Antibacterial Effect, Physical Properties and Interfacial Adaptability of New

MTA-Based Sealer

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بسم الله الرحمن الرحيم

قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ

صدق الله العظيم

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Dedication

To my beloved family for their understanding & support throughout my studies

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To complement proper cleaning and shaping of the root canal system, three-dimensional filling with a biologically inert and dimensionally stable material is a major objective of root canal treatment. To serve this aim, gutta-percha has been used in combination with various endodontic sealers to fill any voids and gaps between the core root filling material and dentin. An ideal root canal sealer should also adhere to both dentin and the core filling material. The relatively recent introduction of methacrylate-based resin endodontic sealers has been a major step towards achieving this goal.

Epoxy resin–based sealers were introduced in endodontics and current modifications of the original formula are widely used for root canal filling procedures. One of these sealers is AH Plus, which has been extensively evaluated for its physical and mechanical properties.

Calcium silicate cements, well known as MTA, are novel self-setting biomaterials for oral and endodontic surgery. The setting reaction of calcium silicate cements requires water, so that they are able to set in a wet environment through the formation of a nanoporous calcium silicate hydrate gel. Because calcium silicate cements set in the presence of moisture such as blood and other fluids, with a great clinical advantage, it appeared interesting to develop endodontic sealers based on calcium silicate hydraulic cements.

These MTA-based root canal sealers produce calcium hydroxide, which is released in solution and induces formation of hydroxyapatite structures in simulated body fluid. MTA-based endodontic sealers may also offer adhesive properties comparable to those of resin-based ones.

MTA-Fillapex is a recently introduced MTA-based sealer composed of resins (salicylate, diluting, natural), radiopaque bismuth, nano-particulated silica, MTA, and pigments. To date, only scant knowledge is available with regard to its adhesive properties.

Although the physical properties, sealing ability and biocompatibility of MTA are well documented, there have been fewer studies [1,2,3] conducted using MTA-based sealers. It is worth to study the physical properties, interfacial adaptability, and antibacterial effect of MTA-Fillapex as a root canal sealer.

1. ***Physical Properties:***

A number of tests have been developed to assess the physical and technological properties of endodontic filling materials, such tests serve a number of purposes. They ensure that the materials are presented in a consistency and workability so that they are practical to use in a clinical situation, they provide a physical characterization of the material when mixed and set, and they may in some instances be helpful in anticipating how the material will perform clinically(4).

McMichen et al (5) compared the solubility, film thickness, flow, working and setting times of five root canal sealer; Roth 801, Tubliseal, AH Plus, Apexit and Endion. Ten samples of each of the five sealers were mixed according to the manufacturer's instructions and packed into copper matrices. The materials were then stored for 48 hours at 37 °C and 100% relative humidity. Solubility was measured by weight changes of standard over a three-month period; the specimens were desiccated and weighted at week intervals. Storage solutions were evaporated and the remaining residue was weighed. Results of their study showed that AH Plus was the least soluble sealer, while Apexit was the most unstable in water.

Versiani et al [6] evaluated setting time, solubility and disintegration, flow, film thickness and dimensional change following setting of Epiphany root canal sealer and compared it with AH Plus. Experiments were performed according to ANSI/ADA specification no. 57. Five samples of each material were tested for each of the properties. The solubility (AH Plus: 0.21%; Epiphany: 3.41%) and dimensional alterations following setting (AH Plus: expansion of 1.3%; Epiphany: expansion of 8.1%) were statistically different. Dimensional alteration test for both cements were greater than values considered acceptable by ANSI/ADA. Epiphany values regarding solubility were also greater than values considered acceptable by ANSI/ADA.

Islam et al [7] evaluated and compared the pH, radiopacity, setting time, solubility, dimensional change, and compressive strength of ProRoot MTA (PMTA), ProRoot MTA (tooth colored formula), white Portland cement, and ordinary Portland cement. Results showed that PMTA and Portland cement have very similar physical properties. However, the radiopacity of Portland cement is much lower than that of PMTA. Compressive strength of PMTA was greater than that of Portland cement.

Carvalho-Junior et al [8] proposed smaller dimensions for samples used in solubility and dimensional change tests of root filling materials on the basis of ANSI/ADA specification no. 57. Volume, mass, and density of the test samples were determined, and 6 different samples of smaller dimensions were proposed for each test. Endofill and AH Plus were used. For the solubility test, 2 samples were weighted, stored in distilled and deionized water for 24 hours, dried, and weighed again. Solubility was determined as percentage weight loss. For dimensional change, samples' heights were measured before and after immersion in deionized water for 30 days. Endofill presented higher solubility values than AH Plus. Endofill presented 0.56% of shrinkage and AH Plus 0.62% expansion. They concluded that smaller dimensions for test samples used in solubility and dimensional change tests are a viable alternative, decreasing the amount of filling material necessary for executing these tests.

Camilleri [9] evaluated properties of MTA as a sealer. MTA was mixed with water at powder/liquid ratios of 4 and 3.33 and an addition of 2 mL to 20 mL of water-soluble polymer. Materials were tested for flow and film thickness, and the optimal quantity of polymer required to conform to ISO 6876 Section 4.3.1, 4.3.4 (2002) was determined. The resultant MTA sealer was tested for radiopacity using methods suggested by ISO 6876 (2002) using