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A SCANNING ELECTRON MICROSCOPIC EVALUATION OF THE CANAL CLEANLINESS USING ENDOACTIVATOR AND ULTRAX WITH TWO DIFFERENT IRRIGANT SOLUTIONS.

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ABSTRACT

Title: A Scanning Electron Microscopic evaluation of the canal cleanliness using Endoactivator and UltraX with two different irrigant solutions.

Objective : To compare the effectiveness of canal cleanliness using Endoactivator(Dentsply Sirona)and UltraX (Orikam 18th)with 3% sodium hypochlorite and a Herbal Irrigant Vitex Negundo Linn ; A Scanning Electron Microscopic study.

Materials&Methods: Twenty five extracted human single-rooted teeth were selected for this study. Access opening was doneand root canals were prepared The irrigation was performed using 3% sodium hypochlorite and a Herbal Irrigant Vitex Negundo Linn. Samples were divided into five equal groups, according to the Irrigation Activation techniques and Irrigants used :

Group 1(n=5) Samples were irrigated using Endoactivator(Dentsply Sirona) with 3% sodium hpochlorite **.**

Group 2(n=5) Samples were irrigated using Endoactivator (Dentsply Sirona)with Vitex Negundo Linn**.**

Group 3(n=5) Samples were irrigated using UltraX(Orikam 18th) with 3% sodium hypochlorite.

Group 4(n=5) Samples were irrigated using UltraX (Orikam 18th)with Vitex Negundo Linn**.**

Group 5(n=5) Control Group Without any Irrigation agitation.

Roots were cross-sectioned longitudinally, and the canal walls were subjected to scanning electron microscopy. The presence of smear layer at coronal, middle, and apical levels was evaluated.

Results : The Endoactivator when agitated with sodium hypochlorite showed better efficacy in the debridement of the root canals at the middle and apical thirds .In the Coronal third,UltraX along with sodium hypochlorite showed superior cleaning efficacy .

Conclusion: Endoactivator along with sodium hypochlorite scored the best in debris removal compared to the other irrigation activation system used.

KEYWORDS: Endoactivator (Dentsply Sirona), UltraX(Orikam 18th), Vitex Negundo Linn, Canal cleanliness, debridement, Agitation, Scanning electron microscope.

INTRODUCTION

It is widely accepted that bacteria and their products play a vital role in the initiation and progression of pulp - periapical pathology. The main principle of endodontic therapy is to control the microbial flora in the complex root canal anatomy, particularly in the apical one-third.(2)

Appropriateinstrumentation combined with adequate irrigation is mandatory to complete the cleaning process and reduce the microbial load in the canal system. The objective of irrigants is to increase mechanical debridement by flushing out debris, disinfecting the root canal system and dissolving pulp tissue.(3)

The most widely used endodontic irrigant is 0.5% to 6.0% sodium hypochlorite (Naocl), because of its bactericidal activity and ability to dissolve vital and necrotic organic tissue . However, Naocl solutions exert no effects on inorganic components of smear layer. (4)

The worry with the chemical agents and its safety concerns increased the attention towards medicinal plants from few decades. According to Badole et al, the other good substitute to current irrigants are Herbs and it needs to be explored more. A Herb may exhibit one or more therapeutic properties like antibacterial, anti-inflammatory, astringent, anticarcinogenic, and antiplaque agent.(5)

Vitex Negundo (V. negundo) belonging to the family Verbenaceae is an important medicinal plant found throughout Bangladesh, India and some other tropical and temperate regions of the world. The extracts from its leaves and roots are most important in the field of medicine and drug. The leaves of V.negundo have been reported to possess pesticidal, antifungal and antibacterial properties (6)

Mechanical instrumentation alone does not to clean all the root canal system, and thus, the leftover biofilms and infected debris can be a possible source of persistent infection and treatment failure.Therefore, the irrigants should be activated inside canals by proper devices to increase the amount of contact with pulp tissue and debris inside canals(7)

EndoActivator (Dentsply,Tulsa Dental) comprises of a compact handpiece and three forms of reusable elastic plastic tips in various sizes without slicing root dentin. The theory is focused on the method of cavitation and acoustic processing, which helps to significantly improve the decomposition and destruction of the smear surface and biofilm. (8)

Ultra X (Eighteenth, Orikam) is a cordless ultrasonic irrigation device that oscillates at 45,000 kHz ultrasonic frequencies using the acoustic microstreaming, agitation and cavitation principle that can reach difficult inaccessible areas (almost 35%) of the complex root canal system. (8)

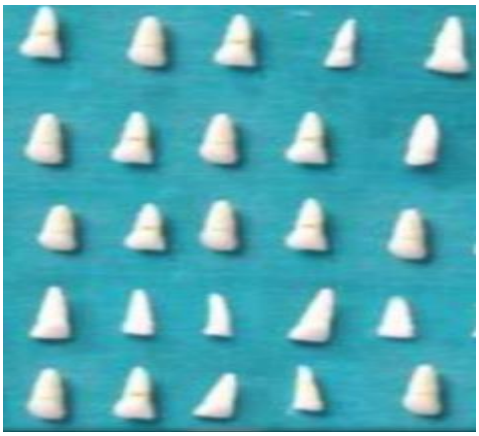
Therefore,this study compares the efficacy of EndoActivator (Dentsply Sirona)and UltraX (Orikam 18th)with Naocl irrigant and Vitex Negundo Linn herbal irrigant in the debridement of the Coronal,Middle and the Apical thirds of the root canal.

MATERIALS AND METHODS

Sample Selection Twenty five extracted human single-rooted teeth were selected for this study.(Fig 1) Access opening of the root canal was done on the palatal side of the teeth.

Root Canal Instrumentation The working length was determined using a size 15k file to the apex. The root canals of teeth in all the groups were instrumented using crown-down technique to the working length. During instrumentation, all four experimental groups and the control group were irrigated with 1 ml of saline between each file. The teeth were randomly distributed into five groups.

Figure 1



Preparation of Vitex Negundo Linn

2.29gm Vitex Negundo Linn extract powder was collected. The powder was diluted in 10 ml ethanol to obtain mother solution. Serial dilution method was used to obtain 100mg/ml of solution and kept in refrigerator for further use.(9)

Final Irrigation

On completion of the canal preparation,each specimen received a final irrigant being activated according to the assigned group.(Fig 2&3)

In Group 1. Endoactivator (Dentsply Sirona)served as the irrigation device with tip size of 25/0.04 taper .This was used along with the irrigant 5ml of sodium hypochlorite and 5ml of EDTA

In Group 2.Endoactivator (Dentsply Sirona) served as the irrigation device with tip zize of 25/0.04 taper.This was used along with the irrigant 5ml of Vitex Negundo Linn.

In Group3.UltraX (Orikam18th)served as the irrigation device with tip size 25.This wasused along with the irrigant 5ml of sodium hypochlorite with 5ml of EDTA

In Group 4.UltraX(Orikam 18th)served as the irrigation device with tip size 25.This was used along with the irrigant such as 5ml of Vitex Negundo Linn,

In Group 5. The root canal was not subjected to any agitation.

Specimen processing and evaluation

The specimens were then longitudinally sectioned, using a serrated laboratory diamond disk to groove the buccal and lingual of each root.(Fig 4 a&b) During sectioning, care was taken to avoid penetration into the canal space. Each half was viewed with a scanning electron microscope .(Fig 5) Three photographs for each specimen were taken at 2000X to visualize the coronal, middle, and apical portion of the root canal system. The areas examined for each sample were standardized using parameters. A digital photograph of the coronal, middle, and apical thirds was taken of each half of each specimen.

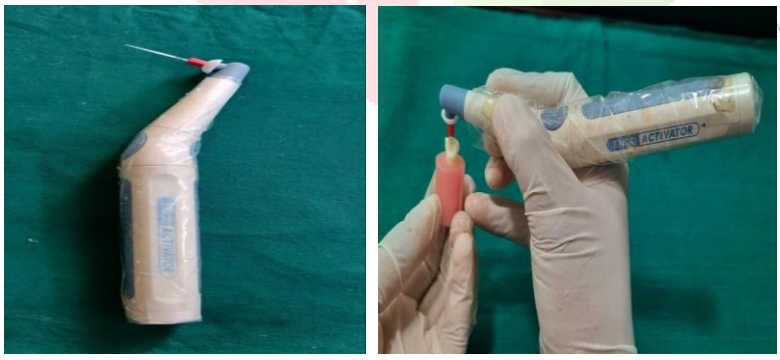
The following scoring criteria were used in the previous studies:

- Score 1: Clean canal wall, only very few debris particles
- Score 2: Few small conglomerations

Score 3: Many conglomerations, 25–50% covered

- Score 4: 50–70% of the canal wall covered
- Score 5: Complete or nearly complete

Figure 2:(a and b) EndoActivator(Dentsply Sirona)

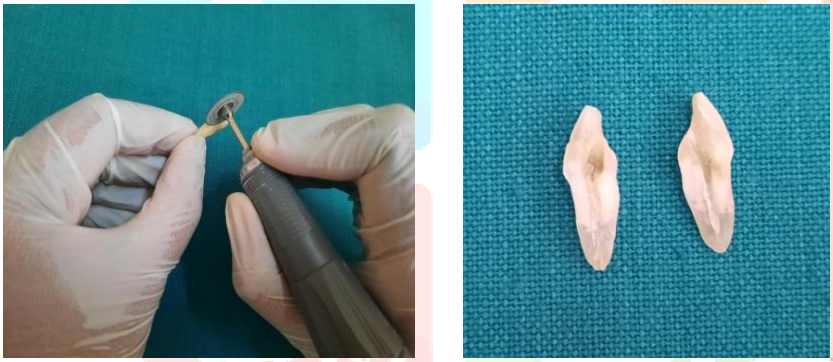


(a) (b)

Figure 3:(a and b) UltraX (Orikam 18th)

(a) (b)

Fig 4(a&b) The cross section of a tooth longitudinally using a serrated diamond disk



(a) (b)

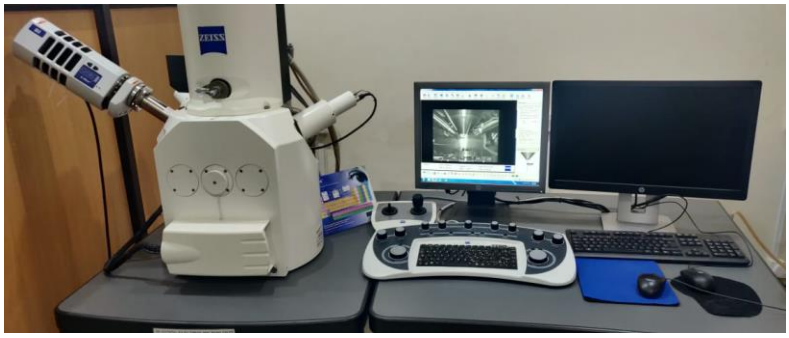


Fig 5 The scanning electron microscope

RESULTS

The groups were scored according to the scoring criteria and the results were analyzed.

Group 1: revealed better debridement of the root canal compared to the other irrigation activation systems .Least debris removal in the coronal thirds of the root canal and highest in the middle thirds of the root canal(Fig 6&Table1)

Group 2: revealed that the debridement of root canal was more on the coronal third of the root canal and less in the apical third of root canal.(Figure 7&Table1)

Group 3: revealed better debridement in the coronal and middle third and least in the apical third.(Figure8 &Table1)

Group 4:revealed least debris removal in the apical and middle third and more in coronal third.(Figure 9&Table 1)

Group 5:revealed the highest debris removal in the coronal and the middle thirds of the root canal and there was minimal debridement of root canal in the apical thirds of the root canal (Figure10&Table1)

Based on the debridement in the coronal, middle, and the apical thirds of the root canal, the following results were obtained;

Table 1: The efficacy of different irrigants and agitation devices in debris removal.

	AGITATION DEVICES USED						MEAN
	GROUP 1(5 samples)						
G1 a	Coronal	2	2	2	3	2	2.2
G1 b	Middle	2	1	2	1	2	1.8
G1 b	Apical	2	2	2	2	2	2.0

GROUP 2 (5 samples)

G2 a	Coronal	3	2	3	3	4	2.6
G2 b	Middle	4	3	4	2	4	3.6
G2 c	Apical	4	3	5	5	5	3.6

GROUP 3 (5 samples)

G3 a	Coronal	1	2	1	2	2	1.4
G3 b	Middle	2	4	2	1	3	2.2
G3 c	Apical	3	3	4	1	4	3.4

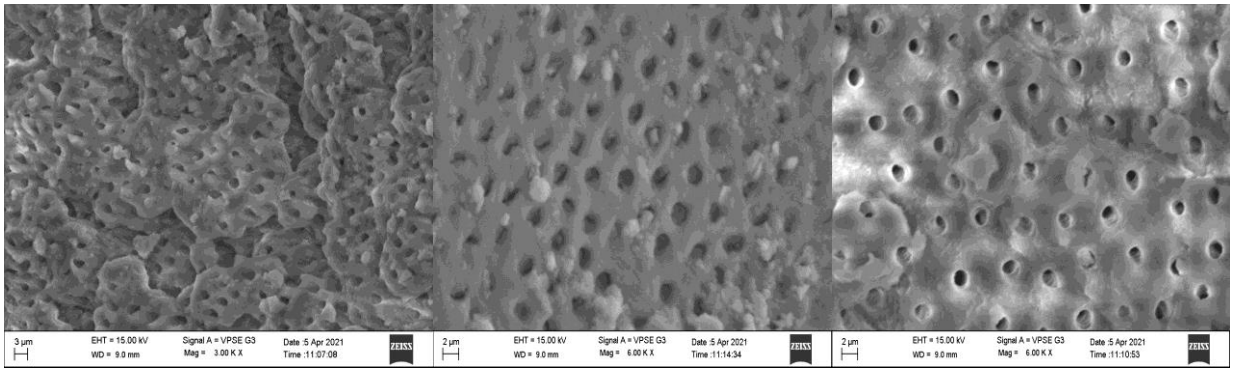
GROUP 4(5 samples)

G4 a	Coronal	2	2	3	1	3	2.2
G4 b	Middle	4	3	4	2	5	3.6
G4 c	Apical	5	4	5	4	4	4.4

GROUP 5(5 samples)

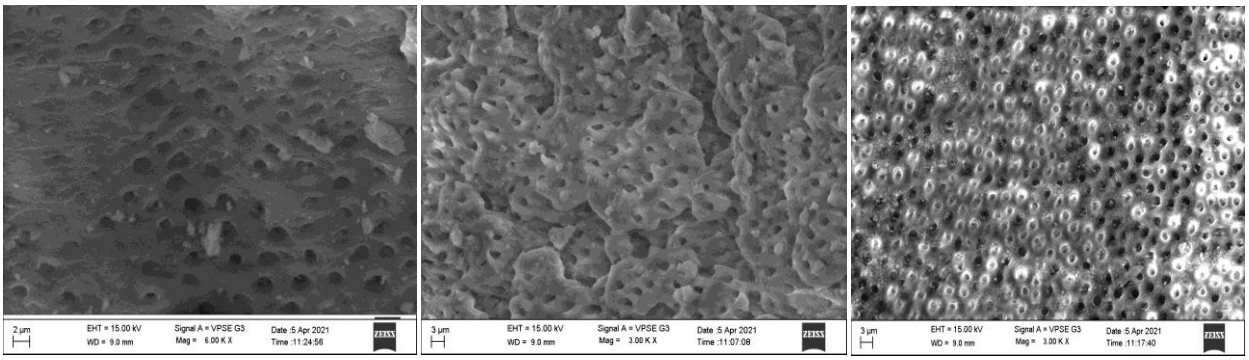
G5 a	Coronal	4	4	4	4	4	4
G5 b	Middle	5	4	5	4	4	4.4
G5 C	Apical	5	5	5	5	4	4.8

Fig 6: Group 1 Endoactivator and Naocl



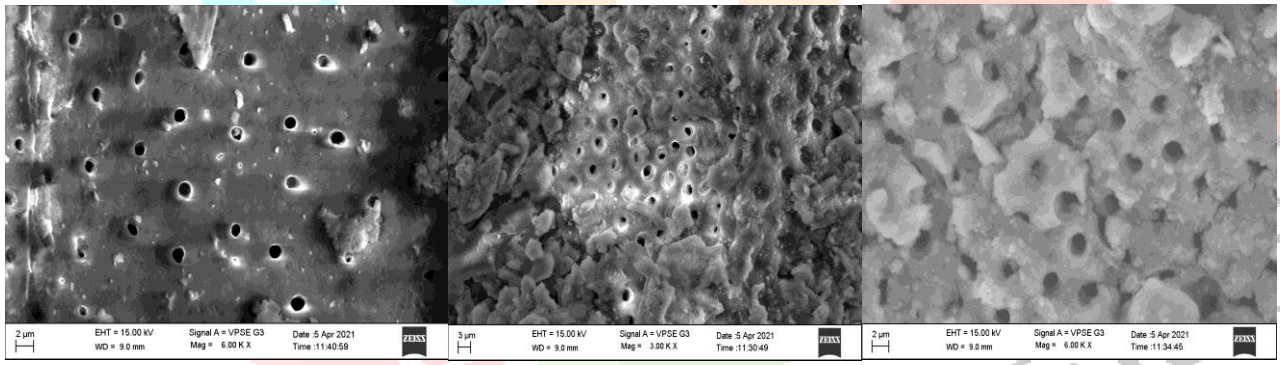
Coronal third Middle third Apical third

Fig 7: Group 2 Endoactivator and VitexNegundo Linn



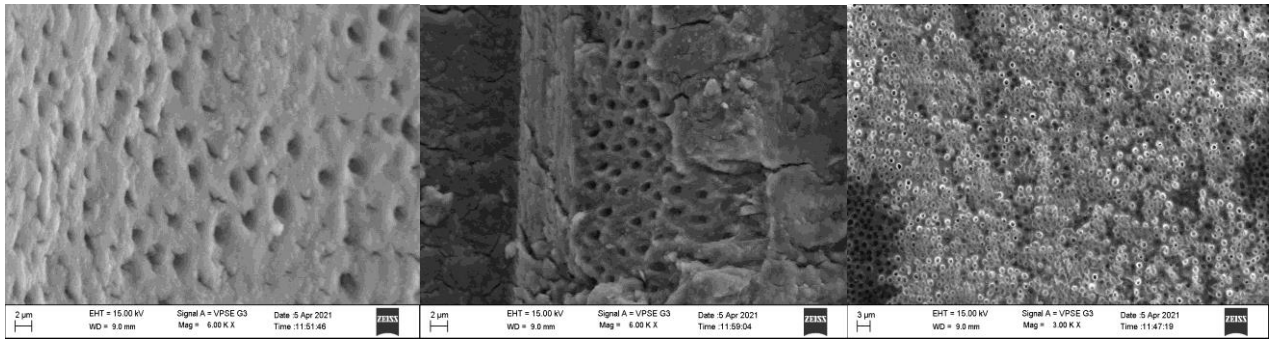
Coronal third Middle third Apical third

Fig 8: Group 3 UltraX and Naocl



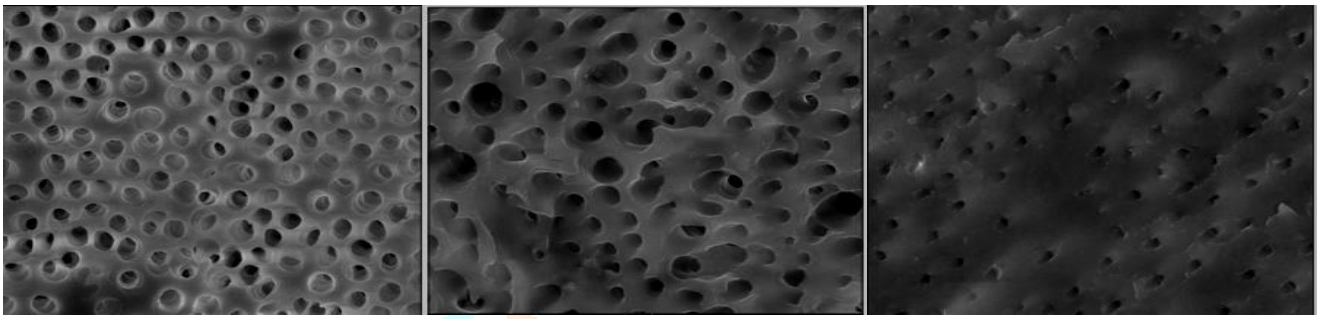
Coronal third Middle third Apical third

Fig 9: Group 4 UltraX and VitexNegundo Linn



Coronal third Middle third Apical third

Fig 10: Group 5 Control group



Coronal third Middle third Apical third

DISCUSSION

In this study, EndoActivator demonstrated better efficacy in the debridement of the root canals with sodium hypochlorite irrigant compared to UltraX. Although disinfection and debridement of the root canal are an essential part during the root canal treatment procedures, none of the irrigation activation systems showed complete debridement of the root canal in the coronal, middle, and the apical thirds. The present study also reveals that, in the coronal thirds, UltraX was effective in debridement, whereas in the middle and the apical thirds of the root canal, Endoactivator served as better system.(1)

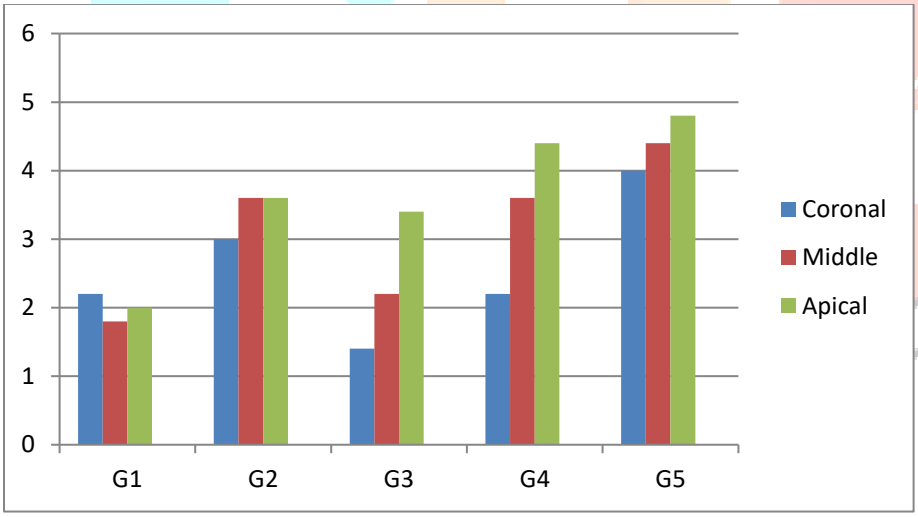
A study conducted for the smear layer removal in the apical thirds of the mandibular molars revealed that the EndoActivator (Dentsply Sirona) was efficient in removing the smear layer, compared to the other irrigation systems. Comparing the sonic, ultrasonic, and the manual dynamic activation, sonic irrigation was the most effective method.(1)

The reason for less efficiency of UltraX could be explained as UltraX creates acoustic microstreaming producing shear stresses for dislodging debris from instrumented canals. It possesses multiple nodes and antinodes all along the length of an activated ultrasonic file and creates undesirable dampening effect of its

characteristic nodes and antinodes pattern when the instrument comes in contact of lateral walls of shaped canals especially. Contrastingly, sonic agitationis not influenced by lateral wall contact.(8)

Among the auxiliary solutions currently used in the biomechanical preparation of root canal treatment,sodium hypochlorite in different concentrations was the most widely used. This was due to the following properties: clarification, organic tissue dissolution, saponification, transformation of acids into chloramines and amino acid salts, deodorization as well as anti-microbial action.(12)

Many of the researchers suggest the use of herbal irrigants as a substitute for the synthetic/chemical agents like sodium hypochlorite, but these herbal products need preclinical and clinical review, their interaction with other materials, and its side effects(5)



G1 –Endoactivator and Naocl

G2-Endoactivator and VitexNegundo Linn

G3-UltraX and Naocl

G4-UltraX and VitexNegundo Linn

G5- Control group

Scanning electron microscopy is the most common method for evaluating the cleaning of root canal walls . Therefore, this study used SEM images to evaluate the effectiveness of the final irrigation protocols in removing the smear layer. The advantage of SEM is that it allows observers to evaluate the presence of debris and the smear layer, unlike optical microscopy .Therefore, it is possible to evaluate the potential of each final irrigation protocol for cleaning of the root canal walls based

on the amount of smear layer and opening of dentinal tubules in all extensions of the root canal. (11)

The debridement of coronal, middle and apical thirds of root canal

Agitation devices &irrigant used	Endoactivator &Naocl	Endoactivator &VitexNegundo Linn	UltraX &Naocl	UltraX &VitexNegundo Linn	No agitation
Coronal	2.2	2.6	1.4	2.2	4
Middle	1.8	3.6	2.2	3.6	4.4
Apical	2	3.6	3.4	4.4	4.8

CONCLUSION

Within the limitations of this in vitro study, it could be concluded that complete removal of debris was not achieved by any method. It was also resulted that Endoactivator was found to show superior debris removal with Naocl as irrigant followed by UltraX and Naocl.Both the Irrigation activation systems showed different degrees of effectiveness in the removal of debris from the root canal. No irrigation system demonstrated the complete debridement of the root canal. Therefore, there is a need for the better irrigation protocols for the complete debris removal in the coronal, middle, and the apical thirds of the root canal.

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