Testing a novel endodontic sealer

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The aim of endodontic treatment is to eliminate microorganisms and their byproducts from the root canal system, together with avoiding re-contamination. The outcome of endodontic treatment is strictly linked to several steps: root canal debridement, disinfection protocols, hermetic obturation of the canal space.

Root canal obturation in a 3-dimensional space with a stable, nontoxic material and the creation of a tight seal is fundamental for the success of the treatment, since the root filling seals the communications between the periodontium and the endodontium and, along with shaping and disinfection, allows a further bacteriological defense.

Sealers should be used to fill the morphologic root canal system irregularities, to avoid gap formation between the dentinal walls and core materials; moreover, sealers should facilitate the placement of the filling core with a lubricant action, facilitate the placement of the filling materials; moreover, sealers should be used to fill the dentinal tubules and sealability has been used widely in medical applications, with antibacterial properties and favorable characteristics in terms of biocompatibility. Unlike resin-based sealers, which are subject to shrinkage, setting reaction of ZOE-based sealers is a chelation reaction occurring between eugenol and the zinc ion of the zinc oxide; this reaction might also occur with the zinc oxide phase of gutta-percha along with the calcium ions of dentin. This might explain the decreased setting shrinkage associated with the ZOE-based sealers.

Michaud et al. have shown that volumetric expansion of gutta-percha (almost 135.97%) occurred in contact with eugenol during a 30-day period, and a pilot study done earlier showed a remarkable increase in the gutta-percha dimensions when placed in eugenol that continued even after 4.5 years.

Theoretically, sealer penetration into dentinal tubules could improve sealing of a root filling by increasing the surface contact area between the root filling materials and dentinal walls. Furthermore, retention of root filling material might be improved by mechanical locking. However, contrary to common belief, a positive correlation between sealer penetration into dentinal tubules and sealability has never been established.

Penetration refers to the amount of sealer entering the dentinal tubules and adaptation qualitatively describes the way in which the sealer conforms to the dentine wall. Penetration and adaptation depend on many factors, including the patency and density of the dentinal tubules.

A study by Russell et al. investigated the penetration and adaptation of common types of root canal sealers (AH Plus, Kerr Pulp Canal Sealer, MTA Fillapex and EndoREZ) in cross-sections of tooth roots exhibiting the butterfly effect and to determine if this differs between coronal and middle root sections. Penetration and adaptation quality varied between obturation material groups but this did not reach significance, reporting AH Plus as the most performing material between the tested cements and Pulp Canal Sealer and EndoREZ as the least performing. The superior adaptation and penetration of a sealer may be attributed to its paradoxical behaviour inside root canals; this has been described as a decrease in viscosity and an increase in flow parallel to an increase in shear rate during filling procedures.

When using gutta-percha with sealer as core material for filling the canal space, the amount of sealer should be kept at the lowest, whereas the amount of gutta-percha placed into the canal must be maximized.

To reach the ideal consistency of the sealer, it is important to calibrate the powder/liquid or paste/paste ratio of the mixed cement, because even small alterations to this ratio may cause a change in thickness and flow of the material, affecting its penetration and adaptation to the dentine.

ZOE cements have some drawbacks, such as the capability to stain the tooth and to have a setting time depending on the heat/humidity of the environments.

In order to improve ZOE powder-liquid sealers, many attempts have been done, adding various substances or substituting Eugenol in the
Tea Tree Oil is the essential oil obtained from the Australian native Melaleuca alternifolia or tea tree, indigenous to northern New South Wales and southern Queensland. Tea tree oil (TTO) is a complex mixture of essential oils, comprising approximately 100 components, most of which are monoterpenes, sesquiterpenes, and their related alcohols. TTO has been shown to possess a wide spectrum of microorganisms, including anti-inflammatory activities, antimicrobial activity against a wide spectrum of microorganisms, for example Staphylococcus aureus, a range of bacteria, ceroid viruses, including herpes simplex and influenza viruses, many fungi including some azole-resistant yeasts. TTO has also demonstrated a potential biofilm inhibiting activity. In an animal study, TTO succeeded to promote healing of the extracted sockets and prevented alveolitis.

According to Siqueira, the microbial flora present in failed canals has unique characteristics, with extremely resistant bacterial strain and even yeasts, and these pathogens survive in an inhospitable environment, often resulting in biofilms. Incorporating plant extracts or purified compounds derived from plant extracts into the traditional sealer mixture can offer a more effective treatment. Research has shown that TTO is particularly effective against resistant micro-organisms. The clinical impressions while using this sealer are positive: mixing and manipulation of the cement are easy (Fig. 8) and the final product has a smooth consistency that allows an easy placement of the gutta-percha cone into the root canal. In addition, this sealer diffuses a pleasant scent during manipulation and its white colour should prevent discolouration issues.

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