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An in Vitro Investigation for Comparative Assessment of Triple Antibiotic Paste, Nitrofurantoin and Neopex on Bond Strength of Sealer

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Abstract:

- ***Aim:***

To compare and evaluate the effect of Nitrofurantoin, Triple Antibiotic Paste and Oil based Calcium hydroxide on the push-out bond strength of MTA based sealer.

- ***Material and Methods:***

The study included sixty (60) mature, single-rooted mandibular teeth that had been recently extracted. Calculus, debris, and soft tissue remains were extracted from the teeth using an ultrasonic scaler. F3 Protaper rotary instruments were used to instrument each sample. After the specimens were instrumented, Based on the location of the intracanal medicament, specimens were split into three experimental groups at random.: Group 1: Triple Antibiotic Paste (TAP), Group 2: Nitrofurantoin (NIT), and Group 3: Oil-based Calcium Hydroxide (n = 20). MTA fillapex was used for obturation following the removal of intracanal medication. A universal testing machine was used to determine the push out bond strength.

- ***Results:***

Compared to the nitrofurantoin group, the triple antibiotic paste group produced even greater bond. When compared to the other test groups, the Neopex group's bond strength was significantly weakened.

- ***Conclusion:***

It may be inferred that Triple Antibiotic Paste, Nitrofurantoin, and oil based calcium hydroxide significantly increased the bonding capacity of resin-based sealer. There are notable differences between Triple Antibiotic Paste, Nitrofurantoin, and oil based calcium hydroxide mean push out bond strength levels.

Keywords: *MTA Fillapex Sealer, Triple Antibiootic Paste, Nitrofurantoin,Universal Testing Machine.*

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I. INTRODUCTION

Endodontic sealers' adherence to dentin is critical to the long-term success of root canal treatment. [1] Various intracanal medications, including as Nitrofurantoin, Triple Antibiotic Paste (TAP), and Oil-based Calcium Hydroxide, can affect the push-out bond strength of MTA-based sealers. [2] MTA-based sealers are popular because of its great sealing capacity, bioactivity, and biocompatibility. Surface cleanliness, dentin permeability, and residual effects of intracanal medicaments all have an effect on how they bond with dentin. [3] Certain medicaments may alter the chemical composition of dentin, affecting sealer penetration and adherence. [4] The push-out bond strength of MTA-based sealers was compared in the current investigation with

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Nitrofurantoin, Triple antibiotic paste, and Oil-based Calcium hydroxide.

Ciprofloxacin, Metronidazole, and Minocycline make up the Triple Antibiotic Paste combination. Metronidazole, a nitroimidazole molecule, is very harmful to anaerobes and is regarded an antibacterial agent. [5] Both gram-positive and gram-negative bacteria are susceptible to the bacteriostatic action of minocycline. [6] As a synthetic fluoroquinolone, Ciprofloxacin has high antibacterial effectiveness against gram-negative bacteria and quick bactericidal effect. [7] Numerous anaerobic bacteria have ciprofloxacin resistance. Because of this, it is frequently used with metronidazole to treat mixed infections in order to make up for its narrow range.[8] Thus, anaerobic, gram-positive, and gram-negative bacteria are all susceptible to inhibition by Triple Antibiotic Paste, and this combination may be useful against odontogenic pathogens. [9]

An antibiotic that is frequently used to treat urinary tract infections is nitrofurantoin, a synthetic product of the nitrofuran group. Its hydrolytic cleavage at low pH produces 3-aminohydantoin and 5-nitro-2-furaldehyde. [10] A greater variety of Gram positive and Gram negative bacteria are susceptible to the antibacterial action of nitrofurantoin. Additionally, it is the recommended course of treatment for infections that are resistant to many drugs. Nitrofurantoin paste was evaluated by Alrahman et al. as a novel intracanal drug that works well for endodontic therapy. [11]

Since its introduction by Hermann in 1920, calcium hydroxide has been used extensively in endodontics as an intracanal medication between appointments. It is a strong alkaline substance with a pH of about 12.5 that has several biological properties, such as antimicrobial activity, suppression of tooth resorption, and healing induced by hard tissue formation.[12] Protein denaturation and destruction to DNA and cytoplasmic membranes are likely the causes of calcium hydroxide's fatal effects on bacterial cells. Long-term calcium hydroxide use has been shown to alter the dentin's physical characteristics, and teeth that have been treated have an unusually high prevalence of root fractures. [13]

Therefore, the aim of this study is to evaluate and compare the effect of 3 different intracanal medicaments on push out bond strength of root dentin.

II. MATERIAL AND METHODS

The study included sixty (60) single-rooted mandibular premolar teeth that had just been extracted.

An ultrasonic scaler was used to remove calculus, debris, and soft tissue remains from the teeth. A 2% chlorhexidine solution was then used to disinfect the teeth.

➢ *Preparation of the Samples*

Using a diamond disc and an underwater coolant system, The removed teeth were decorated to a root length of 15 mm. A diamond disc was used to decoronate each tooth horizontally at the CEJ, resulting in sixty decoronated roots.

The root canal was negotiated up to the apical foramen with an endodontic K file size of 10. The working length was calculated by deducting 1 mm from the resultant working length. All of the samples were instrumented using rotary files up to size F3 Protaper. 2 ml of 3% NaOCI were used for irrigation in between each instrument.

Each canal was then treated for a minute with 5ml of 3% NaOCl and 5ml of 17% ethylenediaminetetraacetic acid (EDTA). The canals were then rinsed with 5 ml of normal saline (0.9%) after being dried with paper points.

After the specimens were instrumented, they were randomly divided into three experimental groups: Group 1 (TAP), Group 2 (NIT), and Group 3 (oil-based calcium hydroxide {NEOPEX}) (n = 20) based on where the intracanal medication was placed.

➢ *Preparation of the Medicament*

Minocycline, metronidazole, and ciprofloxacin powdered were combined in equal amounts to made TAP. The paste was made using a 3:1 powder/liquid ratio using sterile distilled water. The prepared medication paste was inserted into the canals using lentulospirals. After that, cotton and a temporary restorative material were used to temporarily seal the teeth coronal openings.

The nitrofurantoin tablets were crushed into a powder and mixed with distilled water to create a 25 mg/ml concentration of nitrofurantoin paste. The prepared medication paste was inserted into the canals using lentulospirals. After that, cotton and a temporary restorative material were used to temporarily seal the teeth coronal openings.

After that, all the samples were incubated at 37ºC and 100% humidity for 21 days. Following the incubation, 10 ml of 17% EDTA and 10 ml of 3% NaOCI were used to irrigate the canals in order to eliminate antibiotic pastes.

Following irrigation, five milliliters of distilled water were utilized as a final rinse. Each specimen was dried using paper points, and obturation was finished using the cold lateral compaction procedure using Rotary files gutta-percha points and MTA fillapex sealer. A lentulospiral was used to apply the sealer.

After that, temporary restorative material was used to seal the coronal root canal openings. For the sealers to set, the samples were kept at 37°C and 100% humidity for a period of one week. Using a diamond disc and a low-speed handpiece, one slice (3±.1 mm thick) was taken from the midroot of each tooth (n=20).

➢ *Push- Out Bond Strength Test (POBS):-*

A Universal Testing Machine was then used to perform a push-out test on each specimen with a stainless steel cylindrical plunger that applied dislodging force until the debonding occurred.

Newton units were used to express the dislodging forces.

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Fig 1 Preparation of the Samples.

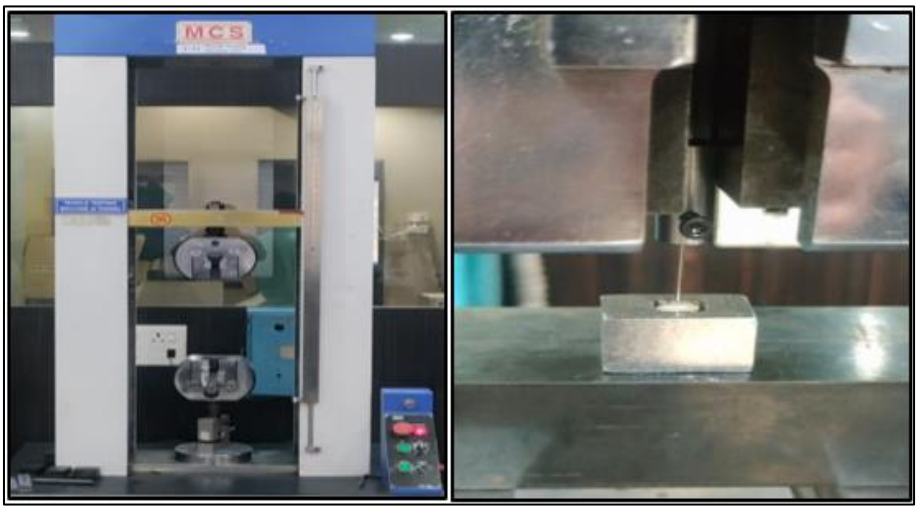

Fig 2 Testing Done Using Universal Testing Machine.

III. RESULT

Compared to the nitrofurantoin group, the TAP group exhibited a greater bonding strength.

In comparison to the other test groups, the Neopex group had significantly reduced bonding strength.

[Table 1] shows the mean and standard deviation of push-out bond strength for different groups following the use of the various medications.

The TAP, Nitrofurantoin, and Neopex test groups did not significantly differ from one another, according to the data [Table 2].

Table 1 Descriptive Statistics of Push Out Bond Strength of the groups

Group	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
TAP	20	5.33	0.21	0.05	5.22	5.43	5.1	5.8
NIT	20	3.42	0.22	0.05	3.31	3.52	3.1	3.8
NEOPEX	20	2.49	0.16	0.03	2.42	2.56	2.2	2.8

SD: Standard deviation, SE: Standard Error, CI: Confidence interval, TAP: Triple Antibiotic Paste, NIT:Nitrofurantoin

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Table 2 Comparison of POBS Between the Groups ANOVA Test

	Sum of squares	*df*	*Mean Square*	*F*	*Sig*	*Inference*
Between Groups	83.61	2	41.8	1053.86	0.000	Significant
Within Groups	2.26	57	0.04			
Total	85.87	59				

Table 3 Post Hoc Tuckey Test for Multiple Comparison

GROUP(I)	*Group (J)*	*Mean Difference (I-J)*	*Std. Error*	*Sig*	*95% Confidence level Inference*	
					Lower Bound	*Upper Bound*
TAP	NIT	1.91	0.06	0.000	1.76	2.06
	NEOPEX	2.84	0.06	0.000	2.68	2.99
NIT	TAP	-1.91	0.06	0.000	-2.06	-1.76
	NEOPEX	0.93	0.06	0.000	0.77	1.08
Neopex	TAP	-2.84	0.06	0.000	-2.99	-2.68
	NIT	-0.93	0.06	0.000	-1.08	-0.77

IV. DISCUSSION

Since gutta-percha does not adhere to root dentin, endodontic sealers' adhesive properties are essential when used in combination with root canal sealers.[14] It was proposed that if a substance adheres to the walls of the root canal, it will prevent the filling from dislodgement.[15] Furthermore, Chemical bonding with root dentin is suggested to improve the push-out bond strength of sealers to root canal walls.[16] The adhesive ability of root canal fillings may be impacted by the use of antibiotic pastes, which could have both beneficial and detrimental effects.[17]

An endodontic sealer's adhesive capacity is determined by either its resistance to dislodgement using the POBS test or its bond strength to dentin. Intracanal medications should be effectively eliminated from the root canals to ensure proper adhesion because their residue may obstruct the sealer's ability to adhere to the dentin. [18]

MTA Fillapex is a new sealer based on calcium silicate and salicylate resin.provides a strong radio-opacity, a long-term sealing capacity, and encourages the deposition of hard tissue.It includes bismuth trioxide, calcium silicate, salicylate resin, diluting resins, natural resin, and nanoparticulated resin. [19]

When the material comes into contact with fluids containing phosphate, the release of calcium and hydroxyl ions from the set sealer is expected to cause the creation of apatite. The chelation of calcium ions by minocycline gives TAP a increased potential for retention in the dentinal tubules. For an intracanal medication to be effective, it must enter dentinal tubules profoundly. In a research by Khanvilkar et al. in comparison to calcium hydroxide and TAP, NIT paste showed greater penetration inside the dentinal tubules.[7]

Intracanal injected medicaments may create a barrier between the sealer and the dentin. Since they cannot be fully removed from the canals, regardless of the techniques employed. Therefore, Even with sufficient irrigation, the NIT group may have had a greater effect on the sealer's penetration than the TAP group because of its deeper penetration into the dentinal tubules.[20]

This explains why the bonding strength in the NIT group was slightly lower than in the TAP group.

V. CONCLUSION

Within the limitations of this investigation, it should be conclude that TAP, NIT, and Neopex significantly increased the bonding capacity of resin-based sealer. The mean POBS values of TAP, NIT and Neopex differ significantly from one another. As a result, NIT is an effective substitute for traditional intracanal medicaments.

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