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An in-vitro evaluation of remaining dentine thickness through CBCT using different file systems

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Abstract

Aim: The present study was undertaken to compare and evaluate the remaining dentin thickness of root canals with Hyflex EDM , Neo endo and Neo endo S systems using cone beam computed tomography for analysis.

Materials and Methods: Forty five extracted human mandibular molars having were collected. Teeth were randomly assigned to three groups (n=15). Samples were decoronized by maintaining root length. Pre-instrumentation cone beam computed tomography scan was done after stabilizing the samples on wax blocks. The working length was determined at 1 mm short from the apical foramen by using a ISO 15 K-file tip protruding at apical foramen. Preparation was carried out according to the manufacturer's instructions. Finally, canals were instrumented upto apically for each group. After each instrumentation, root canals were irrigated with 2ml of 3% sodium hypochlorite solution followed by 2 ml of 17% EDTA solution. Final irrigation was done with 5ml of saline. Post instrumentation cone beam computed tomography scans of all samples in the 3 groups were acquired.

Result: Hyflex EDM and NeoEndo removed less dentin than Neo endo S file system.

Conclusion: Neo endo S file system removed more dentine than Hyflex EDM and Neo Endo file system.

Keywords: Remaining dentine thickness, CBCT

Introduction

Mechanical preparation of the root canal system is recognized as one of the most important stages in root canal treatment. The quality guideline of the European Society of Endodontology states that the elimination of residual pulp tissue, the removal of debris, and the maintenance of the original canal curvature during enlargement are the primary objectives of root canal instrumentation [1]. The amount of dentin being removed during instrumentation is an important parameter to avoid procedural mishaps such as strip perforations. Currently, experimental results have shown that Ni-Ti rotary systems cause less canal transportation and produce a more

centered and tapered preparation. Advanced instrument designs including noncutting tips, radial lands, different cross sections, and varying tapers have been developed to improve working safety, to shorten working time and create a greater flare of preparations [1]. Radiographic examination is essential in diagnosis and treatment planning in endodontics. Conventional radiographic technologies provide two-dimensional representations of three dimensional (3D) objects. Cone-beam computed tomography (CBCT) is a new medical imaging technique that generates 3-D images at a lower cost and absorbed dose compared with conventional computed tomography (CT). This imaging technique is based on a cone-shaped X-ray beam centred on a 2-D detector that performs one rotation around the object, producing a series of 2-D images. These images are re-constructed in 3-D using a modification of the original cone-beam algorithm developed by Feldkamp et al. in 1984. Images of the craniofacial region are often collected with a higher resolution than those collected with a conventional CT. In addition, the new systems are more practical, as they come in smaller Sizes [2].

Computed tomography was initially used in endodontics to confirm the diagnosis of root fractures, to analyze root canal walls and pulp chamber anatomy. More recently, this method has been used to evaluate root canal preparations [3]. Thus, acknowledging the importance of preserving the remaining dentinal thickness through proper usage of various instrument systems, the purpose of this study was to compare and evaluate the area increase of root canals using three different Ni-Ti rotary systems Hyflex EDM , Neo endo and Neo endo S systems.

Materials and Methods: Forty-five freshly extracted human mandibular premolars having single canal and straight root were collected. Samples were stored in normal saline solution until use. They were randomly divided into three groups containing 15 specimens in each of them.

Test apparatus

Samples were decoronized by maintaining root length at 14 mm. Preinstrumentation CBCT scan was done after stabilizing the samples on wax blocks. (Figures 1-2). The working length was determined at 1 mm short from the apical foramen using an ISO 15 K-file tip protruding at apical foramen.

Fig 1: Preoperative CBCT scan at coronal third

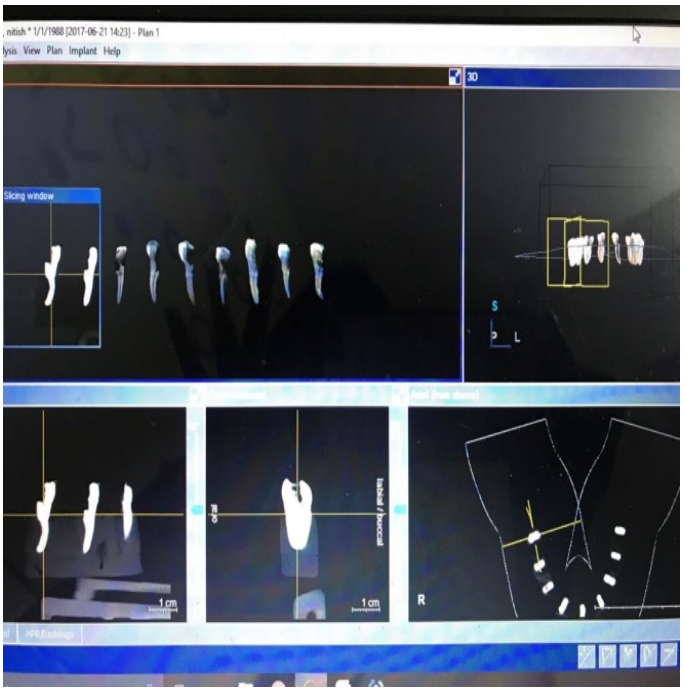


Fig 2: Preoperative CBCT scan

Root canal preparation

All root canals were widened to an ISO 20 K-file (Denstply, Maillefer)(Figure 3) inserted with balanced force movements through the working length, avoiding apical pressure, and under abundant irrigation. (Figure 4)

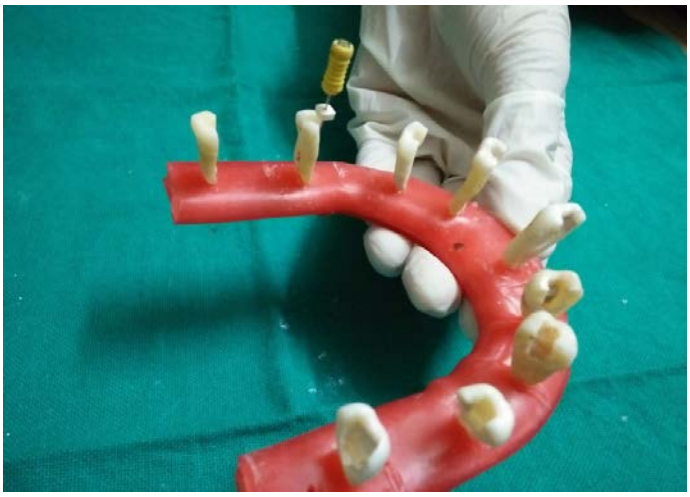


Fig 3: Root canals prepared to 20 K file

Rotary instruments were used with Endomate DT (NSK, Japan) according to manufacturer's recommendation .Irrigation was done between the files to maintain debris free canal.

Fig 4: Irrigation

After each instrumentation, root canals were irrigated with 2 ml of 3% sodium hypochlorite solution (Vensons, Bengaluru, India) followed by 2 ml of 17% EDTA solution (Deor Care, Kerala, India). Final irrigation was done with 5 ml of saline (Claris Lifesciences, Ahmadabad, India). After each rinse, an ISO 10 K-file was inserted inside the canal to check apical patency.

Sample analysis

Postinstrumentation CBCT scans of all samples in the three groups were acquired. The images were saved and were edited with CS3 Photoshop software (Adobe Systems Inc.), recorded in Tagged Image File Format and analysed by Image Tool 3.0 software for Windows software (University of Texas Science Center, USA). The area of each canal was measured at the apical (3 mm from the tip of the radiologicapex), middle (5 mm from the tip of the radiologic apex) and cervical (7 mm from the tip of the radiologic apex) thirds before and after instrumentation for comparison among the three rotary systems as well as to evaluate the area increase in the three-third of the canal. (Figure 5,6,7)

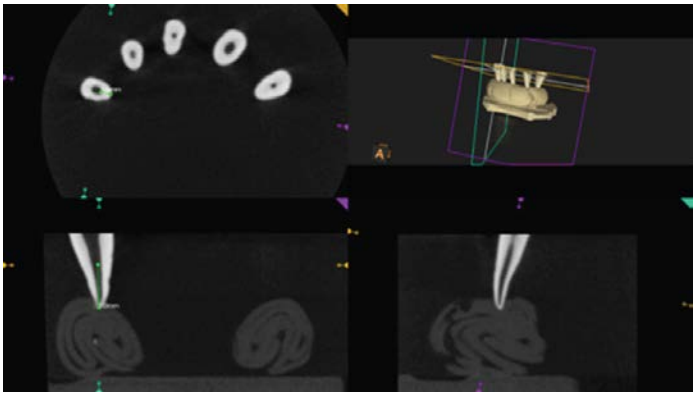


Fig 5: Post-operative CBCT using Neo endo S

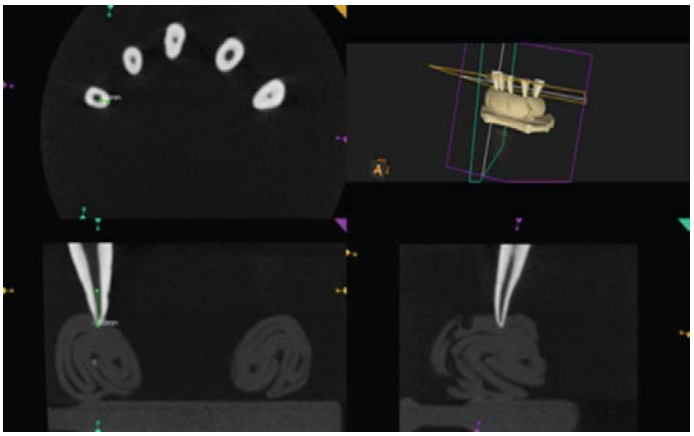


Fig 6: Post-operative CBCT using Hyflex file

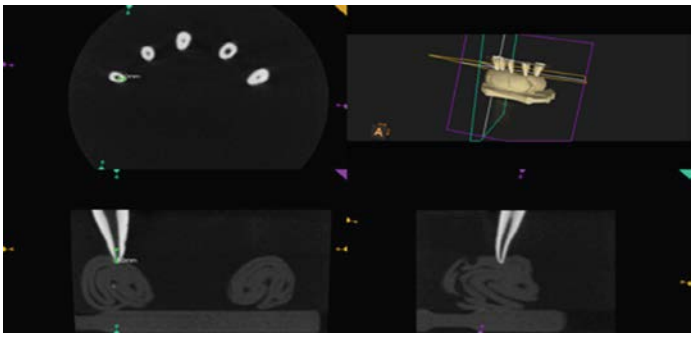


Fig 7: Post-operative CBCT using Neo-endo file

Data were analyzed using one-way ANOVA test for multiple comparisons followed by Tukey's post-hoc test for group comparisons. Comparisons of area measurements before and after instrumentation were carried out by Student's t-test.

Results

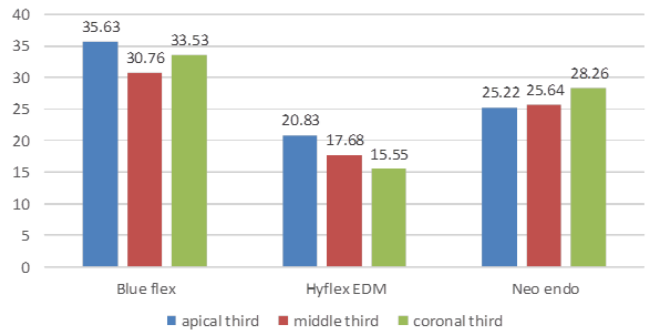
Tables 1,2 shows the means and standard deviations in remaining dentin thickness for each system pre- and postoperative values at different thirdsAt apical third, the mean percentage of area increase was highest ($P<0.05$) with Neo endo S (35.63) followed by Neo Endo (25.22) and least with Hyflex EDM(20.83). Similarly, at the middle third and coronal third, the mean percentage was highest for Neo endo S (30.76) and (33.53) followed Neo Endo(25.64) and (28.26) and least with Hyflex (17.68) and (15.85), respectively.

Discussion

There is overwhelming evidence that the reduction in intracanal micro-organisms is the major goal of endodontic therapy. The primary goals that an endodontist must achieve with root canal treatment are complete disinfection of the canal space, elimination of the progression of the periradicular tissue inflammation and thereby creation of favorable conditions for periradicular healing. This can be achieved using a proper chemo-mechanical preparation which is essential for successful endodontic treatment. However, traditional hand instruments often failed in achieving these objectives. Most canals are curved, whereas endodontic instruments are manufactured from straight metal blanks. This results in uneven force distribution in certain contact areas and a tendency of the instrument to straighten itself inside the canal. Consequently, apical canal areas tend to be overprepared toward the outer curve or the convexity of the canal, whereas more coronal areas are transported toward the concavity. Various studies have investigated the efficiency of Ni-Ti rotary instruments, but few have examined the ability to increase root canal area. In the present study, three Ni-Ti rotary systems namely Neo endo S, NeoEndo, and Hyflex EDM were used to investigate the remaining dentin thickness before and after instrumentation.

	% change in area(Neo endo S)	% change in area(hyflex EDM)	% change in area (Neo endo)	P value	Significance
At apical third	35.63± 6.73	20.83± 2.34	25.22± 4.98	0.001	Significant
At middle third	30.76± 5.89	17.68± 1.89	25.64± 5.21	0.001	Significant
At coronal third	33.53± 6.21	15.55± 1.7	28.26± 4.3	0.001	Significant

Table 1: Comparison of percentage increase in dentin thickness in different third of canal between different file system



Graph 1: showing comparison of percentage increase in dentin thickness in different third of canal between different file system

No file separations occurred in the present study. However, studies have showed that ProTaper systems are more prone to file separation. In endodontics therapy, the quality and quantity of the information obtained from radiographic examinations are very important, because they affect the diagnosis, treatment planning, and prognostic stability [8]. Volumetric or CBCT, a relatively new diagnostic imaging modality has been used in endodontic imaging.A review of digital and 3D applications for endodontic uses published by Nair and Nair summarized the CBCT portion by stating that such technology has proved useful for localization and characterization of root canals, treatment planning of periapical surgery and detection of root fractures in extracted teeth [9].

Add Speed and Torque of Each File

In the present study, we have used CBCT, which provided a practical and nondestructive technique for assessment of canal morphology before and after shaping according to Gluskin et al. Cone-beam computed tomography image analysis software was used which allowed pre- and post-instrumentation measuring of root canal area increase. Under the circumstances of this current in vitro study, it suggests that Neo endo S showed maximum removed dentin in middle and coronal thirds of the root canal compared to NeoEndo and Hyflex EDM systems which were statistically significant. Moreover, the mean percentage of area increase showed that Neo endo S achieved the most followed by NeoEndo and Hyflex EDM systems. Further research is needed in order to confirm and elaborate on its canal transportation, uninstrumented surface area, and preservation of dentin thickness which affects the prognostic stability of the teeth.

Conclusion

Within the limitations of this study, it was concluded that Hyflex EDM showed more amount of remaining dentine thickness than NEO ENDO and Neo endo S.

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