

Influence of the type of endodontic sealer on glass fiber post adhesion: literature review

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ABSTRACT

Introduction: Glass fiber posts are widely used when endodontically treated teeth present great structural loss and require support for coronal reconstruction. Complete adhesion of the post to the root canal wall is fundamental for the success of this restoration. Endodontic sealer residues that remain on the dentin walls, even after preparation for cementation, may negatively interfere with the adhesion and contribute for post displacement. This literature review evaluated the effect of different endodontic sealers and the time between obturation and post cementation on the bond strength. **Methods:** This literature review included 21 studies that analyzed the influence of

endodontic sealers on the adhesion of glass fiber posts, among which 9 added the variable time in their analysis.

Results: Teeth filled with resin-based sealers showed higher post push-out bond strength during testing. There seems to be predominance of lower adhesion values when the posts are cemented immediately after filling with eugenol-containing sealers. **Conclusions:** The type of endodontic sealer and period between obturation and post cementation can affect the bond strength between root canal wall and the glass fiber post.

Keywords: Dental cements. Post and core technique. Root canal obturation.

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Introduction

Restoring the function of an endodontically treated tooth may be challenging when it presents great loss of coronal structure, with difficult retention of restorative material. In this case, the use of intraradicular posts is a viable option to allow coronal reconstruction.^{1,2}

Glass fiber posts have been widely used in such cases, due to their physical properties similar to dentin and easy preparation.^{3,4} Failure of this restoration may occur if intraradicular fixation of the post is not complete, thus leading to rebonding from the root canal. Several factors may contribute to this failure, such as adhesive interaction between sealer and root canal wall, adhesion between post and sealer, type of sealer, tooth preparation for post cementation and composition of endodontic sealer used for root canal obturation.^{2,5}

The endodontic sealers aim to assure adhesion of gutta-percha points to the root canal wall, thus reducing the interface between gutta-percha and root canal wall, providing a more homogeneous obturation⁶. Several endodontic sealers are commercially available, including sealers containing zinc oxide-eugenol (e.g. Grossman, Endofill, Fill canal, Rickert, Endomethasone, Tubli-seal), containing calcium hydroxide (e.g. Sealapex, Sealer 26, Apexit), resin sealers (e.g. AH 26, AH Plus, Real-Seal, EndoRez), glass ionomer sealers (e.g. Ketac-Endo), silicone sealers (e.g. RoekoSeal) and, more recently, calcium silicate sealers. Post cementation occurs after root canal obturation, thus the composition of endodontic sealer and time elapsed between completion of obturation until glass fiber post cementation may negatively influence its adhesion.^{7,4}

Considering the clinical relevance to avoid displacement of the intraradicular glass fiber post due to the reduced bonding force to dentin⁵ and thus achieve greater longevity of the coronal restoration, this literature review evaluated the effect of different endodontic sealers and the time elapsed between obturation and post cementation on the bond strength between post and root canal wall.

Material and Method

The literature review included full papers published in electronic databases PubMed, Scielo, Scopus and Web of Science. The papers selected for the review did not have

date limit and were initially selected by reading the titles and abstracts. After this initial screening, the studies considered relevant were read in full text.

Results

This literature review included 21 studies that analyzed the influence of endodontic sealers on the bond strength of glass fiber posts. Additionally, in 9 studies, the variable time was also analyzed for posts cemented soon after root canal obturation and after some days. In these cases, the authors aimed to analyze if the interference from the sealer was relative, depending on the moment of post cementation. Even though the studies included a wide variety of commercial brands, they usually compared resin sealers with zinc oxide-eugenol (ZOE) sealers; some studies also included resin sealers. Among studies comparing resin and ZOE sealers, 3 did not reveal significant differences, while 8 reported that ZOE sealers negatively interfered with the adhesion. Concerning the moment of cementation, most studies evidenced worse adhesion when ZOE sealers were used for immediate post cementation. Only one study reported better adhesion after 24 hours and compared to two weeks.²⁰ Tables 1 and 2 summarize the results found.

Discussion

The studies included in the present review investigated a wide variety of endodontic sealers, among which the most common were zinc oxide-eugenol sealers and epoxy resin sealers AH Plus.

The inclusion of AH Plus in most studies is justifiable, because it is considered the gold standard in Endodontics and is widely used in comparison with other sealers³. This is due to the excellent physicochemical properties of this obturator material.³ Eugenol-containing sealers are widely used across the world by endodontists because of their long history of clinical success², justifying the wide utilization of this sealer in endodontic studies. Additionally, due to the eugenol release, zinc oxide-eugenol sealers could interfere with the polymerization reaction and consequently the adhesion of posts.²³

Even though the results are controversial, teeth obturated with resin-based sealers usually demonstrated greater post push-out bond strength during testing. In contrast, groups using zinc oxide-eugenol sealers had the lowest strength. Altmann et al²³ conducted

Table 1. Push-out bond strength, according to the results included.

Authors	Sample	Sealers	Results
Boone et al. (2001) ⁸	64 teeth	Control group only with gutta-percha, Kerr Pulp canal Sealer, Sealapex, AH 26	The control group exhibited greater strength. Among the sealers, Sealapex presented the highest strength and Pulp Canal Sealer the lowest
Hagge et al. (2002) ⁹	64 teeth	Kerr Pulp Canal Sealer, AH 26, Sealapex and control group (only gutta-percha).	No difference found.
Davis et al. (2007) ¹⁰	72 teeth	Sealapex and Tubli-Seal	No significant difference between them.
Demiryurek et al. (2010) ¹¹	48 teeth	AH plus, Endofill, Sealapex and control group (only gutta-percha).	The control exhibited higher strength. Among the sealers, Endofill had the lowest strength and Sealapex the highest.
Cecchin et al. (2011) ¹²	50 teeth	Ah Plus, Epiphany, Sealer 26, Endomethasone and control group (only gutta-percha)	No difference was found between control group, AH Plus, Epiphany and Sealer 26. Endomethasone negatively interfered with the adhesion.
Aggarwal et al. (2012) ¹³	50 teeth	Zinc oxide-eugenol, AH Plus, Gutta-Flow and Epiphany	No difference was found.
Aleisa et al. (2012) ¹⁴	135 teeth	Endofill, Tubli-Seal and AH26.	AH26 had highest strength. No significant difference was found between Endofill and Tubli-Seal.
Özcan et al. (2012) ¹⁵	48 teeth	Ah Plus, iRoot, Endofill and control group (only gutta-percha).	No difference was found between control group, AH Plus and iRoot. Endofill negatively interfered with the adhesion.
Aleisa et al. (2013) ⁵	54 teeth	Endofill, Tubli-Seal and AH26.	AH26 had higher strength than Endofill and Tubli-Seal.
Mosharraf et al. (2014) ¹⁶	20 teeth	AH 26 and Endofill.	AH 26 had higher strength.
Forough Reyhani et al. (2016) ³	72 teeth	AH Plus, Dorifill, MTA Fillapex and control group (only gutta-percha).	Dorifill had lower strength. There was no significant difference between MTA Fillapex and AH Plus.
Dibaji et al. (2017) ¹	56 teeth	AH-Plus, Dorifill and BC Sealer and control group (only gutta-percha)	AH Plus had higher strength than BC Sealer.

a systematic literature review and meta-analysis and concluded that zinc oxide-eugenol sealers lead to reduced adhesion of glass fiber posts.

It should be mentioned that each study presented a peculiar methodology for comparison of sealers, and some studies were conducted on human teeth^{1-3,5,8-17,20-22} while others employed bovine teeth.^{4,7,18,19} Other variable between studies is the type of tooth employed: the studies were conducted on incisors,^{3,11,15} canines^{2,8,12,21} and premolars,^{1,5,10,16,20,22} and some studies did not report such information.^{9,13,14,17} Finally, there was no standardization of bond strength tests employed, as well as in the presentation of results, being that some studies reported results in tension (MPa)^{1,3,4,7,11-13,15-19,21,22} and others in force (N).^{2,5,8-10,14,20}

The lack of a standardized methodology between studies unfortunately precludes the direct comparison of results between them. The values found in each study for each endodontic sealer should only be compared with values of other sealers in the same study. This is evident, e.g. in the variation between results obtained with the AH-Plus sealer, which in the same study¹ presented a mean strength of 6.98 MPa with standard deviation of 3.14 in the coronal region and 3.22 MPa with standard deviation of 1.59 in the apical region. The same sealer exhibited a mean strength of 2.08 Mpa³ and 13.3 Mpa¹⁹ in different studies. Conversely, the search and inclusion only of studies with similar methodology would limit this review to a very small number of papers.

Table 2. Push-out bond strength, according the time elapsed between obturation and post cementation in the included studies.

Authors	Sample	Sealers	Time	Results
Vano et al. (2006) ¹⁷	60 teeth	Pulp Canal Sealer and control group (without obturation).	Immediate, 24h and 7 days after obturation	Immediate cementation provided the lowest bond strength values. There was no difference between 24 h and 7 days.
Menezes et al (2008) ¹⁸	60 teeth	Only gutta-percha, Sealer 26, Endofill	Immediate or 7 days after obturation	Sealer 26 did not influence, regardless of the time; Endofill had higher strength for the immediate cementation.
Dias et al. (2009) ²	60 teeth	Endofill	Immediate, 72 h and 4 months after obturation	There was no statistically significant difference.
Mesquita et al (2013) ⁴	40 teeth	Calcium hydroxide sealer	Immediate or 7 days after obturation	Higher bond strength was observed when the posts were cemented after 7 days.
Rosa et al (2013) ⁷	60 teeth	AH Plus, Endofill, and MTA Fillapex	Immediate or 15 days after obturation	Endofill and MTA presented similar bond strength to each other and lower than AH Plus at the immediate period. The highest strength was achieved after 15 days for AH Plus, and the lowest for Endofill after 15 days.
Santana et al (2014) ¹⁹	80 teeth	Sealapex, Sealer 26, AH Plus	Immediate or 2 months after obturation	Both in immediate cementation and after 2 months, the AH Plus had the highest strength and Sealapex the lowest.
Aleisa et al. (2016) ²⁰	72 teeth	Endofill	24h and 2 weeks after obturation	Greater post retention was achieved when cementation was performed after 24 h compared to 2 weeks.
Ruiz et al (2018) ²¹	56 teeth	Endofill and Sealer 26	7 days or 6 months after obturation	The bond strength values were not affected by the type of sealer, yet they were higher six months after obturation.
Vilas-Boas et al (2018) ²²	84 teeth	Endofill, BC Sealer, and AH Plus	Immediate or 7 days after obturation	AH Plus had the highest values, regardless of the moment of cementation. BC Sealer had the lowest strength after 7 days; Endofill had the lowest strength in immediate cementation.

More recent studies included sealers recently introduced in the market and considered bioactive, such as MTA Fillapex and BC Sealer. Dibaji et al¹ evaluated the effect of three different endodontic sealers on the push-out bond strength of glass fiber post to the root dentin, and their null hypothesis was that the type of endodontic sealer used for root canal obturation would have no effect on the bond strength of the glass fiber posts cemented with resin sealer. The results showed that the adhesion of BC sealer and Dorifill was significantly lower compared to the control groups, which did not use endodontic sealer with gutta-percha for root canal obturation, and the AH Plus group. This result highlights the findings of Forough Reyhani et al³ and Demiryurek et al,¹¹ who also presented the highest bond strength values in the control group that used gutta-percha obturation without endodontic sealer. According to Forough Reyhani et al,³ the explanation for this finding is that,

in the group without endodontic sealer, there is greater penetration of the sealer used for post cementation, since the dentinal tubules are free of cement. For Dibaji et al,¹ the retention of glass fiber posts is provided by the contact between root dentin and the sealer used for post cementation; thus, the success of a glass fiber post depends on the correct bond between them. These authors aimed to check if the endodontic sealer could negatively interfere with this bond. Their results showed that, in the cervical third, specimens containing Dorifill and BC Sealer presented lower post push-out bond strength compared to specimens of the cervical third containing AH Plus; in the middle and apical third, there was no significant difference between the strength of the three sealers. The lower strength of Dorifill and BC Sealer in the cervical third compared to AH Plus shows that the type of sealer may interfere with the post fixation. Dibaji et al¹ believe that the lack of significant dif-

ference between results found in the middle and apical thirds between the three sealers can be explained by the divergent characteristics between these thirds, with wider dentinal tubules in the coronal third, thus with greater concentration of endodontic sealer in this region.

Several strategies have been suggested to improve the bond strength of glass fiber posts in teeth filled with zinc oxide-eugenol sealers. Ruiz et al²¹ consider this stage of root canal cleaning and preparation so significant that they believe these are more important factors than the choice of endodontic sealer. Aleisa et al¹⁴ suggested the use of phosphoric acid or alcohol for cleaning, while Rosa et al⁷ believe that the use of a 2.0-mm diameter bur prior to post cementation may remove the cement residues remaining in the canal. It should be mentioned that Vilas-Boas et al²² advised that, if obturation was made with eugenol cement, the post cementation should not be performed with a resin sealer.

The higher strength observed for AH Plus (epoxy resin sealer) can be justified by its resin composition, since post cementation was conducted with resin sealer. Thus, even if AH Plus remained on the dentin wall, its components would not negatively interfere with the polymerization of the post luting agent, since there is affinity between their components. Additionally, Vilas-Boas et al²² believe that AH Plus may form a chemical bond with dentin collagen fibers and provide an ideal environment for post cementation with resin sealer.

Concerning the results observed for specimens containing BC Sealer, the authors believe that the difficulty to remove this sealer from the canal walls is sufficient to justify the low bond strength of these specimens; they also mention that the lack of studies related to this sealer impairs the comparison with the results achieved.^{1,22}

Vilas-Boas et al²² conducted push-out bond strength tests of posts cemented with resin sealer in

root canals obturated with BC Sealer, Endofill and AH Plus, and found the same results reported by Dibaji et al,¹ in which specimens containing cement eugenol (Endofill) and BC Sealer showed lower bond strength than AH Plus. The study of Vilas-Boas et al²² was different due to inclusion of the variable time, since the authors aimed to evaluate if there was difference in the post push-out bond strength when cementation occurred immediately or 7 days after root canal obturation. The authors observed that, regardless of when post cementation was performed, specimens sealed with BC Sealer and Endofill presented lower push-out bond strength compared to AH Plus and to the control group without endodontic sealer.

According to the authors, this result indicates that the most relevant factor for the variable bond strength is the type of endodontic sealer, rather than the variable time; thus, they indicate the use of AH Plus whenever the post is cemented with resin sealer. Forough Reyhani et al³ highlighted this and indicated the utilization of zinc phosphate sealer instead of the resin sealer, as also suggested by Alfredo et al.,²⁴ who observed better results in specimens containing eugenol endodontic sealer and zinc phosphate for post cementation.

Some studies evaluated if the time of post cementation after obturation might interfere with their bonding. The results are controversial; however, there seems to be a predominance of lower bond strength values when the posts are cemented immediately after obturation with eugenol sealers.

Conclusion

Based on the present literature review, it was concluded that the type of sealer used for root canal obturation and the period between obturation and post cementation may affect the bond strength between the root canal wall and the glass fiber post.

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