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## THE EFFECT OF ROOT DENTIN HARDNESS AFTER PLACEMENT OF DIFFERENT INTRA CANAL MEDICAMENTS- NANO SILICA TAP, TAP AND CALCIUM HYDROXIDE

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[doi: 10.33472/AFJBS.6.11.2024.1696-1703](https://doi.org/10.33472/AFJBS.6.11.2024.1696-1703)**ABSTRACT:**

The purpose of this study was to determine the effect of root dentin hardness after placement of different intra canal medicaments such as Nano silica TAP, TAP and calcium hydroxide. forty-five freshly extracted third molars were sectioned, with thickness of 1.5 mm dentin disc, after which each sample was irrigated with 20 ml of 1.5 percent sodium hypochlorite (Naocl). Teeth were randomly divided into three groups (n = 15): group-1 TAP, group-2 Nano-silica TAP, and group-3 calcium hydroxide. The radicular side of each dentin disc was treated with the medicament by applying 0.1 ml of TAP, Nano TAP, and calcium hydroxide. Each specimen were subjected to micro-hardness testing using a Vickers micro-hardness tester. Statistical analysis was done using one way Analysis of Variance (ANOVA), Post-Hoc Tukey test and Paired t-test to compare the pre and post immersion micro-hardness values of the selected samples. The result of the present study shows significantly increase the micro-hardness of root dentin in Nano TAP compared to TAP and calcium hydroxide group. Thus Nano-silica can be added to TAP and used as an intracanal medicament and improves its antimicrobial property.

**Keywords:** Nano silica, antimicrobial property, lesion, Microorganisms, Growth, Survival

**1. INTRODUCTION**

Medication plays an important function in root canal therapy in removing active exudation and necrotic pulp. The category of medication to be given relies on the diagnosis of the lesion associated, the microorganisms involved, their growth, and survival. (1)

Removing most bacteria from the canal may be necessary during biomechanical preparation for root canal therapy (RCT). (2) Before root canal filling, an intracanal medicament should be placed as a key step to alleviate the microbial load. (3) In the RCT, biomechanical preparation and irrigation considerably reduced the number of germs in diseased canals; nevertheless, comprehensive disinfection is difficult to achieve in many circumstances. In the complicated root canal system, persistent bacteria in an obturated channel may grow and invade. Intracanal medication application is essential because chemo-mechanical pre-treatment has little effect on these bacteria. (2)

Hoshino and colleagues first produced triple antibiotic paste in 1996 after conducting a study that indicated that triple antibiotic paste decontaminates Escherichia coli-infected dentin. Metronidazole (nitroimidazole molecule), ciprofloxacin (synthetic fluoroquinolone), and minocycline are the three antibiotics that make up triple antibiotic paste (a semisynthetic derivative of tetracycline). (4)

Calcium hydroxide is recommended as an intracanal dressing because of its biological qualities, including high alkalinity, antibacterial activity, tooth resorption inhibition, and tissue dissolving ability, all of which help improve clinical circumstances.(5) However, some

researchers have suggested that mixing calcium hydroxide with other substances, such as silicon oil-based calcium hydroxide with 38 percent iodoform, can improve its qualities. Iodoform is a brilliant hexagonal crystal with a lemon yellow colour. In comparison to alcohol and ether, it has lower water solubility. In addition, iodine creates elementary iodine after breakdown, oxidizing key enzymes and precipitating proteins. (6)

The bond strength and microhardness of dentin have a close relationship. As a result, microhardness is the best predictor of dentin/restoration behaviour. (7,8) Furthermore, small changes in microhardness can cause the distribution of stresses to be disrupted, allowing the location of failures to be determined. As a result, the current study used Vickers's microhardness test to determine the influence of several intracanal medicaments on radicular dentin microhardness (VHN).

## 2. MATERIALS AND METHODS

### SAMPLE SELECTION

45 newly extracted third molars were chosen and preserved until use. Caries-free human third molars and teeth with adequate thickness and width were chosen. The study did not include teeth that were carious, fractured, or misshapen. Each sample was sectioned, and a 1.5 mm dentin disc was taken from each sample, after which each sample was irrigated with 20 ml of 1.5 percent sodium hypochlorite (NaOCl).

### SAMPLE PREPARATION

According to the medicament utilized, teeth were randomly divided into three groups (n = 15): group TAP, group nano-silica TAP, and calcium hydroxide group. The radicular side of each dentin disc was treated with the medicament by applying 0.1 ml of MTAP or calcium hydroxide based intracanal medicament using a disposable syringe to cover the full surface of radicular dentin in each of the medicament groups. The intracanal medicament was applied in a quantity of 0.1 ml, which was sufficient to cover the radicular surface of the dentin disc.

### VICKER'S HARDNESS TESTING

VHN values (kg/mm<sup>2</sup>) were determined on the 30th day at a load of 50 g indentation for 10 seconds. The burden was divided by the indentation's area. Each specimen had three indentations made in the middle of the radicular dentin. The indenter's long axis was kept parallel to the radicular surface. The three measurements were obtained at the farthest point in the central area, 1000 metres from the pulpal space. Load impressions can be used on brittle materials without causing them to crack. In VHN, the final reading was taken as the average of the three indentations.

### STATISTICAL ANALYSIS

The one-way ANOVA (Analysis of Variance) was used to check to mean differences among the groups. In addition, post hoc analysis was done using Tukey's Honest Significant Difference test. (table 1 and 2)

## 3. RESULTS

Table 1 and 2 Comparison of mean micro-hardness of dentin after 7th day of application of three intra-canal medicaments

Groups	Mean	Std. Deviation	One way ANOVA
Calcium Hydroxide	83.5407	3.33938	0.000
Triple Antibiotic Paste	79.7467	2.89676	

Nanosilica Triple Antibiotic Paste	87.1133	1.68050	
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GROUPS	Comparison	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Calcium Hydroxide	Triple Antibiotic Paste	3.79400*	.99703	.001	1.3717	6.2163
	Nanosilica Triple Antibiotic Paste	-3.57267*	.99703	.002	-5.9950	-1.1504
Triple Antibiotic Paste	Calcium Hydroxide	-3.79400*	.99703	.001	-6.2163	-1.3717
	Nanosilica Triple Antibiotic Paste	-7.36667*	.99703	.000	-9.7890	-4.9444
Nanosilica Triple Antibiotic Paste	Calcium Hydroxide	3.57267*	.99703	.002	1.1504	5.9950
	Triple Antibiotic Paste	7.36667*	.99703	.000	4.9444	9.7890

\*. The mean difference is significant at the 0.05 level.

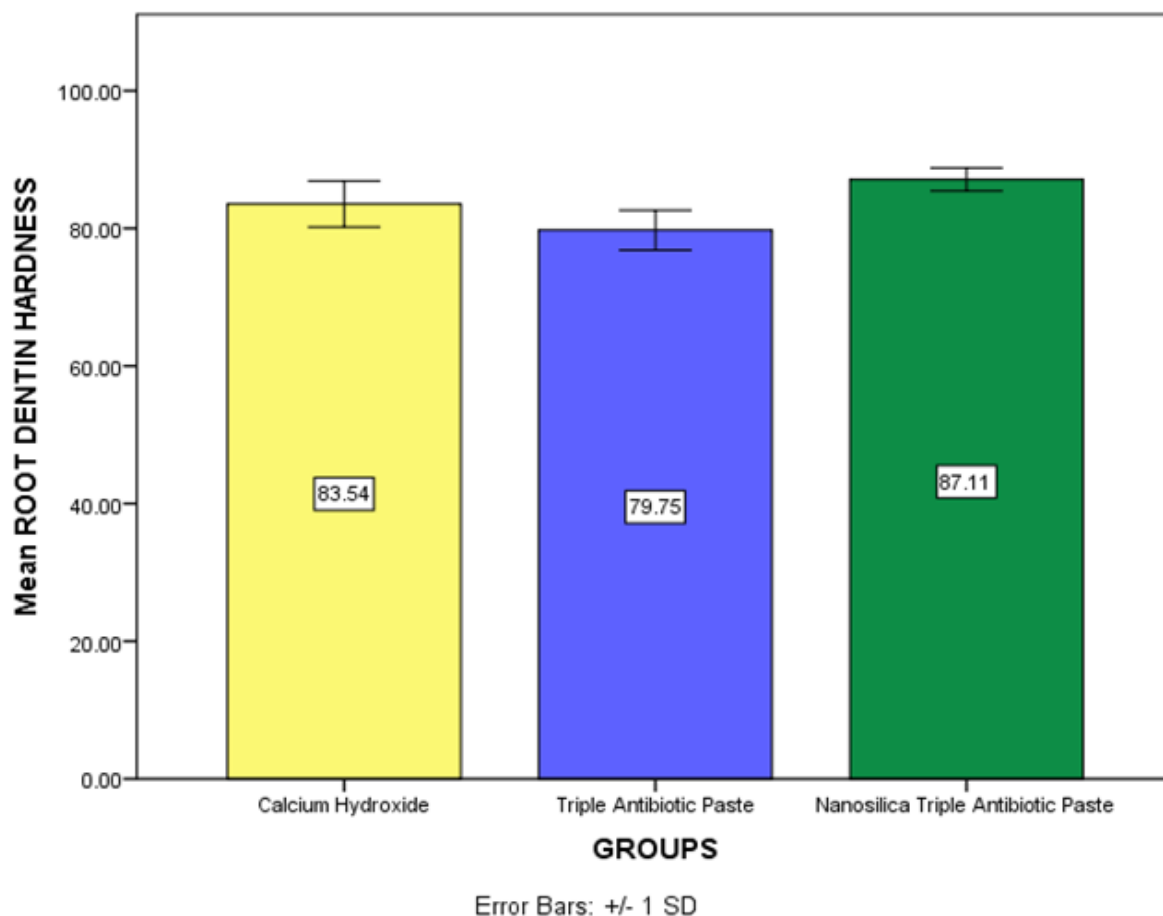


Figure 1: Dentin Hardness  
Figure 1 shows the dentin hardness

#### 4. DISCUSSION

Microorganisms have a significant role in pulpal and periradicular diseases. (9) The eradication of these microbes from the infected root canals is rigorous. (10) The instrumentation alone cannot eradicate the microbes from the complex canal anatomy. Hence, a certain kind of disinfection is required to kill and eliminate the microbes from the root canal. (11)

Intracanal medicaments used in endodontics have various significant purposes, including eradicating the remaining microbes, maintaining the canal entity inert, and preventing postoperative pain. (12) However, apart from this, alteration in root dentin's mechanical and chemical properties occurs due to the disinfectant protocol in endodontic therapy. This causes a change in microhardness, solubility, and permeability due to the change in dentin structure's inorganic/organic ratio. (13)

Microhardness is characterized as the resistance to local deformation. These tests are based on the induced permanent surface deformation after removing the load. Hardness measurements can be coordinated with other mechanical properties such as yield strength, modulus of elasticity, and fracture resistance. (14) A strong correlation exists between the microhardness of dentin and bond strength. (15) Hence, microhardness provides the initial step to determine the dentin/restorations interface results and the locations of failures.

Irrigation plays a crucial role in counteracting problems such as a complex anatomical structure that prohibits the complete removal of microorganisms. (16) Sodium hypochlorite is the most frequently used irrigating solution, but it also has certain limitations of causing cytotoxicity, corrosion of instruments, etc. Furthermore, no irrigating solution is considered optimal. Therefore, a combination of adjunct irrigants with a proper sequence is required to obtain successful results. Another commonly used irrigating agent is ethylenediaminetetraacetic acid (EDTA), which dissolves the inorganic component. EDTA also provides additional advantages, such as helping in RCT procedures, ease of access for root canal armamentarium, and minimal or reduced corroding activities for instruments. In addition, it is also useful in preparing teeth with calcified canals. However, the higher concentration of NaOCl causes cytotoxic effects when extruded in the periradicular tissue. Thereby leading to severe pain, immediate swelling, and exuberant bleeding.

Furthermore, it is noted that NaOCl causes interference in the bonding of the resin-based sealer used in endodontic therapy. Therefore, the American Association of Endodontics used the concentration of 1.5% NaOCl in the present study as per the current endodontic regenerative protocol recommendations. Final irrigation with 17% EDTA was recommended during endodontic regeneration (17,18). The chelating agent improved the chemo-mechanical debridement of the root canal by eliminating the smear layer. However, it was also found to significantly reduce the radicular dentine microhardness (19) and root resistance to fracture (20).

Calcium hydroxide is the commonly used intracanal medicament. The antibacterial effect of calcium hydroxide is maintained when the pH is high. (21) Various studies have been done to evaluate the effect of calcium hydroxide mixed with other substances, which will improve its properties. The additional factors that affect the outcome include vehicles that alter ionic dissociation, antimicrobial activity, and radiopacity. It also includes consistency, which helps in filling the canal. Silicon oil-based calcium hydroxide containing 38% of iodoform is commercially available as a metaper. (22,23) Andreasen et al. theorized that the proteolytic action of Ca (OH) 2 could weaken a tooth up to 50%, and this weakness could lead to an increase in fracture. (24) White et al. reported a 32% decrease in dentine strength after using Ca (OH) 2. They proposed that this was caused by the breakdown of calcium hydroxide's protein structure and alkalinity. (25) Grossman initially introduced the use of antibiotics in

endodontics in 1951 as a combination of different antibiotics known as polyantibiotic paste. The triple antibiotic paste is a mixture of metronidazole, ciprofloxacin, and minocycline, the widely used intracanal medicament became popular and regular after its role revascularization. Metronidazole is particularly effective against anaerobes and has an antimicrobial effect against protozoa and anaerobic bacteria. (26)

In the field of dentistry, nano-silica is used as a dental filler. (27) However, variation in the dimension and outline of packing particles affect the possessions of the materials. Thus various dental fillers are added to improve their mechanical properties. Moreover, Nano-silica can be added to TAP and used as an intracanal medicament and improves its antimicrobial property.

## 5. CONCLUSION

VHN has been used in our study to assess teeth microhardness on the application of various remineralizing agents. This test gives accurate readings in both soft and hard materials. Furthermore, it gives identical hardness numbers on similar materials at different loads, while other tests need arbitrary changes. The decalcified teeth lose the inorganic components leading to decreased hardness, but the accurate readings of this test made it our choice of analysis for microhardness. Intracanal medicaments are capable of decreasing the microhardness of dentin. Irrigation protocol performed during treatment also affects the microhardness. Therefore, the type and duration of medicament have a pivotal role in maintaining dentin microhardness. Thus, nano-silica TAP has better hardness and strength than TAP alone or other intracanal medicaments.

## 6. REFERENCES:

1. Karamifar K, Tondari A, Saghiri MA. Endodontic periapical lesion: An overview on the etiology, diagnosis and current treatment Modalities. *European Endodontic Journal*. 2020;5(2):54.
2. Narayanan LL, Vaishnavi C. Endodontic microbiology. *Journal of conservative dentistry: JCD*. 2010 Oct;13(4):233.
3. Trope M, Bergenholtz G. Microbiological basis for endodontic treatment: can a maximal outcome be achieved in one visit?. *Endodontic Topics*. 2002 Mar;1(1):40-53.
4. Sato I, Ando-Kurihara N, Kota K, Iwaku M, Hoshino E. Sterilization of infected root-canal dentine by topical application of a mixture of ciprofloxacin, metronidazole and minocycline in situ. *Int Endod J*. 1996;29(2):118-24.
5. Estrela C, Holland R. Calcium hydroxide: study based on scientific evidences. *Journal of Applied Oral Science*. 2003;11:269-82.
6. Fulzele P, Baliga S, Thosar N, Pradhan D. Evaluation of calcium ion, hydroxyl ion release and pH levels in various calcium hydroxide based intracanal medicaments: An in vitro study. *Contemporary clinical dentistry*. 2011 Oct;2(4):291.
7. Massoud SF, Moussa SM, Hanafy SA, El Backly RM. Evaluation of the microhardness of root canal dentin after different irrigation protocols (in vitro study). *Alexandria Dental Journal*. 2017 Apr 1;42(1):73-9.
8. Yassen GH, Eckert GJ, Platt JA. Effect of intracanal medicaments used in endodontic regeneration procedures on microhardness and chemical structure of dentin. *Restorative dentistry & endodontics*. 2015 May 1;40(2):104-12.
9. Dudeja PG, Dudeja KK, Srivastava D, Grover S. Microorganisms in periradicular tissues: Do they exist? A perennial controversy. *Journal of oral and maxillofacial pathology: JOMFP*. 2015 Sep;19(3):356.

10. Wong J, Manoil D, Näsman P, Belibasakis GN, Neelakantan P. Microbiological aspects of root canal infections and disinfection strategies: an update review on the current knowledge and challenges. *Frontiers in Oral Health*. 2021:34.
11. Iqbal A. Antimicrobial irrigants in the endodontic therapy. *International journal of health sciences*. 2012 Jun;6(2):186.
12. Kumar A, Tamanna S, Iftekhar H. Intracanal medicaments–Their use in modern endodontics: A narrative review. *Journal of Oral Research and Review*. 2019 Jul 1;11(2):94.
13. Hülsmann M. Effects of mechanical instrumentation and chemical irrigation on the root canal dentin and surrounding tissues. *Endodontic Topics*. 2013 Sep;29(1):55-86.
14. Fuentes V, Toledano M, Osorio R, Carvalho RM. Microhardness of superficial and deep sound human dentin. *Journal of Biomedical Materials Research Part A: An Official Journal of The Society for Biomaterials, The Japanese Society for Biomaterials, and The Australian Society for Biomaterials and the Korean Society for Biomaterials*. 2003 Sep 15;66(4):850-3.
15. Koç-Vural U, Ergin E, Gurgan S. Microhardness and shear bond-strength of carious dentin after fluorescence-aided or conventionally excavation:(An in-vitro comparison). *Journal of clinical and experimental dentistry*. 2018 Jul;10(7):e668.
16. Haapasalo M, Shen Y, Qian W, Gao Y. Irrigation in endodontics. *Dental Clinics*. 2010 Apr 1;54(2):291-312.
17. Galler KM. Clinical procedures for revitalization: current knowledge and considerations. *International endodontic journal*. 2016 Oct;49(10):926-36.
18. Kontakiotis EG, Filippatos CG, Tzanetakakis GN, Agrafioti A. Regenerative endodontic therapy: a data analysis of clinical protocols. *Journal of endodontics*. 2015 Feb 1;41(2):146-54.
19. De-Deus G, Paciornik S, Mauricio MH. Evaluation of the effect of EDTA, EDTAC and citric acid on the microhardness of root dentine. *International Endodontic Journal*. 2006 May;39(5):401-7.
20. Uzunoglu E, Aktemur S, Uyanik MO, Durmaz V, Nagas E. Effect of ethylenediaminetetraacetic acid on root fracture with respect to concentration at different time exposures. *Journal of endodontics*. 2012 Aug 1;38(8):1110-3.
21. Farhad A, Mohammadi Z. Calcium hydroxide: a review. *International dental journal*. 2005 Oct 1;55(5):293-301.
22. Kim D, Kim E. Antimicrobial effect of calcium hydroxide as an intracanal medicament in root canal treatment: a literature review-Part I. In vitro studies. *Restorative dentistry & endodontics*. 2014 Nov 1;39(4):241-52.
23. Kim D, Kim E. Antimicrobial effect of calcium hydroxide as an intracanal medicament in root canal treatment: a literature review-Part II. in vivo studies. *Restorative dentistry & endodontics*. 2015 May 1;40(2):97-103.
24. Andreasen JO, Farik B, Munksgaard EC. Long-term calcium hydroxide as a root canal dressing may increase risk of root fracture. *Dental Traumatology*. 2002 Jun;18(3):134-7.
25. White JD, Lacefield WR, Chavers LS, Eleazer PD. The effect of three commonly used endodontic materials on the strength and hardness of root dentin. *Journal of endodontics*. 2002 Dec 1;28(12):828-30.
26. Parhizkar A, Nojehdehian H, Asgary S. Triple antibiotic paste: momentous roles and applications in endodontics: a review. *Restorative dentistry & endodontics*. 2018 Apr 26;43(3).
27. Rodríguez HA, Casanova H. Effects of silica nanoparticles and silica-zirconia nanoclusters on tribological properties of dental resin composites. *Journal of Nanotechnology*. 2018 Jan 1;2018

