



ORIGINAL RESEARCH ARTICLE

EVALUATION OF THE EFFECTS OF TRIPHALA ON DENTIN MICRO-HARDNESS AS IRRIGATION SOLUTIONS

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ABSTRACT

Aims: The purpose of this study was to compare the effect of 0.005% *Triphala* and 2% chlorhexidine and 5.25% hypochlorite sodium on the micro-hardness of root canal dentin used to irrigation solutions. **Settings and Design:** in vitro. **Methods and Material:** 88 single-rooted mandibular premolars were selected. The teeth were sectioned horizontally at mid-root, then were embedded in resin blocks. The samples ground-polished. samples were randomly assigned to four test groups (n=22). Group I: distilled water (control group); Group II: *Triphala*; Group III: 2% chlorhexidine; Group IV: 5.25% hypochlorite sodium. Following treatment with irrigation solutions for 15 min micro-hardness of dentin blocks was evaluated using Vickers hardness indentation machine. **Statistical analysis used:** one-way ANOVA and post hoc-Tukey's test. **Results:** the results indicated that 5.25 % hypochlorite sodium solution was significantly decreased root-dentin micro-hardness when compared with the control group ($p < 0.05$). *Triphala* had the least effect on micro-hardness in comparison with 2% chlorhexidine and 5.25% NaOCl. **Conclusions:** Although there are many factors for irrigation solution preference, according to the results of this study *Triphala* seems to be an appropriate endodontic solution because of its harmless effect on the micro-hardness of root dentin.

Key words: Chlorhexidine, dentin micro-hardness, hypochlorite sodium, *Triphala*

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INTRODUCTION

Root canal preparation involves action of endodontic instruments and irrigation solution simultaneously so irrigation is considered an important step during root canal treatment. It assists in cleaning root canal system areas that are not accessible by instruments. An ideal irrigant should have a number of functions, including lubrication, debridement, antimicrobial effect, and dissolution of organic and inorganic materials^[1].

During all the instrumentation procedures, the root canals are irrigated with a solution for disinfection purposes and removal of organic materials or debris by dissolving them.

Different concentrations of hypochlorite sodium (NaOCl), H₂O₂, chlorhexidine gluconate (CHX), MTA and EDTA are routinely used as irrigants in endodontic therapy^[2].

At present, NaOCl is the most commonly used root canal irrigation solution due to its strong proteolytic potential that results in sufficient tissue lysis and antimicrobial effects^[3-6]. However, it might exert detrimental effects, including unpleasant

odor and taste, toxicity, paresthesia of the mandibular nerve, allergy and finally give rise to an increase in coronal micro-leakage of adhesive restorations^[4-6]. Yamada et al reported that a final rinse with 10 ml of 17% EDTA followed by 10 ml of 5.25% NaOCl was the best option^[7].

Chlorhexidine gluconate (CHX) has found applications in endodontics as an irrigant and an intra-canal medicament. CHX has a broad-spectrum antimicrobial activity, destroying bacterial species resistant to Ca(OH)₂. It is not recommended as a routine intra-canal medicament because it cannot properly dissolve tissue remnants and exhibits cytotoxic effects. In addition, some patients might exhibit allergic reactions upon exposure to CHX^[8].

Investigations into the mechanism of action and efficacy of different chemical irrigation solutions have shown that they directly affect both organic and inorganic components of root canal dentin, resulting in alterations in the mechanical, chemical and physical properties of dentin. There are reports that micro-hardness of dentin is affected by composition and surface changes of tooth structures^[9]. The effect of

irrigation solutions on dentin should be evaluated due to irrigation solutions come in contact with dentin during irrigation procedures, which might alter dentin and enamel surfaces, affecting their interactions with obturation and coronal restorative materials^[10]. The effects of some chemical agents such as EDTA, NaOCl, chlorhexidine, etc on dentin hardness have been evaluated^[10-12]. Garcia et al reported that different concentrations of NaOCl decreased the micro-hardness of root canal dentin in cervical and apical thirds^[13].

Studies have shown a decrease in micro-hardness of radicular dentin exposed to NaOCl^[14,15] and 2% CHX as root canal irrigation solutions^[15]. Therefore, it is advisable to find a new, safe, and effective irrigation solution for use during root canal preparation.

Triphala is a plant-derived solution originating from India, with the powder being a combination of three dried plants, namely *Terminalia belleria*, *Terminalia chebula* and *Embilica officinalis* with tannic acid as its principal constituent^[16]. *Triphala* is used in Indian traditional medicine to

treat headaches, constipation and hepatic disorders^[17]. Initial studies have shown that tannic acid has bacteriostatic and bactericidal activity against gram-positive and gram-negative bacteria^[18]. It is safe, with compounds exhibiting proper physiologic effects in addition to its anti-oxidative and anti-inflammatory properties, believed to effect more beneficial properties compared to other routine root canal irrigation solutions^[19]. Shakouie et al^[20] compared the antibacterial activity of *Triphala* with different concentration of sodium hypochlorite (NaOCl) as irrigant solution against enterococcus faecalis and concluded *Triphala* exhibited better antibacterial activity compared to 0.5 and 1 % NaOCl.

In addition the advantages of plant-derived medications include easy access, low cost, long-term substantivity, less toxicity and no induction of microbial resistance^[18].

There are no reports on the influence of *Triphala* on dentin micro-hardness. Therefore, this in vitro study was designed to evaluate and compare the effects of *Triphala* (a new herbal irrigation solution),

5.25% NaOCl and 2% CHX on the micro-hardness of root dentin.

MATERIALS and METHODS:

Eighty-eight single-rooted mandibular premolars with single canal (40-45 years old patients), that were extracted for periodontal reasons were selected and stored at 37°C in buffered saline solution. The inclusion criteria were the absence of caries, root cracks or restorations. The teeth were sectioned horizontally at mid-root with a diamond disc under water spray to prevent overheating. All the samples were cleaned with saline solution to remove the surface debris. A total of 88 samples were embedded in resin blocks to facilitate handling. The samples were ground-polished with water-cooled Sof-Lex (3M ESPE) polishing and finishing disks, followed by examination under a stereomicroscope (SMZ1500, Nikon, Japan) to exclude the teeth with cracks. New specimens meeting the inclusion criteria were included to compensate for them. A total of 88 samples were randomly assigned to four test groups (n=22). Irrigation solutions were freshly prepared and samples in each group were immersed

in respective irrigation solution. Group I: distilled water as control group; Group II: *Triphala* (*Triphala* powder, IMPCOPS Ltd, Chennai, India) was dissolved in 10% dimethyl sulfoxide" DMSO" (SD Fine Chemicals, Chennai, India) to prepare an irrigation solution at a concentration of 5mg/ml; Group III: 2% CHX (GlucocheX; P.P.H. CerkaMed, ul Kwiatkowskiego 1, 37-450 Stalowa Wola, Poland); Group IV: 5.25% NaOCl. At the end of active treatment period (15 min), the samples were rinsed with distilled water and dried. Following treatment with irrigation solutions micro-hardness of dentin blocks was evaluated using Vickers hardness indentation machine (UHL VMHT Auto, Walter UHL Technische Mikroskopie, GmbH and Co., KG, Loherstrabe 7, D-35614 ABlar, Germany) at 400µm from the canal lumen. Baseline data was recorded in the control group. All the indentations were made with a 200g load and a dwell time of 15 seconds^[21]. Dentin micro-hardness was measured at three different points and the means were calculated. The values are obtained in Vickers hardness number (VHN). The statistical package SPSS

(Statistical Package for Social Science, version 17) was used for statistical analysis. The data were analyzed statistically using one-way analysis of variance (ANOVA), and the comparison of means was conducted using Tukey multiple comparison test. The

testing was performed at the 95% level of confidence ($P < 0.05$).

RESULTS:

The means and standard deviations of the root dentin micro-hardness values for the irrigation solution treatment groups and control group are listed in Table 1.

Table 1. Comparison of mean micro-hardness values between the various groups at 95% confidence interval

Endodontic Irrigation Solution	N	Mean	SD	P-value
Distilled water	22	45.27	7.25	0.001
<i>Triphala</i>	22	44.96	7.15	
2% Chlorhexidine	22	41.62	5.23	
5.25% hypochlorite sodium	22	38.12	6.71	

The results of one-way ANOVA showed significant differences in the mean micro-hardness values between the groups ($P = 0.001$). Two-by-two comparisons with post hoc Tukey tests showed significant differences only between 5.25% NaOCl and distilled water, 5.25% NaOCl and *Triphala*.

As results treatment with 5.25 % NaOCl solution was significantly decreased root dentin micro-harness when compared with the control group ($p < 0.05$).

DISCUSSION:

This study was designed to measured different root canal irrigations (5.25%

NaOCl, 2% CHX and *Triphala*) in altering the root dentin micro-hardness. Results of this study was shown all the irrigation solutions decreased micro-hardness of root canal dentin and, might affect the components of dentin structure. Among these irrigants only NaOCl decreased micro hardness of dentin significantly and *Triphala* and 2% chlorhexine had not significantly effect on decreasing of micro-hardness. Effect of *Triphala* on micro-hardness of dentin was near to distilled water. Distilled water was used as a control because it does not induce any chemical changes on dentin [22].

Micro-hardness evaluation furnishes indirect evidence of mineral loss or gain in tooth hard structures. Decrease of dentin micro-hardness probably contributes to increase the incidence of fractures and/or cracks [23,24]. Previous studies have shown the suitability and practicality of Vickers micro-hardness test for evaluating surface changes of tooth hard structures exposed to chemical agents [11]. Pashley et.al. [25] found an inverse correlation between dentin micro-hardness values and tubular density, with degree of mineralization and

the density of hydroxyapatite in the inter-tubular substance being important determinants of the intrinsic hardness of dentin structure [9].

So in the present study Vickers micro-hardness test was applied because it is more sensitive and less sensitive to measurement errors and surface conditions respectively and small specimens can be tested accurately [10].

Several studies were done to evaluate different effects of NaOCl and CHX as irrigations in root canal system. In a study, 5% NaOCl resulted in a significant decrease in bond strength to adhesive resin [26] Grigoratos et.al. [27] and Sim et al [28] reported that NaOCl resulted in a decrease in modulus of elasticity and flexural strength of dentin.

Oncag et al [29] found that Cetrexidin (0.2% CHX plus 0.2% cetrimide) and 2% CHX were more effective, exhibited more residual antibacterial effects, and exerted lower toxicity compared to 5.25% NaOCl solution. Vianna et al [30] reported that the time necessary for 1.0% and 2.0% CHX to eliminate all the microorganisms was the same as that for 5.25% NaOCl. In another

in vitro study, White et al^[31] and Leonardo et al^[32] showed that CHX is absorbed by dentin and released from dentin up to 48–72 hours after instrumentation. Absorption of chlorhexidine by dentin might have resulted in a positive effect that can probably explain this result.

As regard of effects on micro-hardness, Slutzky-Goldberg et al^[33] reported that instrumentation and irrigation with NaOCl resulted in alterations in the biomechanical properties of dentin, indicating direct effects of these chemical solutions on organic and mineral content of dentin structure^[34]. Results of Zapparoli et al study indicated 17% EDTA solution and 1%NaOCl individually and NaOCl/EDTA in alternation decreased dentin micro-hardness^[35].

Two studies showed that 0.2% CHX had no effect on micro-hardness of root canal dentin and was more effective, because of more residual antibacterial effects and exhibited lower toxicity compared to NaOCl^[36,37].

On the other hand Oliveira et al^[15] in a study showed micro-hardness of dentin treated with 2% CHX was reduced. CHX is a cationic compound that has ability to bind

anionic molecules such as the phosphates present in the hydroxyl apatite structure inducing changes in the Ca/P ratio which could explain the reduced values of micro-hardness in root dentin exposed to CHX^[38]. Beside this, CHX is not recommended as a routine intra-canal medicament because it cannot properly dissolve tissue remnants and exhibits cytotoxic effects. In addition, some patients might exhibit allergic reactions upon exposure to CHX^[8].

Recently herbal drugs like *Triphala* (plant-derived solution) are being introduced in dentistry^[39]. In the present study, DMSO was used as a solvent for *Triphala* to make it as solution. Hebling et al^[38] reported that DMSO exhibited no or minor cytotoxic effects on odontoblast-like cells. Tjäderhane et al^[40] showed that DMSO, used as a solvent, might help preserve the long-term dentin-adhesive bond strength, which is attributed to inhibition of dentinal enzymes or improved wetting of collagen by adhesive agents.

In Shakouie et al^[20] and Prabhakar studies^[41] *Triphala* exhibited antimicrobial activity against *E. faecalis* more than 0.5 and 1% NaOCl as root canal irrigant. Same studies

showed that *Triphala* mouthwash was an effective anti-plaque agent similar to 0.2% CHX^[17,42].

Based on the results of the present study, it can be concluded that *Triphala*, does not affect the micro-hardness of root dentin over time, so it is superior to NaOCl and CHX as regard of its harmless effect on the micro-hardness of root canal dentin.

But Before extrapolating this result to clinical situations, it has to be evaluated for its other properties like biocompatibility, staining and substantively, which are necessary for its use as an efficient intra-canal irrigant. Therefore, further studies are required so that it can be recommended as a new irrigation solution.

CONCLUSION:

Triphala has the least effect on micro-hardness of dentin in comparison with CHX and NaOCl and seems to be an appropriate irrigation solution because of its harmless effect on the micro-hardness of root canal dentin.

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