ROOT REINFORCEMENT USING CAST POST CEMENTED WITH DIFFERENT TYPES OF CEMENTS

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Abstract

The purpose of this in-vitro study is to evaluate and compare the fracture resistance of endodontically treated teeth restored using cast posts cemented with different types of cement. Thirty intact human maxillary central incisors were selected for this study. The crowns were removed and endodontic therapy were done on the roots, which were then prepared to receive cast posts, after their fabrication, the cast posts were cemented with zinc phosphate cement (group I), resin modified glass ionomer cement (group II),and resin cement (group III). The samples were subjected to compressive fracturing loads by a Zwick testing machine at a cross head speed of 5mm/min., with an angle of 45º to the long axis of the tooth. The results showed that the posts cemented with resin cement exhibited the highest mean failure load followed by posts cemented with resin modified glass ionomer cement , while posts cemented with zinc phosphate cement exhibited the lowest mean failure load.

Keywords: Casts post, Resin cement,Resin-modified glass ionomer cement.

Introduction

Contemporary endodontic therapy has allowed patients to retain severly damaged teeth. The restoration of most endodontically treated teeth involves complex and contraversial procedures. These teeth commonly have lost significant coronal dentin as a result of endodontic access or previous dental caries and restoration. There is a diversity of opinion about the need for coronoradicular stabilization and numerous post systems and techniques have been described [1].

Custom cast posts and cores have been the most accepted treatment mode for many years, then commercial prefabricated posts with plastic core materials have become a common and a popular method for post and core build up [2].

Parameter such as cementing medium, length, diameter, configuration, surface roughness and matrial used in the dowel all affect their retention and strength [3].

The bond strength of the cementing agents plays an important role in the longivity and success of the cast restoration, zinc phosphate cement, although lacks adhesion to tooth structure, it has been selected for cementation of posts for many years.However, newer materials such as adhesive resin cements have been advocated for cementation of posts because they bond dentin to metal post and thereby achieve a stronger and more retentive restoration [4].

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More recently resin modified glass ionomer cement with improved mechanical properties and chemical adhesion to tooth structure, has been used as a cementing medium [5].

Materials and Methods

Thirty intact human maxillary central incisors recently extracted due to periodontal reasons, of comparable root length and width were selected, cleaned and stored in normal saline solution at room temperature through all the time of experimentation.

The anatomic crowns of the teeth were removed at the level of cementoenamel junction perpendicular to the long axis of the tooth using diamond bur (Komet, Germany) rotating at a high speed under constant water spray coolant.

Endodontic therapy has been done for all teeth, and then post spsces preparation were done using pessoreamers from No.1 to No.6 successivly in an increasing order of width and for a length of 8 mm measured from the coronal end of the root with the aid of a rubber stopper. After that, 1mm gingival chamfer finishing line was done with a diamond chamfer bur on a sound tooth structure.

The external surfaces of the roots were carefully notched using diamond fissure bur approximately 3mm from the apex and at 0.5mm depth to provide adequate retention for the teeth in acrylic resin blocks. After that, teeth were embedded in individual blocks of self curing resin to about 2mm below their coronal ends.

Wax pattern of posts (post crowns) were made directly on the prepared teeth using type II blue inlay wax and plastic posts, and then invested with a phosphate bonded investment material and the casting procedure was performed using nickle-chromium casting alloy.

After casting, the obtained cast posts were cleaned and smoothed and were carefully fitted into their canal spaces to assure proper seating and fitness, then for each post a groove was made along the side of the post with No.1/4 round bur rotating at a high speed to provide an escape vent for cement during cementation.

For all teeth in all groups, post spaces were cleaned with 1ml of 95% ethyl alcohol to remove any residual eugenol contaminantes from the sealer [6], then rinsed with normal saline solution and dried with paper points. 37% phosphoric acid was applied to post spaces for 15 seconds then rinsed thoroughly with water for 30 seconds, dried with paper points and air blower [7].

The cast posts and their respective prepared roots were randomly divided into 3 groups of ten each:

Group I: teeth with cast posts cemented using zinc phosphate cement (Multifix, Dorident,Austria)

Group II: teeth with cast posts cemented using resin modified glass ionomer cement (GC Fuji PLUS, Japan).

Group III: teeth with cast posts cemented using resin cement (Avanto, Voco product, Germany).

To reduce variables, the cementation procedure was performed by the same investigator and at a room temperature around 25ºC, and a static load of 5 Kg was used to hold each posts in their canals for about few minutes according to the setting time of each cement.

The samples were placed in a fixture (mounting apparatus specially made for the purpose of this study), attached to a universal testing machine (Zwick testing machine). A continuously increasing compressive force was applied to the facial cusp in

the axio-occlusal line angle, 45 degrees to the long axis of the tooth at a crosshead speed of 5mm/min. until failure [8,9]. The data obtained were then statistically evaluated using one way analysis of variance (ANOVA) test and Least Significant Difference (LSD) test.

Results

Results were obtained for all thirty test specimens. The means and standard deviations of the three groups are presented in table (1).

Statistical analysis of data by using analysis of variance "ANOVA" test revealed that there is a statistically very highly significant difference ($P<0.001$) between the mean forces among the three groups, as showon in table(2).

The source of this statistically significant difference was further investigated by using Least Significant Difference (LSD) test to show where the significant difference has occurred, as shown in table (3).

The results showed that the posts cemented with resin cement (group III) exhibited the highest mean failure loads followed by posts cemented with resin modified glass ionomer cement (group II), while posts cemented with zinc phosphate cement (group I) exhibited the lowest mean failure loads.

Tableÿÿ1): Descriptive statistiÿÿÿÿf failure loads (in Kg) for the three groups.

Groups	I	II	III
Mean	94	104	135
S.D	6.38	7.32	6.83
Min.	82	94	128
Max.	101	115	147

Table (2): Analysis of variance (ANOVA) test.

Sources of Variance	Degree of Freedom	Sum of Squares	Mean Squares	F Value	Significance
Between Groups	2	9140.000	4570.000	97.311	Very Highly Significant
Within Groups	27	1268.000	46.963		
Total	29	10408.000			

Table (3): Least Significant Difference (LSD) test to compare the mean failure loads between groups.

Groups		Mean differnce	Significance
I	**II**	-10.00	H.S
I	**III**	-41.00	V.H.S
II	**III**	-31.00	V.H.S

H.S = highly significant, V.H.S = very highly significant.

Discussion

A cast post is considered the most retentive post with a high degree of biocompatibility.

The retention of cast post is further enhanced when a resin cement is used [10]. When these posts are just cemented and not bonded to dentin, they have been shown not to strengthen the root and may actually weaken it [11].

Many manufacturers today claim that their root reinforcement systems can actually strengthen the root and help prevent fracture. In this study, the effect of resin cement and resin modified glass ionomer cement was compared to determine whether bonding the post to dentin provided the root greater resistance to fracture. Zinc phosphate cement, a cement that creates no bond between the dentin in the root canal and the post was also used as it remains one of the more traditional and widely used cementing agent.

A compressive head angle of 45 degrees to the long axis of the tooth was applied to the facial cusp in the axio-occlusal line angle of the artificial crown. This angle was used to approximate the combination of forces on teeth as opposed to purely compressive or shear forces, thus simulating the angle of occlusion of the cusps of the opposing teeth [9].

Although every effort has been made to select specimens of comparable characteristics and to standardize the experimental procedure accurately, a range failure load values with each group could not be avoided. The variability of physical properties of human teeth may be a reason for such data range, dentin is a heterogenous tissue, its structure, degree of calcification, and degree of cellularity vary from one tooth to another.

Under the conditions of this study results showed that the type of cement has a significant effect in root reinforcement, posts cemented with resin cement recorded the highest mean failure loads than those cemented with either resin modified glass ionomer cement or zinc phosphate cement. This was comparable with findings of Mendoza et al. [12] which could be attributed to the fact that resin cement has desirable physical properties, its compressive and tensile strengths exceeded that of resin modified glass ionomer cement and zinc phosphate cement with an ability to adhere to tooth structure via dentin bonding agents which are responsible for the penetration of resin tags inside the dentinal tubules and demineralized intertubular dentin with the formation of resin reinforced hybrid dentin layer, resulting in a micromechanical bond between the adhesive cement and dentin, and also resin cement has the ability to adhere to post metal surface, such features can afford the root canal system additional resistance to fracture.

Also the results of this study showed that posts cemented with resin modified glass ionomer cement recorded higher mean failure loads than posts cemented with zinc phosphate cement. A possible explanation is that the values of tensile strength of resin modified glass ionomer cement (13-24) Mpa exceed that of zinc phosphate cement (3.1-4.5) Mpa [13], and also the adhesive nature of resin modified glass ionomer cement (chemical chelating) can afford root canal system significant additional resistance to fracture.

Conclusions

1- Cast posts cemented using resin cement showed significantly greater resistance to root fracture

than those cemented with either resin modified glass ionomer cement or zinc phosphate cement.

2- Cast posts cemented using resin modified glass ionomer cement showed significantly greater resistance to root fracture than those cemented with zinc phosphate cement.

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