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## Comparative evaluation of efficacy of different irrigation devices in removal of calcium hydroxide in teeth with simulated internal resorption cavities.

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#### ABSTRACT

**Background:** The placement of calcium hydroxide as intracanal medication is an important step in the management of endodontic infections and inflammation. The present study was conducted to assess efficacy of these different irrigation devices in removal of CH in teeth with simulated internal resorption cavities.

**Materials & Methods:** 60 single-rooted mandibular premolars were decoronated and prepared using the ProTaper Gold system up to F5. 10 specimens were served as group I – negative control. 10 specimens were served as group II – positive control. The remaining specimens were divided into 4 groups, where NaOCl and EDTA were activated using PUI, XP-endo, EA, and EI for 1 minute. The remnants of CH were scored as 0- Free of CH debris, 1- Less than half was filled with CH debris, 2- More than half was filled with debris, and 3- Completely filled with debris

**Results:** None of the tested groups were able to remove complete CH paste from simulated internal resorption cavities. PUI and XP-endo file showed superior and effective results as compared to all other groups. EndoActivator (EA) showed similar results to XP-endo but significant difference with PUI whereas Endo-Irrigator Plus (EI) showed the least amount of CH removal ( $P < 0.05$ ). Score 0, 1, 2 and 3 in group I was as 100%, in group II was 100%, in group III was 50%, 38%, 12%, in group IV was 55%, 10%, 27% and 8%, in group V was 24%, 16%, 40% and 20%, and in group VI was 6%, 32%, 42% and 21% respectively. The difference was significant ( $P < 0.05$ ).

**Conclusion:** In artificial internal resorption cavities, CH could not be entirely eliminated by any irrigation method. In this case, PUI outperformed all other irrigation tools, while XP-endo eliminated CH just as well as PUI did—but better than EA and EI plus.

**Keywords:** Calcium hydroxide, EndoActivator, irrigation

## Introduction

Eliminating microbes, microbial toxins, and vital and necrotic remnants of pulp tissues from the root canal system is the main objective of a successful endodontic procedure. Due to its complicated architecture, it is extremely hard to completely debride a root canal using chemomechanical preparation, cleaning, and shaping, as evidenced by numerous studies.<sup>1</sup>

Calcium hydroxide (CH) is commonly used in endodontics as an intracanal medication.<sup>2,3</sup> It has several properties that make it beneficial for this purpose, including its antimicrobial activity, ability to promote tissue healing, and alkaline pH, which helps neutralize acids and disinfect the root canal system.<sup>4</sup> Calcium hydroxide is often used as an intracanal medication in cases of pulp necrosis, periapical inflammation or infection, and as an interim medication between endodontic appointments. It is particularly useful in cases of persistent infection or when the root canal system is not fully accessible during the initial treatment.<sup>5</sup>

Passive ultrasonic irrigation (PUI) has been shown to be the most effective method for chemical irrigant activation in numerous research on mechanical irrigant activation. It can remove more intracanal medication, but not the entire CH.<sup>6</sup> The present study was conducted to assess efficacy of these different irrigation devices in removal of CH in teeth with simulated internal resorption cavities.

## Materials & Methods

The present study consisted of 60 single-rooted mandibular premolars. Teeth were decoronated and prepared using the ProTaper Gold system up to F5. Samples were buccolingually sectioned and resorption cavities were prepared. 10 specimens were served as group I – negative control. In the remaining specimens, CH was delivered and root halves were brought together. 10 specimens were served as group II – positive control. The remaining specimens were divided into 4 groups, where NaOCl and EDTA were activated using PUI, XP-endo, EA, and E1 for 1 minute. The remnants of CH were scored as 0- Free of CH debris, 1- Less than half was filled with CH debris, 2- More than half was filled with debris, and 3- Completely filled with debris and were analyzed. Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

## Results

**Table I U1 and U2 value in groups**

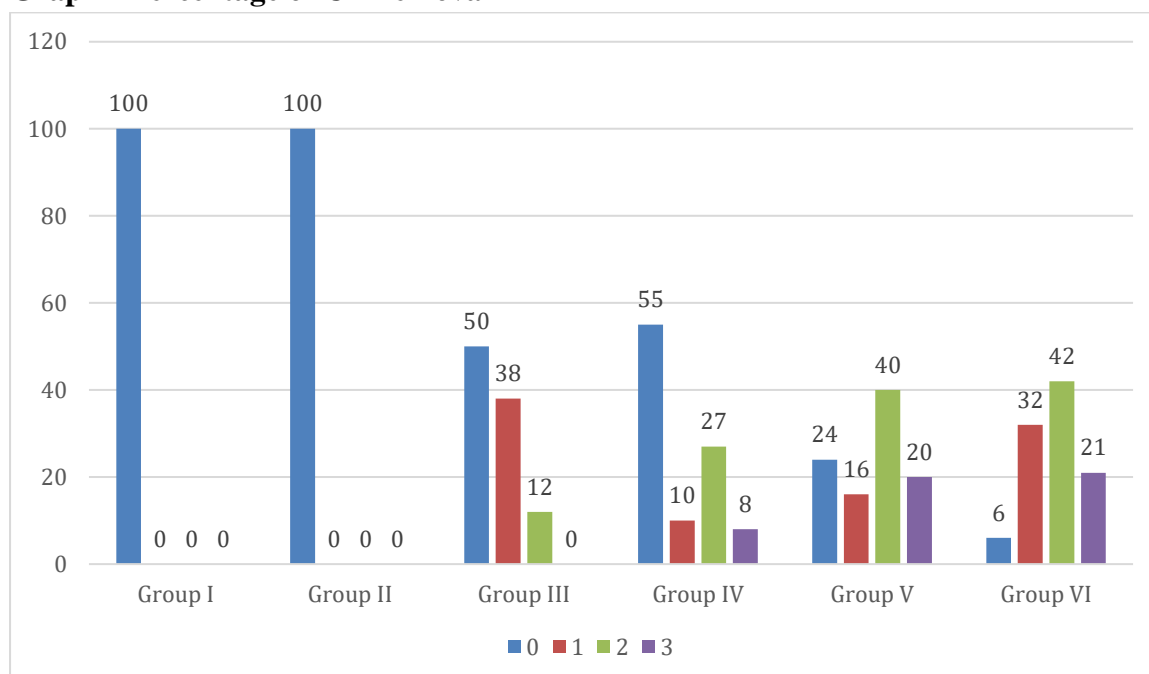
Groups	U1	U2	P value
PUI-XP	185	215	0.94
PUI-EA	114	282	0.01
PUI-EI	96	346	0.01
XP- EA	138	255	0.09
XP- E1	110	283	0.02
EA- E1	174	230	0.62

Table I shows that none of the tested groups were able to remove complete CH paste from simulated internal resorption cavities. PUI and XP-endo file showed superior and effective results as compared to all other groups. EndoActivator (EA) showed similar results to XP-endo but significant difference with PUI whereas Endo-Irrigator Plus (EI) showed the least amount of CH removal (P < 0.05).

**Table II Percentage of CH removal**

Groups	0	1	2	3	P value
Group I	100	0	0	0	0.01
Group II	100	0	0	0	0.02
Group III	50	38	12	0	0.04
Group IV	55	10	27	8	0.05
Group V	24	16	40	20	0.05
Group VI	6	32	42	21	0.04

Table II, graph I shows that score 0, 1, 2 and 3 in group I was as 100%, in group II was 100%, in group III was 50%, 38%, 12%, in group IV was 55%, 10%, 27% and 8%, in group V was 24%, 16%, 40% and 20%, and in group VI was 6%, 32%, 42% and 21% respectively. The difference was significant ( $P < 0.05$ ).

**Graph I Percentage of CH removal**

## Discussion

The placement of calcium hydroxide as intracanal medication is an important step in the management of endodontic infections and inflammation. It helps to disinfect the root canal system, promote healing of periapical tissues, and facilitate successful root canal treatment.<sup>7,8</sup> Proper technique and adherence to established protocols are essential for achieving optimal outcomes with intracanal calcium hydroxide therapy.<sup>9</sup> The present study was conducted to assess efficacy of these different irrigation devices in removal of CH in teeth with simulated internal resorption cavities.

We found that none of the tested groups were able to remove complete CH paste from simulated internal resorption cavities. PUI and XP-endo file showed superior and effective results as compared to all other groups. EndoActivator (EA) showed similar results to XP-endo but

significant difference with PUI whereas Endo-Irrigator Plus (EI) showed the least amount of CH removal ( $P < 0.05$ ). Arora et al<sup>10</sup> compared the efficacy of newly developed irrigation systems, i.e., XP-endo Finisher file (XP-endo), EndoActivator (EA), and Endo-Irrigator Plus (EI) with gold standard passive ultrasonic irrigation (PUI) tip and in removal of calcium hydroxide (CH) from single-rooted teeth with artificial simulated internal resorption cavities. One hundred and twenty single-rooted mandibular premolars were decoronated and prepared using the ProTaper Gold system up to F5. Samples were buccolingually sectioned and resorption cavities were prepared. Twenty specimens were served as Group 1 – negative control. In the remaining specimens, CH was delivered and root halves were brought together. Twenty specimens were served as Group 2 – positive control. The remaining specimens were randomly divided into four experimental groups ( $n = 20$ ), where NaOCl and EDTA were activated using PUI, XP-endo, EA, and EI for 1 min. The remnants of CH were scored. PUI and XP-endo removed more CH than other devices ( $P < 0.05$ ), showing no significant difference between them.

We found that score 0, 1, 2 and 3 in group I was as 100%, in group II was 100%, in group III was 50%, 38%, 12%, in group IV was 55%, 10%, 27% and 8%, in group V was 24%, 16%, 40% and 20%, and in group VI was 6%, 32%, 42% and 21% respectively. Denna et al<sup>11</sup> evaluated the efficacy of the rotary instrument XP-endo Finisher for the removal of Ca(OH)<sub>2</sub> aided by different irrigation regimens. Sixteen double-rooted upper premolar human teeth were selected for the study. Thirty-two canals were prepared using a ProTaper Next rotary system up to X3. Then, the canals were filled with Ca(OH)<sub>2</sub>. The volume of Ca(OH)<sub>2</sub> inside the canals was measured by microcomputed tomography (micro-CT). After that, the teeth were randomly allocated into two experimental groups, i.e., A and B ( $n = 16$  canals). In group A, Ca(OH)<sub>2</sub> was removed using the master apical file (X3). In group B, Ca(OH)<sub>2</sub> was removed using a XP-endo finisher. In half of both groups ( $n = 8$ ), syringe irrigation (SI) was used, while passive ultrasonic irrigation (PUI) was used for the other half. After removal, the remaining volume of Ca(OH)<sub>2</sub> was measured. The percentages of remaining Ca(OH)<sub>2</sub> in the apical thirds of all canals were significantly higher as compared with the middle and coronal thirds in all groups ( $p < 0.05$ ). There was no significant difference between different files and techniques ( $p > 0.05$ ).

The limitation of the study is the small sample size.

## Conclusion

Authors found that in artificial internal resorption cavities, CH could not be entirely eliminated by any irrigation method. In this case, PUI outperformed all other irrigation tools, while XP-endo eliminated CH just as well as PUI did—but better than EA and EI plus.

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