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Original Research

Comparative evaluation of debris extrusion by two file systems with different cross sectional design an in vitro study

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ABSTRACT:

Aim: The purpose of the study is to compare in vitro the amount of debris extruded apically using One Shape and Neo-Niti rotary instruments. **Material and Methods:** Fifty freshly extracted mandibular premolar teeth were selected and disinfected with chloramine T. Radiographs in buccal and proximal directions were taken for the presence of a single canal. The teeth were cleaned of debris and soft-tissue remnants and stored in distilled water. **Results:** The difference between pre- and post-weights was significantly greater for the One Shape system. **Conclusion:** Both the rotary single-file systems used resulted in extrusion of debris beyond the apical foramen. The NeolixNiti single file system showed significantly less amount of extrusion than the One Shape single file system.

Keywords: Apical extrusion, Neo Niti, One Shape, single file system

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INTRODUCTION

During the root canal preparation procedures, dentin chips, pulp tissue, microorganisms and/or irrigants may get extruded into the periradicular tissues. Though a thorough control of the working length (WL) may decrease the risk, but nevertheless extrusion of any debris may potentially cause post-operative complications such as flare-ups,[1]which are characterized by pain, swelling causing unscheduled visits of the patients resulting in interappointment emergency.[2,3,4]

The cleaning of the root canal system and the removal of inflamed and/or necrotic tissue remain one of the most important steps in endodontic therapy.[5] Dentine chips, pulp tissue fragments, necrotic tissue, microorganisms, and intracanal irrigants may be extruded from the apical foramen during the canal instrumentation, which may cause pain or flare-up.[1]

The interappointment flare-up is a true complication characterized by the development of pain, swelling, or both, which commences within a few hours or days after root canal procedures and is of sufficient severity to require an unscheduled visit for emergency treatment.[6] The causative factors of interappointment flare-ups comprise mechanical, chemical, and/or microbialinjury to the pulp or periradicular tissues.[1,7] In asymptomatic chronic periradicular lesions associated with infected teeth, there is a balance between microbial aggression and host defense in the periradicular tissues. Microorganisms that are extruded apically during chemomechanical preparation cause the host to be challenged by a larger number of irritants than before. Consequently, the transient disruption in the balance between aggression and defense will cause the host to mobilize an acute inflammation to reestablish the equilibrium.[6]

At present, all preparation techniques and instruments are associated with extrusion of debris, even when the preparation is maintained short of the apical terminus. VandeVisse and Brilliant were the first to quantify the amount of apically extruded debris during instrumentation.[8] Several studies reported that instrumentation with an in-and-out motion tended to produce more apicallyextruded debris than

instrumentation with rotational motion.[9] This has led to the assumption that engine-driven rotary instruments produce less extrusion than hand instrumentation as rotary instruments have a tendency to pull the debris into their flutes, thus leading the debris out of the root canal in a coronal direction.[10]Recent advances for root canal preparation have focused on the concept "Less is more." Single file system was used to shape the root canal completely from start to finish. They have advantages such as lower cost, decreased shaping time allowing the clinician to spend more time on cleaning the canal with more advanced irrigation technique. Furthermore, the system eliminates procedural errors using a single instrument rather than using multiple files.[11]

MICRO-MEGA® offers One Shape®, Ni-Ti instrument in the continuous rotation for quality root canal preparations. One Shape® allows for curved canal negotiation with an instrumental and easy dynamic. Its nonworking tip ensures an effective apical progression avoiding obstructions which are often preceded by instrument separation. Both the systems are single files with one coronal shaping instrument.

Thus, the purpose of this study is to compare in vitro the amount of debris extruded apically using One Shape and Neo-Niti rotary instruments. The null hypothesis is that there is no difference between these file systems in the apical extrusion of debris.

MATERIALS AND METHODS

Fifty freshly extracted mandibular premolar teeth were selected and disinfected with chloramine T. Radiographs in buccal and proximal directions were taken for the presence of a single canal. The teeth were cleaned of debris and soft-tissue remnants and stored in distilled water. To ensure standardization of tooth length of 16 mm, all teeth were measured and decoronated with a high-speed diamond disk. Then, an access cavity was prepared in each tooth. Working length was determined by advancing a size 10 K-file into the canal until it was just visible at the foramen and then subtracting 1 mm from this measurement. The size of the minor constriction was standardized, and any tooth where the size 15 K-file extruded beyond the apical foramen was excluded. For each tooth, one Eppendorf tube was preweighed for three consecutive measurements using an electronic weighing machine. The selected teeth were mounted on rubber caps of vials through standardized holes created using a biopsy punch. The apical part of the root was suspended within the Eppendorf tube, which will act as a collector for extruded debris, and the whole assembly was placed in a vial. The assembly was then randomly divided into two groups using the coin toss method: Group 1 - One Shape system and Group 2 - Neo-Niti system. To prevent bias on the basis of visibility, the glass vials were painted on the exterior with single color coding for each group: black for Group 1 and red for Group 2. The operator was blinded as regards the rotary system for each group. A bent 27-gauge needle was forced alongside the stopper to equalize the internal and external air pressure. Canal preparation and irrigation were conducted by a single operator for both groups.

Group 1

One Shape Ni-Ti rotary instruments were used at 400 rpm at a maximum of 2.5 N/cm torque according to the manufacturer's instructions. The Endoflare which has a tip size of #25 and taper of 0.12 was used in the coronal 3 mm of the canal in an in-and-out motion. This was followed by the use of the One Shape file with a tip size of 25 and taper of 0.6% in an in-and-out motion without pressure.

Group 2

Neo-Niti files were used at a speed of 300 rpm as per the manufacturer's recommendations. The size 25/0.12 taper instrument (C1) was used for coronal flaring only in the coronal two-third. The size 25/0.06 taper instrument (A1) was used up to the full working length using pecking motion and cleaning the instrument in between and following the established standardized irrigation protocol.

During root canal instrumentation, 1 ml of distilled water was used after every time the instrument is withdrawn from the canal. Irrigation was performed withan in-and-out motion of the syringe using a side-vented 30-gauge needle placed (Max-i-Probe, Max-i-Probe, Dentsply Rinn) up to 3 mm of the working length. The total volume of irrigant in each group was the same - 8 mL (4 ml during instrumentation +2 ml final irrigant +2 ml external wash) for every tooth. The apex was prepared till #25 file in both instrumentation techniques. The external tip of the tooth was irrigated using 2 ml distilled water. The Eppendorf tubes were stored in an incubator at 68°C for 5 days to facilitate the evaporation of the moisture before weighing the dry debris using an electronic balance.

Weighing was carried out on an electronic balance for three consecutive weights for each sample, and the average was calculated. The evaluator was blinded to the preparation technique used for the respective groups. The measurements obtained were statistically analyzed.

Statistical analysis was done using SPSS, version 12 (SPSS Inc., Chicago, USA). The mean variance of the variables was analyzed using independent t-test, and the P value was set at 0.05.

RESULTS

Table 1: The mean of pre- and post-difference values of extruded debris produced during using of the two nickel-titanium file systems

Groups	N	Mean	SD	SEM	Mean diff.	p
Preweighted One shape system	25	2.300	0.150	0.030		
Neo NiTi system	25	2.250	0.100	0.025	-0.035	0.430
Postweighted One shape system	25	2.290	0.136	0.032		
Neo NiTi system	25	2.260	0.080	0.024	0.045	0.355
Difference One shape system	25	0.090	0.125	0.022		
Neo NiTi system	25	0.010	0.007	0.001	0.070	0.035

The mean of pre- and post-difference values of extruded debris produced during using of the two nickel-titanium file systems.

DISCUSSION

A major objective of root canal therapy is to obtain a clean root canal system. Debris such as dentine chips, necrotic pulp tissue, microorganisms and irrigants may be extruded into the periradicular tissue during canal instrumentation which leads to endodontic flare-up. Apical extrusion of infected debris to the periradicular tissues is possibly one of the principle cause of this post-operative pain.[1] Many factors affect the amount of extruded debris such as the instrumentation technique, instrument type and size, preparation endpoint and irrigation solution.[12,13]

The main objective of the present investigation was to determine the apical extrusion of dentine debris as a result of canal shaping by different rotary systems.

As per the results obtained, extrusion of debris apically occurred independent of the type of instrument used. The reciprocating single-file system showed significantly more debris extrusion compared with both the full-sequence rotary NiTi instruments ($P < 0.05$). The obtained differences may be caused by the preparation technique and/or the cross-sectional designs of the instruments.[14]

One of the most significant complications as a consequence of apical extrusion is an interappointment flare-up due to inflammatory reactions. It causes bone resorption, edema, and postoperative pain which is an undesirable occurrence both for the patient and the dentist.[1,10] Many factors affect the amount of extruded debris such as the preparation end-point, irrigation solution type and quantity, instrumentation size, technique, and instrument type.[12,15]

Mature mandibular premolars between the age group of 25 and 40 years with single straight root and canal were used in the study. Thus, the results are valid only for teeth with fully formed apices and straight canals.

Studies have shown that when instrumentation was performed to the apical foramen, significantly more debris was forced apically than wheninstrumentation was 1 mm short. In the present study, the working length was 1 mm short of the apical foramen so that variables which may affect results could be minimized.[16,17]Irrigation is a necessary and important phase of cleansing the canal.[18] Distilled water was used as an irrigant to avoid any possible weight increase due to NaOCl crystal formation. The tubes were stored in an incubator to evaporate the moisture and weigh the dry debris. The 27-gauge needle functioned as an air vent to permit extrusion of irrigant.[19]

Al-Omari and Dummer[20] reported that techniques involving a linear filing motion, such as step-back techniques, create a greater mass of debris than those involving some sort of rotational action. In previous studies, rotary Ni-Ti systems were mostly associated with less apical extrusion than manual instrumentation. To reduce the operator time and cost, newer single file system has gained popularity. The newer single-file Ni-Ti systems such as Neo-Niti andOneShape are designed to completely prepare root canals with only one instrument.According to Küçükyilmaz et al.,[21] One Shape demonstrated less apical extrusion of debris than ProTaper and Reciproc file system. Nayak et al.[22] showed that between One Shape and Wave one, One Shape produces less apical extrusion. Hence, it was clear that single rotary file system exhibits less apical extrusion than multi-file rotary systems and reciprocation file systems. The results were in conflict with those of Elmsallati et al.,[23] who showed that the short pitch design extruded less debris than the medium and long pitch design, since One Shape had a shorter pitch as compared to NeolixNiti system. However, standardization of apical diameter was not considered as well as the fact that Tinaz et al.[24] showed an increase in the extrusion of debris as the extent of apical patency increased.

Koch et al.[25] stated that files with constant helical angle allow debris to accumulate and varying the helical angle enhances removal of debris more efficiently. The Neolix Ni-Ti file possesses a variable helical angle of 28°C to 16° from tip to rear as compared to the constant helical angle of the One Shape which explains the screwing in effect of One Shape and enhanced extrusion of debris while using the same.The three-point contact of the blades at the

tip with a changing triangular cross section of the One Shape may result in the greater generation of debris as compared to rounded gothic tip with nonhomothetic rectangular cross section with two-point contact of the Neo-Niti system.

CONCLUSION

Both the rotary single-file systems used resulted in extrusion of debris beyond the apical foramen. The NeolixNiti single file system showed significantly less amount of extrusion than the One Shape single file system.

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