Comparative evaluation of the shaping ability of Protaper Next and BT RaCe rotary nickel titanium instruments in curved simulated root canals

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BY

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Introduction

Introduction

Root canal treatment is performed to treat endodontic disease by eradicating bacteria from the root canal space. It is widely accepted that disinfection and subsequent obturation of the root canal space require mechanical enlargement of the main canals. The mechanical objectives of root canal preparation according to Schilder is to shape the canal to a continuously tapering funnel shape from the apex to the orifice cavity, and the preparation should respect the original shape of the canal. Also the apical foramen should remain in its original position [(1)].

Shaping is easily done in straight canals, but in curved canals there is tendency to transport the canal away from its original axis. stainless steel files were the main files used for mechanical enlargement of the root canal. Due to the mechanical properties of SS files its behavior in curved canals was not satisfactory as it tends to transport the canal from its original shape, also it has high rates of ledge formation and file separation. Root canal transportation is defined as: “the removal of canal wall structure on the outside curve in the apical half of the canal due to the tendency of the file to restore themselves to their original linear shape during the canal preparation”. [(2)]

With the introduction of the NiTi alloy it played a big role in minimizing procedural errors such as ledge formation, canal transportation and perforation, as the alloy can exhibit super-elastic behavior and shape memory which helps in overcoming those errors. In the last 10 years a lot of NiTi rotary systems were introduced in the market. They have different metallurgical and design features.

FKG Dentair company made a modification in the tip that enables a faster progression through the canal, while respecting its anatomy and shape as it was incorporated in a new system called BT RaCe (BTR). Its made from a conventional austenite NiTi alloy and has a triangle cross section. A modification in the taper was made in file number two "BT2" which has no taper to increase the flexibility [3]

DENTSPLY company used M-Wire alloy in manufacturing of Protaper Next (PTN) as to increase the flexibility and cyclic fatigue resistance. In addition to the alloy a modification in cross-section was made by making it off centered rectangular cross-section, as the manufacturer claim that this increase both strength and space for debris removal.[4]

Therefore, conducting a study to evaluate the impact of these new systems with their novel modifications on the quality of

root canals preparation was thought to be of value.

Review of Literature

Review of literature

Luiten et al [5] evaluated the ability of four instrumentation techniques to enlarge and maintain the central axis of 51 curved canals was evaluated radiographically. Curved canals in extracted human teeth were instrumented using a step-back preparation with K-files, crown down preparation with K-files, sonic instrumentation with Shaper-Sonic files, and the NiTi Matic preparation system. Following coronal pre flaring, each canal was instrumented to a #35 file 1 mm from the anatomic foramen. Radiographs were taken with mercury filling the canal system using a specially designed model that allowed for the pre- and post instrumentation canal to be viewed on the same radiograph. Canal enlargement and apical transportation resulting from the various instrumentation techniques were evaluated using computer analysis. No statistically significant differences were found for canal transportation. Sonic instrumentation significantly increased coronal flaring. The crown-down and sonic techniques produced more ledges. Elbow formation was associated with all instrumentation techniques. The model system developed for this study provided an accurate method of assessing the

preparation techniques and the instrument effects on the canal walls.

Gambill et al [6] used Computed tomography to evaluate root canals prepared by nickel-titanium (Ni-Ti) hand and stainless steel hand endodontic instruments. Thirty-six single-rooted teeth of similar shape and canal size were divided into three groups. The teeth were scanned by computed tomography before instrumentation. In group A, canals were instrumented using a quarter turn/pull technique with K-flex files. In group B, canals were prepared with Ni-Ti hand files using the same technique as group A. Group C was prepared with Ni-Ti hand files using a reaming technique. Instrumented teeth were again scanned using computed tomography, and reformatted images of the uninstrumented canals were compared with images of the instrumented canals. Ni-Ti instruments used in a reaming technique caused significantly less canal transportation, removed significantly less volume of dentin, required less instrumentation time, and produced more centered and rounder canal preparations than K-flex stainless steel files used in aquarter turn/pull technique. The computed tomography imaging system used in this study provided a repeatable, noninvasive method of evaluating certain aspects of endodontic instrumentation.

Peters et al [7] used nondestructive high-resolution scanning tomography to assess changes in the canals' paths after preparation. A microcomputed tomography scanner was used to analyze 18 canals in 6 extracted maxillary molars. Canals were scanned before and after preparation using either K-Files, Lightspeed, or ProFile .04 rotary instruments. A special mounting device enabled precise repositioning and scanning of the specimens after preparation. Differences in surface area and volume of each canal before and after preparation were calculated using custom-made software.. Canal anatomy and the effects of preparation were further analyzed using the Structure Model Index and the Transportation of Centers of Mass. Under the conditions of this study variations in canal geometry before preparation had more influence on the changes during preparation than the techniques themselves. Consequently, studies comparing the effects of root canal instruments on canal anatomy should also consider details of the preoperative canal geometry.

Schafer et al [8] made a study to compare the shaping ability of Protaper with Reamer with alternating cutting edges (RaCe) instruments in simulated canals with 28° and 35° curves in resin blocks. Preparation was done using crown -down preparation technique. Images of pre and post

instrumentation were recorded and analyzed by computer image analysis program. Measurements were taken at 20 points 1 mm from the apex. Canal aberrations, preparation time, changes of working length and instrument failures were recorded. Statistics were done using the Mann-Whitney U-test or the chi-square test. They found that canals prepared with RaCe files were better centered than those prepared with Protaper files. RaCe instruments were faster than Protaper. Two Protaper files were fractured while three RaCe file fractured.

Song et al [9] conducted a study to compare great taper hand files using a reversed balanced force technique, nickel-titanium flex files with a balanced force technique and stainless steel k-type files using a step-back technique. They found that Gt hand files and NiTi flex files remain better centered and had less transportation in curved canals than SS-K files.

Iqbal et al [10] used a newly developed radiographic technique to compare apical transportation and loss of working length (WL) between. 06 taper ProFile™ Series 29 and Protaper nickel–titanium (NiTi) rotary instruments *in vitro*. Mesio-buccal canals of 40 extracted mandibular molars were randomly divided into two groups.