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Evaluation of Two Rotary Systems in Removing Root Canal Filling Material Using Different Ultrasonic Irrigation Techniques (SEM Study)

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ABSTRACT

Aim: The first step in the retreatment of failed endodontically treated teeth is the removal of obturation materials from the root canals system. This study aimed to assess the effectiveness of two ultrasonic irrigation techniques using two different file systems in non-surgical endodontics retreatment.

Materials and methods: Forty eight extracted maxillary first molars palatal roots were prepared using size X3 (protaper next, dentsply) and obturated using a single cone technique using a bioceramic sealer. After two weeks of storage at 37°C and 100% humidity, the teeth were randomly divided into two groups (n=24) based on the type of instrument used for retreatment: Reciproc (R25) and Wave One Gold (WOG), then each group was subdivided according to the irrigation technique used: Conventional Needle Irrigation (CNI), Passive Ultrasonic Irrigation (PUI) and Continuous Ultrasonic Irrigation (CUI). Subsequently, the roots were then split and the sections parts were examined under SEM and scored according to somma classification. The results were analyzed statistically by the Kruskal-Wallis test and Mann-Whitney U test.

Results: Both groups show an amount of residual obturation materials covering the dentinal tubeless. CUI significantly reduced the amount of residual obturation materials (P<0.05).

Conclusion: None of the removal approaches successfully removed all of the root canal filling materials. CUI was found to improve the removal of root filling material in both groups.

Key words: Continues ultrasonic irrigation, Passive ultrasonic irrigation, Non-surgical treatment, Reciproc, Wave one gold

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INTRODUCTION

Root canal treatment plays a major role in restoring and preserving damaged teeth, cleaning and shaping the root canal system and filling the entire root canal space with a three dimensional obturating material is the objective of root canal treatment [1]. Although root canal treatment occasionally is a companied with a high success rate, failure may occur [2]. The first retreatment option is non-surgical retreatment. Retreatment of failed endodontically treated teeth requires the complete elimination and clearance of old root canals filling materials and exposing the hidden bacteria and its by-products [3]. The removal of gutta-percha and sealer from the root canals system is accomplished by many techniques including various instruments, such as stainless steel hand files and nickel titanium, solvents and heat. The removal of root canal filling materials using stainless steel and nickel titanium files had been reported to not completely remove the entire root canal filling materials [4]. Solvents also come with limitations as more gutta-percha and sealer fine particles remain inside dentinal tubules [5]. To overcome the limitation of previously mentioned methods researchers have suggested using ultrasonic irrigation after instrumentation, to improve the removal of old filling material and sealer from the root canal system [6]. Continues ultrasonic irrigation tends to be more effective in penetration of curved and lateral canals than passive ultrasonic irrigation [7,8]. Continuous irrigation depends on the dynamics and flow of the fluid within the canal that will improve root canal disinfection. Activation of the irrigation solution plays a critical role in facilitating penetration of the fluid to canal irregularities and thus improving the overall cleaning and disinfection processes [9]. The recruiting of continuous ultrasonic irrigation seems to be effective in improving the retreatment procedure [10]. This study aims to test and research the hypothesis that using continuous ultrasonic irrigation will

improve the retreatment procedure and compare it with passive ultrasonic irrigation and conventional needle irrigation using two types of file systems.

MATERIALS AND METHODS

Ethical approval was obtained from the ethical committee at the Baghdad University (288521/2021). A total of 48 human maxillary first molar teeth were selected for this study. The teeth were without root decay, visible cracks, internal resorption, previous endodontic treatment and the teeth were with mature and closed apex and root length was at least 15 mm and maximum apical diameter of ISO size #20. The teeth were then cleaned with cumine and washed under tap water and kept in distilled water solution. The crown of each tooth was removed at the level of the cementum enamel junction (palatal roots with a minimum length of 15 mm were selected). Each root canal was initially negotiated with a #10 stainless steel K-file (M ACCESS™, Dentsply Maillefer, Switzerland) until the file was barely visible through the apex, then the working length was then determined by subtracting 0.5 mm. The root canals were prepared with protaper next rotary system in crown down using an endodontic micro motor, with the speed set to 300 rpm and a torque of 2.0 Ncm. The instrumentation started with X1 followed by X2 and X3 to the full working length. After each file and before switching to the next file in the instrumentation sequence, apical patency was checked with a #10 stainless steel K-file and the canals were irrigated with 1.0 ml of 5.25% NaOCl delivered by a 5.0 ml disposable syringe with a 27 gauge side vented needle. At the end of the preparation, the samples were irrigated with 2 ml distilled water to prevent the prolonged effect of sodium hypochlorite and dried with paper point size X3. PTN X3 GP points (30/07) were used to obturate the dried canals, using the single cone technique and bio ceramic sealer. The obturated teeth were removed from the heavy body and wrapped with moist cotton and placed individually in test tubes. The tubes were arranged in a tray and placed in an incubator at 37°C for two weeks in 100% for the complete set of the sealer and aging of the filling material.

The 48 root samples were randomly divided into two groups of eight samples each. Group A samples have retreated with reciproc (size 25, 0.08 taper) and group B samples retreated with wave one gold (size 25, 0.07 taper). The files were mounted on the endo motor at reciprocating motion (30°CCW, 150°CW). The files were used with slight apical pressure with an in and out action in a crown down manner to clean the cervical, middle and apical thirds of the canal. The obturation materials were removed by 3 strokes until reaching the working length and after each stroke, the canal was irrigated with 1 ml distilled water.

After the removal of gutta-percha, the two main groups were then subdivided into three subgroups according to the method of irrigation used. The first subgroup was irrigated with a 5 ml disposable syringe with a 27 gauge side vented needle. The needle moved in the root canal up and down 2-3 mm and a flow of 5 ml distilled water was in a total time of 60 seconds. The flow rate was approximately 0.08 ml/sec. The second subgroup was irrigated with passive ultrasonic irrigation using a piezoelectric ultrasonic unit (Woodpecker, Guilin, Guangxi, China) set at a power setting of 3 with an E2 ultrasonic endo tip inside the canal, with intermittent flush consisting of three 20 second cycles of ultrasonic activation, such that each canal was irrigated with passive ultrasonic irrigation for 1 minute. Irrigation of a total of 5 ml of distilled water was carried out between cycles at a flow rate of about 0.08 ml/sec [11]. The third subgroup was irrigated with continuous ultrasonic irrigation using stainless steel E2 ultrasonic endo tip with the same procedure of passive expect it with continues flush for 60 seconds so that each canal will be subjected to 1 minute of continuous ultrasonic irrigation. Irrigation of a total of 5 ml of irrigants' distilled water was carried out at a flow rate of about 0.08 ml/sec.

The residual obturation materials were evaluated using scanning electron microscopy after sectioning each sample longitudinally. Each sample was examined at the center of coronal, middle and apical thirds. The samples were imaged first under 1X to 3X magnifications. The images of SEM were obtained and analyzed according to the scale defined by somma and his coworkers [12]. Score 0: There is no or very little residual debris on the dentinal surface (0%–25%), presence of 25% to 50% residual debris on the surface, 2: Moderate residual debris presence (50%–75%) and 3: The entire or nearly entire surface (75%–100%) is covered with residual debris (Figure 1). Statistical analysis for the data obtained from the SEM images was done using the statistical package for the social sciences (SPSS Inc, Chicago, IL version 26).

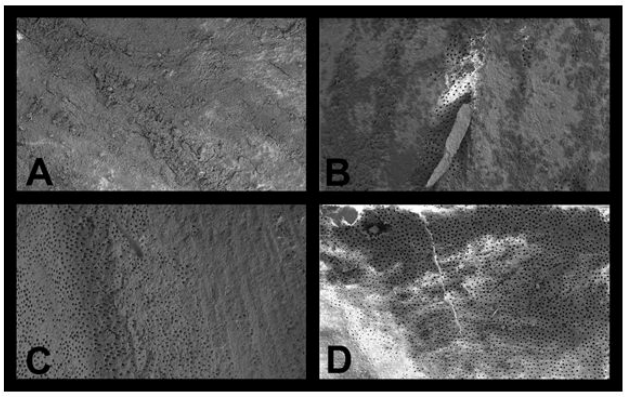

Figure 1: SEM images analyses (A): Score 4, (B): Score 2, (C): Score 3, (D): Score 1.

RESULTS

Two examiners scored the data, both examiners had a high agreement (weighted kappa=0.86) in the inter examiner analysis. Mean rank was used during the statistical analysis because of the nonparametric nature of the data. The residual of obturation materials was found to be greater in the apical third of all groups and decreased when moving towered the coronal third

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