

New technology in endodontics – the Resilon-Epiphany system for obturation of root canals

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Abstract

Purpose: Clinical and laboratory assessment of a new root canal filling material – Resilon-Epiphany system.

Material and methods: In 21 patients, 48 root canals were filled using a single-cone method or lateral condensation technique of gutta-percha with addition of Epiphany sealer. Laboratory investigations were performed on 4 extracted one-root human teeth, which were prepared by means of a crown-down technique and obturated with Resilon-Epiphany using System B and Obtura II. Next, the roots were transversely cross-sectioned in the mid-length at a 2 mm distance from the apex and analysed in SEM.

Results: After a year, the treatment proved to be clinically and radiologically successful in all the patients. SEM analyses revealed good adhesion of Epiphany sealer to the canal walls with visible tags in dentine tubules. Good adherence was also found of Epiphany to Resilon and Resilon to root dentine, but few gaps were also observed.

Conclusions: Our preliminary positive results require more thorough evaluation, longer observation period and a larger group of patients. However, they allow the assumption that resin-percha will successfully replace gutta-percha in the nearest future.

Key words: Resilon, endodontic treatment, seal of root canal obturation.

Introduction

Success in endodontic treatment is predominantly determined by complete obturation of the canal system. Gutta-percha, which has been commonly used for this purpose, does not prevent bacterial leakage and further complications, even when applied together with a sealer [1-4]. Thus, finding a gutta-percha substitute that would provide a superior seal of the root canal system has become a challenge in modern endodontics. A new material, the Resilon-Epiphany system with its novel formula, may revolutionize endodontic treatment (*Tab. 1*). The system consists of three parts: Resilon – a thermoplastic synthetic polymer-based (polyester) root canal filling material, as the major component; Epiphany sealer – a resin-based composite that forms a bond to the dentin wall and the core material under chemical reactions and halogen curing light; and Primer, which prepares the canal wall to get in contact with Resilon and the sealer [5-7]. Resilon looks and handles like gutta-percha and is therefore called resin-percha [8]. It is available in standardized points that fit endodontic instruments and in various tapers, as well as in accessory points and pellets for use with the Obtura II delivery system. Various techniques can be employed to place this material in the canal (single-cone method, cold lateral condensation and thermoplastic techniques), with the same instruments and devices that are used for gutta-percha condensation [9,10].

Based on composite resins, the Resilon-Epiphany system is a new generation material used so far for cavity restoration in the coronal hard tissues. Endodontically applied, this system allows formation of the so called mono-block made of root dentine, sealer and resin-percha [5-7], which has the potential to strengthen the structure of the tooth attenuated by endodontic treatment [7], at the same time ensuring complete sealing of the root canal, resistant to bacterial leakage [9,10].

The aim of the study was to present clinical and laboratory assessment of a new root canal filling material – the Resilon-Epiphany system.

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Table 1. Composition of Resilon System

Resilon core material
organic part: thermoplastic synthetic polymer – polycaprolactone, inorganic part: bioactive glass, bismuth oxychloride, barium sulphate
Resilon Sealer
organic part: BisGMA, ethoxylated BisGMA, UDMA, hydrophilic difunctional methacrylates inorganic part: calcium hydroxide, barium sulphate, barium glass, bismuth oxychloride, silica
Resilon Primer
sulfonic acid terminated functional monomer, HEMA, water, polymerization initiator

Material and methods

Twenty-one patients (16 women and 5 men) aged 14–55, with endodontically treated 48 root canals in 24 teeth (5 incisors, 1 canine, 6 premolars and 12 molars) were enrolled in the study. The patients' history, as well as dental and radiological examinations revealed irreversible pulpitis with vital pulp in 11 cases, acute apical periodontitis in 2 cases, chronic apical periodontitis in 5 cases (granulous in 4 and suppurative in 1), and exacerbated apical periodontitis with submucous abscess in 2 cases. Four teeth with vital pulp were treated for periodontal reasons, prior to periodontal surgery. Pulpectomy was performed in 15 teeth: in local anaesthesia (8) or after intentional devitalization (7). In the remaining cases, antiseptic root canal treatment was instituted with the use of calcium hydroxide nonsetting paste – Biopulp, placed in the canal with a Lentulo spiral for 7–21 days. In two patients with submucous abscess, abscess was incised, and the patients were given Dalacin C at a dose of 0.15 g every 6 hours and Metronidasol at a dose of 0.25 g every 8 hours. "The tooth left-open treatment" was not employed.

When radiographs were taken, the teeth were isolated from the saliva and the coronal cavity was prepared to allow access to root canals. Then, the canal orificies were prepared with Gates Glidden drills and barbed broaches or files were used to remove the canal contents. Working length of the root canal was established by means of an electronic apex locator Raypex 4 (Morita). Root canals were prepared manually to obtain the size of master apical file (30–40), by means of the step-back method with Kreamers and nickel-titanium S-files (Poldent) or by means of a crown-down technique with nickel-titanium rotary files Hero 642 (MicroMega) to the level of dentinocemental junction. During instrumentation, the canals were irrigated with 1% sodium hypochlorite solution, 17% sodium versenate and distilled water applied with a syringe and needle with lateral opening. Then, they were dried with sterile paper points. When extirpated in anaesthesia, the canals were filled immediately after instrumentation or on the subsequent visit. The infected canals were closed during the second and third visit. Resilon points and Epiphany sealer (Pentron), used to fill the canals, were inserted by means of a cold lateral condensation technique (for hand preparation) or by a single-cone method with grater-taper points (for rotary instrumentation). Prior to resin-percha point application, the canal walls were coated with a self-etching primer (Epiphany

primer) placed for 30 sec. with a special brush included in the set. Primer excess was removed with paper points. In the lateral condensation technique, a premeasured master point to fit the diameter and length of the root canal, coated with the sealer (Epiphany Root Canal Sealant) was placed in the root canal and condensed with a finger spreader. The rest of the canal was filled up with accessory points dipped in a small amount of sealer, which was halogen light cured for 40 seconds. When the single-cone method was used, the sealer was applied to the canal with a Lentulo spiral (Poldent), and then a suitable Resilon cone (04) was placed to working length. When the canals were filled, the excess points were removed with a hot instrument and a control radiograph was taken. Phosphate cement Agatos was inserted into the chamber and a composite material Herculite XR (Kerr) was placed in the cavity.

After the canals had been filled, as well as 6 and 12 months after treatment, we examined the patients for spontaneous and biting pain, tenderness to palpation of the alveolar process in the projection of the root apices of the treated teeth, periapical tissue reaction to vertical and horizontal percussion, and crown colour. Radiographs were analysed for the quality of obturation (tightness, the level of filling from the radiographic apex), periapical status (the width of periodontal ligament space, lamina dura continuity around the apex, structure of the alveolar bone in the periapical region).

Laboratory investigations evaluating the tightness of the seal of the obturation were performed on 4 extracted one-root and one-canal human teeth, which were stored after extraction in 1% sodium hypochlorite solution. The crowns were cut off at the level of the cemento-enamel junction with a high-speed diamond bur. Then, the canal orificies were prepared with a Gates Glidden drill and a barbed broach was used to remove the pulp. The working length of the root canal was established at 1 mm short of the anatomical apex. Root canals were prepared using the crown-down technique with nickel-titanium rotary instruments Hero 642 (MicroMega) to obtain the 30/40 size of the master apical file. During instrumentation, the canals were rinsed with 1% sodium hypochlorite, 17% sodium versenate and distilled water applied with a syringe and needle with lateral opening. Then, they were dried with sterile paper points and filled with the Resilon-Epiphany system. Prior to the application of the obturative system, the canal walls were coated with a self etching primer, as above; 1/3 of the periapical part of the root was filled with a suitable Resilon point, using the continuous wave method and System B (SybronEndo). A small amount of Epiphany sealer was placed into the root canal with point. Backfilling was performed with Obtura II (Obtura Corp.) using 25 gauge needle tips at a temperature of 160°. Epiphany sealer was not light-cured. Control radiograph was taken and the chamber was closed with phosphate. The roots were stored at 37°C for 7 days, in hermetic vials containing cotton-wool swabs soaked with distilled water. Then, the roots were cross-sectioned transversely at the mid-length and 2 mm from the anatomical apex (8 samples) [11]. Sectioned root fragments were embedded in aluminium rings filled up with epoxy resin. The images were analysed in a scanning electron microscope SEM Hitachi S-300 (Hitachi), without coating in low-vacuum conditions (40 Pa) [12]. The sealer adherence to resin-percha and root dentin, as

Figure 1. Patient RTG, 36 years old, tooth 26, diagnosis – pulpopathia irreversibile



a) Radiograph before treatment b) Radiograph directly before root canal filling c) Radiograph a year after treatment

Figure 2. Transverse cross-section of the root canal obturated with Resilon-Epiphany system. Sealer (U) adheres tightly to dentine (Z) and Resilon (R), sealer tags are visible in dentine tubules (arrow). Magnification 3000x

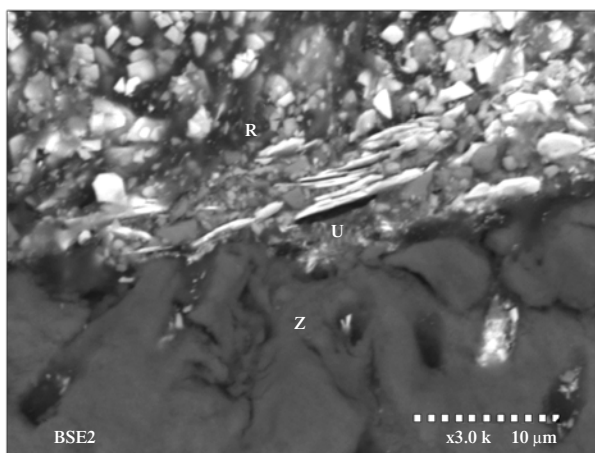
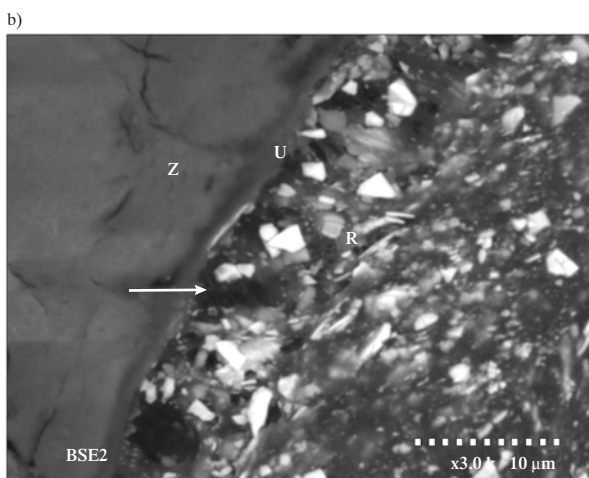
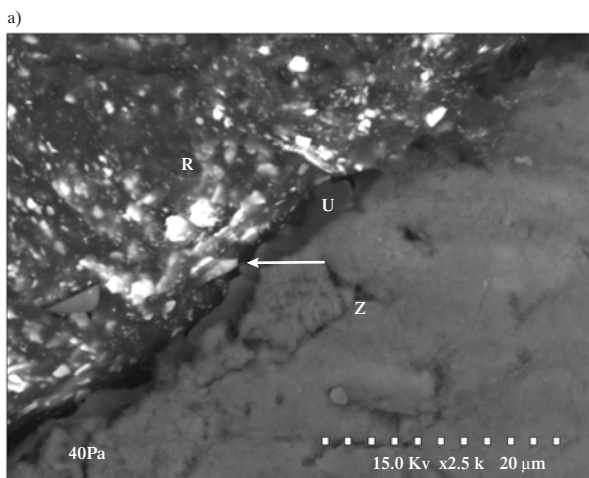


Figure 3. Transverse cross-section of the root canal obturated with Resilon-Epiphany system: a) A 1,2 µm wide gap visible between sealer (U) and Resilon (R) (arrow). Magnification 2500x; b) Visible is the sealer (U) adhering to dentine (Z) as well as gaps between the sealer and Resilon (R) (arrows), a likely result of root cutting. Magnification 3000x



well as bonding of resin-percha to the canal walls were evaluated. The gap width between the respective elements of the filling and dentine was recorded.

Results

A. Clinical evaluation

Treatment results have been presented in Fig. 1a, 1b and 1c. Directly after filling insertion, in four cases with radiologically confirmed root canal overfilling, we observed pain on biting and positive reaction of periapical tissues to vertical percussion. The symptoms subsided after 2-3 days. In the remaining cases, the canals were properly filled (0-2 mm filling distance from the radiographic apex) and no pain was reported either after the fillings were inserted or 6-12 months after treatment termination. No clinical crown discoloration was noted throughout the observation period. All the follow-up radiographs showed normal picture of the periapical structures. Bone regeneration at the site of bone loss was observed in teeth with chronic and exacerbated apical periodontitis.

B. Laboratory evaluation

The results have been presented in Fig. 2-3a, b. The transverse cross-section pictures of the periapical and pericoronal margins were recorded. All the samples exhibited very good adhesion of the sealer to the dentine and resin-percha. In

large magnifications (1500x, 3000x) sealer tags were present in dentine tubules (Fig. 2). Sporadically, single gaps, 1.2-6µm wide, were noted between the sealer and Resilon (Fig. 3a, b). Moreover, in four sites of the analysed pictures (2 samples), sealer-free, uneven Resilon adherence to dentine and 0.75-8 µm gaps could be seen.

Discussion

According to the producer, the unique properties of the Resilon-Epiphany system allow the formation of the so called mono-block with root canal walls – the sealer adheres to Resilon points and root dentine, properly prepared by means of the primer. This is expected to ensure a complete hermetic canal filling seal reducing bacterial leakage [5].

In all the current study cases, we observed a positive outcome 6-12 months after treatment termination. As no literature reports are available on the clinical assessment of Resilon, we were not able to compare the present results. Shipper et al. [10] evaluated the efficacy of Resilon and Epiphany in comparison to gutta-percha and AH 26 pasta in the prevention of apical periodontitis. They created conditions for reinfection of the previously filled root canal system and found a significantly lower rate of apical periodontitis in resin-percha filled teeth. The authors suggest that Resilon and Epiphany have better sealing properties and thus greater resistance to bacterial leakage as compared to gutta-percha, the finding which has been also confirmed by other studies [5,9].

The laboratory examinations revealed very good, gap-free adherence of sealers to dentine, both in the periapical and coronal root fragments. Single gaps were seen between Resilon and Epiphany, as well as between Resilon and dentin. Similar results have been reported by Tay et al. [13], who in SEM compared the tightness of root canal obturation with the Resilon-Epiphany system and gutta-percha and AH Plus pasta, using System B and Obtura II. In both groups, the authors observed both gap-free and gap-containing regions. It is assumed that these gaps are probably created by rapid polymerization contraction, promoted by heat generated during material condensation with a hot plugger. Additional manipulations in the course of further insertion of the material to the canal damage the bonds between the respective elements of the filling and root dentine [13-15]. Other causes of gap formation may include manipulations during sample preparation for SEM examinations i.e. root cutting, placement in vacuum, dehydration prior to coating [16,17]. In our study, some gaps had contours corresponding in shape and size to the filler particles that were probably pulled out during root cutting (Fig. 3 b)

Conclusions

The present evaluation of the Resilon-Epiphany system has yielded positive outcome both in clinical and microscopic examinations. However, these preliminary results require more profound analysis, longer follow-up period and a larger number of patients. Nevertheless, we can assume that resin-percha will successfully replace gutta-percha in the nearest future.

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