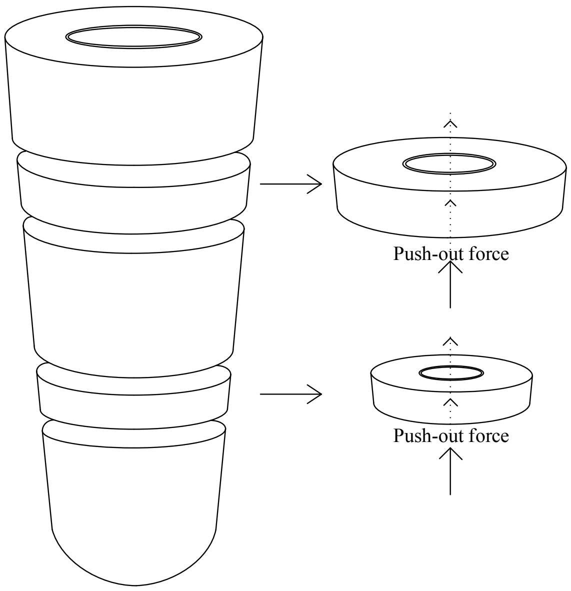

Figure 1: Schematic view of obtaining coronal and apical sections

The thickness of each specimen was measured and recorded by a digital caliper (Insize, Insize Co., LTD, USA) having the accuracy of 0.001 mm. Apical side of each slice (1.0 ± 0.1 mm) was marked with an indelible marker.

Push-out tests were performed by applying a compressive load at a crosshead speed of 0.5 mm/min to the apical aspect of each slice via a cylindrical plunger mounted on a Universal Testing Machine (Lloyd LR 30K; Lloyd Instruments Ltd, UK). Load was performed until the breakdown occur. Maximum failure load value was recorded.

Statistical analysis

The statistical difference between the push-out bond strength values of the groups were analyzed using One-way ANOVA. Then Kruskall-Wallis tests were performed to assess the significance among groups

RESULTS

Push-out test results are shown in Table 1. RelyX Unicem exhibited the highest mean push-out bond strength values at the coronal section of the samples. On the other hand Maxcem Elite exhibited the least mean push-out bond strength values at the apical section of the samples.

G-Cem exhibited higher push-out bond strength values at apical section than both RelyX unicem and Maxcem Elite adhesives, however this was not statistically significant at 0,05 confidence level, conversely the push-out values at the coronal third obtained with RelyX Unicem adhesive was significantly higher than other groups. ($p<0.05$).

The overall bonding data of RelyX Unicem was also observed to be the highest among groups. However the differences among all groups were not statistically significant ($p>0.05$).

DISCUSSION

Dual-cure adhesive systems need multi-clinical steps and do require pretreatment at dentin/enamel surface however, self-adhesive systems do not require any pretreatment. Self-adhesive systems have methacrylate monomer formulation with phosphoric acid esters, which produces polymerization in an acidic environment[13]. Methacrylate monomers infiltrate into dentin while the acidic esters demineralize the surface. To balance the acidic activity of the esters during and after the process glass-ionomer formulations are added into many of the self-adhesive systems. The interaction between the hydroxyapatite crystal of dentin and the methacrylate monomers are altered by such compositional changes. In addition, it should be reminded that the retentive data may vary depending on the composition of the adhesive system itself. As the particle size of the filler ingredient increase (for cohesive strength) the flowing ability will degrease which is essential for self-adhesive systems to move through the retentive areas. Therefore, the activity of the material should be evaluated carefully for a detailed discovery of functional ability.

Several studies reported controversial results regarding bond strengths of different luting agents in the root canals[7, 14-16]. Kerstin and Sebastian[17] found that RelyX self-adhesive cement pointed out significantly higher push-out bond strength values than Panavia and Variolink II dual cure adhesive systems. They speculated that the moisture tolerance of these systems may explain the favorable adhesion of RelyX[1]. This result is also compatible with ours, that RelyX Unicem showed significantly higher bonding values in the coronal section ($p<0.05$). The degree of moisture is known to be difficult to control inside the root canal. However, etch-and-rinse based adhesives need to be applied on the restrained moist dentin. Moreover, this is essential for the use of dual cure materials inside the root canal.

Table 1: Mean push-out bond strengths for experimental groups

	RelyX Unicem	G-Cem	Maxcem Elite
Coronal third	17.53 ± 3.01 N	15.43 ± 4.17 N	14.91 ± 3.46 N
Apical third	14.77 ± 2.72 N	15.07 ± 3.23 N	14.22 ± 3.82 N
Overall	16.15 ± 2.94 N	15.25 ± 3.76 N	14.56 ± 3.22 N

The success of RelyX Unicem in our study may also be attributed to the optimum film thickness of this material[18]. Because of the ingredients and composition of adhesive materials, it may be very difficult to produce thinner film thickness which is essential to avoid cohesive failures. Cohesive failures in adhesive materials induce failure of the restoration even the penetration into dentin or restoration is quite acceptable. On the other hand, degree of conversion rates of this adhesive system is claimed to be very high[19]. It is known that for the completion of the polymerization (adequate bond strengths and mechanical properties) 24 hours is requisite at the areas without energy of light[20]. In our study all the samples were stored in water for sufficient polymerization for 24 hours.

On the contrary, Maxcem Elite represented significantly lower bond strength values than G-Cem and RelyX Unicem in both apical and coronal sections in our study ($p<0.05$). The 37% phosphoric acid activity of this system may not be enough to decalcify and remove dentin from the surface. The excess smear-like substrate is un-favored situation for adhesive activity.

The acidic activity of the material is a very effective factor which is the first step of penetration of the resin into dentinal canals or irregular surfaces. It is known that irregular surfaces and/or dentinal canals are necessary for retention of the resin material. Higher pH concentration may completely deform the dentinal canal formation which is never desired. On the other hand, lower pH values may not be enough for required decalcification. Therefore, optimum acidic concentration is essential. Self-adhesive systems have a self-etch process that provide rough dentin surface which is essential for adhesive penetration as mentioned. The self-etch process of these systems cannot be inspected visually and may sometimes be inadequate. According to our results Maxcem Elite represented the lowest test values at both sections with respect to RelyX Unicem and G-Cem.

Investigations about the composition and structure of apical and coronal parts of root canal dentine also depicted conflict results. While some of the investigators reported higher bond strengths to root canal dentin in the apical one-third[21, 22], others claimed that higher values were obtained at the coronal one-third[23, 24]. In our study we obtained higher bond strength values at coronal sections of each sample than apical sections. The difference was statistically significant for Relyx Unicem samples ($p<0.05$) but not for Maxcem Elite and G-cem samples.

Dual cure adhesive systems polymerize both with light and chemical activation. It is clear that during a root canal cementation because of non-light areas, chemical curing specialty should be assumed as more important than the light curing. However, the process starts with the light activity. Within the limitations of this study the samples for push-out tests were obtained from apical and coronal sections which are impossible to be light activated. The lower bonding values at each sample may be attributed to this issue as mentioned. Polymerization shrinkage is one of the most important issue for light activated or dual cured resin systems. Researchers claimed that[25, 26] chemical cured systems produces higher bonding strength than dual cured systems. Therefore, push-out data of samples that are chemically cured may be different from dual cured.

CONCLUSIONS

Self-adhesive systems are of practical ways of intra-canal cementation. It does not require multiple steps for success. All the systems offered acceptable retention ability.

Conflict of Interest

We the authors declare that we do not have any conflict of interest

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