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Comparative evaluation of intracanal calcium hydroxide removal with different hand and rotary file systems: An in vitro study

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Abstract

Background: Calcium hydroxide (Ca(OH)2) is the most commonly used intracanal material; it needs to be removed in entirety before obturation. Several techniques have been used for the same including use of various hand and rotary files.

Aim: This study was carried out to compare the efficacy of Hand K files and single and multiple rotary file system in removal of Ca(OH)2.

Methodology: 30 mandibular premolars were selected on the basis of specified inclusion and exclusion criteria. They were divided into three groups - Group 1 (K file), Group 2 (protaper hand), and Group 3 (protaper rotary). Biomechanical preparation (BMP) was carried out as per the manufacturer's instructions; 2.5% sodium hypochlorite was used as the irrigant and 17% ethylenediaminetetraacetic acid as the penultimate irrigant. Canals were then filled with metapex and were sealed. After 7 days, metapex was removed, using the same file system as that used for BMP. Samples were sectioned longitudinally and evaluated under a stereomicroscope.

Statistical Analysis: Statistical analysis of the obtained data was carried out using one-way analysis of variance test.

Results: Protaper rotary displayed better removal of metapex than Protaper hand and Hand K file. Moreover, removal was better in the middle third of canal than apical third.

Conclusion: Rotary file system is more effective in removal of Ca(OH)2 than the hand file system.

Keywords: Metapex, Protaper Rotary, Protaper Hand and K Files.

Introduction

Bacteria and their by-products or necrotic pulp can cause pathologic changes, in the periapical tissues. Hence, the first objective of endodontic treatment is the elimination of bacterial infection and debris from the root canal.[1] There are various methods which help in reducing the root canal infection such as mechanical instrumentation along with irrigant solutions and use of medicaments.[2] Intracanal dressing has been advocated to disinfect the root canal system enhancing the success of root canal treatment.[3]

The crux of endodontics revolves around the efficient preparation and obturation of the apical third of root canal. Intracanal dressing has been advocated to disinfect the root canal system enhancing the success of root canal treatment. Calcium hydroxide (Ca(OH)2) was first introduced in endodontics by Herman in 1920. At present, Ca(OH)2 is one of the most commonly used intracanal medicament. It is alkaline in nature with a pH of approximately 12.5. It has antimicrobial activity, has tissue-dissolving ability and inhibits tooth resorption.[4] It even leads to hard-tissue formation. Before obturation, entire intracanal dressing has to be removed. Residue of Ca(OH)2 affects the sealer penetration into the dentinal tubules, physical properties, adhesion of sealer, and dentinal bond strength.[5]

Several techniques have been proposed to remove the Ca(OH)2 dressing , including use of endodontic Hand file, sonic activation, passive ultrasonic irrigation, canal brush system, and nickel-titanium (NiTi) rotary instruments. Removal with Hand files using irrigation solutions may be insufficient, so the use of NiTi rotary instruments has been advocated.[5] This study is carried out to compare the effectiveness of hand ProTaper file system with ProTaper rotary file system and k file system for the removal of metapex from the root canal.

Materials and methods

Freshly extracted permanent mandibular premolar teeth were collected. Teeth - washed thoroughly under running water & cleaned with ultrasonic instruments. Then disinfected with 5.25% sodium hypochlorite. Inclusion criteria: Single rooted premolars, No root caries. Exclusion criteria: Root fractures, Root canal treatment, Resorption, Severe root curvature or calcification, Caries. Tooth -sectioned at cementoenamel junction (measuring 14 mm in length) using a diamond disc and water spray. A #10 K file (MANI, Japan) - inserted into the canal till apex of the root. Working length was established 1 mm short of the apex.

Group 1: Prepared manually using step-back technique and the apical preparation was carried out till No. 25 with 2% taper K files

Group 2: Prepared with protaper hand file system, using crown-down technique till no.F3

Group 3: Prepared with protaper rotary file system till no. F3

During BMP, 2.5% sodium hypochlorite used as irrigant. Rinse with 17% EDTA solution for 1 min and distilled water was used as final rinse. Root canal was dried with paper point

Metapex is then filled into the canal. Temporary filling of calcinol, 3–4 mm in thickness placed over a moist cotton

pellet. The samples were incubated at 37°C and 100% humidity for 7 days. After 7 days, temporary filling was removed with the help of spoon excavator $Ca(OH)_2$ was removed in each group using the same file system, which used for BMP. Two longitudinal grooves were made in the buccal and lingual aspect of each root, with a diamond disk and split into two halves by a chisel. Each section examined under a stereomicroscope at ×20 magnifications, and photograph was taken with the help of a digital camera. Photographs were evaluated. The marked middle and apical portion was evaluated as per the following scores: Score 1: Absence of remnants Score 2: Scattered remnants; Score 3: Mass remnants Score 4: Densely packed remnants.

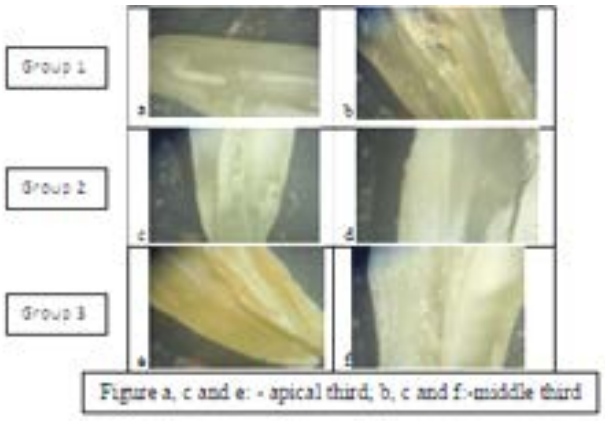

Figure 1

Statistical Analysis

Statistical analysis was done using Statistical Package for Social Sciences (SPSS for Windows v.16). Comparison of calcium hydroxide removal scores among three groups was done using Kruskal-Wallis test followed by Mann-Whitney test for multiple comparisons. The level of significance for the study was fixed at $p<0.05$.

Results

The comparison of calcium hydroxide removal was done at two levels, i.e., middle and apical third. In the middle and apical third region, there was a statistically significant difference in the three groups ($p<0.001$).

Kruskal-Wallis test				
Group	N	Mean rank	Mean score	p-value
Middle third				
K file	10	24.80	3.3	0.000
Hand ProTaper	10	11.80	1.8	
Pro Taper Rotary	10	9.90	1.6	
Total	30			
Apical third				
K file	10	25.20	3.7	0.000
Hand ProTaper	10	13.10	1.9	
ProTaper Rotary	10	8.20	1.3	
Total	30			

Table 1

Inference

Graph 1

Discussion

Ca(OH)2 is the most commonly used intracanal medicament as it is effective against a wide variety of microorganisms.[2] Metapex contains radiopaque component barium sulfate which can help to control the deposition of material when seen radiographically. Iodoform is incorporated to improve the antibacterial properties of the material. Silicone oil acts as a vehicle.[6] Metapex contains silicone oil as its vehicle and has a pH below that which is effective to kill E. faecalis. The superior antimicrobial effects of Metapex may be due to

the combination with iodoform and to the viscous and oily vehicle, which may prolong the action of the medicament. Accordingly, Gomes et al showed that oily vehicles increase the antimicrobial effects of calcium hydroxide against E. faecalis and other bacteria.[7] The strong bactericidal properties of iodoform paste have been demonstrated in previous studies.[8]

Before obturation of the canal, removal of entire Ca(OH)2 content is important since it may interact with the sealer and form unstable matrix. Zinc oxide-eugenol-based sealers are the most commonly used because of their satisfactory physicochemical properties.[9] Kuga et al. reported that residual Ca(OH)2 may interact with zinc oxide-eugenol sealer and result in calcium eugenolate formation.[5]

These residues might also affect the adhesion of sealer to root canal wall. Sealing ability of silicon-based sealer is also affected by the residual Ca(OH)2.[2] Penetration of sealer in the dentinal tubule improves the sealing ability and retention of obturating material,[11] but this residue acts as a barrier in penetration of the sealer.[2] According to Komabayashi et al., the average size of Ca(OH)2 particles ranges between 0.5 and 2 μm, which is less than the dentinal tubule diameter.[10] As a result, residual Ca(OH)2 particles can easily penetrate and block the dentinal tubules.

In our study, ProTaper rotary is found to be most effective in removal of Ca(OH)2 whereas K file was least effective. Musale and Mujawar also found rotary files to possess better ability to clean canal and reduce instrumentation time. Koçak et al. so concluded that rotary files are more effective in removal of medicament than Hand file. Böttcher et al. also concluded that Hand files are not able to completely remove Ca(OH)2. However, studies have reported that flute design and cross-section of files are important factors in efficacy of debris and material removal.

In the present study, Ca(OH)2 was removed more effectively in the middle third of the root as compared to the apical probably because of more anatomical variations and constrictions being present in the apical third.

Conclusion

Rotary file system is more effective in removal of Ca(OH)2 than the hand file system. For more conclusive results, a wider study needs to be undertaken.

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