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Research Article

Influence of MTAD Combined with Endosonic Irrigation on Apical Leakage of Two Obturation Materials

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ARTICLE INFO

Article history:
Received 16 March, 2018
Accepted 23 March, 2018
Published 2 April, 2018

Keywords:
Apical leakage
epiphany
GuttaFlow2
MTAD
Endosonic irrigation

ABSTRACT

Objective: The purpose of this study is to assess the influence of MTAD combined with endosonic irrigation on apical leakage associated with the Resilon/Epiphany SE and GuttaFlow2 endodontic obturation systems.

Material and Methods: Thirty single-canal extracted teeth were used for the study. The root canals were prepared by using ProTaper nickel titanium rotary files. During preparation and between each file action, 1 ml of 5% sodium hypochlorite was used as an irrigant. After completion of the instrument operations all specimens received a final flush of MTAD combined with endosonic irrigation and dried with paper points. The specimens were obturated with Resilon/Epiphany SE and GuttaFlow2. All specimens were centrifuged at 3 G for 5 minutes in 2% Rhodamine B dye solution. Dye penetration was measured from the apical to the coronal part of the root canal using a stereomicroscope with an ocular micrometer.

Results: GuttaFlow2 specimens showed less leakage than the Epiphany SE specimes. There is a significant difference in amount of leakage values between Epiphany SE and GuttaFlow2 groups ($p<0.05$).

Conclusion: GuttaFlow2 filling material had higher sealing ability than Epiphany SE when the root canals were irrigated with endosonic irrigation of MTAD as a final irrigation..

Introduction

One of the keys to success of root canal therapy is to adequately obturate the prepared root canal space [1]. Re-infection of a root canal system is one of the crucial factors that influence treatment outcomes [2]. Thus, it is necessary to use materials which are able to create a hermetic seal between the root canal system and periapical tissue [3].

In attempts to successfully fill root canals various materials and techniques have been utilized. Gutta-percha and endodontic sealers are currently the most common materials used to fill root canals [4]. Recently, a new technique has been introduced that is being advertised as the next generation of root canal obturation materials. GuttaFlow2 has been introduced as a cold, flowable, self-curing obturation material for root canals that combines gutta-percha and sealer into an injectable system. The sealer has silicone-based polymethyl hydrogen siloxane as its main component which contains micro-silver particles. The powder consists of finely ground gutta-percha [5]. It expands slightly during

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http://dx.doi.org/10.31487/j.DOCR.2018.10.004

setting. Another, popular obturation material is Epiphany, a soft resin endodontic obturation system. It consists of two components: EpiphanySE sealer and Resilon (Pentron Clinical Technologies LLC, Wallingford, CT, USA). This third generation methacrylate resin–based sealer has eliminated the use of self-etching primers by the incorporation of acidic resin monomers [6]. With this material, a thermoplastic core material is bonded to the resin-based sealer, thereby establishing a so-called 'monoblock obturation' [7].

Various methods have been used for evaluating the apical sealing property of root canal filling materials. Examples of such methods are the dye penetration test, fluid filtration methods, radioactive isotope studies, electrochemical leakage tests, scanning electronic microscopic analysis, and a bacterial penetration test [8-13]. There is no consensus concerning the methods used [14]. The assessment of linear dye penetration apically or coronally is the most common in vitro method of examining the adaptation of a root filling to the canal walls, because of its sensitivity and ease of use [15]. The method is based on the supposition that the depth of dye penetration displays the gap between the root filling and the canal walls.

The aim of this study is to assess the influence of endosonic irrigation of MTAD on apical leakage associated with the Resilon/Epiphany SE and GuttaFlow2 endodontic obturation systems.

Material and Methods

Thirty single-canal extracted teeth were collected and stored in sterile water. The teeth were carefully examined. Those teeth with immature apices, that had undergone root canal treatment, had root caries or restorations, or had root fractures or cracks were excluded from the study.

Access cavities were prepared, and the working length was determined by introducing a size-10 file into the canal until it exited from the apex; this length was measured, and the working length was set 1mm short of that length. The roots were prepared by using ProTaper nickel titanium rotary files (Dentsply Maillefer, Ballaigues, Switzerland). After the application of hand files and the establishment of a glide path, ProTaper files were used to clean and shape the root canal. During preparation and between each file action, 1 ml of 5% sodium hypochlorite was used as an irrigant. Also, a small size-10 hand file was used to maintain patency of the apical constriction. The canals were all prepared by a F4 ProTaper file. After completion of the instrument operations all specimens received a final flush of MTAD (Dentsply Tulsa Dental, Johnson City, TN) following the manufacturer's instructions. Then for mechanical agitation, the tip of the Endoactivator were placed 5 mm into the root canal and activated for 30 seconds. Afterwards, the specimens were dried with paper points.

The specimens were randomly divided into two experimental groups of 12 teeth each and a specific obturation material was used for each group, and into two further groups of 3 teeth each for positive and negative controls.

Epiphany SE sealer was mixed on a mixing pad. Resilon master cone was coated with Epiphany SE sealer and then inserted to the working length. The specimens were obturated with Resilon/Epiphany SE sealer by using the cold lateral compaction technique. After completion of canal obturation, the excess Resilon was removed with a heated instrument and was then compacted vertically using a plugger. The coronal surface of the obturation was light-cured for 40 seconds with a halogen device (Lunar, Benlioglu Dental, Ankara, Turkey) (450-500nm) to create an immediate coronal seal according to the manufacturer's instructions.

GuttaFlow2 (Coltène-Whaledent, Altstatten, Switzerland) was prepared according to the manufacturer's instructions. The tip of the GuttaFlow2 dispenser was inserted into the root canal at 3mm short of the working length, and a small amount of the filling material was dispensed into the canal until the flow of the material could be observed. A fresh mix was obtained on a glass slab by pressing the mixing pistol. A 0.06 taper master Gutta Percha cone was coated with the freshly mixed GuttaFlow and slowly inserted into the canal until the working length was reached. The tip of the GuttaFlow2 dispenser was inserted laterally to the master cone, and Multiple 0.02 taper accessory GP cones were used without lateral condensation until the entire length of the root canal was filled. After the obturation process, excess root canal filling materials were removed.

The coronal access cavities of all specimens were filled with Cavit G (3M ESPE AG, Seefeld, Germany). The specimens were stored for three weeks in 100 % relative humidity at 37° C to allow the sealers to set.

The root surfaces of teeth in these two groups were covered with two layers of nail varnish, except for the apical 3 mm. The negative controls were entirely coated with two layers of nail varnish, and the positive controls were coated with two layers of nail varnish except for the apical 3mm. After the filling process all samples were stored in saline solution at 37°C for 72 hours. All specimens were centrifuged at 3 G for 5 minutes in 2% Rhodamine B dye solution to allow evaluation of any apical leakage. The specimens were washed under running tap water for 5 minutes. The tooth roots were longitudinally grooved with a diamond disk and split with a chisel, to verify that the root canal filling had not been penetrated, and were then split into halves by levering with a plaster knife. Dye penetration was measured from the apical to the coronal part of the root canal using a stereomicroscope with an ocular micrometer, and the mean leakage value for each group was calculated and recorded. Differences between materials were identified by T-test.

Results

The microleakage values of the groups are presented in Table 1. The positive control specimens leaked but none of the negative control specimens leaked during experiment. GuttaFlow2 specimens showed less leakage than the Epiphany SE specimens when irrigated with MTAD combined with endosonic irrigation.. There is a significant difference in amount of leakage values between Epiphany SE and GuttaFlow2 groups ($p<0.05$)

Table 1: The mean rank and standart deviation of comparisons among the experimental groups. (mm)

Obturation materials	Mean±SD
GuttaFlow2	4.49±0.56
Resilon/Epiphany SE	5.75±0.61
p-value	<0.05

Discussion

The primary purpose for using obturating materials is to create a seal that will prevent penetration of irritants from the oral cavity into the radicular tissue via unfilled root canal space. The ideal root canal obturating material should be well adapted to the canal walls to prevent re-infection [16]. The introduction of new materials in endodontics is facilitated by technological innovations associated with the search for higher clinical success [17].

Various methodologies are available for assessing leakage, although dye penetration methods are simple and easy. However, one of the major considerations with respect to dye penetration studies is that air entrapped in voids along the root canal filling may hinder fluid movement. It has been recommended that dye penetration should be performed under pressure [18, 19]. Wimonchit et al. found that the active dye penetration method resulted in significantly more dye penetration than fluid filtration and passive methods when comparing different dye leakage test techniques [20].

By using and evaluating various types of dye for leakeage tests Vogt et al. and Souza et al. determined that the choice of dye could influence the penetration in root-end filling studies [21, 22]. Methylene blue is commonly used. But since it has been established that Rhodamine B gives more accurate results, it was preferred in the present study [22,23].

Kangarlou reported that no significant differences in sealing ability were found between the root canals obturated with Guttaflow and Resilon/Epiphany using the bacterial leakage method [24]. Nawal et al. stated that there was no statistical difference in sealing abilities between Resilon and GuttaFlow groups as determined by the bacterial leakage method [25]. Bouillaguet et al. stated that there were no statistical differences between leakage rates of Epiphany and GuttaFlow in long-term sealing ability [26]. These differences might be due to the differences in methodology and irrigation solutions of the present study. However, Kqiku stated that Epiphany/Resilon showed less dye penetration than GuttaFlow centrifuged for three minutes in 2% methylene blue [27]. This difference may be caused by usage of EpiphanySE and a different dye and irrigation solution. There is no study to compare the obturation materials, Epiphany SE and GuttaFlow2 on sealing ability when the root canals were irrigated with MTAD combined with endosonic irrigation.

NaOCl+MTAD and NaOCl+EDTA combinations were compared in the study of Tay et al. who found that a precipitate was formed because of the oxidation of doxycyline by NaOCl [28]. This degradation product had a high affinity for hydroxyl apatite. The results of the current study demonstrate that the sealing ability of EpiphanySE is less than GuttaFlow2. The cause of greater leakage results are thought to be dependant on the crystallized residuaries of MTAD and NaOCl which decreases the adhesion of Epiphany SE to dentine.

It is conclusion that GuttaFlow2 filling material had higher sealing ability than Epiphany SE when the root canals were irrigated with MTAD combined with endosonic irrigation.

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