Original Research Article

Title: TO COMPARE THE PURSUANCE OF ULTRASONIC ACTIVATION AT DISTINCT PLANES OF ENODONTIC THERAPY ON FILLING SUPERIORITY OF DIFFERENT ROOT CANAL SEALERS.

ABSTRACT

Aim : The purpose of this study is to evaluate the effect of ultrasonic activation at different levels of endodontic therapy on filling quality.

Materials and methods : Sixty extracted human single rooted teeth are divided into 4 groups(n=15) based on the sealer used to obturate the root canal instrumented upto F4 protaper . These groups are subsequently divided into 3 sub-groups(n=5) each depending on the activation protocol followed in the study(ie, no activation of irrigant /sealer, activation of final irrigant, activation of both irrigant and sealer). All samples are sectioned at 2, 4,6 mm from apex. The percentage of,sealer penetration of canals are analyzed.

Results : In the groups where the final irrigant & sealer is ultrasonically agitated showed statistically significant difference between the coronal, middle and apical sections when compared to other groups.

I root SP (D) showed statistically significant increase in sealer penetration when compared to ZOE, AH plus, & HRS.

Conclusion: Tubular penetration doesnt parallelly make even with the different physico-chemical properties of the sealers used. It significantly varies. The use of ultrasonic activation at differential levels triggered better dentinal sealer penetration with I Root SP and AH Plus

showing optimal tubular penetration. I-root SP has solely satisfied & surpassed the test of better sealer penetration even at the apical level.

INTRODUCTION

Biomechanical preparation,a paramount phase for infection-expulsion(1), is the germinal stage in Infection-preventive maneuvering (2). Fluid tight root canal filling and coronal restoration are the best modus-operandi for effective-sealing aiming at prevention of reinfection and is envisaged as the main objective (3).

In root canal system, pulpal and peri apical diseases are primary ones for which micro organisms and their byproducts are inciters (4). A successful root canal therapy aims at complete disruption of microorganisms from the bio-frame. However ,Chemomechanical preparation also suffices helping bacterial load reduction, but incomplete and tentative project for mere updated findings. Eventually,it got accounted for research studies,provoking a gutsy-challenge as it has to survive the root canal system's intrinsic complex nature (5).

Henceforth, endodontic succes mainly depends on

1. Effective cleaning of root canal system.

2.Effective sealing

Irrigation,an obligatory and vital part of biomechanical preparation relies both on mechanical flushing action and chemical ability of irrigants to dissolve tissue (6, 7). An expection that magnitudinal-increase of irrigant would facilitate their improvement of flushing action and efficacy of debris-removal is false. This vigorousity stays unhelpful and never a supplementary-concern. Satisfactory way of hastening the effect of task is by the use of ultrasonic action fused with irrigant (8, 9). This infact justifies in encountering the dentine-debris as "complementary-therapy" .

Ensuing Sealer-cement and central core material is Standard root canal filling. Core acts as a piston on the substrating-flowable-sealer, diligently spreading it, fill exemptive voids and wet contacted dentinal walls. Several kinds sealers are in vogue for endodontic practice while every equipment got its own flaws and fairs.Selection for pilot or any simulataneous operation must desperately justify the multi-facets which constitute sealing ability ,adhesiveness, biocompatibility and antimicrobial efficacy.Factor-fairness for biomedical-equipment is imperative.

Conventional ZOE sealer and the seal obtained through GP are second-rate mediocres (10, 2). Despite its strong traits, GP and conventional sealer combination disfavours ability to strengthen root, dentin un-adhering, under-control of microleakage& solubility of sealer makes prognosis dilemmatic and unassuring (11, 12, 13).

To compensate the second and tenth-rates, ZOE has become amicable to the root canal seal imparting more strength. It is the real-astute for better compilation. Such enhanced sealers include epoxy resin based sealers with elevated possibilty of adhesion to dentin with lower water solubility & hybrid root ,a self etching methacrylate resin based sealer working upon hybridization and biocompatability (10, 2). These are harbingers for auspice dentine-omen.

Recent one is I Root SP, a bioceramic sealer based on formation of monoblock and low water sorption.Activation of root canal sealer possibly favours its penetration into dentinal tubules thereby increases stability and antimicrobial effects (14).

Repercussions' in ultrasonic activation of sealer in root canal and its filling quality are yet to be deciphered. Thus, ongoing research study aimed comparision of influence of ultra sonic activation at different levels of endodontic treatment on the filling quality of different sealers".

Null hypothesis that was tested is that ultrasonic activation improves the filling quality of sealers.

AIM

This study aims to "compare the influence of ultrasonic activation at different levels of endodontic treatment on the filling quality of various sealers".

Null hypothesis approved ultrasonic activation improvisation over the filling quality of sealers.

OBJECTIVES:

1. Comparision and Evaluation of ultrasonic activation of the irrigant on the filling quality of the sealer.

2. Comparision and Evaluation of the influence of ultrasonic activation of different sealers on the filling quality.

MATERIALS AND METHODS

60 single rooted premolars extracted for the reasons other than the study with root curvature less than 5' have been selected. Ethics Committee approved the use of these teeth for the research. The calculus and debris on the roots were removed with periodontal scaling unit. Teeth was disinfected in 0.5% chloramine solution for 48hrs and stored in distilled water until use.

The crowns were removed at the cemento enamel junction using 0.3mm low speed diamond disc standardizing the root length to 15mm. 10 k file is inserted into the canal until it is visible at the apical foramen. Then working length is established by subtracting 1mm from it. The root canal shaping is performed using protaper rotary instruments at the working length upto F4protaper file. After use of each instrument the canals are irrigated with 2 ml of 2.5% NaOCl. A final flush of 2ml of 17% EDTA is applied for 3 min to eliminate the smear layer. The specimens are divided into 4 groups[(A,B,C,D) (n=15)] according to the sealer used to obturate the root canal.

GROUP A- ZOE sealer

GROUP B- AH Plus sealer

GROUP C- Hybrid root seal

GROUP D- I Root SP

Each group is further divided into 3 sub groups depending on the activation protocol (Box -1) followed in the study. for eg group A is divided into A1,A2,A3 sub groups and this is similar for all the groups B,C,D. Passive ultrasonic activation is performed for the final irrigant in A2,A3,B2,B3,C2,C3,D2,D3 subgroups. Then the canals in all groups are washed with 5 ml of saline solution and dried with paper points.

Box -1

A1,B1,C1,D1 - No activation of either irrigant or sealer

A2,B2,C2,D2 - ultrasonic activation of final irrigant

A3,B3,C3,D3 - ultrasonic activation of both final irrigant and sealer

The sealers are manipulated according to the manufacturer's instructions. For the visualization in confocal microscopy, the sealers are mixed with flouroscentrhodamine dye to an appropriate concentration of 0.1%. The sealers are placed in each root canal by using a size 30 rotary lentulospiral maintaining the instrument 4mm from the apex. Passive ultrasonic activation of the sealer is performed for A3,B3,C3,D3 sub groups. For ultrasonic activation the ultrasonic tip is activated for 20 sec in buccolingual and another 20 sec in mesio-distal direction of the root canal, 2mm short of working length and it is standardized.

A single GP cone F4 slightly coated with respective sealer & placed in root canal to working length, because root canals are prepared using rotary instruments upto F4protaper file. All specimens are obturated using single cone techinque with matching taper to obtain standardized specimens. Specimens are sealed with provisional filling material and stored in 100% humidity at 37'c for 1 week to allow sealer to set.

SEGMENT OF SEALER PENETRATION:

After 1 week each specimen is sectioned perpendicular to the long axis using 0.3 mm isomet saw at low speed and water coolent. Horizontal sections are performed for all the specimens at 2-,4-, and 6-

mm levels from the apical foramen and polished with sand paper with the thickness of specimen being 1±0.1mm.

The segments of the root canal in which the sealer penetrated into dentinal tubules were analyzed on an inverted leica TCS-SPE confocal laser scanning microscope.

STATISTICAL ANALYSIS:

Tests of normality (shapirowilks) showed that data is clearning normality so parametric tests like anova and paired ‘t’ are used.

RESULTS:

Comparing Dentinal Sealer Penetration -

In case of A,B,C there is no significant difference between the groups , that is no significant difference between A1,B1,CI when compared with A2,B2,C2, but A3,B3,C3 showed statistically significant difference

Coming to D , there is statictically significant difference between D1,D2,D3 (Table -1)

2.Comparing The Sealers At Different Activation Levels-

No Activation Of Either Irrigant / Sealer-

There is no difference Between A1,C1 gropus, D1 showed highest value followed by B1which is followed by C1which showed similar value as that of A1.

A1=C1 <B1 < D1 [Figure -1]

Activation Of Final Irrigant-

A2< B2= C2< D2.

Activation Of Both Final Irrigant And Sealer-

I root SP (D) showed an overall statistically significant increase in sealer penetration when compared to ZOE, AH plus, & HRS. (A,B,C) [Table 2], [Figure-2], [Fig-4,Fig-5,Fig-6 (Pink colour indicates amount of sealer penetration)]

3.Comparing The Sealer penetration At Different Root Sections (Coronal, Middle , Apical) -

In the groups where the final irrigant & sealer is ultrasonically agitated showed statistically significant difference between the coronal, middle and apical sections when compared to their respective non agitated groups. (Table -3),[Figure-3], [Fig-4,Fig-5,Fig-6]

DISCUSSION

Null-hypothesis is acceptable as the ultrasonic activation regulated the increase in the efficiency of sealer penetration. Aim was to evaluate the effect of ultrasonic activation on the filling quality of different sealers.

Unfortunately meticulous disinfection of the most apical part of any preparation remains demanding (15). Nevertheless, the finer way to clean is through manoeuvring irrigating solutions (16), as mechanical cleansing of webs and fins is intractable(17). A proved demonstration construed the continuous movement of irrigant and thus rejuvenated the use of irrigant-ultrasonic vibration in endodontics. Null hypothesis approved ultrasonic activation improvisation over the filling quality of sealers.

This encompassed the direct association with efficient cleaning of root canal space(18). In this study, EDTA was used as a final irrigant to peel-off the smear layer and is ultrasonically activated for squeaky-cleaner canals as an outcome(19).

In lineage with the results mentioned previously, the present study even showcased that ultrasonic activation at different levels favoured a greater dentinal-sealer-penetration which can promote a high contact and confinement of micro-organisms present in dentinal tubules (20).

Many factors contribute to the sealer digging into the dentinal tubules like smear layer removal (21), dentinal permeability (the number and the diameter of tubules), root canal dimension, and the physio-chemical properties of the sealer (22, 23, 24). Flow is one of the prominent chemical/physical factors stresses upon determination of consistency, particle size, shear rate, temperature, time, internal diameter of the root canal, and the rate of insertion (24). It is quintessential as it reflects the ability to penetrate into small irregularities and ramifications of the root canal system and dentinal tubules and ultimately propelling into the uninstrumented accessory root canal anatomy (23).

<u>The sealer penetration into dentinal tubules can beneficial, that is</u>

A. Preventing reinfection because of sealers antibacterial property and by locking the residual microorganisms in dentinal tubules(25, 26).

B. The sealer inside the tubules promotes a mechanical interlocking, improving material retention (25, 27).

Previous study reported the performance of lateral condensation technique , and all the typical sealer placement methods (using GP cone, K file, lentilospiral). Significant difference in the percentage-statistics filling material has not been encaptulated while in single cone technique the sealer placement method interceded the anomaly of filling quality. According to Adriana Simionatto et al , the sealer placement with lentulospiral is beneficial(28). Hence lentulospiral has been a good venture in endodontics.

According to **Weis and Sevimay** *et al*, the penetration in the dentinal tubules was significantly greater in the coronal and middle of the root canal than the apical part of the root canal and also earned the support of other studies(23, 29). Infact the reason would be that the apical root canal contains less tubules, moreover, the diameter of the merely present tubules is smaller or they are more often closed (30, 31, 32) Furthermore, the apical portion of roots shows a pronounced variation in structure (32).

In accordance previous studies claim that ultrasonic activation promoted better sealer penetration at 6mm & 4mm did not figure out any significant difference at 2mm level, Nonetheless, according to the results obtained , the present study showed a notable sealer penetration even in the 2mm minor section. The following explaination suffices this, i.e,

A. EDTA which was used as a final irrigant has been ultrasonically agitated.

B, Previous study reported that ultrasonic activation results in a better irrigation at 4mm and 2mm from working length when compared to traditional needle irrigation (33).

C, and also the effect of ultrasonic vibrations will be more effective at the tip of the file than along its length (19).

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The cornerstone-reasons for the better performance of the novel filling material I root SP are "low particle size (incorporated nano particles in i root SP), hydrophilicity, low contact angle" which eases the spread of cement over the dentinal walls of root canal elegantly, enthrusts into it and fills the dentinal tubules and lateral canals (34). Next parallely prosperous one, but little subsidiary is AH Plus, an epoxy Resin based sealer, known to have adequate flow and deeper penetrability, owing to their thin film structure (35).

CONCLUSION

Tubular penetration doesnt parallelly make even with the different physico-chemical properties of the sealers used. It significantly varies. The use of ultrasonic activation at differential levels triggered better dentinal sealer penetration with I Root SP and AH Plus showing optimal tubular penetration. I-root SP has solely satisfied & surpassed the test of better sealer penetration even at the apical level.

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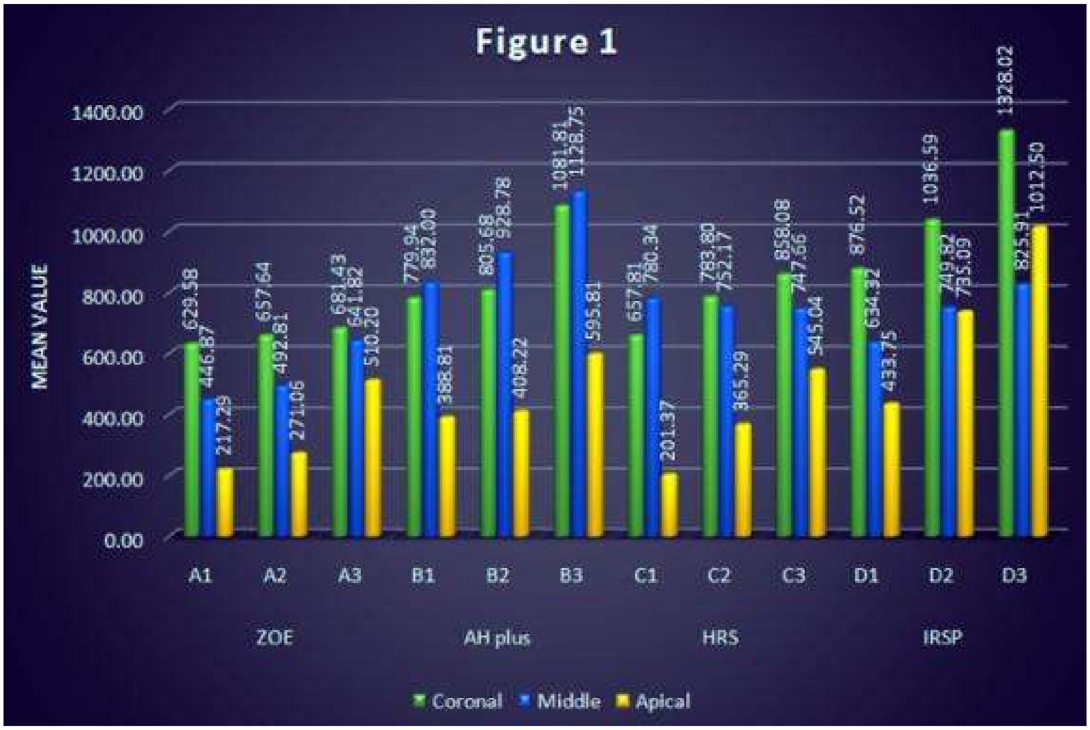

Figure 1

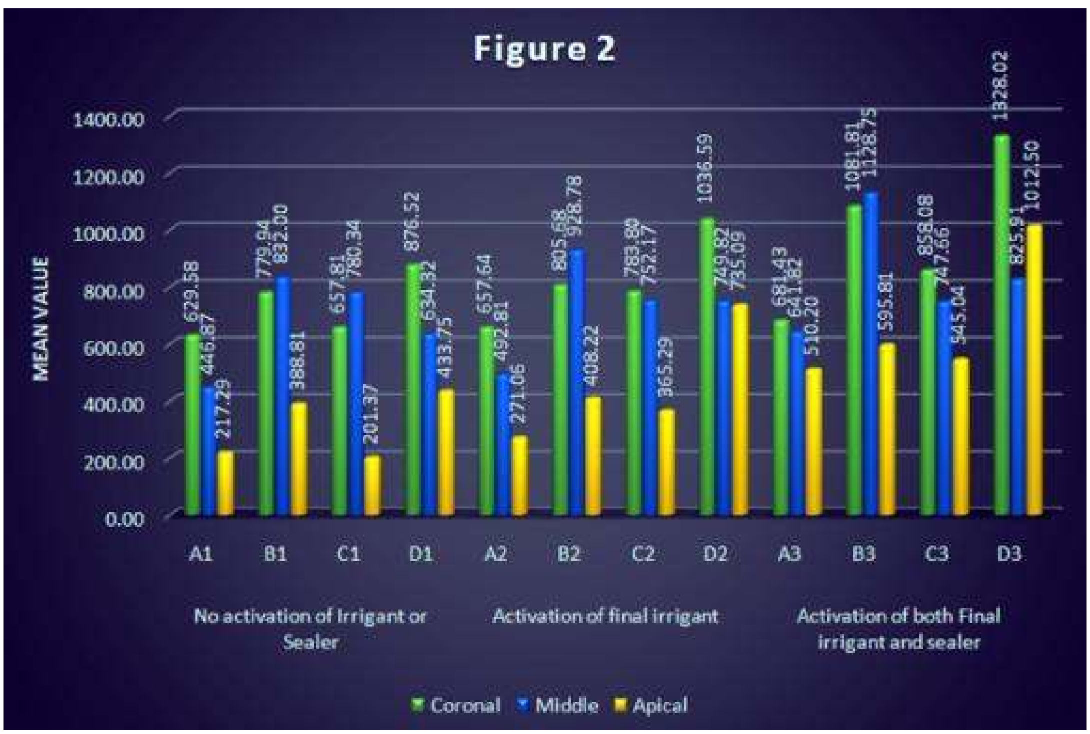

Figure 2

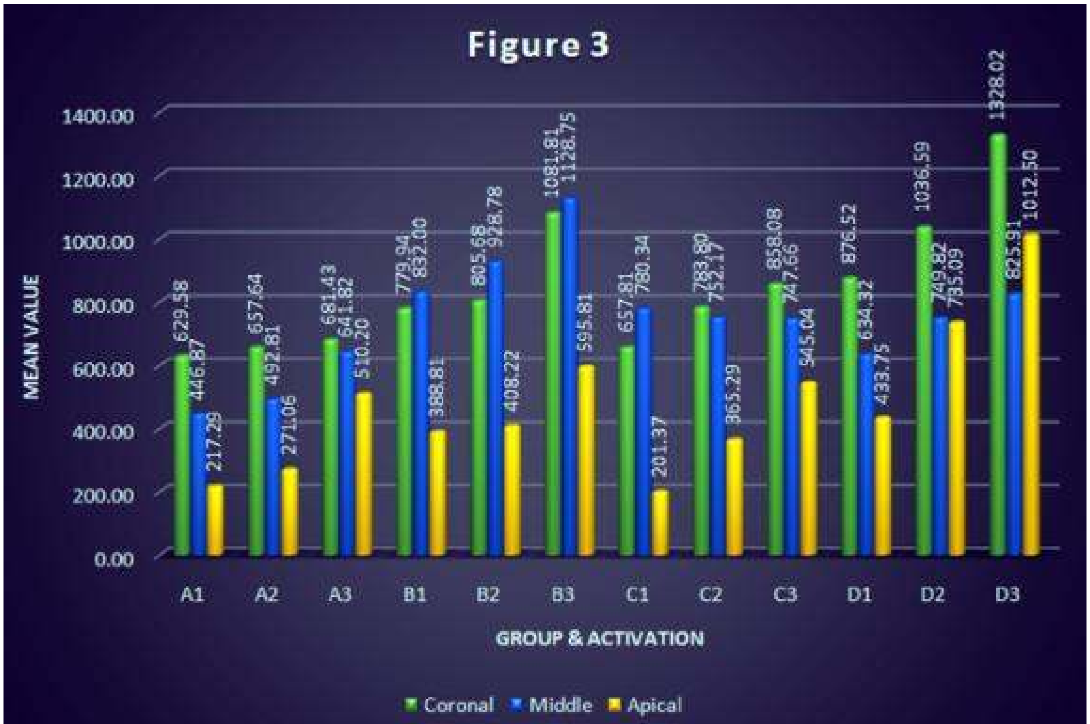
Figure 3
1400.00
1200.00
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800.00
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MEAN VALUE
629.58
446.87
217.29
657.64
492.81
271.06
681.43
641.82
510.20
779.94
832.00
388.81
805.68
928.78
408.22
1081.81
1128.75
595.81
657.81
780.34
201.37
783.80
752.17
365.29
858.08
747.66
545.04
876.52
634.32
433.75
1036.59
749.82
735.09
1328.02
825.91
1012.50
A1
A2
A3
B1
B2
B3
C1
C2
C3
D1
D2
D3
GROUP & ACTIVATION
Coronal
Middle
Apical

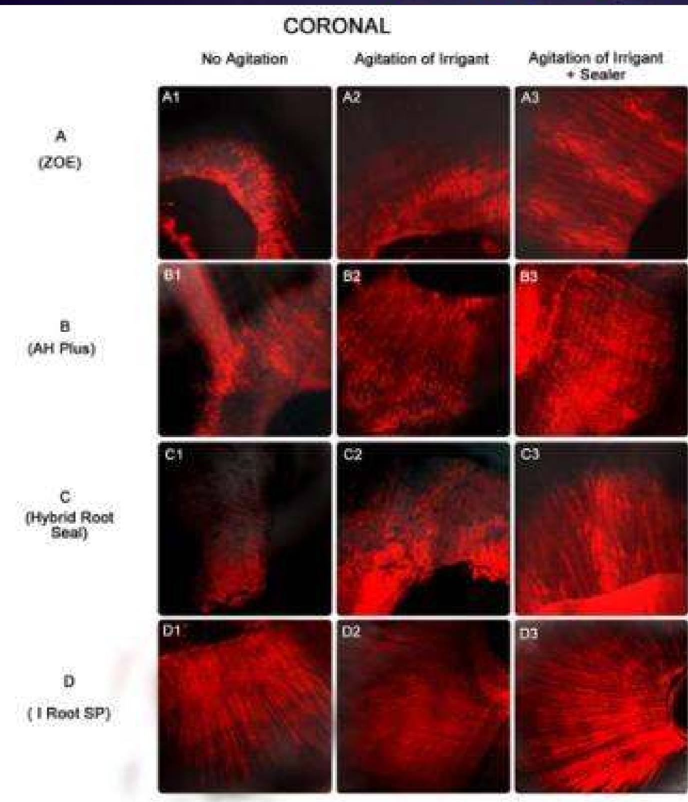
CORONAL
No Agitation
Agitation of Irrigant
Agitation of Irrigant + Sealer
A (ZOE)
B (AH Plus)
C (Hybrid Root Seal)
D (I Root SP)
A1
A2
A3
B1
B2
B3
C1
C2
C3
D1
D2
D3

FIGURE 4

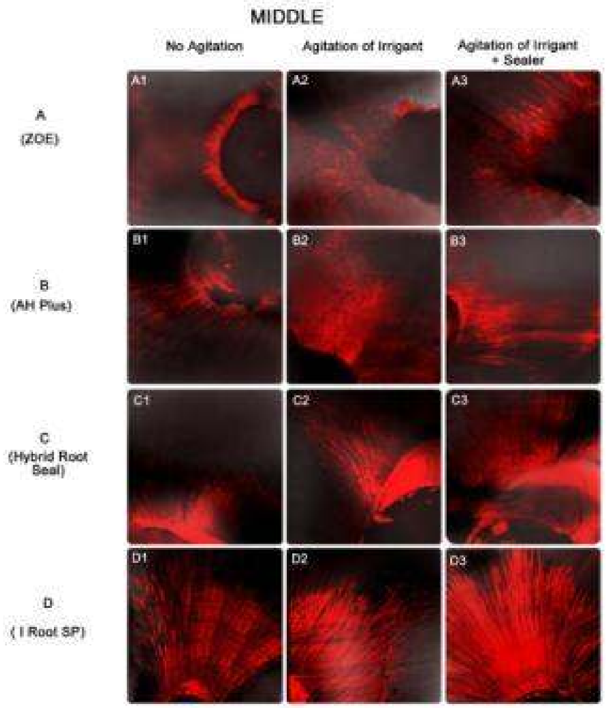

FIGURE 5

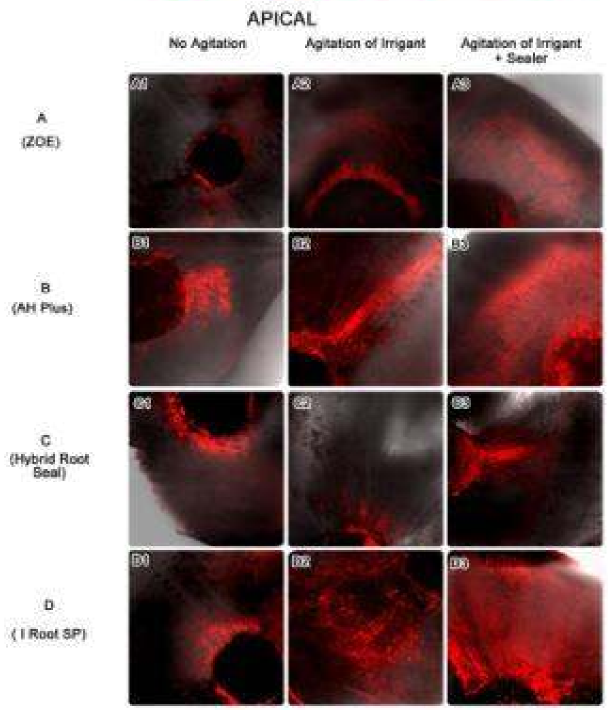

FIGURE 6

RESULTS:

TABLE : 1

Group	Activation	Coronal	Middle	Apical
ZOE	A1	629.58 ± 15.32^{a}	446.87 ± 16.24^{a}	217.29 ± 39.69^{a}
	A2	657.64 ± 15.74^{ab}	492.81 ± 52.27^{a}	271.06 ± 43.68^{a}
	A3	681.43 ± 16.99^{b}	641.82 ± 41.56^{b}	510.20 ± 14.52^{b}
AH plus	B1	779.94 ± 27.02^{a}	832.00 ± 45.80^{a}	388.81 ± 42.93^{a}
	B2	805.68 ± 27.97^{a}	928.78 ± 34.30^{b}	408.22 ± 26.46^{a}
	B3	1081.81 ± 21.02^{b}	1128.75 ± 45.64^{c}	595.81 ± 81.04^{b}
HRS	C1	657.81 ± 34.26^{a}	780.34 ± 43.73^{a}	201.37 ± 49.10^{a}
	C2	783.80 ± 17.91^{b}	752.17 ± 53.87^{a}	365.29 ± 25.24^{b}
	C3	858.08 ± 31.34^{c}	747.66 ± 22.71^{a}	545.04 ± 20.76^{c}
IRSP	D1	876.52 ± 19.64^{a}	634.32 ± 25.93^{a}	433.75 ± 24.96^{a}
	D2	1036.59 ± 27.79^{b}	749.82 ± 32.82^{b}	735.09 ± 24.25^{b}
	D3	1328.02 ± 15.42^{c}	825.91 ± 24.60^{c}	1012.50 ± 27.09^{c}

Different alphabets denotes significant difference among activations within group

TABLE : 2

Activation	Group	Coronal	Middle	Apical
No activation of irrigant or sealer.	A1	629.58 ± 15.32^{a}	446.87 ± 16.24^{a}	217.29 ± 39.69^{a}
	B1	779.94 ± 27.02^{b}	832.00 ± 45.80^{b}	388.81 ± 42.93^{b}
	C1	657.81 ± 34.26^{a}	780.34 ± 43.73^{b}	201.37 ± 49.10^{a}
	D1	876.52 ± 19.64^{c}	634.32 ± 25.93^{c}	433.75 ± 24.96^{b}
Activation of final irrigant.	A2	657.64 ± 15.74^{a}	492.81 ± 52.27^{a}	271.06 ± 43.68^{a}
	B2	805.68 ± 27.97^{b}	928.78 ± 34.30^{b}	408.22 ± 26.46^{b}
	C2	783.80 ± 17.91^{bc}	752.17 ± 53.87^{c}	365.29 ± 25.24^{bc}
	D2	1036.59 ± 27.79^{d}	749.82 ± 32.82^{c}	735.09 ± 24.25^{d}
Activation of both final irrigant and sealer	A3	681.43 ± 16.99^{a}	641.82 ± 41.56^{a}	510.20 ± 14.52^{a}
	B3	1081.81 ± 21.02^{b}	1128.75 ± 45.64^{b}	595.81 ± 81.04^{a}
	C3	858.08 ± 31.34^{c}	747.66 ± 22.71^{c}	545.04 ± 20.76^{a}
	D3	1328.02 ± 15.42^{d}	825.91 ± 24.60^{d}	1012.50 ± 27.09^{b}

Different alphabets denotes significant difference among groups within Activations

TABLE : 3

Group & Activation	Coronal	Middle	Apical
A1	629.58 ± 15.32[a]	446.87 ± 16.24[b]	217.29 ± 39.69[c]
A2	657.64 ± 15.74[a]	492.81 ± 52.27[b]	271.06 ± 43.68[c]
A3	681.43 ± 16.99[a]	641.82 ± 41.56[a]	510.20 ± 14.52[b]
B1	779.94 ± 27.02[a]	832.00 ± 45.80[a]	388.81 ± 42.93[b]
B2	805.68 ± 27.97[a]	928.78 ± 34.30[b]	408.22 ± 26.46[c]
B3	1081.81 ± 21.02[a]	1128.75 ± 45.64[b]	595.81 ± 81.04[c]
C1	657.81 ± 34.26[a]	780.34 ± 43.73[a]	201.37 ± 49.10[b]
C2	783.80 ± 17.91[b]	752.17 ± 53.87[a]	365.29 ± 25.24[b]
C3	858.08 ± 31.34[a]	747.66 ± 22.71[b]	545.04 ± 20.76[c]
D1	876.52 ± 19.64[a]	634.32 ± 25.93[b]	433.75 ± 24.96[c]
D2	1036.59 ± 27.79[a]	749.82 ± 32.82[b]	735.09 ± 24.25[b]
D3	1328.02 ± 15.42[a]	825.91 ± 24.60[b]	1012.50 ± 27.09[c]

Different alphabets denotes significant difference among Coronal, Middle and Apical levels

Table -1 & Figure -1: Comparing sealer penetration of different sealers.

Table – 2 & Figure - 2: Comparing the sealers at Different Activation Levels

Table – 3, & Figure 3: Comparing the sealer penetration at Different Root Sections (Coronal, Middle , Apical) –

Figure 4: Coronal sections showing the amount of sealer penetration at different agitation levels. (Pink colour indicates amount of sealer penetration)

Figure 5: Middle sections showing the amount of sealer penetration at different agitation levels. (Pink colour indicates amount of sealer penetration)

Figure 6: Apical sections showing the amount of sealer penetration at different agitation levels. (Pink colour indicates amount of sealer penetration)