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Research Article

A Comparative Evaluation of Remaining Root Dentin Thickness Using Hand and Rotary System Through Cone-Beam Computed Tomographic Analysis - An *in vitro* Study

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Abstract

Aim and Objective: This study aimed to compare and evaluate the amount of remaining dentin thickness in cervical, middle and apical third after instrumentation with stainless steel k -file [Hand instrumentation] and Neo Endo flex rotary file system by using Cone-beam computed tomography (CBCT).

Materials and Methodology: Ten freshly extracted human mandibular single-rooted teeth were selected. IOPA of all the teeth were taken to know the internal morphology. Teeth with simple morphology and single straight root canal were selected. Teeth were randomly assigned to two groups of five samples each. group1: k-file (stainless steel hand instrumentation) group 2: Neo Endo flex (rotary file system). Pre instrumentation cbct scan was taken for two groups by stabilizing the samples on wax blocks. Dentin thickness values measured at the cervical, middle, and apical third. The Access cavity was prepared, and canal patency was checked using 10 k-file by placing the file up to apical foramen. Working length was determined using the same file1 mm short of the apical foramen. Root canal instrumentation was done in two groups with hand files and rotary file system respectively, according to the manufacturer's instructions. Finally, root canals were irrigated with 2 ml of normal saline. Postoperative cbct scan was taken for two groups at cervical, middle, and apical third.

Results: Statistically, a significant difference was observed between the two groups. The k- file (stainless steel) hand instrumentation system removed more amount of dentine than that of Neo Endo flex ($P > 0.05$).

Conclusion: Stainless steel k-type file (Hand instrumentation) files showed more remaining dentin thickness than Neo Endo rotary files (Rotary file system).

Keywords: Remaining Dentine Thickness; Stainless Steel K- File; Neo Endo Flex Rotary File; Cone-Beam Computed Tomography

Introduction

Bio-mechanical preparation is one of the most critical stages of root canal treatment [1]. Instrumentation should be equal from all canal walls, producing a uniform debridement and avoiding excessive thinning of the root structure. Thus, the primary objective in endodontic instrumentation is maintaining the original canal curvature [1,2]. According to many studies currently used instrumentation techniques or devices cannot clean the root canals thoroughly, especially curved roots [3-5]. Perhaps the cleaning ability of manual root canal instrumentation is better than automated machines [6]. Though, instrumentation with rotary nickel-titanium (Ni-Ti) instruments led to favorable results; maintaining canal curvature and a rounder canal preparation even in severely curved root canals [7-11]. The remaining dentine

thickness after the root canal procedures may be the most crucial iatrogenic factor that correlates to incoming fracture resistance of the root [12]. According to Lim and stock, the minimum thickness of root canal walls after mechanical preparation should be 0.3mm. It allows adequate resistance against lateral forces during canal obturation and occlusal forces [13]. Radiographic examination is essential diagnostic tool in endodontic treatment. 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-dimensional images at a lower cost and absorbed dose compared with conventional computed tomography (CT) [14].

Aim

This study aimed to compare and evaluate the amount of remaining dentin thickness in cervical, middle and apical third after instrumentation with stainless steel k -file [Hand instrumentation] and Neo Endo flex rotary file system by using Cone-beam computed tomography (CBCT).

Methodology

Ten freshly extracted human single-rooted teeth with a patent single straight root canal were selected for this study. Samples were stored in normal saline until they use. They were randomly divided into two groups containing five specimens in each group. Buccal and proximal radiographs (Dental Intraoral E speed) were taken to ensure that the teeth had only one canal. Pre instrumentation cone-beam computed tomography scan was taken for two groups by stabilizing the samples on wax blocks, and dentin thickness values were measured at cervical, middle, and apical third (Table 1 and 2). Standard access cavities were prepared using endo access bur (Dentsply maillerfer, Switzerland). The incisal edge of each tooth was flattened as it is taken as a reference point. The canal patency was established with a size of10 K-file (Mani, Tochigi, Japan).The working length (WL) of each canal was determined 1 mm short of apical foramen, using size 10 K-file that was visible at the major diameter of the apical foramen.

Group 1 (Stainless steel k- file)

Root canal instrumentation was done with stainless hand files up to 35 and 40K file (Mani, Tochigi, Japan) based on the initial apical file, using the conventional technique. During preparation, 2 ml of normal saline (Claris Lifesciences, Ahmadabad, India) as used for irrigation.

Group 2 (Neo Endo flex)

Rotary instrumentation was done with Neo Endo flex rotary files using x smart plus(Dentsply maillerfer, Switzerland) by using crown down technique at 350 rpm and a torque of 1.5 ncm. The Orifice was enlarged with orifice opener, then 17/4% and 20/4% files were used in brushing motion up to working length. During instrumentation, canals were irrigated with 2 ml of normal saline. Postoperative cbct scan was taken for two groups at cervical, middle, and apical third.

Statistical analysis

The data were analyzed with SPSS version 15 using Kolmogrov-Smirnov test for normality, Leven's Test for equality of variances and t-test with 0.05 as the level for statistical significance. Group 1 p-value is > 0.5 compare to group 2, so it shows significant (Graph-1 and 2).

Results

Mean of removed dentine thickness after instrumentation in the two file systems at coronal, middle and apical thirds represented in (table 3 and 4).The results showed that hand instrumentation with k files removed more dentin than rotary instrumentation with Neo Endo files at coronal, middle and apical thirds. ($p < 0.05$).

Discussion

Biomechanical preparation of the root canals is one of the most critical stages of a root canal treatment [1]. The quality guideline of the European Society of Endodontology states that the elimination of pulp tissue remnants, debris and the maintenance of the original canal curvature are the primary objectives of root canal instrumentation [15].

The amount of dentin being removed during instrumentation is a vital parameter to avoid procedural mishaps such as strip perforations [16]. Fracture of endodontically treated teeth increases proportionally with an increase in the amount of root dentine removal [17]. Endodontically treated maxillary and mandibular premolars are more prone to fracture, as the mesiodistal (MD) width is much narrower than the buccolingual [17-19]. It has been suggested that 0.3 mm of root canal wall thickness should be present after mechanical preparation as the minimum remaining dentin thickness (RDT). It is essential for providing enough resistance against lateral forces during canal filling and occlusal forces [13]. In the present study, Stainless steel k-files removed more dentine from the root canals than Neo Endo rotary files at

coronal, middle and apical levels. It is because of the rigidity of the stainless k files. This is in accordance with the previous studies [11] The Neo Endo instruments have alternating cutting edges, and this design is presumed to have two functions:(i) to eliminate screwing in and blocking in continuous rotation and (ii) to reduce the working torque.

In endodontics therapy, radiographic information is very important, as they affect the diagnosis, treatment planning, and prognostic stability [15]. Volumetric or CBCT, a relatively new diagnostic imaging modality has been used in endodontic imaging [20]. Nair and Nair summarized that, CBCT has proved useful for localization and characterization of root canals, treatment planning of periapical surgery and detection of root fractures in extracted teeth [21,22]. 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. M *et al*.

Cone-beam computed tomography image analysis software was used, which allowed pre and post-instrumentation measuring of remaining dentin thickness. Under the circumstances of this current in vitro study, it shows that stainless steel k files removed more dentin than Neo Endo rotary files. Further research is needed to confirm and elaborate on its, un instrumented surface area, and preservation of dentin thickness in the mesiodistal direction, which affects the prognostic stability of the teeth.

Conclusion

Within the limitations of the study, it was concluded that stainless steel k files showed more remaining dentin thickness than Neo Endo rotary files.

Pre operative CBCT Images

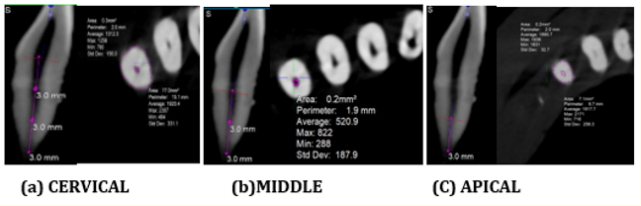


Figure 1

Post operative CBCT Images

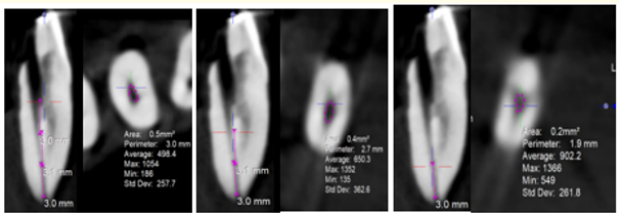


Figure 2

Cervical middle apical cervical middle apical

Teeth No	Pre	Post	Pre	Post	Pre	Post
1	16.7	16.1	13.5	13.4	6.9	6.9
2	16.5	16.4	12.4	12.3	8.6	8.6
3	14.5	14.3	11.3	11.1	8.6	8.5
4	12.3	12.1	6.3	6.2	1.4	1.4
5	10.8	10.6	10.9	9.3	6.6	6.2

Table 1: Group -1 Pre And Post Values of CBCT.

Teeth No	Pre	Post	Pre	Post	Pre	Post
1	13.6	13.3	10.1	9.8	6.5	6.4
2	14.2	14.1	10.8	10.7	8.6	8.5
3	13.9	13.5	10.8	10.7	7.1	7.0
4	12.5	12.1	10.1	10.0	10.1	10.0
5	14.2	14.0	12.4	12.3	8.7	8.7

Table 2: Group -2 Pre And Post Values of CBCT.

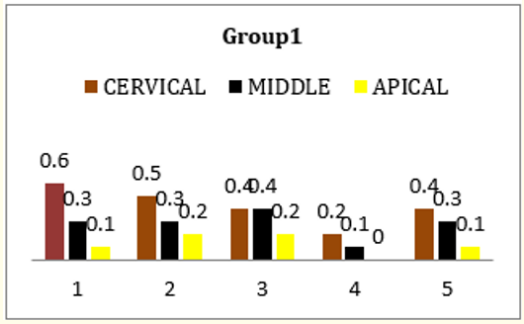
Teeth No	Cervical	Middle	Apical
1	0.6	0.3	0.1
2	0.5	0.3	0.2
3	0.4	0.4	0.2
4	0.2	0.1	0
5	0.4	0.3	0.1

Table 3: Group - 1 [K- File] Mean Of Removed Dentine Thickness After Instrumentation.

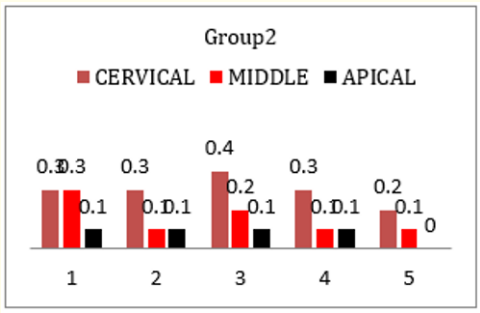
Teeth No	Cervical	Middle	Apical
1	0.3	0.3	0.1
2	0.3	0.1	0.1
3	0.4	0.2	0.1
4	0.3	0.1	0.1
5	0.2	0.1	0

Table 4: Group -2 [Neo Endo Flex]. Mean Of Removed Dentine Thickness After Instrumentation.

Mean of removed dentine thickness after instrumentation



Graph 1



Graph 2

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