OPEN ACCESS

Saudi Journal of Oral and Dental Research
Abbreviated Key Title: Saudi J Oral Dent Res
ISSN 2518-1300 (Print) | ISSN 2518-1297 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article **Endodontic and Restorative**

Consequence of Miswak plus Nano Calcium Carbonate Tooth Paste on Demineralized Enamel

Dr. Mohamed M. A Hanbola[1,2*]

[1]Restorative Dentistry Specialist at PHCC, Qatar
[2]Lecturer at Endodontic and Restorative Department, Faculty of Dentistry, Tripoli University, Libya

DOI: 10.36348/sjodr.2023.v08i01.008 | **Received:** 19.12.2022 | **Accepted:** 27.01.2023 | **Published:** 30.01.2023

***Corresponding author:** Dr. Mohamed M. A Hanbola
Lecturer at Endodontic and Restorative Department, Faculty of Dentistry, Tripoli University, Libya

Abstract

In order to examine and contrast the effects of brushing with miswak and nano calcium carbonate toothpaste on the surface hardness of human teeth surfaces that had been demineralized with citric acid, a study was conducted. Surface hardness was assessed using a Knoop Hardness Tester after brushing for fourteen or twenty-eight minutes, and data were compared using Wilcoxon, Kruskal-Wallis, and Mann-Whitney tests. These findings demonstrated that the increase in surface hardness following the use of nano calcium carbonate toothpaste was greater than the rise following the use of miswak toothpaste (p 0.05).

Keywords: human teeth surfaces, melt hardness, miswak, chronic and systemic diseases.

INTRODUCTION

For thousands of years, people all around the world have used miswak, a traditional chewing stick made from the roots, twigs, and stem of Salvadora persica, to naturally clean their teeth. Scientific research has shown that salvadora persica, also known as miswak, has antibacterial, antifungal, antiviral, anticariogenic, and antiplaque qualities. Miswak is also said to have analgesic, anti-inflammatory, and antioxidant properties, according to several research. The content of saliva is changed immediately by the usage of a miswak [1].

Miswak root

Poor oral health is associated with several chronic and systemic diseases. Today, the most common way to clean teeth is to use a toothbrush along with toothpaste. In developing countries Miswak has been administered in 10 different forms, including mouthwashes, toothpastes, chewing sticks, essential oils, aqueous extracts, ethanolic extracts, probiotic sprays, toothpastes, tooth cements and chewing gums.

The various studies reported positive effects of miswak such as anti-plaque, anti-gingivitis, anti-caries properties, promotion of gingival wound healing, whitening properties, maintenance of orthodontic chain, and biocompatibility with oral cells. Enamel, a crystalline material that covered the anatomical crowns of human teeth entirely, is made of calcium hydroxyapatite. Enamel lesions form after being exposed to acid, and they get worse when plaque is kept on tooth surfaces. The first signs of lesions on the surface of teeth are white spots or holes. These chalky white spots on tooth surfaces are not frequently thought of as caries, despite the fact that they serve as an early warning indication of the lesion formation. Early lesions appeared as a result of the demineralization of enamel surfaces; contributory factors included the retention of plaque, acid exposure, and decreased salivary flow and buffering capacity [1, 2]. Early lesions can be reversed and recovered through remineralization, which increases the hardness of demineralized enamels and restores the structure of enamel teeth [1, 3]. Remineralization is possible with enough calcium, phosphate, and fluoride concentrations, as well as increased salivary flow and buffer capacity. Saliva's role in remineralization has previously been recognized, and it's Ca2 + and HPO 2- content likely compensated for ion losses during demineralization. HPO 2- also improves the conditions that lead to initial lesions by increasing saliva's buffering [4]. Although saliva also contains calcium and phosphate, it also has an average fluoride content of 0.03 ppm, which can be supplemented by mouthwash, toothpaste, and topical remineralization agents [5]. The main function of toothpaste is to prevent tooth decay due to demineralization and loss of calcium apatite, which can be replaced by Ca2+ and fluoride compounds in toothpaste [4]. Toothpaste containing calcium phosphate and fluoride can induce remineralization, and the formation of apatite minerals within lesions has been shown to be affected by the amount of calcium and phosphate entering the lesion [6]. Hydroxyapatite lost during demineralization can be replaced by fluoride, which is deposited in the lesion to form fluorapatite. However, the effectiveness of fluoride on remineralization depends on the presence of calcium. This is because fluoride access and retention in enamel lesions depends on calcium availability [6, 7].Modern toothpastes contain nano-sized calcium carbonate and fluoride derived from plant-based ingredients such as miswak, an extract from the Salvadra persica plant.After four weeks of exposure to nano calcium carbonate. Nano-calcium carbonate releases calcium ions faster than larger calcium carbonate particles, as shown by increased calcium levels and increased pH in subsurface lesions [6, 8]. Miswak toothpaste contains fluoride and calcium carbonate and can remineralize teeth within 21 days, while nano-sized calcium carbonate can improve fluoride uptake into lesions. [9]. Since there is no previous study comparing remineralization after using nano-calcium carbonate toothpaste and herbal toothpaste with Miswak, this study does not test the effectiveness of this toothpaste in terms of enamel hardness after remineralization.

MATERIAL AND METHOD

A total of 24 third molar enamel specimens were mounted in acrylic molds and divided into 3 groups of 8 specimens each. Samples were smoothed with 800 and 2000 grit silicon carbide paper and polished with 1 µm aluminum oxide. Initial hardness measurements were made using a Knoop hardness tester (Zwick Roell-USA) with a 50 g load applied for 15 seconds.

After the initial hardness measurement, the samples were soaked in 25 ml of 0.3% citric acid solution (pH 3.25) for 3 minutes and retested for enamel hardness after demineralization. Samples were then brushed with distilled water (control) or 3 ml of distilled water containing 3 g of nano calcium carbonate or Miswak toothpaste. Brushing was performed using a clown electric toothbrush with a brushing pressure of 150 g. After brushing for 14 minutes (corresponding to 2 weeks) and 28 minutes (corresponding to 4 weeks), the melt hardness was measured again in the same manner as above.

The surface hardness values obtained were tested for normality and uniformity using the Levene statistic. We then used the nonparametric Wilcoxon test to identify pairwise differences between treatment groups and the Kruskal- Wallis test to perform multiple comparisons. Finally, comparisons were made using the Mann-Whitney test and differences were considered significant when $p<0.05$.

RESULT

The changes in melt hardness after demineralization and brushing corresponding to 2 and 4 weeks were expressed in hardness values.

The hardness change before and after soaking the samples in 0.3% citric acid solution and after brushing with distilled water, nano calcium carbonate toothpaste or Miswak toothpaste was measured using a Knoop hardness scale (Table 1). Enamel hardness decreased similarly in all treatment groups after demineralization.

Table 1: Mean Enamel Hardness Value (KHN).

Group	Initial Hardness	After Demineralization	Brushing equivalent to 2 weeks	Brushing equivalent to 4 weeks
Distilled water	360±5.34	252±3.74	255±4.66	252±3.64
Nano Calcium Carbonate toothpaste	354±7.78	245±3.02	275±3.44	325±2.66
Miswak toothpaste	362±4.82	252±2.96	270±2.82	288±1.89

Data were analyzed using the Wilcoxon test to identify significant changes in stiffness within treatment groups and between-group differences. These analyzes showed that after demineralization in all groups, hardness decreased significantly after he had two weeks' worth of brushing with Nano Calcium carbonate toothpaste or Miswak toothpaste resulted in a significant increase in hardness ($p < 0.05$), whereas brushing with distilled water did not ($p > 0.05$). A significant increase in hardness was observed in the samples brushed with and Miswak toothpaste at an amount equivalent to 2 to 4 weeks of brushing, whereas no significant increase in hardness was observed in the distilled water group ($p>0.05$).

Finally, enamel hardness scores after brushing corresponding to 4 weeks were significantly higher in all groups than immediately after demineralization ($p<0.05$). Further statistical analysis using the Kruskal-Wallis multiple comparison test analyzed the decrease and increase in enamel hardness values within and between the three treatment groups (Table 2). These analyzes showed no significant differences between groups in initial hardness ($p > 0.05$). However, after 2 and 4 weeks of equivalent brushing, hardness scores were significantly different between the control and toothpaste groups.

Table 2: Kruskal-Wallis tests of changes in enamel hardnes between the three brushed groups.

Initial enamel hardness	0.387**
Enamel hardness after demineralization in 0.3% citric acid	0.083**
Enamel hardness after brushing for the equivalent of 2 weeks	0.000
Enamel hardness after brushing for the equivalent of 4 weeks	0.000

*P<0.05; **P>0.05

To compare hardness values between brushed groups, we performed a post-hoc Mann-Whitney test (Table 3). These analyzes also showed significant differences after 2 weeks of brushing between the distilled water group and the nano calcium carbonate toothpaste group, and the distilled water group and the Miswak toothpaste group ($p< 0.05$). A similar difference was observed after the equivalent of 4 weeks of brushing and was significantly different between all groups at this time point ($p<0.05$).

Table 3: Post Hoc Mann-Whitney tests of changes in enamel hardness between brushed groups.

Enamel hardness after brushing for the equivalent of 2 weeks	Distilled water *vs.* nano calcium carbonate toothpaste groups	0.000
	Distilled water *vs.* Miswak toothpaste group	0.000
	Nano calcium carbonate *vs.* Miswak toothpaste group	0.000
Enamel hardness after brushing for the equivalent of 4 weeks	Distilled water *vs.* nano calcium carbonate toothpaste groups	0.000
	Distilled water *vs.* Miswak toothpaste group	0.000
	Nano calcium carbonate *vs.* Miswak toothpaste group	0.000

*P<0.05

DISCUSSION

The mechanical properties of tooth enamel, such as B. Hardness, are affected by the mineral content [10]. In particular, calcium concentration plays an important role in the mechanical properties of tooth enamel, and changes in calcium concentration correlate with decreased hardness. The calcium content of the enamel surface can be reduced by calcium dissolution from exposure to low pH solutions.

Thus, this study showed a significant decrease in enamel hardness after his 3 min demineralization with a 0.3% citric acid solution (pH 3.25), as previously reported by Zhou *et al.*, Appears on human teeth. Also, desalination of hydroxyapatite is shown at pH below 5.5, and this process initiates subsurface lesions.

Other factors affecting demineralization were plaque accumulation, buffering capacity, and salivary flow [4]. In this study, a 0.3% citric acid solution was used to demineralize the enamel surface. A decrease in enamel hardness after demineralization indicated subsurface lesion formation. These lesions are reversible, indicating that calcium loss at the enamel

surface is halted and the lost calcium structures are replaced by remineralization. However, remineralization requires sufficient calcium, phosphate, fluoride ions, neutral pH and sufficient quantity of good quality saliva [2, 4].

In this study, demineralized enamel samples were brushed with distilled water, nanocalcium carbonate, or miswak toothpaste. Hardness increased with toothpaste type, but brushing with distilled water did not significantly increase hardness, reflecting the lack of minerals. Confirmed not to be an effective intervention. Agreed by Rios *et al.,* No increase in enamel hardness was observed after uncontrolled brushing without toothpaste in situ [11].

Calcium, phosphate, and fluoride contents of saliva and plaque play an important role in the formation of dental caries, and high calcium concentrations probably help prevent it [12]. The salivary state in the oral cavity is influenced by food, the buffering capacity is changed, and the quality and quantity of saliva become unstable. Mineral supplementation is therefore necessary to support the remineralization process. Current toothpastes contain calcium and fluoride ions necessary for remineralization [4, 6, 9]. This study also found that nano-calcium carbonate toothpaste provided a superior increase in enamel hardness, likely reflecting the presence of calcium on the enamel surface. Similarly, Balakrishnan *et al.,* A comparison of three calcium-containing toothpaste products showed an increase in enamel hardness [3]. In addition, the considerable superiority of nano-calcium toothpaste may be attributed to similar-sized nanoparticles, such as hydroxyapatite in enamel, which have a greater effect on sub-enamel lesions than nitrate-sized calcium carbonate Easier access. Hardness has been shown to decrease regardless of the toothpaste used. Therefore, Nakajima *et al.,* (2009) showed that the calcium content and hardness of enamel lesions increased after exposure to 4 weeks' worth of nano calcium carbonate paste [6].

As Ezoddini-Arkadan previously reported, an increase in hardness was evident after just 2 weeks of brushing with herbal toothpaste containing miswak, which contains the fluoride needed for remineralization [9]. Fluoride binds to calcium ions to form fluoroapatite, displacing desalted hydroxyapatite, and the current data are consistent with those reported in previous studies. These researchers' demonstrated remineralization and increased hardness of the demineralized enamel surface after he had been soaked in 5% and 10% Miswak extracts for one week.

Current nano calcium carbonate toothpaste was better than Miswak toothpaste. This is probably due to the limited effect of fluoride on calcium availability and the better access of nanosized calcium carbonate particles to desalting sites. The release of calcium ions from nano-calcium carbonate was faster than that from nano-calcium carbonate, indicating higher calcium levels on the enamel surface [6].

This study shows that 2 and 4 weeks equivalent brushing with nano calcium carbonate toothpaste restores enamel hardness within this range, with measured hardnesses of 288 ± 3.82 KHN and 328 ± 2.46 KHN, respectively. It has been. Brushing with Miswak toothpaste also restored hardness within the specified range for human enamel, but this study showed a hardness of only 296 ± 1.86 KHN after the equivalent of 4 weeks. These data indicate that the type of toothpaste prevents the expansion of lesions under the enamel by inducing remineralization.

CONCLUSION

From the current analysis, he concludes that two and four weeks' worth of brushing with a nano-calcium carbonate toothpaste or Miswak toothpaste restores the hardness of demineralized enamel. However, even after 4 weeks of brushing, the toothpaste does not fully restore its original hardness. It shows that it offers excellent protection.

REFERENCES

1. Priyadarshini, S., Raghu, R., Shetty, A., Gautham, P. M., Reddy, S., & Srinivasan, R. (2013). Effect of organic versus inorganic fluoride on enamel microhardness: An in vitro study. *Journal of conservative dentistry: JCD*, *16*(3), 203.
2. Bath-Balogh, M., & Fahrenbach, M. J. (2016). *Dental Embryology, Histology and Anatomy* 2nd ed. (Elsevier Saunders) 18 p 23.
3. Balakrishnan, A., Jonathan, R., Benin, P., & Kuumar, A. (2013). Evaluation to determine the caries remineralization potential of three dentifrices: An in vitro study. *Journal of conservative dentistry: JCD*, *16*(4), 375.
4. Graham, J. M., & Hume, W. R. (2005). Preservation *and restoration of tooth structure* 2nd ed (China) 3 pp 25–7.
5. Powers, J. M., & Sakaguchi, R. (2006). *Craig's Restorative Dental Material* 12th ed. (United States of America: Mosby Elsevier) 103 pp 106, 200–2.
6. Nakashima, S., Yoshie, M., Sano, H., & Bahar, A. (2009). Effect of a test dentifrice containing nano-sized calcium carbonate on remineralization of enamel lesions in vitro. *Journal of oral science*, *51*(1), 69-77.
7. Prabhakar, A. R., Jaiswal, A. M., & Basappa, N. (2013). In vitro remineralization of enamel subsurface lesions and assessment of dentine tubule occlusion from NaF dentifrices with and without calcium. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, *31*(1), 29-35.
8. Jeong, S. H., Jang, S. O., Kim, K. N., Kwon, H. K., Park, Y. D., & Kim, B. I. (2006). Remineralization potential of new toothpaste containing nano-

hydroxyapatite. In *Key Engineering Materials* (Vol. 309, pp. 537-540). Trans Tech Publications Ltd.

9. Ezoddini-Ardakani, F. (2009) Efficiency of Miswak (Salvadorapersica) in preventing dental caries. *Sch. Dent. Shahid Sadoughi Univ. Med. Sci. Yazd. Iran*. 499–504.
10. Zhou, C., Zhang, D., Bai, Y., & Li, S. (2014). Casein phosphopeptide–amorphous calcium phosphate remineralization of primary teeth early enamels lesions. *Journal of dentistry*, *42*(1), 21-29.
11. Rios, D., Honório, H. M., Magalhães, A. C., Buzalaf, M. A. R., Palma-Dibb, R. G., Machado, M. A. D. A. M., & Silva, S. M. B. D. (2006). Influence of toothbrushing on enamel softening and abrasive wear of eroded bovine enamel: an in situ study. *Brazilian Oral Research*, *20*, 148-154.
12. Li, X., Wang, J., Joiner, A., & Chang, J. (2014). The remineralisation of enamel: a review of the literature. *Journal of dentistry*, *42*, S12-S20.
13. AL-Obaidy, N. M., Sulafa, K., & Majeed, A. H. (2008). Effect of Siwak Extract on the Microhardness and Microscopic Feature of Initial Caries-Like Lesion of Permanent Teeth, Compared to Fluoridated Agents. *Mustansiria Dental Journal*, *5*(4), 365-371.
14. Hoobi, N. M., Hussein, B., Qasim, A. A., & Abdulrahman, M. (2014). Dissolution of calcium ion from teeth treated with different concentrations of siwak water extract in comparison with sodium fluoride. *J. Bagh. College Dent.*, *26*, 166-170.