

Clinical Evaluation of Cement Thickness Around Pre-Fabricated vs. Costume-Fabricated Posts

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Abstract

Objectives: The purpose of this study was to evaluate the variation of cement thickness in different regions of the root in case of prefabricated and custom-fabricated posts.

Material and methods: Totally twelve extracted human incisors and premolars with single tooth canals were distributed among 3 experimental groups of 4 specimens each.

They were treated endodontically and restored with prefabricated fibre posts or custom-fabricated metallic posts, cemented with different adhesive cements. Each sample was immersed in 1% methylene blue solution and after 10 days the teeth were sectioned into horizontal slices, resulting in three slices for each specimen. The distances between the canal wall and the post perimeter were measured on images of each slice with digital caliper.

Results: The costume-fabricated post groups (group 2,3) obtained statistically significant lower cement thicknesses, in particular in the apical third. The prefabricated post group (group 1) showed the highest cement thickness. Cement thickness was less for the specimens prepared using direct impression technique.

Keywords: Fiber post, metallic post, prefabricated, costume-fabricated, endodontically treated teeth

Introduction

Post and cores are frequently used in endodontically treated teeth that suffered an excessive loss of hard tissue of coronal structure. The material from which the post is constructed plays a crucial role in the biomechanical performance of root canal treated teeth because they need to retain a core for the definitive restoration. Several post core systems have been described in the literature.

Cast and prefabricated metal post and core have been used a long time by clinicians. These posts were cast in a precious alloy or made of stainless steel. The construction of post-core castings is relatively more time consuming and demands extra clinic and laboratory time. Prefabricated posts allow fast, cheap, and easy techniques, but they do not take into account the individual shape of the root canal and their adaptation is not always ideal.

The thickness of the cement may represent a critical factor in the clinical performance of the posts. An excessively thick layer of resin cement around a post has been reported to be an unfavorable factor for the long-term success of post-retained restorations in vivo, as it might be correlated to higher frequencies of post debonding.

Many in vitro studies investigated the influence of different cement thicknesses on the bond strength of posts but, to date, there is no consensus in the literature on the ideal thickness of resin cement to improve the post retention strength. The cement thickness is correlated to the post fitting into post space: the more the post is adapted to the canal walls, the less is the cement thickness.

I.

Materials and methods

Twelve intact, caries free extracted human incisors and premolars with single tooth canals were randomly assigned to three experimental groups with four teeth each.

The endodontic preparation consisted in pulp removal and a mechanical preparation with Kerr files and Haestrom instruments with intermittent 5% NaOCl rinsing. The canal was then obturated with Endomethasone sealer and vertically condensed gutta-percha. Thereafter, the entire clinical crown was removed up to the dentin-enamel junction and the root canals were prepared to a standardized depth for post reception. Gutta-percha was removed with bur No.2 (Gates-Glidden burs) leaving at least 4 mm of the root filling in the apical portion.

The restorations we used in group 1 was prefabricated glass fiber posts and for group 2,3 costume-fabricated posts.

Group 1

35% phosphoric acid gel (Etching Gel, Kerr) was applied for 15 s into the canal and to the occlusal surface and subsequently rinsed for 30 s.

Thereafter Optibond Solo Plus (Kerr) was applied into the canal and onto the preparation, the excess material was blown out with compressed air and light cured for 20 s.

The surface of the glass fiber post was cleaned with alcohol, dried and coated with the respective adhesive.

The dual-cured composite cement was mixed for 15 s and applied into the canal, followed by immediate post insertion and light curing for 40 s after excess removal. The core build-up was made with the composite resin material.

Group 2(Direct Technique)

To obtain an impression of the root canal we used a chemically activated acrylic resin (Duracryl Plus, Spofadental) directly to the unobstructed canal. To prevent bonding between the acrylic resin and the dentin, a layer of petroleum jelly was applied in the root canal. The obtained acrylic structure was then submitted to the laboratory to be manufactured the metal post.

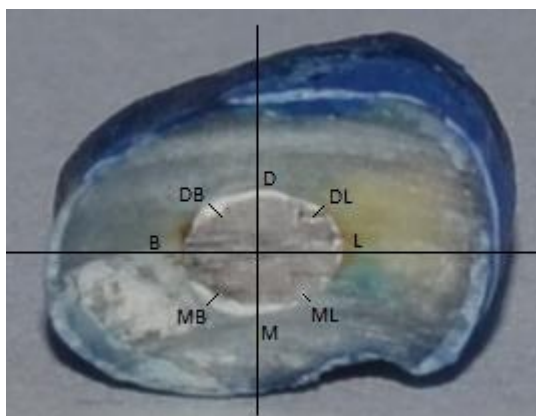
Group 3(Indirect Technique)

For the dental impression, we used the 2-step technique, a very high-viscosity material for the preliminary impression (Zetaplus, Zhermack), while the final impression was performed with a lower-viscosity C silicone (Oranwash L, Zhermack).

The procedure for cementation of the posts was identical in the group 2,3. For half of the post cementation, we used a radiopaque classical strontium glass cement (Glass Cem, Schulzer) and for the other half a zinc-phosphate cement (Adhensor, SpofaDental).

The obtained 12 teeth were stored in 1% methylene blue solution for 10 days.

All teeth were prepared by the same operator. To evaluate the cement thickness, the teeth were sectioned into 3 slices, using a low-speed diamond saw under water-cooling and each specimen thickness was measured with a digital caliper.



Results

Table 1 summarizes all cement thickness measurements.

		Average	L	ML	M	MB	B	DB	D	DL
Group 1	Coronal	0,922	1,246	0,611	0,689	1,015	1,354	0,851	0,832	0,836
	Midle	0,346	0,557	0,185	0,197	0,541	0,612	0,242	0,211	0,221
	Apical	0,640	1,563	0,234	0,254	0,523	1,486	0,395	0,276	0,387
Group 2	Coronal	0,573	0,957	0,483	0,493	0,491	0,684	0,497	0,503	0,475
	Midle	0,212	0,641	0,142	0,147	0,151	0,173	0,148	0,150	0,142
	Apical	0,171	0,384	0,138	0,149	0,128	0,137	0,142	0,147	0,139
Group 3	Coronal	0,612	0,205	0,153	0,988	0,873	1,007	0,735	0,824	0,112
	Midle	0,208	0,164	0,149	0,306	0,225	0,321	0,178	0,204	0,115
	Apical	0,164	0,184	0,138	0,205	0,128	0,214	0,142	0,158	0,139

Table 1. Means of the cement thickness measured in each measurement point of each canal third in each experimental group. The values are given in mm
(L= lingual; ML- Mesio-lingual; M= Mesial; MB= Mesio-buccal; B= Buccal; DB= Disto-buccal; D= Distal; DL= Disto-lingual)

The statistical analyzes detected significant differences between pre and custom- fabricated posts. Analyzing the cement thickness means along the entire post space length, the costume-fabricated post groups obtained statistically significant lower values than the other group.

Comparing the results of costume-fabricated posts, group 3 (indirect impression technique) showed highest cement thickness values than group 2 (direct impression technique).

Our expectation was that the cement thickness would be increased nearer the apex because of the accessibility, was completely supported by our results in case of prefabricated posts.

Discussion

Today, the clinician can choose from a variety of post-and-core systems for different endodontic and restorative requirements. However, no single system provides the perfect restorative solution for every clinical circumstance, and each situation requires an individual evaluation. The restoration of an endodontically treated teeth to achieve optimum strength, esthetics and function still remain a challenge.

The higher values as results for the pre-fabricated posts group are indicative of the highly unpredictable effect of dentin bonding and the increased chance of dislocation of the bonded posts. In contrast, the costume-fabricated posts seem to give more predictable results. Although, it must be remarked that this study did not investigate the fracture resistance of the restored tooth and didn't examine important factors of post retention, like the

interaction of the variables cementation material and the bonding of root dentin.

Placing a post into an oval-shaped canal presents some problems related to the particular canal configuration. The oval shape does not permit complete instrumentation and cleanliness of the canal wall during the endodontic treatment, this could be the explanation of the higher values in the case of prefabricated posts. Moreover, the placement of a prefabricated post implies the sacrifice of more dental tissue in order to adapt the canal shape for achieving a good post fitting.

The custom-fabricated posts, made with different impression techniques were effective in improving post fitting, respecting the canal's anatomy and not increasing the resin cement, but require clinical ability and are more time-consuming, factors that could represent disadvantages during clinical procedures.

Ferrari et al. compared carbon fiber post with cast post-and-core and observed clinical success rates of 95% and 84%, respectively. The most important failure found in case of fiber posts was periapical lesions (2%) and root fractures to cast posts (9%).

In the same way, Glazer et al. showed 7.7% of failures with periapical lesions occurring in about 50% of carbon fiber posts.

Regarding the comparison between fiber and metallic posts, Schmitter et al. found that the survival rate of the metallic post was significantly lower than that of glass fiber posts, correlating tooth extractions with unrestorable root fractures, resulting in 63.63% of all failures. However, Hatzikyriakos et al. observed no significant difference among metallic posts after three years.

In the literature, many studies report that the metal posts were associated with more unfavorable complications, namely root fractures. The metal modulus of elasticity is about 10 times greater than natural dentin, and this can create stress concentrations in the less rigid root, resulting in post separation and failure. The transmission of occlusal forces through the metal core can focus stresses at specific regions of the root, causing the root fracture. So long as the resin post has almost the same modulus like dentin and has more uniform distribution of stress along the post length.

Mechanical failure of restored teeth with fiber reinforced post can be related to the amount of the residual coronal structure. A prospective clinical study showed that type of posts was not relevant with respect to survival, but the amount of remaining dentin after preparation influenced significantly the longevity of the restoration. A preparation design that involves the cervical portion of the tooth may resist lateral forces better than a shoulder preparation. The ferrule adds some retention, but primarily provides a resistance from and enhances longevity to the endodontically treated teeth

restored with the post. A minimum of 1,5-2 mm ferrule of dentin has been consistently described as an essential factor for the success of fiber post systems. In the absence of coronal ferrule, Fokkinga et al. suggested using cast post and cores.

For fiber post, the failures observed are periapical failures. On the other hand, studies showed that the presence of the post may not necessarily be the factor that generates endodontic faults, but the periapical conditions and the quality of filling could be considered the main factors influencing the success of the treatment. Besides that high- quality root canal treatment and the appropriate restorative protocol to each specific clinical situation are important for high survival and low complication rates of root-filled teeth.

Some studies, however point out that post does not strengthen teeth, but instead that the preparation of a post space and the placement of a post can weaken the root. These studies further suggest that a post should be used only when there is insufficient tooth substance remaining to support the final restoration. In other words, the main function of a post is the retention of a core to support the coronal restoration. Perhaps using new adhesive materials and technology, with all components having similar physical properties successfully bonded together clinicians may be able to claim that a post can strengthen and reinforce the root.

The most important factors are to make an appropriate selection of the post system, use the cementation material accurately, and properly evaluate the remaining root filling. In addition, it is important to assess the presence or absence of ferrule and determine which type of final restoration will be necessary to increase the longevity and prevent later failures.

Conclusion

Within the limitations of this in vitro study, it may be concluded that a better post fitting can be obtained using direct impression technique and custom-fabricated posts.

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