

Microleakage of Postendodontic Systems

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Summary

The aim of this paper is to emphasize the importance of following the proper rules for performing a procedure, such as making a postendodontic post and core system. A postendodontic system should provide retention and resistance of the restoration, resistance of the remaining tooth structure and good sealing of the root canal. Microleakage can occur in the root canal filling as well as in the post and core system. After preparation of the intraradicular post space remains apical root canal filling which is 3-5 mm in length, and is a questionable barrier to prevent microorganisms and their toxins from penetrating into the periradicular tissue. Therefore, one should use the proper techniques in aseptic conditions during post and core treatments.

Key words: *postendodontic systems, post and core systems, microleakage.*

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Introduction

Proper endodontic treatment with exact trodimensional obturation of the root canal is the prerequisite for restoration of crownless teeth and teeth with minimal coronal tooth structure. However, the coronal seal achieved by the restoration is considered as important for the ultimate success of endodontic treatment (1-5).

A large number of intracanal posts made of different materials are available on the market along with materials for popular individual cast cores. A number of studies have been performed on retention and resistance quality of different postendodontic systems, as well as postendodontic obturation quality of the root canal (1, 7-10).

It is very important to estimate the condition of the tooth structure after the endodontic therapy and to choose the right type of intracanal post and material for postendodontic build up. The adhesion achieved between the used materials, as well as between the material and hard dental tissue will provide good future prognosis of a postendodontic system (11, 12).

Microleakage of the root canal filling

The purpose of a root canal obturation is to avoid penetration of microorganisms and their toxins from the oral cavity through the root canal into the peri-

radicular tissue at both the coronal and apical ends. Apical obturation prevents infection by anachoresis and penetration of microorganisms which survived in the endodontic space even after instrumentation and disinfection (13).

Endodontically treated teeth have to be restored as soon as possible because sealed root canals can be recontaminated under several circumstances (14):

- If placement of the permanent restoration is delayed.
- If the seal of temporary filling material has broken.
- If filling material and/or tooth structures have fractured or been lost.

Torabinejad (14) found *in vitro* penetration of *Staphylococcus epidermidis* and *Proteus vulgaris* through entire root canals in 50% of samples after 19 and 42 days respectively. Miletić (15) proved bacterial and fungal penetration through root canals obturated with AH 26 and AH PLUS root canal sealers.

In root canal treatment, root canal sealers serve to fill voids and minor discrepancies of fit between the gutapercha filling and the root canal wall. Leakage along a root canal filling may be expected to occur (16):

- Between the sealer and dentine.
- Between the sealer and gutapercha.
- Through the sealer itself.

Microleakage of post and cor systems

Restoration of the endodontically treated tooth with minimal coronal tooth structure is generally accomplished by using some type of post and core buildup with or without a full crown (6). Accomplishing a post and core postendodontic system is an attempt to make a unite system from several different materials (tooth structure, post material, core buildup material and luting cement) which has to be a perfectly sealed unit and resistant to cyclic chewing forces (17, 18).

In teeth restored with post and core systems leakage may be expected to occur at connections of different materials (Figure 1):

- Between the luting cement and dentine-1
- Between the luting cement and post-2
- Between the core buildup and post-3
- Between the core buildup and remaining coronal tooth structure-4.

Clinically, failure occurs over a period of time after the repeated application of masticatory loads. Each individual load is less than that required to cause the restoration to fail with a single application. With repeated applications, however, this smaller load may eventually cause failure of the restoration (6).

This type of repeated force application is called load fatigue (6).

A preliminary failure mode that occurs during fatigue testing has been described by Fan et al. (19) and Libman and Nicholls (20). They defined preliminary failure as the "formation of a crack in the luting cement caused by cyclic loading". The occurrence of preliminary failure is clinically undetectable, yet it allows leakage between the restoration and tooth that may extend down the prepared post space (6).

Recent studies (6, 21, 22) reported microleakage of endodontically treated teeth, restored with different posts and different luting cements.

Fogel (21) reported measuring by fluid filtration technique and showed that steel-vented Para-Posts cemented with zinc phosphate cement, polycarboxylate cement and composite resin were not capable of consistently achieving a fluid - tight seal.

If the seal provided by the cemented post is disrupted, the remaining apical root canal filling 3-5 mm in length (Figure 2, 3) is a questionable barrier to prevent toxins and microorganisms penetrating into the periapical tissues. In a short filling the voids may be more easily connected with one another than in a long filling and can permit leakage over the full length. It is known that bacteria in the canal regrow and may take only a few days for bacteria to pass the apical 3 to 5 mm of root canal filling (17).

Factors affecting the luting process and good sealing properties of the post and core system

Cementation of the post into the canal is critical, because the process should achieve a seal along

the canal wall and is central to post retention. Good sealing ability of the post system should prevent microleakage through a short canal filling that remains in the apical portion of the root canal after preparing the intracanal space for intraradicular retention of the post.

One should keep in mind several factors that could affect the quality of the luting process and good sealing properties of the post and core system:

- Intraradicular preparation for the post immediately after root canal obturation before completely setting of the sealer; during mechanical preparation of the post space it is possible for the root filling to become twisted or vibrate in such a way as to break the apical seal (23).
- Removal of the smear layer from the canal walls in order to apply glass ionomer cements (16, 21, 24) and adhesive resin cements (25).
- Choosing the type of the post and luting material (22)
- Incomplete removal of the sealer or temporary restorative material from the post space (Figure 4 ab) can interfere with adhesion of the luting cement (21).
- Luting method (26): placing the luting agent on the post and/or placing the luting agent in the canal with a lentulospiral, a paper point or an endodontic explorer; or placing the luting agent only on the post, which is recommended by the manufacturer of Panavia Ex cement (18) and may result in incomplete distribution of the cement in the root canal wall.

- Poor manipulation technique with the material.
- Incompatibility of resin cements with eugenol-containing canal sealers; eugenol has been shown to inhibit the polymerization of resins (27). Tjan and Nemetz (28) compared noncontaminated post spaces to post spaces contaminated with eugenol liquid. They reported a substantial loss of retention when eugenol was used with a resin cement. On the other hand, Schwartz et al. (29) investigated the effects of eugenol and noneugenol sealer cements on retention of the post cemented with zinc phosphate cement or resin cement. The type of sealer used had no effect on post retention with either cement.
- Clinical condition (contamination of the post space with saliva)
- Location in the dental arch (30, 31) (the maxillary anterior region is considered to be a high risk area for failure, which may partly be due to the result of unfavorable directional loading during function).

Conclusion

All steps of endodontic as well as postendodontic treatment are of great importance in the establishment of good sealing properties of post and core systems. Therefore, dentists should be advised to use aseptic techniques and perform the proper technique in order to achieve good sealing postendodontic systems.