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Comparison of apical sealing between the Tagger hybrid technique and lateral condensation technique with different sealers

Belu Ccori Peña[1], Luis Adrian Mejía Gonzáles[1], Luis Alexander Orrego-Ferreyros[1*]

Abstract

Objective: This study aimed to compare the effectiveness of the Tagger technique and the lateral condensation technique with different obturation cements in achieving optimal apical sealing in endodontic treatments.

Methods: An in vitro study was conducted on 68 extracted human upper or lower first premolars. Teeth were randomly divided into four experimental groups (n=17) based on two obturation techniques and endodontic sealers employed, as follows: Group 1, Tagger technique with the zinc oxide-eugenol sealer; Group 2, Tagger technique with the resin-based sealer; Group 3, lateral condensation technique with zinc oxide-eugenol sealer, and Group 4, lateral condensation technique with resin-based sealer. Homogeneity of the gutta-percha mass and apical obliteration were evaluated under a digital stereomicroscope. Data were analyzed using the chi-square test, and a P-value<0.05 was considered statistically significant.

Results: Most group specimens exhibited non-homogeneous gutta-percha, whereas apical obliteration was achieved in a significant proportion of samples across all groups. No significant difference was found between the study groups either in the homogeneity of the gutta-percha mass (P=0.978) or in the optimal apical obliteration (P=0.782).

Conclusions: The study found no significant difference in the effectiveness of the Tagger hybrid and lateral condensation techniques using different sealers in achieving optimal apical sealing and gutta-percha homogeneity. This highlights the critical role of the clinician's expertise in ensuring successful endodontic outcomes.

Keywords: Endodontics, Gutta-percha, Root canal filling materials; Root canal obturation, Root canal preparation, Root canal sealer

Introduction

Long-term survival of endodontically treated teeth relies on achieving a well-sealed apical area, an optimal coronal restoration, and adhering to fundamental endodontic principles. Due to the morphological complexities of the root canal system, optimal root canal filling can sometimes be challenging, especially in teeth with lateral or accessory canals (1). Successful endodontic treatment requires a comprehensive understanding of the biology of the dental pulp and periradicular tissues, the causes of related diseases, and the strategies for diagnosing, preventing, and treating various pathologic conditions (2, 3).

A Critical stage in root canal treatment is obturation, which aims to prevent the penetration of microorganisms and fluids from the oral cavity into the periapical tissues. This procedure also seeks to entrap any bacteria that survived after root canal cleaning and irrigation and prevent periradicular exudates from entering the root canal system (4, 5). Up to 58% of endodontic treatment failures are due to insufficient canal obturation (6).

Various materials, such as root canal filling materials and root canal sealers, are used in the obturation procedure. Gutta-percha is the most commonly used root canal filling material, but it does not adhere to the dentinal walls of the canal. Root canal sealers must possess specific physical, biological, and handling

[1] Universidad César Vallejo, Facultad de Ciencias de la Salud, Escuela de Estomatología, Piura, Perú

*Corresponding Author: Luis Alexander Orrego-Ferreyros
Email: laorrego@ucvvirtual.edu.pe

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properties (7, 8). They should create a bond between the filling material and the root canal dentin walls and fill the canal areas that solid materials cannot reach, preventing fluid and bacterial leakage (9). There is a great variety of commercially available endodontic sealers, which are classified according to their composition: zinc oxide eugenol (ZOE) based, calcium hydroxide based, glass ionomer based, epoxy resin-based, and the most recently introduced bioceramics (7, 10-13).

Lateral condensation is the most widely used technique in endodontics due to its simplicity and low cost. Despite its advantages, canals obturated using the cold lateral condensation technique often lack adequate gutta-percha homogeneity and have a higher void percentage than other obturation techniques (13, 14). To address these limitations, new techniques using warm gutta-percha have been introduced (15, 16).

Tagger's hybrid technique is the modification of the technique proposed by McSpadden. In the original McSpadden technique, McSpadden's compactors are used at 20,000 rpm to produce friction between the gutta-percha and the internal walls of the root canal, thus resulting in the thermoplasticization of gutta-percha (17). However, that technique has some disadvantages, such as the high incidence of overfilling. To address this issue, Tagger (16) proposed a hybrid obturation technique in which the cold lateral compaction of gutta-percha is conducted in the apical third. In contrast, thermo-mechanical compaction is performed in the middle and coronal thirds of the canal. It is assumed that heating gutta-percha improves its adaptation to the root canal's internal anatomy (18, 19).

Several studies have compared different obturation techniques regarding apical sealing capacity as measured by dye infiltration and the homogeneity of obturation radiopacity. Some studies have demonstrated the superiority of one technique over the other (20, 21), but the results are inconclusive. This study aimed to evaluate the sealing ability of two different obturation techniques (lateral condensation and Tagger techniques) and two different endodontic sealers (zinc-oxide eugenol and resin-based sealers) through digital stereomicroscope analyses.

Materials and methods

Study design

The research ethics committee (CIEI) of César Vallejo University reviewed and provided the approval opinion for the execution of this in vitro research (0120-2024-/UCV/P).

Sample collection and preparation

This study included 68 extracted human upper or lower first permanent premolars following radiographic confirmation. The inclusion criteria included single canals with fully formed apices. The exclusion criteria involved teeth that were cracked, fractured, or had morphological alterations. Furthermore, teeth with root canal calcification or root curvature greater than 30° were excluded.

A simple random sampling method was employed, assigning each sample a random number generated by Microsoft Excel®. The samples were then randomly divided into four experimental groups based on the obturation techniques and endodontic sealers, with 17 samples allocated to each group. The study groups were as follows:

Group 1: The Tagger technique with zinc oxide-eugenol sealer (Pulp Canal Seale; Kerr Co, Lake Bluff, Il, USA).

Group 2: The Tagger technique with resin-based sealer (AH26; Dentsply, Konstanz, Germany).

Group 3: The lateral condensation technique with zinc oxide-eugenol sealer.

Group 4: The lateral condensation technique with resin-based sealer.

The canal was prepared using conventional K-files (Mani, Japan) and a Reciproc R40 (40/0.06) instrument (VDW GmbH, Munich, Germany), according to the manufacturer’s instructions. During instrumentation, canals were irrigated with 2.5% sodium hypochlorite (NaOCl; Marvaban, Iran), and 5 ml of 17% ethylenediamide tetraacetic acid (EDTA) was used to remove the smear layer. The final irrigation was performed with 2.5% NaOCl for 30 seconds. The canals were then dried with paper points.

Subsequently, the specimens in groups 1 and 2 were obturated with Tagger’s hybrid technique using gutta-percha and the zinc oxide-eugenol or resin-based sealer, respectively. This technique has been explained elsewhere (16, 17). One clinician, guided by an experienced endodontist, practiced the Tagger hybrid technique on pilot samples using single-rooted teeth.

The teeth in groups 3 and 4 were filled with a conventional lateral condensation technique, using gutta-percha and zinc oxide-eugenol or resin-based sealers, respectively.

Homogeneity and apical obliteration evaluation

Apical sealing was assessed by dye penetration according to a previous study performed by Kuba et al.

Table 1. Evaluation of apical obliteration quality according to the applied obturation technique and sealer type

Groups	Definition	partially obliterated	completely obliterated
Group 1	(Tagger technique + zinc oxide-eugenol sealer)	3 (17.6)	14 (82.3)
Group 2	(Tagger technique + resin-based sealer)	3 (17.6)	14 (82.3)
Group 3	(Lateral condensation technique + zinc oxide-eugenol sealer)	3 (17.6)	14 (82.3)
Group 4	(Lateral condensation + resin-based sealer)	5 (29.4)	12 (70.6)
P-value		0.782	

(22). The teeth were sectioned along the long axis of the tooth and examined under a digital stereomicroscope (Leica EZ4W, Germany) at ×10 magnification and photographed.

Apical sealing was assessed by dye penetration technique, using 2% rhodamine B for 24 hours, An experienced blinded examiner assessed the extension of dye penetration along the apical interfaces. In this study, teeth with less than 1 mm dye penetration were considered completely obliterated, and those with higher penetration than 1 mm were considered partially obliterated .

The homogeneity of the gutta-percha mass was assessed according to a method proposed by Vyavahare et al. (23) at the junction of the apical and middle thirds. The photographs were taken at x20 magnifications, and the area of voids (%) was measured using AutoCAD software. In this study, teeth with less than 2% voids were considered homogenous, and those with ≥2% voids were recorded as non-homogenous.

Statistical analysis

STATA software (version 18, StataCorp, Texas, US) was used for statistical analysis. Pearson's chi-square test was employed to determine the differences between the groups. The significance level was set at $p<0.05$.

Results

Table 1 presents the frequency and percentage of teeth with partial or complete apical obliteration in the study groups. Most specimens exhibited complete obliteration of the apical area, regardless of the technique or sealer used. The chi-square test revealed no significant difference between the experimental groups considering apical obliteration (P=0.782; Table 1).

Table 2 presents the distribution of gutta-percha mass homogeneity in the study groups. Most samples displayed non-homogeneous gutta-percha, irrespective of the technique or sealer utilized. The chi-square test showed no significant difference between the groups regarding gutta-percha homogeneity (P=0.978; Table 2).

Discussion

In this study, the sealing effectiveness of the Tagger hybrid technique and lateral condensation technique was assessed, using both zinc oxide-eugenol and resin-based sealers. Two variables were compared among groups including gutta-percha homogeneity and apical obliteration. The results were presented as scores for more simplicity in data interpretation.

In the present study, 71-82% of samples in different groups showed optimal apical obliteration. Considering gutta-percha mass homogeneity, about 29%-35% of

Table 2. Distribution of gutta-percha mass homogeneity according to the applied obturation technique and sealer type

Groups	Definition	Non-Homogeneous	Homogeneous
Group 1	(Tagger technique + zinc oxide-eugenol sealer)	11 (64.7)	6 (35.3)
Group 2	(Tagger technique + resin-based sealer)	11 (64.7)	6 (35.3)
Group 3	(Lateral condensation technique + zinc oxide-eugenol sealer)	12 (70.6)	5 (29.4)
Group 4	(Lateral condensation + resin-based sealer)	11 (64.7)	6 (35.3)
P-value		0.978	

The difference between groups is statistically significant at $p<0.05$ according to Pearson's chi-square test.

samples in different groups displayed homogeneous gutta-percha. The study groups showed no significant differences regarding apical obliteration or gutta-percha homogeneity. Therefore, the Tagger hybrid technique was not more effective than the lateral condensation technique in achieving apical seal and gutta-percha homogeneity.

The results of this study are consistent with those presented by Olczak and Pawlicka (24) and Ho et al. (25), who indicated comparable root canal sealing outcomes irrespective of the obturation method used, in contrast to the outcomes of this study. El Sayed (26) evaluated and compared the penetration depths of three different endodontic sealers (AH-Plus, BioRoot RCS, and GuttaFlow 2) after obturation with the lateral condensation technique. They found that the type of root canal sealer significantly influences the filling of the lateral canals. Libonati et al. (27) evaluated the gutta-percha-filled area after root canal obturation with different techniques and with or without using endodontic sealers. They reported that using endodontic sealers could compromise the progression of thermoplasticized gutta-percha.

This study's outcomes suggest that the efficacy of root canal treatments is possibly not influenced by the type of sealer or the obliteration technique because both sealers and techniques demonstrated comparable homogeneity of the final obturation or apical obliteration. This implies that achieving an adequate apical seal might depend more on the clinician's expertise and precision in executing the treatment process rather than on the choice of sealer material or obturation technique (28).

This study was performed in laboratory conditions. Further long-term studies are suggested in the clinical setting to assess the effectiveness of the Tagger hybrid technique with different sealers on the success rate of endodontic treatment. It is also suggested that future studies use electron microscopy analysis to better examine apical sealing and gutta-percha mass homogeneity using a large sample of teeth with different morphologies.

Conclusions

Within the limitations of the present study, no significant difference was observed between the effectiveness of the Tagger hybrid and lateral condensation technique using zinc oxide-eugenol or resin-based sealers in achieving optimal apical seal and gutta-percha homogeneity.

Conflict of interest

The authors declare no conflict of interest.

Authors' contributions

BC and LM were responsible for conceptualization, investigation, resources, and writing the original draft preparation. LO handled data curation, formal analysis, methodology, supervision, software, and writing, including review and editing. All authors read and approved the final manuscript.

Ethical approval

The research ethics committee (CIEI) of César Vallejo University reviewed and provided the approval opinion for the execution of this in vitro research (0120-2024-/UCV/P).

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