



INFLUENCE OF THREE CEMENTATION PROTOCOLS ON BONDING OF TWO FIBER REINFORCED POST SYSTEMS

Adel Ahmed Siddiq^{*}; Mohammad M Rayyan^{**}
and Mohamed A. Ibrahim^{***}

ABSTRACT

Aim: to evaluate the bond strength of two fiber posts systems to root canal dentine using three different protocols of dual-cure resin cements (self-adhesive, self-etch, total-etch).

Materials and methods: 60 newly extracted premolar teeth were decoronated and their root canals were treated endodontically, then a post space were prepared to a depth of 8 mm and width of 1.3 mm. Teeth were randomly classified into two main groups (n= 30) according to the fiber post ability to transmit light (group I; "Reforpost" non-light transmitting, group II; "Exacto" light transmitting fiber post), etch group were further subdivided into three groups (n=10) according to the adhesive protocol that were cemented with (subgroup A; "SpeedCEM" self-adhesive, subgroup B; "Multilink Automix" self-etch, subgroup C; "Variolink II" total etch), Three post/dentin sections (coronal, middle and apical) 2 mm in thickness was obtained from each sample, using IsoMet Low Speed Saw device, and pushed until failure with an Instron machine.

Results: self-etch cement provided the highest bond strength among the three resin based luting agents in all regions. A remarkable increase of bonding ability with light transmitting post in both subgroups A, C (self-adhesive, total-etch) were found. However there is no statistical difference observed in subgroup B (self-etch).

Conclusion: Self-etch adhesive system may be a good choice for luting fiber post as it had a higher bond strength compared with other techniques. Also, the light had more effect in total-etch and self-adhesive subgroups than it had with self-etch subgroup.

KEYWORDS: Push-out test, Non-light transmitting fiber post, Light transmitting fiber post, Total-etch resin cement, Self-etch resin cement, Self-adhesive resin cement.

^{*} Clinical Instructor of Prosthodontics, Faculty of Dentistry, Beirut Arab University, Beirut, Lebanon.

^{**} Assistant Professor of Fixed Prosthodontics, Faculty of Dentistry, Beirut Arab University, Beirut, Lebanon. Assistant Professor of Fixed Prosthodontics, Faculty of Dentistry, Misr University for Science and Technology, Cairo, Egypt.

^{***} Associate Professor of Operative dentistry, Faculty of dentistry, Beirut Arab University, Beirut, Lebanon.

INTRODUCTION

Restoration of endodontically treated teeth present a problematic issue in modern dentistry. Posts and cores are frequently used to restore teeth with considerable loss of coronal tooth structure. Since the 90s, prefabricated fiber post have been widely used following the increased demand of esthetic. In such cases, cementation of post inside the root would provide retention for the final coronal restoration, which would be influenced by the selected luting agent and the cementation procedures⁽¹⁾. Resin cements allow superior post retention and increase the fracture resistance of the post-restored tooth when compared to conventional cements. Several factors contribute to render post luting procedures difficult; the lack of direct vision and the limited access to the bonding substrate make cementation procedures very technique related, Moisture control within root canals represents an additional limitation during the management of the cements⁽²⁾.

Most clinical failures involving reconstructed teeth with posts are due to cementation failure of the posts⁽³⁾.

Until a few years ago, most adhesive were available in three application steps (total-etch). Nowadays, three categories of resin are used for luting fiber posts into the root canal, and they mainly classified as total-etch, self-etch and self-adhesive resin cements.

Total-etch resin cements require the separate use of phosphoric acid followed by two steps before the application of the resin cement. This system results in higher bond strengths on coronal dentin; although insufficient moisture control and incomplete resin inter-diffusion significantly decreases the bond strength to radicular dentin⁽⁴⁾. This technique has been reported to be complex and sensitive procedure which can influence bonding effectiveness⁽⁵⁾.

Self-etch resin cements use an acidic primer, which when used without rinsing, can alter tooth structure before bonding; therefore, the clinical steps are simpler than those with total-etch cements.

Both techniques used terms as wet, moist or dry. These terms used to confuse the practitioner. How moist is the “moist”? How wet is the “wet”? To which extent is the dry? Plot or wipe?

Recently, a new subgroup of resin cements, self-adhesive cements (one-step self-etch adhesives (1-SEAs) or all-in-one adhesives), have been commercialized from several manufacturers. These materials were designed with the purpose of overcoming some of the limitations of both conventional and self-etch resin cements⁽⁶⁾.

Self-adhesive cements do not require any pre-treatment of the tooth substrate, once the cement is mixed, application is accomplished in a single clinical step. This technique gained popularity among clinicians due to its -so called- “mistake free” application technique.

The use of self-adhesive cements eliminate the sensitive steps of etching and bonding inside the canal. As complete removal of etchant agent and excess bond may be not simple as it regarding composite filling in the crown. Do self-adhesive cements have the enough bond strength to retain the post inside the root compared with other techniques or not?

The null hypothesis of this research is that there are no differences in adhesive ability between the three tested techniques.

MATERIALS AND METHOD

Sixty freshly extracted mandibular second premolars were collected, cleaned using ultrasonic scaler then with brass wire cleaning brush to remove adherent soft or hard tissues on the roots. Then teeth were sterilized in an autoclave at 121°C, 15 psi for 40 minutes, and stored in distilled water for 72 hrs. The crowns were amputated horizontally at cemento-enamel junction with water-cooled high speed round-end tapered carbide bur, and root canal treatment was performed using lateral condensation technique by gutta-percha and eugenol-free root canal sealer.

Samples were divided into two main groups according to the fiber post used (non-light transmitting or light transmitting), each group was further subdivided into three subgroups according to cementing protocol used as shown on table (1).

Gates Glidden and Peeso-reamers drills were used to prepare the post space (8 mm in depth) followed with the corresponding post drill (1.3 mm in diameter). Fiber posts were tried for proper length, then were cleaned with alcohol and dried with oil-free air. All fiber post surfaces were treated with Monobond Plus silane.

Each subgroup was cemented according to the resin manufacture instructions, and two fiber post systems were used according to the protocol.

For subgroup A (self-adhesive cement); the Speed CEM cement was injected into the root canal in a one single step, then the silanated post was inserted, and the cement were cured.

For subgroup B (self-etch cement); the two primer liquids Multilink primer A and B were mixed, then applied to the entire root surface. Then the Multilink Automix cement was applied (Fig.1) followed by insertion of the silanated post and light cure.



FIG. (1) Multilink Automix application

For subgroup C (total-etch cement); Root canals were etched using phosphoric acid gel (37%), then Excite F bond was applied into the canal walls, and light-cure was applied. Variolink was loaded in a special plastic syringe with a root tip, and post were inserted followed by light curing.

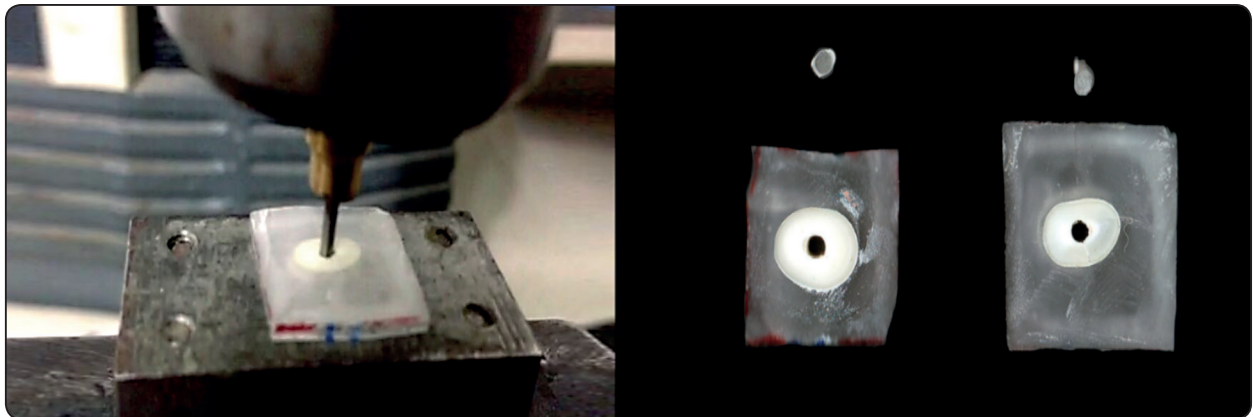
Using IsoMet Low Speed Saw, three post/dentin sections (coronal, middle and apical) was obtained from each block, with a thickness of 2 mm (Fig.2). then a push-out test was performed at a cross-head speed of 0.5 mm/min (Fig.3).

TABLE (1) Samples grouping

Type	Group	No.	Type of cement	Subgroup	No.
Non-light transmitting	I	30	Self-adhesive cement	IA	10
			Self-etch cement	IB	10
			Total-etch cement	IC	10
Light transmitting	II	30	Self-adhesive cement	IIA	10
			Self-etch cement	IIB	10
			Total-etch cement	IIC	10
				Total	60



FIG. (2) Sectioned samples

FIG. (3): **a**; Push out test. **b**; Specimen after dislodgment of the fiber post by push-out test

The maximum failure load was recorded in N and converted into MPa, by computed surface area measurements (Fig.4) and using the following formula

$$\text{Bond} = F/A \quad [A = (\pi h (r_1 + r_2))],$$

Where π is the constant 3.14, r_1 apical radius, r_2 coronal one, and h is the thickness of the sample in mm.



FIG. (4) Magnification for area measurement

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) within the same used cement are displayed in (table 2 & chart1)

TABLE (2) Group I & II mean and standard deviation values

Type of cement	Part	Type of post	Mean	Std. Dev
Self-adhesive cement	coronal	Non-light	6.51	2.93
		Light	11.75	3.66
	middle	Non-light	6.98	3.90
		Light	10.30	4.61
	apical	Non-light	4.45	1.99
		Light	4.39	2.10
Self-etch cement	coronal	Non-light	15.81	2.89
		Light	18.80	5.15
	middle	Non-light	21.20	6.24
		Light	16.71	3.29
	apical	Non-light	16.75	4.09
		Light	17.04	6.56
Total-etch cement	coronal	Non-light	7.26	5.81
		Light	15.40	7.02
	middle	Non-light	11.98	10.64
		Light	14.02	11.55
	apical	Non-light	4.19	2.88
		Light	7.20	4.35

In group I (Non-light transmitting fiber post), the highest resisting force mean scored in the middle part in all subgroups, which was recorded in subgroup B (self-etch) 21.20 MPa followed by subgroup C (total-etch) which scored 11.98 MPa, and finally subgroup A (self-adhesive) which scored 6.98 MPa.

Comparing each part (coronal, middle, apical) in the three subgroups, the statistical analyses showed a P-values which ensure that there is a significant difference between the three cements (Table 3). The results revealed that the subgroup B (self-etch) provide the highest bond strength in every region.

TABLE (3) Group I; regional p-values

	Coronal part	Middle part	Apical part
<i>P-value</i>	0.0001	0.0017	9.63×10^{-9}

In group II (light transmitting fiber post) the highest resisting force mean scored in the coronal parts in all subgroups, which recorded in subgroup B (self-etch) 18.80 MPa followed by subgroup C (total-etch) which scored 15.405 MPa, and finally subgroup A (self-adhesive) which scored 11.75 MPa.

Comparing each part (coronal, middle, apical) in the three subgroups, the P-value showed that there is a significant difference in the coronal and

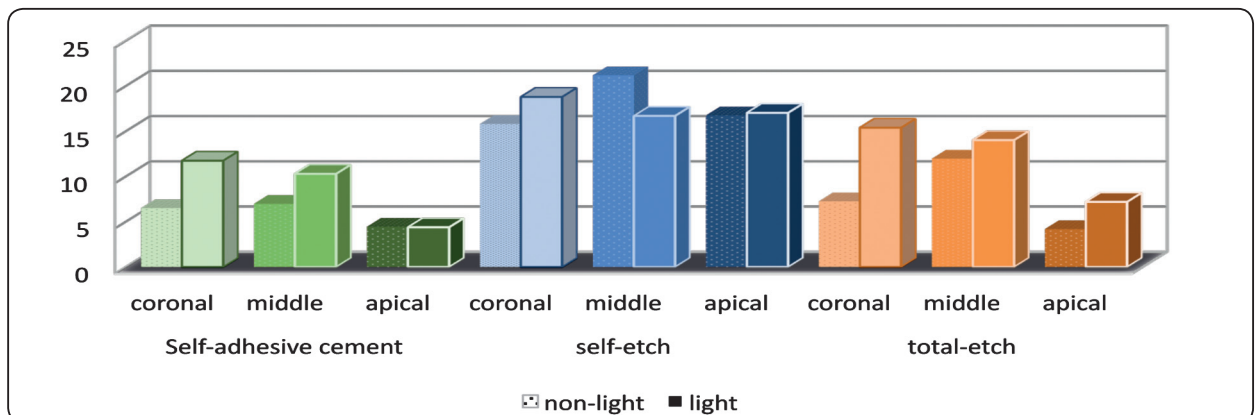


Chart (1) Group I & II mean values chart

apical parts of the three subgroups of resin cements (Table 4). However there is no significant difference between the three cements on the middle part.

TABLE (4) Group II; regional p-values

	Coronal part	Middle part	Apical part
<i>P-value</i>	0.0380	0.2062	1.74×10^{-5}

Almost in all groups the scored values were higher with the light transmitting fiber post except the middle part of the self-etch resin cement which scored in the non-light transmitting post 21.20 MPa and in light transmitting post 16.71 MPa.

DISCUSSION

The results demonstrated that self-etch resin provided the highest bond strength among the three resin based luting agents in all regions. Total-etch system, was significantly lower than self-etch. This might result from the application procedures of the total-etch, which extremely technique sensitive. After etching and rinsing, moist dentin is required for optimal bond strengths. However, the limitations of accessibility and visibility during bonding procedures were obstacles for moisture control. Excessive removal of water could respectively result in collapse of the collagen fibers or in dilution of the primer⁽⁷⁾, whereas excess residual water on dentin may contribute to separation of the adhesive system⁽⁸⁾. Self-etching adhesive eliminate this washing step, since the acid monomer promote superficial dentin demineralization in a less aggressive manner. In addition, the self-etch adhesives form a more uniform hybrid layer when compared to total-etch adhesives, promoting a better hybrid layer infiltrated by adhesive resin⁽⁹⁾. The total-etch adhesive systems promote the formation of a thicker hybrid layer, when compared with self-etch adhesives⁽¹⁰⁾. However, the quality of the hybrid layer formed is the most important factor

in obtaining higher bond strength values between dentin and restorative material, the thickness is not related to bond strength⁽¹¹⁾.

The self-adhesive showed the least bonding strength in this study, this might be due to the fact that self-adhesive have limited etching capability to demineralize dentin substrate⁽¹²⁾, results in an incomplete elimination of the smear layer and are not as effective as etch used with other systems to dissolve the thick smear layer created on the root canal walls during the post space preparation. Also failure of the resin monomers to penetrate adequately through the retained partly dissolved smear layer resulting in interfacial gaps and lower bond strength⁽¹³⁾.

The effect of light in group II, showed a remarkable increase of the bonding mean values in both subgroups A, C (self-adhesive, total-etch), this might be due to the higher content of light-cure initiator on these systems. On the other hand, there is no significant difference of light effectiveness in subgroup B (total-etch) which seems to be highly dependence on the chemical-activation initiators.

These findings are consistent with the existing literature (in 2014, Daphne Câmara Barcellos, et al⁽¹⁴⁾; in 2014, Pala K, et al⁽¹⁵⁾; in 2008, Wang VJ⁽¹⁶⁾), they showed that a self-etch system may create a better bond to the cervical, middle, and apical thirds of the radicular dentin than total-etch and self-adhesive cements.

Numerous authors (in 2011, Parnian Alizadeh Oskoe, et al⁽¹⁷⁾; in 2009, Ivana Radovic, et al⁽¹⁸⁾) have reported that fiber post cementation with the resin cement associated with etch-and-rinse adhesive and self-adhesive may generate greater bonding potential than self-etch. These finding probably due to the use of mild acidity systems of self-etching cements.

Results showed that the bond strength effected by the type of luting resin cement. In other words,

this testing results proved that the null hypothesis was rejected, and there are differences in adhesive ability between the three tested techniques.

Finally, it should be pointed out that all the in-vitro studies have limitations and cannot completely replace clinical trials. The bonding agents and resin cement used are only one of several available products for each adhesive strategy in the market; considering the chemical component variations, it is suggested to investigate retention properties of fiber posts using a broad range of products within each category. More in-vitro studies are required to evaluate the durability of the bond after aging, and long-term clinical studies are needed before any clinical recommendations.

CONCLUSIONS

Self-etch adhesive system may be a good choice for luting fiber post as it had a higher bond strength compared with other techniques, and the light had more effect in total-etch and self-adhesive subgroups than it had with self-etch subgroup.

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