Insights into a comparison of three different cements on the push-out bond strength of a glass-fibre post

SADJ April 2017, Vol 72 no 3 p126 - p127

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ABSTRACT

One of the main causes of failure of fibre posts is de-bonding of the post in the prepared post space. The adhesive properties of total etch adhesive cements were assessed by comparing the performance of cements using self-etching adhesive resins, to verify which system provided the best retentive capabilities with a double tapered post system. Extracted maxillary central incisors were endodontically treated and randomly divided into three groups: the Calibra (Dentsply), RelyX Ultimate (3M ESPE) and Panavia F2.0 (Kuraray) groups. RelyX Ultimate produced significantly the highest de-bond stress values ($p<0.05$) in the overall performance, as well as in the coronal, middle and apical sections of the tooth. Thus RelyX Ultimate with self-etching adhesive reliably can be used for post cementation with a double tapered post system in endodontically treated anterior teeth.

INTRODUCTION

Endodontically treated teeth are usually more brittle and prone to fracture. In the past, the most accepted restorative option has been the cast metallic core because of its inherent ability to fit into the treated canal and its toughness. However, this restorative option creates undesirable stress concentrations generated inside the apical region of the tooth due to its rigidity.[1]

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These stress concentrations lead to an increased likelihood of unfavourable root fractures. To alleviate this complication, fibre posts with an elastic modulus close to dentine and a high flexural strength were developed. These characteristics ensure an even distribution of forces on the tooth and strengthen the core restoration.[2] Double tapered fibre posts systems were developed to prevent over preparation of the apical third of canals (cylindrical posts) and to ensure a better fit of the coronal third of the post space which was a problem with the conventional tapered posts.[3] One of the main causes of failure of fibre posts is de-bonding of the post in the prepared post space. The conditioning of root dentine as part of the cementation methods used with modern cements can be divided into three groups; the etch and rinse adhesive method, the use of self-etching primers and the self-etching adhesive cements.[4]

Etch and rinse adhesive methods involves the use of an acid (etchant) to condition the dentinal surface prior to the application of a primer and adhesive or simultaneous application of both depending on the system used. The acid (etch) removes the debris in the root canal space that was formed during canal preparation.[5] Self-etching primers were developed to simplify cementation procedures by eradicating etching, rinsing and drying steps.[6] As a further refinement, self-etching adhesive cements consist of acidic and hydrophilic monomers in the cement that have unique chemical capabilities to condition, infiltrate and bond to enamel and dentine.[5]

Thus, the aim of this study was to evaluate, in three segments of the roots of the teeth (the cervical, middle, and apical thirds) the push-out bond strength of a glass fibre post that was cemented with self-etching and total etching luting cements.

MATERIALS AND METHODS

Thirty freshly extracted maxillary central incisors with fully closed apices were used (extracted for periodontal reasons, ethical clearance # 12/3/31 and stored in 0.5% chloramine-T solution at 4ºC for less than 1 month). The apical portions were removed to ensure a standardized

root length of 14 mm.[7] The roots were instrumented with Protaper hand files (Dentsply, USA) and irrigated with 2,5% sodium hypochlorite.[8] Obturation of the canal was done using the cold lateral condensation technique.[9] Cavit W (3M ESPE) was utilised as a temporary restoration while the teeth were stored in an aqueous solution at 37˚C until use.[5,7] During post preparation, sodium hypochloride was used to irrigate, followed by flushing with distilled water. The post spaces were prepared according to the manufacturer's instructions for DT Light-Post (Bisco, USA). A double-taper D.T. Light-Post (Bisco, USA) was used for all canals. For the RelyX Ultimate group the fibre post was pre-treated with alcohol and Scotchbond Universal Adhesive (3M ESPE), the adhesive cement applied to the entire tooth structure and the post seated. For the Calibra group, the canals were etched with 34% Caulk tooth conditioner, the post pre-treated first with alcohol and then with Prime and Bond NT. The adhesive cement was applied to the post space and the post seated. For the Panavia group, the post was cleaned with alcohol, the adhesive cement ED primer II liquid A and B placed in the post space and also applied to the post and the post then seated. After post cementation, the teeth were stored in water in an incubator for seven days at 37˚C. All specimens were placed in a mould and encased in resin. Two mm slices from the coronal, middle and apical areas were cut and subjected to a push out test to assess the de-bond stresses required to dislodge the post from the specimens.

RESULTS AND DISCUSSION

The median de-bonding values (MPa) are given below.

Cement	Coronal	Middle	Apical	Combined
Calibra	2.45	0.99	0.66	1.21
Panavia F2.0	2.77	2.35	2.21	2.57
RelyX Ultimate	8.18	9.40	8.52	8.82

RelyX Ultimate showed throughout higher de-bond stress values than Panavia F2.0 and Calibra. Panavia, the differences being statistically significant (Tukey Kramer, $p<0.05$). F2.0 also showed throughout higher de-bond stress values than Calibra but the differences were not statistically significant.

There is conflicting evidence in the literature with regard to the bond strengths between total etch adhesive systems and self-etch adhesive systems.[7-10] These results have shown that one of the self-etch adhesive systems had significantly higher push out values than the total-etch system while there was no significant difference between the other self-etch adhesive system compared with the total etch system. The manufacturer of RelyX Ultimate advocates agitating the adhesive for 20 seconds into the dentine to facilitate the penetration of the cement into the surrounding dentinal tubules. This seemed to pay off because we could see dentinal chips present on all the samples, which indicate that the resin tags penetrated the dentine sufficiently. Another noteworthy observation was the absence of air voids in all samples. This can be accredited to the unique application tips (Aplicap Elongation Tip), which allows the clinician to reach the apex of the tooth and, with a backfill technique, to gradually apply the cement from apical to coronal in a slow retraction action.

The manufacturers of Calibra (Dentsply Caulk) advocate the application of the cement into the post space with a lentulo spiral - which seems not to play a main part overall.

The manufacturers of Panavia F2.0 (Kuraray) do not have any specific recommendations for the use of their cement on fibre posts and therefore the clinical application technique for metal posts were followed.

All the cements showed a decline in the push out strengths from the coronal through the middle to the apical section. This finding is in agreement to other studies.[7-10] The reasons given vary from debri, curing light distance, apical sclerosis, humidity to density of dentinal tubules.[7-10]

CONCLUSION

Within the limitations of the present investigation, it can be concluded from this study that the resin cement, RelyX Ultimate (3M ESPE), used with self-etching Scotchbond Universal adhesive, was significantly stronger than Panavia F2.0 with self-etching ED Primer II (Kuraray) and Calibra (Dentsply) with its total-etch adhesive. RelyX Ultimate reliably can be used for post cementation in endodontically treated teeth with a double tapered post system on anterior teeth.

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