Cleaning Ability Of Multiple Versus Single Rotary File Systems

(In-Vitro Study)

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Dedication

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Introduction

The ultimate objective of canal preparation is the elimination of irritant and maintenance of healthy periapical tissues. Preparation of root canal system is one of the most important procedures in endodontic treatment. There has been a constant quest for quicker, safer and more efficient method for cleaning and shaping of root canals. Use of automated Ni-Ti instruments was a logical development to improve the efficiency of the treatment.

Rotary instruments have tendency to pull the debris into their flutes, lifting them out of the root canal in the coronal direction, thus reducing extruded debris apically.

The removal of debris and smear layer from the root canal system prior to obturation is one of the primary aims of endodontic treatment. Smear layer differs from the dusty pattern of superficial debris in that it is a layer of muddy material, composed of an amorphous layer of organic and inorganic debris, and sometimes bacteria, which is compacted against the dentine walls as a result of the rasping action of endodontic instruments. It has been suggested that the presence of a smear layer may prevent bacterial penetration into the underlying dentinal tubules. On the contrary, the presence of an infected smear layer may prevent antimicrobial agents from gaining access to the infected dentinal tubules.

Furthermore, the removal of the smear layer may enhance the penetration of sealers into dentinal tubules and adaptation of obturation materials to the root canal walls.

Newly designed NiTi rotary instruments are continually developed, but the extent of extruded debris and smear layer formation is not well-known.

Instruments alone cannot effectively eliminate bacteria from the root canal system and modern rotary instrumentation techniques produce a large quantity of smear layer that covers root canal walls. In the last decade many nickel-titanium (NiTi) rotary instruments have been introduced. All NiTi rotating instruments have been shown to produce moderate to heavy smear layer that need to be removed with the use of chemical solutions The chelating agents like ethylenediaminetetraacetic acid (EDTA) are currently used to remove the smear layer formed during preparation of the root canals. The association of EDTA and NaOCl solutions is the gold standard in chemo-mechanical preparation of the root canals. EDTA acts upon the inorganic components of the smear layer and decalcifies the peri- and intertubular dentine and leaves the collagen exposed. Subsequently, the use of NaOCl dissolves the collagen, cleaning the dentinal walls. Combined use of irrigating solutions and rotary instruments decreases bacterial counts in the root canal when compared to standard instrumentation alone. Several SEM studies revealed that rotating files associated to

EDTA and NaOCl irrigation leave dentine surfaces substantially free from smear layer. The combination of NaOCl and EDTA favorites the removal of smear layer and the removal of a great portion of circumferential dentinal collagen and mineralized dentine from the surfaces of tubules. This means that absence of smear layer and presence of clean dentinal walls provide a reduction in bacterial count. Today is well known that mechanical NiTi instrumentation in combination with chemical cleaning greatly reduces the microorganisms remaining in the root canal system. Total removal of smear layer facilitates the diffusion of the irrigants and the medications to the root canal system and then improves the adaptation of the filling materials to the root canal dentine, reducing apical and coronal microleakage of the root canal filling materials.

Review of literature

Sen et al.[1] Reviewed that when the root canals are instrumented during endodontic therapy, a layer of material composed of dentine, remnants of pulp tissue and odontoblastic processes, and sometimes bacteria, is always formed on the canal walls. This layer has been called the smear layer. It has an amorphous, irregular and granular appearance under the scanning electron microscope. It has been shown that this layer is not a complete barrier to bacteria and it delays but does not abolish the action of endodontic disinfectants. Endodontic smear layer also acts as a physical barrier interfering with adhesion and penetration of sealers into dentinal tubules. In turn, it may affect the sealing efficiency of root canal obturation. When it is not removed, the durability of the apical and coronal seal should be evaluated over a long period. If smear layer is to be removed, EDTA and NaOCl solutions have been shown to be effective, among various irrigation solutions and techniques, including ultrasonics. Once this layer is removed, it should be borne in mind that there is a risk of reinfecting dentinal tubules if the seal fails.

Gambarini et al.[2] Evaluated debris and smear layer remaining following canal preparation with GT rotary instruments. Sixteen freshly extracted single-rooted premolar teeth were instrumented with GT rotary instruments using a crown-down preparation technique. All specimens were flushed with 2 mL of 5% NaOCl between each rotary instrument. All teeth were split longitudinally and prepared for SEM evaluation. The presence of debris and smear layer was evaluated from photomicrographs at x200 and x1000 magnification taken in the apical, middle and coronal thirds of the canals. A five category scoring system for debris and smear layer was used. The study found that there was no significant difference between the three regions of the root for debris. The study concluded that GT rotary instruments removed debris effectively, but left root canal walls covered with smear layer, particularly in the apical third.

Versümer et al.[3] Compared several parameters of root canal preparation using two different rotary nickel-titanium instruments: ProFile .04 and Lightspeed. Fifty extracted mandibular molars with root canal curvatures between 20 degrees and 40 degrees were divided into two similar groups having equal mean curvatures. All root canals were prepared using ProFile .04 or Lightspeed Ni-Ti instruments to size 45 following the

manufacturers' instructions. The Lightspeed system was used in a step-back technique: ProFile .04 instruments were used in a crown-down technique. The following parameters were evaluated: straightening of curved root canals, postoperative root canal diameter, cleaning ability (SEM-evaluation of root canal walls using a five-score system for debris and smear layer), and working time. The study found that The results for remaining smear layer were similar: the lowest amount of smear layer on the root canal walls was found after preparation with Lightspeed (30.7% scores 1 and 2) followed by Profile.04 (23.1%). In the coronal third of the root canals Lightspeed performed significantly better than Profile .04 in the middle and apical third the differences were not significant. The study concluded that Both systems under investigation respected original root canal curvature and were safe to use.

Schäfer et al.[4] Evaluated the cleaning effectiveness and the shaping ability of K3 nickel-titanium rotary instruments and stainless steel hand K-Flexofiles during the preparation of curved root canals in extracted human teeth. A total of 60 root canals of mandibular and maxillary molars were divided into two groups of 30 canals. Canals were prepared by K3 instruments using a crown-down preparation technique or by K-Flexofiles using a reaming motion up to size 35. After each instrument, the root

canals were flushed with 5 mL of a 2.5% NaOCl solution and at the end of instrumentation with 5 mL of saline. After splitting the roots longitudinally, the amount of debris and smear layer were quantified on the basis of a numerical evaluation scale, using a scanning electron microscope. The study found that None of the stainless steel K-Flexofiles but 5 K3 nickel-titanium instruments separated. For debris removal, K-Flexofiles achieved significantly better results than K3 instruments. K3 instruments maintained the original canal curvature significantly better than K-Flexofiles. The study concluded that K-Flexofiles allowed significantly better removal of debris than K3 instruments, K3 files maintained the original curvature significantly better.

Jeon et al.[5] Evaluated and compared the quality and amount of smear layer generated in the apical third of straight root canals by 2 rotary nickel-titanium reamers and 1 rotary steel reamer with different cutting blade designs. Seventy single-rooted human mandibular premolars used. Before instrumentation, the cervical portion of all teeth was removed by using a microtome, leaving 13-mm-long roots. Automated preparation was performed with ProFile and Hero 642 reamers by using the crown-down technique and with a stainless steel engine reamer by using a reaming motion. All root canals were instrumented to No. 40. A control group was also included. After the instrumentation, each

root was split longitudinally, and a scanning electron microscope was used to examine the selected areas of the canal walls at the apical third from 2 different perspectives. A 4-category scoring system for smear layer was used. The study found that The least smear layer remained in the Hero 642 group at the selected apical third of straight root canals. However, all instruments left a smear layer. The study concluded that the design of the cutting blade of rotary instruments can affect root canal cleanliness in straight root canals.

Foschi et al.[6] Evaluated root canal walls following instrumentation in vitro with two different rotary NiTi instruments using scanning electron microscopy (SEM). Twenty-four single-rooted human teeth were selected. Two types of NiTi instruments were used, Mtwo and ProTaper. Irrigation for both groups was performed after each instrument change with 5% NaOCl, 3% H2O2 and 17% EDTA solutions. Three different areas (coronal, middle and apical thirds) of the root canal were evaluated using SEM. The canal wall of each sample was assessed and compared using a predefined scale of four parameters, namely, smear layer, pulpal debris, inorganic dentine debris, surface profile. The study found that a statistically significant difference was found between the apical third and the middle and coronal thirds for both groups and no difference was