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Efficiency of using microscope with ultrasonics in nonsurgical endodontic retreatment

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EFFICIENCY OF USING MICROSCOPE WITH ULTRASONICS IN NONSURGICAL ENDODONTIC RETREATMENT

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Abstract

The aim of the study was to study the effectiveness of using clinical microscope and ultrasonics with rotary Universal Protaper files in removing gutta-percha and sealer from root canals.

Twenty single straight-rooted, extracted human mandibular premolars were prepared, filled with gutta-percha and sealer (Zinc oxide with eugenol). Specimens were then divided into two groups. Root filling material was removed using rotary Universal Protaper system with eucalyptol in group 1 (n=10); Rotary Universal Protaper system with eucalyptol followed by using microscope with ultrasonic tip were applied in the group 2 (n=10).

After retreatment, the efficacy of each technique was examined at 8× magnification of a stereomicroscope then the images were analyzed using AutoCAD 2010 according to Hulsmann and Stotz scale.

Data were statistically analyzed using Mann–Whitney U-test. There was a significant difference when using clinical microscope and ultrasonics ($p<0.01$), when considering the root canal in its entirety. When the root canal was divided to three thirds, there was a significant difference between groups 1 and 2 in the middle and the apical thirds ($p<0.01$). However, there was no statistically significant difference between the two groups in the cervical third.

The use of the dental operating microscope and ultrasonic tips to remove the filling material from root canal walls rendered better results even though remnants of filling material were observed on the canal walls in all the examined teeth in both groups.

Keywords: Retreatment – microscope – ultrasonic.

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EFFICACITÉ DE L'UTILISATION DU MICROSCOPE ET DES ULTRASONS DANS LES RETRAITEMENTS ENDODONTIQUES NON CHIRURGICAUX

Résumé

L'objectif de l'étude était d'étudier l'efficacité de l'utilisation du microscope et des ultrasons avec des instruments endodontiques rotatifs universels Protaper pour éliminer la gutta-percha et le ciment de scellement des canaux radiculaires.

Vingt prémolaires mandibulaires monoradiculées humaines extraites ont été préparées, obturées avec de la gutta-percha et du ciment à base d'oxyde de zinc eugénol. Les spécimens ont été ensuite divisés en deux groupes:

Groupe 1 (n = 10): le matériau d'obturation radiculaire a été retiré en utilisant le système rotatif "Universal Protaper" avec de l'eucalyptol.

Groupe 2 (n=10): le système rotatif "Universal Protaper" suivi d'un microscope à pointe ultrasonique a été utilisé pour désobturer les canaux.

Après le retraitement, l'efficacité de chaque technique a été évaluée à un grossissement x8 d'un stéréomicroscope. Ensuite, les images ont été analysées à l'aide d'AutoCAD 2010 selon l'échelle de Hulsmann et Stotz.

Les données statistiques ont été analysées à l'aide du test U de Mann-Whitney. Une différence statistiquement significative a été observée lors de l'utilisation du microscope clinique et des ultrasons ($p <0,01$), en considérant le canal de la racine dans sa totalité. Lorsque le canal de la racine a été divisé en trois tiers, une différence statistiquement significative a été retrouvée entre les deux groupes au niveau des tiers médian et apical ($p <0,01$).

Cependant, il n'y avait pas de différence statistiquement significative entre les deux groupes au niveau du tiers cervical. L'utilisation du microscope et des pointes ultrasonores pour enlever le matériau d'obturation endocanalaire des parois des canaux a donné de meilleurs résultats, même si des restes de matériaux de remplissage ont été observés sur les parois des canaux dans toutes les dents examinées.

Mots-clés: retraitement endodontique – microscope – instruments ultrasoniques.

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Introduction

The major cause of endodontic failures is the persistent or secondary intraradicular infection [1, 2]. Common reasons for an endodontic failure include missed canals, ledge formation, perforations, fractured instruments, inadequately filled canals, coronal leakage and error in post placement [3].

For a successful nonsurgical retreatment, the removal of the endodontic filling material is essential to allow access to the canals for a successful debridement and re-obturation of the root canal system. [4]

The American Association of Endodontists Glossary of Terms' states that these procedures revise the shape of canals, remove root canal filling materials and obturate canals [5].

Gutta-percha is the most common root canal filling material, and it should be all removed when retreatment is required [6].

Condensed gutta-percha root fillings can usually be removed using: Hedström files, heat, burs, rotary instruments, ultrasonic tips and lasers [7].

Retreatment cases are often technically complicated and require high-level skills of the dentist.

The use of Ni-Ti rotary instruments has the advantage of removing gutta-percha as well as shaping the root canals in an under-prepared tooth, simultaneously [8].

Qualitative improvement of ultrasonic units and the increased availability of new tips go hand in hand with the refinement of endodontic technique which is likewise constantly progressing [9].

The surgical microscope has brought light and vision into the pulp chamber. So working under high magnification makes it easier to remove difficulties, locate small root canal orifices and control intracanal procedures [10 - 12].

Materials and methods

Specimen preparation

Twenty single straight-rooted, extracted human mandibular premolars were selected and stored in saline before use. Teeth were radiographed at two directions bucco-lingual and mesio-distal to assure that the canals are straight (less than 15°). To avoid anatomical variation and to standardize the measurements in this study, the teeth were decoronated to a standardized root length of 14 mm. The working length was determined visually 1mm short of the apical foramen with k-file #10 (Mani, Inc, Japan).

The coronal third of the root canal was flared with Gates Glidden #3, #4 (Mani, Inc, Japan). The root canals were instrumented using k-files with the traditional technique to the size of 40 (Mani, Inc, Japan). Root canals were irrigated between each two instruments with 5mL of 5.25% NaOCl solution. After root canal preparation, the canals were irrigated with 2mL of 17% EDTA (META Biome Co Lid, Korea) for 1 minute and then finally rinsed with 5mL of saline solution. Canals were dried with paper points (META Biome Co Lid, Korea).

Root canal filling

A zinc oxide eugenol–based sealer was mixed according to manufacturer's instructions (Kemdent,LTD,UK) until it reached a thick consistency. A size 40 master gutta-percha cone (META Biome Co Lid, Korea) and root canal sealer was placed in the canal. Lateral condensation was accomplished using finger spreaders and gutta-percha accessory points with sealer until the canal was completely filled. The obturation was judged to be complete when a spreader could not penetrate more than 3 mm into the gutta-percha mass. A heated instrument was used to cut the gutta-percha off at the entrance of the canal.

Teeth were radiographed to confirm quality control of root filling. Accesses were sealed with temporary filling material (META Biome Co Lid, Korea), and teeth stored at a humidor under 100% humidity at 37°C for 30 days to allow the root canal filling to set completely.

Then, the teeth were randomly divided into two groups:

- Group 1 (n=10): Retreatment with rotary Universal Protaper system with eucalyptol: 0.1mL eucalyptol (Maquira, LTD, Brasil) was introduced into the root canal to soften the gutta-percha. Rotary Universal Protaper system was used at a constant speed of 250 rpm according to manufacturer's instructions (Dentsply Maillefer, Switzerland).

Files were used to remove the filling material according to the manufactures' instructions as follows: D1 (16mm, Iso 030-9%) for the cervical third, D2 for the middle third (18mm, Iso 025-8%), and D3 (22mm, Iso 020-7%) for the apical third until the WL was reached.

With each file change, the root canal was irrigated with 2 mL of 5.25% NaOCl. At the end, 2 mL of 17% EDTA (META Biome Co Lid, Korea) were applied for 1 minute, followed by a final rinse with 5 mL of saline. Eucalyptol sometimes was reused after irrigation.

Retreatment was completed when the working length was achieved and no more gutta-percha debris were retained on the instruments.

- Group 2 (n=10): Retreatment with rotary Universal Protaper system with eucalyptol followed by using microscope with ultrasonic tip: After following the same steps in group 1, each tooth was observed with the aid of a clinical operating microscope (DENTA 300/ Mueller-Wedel, Germany) using coaxial illumination and x8 magnification.

Canals were inspected for gutta-percha/sealer remnants to the extent permitted by the microscope. When debris were detected, a smooth ultra-

Group	Specimens (n)	Removal technique	I	II	III	IV	V	VI
1	10	Protaper + eucalyptol	-	1	2	-	-	7
2	10	Protaper + eucalyptol + (micropscope+ ultrasonics)	2	6	1	-	-	1

Table 1: The cleanliness scores of the root canal in its entirety.

Group	Thirds	I	II	III	IV	V	VI
1	Cervical	3	2	2	1	-	2
	Middle	1	2	2	4	1	-
	Apical	-	3	1	5	1	-
2	Cervical	8	2	-	-	-	-
	Middle	8	1	-	1	-	-
	Apical	2	7	-	1	-	-

Table 2: The cleanliness scores of the root canal walls when divided into three thirds.

sonic tip E2 (Woodpecker Medical Instrument Co Ltd, China), Ni-Ti U-files (#25) attached to E2 ultrasound stainless-steel tip (Woodpecker Medical Instrument Co Ltd, China) mounted on a hand piece powered by an ultrasonic unit was used to remove filling remnants without simultaneous irrigation.

Irrigation with 3 mL 5.25% Naocl, 2 mL 17% aqueous EDTA solution followed. Canals were dried with paper points.

The procedure was repeated until no gutta-percha/sealer debris could be seen on the canal walls. All procedures were done by the same operator.

Evaluation

Teeth were split longitudinally on the buccal and lingual surfaces using steel discs and examined at 8× magnification in a stereomicroscope.

The specimens were scored for remaining root canal filling material using the following scale, according to Hulsmann and Stotz [4]:

I: No root canal filling material.

II: One to 3 small isles (< 2 mm long) of root canal filling material.

III: More than 3 small isles (< 2 mm long) of root canal filling material.

IV: One large piece (> 2 mm long) of root canal filling material.

V: Root canal filling material > 5 mm long.

VI: Several isles of root canal filling material, one of them> 2 mm long

The main purpose of this study was to determine the best removal technique based on filling material left on root canals.

Statistical analyses

The statistical analyses were performed using a software program (SPSS for Windows version 19, Chicago, IL, USA. The analyses were carried out using Mann–Whitney U test. Significance level was set at $p< 0.01$.

Results

Cleanliness of root canal walls

When considering the root canal in its entirety, the Table 1 shows the root canal wall cleanliness scores for the two groups.

A statistically significant difference between group 1 and group 2 ($p<0.01$) is noticed. Specimens retreated without using microscope and ultrasonics (group 1) retained significantly more obturation material than specimens retreated with microscope and ultrasonics (group 2) ($p < 0.01$).

The table 2 represents the cleanliness scores of the root canal walls when divided into three thirds (cervical, middle, apical). A statistically significant difference was observed between groups 1 and 2 in the middle ($p=0.003$) and the apical thirds ($p=0.007$), but there was no statistically significant difference between groups in the coronal third.

However, remnants of filling material debris were observed on the root canal walls in both groups (Figs. 1 and 2).

Discussion

Removal of gutta-percha and sealer from inadequately prepared root canals is a major step in endodontic retreatments. It is important to remove as much filling material as possible to uncover remnants of necrotic tissue or bacteria which may be responsible for endodontic failure [8, 13].

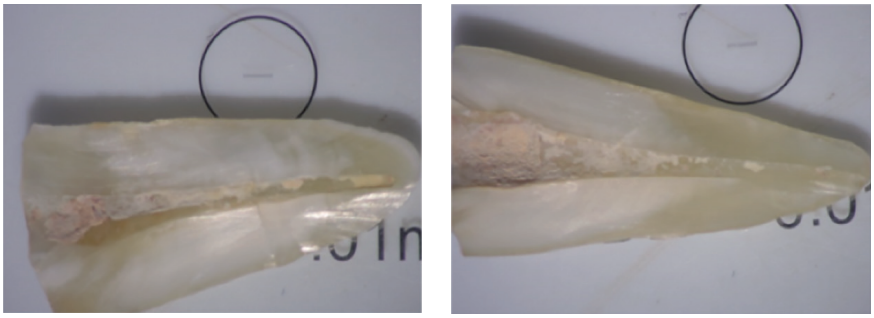

Fig. 1: Specimens from group 1.

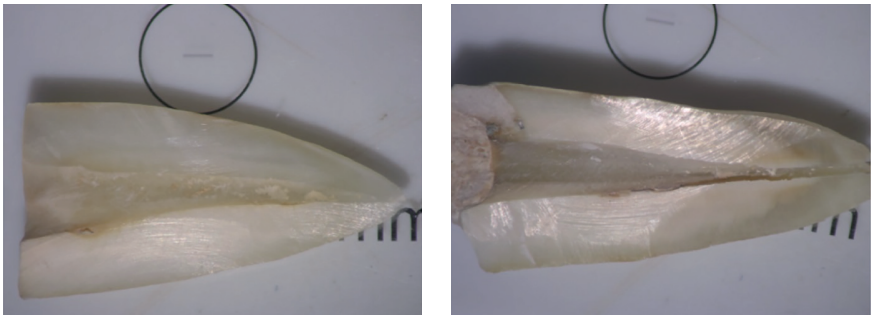

Fig. 2: Specimens from group 2.

Various techniques were introduced to remove gutta-percha and sealer from filled root canals: hand files, burs, rotary systems, ultrasonics with solvents or heat [14, 15].

Depending on the dentist tactile sensation when removing filling material of the canal is not enough to get it clean. Therefore, it was necessary to get light with a good magnification so details can be seen easily observed and problems can be solved with high expectations.

Visualization of the root canal under a microscope during retreatment increases the ability of the operator to remove remaining obturation material [16, 17].

However, the use of an ultrasonic instrument is essential, to dislodge filling material remnants without causing damage to the internal walls of the roots.

Our results supports the clinical impression that advantages provided by intense coaxial lighting and magnification coupled with the use of ultrasonics can improve precision and control the removal of filling debris from the canal walls. Group 2 in which these devices were used, had significantly cleaner canal walls compared to the group 1.

Our results are in agreement with those reported by J. Junior et al. [18] who found a significant difference when using the microscope with ultrasonics in endodontic retreatment after removing gutta-percha and sealer from root canals.

However, Baldassari-Cruz and Wilcox [19] concluded that there was no significant difference when using the microscope to remove gutta-percha from root canals. The controversy might be due to the fact that they did not use an ultrasonic tip to remove the filling material debris [19].

Other researches should be done to study the efficiency of operating microscope in roots with different shapes and diameters with different ultrasonic tips. Also, it is important to do further researches to evaluate this new technology clinically.

Conclusion

The use of the microscope with ultrasonics helped to remove the filling material from root canal walls better even though specimens in both groups had remaining filling material on canal walls.

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