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Effectiveness of gutta-percha and Resilon in filling lateral root canals using thermomechanical technique

Eficácia da guta-percha e Resilon na obturação de canais laterais usando técnica termomecânica

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Resumo

Objetivo: O objetivo do estudo foi avaliar a efetividade da guta-percha e Resilon no preenchimento de canais laterais nos terços cervical, médio e apical radicular quando utilizada a técnica termomecânica. **Material e método:** Canais radiculares de dentes artificiais foram preparados utilizando um método padrão. Canais laterais foram confeccionados utilizando broca com 0,3 mm de diâmetro nos três terços radiculares. Os canais radiculares foram obturados pela técnica híbrida de Tagger utilizando-se o compactador de McSpadden. Foi avaliado o preenchimento dos canais laterais pelos seguintes materiais: cones de guta-percha Dentsply, guta-percha Endopoint e Resilon. A avaliação foi realizada por meio da análise de radiografias digitalizadas usando o programa Image Tool. A porcentagem da área preenchida pela área total de cada canal lateral foi determinada. Os dados foram submetidos à análise de variância (ANOVA) e teste de Tukey com nível de significância de 5%. **Resultado:** O Resilon mostrou melhor efetividade como material de preenchimento. Na comparação entre os terços, o Resilon foi mais efetivo no terço apical que no cervical ($p < 0,05$). **Conclusão:** O Resilon foi o material mais efetivo para o preenchimento dos canais laterais quando utilizada a técnica termoplástica.

Descritores: Endodontia; guta-percha; obturação do canal radicular.

Abstract

Objective: The aim of this study was to evaluate the effectiveness of gutta-percha and Resilon in filling lateral root canals in cervical, middle, and apical third using a thermomechanical technique. **Material and method:** Root canals of artificial teeth were prepared using a standard preparation. The lateral canals were fabricated using a 0.3-mm-diameter bur at 3 parts of each root. By using Tagger's hybrid technique with a McSpadden thermomechanical compactor, the root canal was filled using the following filling materials: Dentsply gutta-percha, Endopoint gutta-percha, and Resilon cones. The root canal fillings were evaluated using digitized radiographs and the Image Tool software. The percentage of filled area of each lateral canal was determined. The data were subjected to analysis of variance (ANOVA) and Tukey tests at a 5% significance level. **Result:** Resilon showed better effectiveness as a filling material. When the three thirds were compared, Resilon was more effective in the apical third than in the cervical third ($p < 0.05$). **Conclusion:** Resilon is an effective filling material for lateral root canals using a thermomechanical technique.

Descriptors: Endodontics; gutta-percha; root canal filling.

INTRODUCTION

Endodontic treatment aims to achieve periapical repair by appropriately filling the pulp cavity after cleaning and shaping the root canals[1-6]. The filling technique and the properties of filling material are important factors that influence the three-dimensional filling of the root canal system[7-9].

An ideal root canal filling should consist of an amount of gutta-percha covered by a thin layer of sealer[10,11]. Therefore, several filling techniques using thermoplastic gutta-percha have been evaluated for their effectiveness in filling irregular or lateral canals[10,12-18].

When using thermomechanical techniques for root canal filling, it is important to assess the properties of gutta-percha at high temperatures[19-21]. The thermoplasticity of gutta-percha depends on their chemical composition[19,22,23] and is influenced by

the thermal changes induced during the manufacturing process and during their use[20,22]. Many studies have evaluated several endodontic techniques for their ability to fill a root canal and its irregularities[10,14,16,17]. However, few studies have focused on the thermoplasticity of different brands of gutta-percha when used with thermomechanical techniques[9,13,15,17,24,25].

Resilon (Resilon Research LLC, Madison, CT, USA), a synthetic polymer-based material, has been proposed as an alternative to gutta-percha[8]. The thermoplastic properties of Resilon were studied by Miner et al.[11] (2006), who showed that Resilon and gutta-percha have a similar melting point of approximately 60 °C. Tanomaru Filho et al.[25] (2007) compared the thermoplastic properties between different gutta-percha cones and Resilon and showed that the latter has higher thermoplasticity.

Several methods have been suggested to promote plasticization of gutta-percha cones. McSpadden's[26] (1978) technique uses a thermomechanical compactor, rotating at a minimum speed of 8,000 rpm, to heat, plasticize, and compact the gutta-percha inside the root canal. In order to achieve better control over the apical limits, Tagger et al.[27] (1984) recommended a hybrid technique that associates lateral condensation in the apical third and thermomechanical compaction in the remaining two-thirds of the root canal.

The thermoplastic properties of filling materials recommended for use with thermomechanical techniques may affect their ability to completely fill the root canal system. Sant'Anna et al.[28] (2009) reported that during thermomechanical compaction, gutta-percha and Resilon present similar temperature-induced changes.

The aim of this study was to assess the ability of different materials (2 different brands of gutta-percha, and Resilon) to effectively fill the artificial lateral canals when used with Tagger's hybrid thermomechanical technique.

MATERIAL AND METHOD

Thirty transparent resin teeth (Odontofix Indústria e Comércio de Material Odontológico Ltda., Ribeirão Preto, SP, Brazil) were used for the study.

Root canal preparation of the root canals was performed at 1 mm short from the apex by using a rotary system with nickel-titanium files (K3 Endo; Sybron Kerr, Orange, CA, USA). A crown-down technique was used, starting with 0.08-taper files until the apical preparation with a size 35 K3 0.04-taper file. At each file change, the root canals were irrigated with 2 mL distilled water. After instrumentation, the root canals were dried using a size-35 paper cone (Dentsply Indústria e Comércio Ltda., Petrópolis, RJ, Brazil).

The lateral canals were made in the cervical, middle, and apical thirds of the root (4, 8, and 12 mm from the apex) using a cylindrical 0.3-mm bur (ST2 bur; Pluritec, SP, Brazil). An apparatus (Bio-Art Equipamentos Odontologicos Ltda., São Carlos, SP, Brazil) was modified in order to standardize the orientation of the artificial lateral canals. The teeth were randomly divided into 3 groups of 10 specimens, and the root canals were filled with the filling materials being evaluated (Table 1).

The root canal obturation was performed using the Tagger's hybrid technique without endodontic sealer. After placement of the main gutta-percha cone, an endodontic spreader (size-C finger spreader; Dentsply Maillefer, Ballaigues, Switzerland) was used to open space to the insertion of 3 auxiliary cones of the same brand of the main cone. A size-40 thermomechanical compactor (gutta condenser: Dentsply Maillefer), rotating clockwise at 8,000 rpm and penetrating up to 2 mm short of the working length, was used for 10 seconds. The excess root canal filling material was then removed from the pulp chamber.

1. *Analysis of the Digitized Images*

Radiographs of each tooth were obtained in the buccal-lingual position, and then, digitized and standardized using Adobe Photoshop software (Adobe Systems Inc., San Jose, CA, USA). These images were analyzed using the Image Tool software (UTHSCSA Image Tool for Windows version 3.0, San Antonio, TX, USA). The total and filled areas of each lateral canal were measured for all specimens (Figure 1) to determine the percentage of the filled area. The results obtained were then compared at the 3 lateral canals regions (apical, middle, and cervical). The data were subjected to analysis of variance (ANOVA) and the groups were compared using the Tukey test, both at a 5% significance level.

RESULT

The mean and standard deviation of the percentage of filled area in the different regions of the lateral canal in the 3 experimental groups are shown in Figure 2. Statistical analysis showed that Resilon was the more effective filling material, followed by Endopoint gutta-percha in the 3 evaluated regions of the root ($p < 0.05$). Resilon showed better filling effectiveness in the apical third than in the cervical third ($p < 0.05$); the other 2 materials showed no difference in their filling abilities between the different regions of the root.

DISCUSSION

Root canal filling techniques using thermoplastic gutta-percha as filling material allow a homogeneous mass that fills the irregularities of the root canal[9,24]. These techniques rely on the thermoplastic properties of gutta-percha, which may vary among the different types and commercial brands of gutta-percha[9,24].

In this study, artificial lateral canals were prepared using a bur with 0.3 mm diameter. The aim of this study was to compare the

Table 1. Filling materials used in the different experimental groups

Group	Material and manufacturer
G1	Gutta-percha Dentsply Termoplástica (Dentsply Indústria e Comércio Ltda., Petrópolis, RJ, Brazil)
G2	Gutta-percha Endopoints Termoplástica (Endopoints Indústria E Comércio Ltda. Paraiba do Sul, RJ, Brazil)
G3	Resilon (Resilon – Pentron Clinical Technologies, Wallingford, PT, USA)

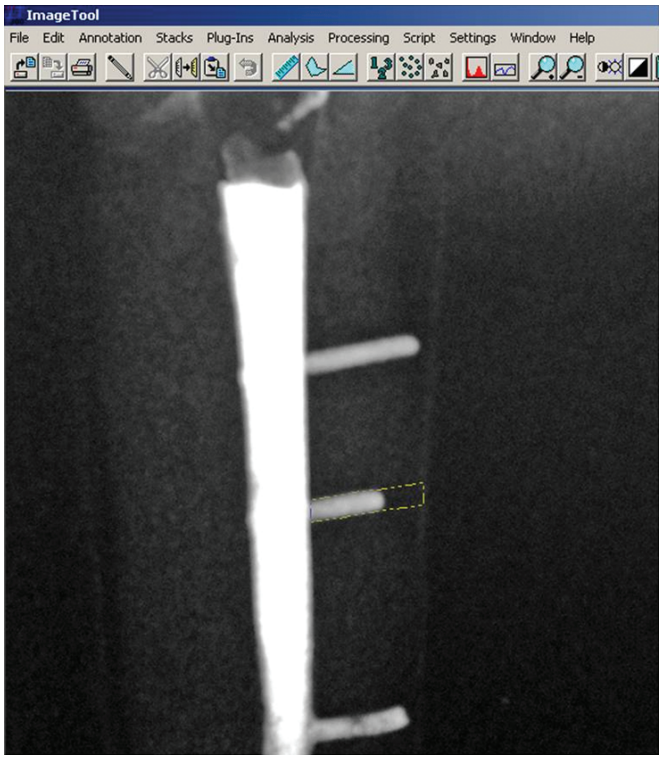

Figure 1. Measurement of the filled area of the lateral canal.

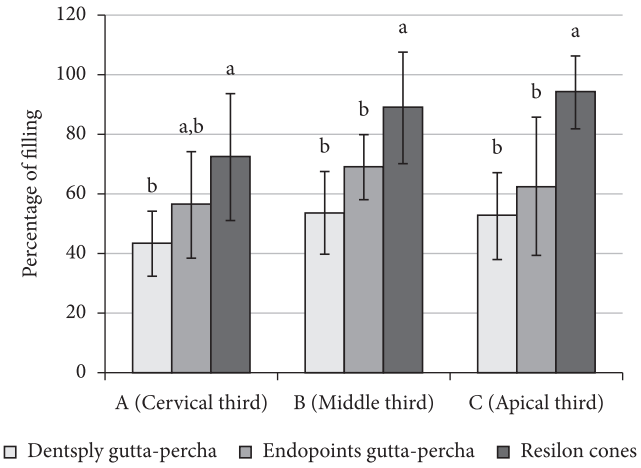

Figure 2. Means and Standard Deviation in percentage of the filled areas in the lateral canals, in the different experimental groups and different thirds of the root canal. Means with the same letter (a, b) did not show statistically significant differences ($p > 0.05$).

plasticity of solid root canal filling materials (gutta-percha and Resilon) without using endodontic sealers. The prepared lateral canals allowed the evaluation of the lateral canal filling ability of different root canal filling materials. Compared to the other 2 brands of gutta-percha, Resilon had better lateral canals filling ability using the thermomechanical technique ($p < 0.05$).

The differences observed between the 2 commercial brands of gutta-percha are in agreement with the findings of Gurgel-Filho et al.[24] (2006), who compared the effectiveness of 5 different brands of gutta-percha to fill lateral canals by using a thermomechanical technique and vertical condensation. They concluded that different brands of gutta-percha can present different results when used as a filling material. Gutta-percha is a natural polymer that undergoes industrial processing before being applied in dentistry. The thermoplastic properties of gutta-percha directly depend on its composition, and are more pronounced in the native gutta-percha than in its processed form[19]. Previous studies have reported that the amount of inorganic elements added to gutta-percha as well as the thermal changes induced during cone manufacturing may affect its properties[22,24].

Tanomaru-Filho et al.[25] (2007) evaluated the thermoplastic properties of gutta-percha and Resilon, and observed that the latter had higher values ($p < 0.05$). Endopoints (Endopoints Indústria e Comércio Ltda., Paraiba do Sul, RJ, Brazil) had the highest thermoplasticity values, and the values significantly differed from those of the other commercial brands of gutta-percha cones ($p < 0.05$). These findings are in accordance with the present study with regard to the filling ability of gutta-percha in lateral canals obturated by the thermomechanical technique.

New devices and systems using thermoplasticized gutta-percha as root canal filling material have been developed, as the Obtura II system (Model 823-700; Obtura Spartan, Fenton, MO). In comparison to lateral condensation, this technique has shown better adaptation to the root canal walls[29] and can fill a great number of simulated lateral canals[30].

The findings of this study are also in agreement with those of Karabucak et al.[31] (2008), who evaluated Obtura II and Calamus systems as filling materials for artificial lateral canals in resin teeth. They compared conventional gutta-percha, Flow 150 gutta-percha (Obtura Spartan, Fenton, MO, USA), and Resilon (Resilon Research LLC, North Branford, CT, USA) and found that the flowability of a material depends more on its own properties than on the mechanical properties of the obturating systems. Resilon showed better flow ability in lateral root canals obturated by simple vertical condensation. Tanomaru-Filho et al.[18] (2011) observed that Resilon and EndoFlow gutta-percha were effective in filling lateral canals by using the Obtura II system.

The ability to fill simulated lateral canals of different techniques and root canal filling materials has been studied using natural[32] or artificial teeth[18,24,31]. The use of artificial teeth can positively or negatively influence the flow properties of the gutta-percha or sealer[15]. However, the resin teeth allow to create a similar root canal preparation and standardized lateral canals[15,18,31].

Almeida et al.[32] (2007) evaluated decalcified and cleared specimens by radiographic and visual analyses after obturation by using lateral condensation. They observed that the radiographic analysis did not detect lateral canal fillings in 8% of the specimens visualized in the decalcified and cleared teeth. However, Tanomaru-Filho et al.[17] (2012) showed similar results from the radiographic and visual analyses of cleared specimens studying lateral canal filling.

CONCLUSION

The results of this study support the use of Resilon as a filling material when employing Tagger's hybrid thermomechanical technique. However, additional studies comparing Resilon and gutta-percha are necessary to evaluate the performance of these materials when used with different thermomechanical root canal filling techniques.

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CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

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