Study Protocol

Comparative evaluation of centering ability of three different rotary file systems in human extracted teeth using Cone Beam Computed Tomography-In Vitro study.

Abstract

Background: Centering ability of root canal is considered to be an imperative factor during root canal instrumentation. Hence it is decided to evaluate and compare the centering ability of Reciproc, Reciproc Blue, and WaveOne files in teeth by means of cone beam computed tomography in vitro condition.

Objectives:

1. To evaluate the centering ability of the Reciproc file system in extracted mandibular molar.
2. To evaluate the centering ability of the Reciproc Blue file system in extracted mandibular molar.
3. To evaluate the centering ability of the WaveOne file system in extracted mandibular molar.
4. To compare the above file systems with each other.

Methodology: 30 Newly extracted mandibular molars will be considered in the study. Before access opening teeth will be exposed for a pre-instrumentation CBCT scan. After this scanning standard access cavity preparation will be done followed by checking canal patency using 10#K-file. Then teeth will be divided into three groups for root canal instrumentation. Group 1: Instrumentation by using Reciproc file, Group 2: Instrumentation by using Reciproc Blue file, Group 3: Instrumentation by using WaveOne file. For evaluation of centering ability, the equation introduced by Gambill (1996) i.e., (m1 – m2) ÷ (d1 – d2) or (d1 – d2) ÷ (m1 – m2) and (b1-b2) ÷ (l1-l2) or (l1-l2) ÷ (b1-b2) will be used after post instrumentation CBCT scanning.

Expected Results: The Reciproc Blue file system is expected to give better results in canal centering ability.

Conclusion: Centering ability is considered to be important factor in biomechanical preparation, as it can retain the instruments in centre which is crucial to offer a precise extension, without weakening of the root structure. Different files are used to compare and evaluate the centering ability of instrument by CBCT.

Keywords: Centering Ability, Reciproc, Reciproc Blue, Wave One Files.

INTRODUCTION:

Biomechanical preparation is the most significant step in the root canal procedure. The principles of the root canal shaping comprise of continuous tapering conical shape from the canal orifice to the root apex while preserving the actual shape of the root canal without altering the root canal curvature [1,2,3]. Horizontal cross-section of root canal is categorised as the round, oval, long oval, flattened, and irregular. It is a well-known fact that the canals are rarely circular and often oval [4,5]. In teeth with an oval cross-section, the original anatomy of the root canals along with its maximum dentinal thickness can be preserved by using an appropriate root canal instrument. Centering ability of canal is considered to be an important factor during root canal instrumentation as it keeps instrument centered which is necessary for providing the accurate enlargement, without causing an unnecessary weakening of the root structure of the teeth. Based upon the formula given by Gambill, centering ability states that the mean centering ratio is the rat io which specifies capability of the instrument for remaining positioned in the root canal of tooth[6]. Earlier, stainless-steel hand files were taken into consideration for biomechanical preparation of root canal of tooth, which tend to restore their original linear shape that may result in canal transportation, unwanted aberrations like elbows, zips, and danger zone [7.] *Song et al* in his study showed that the while evaluating centering ability of canal using two Nickel-titanium and one stainless steel K-type in teeth, the result showed that Ni-Ti contributes for even cutting of the dentin with the canal wall further making them centred as compared to the stainless-steel K-type file[2,7]. To overcome this complication rotary instruments were used. The first commercial nickel-titanium rotary instrument was introduced by Civijan in 1991[7]. These instruments have improved safety, efficiency, procedural simplicity, and super elasticity. But it had certain limitations as it has a larger taper so it generates more friction and stress as compared to the conventional hand file system[8].

Now the newer file systems have been introduced to overcome those drawbacks for example; Wave One, Reciproc Blue, Reciproc file system, etc., Reciproc system (VDW, Munich, Germany) was presented to upsurge the clinical provision of Nickel-Titanium files and their resistance to cyclic fatigue as compared to constant motion as it is appealed that reciprocating motion causes decrease in torsional stresses created by the reverse cyclic file rotation. These files are made of M-wire, with regressive taper. They have an cross-section of 'S' shape & two effective cutting edges. The rational of reciprocating movement is based on a balanced-force technique. These files are used at 10 cycles of reciprocating motion per second for the preparation of a small, curved canal [9]. WaveOne file system (Dentsply maillefer) is the one time-use reciprocating system made-up from M-wire alloy, which increases flexibility, preserves the remaining dentinal thickness of the canal, and improves cyclic fatigue. This file system consists of noncutting modified guiding tip [10]. Reciproc Blue (RB) manufactured by (VDW, Munich, Germany) is innovated by a special heat treatment which results in the change of the molecular structure of alloy gaining the instrument blue colour. This heat treatment helps to increase both flexibility and cyclic fatigue resistance with less surface micro-hardness values compared with its predecessor [11].

So far, adequate data pertaining to comparison of centering ability of Reciproc, Reciproc Blue, and WaveOne file systems is not available.

Cone-beam computed tomography is an effective means of determining the centric ability of dissimilar files in the root canal as it is non-destructive method providing three-dimensional

reproduction of the tooth and allows better pre- and post-operative evaluation as the image are provided in orthogonal planes and in oblique planes for better assessment of the root canal anatomy [12,13] Hence it is decided to conduct a research for evaluating and comparing the centering ability of 3 different rotary files i.e., Reciproc, Reciproc Blue, and WaveOne file systems in posterior teeth by means of Cone beam computed tomography in vitro condition.

AIM:

To compare and evaluate the centering ability of three different rotary file systems in mandibular first molar using cone-beam computed tomography.

OBJECTIVES:

1. To evaluate the centering ability of the Reciproc file system in extracted mandibular molar.
2. To evaluate the centering ability of the Reciproc Blue file system in extracted mandibular molar.
3. To evaluate the centering ability of the WaveOne file system in extracted mandibular molar.
4. To compare the above file systems with each other.

MATERIAL AND METHODS :

SOURCES OF DATA

The study will be conducted in Sharad Pawar Dental College, In Department Of Conservative Dentistry And Endodontics and 30 freshly extracted mandibular molars teeth will be collected from Department Of Oral Surgery.

STATISTICAL ANALYSIS-

Based on the result of previous studies, sample size is calculated by using the formula: -

Sample size will be calculated on following parameters by using Epi Info software.

$$N = \frac{2 (Z_\alpha + Z_\beta)^2 S^2}{d^2}$$

Z_α – 1.96 for α=0.05

Z_β – 0.84 for β=0.2 i.e., 80% power

$$S^2 = \frac{S_1^2 + S_2^2}{2}$$

S_1^2 = Standard deviation of mean centering ability in Reciproc file system group = 0.081

S_2^2 = Standard deviation of mean centering ability in Wave-One file system group =0.078

m_1 = mean centering ability in Reciproc file group =0.54

m_1 = mean centering ability in Wave-One file group =0.64

d= difference between mean centering ability in Reciproc file group & Wave-One file group

Sample size: 10 per group

Thus, total sample size of 30 will be required for 3 groups.

STUDY DESIGN

In this study, a total of 30 samples will be divided into three groups:

The groups are as follows:

Group 1. 10 samples instrumentation by using Reciproc file system (VWD Dental)
Group 2. 10 samples instrumentation by using Reciproc Blue file system (VWD Dental)

Group 3. 10 samples instrumentation by using WaveOne file system (Dentsply maillefer)

INCLUSION CRITERIA

- Completely formed root apices and root canal.
- Single canal with single apical foramen.
- Canal with closed apex.
- Roots with the angle of curvature ranging from 20-40 degrees.
- The posterior tooth with oval canals.

EXCLUSION CRITERIA

- Teeth with signifying resorption.
- Fractured teeth.
- Teeth with immature apices.
- Teeth with root caries.
- Teeth showing external, internal resorption, and calcification.
- Teeth with restorations.

MATERIALS

- 30 Freshly extracted mandibular molars.
- Reciproc file system (VWD Dental)
- Reciproc Blue file system (VWD Dental)
- WaveOne file system (Dentsply Maillefer)
- 2.5% NaOCl
- Come Beam Computed Tomography

STEPS- 30 Newly extracted mandibular molars will be considered in the study. Teeth with canal curvature of 20-40 degrees will be selected with mature apices**.** Before access opening teeth will be exposed for a pre-instrumentation CBCT scan.

After pre-instrumentation scanning teeth will be subjected to a standard access cavity preparation followed by checking canal patency using 10#K-file. Then teeth will be divided into three groups for root canal instrumentation.

Group 1: Instrumentation by using Reciproc file system (VWD Dental)
Group 2: Instrumentation by using Reciproc Blue file system (VWD Dental)
Group 3: Instrumentation by using WaveOne file system (Dentsply maillefer)

Instrumentation using Reciproc, Reciproc Blue, WaveOne file systems instrumentation will be carried out by the manufacturer's instructions.

Ultimately in all the 3 groups irrigation will be done between every two successive files with 2ml of 2.5%NaOCl.

After completion of root canal instrumentation 1ml of 15%EDTA will be applied for 1min and the canals flushed again with 3ml of NaOCl.

For evaluation of centering ability, the formula introduced by *Gambill et al (*1996) i.e., (m1 – m2) ÷ (d1 – d2) or (d1 – d2) ÷ (m1 – m2) and (b1-b2) ÷ (l1-l2) or (l1-l2) ÷ (b1-b2) will be used after post instrumentation CBCT scanning.

GROUPS	File system	Sample size
Group 1	Reciproc file system (VWD Dental)	10
Group 2	Reciproc Blue file system (VWD Dental)	10
Group 3	WaveOne file system (Dentsply maillefer)	10

STATISTICAL ANALYSIS

SPSS v21.0 software (IBM SPSS Inc. Chicago, IL) will be used for data analysis. For testing distribution of data Shapiro Wilk test will be used. Depending on the data distribution, for Parametric data, One-way ANOVA test will be used or Kruskal Wallis test will be used for Non-Parametric data to compare mean centering ability across the Reciproc, Reciproc blue & Wave-One rotary file systems. Statistical significance will be kept at p value ≤ 0.05.

EXPECTED RESULTS:

The Reciproc Blue file system is expected to give better results in canal centering ability.

DISCUSSION

According to one study the canal transportation of root also its centering ability was evaluated using Nickel-Titanium rotary instruments in 128 lower premolars. Ni-Ti files: WaveOne, Reciproc, ProTaper Gold, Mtwo, WaveOne Gold, and RaCe file systems were used. Pre-

instrumentation and post instrumentation scanning of root canals were done by CBCT in the similar position & then the calculation of the centering ability was done by formula proposed by *Gambill et al* (1996). This concluded that ProTaper Gold showed the uppermost results concerning centering ability, however the least one was allied with BioRaCe [6.]

Another author performed study for assessment of canal transportation pf root structure along with centering ability for three rotary files by using cone beam computed tomography. 30 permanent maxillary 1st molars have been selected for the study and categorised in 3 various groups, according to the instrumentation of root canals following files were used that includes Hyflex EDM, OneShape and Reciproc blue. Pre and post instrumentation scanning of the root canals were done by using CBCT. Centering ability was calculated according to the following formula: (m1 – m2) ÷ (d1 – d2) or (d1 – d2) ÷ (m1 – m2) and (b1-b2) ÷ (l1-l2) or (l1-l2) ÷ (b1-b2). This study resulted that the Reciproc blue file system has shown improved clinical presentation as compare to OneShape file system regarding both transportation and centering ratio [9.]

Another study estimated canal transportation of file and its centering ability in 90 MB root canals of newly extracted lower 1st molars. According to inclusion and exclusion criteria teeth were selected i.e., teeth with matured apex, 15-30-degree curvature of canal. Three rotary files were used in this study for root canal preparation-

Reciproc file with eight percent taper, 0.25mm tip diameter.

WaveOne file with eight percent taper, 0.25mm tip diameter.

Edge File file with six percent taper, 0.25mm tip diameter.

Teeth were arbitrarily alienated into 3 groups, and root canal instrumentation of molars were carried out using these three file systems conferring to the producer's directions. Pre-instrumentation and post instrumentation scanning of root canals were done by means of cone beam computed tomographic machine in the similar position. The centering ability has been estimated using a1-a2 ÷ b1-b2 or b1-b2 ÷ a1-a2 formula. It resulted that the centering ability of Edge File system was more definite and superior as compare to WaveOne file system and Reciproc file system [14]. Other studies related to different endodontic treatment modalities were reviewed[15-17.]

LIMITATIONS:

- Centering ability will be evaluated in the posterior teeth and the values may differ in the anterior teeth.
- Results obtained from in vitro studies may differ significantly from those of in vivo studies.

CONCLUSION:

Though the centering ability Is considered to be important factor in biomechanical preparation, as it can retain the instruments in centre which is crucial to offer a precise extension, with no

unwarranted weakening of the root structure of tooth. Different file system is used to compare and evaluate the centering ability of instrument by CBCT.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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