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CBCT ANALYSIS OF VARIOUS METHODS FOR PLACEMENT OF CALCIUM HYDROXIDE PASTE IN THE ROOT CANAL: AN IN VITRO STUDY

Endodontic

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ABSTRACT

AIM: The aim of this study was to compare the efficacy of six techniques for placement of calcium hydroxide intracanal medicament into the root canal system.

MATERIALS AND METHODS: Total 30 extracted human mandibular premolars were decoronated to standardize the root length and subsequently prepared with Heroshaper rotary file system upto file 25 4%. After cleaning and shaping of the canals the roots were divided into six groups on the basis of six insertion techniques for calcium hydroxide paste: group 1: conventional technique using handfiles (MAN); group 2: rotary lentulo spirals; group 3: combination of handfile and sonic activation through EndoActivator (EA), group 4: sonic devices MM sonic (Micromega), group 5: Gutta Percha cones and group 6: Pastinject (Micromega). The quality of calcium hydroxide fillings in the root canal system was evaluated at coronal, middle and apical third of the canal with the help of NNT viewer software of CBCT.

RESULT: In general, calcium hydroxide paste was nearest to the apex in MM sonic and Endoactivator groups as compared to other groups.

CONCLUSION: the present study results showed that sonic devices used in the present study provide a superior coating of calcium hydroxide intracanal medicament than other techniques used.

KEYWORDS

calcium hydroxide, placement techniques, CBCT

INTRODUCTION

Calcium hydroxide paste (Ca(OH)2) intracanal medication is routinely used to carry out the root canal disinfection following the biomechanical preparation.(1) Studies have shown that this procedural step has a positive influence on the outcomes of endodontic treatment in cases of infection.(1-3) However, a uniform and homogeneous filling up to working length (WL) is important to get adequate effectiveness of Ca(OH)2 pastes.(4) A number of methods are used to insert Ca(OH)2 pastes into the root canal, including a hand file, Lentulo spiral, and special devices such as syringes and compactors.(5-7)

Studies comparing different techniques to fill root canals with Ca(OH)2 show controversial results. One study found that the endodontic hand file is superior to McSpadden compactor and Lentulo spiral in root canals of dogs premolars, and the endodontic hand file produced the lowest number of empty spaces in the three thirds evaluated .(5) However, another study reported that there were no differences in outcomes between using a Lentulo spiral or a hand file in human mandibular premolars.(8)

Alternative devices/techniques have been examined to improve the quality of Ca(OH)2 filling.

For instance, one study compared different devices/instruments including K-file, ultrasonic file, and Lentulo spiral in single-rooted premolars, and showed comparable quality of fillings.(6) Currently, ultrasound as well as sonic devices are very popular among endodontists, and their applications include activation of irrigation solutions and sealer placement.(9) Sonic systems are suggested to improve the quality of Ca(OH)2 root canal filling; however, there is no scientific evidence that supports this statement, to date. (11)

The aim of this study was to compare the efficacy of six techniques for placement of calcium hydroxide intracanal medicament into the root canal system.

MATERIALS AND METHODS

-Teeth selection and initial preparation

Single rooted 30 teeth with single canals which were non-carious, fully mature apex were taken for study purpose and teeth with multiple canals, caries, resorption, immature apex, cracks, and calcified canals were excluded. All samples were immersed in 10% formalin solution (for not longer than 2 weeks) and then were cleaned with scalers to remove debris and deposits. All teeth were kept in 5.25% NaoCl for 2 hours and were stored in 0.9% saline solution until they were used. Periapical radiographs of all teeth were taken to rule out the possibilities of multiple canals and calcifications.

The teeth were decoronated by using a diamond disc to obtain roots with a standardised length. A number 10 k-file was inserted into the root canal, until the tip of instrument is visible at the foramen. Then, 1mm was deducted from this measure to obtain the working length (WL). Apical patency was confirmed with a 15 k-file and irrigation was done with 3% sodium hypochlorite. The canals were first prepared using hand files upto No. 20 K-file. Then, the cleaning and shaping of the root canals was done with the HeroShaper rotary files upto the size 25.04. During shaping procedure, root canals were irrigated with 3% sodium hypochlorite (NaoCl). A final flush was done using 3ml of 3% NaoCl and normal saline. Root canals were dried with paperpoints.

Now, these roots were randomly divided into six groups of 5 teeth each based on the technique of insertion of calcium hydroxide. In this study, oil-based calcium hydroxide paste Ca(OH)2 was used. The groups were as follows:

1. **Hand file group** : A small quantity of Ca(OH)2 was dispensed at the orifice and a size 25 K-file (MANI) was inserted into the canals up to the apex and removed with counterclockwise movements. This procedure was repeated thrice for each tooth. Thereafter, a cotton pellet was applied gently onto the canal orifice.
2. **Gutta percha group (GP)**: A small quantity of Ca(OH)2 was dispensed at the orifice and a gutta percha cone of size 25 was used by coating the cone with Ca(OH)2 paste and then coating the root canal wall with the cone. Thereafter, a cotton pellet was applied gently onto the canal orifice.
3. **Lentulo group (LEN)**: A small quantity of Ca(OH)2 was dispensed at the orifice and Lentulo spiral No.25 (MANI) was inserted into the canals up to 2 mm from the root apex. The LEN was powered by a motor in a clockwise movement at 1000 rpm. Slight pumping motion was applied. This procedure was repeated thrice for each tooth. Thereafter, a cotton pellet was applied gently onto the canal orifice.

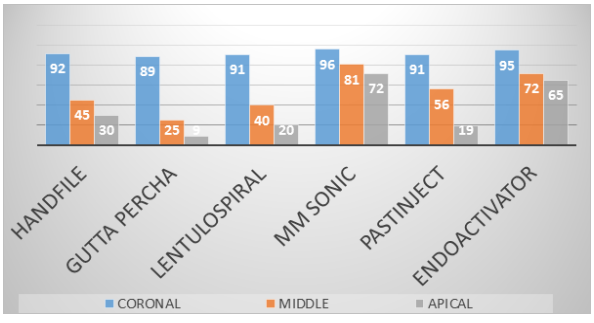
4. **MM Sonic group:** A small quantity of Ca(OH)2 paste was dispensed into the coronal third of the root canal and then MM Sonic (MicroMega) was used upto the working length.
5. **Pastinject group**: a small quantity of Ca(OH)2 paste was dispensed into the coronal third of the root canal followed by application of the Pastinject (MicroMega),an engine driven instrument,of size 25.
6. **EndoActivator group (EA):** A small quantity of Ca(OH)2 paste was dispensed into the coronal third of the root canal followed by application of the EndoActivator (Dentsply Tulsa Dental Specialties, Johnson City, TN, USA) with a red tip size #25/0.04 positioned at 2 mm from the WL. The EndoActivator was activated at 6.000 cpm for 20 seconds. This procedure was repeated thrice for each tooth. Thereafter, a cotton pellet was applied gently onto the canal orifice.

Cone Beam Computed Tomography (CBCT) analysis:
Post $Ca(OH)_2$ placement CBCT imaging was done for all the samples in group, and volume of medicament inside the canal left in each specimen was estimated .

The calculation of Ca(OH)2 volume was performed using NNT viewer software version 7.2 by NewTom Cone beam 3D imaging in MPR view**.** The evaluation of paste fillings was executed on the basis of the volume measurement with ITK Snap software version 3.6.0. Calculations of volume were done at 3 levels: coronal, middle and apical thirds.

The volume of calcium hydroxide was statistically analysed by one-way anova of variance at a significance level of .05. The multiple comparisons at different level mean values were compared with the post hoc tukey test

RESULTS:



GRAPH 1

The volume of Ca(OH)2 among the tested groups showed statistical significant difference ($p < 0.05$). In general, the sonic devices MM sonic and Endoactivator showed highest volume of Ca(OH)2 followed by Pastinject, Handfile, Lentulospiral and Guttapercha groups.

Multiple comparisons at different levels showed highest volume of the paste in coronal third for all groups followed by middle third and apical third. In general, root canal filling was nearest to the apex in MM sonic and Endoactivator groups as compared to other groups.

DISCUSSION:

Calcium hydroxide paste has been used extensively as an intracanal medicament in endodontics because of its antibacterial properties and it also stimulates repair by deposition of mineralised tissue.(12,13)To increase its effectiveness, the paste must be perfectly coated to the root canal walls and completely fill the canal space.(4)

The cleaning and shaping of root canal must be done meticulously. If the canal preparation is not well done, the intracanal medicament will not be effective. So, the root canal should be enlarged upto a large diameter compatible with its anatomical condition. When the canals are not enlarged, filling with medication becomes slightly difficult.(14,15)

Rotary files have been used as they provide uniform canal preparation for all samples.

Many studies have been done to test the effectiveness of lentulospirals, gutta percha and hand files for application of medicament, but sonic instruments, EndoActivator and MM Sonic have not been used. The possible reason for sonic instruments to show better results could be that sonic energy has ability to create several nodes along the entire length of root canal and this sonic movement provides better penetration of paste into the canal upto apical third.

Selection criteria of CBCT was that it gives a 3 dimensional interpretation of specimens and it has been used for analysis of different techniques for removal of calcium hydroxide but there is no literature till date using CBCT for evaluation of techniques of placement.(16)

The present study has some limitations including the use of teeth with non-complicated root canal anatomy, and the *in vitro* experimental design. For these reasons, the results are not directly applicable to the clinical field.

CONCLUSION:

In conclusion, sonic devices used in the present study provide a superior coating of calcium hydroxide intracanal medicament than other techniques used.

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