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Effectiveness of four different techniques in removing intracanal medicament from root canals - An in vitro study

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Abstract

Aim: The aim of the study was to compare all the techniques and evaluate which technique is best for removing calcium hydroxide from the root canals

Material and methodology: 16 freshly extracted mandibular premolars were taken. Root canals were instrumented with Protaper rotary system. During the preparation, root canals were irrigated with 2 ml of 2.5%NaOCL. When instrumentation was completed, a final flush was done using 5ml of 17% EDTA and 5 ml of 2.5% NaOCl. Canals were then dried and filled with the calcium hydroxide. Teeth were randomly assigned to four groups of 4 teeth each. In Group I, root canals were irrigated and filed manually with a Protaper F3 instrument, giving a final flush. In Group II, the canals were irrigated and a Protaper F3 instrument was used and given a final flush. In Group III, the root canals were irrigated and a piezo electronic unit using a size 15 K file was inserted to the working length and activated for 30 s in each canal. In Group IV, root canals were irrigated,

and a medium-sized Canal Brush was placed and advanced to the working length. Teeth were sectioned and seen in scanning electron microscope. Images were further scored by Kuga et al scoring criteria. One-way analysis of variance with *post-hoc* Tukey test was used for statistical analysis for collected data.

Keywords: Canal brushes, Protaper, SEM, ultrasonic

Introduction

The main goal of an endodontic treatment is complete removal of bacteria, their by-products [(1)]**.** However, due to complex root canal configuration, complete debridement through mechanical instrumentation alone cannot remove entire bacterial load. Contemporarily use of intracanal medicaments are requisite to debride infected tissues and eradicate microorganisms from the root canal system [(2)]

Calcium hydroxide as intracanal medicament has many advantageous biological properties attributed to this substance, such as anti-microbial activity, high alkalinity, inhibition of tooth resorption, and tissue dissolving ability. Despite these advantages it has a critical limitation. Ca (OH)2 placed inside the root canal has to be completely removed before obturating the canal with permanent obturating materials. Otherwise, remanets of Ca (OH)2 can hinder the penetration of sealers into the dentinal tubules, markedly increase the apical leakage of root canal-treated teeth and potentially interact with the zinc oxide eugenol sealers, rendering them brittle and granular [(4)]. Kuga et al 2011 reported that residual Ca (OH)2 may interact with zinc oxide-eugenol sealer and result in calcium eugenol ate formation [(5)]. Residual Ca (OH)2 in root canals can also shorten the setting time of zinc oxide eugenol-based endodontic sealers if used for final obturation.

The review of literature shows that the removal of Ca(OH)2 is most frequently incomplete, resulting in a residue covering 20%–45% of the canal wall surfaces, even after copious irrigation with saline, NaOCl, or ethylenediaminetetraacetic acid EDTA. The most commonly described method for removing Ca(OH)2 is instrumentation along with sodium hypochlorite and ethylenediaminetetraacetic acid irrigant solutions combined with use of “master apical file” at working length .Several other techniques that have been proposed to remove the calcium hydroxide dressing from the root canal system, include the use of sonic activation , passive ultrasonic irrigation ,the canal brush system and nickel-titanium rotary instruments .

Thus, the purpose of this study is to evaluate the presence of remaining Ca (OH)2 canals of mandibular premolars after attempted removal with Hand Protaper instruments, Protaper rotary instrumentation, Canal brush and Ultrasonic.

Material and methodology

Sample selection

Fourth freshly extracted human single-rooted lower premolars with relatively similar dimension and morphology. Teeth should be free of carious lesion, root filling, fracture. Teeth should have fully formed apices.

methodology

This in- vitro study was conducted in the Department of Conservative Dentistry and Endodontics of Desh Bhagat Dental College and Hospital, Gobindgarh. The Scanning electron microscope study was done at Thapar university, (patiala).

Preparation

The selected teeth were cleaned from soft or hard attached tissues and then stored in normal saline. The samples were then autoclaved. Access cavity was prepared, by using Endo Z access bur. The canal was irrigated using 2.5% sodium hypochlorite solution and finally flushed copiously with distilled water and canal

patency was seen with no. 10 K-file in each tooth. The biomechanical preparation of root canals was done with Protaper gold rotary system to a size F3 instrument as the master apical file. During the preparation, the root canals were irrigated with 2 ml of 2.5% NaOCl solution after each instrument. When instrumentation was complete, a final flush was done using 5ml of 17% EDTA and 5 ml of 2.5% NaOCl. Excess sodium hypochlorite was removed by paper points. The canal were then filled with the calcium hydroxide. Radiograph were taken to check if the calcium hydroxide is filled properly in the canal. The samples were stored for 1 week at 37˚C in 100% relative humidity and then teeth were randomly divided into 4 groups.

Group 1	Hand Protaper system (Dentsply)
Group 2	Protaper gold rotary system (Dentsply)
Group 3	Ultrasonic system (woodpecker)
Group 4	Canal brushes (Coltene)

In group 1, root canals were irrigated with 5 ml of 2.5%NaoCL, filed manually with size F3 Protaper hand instrument, and received a final flush with 5 ml of 2.5% NaOCl.

In group 2, the canals were irrigated with 5 ml of 2.5 %NaOCl and Protaper F3 instrument in an electric motor, and received a final flush with 5ml of 2.5%NaOCL.

In group 3, the root canals were irrigated with 5 ml of 2.5%NaOCL and a piezo electronic unit using a size 15 Various U file was inserted to the WL and activated for 30sec each canal. The final flush was given with 5ml of 2.5%NaOCL

In group 4, root canals with irrigated with 5ml of 2.5% NaOCl, and a medium sized canal brush was placed in a slow speed handpiece and advanced to the Working length. A circumferential motion was made with the canal brush for 30s, and a final irrigation of 5ml of 2.5% NaOCl was used.

After each technique, the canals were dried with paper points. Grooves were made on the buccal and lingual surfaces of the teeth with a water-cooled diamond disc, and the teeth were split along their long axis in a buccolingual direction using a surgical chisel. For SEM analysis, the specimens were dehydrated for 48 hours in a desiccator. SEM analyses were performed under 1000 X magnification in the middle The specimens were examined under a scanning electron microscope. Several photographs (×100) were taken to observe the calcium hydroxide residues at the apical, middle and cervical thirds of each specimen. The images were scored according to the following criteria given by Kuga et al.

- 0- absence of residues,
- 1- small amounts of residues (upto20% of the surface covered).
- 2- moderate amount of residues (20% to 60% of surface covered).
- 3- large amounts of residues (more than 60% of surface covered).

The scores were assigned to the apical, middle and cervical thirds independently.

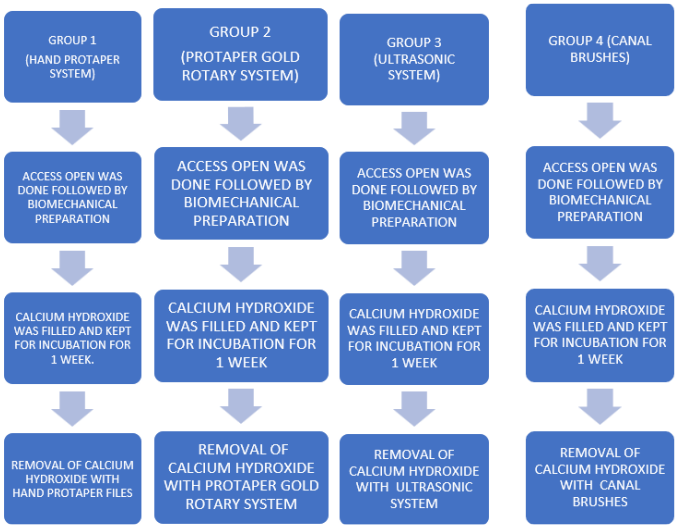


Fig 1:

Statistical Analysis

One-way analysis of variance with post-hoc turkey test was used for statistical analysis for collected data at a 95% confidence level.

Results and observation

The present in vitro study was carried out with an objective to evaluate and compare the effectiveness of four different techniques in removing intracanal medicament from the root canal. The coronal, middle and apical thirds were examined under scanning electron microscope at 100 x magnification. The specimens were further evaluated.

Amongst the four groups the remnants were observed in all the groups i.e none of the group was able to completely remove calcium hydroxide from the root canal. The canal brushes left minimum remnants followed by ultrasonics then Rotary and Hand Protaper.

A total of 40 tooth sample included in the study, samples were randomly divided in 4 groups and assessed by Kuga et al assessment criteria

Criteria for assessment- Kuga et al.

0- Absence of residue

1- Small amount of residues up to 20%

2- Moderate amount of residues up to 20%-60%

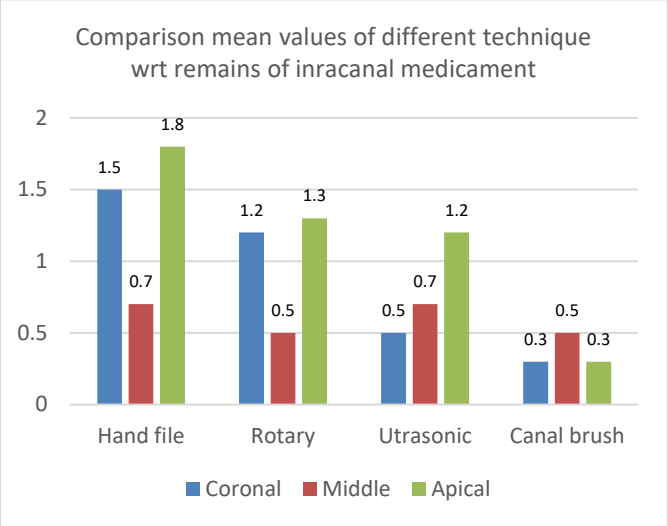
3- Large amount of residues more than 60%

Table Demonstrates the mean value and standard deviation between the four methods-

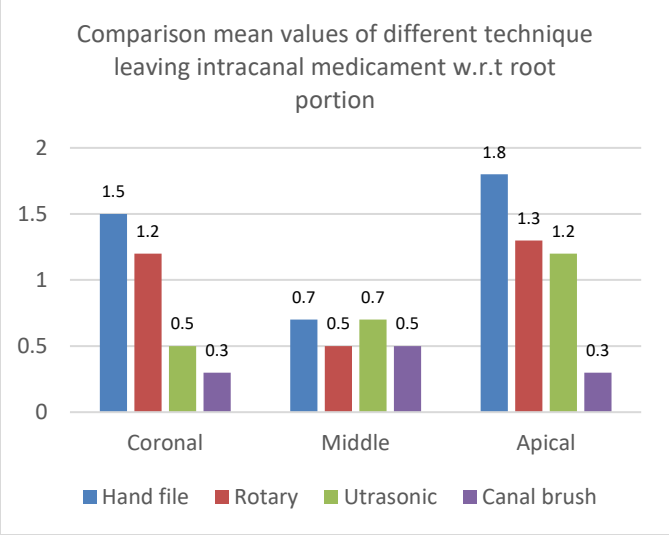
The table 4 demonstrates that mean value of Protaper hand files is 1.3, rotary is 1, ultrasonic tips is 0.7 and canal brushes is 0.3 which concludes that canal brushes were most effective in removing calcium hydroxide followed by ultrasonic tips and rotary and hand Protaper files were least effective in removing calcium hydroxide from the canals.

Descriptives Analysis								
Overall								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Protaper Hand file	10	1.3350	.41605	.13157	1.0374	1.6326	.67	1.67
Rotary	10	1.0000	.22000	.06957	.8426	1.1574	.67	1.33
Ultrasonic	10	.7990	.39134	.12375	.5191	1.0789	.33	1.33
Canal brush	10	.3660	.24757	.07829	.1889	.5431	0.00	.67
Total	40	.8750	.47621	.07530	.7227	1.0273	0.00	1.67

Table 1: Descriptive analysis for Protaper hand files, rotary, ultrasonics and canal brushes



Graph 1:



Graph 2:

Discussion

The main etiologic factors responsible for apical inflammatory pathologies are microorganisms. The goal of endodontic treatment is the prevention and control of pulpal and periradicular infections. Numerous measures have been introduced to reduce the number of microorganisms from the root canal system, including various mechanical instrumentation techniques, irrigation regimes, and intracanal medicaments [7]

Intracanal medicament have been recommended with the goal of eliminating bacteria from the root canal, preventing bacterial proliferation between appointments, and acting as a physiochemical barrier preventing root canal infection. [8]

Hermann introduced calcium hydroxide as a pulp-capping agent, since then it has been widely used in endodontics. Various biological properties of Ca (OH)2, such as antimicrobial activity, tissue-dissolving ability, inhibition of tooth resorption, and hard tissue formation.

The objective of this study is to evaluate the effectiveness of four different techniques i.e Hand Protaper, Rotary, Ultrasonics and Canal Brushes in removal of calcium hydroxide from the root canal and imaged using scanning electron microscope as it is one the most efficient assessment method.

Sodium hypochlorite solution is recommended as the main irrigant and compatibility of NaOCl and calcium hydroxide has been reported. Irrigation with NaOCl only was thought to have minimal effect on root canal degradation. Repeated instrumentation even with precurved hand files has been shown to cause transportation and calcium hydroxide may be packed apically during removal procedures [10]

In the present study four systems were chosen i.e Hand Protaper, Protaper gold rotary, Ultrasonic and canal brushes.

Traditionally Hand Protaper files were used for calcium hydroxide removal. Studies like R.P.A Balvedi et al, Margelos et al and Knee et al concluded the efficacy of Hand Protaper files in removal of calcium hydroxide from the root canal and found that the complete removal of Calcium Hydroxide pastes from the canal walls was not obtained for the conditions tested. Repeated instrumentation with hand files has been shown to cause transportation and calcium hydroxide may be packed apically during the removal procedure.

Kenee et al. 2006 evaluated the amount of calcium hydroxide remaining in the mesial canals of molars after

removal with NaOCl and EDTA irrigation, hand files, rotary instrumentation or ultrasonic techniques. They found that rotary and ultrasonic techniques removed significantly more residues than the hand file and irrigation solution technique. [12]

The last system used in our study is canal brushes. Canal brush is used with permanent rotation in a slow speed. Use of canal brush have resulted in a better transfer and exchange of irrigant within the canal spaces but mechanical scrubbing of bristles is more likely to be the main factor responsible for removing calcium hydroxide debris, particularly when used with permanent rotation.

Ljubisa Markovic ,Frank Booth, Stefan Zimmer2015 evaluated the use of the Canal Brush improves removal of calcium hydroxide paste from instrumented straight root canals. [9]

The Canal Brush has been shown to be safely used both with rotation and sonic activation in previous studies. It is not clear whether mechanical action of the bristles, irrigant activation, or a combination of both have contributed to the good cleaning efficacy of the Canal Brush. Use of the Canal Brush may have resulted in a better transfer and exchange of the irrigant within the canal spaces, but mechanical scrubbing of the bristles is more likely to be the main factor responsible for removing calcium hydroxide debris, particularly when used with permanent rotation. [9].

In previous studies, the amount of calcium hydroxide in the canal was calculated by measuring the surface area of the residues of the canal walls in terms of $mm^{2,}$ using a scoring method, using scanning electron micro scopy After each removal technique, the roots are disassembled, and photos are taken which are analyzed with with digital imaging processing to measure the surface area covered with residual materials. In the present study, a scanning electron microscope was used.

In the present study one way analysis of variance with post hoc turkey test was used for statistical analysis.

Results of present study are in accordance with study reported by AC Bhuyan et al 2015 who reported that none of the techniques used was completely able to remove Ca $(OH)_2$ from the root canals but the Canal Brush and ultrasonic were significantly better than the rotary instrument and hand Protaper groups [13]

We also concluded that none of the techniques used completely able to remove Ca $(OH)_2$ from the root canal but canal brushes and ultrasonic were significantly better than rotary and hand Protaper group.

Under this comparison we found that in coronal and apical third all the 4 groups were inefficient in removing Ca $(OH)_2$.

On contrary to our results LjubisaMarkovic ,Frank Booth ,Stefan Zimmer in 2015 evaluated the use of the Canal Brush improves removal of calcium hydroxide paste from instrumented straight root canals .They concluded that canal brush significantly improves the removal of calcium hydroxide, with no significant difference between rotary motion and sonic activation. After use of the Canal Brush the apical third of the root canal was free of remnants in half of the cases while after syringe irrigation distinct masses or densely packed remnants were observed in 83% of the cases. At the apical and middle thirds, no root canals were completely cleaned after syringe needle irrigation, and at the cervical third, only two specimens were free of residues [9].

Sowmiya Tamil et 2011 compared evaluation of intracanal calcium hydroxide removal with hand file, rotary file, and passive ultrasonic irrigation in the canal. They concluded that passive ultrasonic irrigation had the highest ability to remove They further concluded that

least remnants were present in the middle third followed by coronal and apical third.

Conclusion

This in vitro study was conducted using a scanning electron microscope to evaluate and compare the effectiveness of four different techniques in removal of calcium hydroxide from the root canal.

Within the parameters of this study, the following conclusions can be made-

1) All of the four techniques removed calcium hydroxide but none of the technique was completely able to remove calcium hydroxide from the root canals.

2) Canal brushes gave minimal amount of calcium hydroxide residues followed by ultrasonics then Protaper gold rotary and hand Protaper.

3) Canal brushes and ultrasonics are significantly better than hand Protaper and Protaper gold rotary.

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