A Comparative Study of Cytotoxicity and Solubility of A Recently Introduced Root Canal Sealer (An In vitro study)

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(قَالُوا سُبْحَانَكَ لا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ)

(البقرة:32)

Dedication

This work is dedicated mainly to my beloved mother, soul of my father, my dear brothers, and sisters for their endless love, care and support.

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Introduction

The major goal of root canal treatment is the elimination of microorganisms from the root canal system and the prevention of subsequent reinfection. Three-dimensional sealing of the root canal is the final phase of endodontic treatment and is essential for preventing reinfection of the canal and for preserving the health of the periapical tissues thereby ensuring the success of root canal treatment.

Biological compatibility of materials used in dentistry is of special interest, because the toxic ingredients present in these materials could produce irritation or even degeneration of the surrounding tissues. As sealers not only intervene between the canal wall and gutta-percha cones but also come in direct contact with surrounding vital apical tissues for a long period, biocompatibility is thought to be an important requirement for root canal sealers.

To curtail residual microorganisms, root filling materials should ideally be bactericidal, while also being biocompatible. In addition, the root filling materials are expected to act as a physical barrier to prevent the leakage of substrate to any residual microorganisms and the ingress of additional microorganisms.

Root canal sealing generally includes the use of a semisolid material (gutta-percha) and sealing cement. The gutta-percha serves as the core filling material, whereas the root canal sealer is required to adhere to dentin and fill the discrepancies between the core-filling material and the dentinal walls.

Sealite Ultra is a recently introduced root canal sealer, formulated with a non steroidal anti-inflammatory (enoxolone) and non irritating antiseptic (diiodothymol).

As cytotoxicity and solubility are essential properties of root canal sealers, testing these two properties on a recently introduced root canal sealer (Sealite Ultra) may be beneficial.

Review of Literature

Importance and function of root canal sealers

One of the major objectives of root canal therapy is the three dimensional obturation to prevent reinfection, [(1)] by preventing periapical exudate from diffusing into the apical part of the canal, preventing re-entry and colonization of bacteria, and in turn preventing residual bacteria from reaching the periapical tissue. [(2)]

For many years the use of gutta-percha cones in conjunction with root canal sealers has been the most widely accepted technique. Sealers not only intervene between the canal wall and gutta-percha cones, but also are in direct contact with surrounding vital apical tissues. Therefore, biocompatibility is thought to be an important property for root canal sealer.[(3)]

Sealers perform several functions during the obturation of root canal system with gutta-percha. Thus, serve as a lubricant during seating of the master gutta-percha cone, act as a binding agent between the gutta-percha and the canal wall, fill the irregularities between the dentinal walls and the gutta-percha core, and fill anatomical spaces that primary filling material has failed to reach. [(4)] Root- canal sealers, although used only as adjunctive materials in the obturation of root canal systems, have been shown to influence the outcome of root canal treatment. [(5)]

Types and properties of root canal sealers

Many types and brands of sealing cements are commercially available. They can be divided into 4 main groups; zinc-oxide eugenol based cements, calcium hydroxide based, glass-ionomer and plastic resins.[6] Recently, silicone has been developed for obturation of the root canal space.

An ideal root canal sealer should adhere to dentine, seal the root canal system, must not be toxic, should be dimensionally stable, insoluble and unaffected by the presence of moisture. [7]

I- Cytotoxicity

It is widely recognized that sealers may come in direct contact with the living periapical tissues over a long periods of time and might affect the periapical tissue if extruded. In such a condition, they could cause not only degeneration of the tissue lying underneath the endodontic sealer but also interfere with healing process or may cause allergic reactions. Therefore, the biocompatibility of the sealers is of primary importance. [8]

The biocompatibility of different root canal sealers varies considerably. Most products exert some toxic effect, when they are fresh and the effect is reduced over time as the concentration of leach able components decrease. [9, 10] Root canal filling materials have been formulated in an attempt to obtain better physical and biological properties. [11]

Little information is available about the cytotoxic potency of various types of sealers during the initial period after mixing, because most experiments focus on the toxic features of the set specimens. Yet, some

sealers may be more irritating when freshly mixed in comparison to set material, whereas other endodontic materials seem to be well compatible even when tested fresh.[12]

Studies showed that treatment success is not only preparation technique- sensitive, but also depends on the selection of the proper root canal sealer.[13] However, many researches have shown that most commercially available sealers irritate the apical tissue.[14, 15]

Cytotoxicity of Zinc oxide eugenol sealers

Many studies evaluated the cytotoxicity of Zinc oxide eugenol based sealer by different methods and techniques. Endodontic materials based on zinc oxide- eugenol exhibited severe cytotoxic effects in vitro and vivo as well. In particular, those ZnOE sealers containing paraformaldehyde were highly cytotoxic. [16, 17, 18, 19.]

Gulati et al. (1991) compared the tissue- toxicity of zinc oxide eugenol and zinc oxide-glycerine sealers. An amount of each 0.1 ml of the sealer was injected into the rat subcutaneously. Five animals were killed at 1, 7 and 15 days. Area of skin and subcutaneous tissue containing implant was excised, then fixed on slide and examined microscopically. Zinc oxide-eugenol showed grade 2 inflammatory responses at day 1.After 7 days the polymorphonuclear cells increased with grade 3 response. After 15 days there was grade 4 response. Zinc oxide-glycerine showed milder response at day 1 which was grade 1. At day 7 grade 3 slightly less than zinc oxide-eugenol. At day 15 the response was half that of the other material at grade

2. The toxicity was greater for the eugenol containing sealers and increased during the periods. For the glycerine containing sealers the response was milder. [16]

Pissiotis and spangberg. (1991) evaluated the cytotoxic effect of a zinc oxide-eugenol-based paste Pulpispad in vitro after setting for 1 day and 1 week. Target cells were L929 cells, gingival, periodontal ligament and pulpal fibroblasts. The material was incubated with the cells and its toxicity was evaluated. Pulpispad was highly cytotoxic to all cell lines even after setting for 1 week. The various responses among the four cell lines indicated that diploid cell lines can under certain circumstances be less sensitive than aneuploid cell lines. [17]

Araki et al (1993) studied the cytotoxicity of two zinc oxide root canal sealers. The sealers were freshly mixed and set for 24 and 168 hrs. The sealers had identical powders, but different liquid components. One (Canals) used eugenol, while the other (Canals-N) used fatty acids. L929 cells were incubated for 4 and 24 hrs in direct contact with the materials. The toxicity was evaluated. The results showed that both sealers were cytotoxic when freshly prepared or after 24 hrs of setting. After 1 wk of setting, Canals was still toxic, while Canals-N was not significantly different from the control in the 4-hrs assay. The liquid of Canals-N was clearly less cytotoxic than liquid from Canals. [18]

Chang et al. (2007) evaluated the cytotoxicity of formaldehyde on human osteoblastic cell line U2OS in vitro. Formaldehyde demonstrated a cytotoxic effect to U2OS cells in a dose-dependent manner. Formaldehyde