

## International Journal of Medical Science and Innovative Research (IJMSIR)

IJMSIR : A Medical Publication Hub

Available Online at: [www.ijmsir.com](http://www.ijmsir.com)

Volume - 6, Issue - 4, August - 2021, Page No. : 158 - 163

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

<sup>1</sup>Dr. Anil K Tomer, <sup>2</sup>Dr. Sachin Poonia, <sup>3</sup>Dr. Shivendra Ahlawat, <sup>4</sup>Dr. Ayush Tyagi, <sup>5</sup>Dr. Hysum Mushtaq, <sup>6</sup>Dr. Shivangi Jain, <sup>7</sup>Dr. Kanika

<sup>1-7</sup>Department of Conservative Dentistry and Endodontics, Divya Jyoti College of Dental Sciences and Research, Modinagar, Ghaziabad, Uttar Pradesh 201204, India.

**Corresponding Author:** Dr. Sachin Poonia, Post Graduate Student, Department of Conservative Dentistry and Endodontics, Divya Jyoti College of Dental Sciences and Research, Modinagar, Ghaziabad, Uttar Pradesh 201204, India.

**Citation this Article:** Dr. Anil K Tomer, Dr. Sachin Poonia, Dr. Shivendra Ahlawat, Dr. Ayush Tyagi, Dr. Hysum Mushtaq, Dr. Shivangi Jain, Dr. Kanika, "An in-vitro evaluation of remaining dentine thickness through CBCT using different file systems", IJMSIR- August - 2021, Vol – 6, Issue - 4, P. No. 158 – 163.

**Type of Publication:** Original Research Article

**Conflicts of Interest:** Nil

### Abstract

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

**Materials and Methods:** Thirty extracted human mandibular molars were collected. Teeth were randomly assigned to two 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. A size 15 K file was introduced into the canal until it was visible at the apical foramen, and the working length was determined by reducing 1mm from this length.. Preparation was carried out according to the manufacturer's instructions. 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 2 groups were acquired.

**Result:** Hyflex EDM removed less dentin than Neolix Neoniti file system.

**Conclusion:** Neolix Neoniti file system removed more dentine than Hyflex EDM 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 Endodontontology 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 reconstructed 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 two different Ni-Ti rotary systems Hyflex EDM and Neolix Neoniti systems.

## Materials and Methods

Thirty 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 two groups containing 15 specimens in each of them.

**Test apparatus:** Samples were decoronized by maintaining root length at 14 mm. Pre-instrumentation CBCT scan was done after stabilizing the samples on wax blocks. (Figures 1-2). A size 15 K file was introduced into the canal until it was visible at the apical foramen, and the working length was determined by reducing 1mm from this length. Preparation was carried out according to the manufacturer's instructions.



Fig 1: Preoperative CBCT scan at coronal third

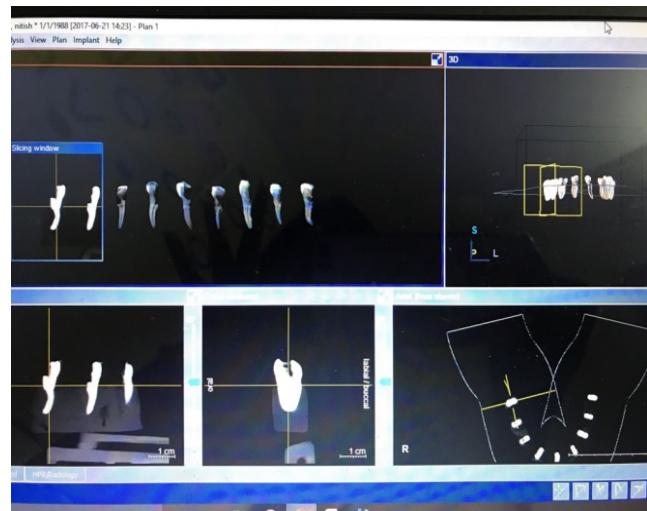


Fig 2: Preoperative CBCT scan

**Root canal preparation:** All root canals were widened to an ISO 20 K-file (Dentsply, 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

Post-instrumentation CBCT scans of all samples in the two 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 radiologic apex), 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)

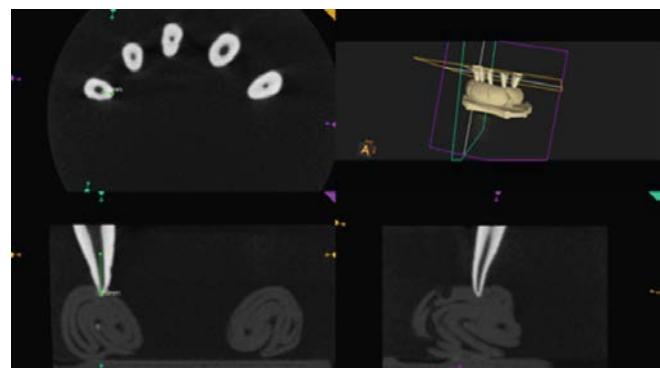


Fig 5: Post-operative CBCT using Neolix Neoniti

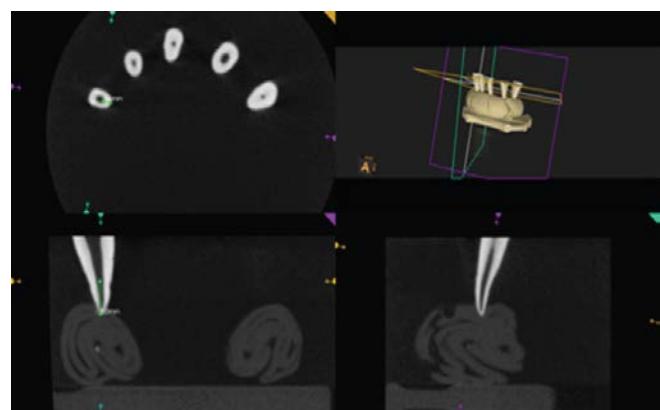


Fig 6: Post-operative CBCT using Hyflex file

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 and Graph 1 shows the means and standard deviations in remaining dentin thickness for each system pre- and postoperative values at different thirds. At apical third, the mean percentage of area increase was highest ( $P<0.05$ ) with Neolix Neoniti (25.22) and least with Hyflex EDM(20.83). Similarly, at the middle third and coronal third, the mean percentage was highest for Neolix Neoniti (25.64) and (28.26) and least with Hyflex (17.68) and (15.85), respectively.

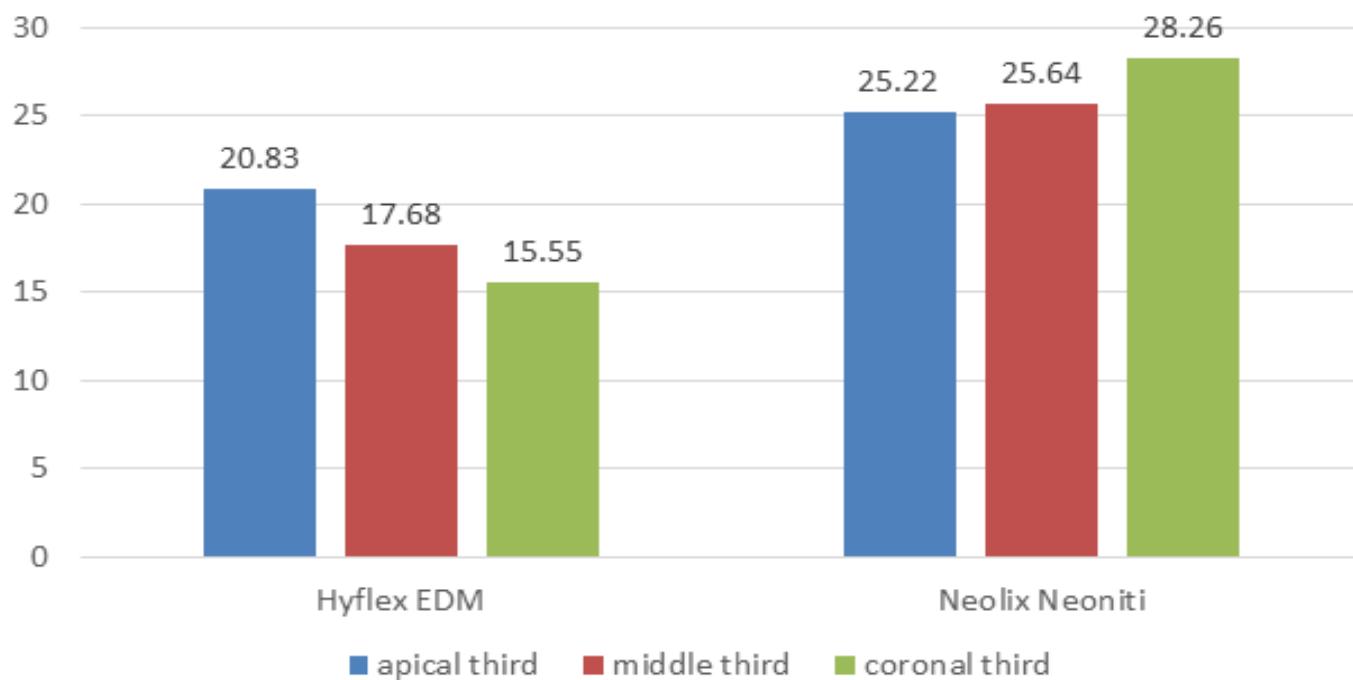
## Discussion

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, two Ni-Ti rotary systems namely Neolix Neoniti and Hyflex EDM were used to investigate the remaining dentin thickness before and after instrumentation.

	% change in area(hyflex EDM)	% change in area (Neolix Neoniti)	P value	Significance
At apical third	20.83± 2.34	25.22± 4.98	0.001	Significant
At middle third	17.68± 1.89	25.64± 5.21	0.001	Significant
At coronal third	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: Comparison of percentage increase in dentin thickness in different third of canal between different file system  
 No file separations occurred in the present study. 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].  
 In the present study, we have used CBCT, which provided a practical and non-destructive 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 Neolix Neoniti showed more dentin removal in middle and coronal thirds of the root canal compared to Hyflex EDM systems which were statistically significant. Moreover, the mean percentage of area increase showed that Neolix Neoniti achieved the most followed by 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 Neolix Neoniti.

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