

Efficacy of three Ni–Ti rotary systems for removal of filling materials from root canal system of extracted teeth

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Abstract

Objectives: The aim of the present laboratory study was to evaluate the efficacy of ProTaper Next (PTN) in removing root canal fillings and comparing it with ProTaper Universal (PTU) and ProTaper Retreatment (PTR).

Methods: Root canals in 60 single-rooted teeth were instrumented and obturated with gutta-percha and MTA Fillapex sealer then stored for one week. After that, the samples were divided randomly into three groups according to the instrument used in retreatment. Group 1, retreatment was done using ProTaper Retreatment (PTR), Group 2, retreatment was done using ProTaper Universal (PTU), and Group 3, retreatment was done using ProTaper Next (PTN). The total time required to achieve the end-point of root filling removal was recorded for each sample. Roots were split longitudinally, canals were observed using a stereomicroscope at 10×. The images were subjected to morphometric analysis to assess the amount of remaining root filling material. Statistical analysis was performed by ANOVA and Tukey's honest significance difference post hoc tests were run on the data to determine significant differences between the groups.

Results: PTN showed the shortest time for removal of the root canal filling material followed by PTR then PTU which had the longest time. PTN produced a statistically significantly lower remaining filling material in both middle and apical third when compared to the other two systems. However, both PTU and PTR produced statistically significantly less remaining debris in the coronal third.

Conclusion: ProTaper Next was efficient in removal of gutta-percha and MTA Fillapex root canal sealer.

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Keywords: Protaper next; Retreatment; Ni–Ti rotary system; Gutta percha removal; MTA Fillapex

1. Introduction

Persistent microorganisms within the root canal system are one of the known causes of postoperative apical periodontitis in root filled teeth [1]. Failure of the root canal therapy requires retreatment. Retreatment options include conventional orthograde retreatment, periradicular surgery with retrograde filling, or extraction. Whenever possible, the nonsurgical

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retreatment option is preferred as it is the most conservative method to solve the problem [2]. The main goal of retreatment is to regain access to the apical foramen by complete removal of the root canal filling materials, thereby facilitating sufficient cleaning and shaping of the root canal system then proper obturation [3,4].

Several materials have been used for the filling of root canals, gutta-percha is the most commonly used with a variety of sealers [5]. Recently, calcium silicate-based materials such as mineral trioxide aggregate (MTA)-based sealers have been developed and claimed to be biocompatible, to stimulate biomineralization, and to offer a superior seal [6]. MTA Fillapex is a 2-paste mineral trioxide aggregate-based root canal sealer that contains MTA, salicylate resin, natural resin, bismuth, and silica.

Different techniques have been advocated for the removal of gutta-percha from the root canal system including hand instruments with chemical solvents (chloroform, eucalyptol and orange oil), heat pluggers [7], ultrasonic instruments [8] and rotary nickel–titanium (Ni–Ti) instruments [9–11]. Removal of root canal filling materials using rotary Ni–Ti instruments is considered effective and time saving [9,10]. ProTaper nickel titanium system, which is considered the benchmark in rotary systems, had been upgraded to ProTaper Universal (PTU) system and ProTaper rotary Retreatment files (PTR). ProTaper Universal (PTU) system has shaping and finishing files that are characterized by progressively increasing tapers, a convex triangular cross-section, and a modified guiding tip. ProTaper rotary Retreatment files (PTR) are three in number (D1, D2 and D3) with different lengths and tapers. They are used in sequence for removal of the filling materials from the root canal system. Several studies investigated the effectiveness of these rotary files in the removal of gutta-percha during endodontic retreatment [12–14].

Recently, ProTaper Next (PTN) has been introduced in the dental market with an off-centered rectangular design, progressive and regressive percentage tapers on a single file. It is manufactured from M-Wire to enhance flexibility and cyclic fatigue resistance [15,16]. Up to date, there is scarce information about its efficiency in retreatment of obturated root canals, hence, the aim of the present laboratory study was to evaluate the efficacy of ProTaper Next (PTN) in removing root canal fillings and comparing it with PTU and PTR. The null hypothesis was that there is no significant difference between these systems in removing filling materials from root canal system.

2. Materials and methods

2.1. Sample selection and preparation

Sixty extracted single rooted human mandibular first premolars were collected and stored in normal saline at room temperature. Teeth were selected with the following criteria: existence of a single root canal, absence of visible root caries, fractures or cracks, and a fully formed apex. Calculus was mechanically removed from the root surfaces using ultrasonic scaler then all were immersed for 15 min in 5.25% sodium hypochlorite for disinfection. The crowns of the teeth were cut at the level of cemento-enamel Junction (CEJ) using diamond coated high-speed bur with copious coolant. All roots were ground to have a uniform 15 mm length. The working length of the canal was determined by introducing size 15 K-file² into the canal until it exited from the apex and apical patency was confirmed; this length was measured, and the working length (WL) was set 1 mm short of that length.

2.2. Root canal instrumentation

Mechanical instrumentation of root canals was done using the ProTaper Universal System² according to manufacturer instructions to size F3. Between instruments, canals were irrigated by applying 5 mL of 5.25% sodium hypochlorite. All instruments were cleaned after each use, each sequence were used for 8 times before being discarded.

2.3. Root canal filling

The root canals were dried with paper points and obturated with gutta-percha and MTA Fillapex sealer³ using the lateral compaction technique. The quality and apical extent of the root canal filling were assessed with postoperative radiographs⁴ in buccolingual and mesiodistal directions. Roots exhibiting voids were immediately discarded and replaced. All endodontic procedures were performed by the same operator to avoid interoperator variability. The root orifices were sealed with Cavit⁵ and then stored at 37 °C for one week to allow complete setting of the sealers.

² Dentsply Maillefer, Ballaigues, Switzerland.

³ Angelus, Londrina, Parana, Brazil.

⁴ Ultraspeed; Kodak, Rochester, NY, USA.

⁵ 3M-ESPE, Seefeld, Germany.

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