Original Article

Effect of 0.2% Chlorhexidine and Alcohol-Free Listerine on Microhardness of Major Plus Acrylic Denture Teeth

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ABSTRACT

Background and Aim: The hardness and wear resistance of denture teeth have great importance in the longevity of dentures. This study assessed the effect of 0.2% chlorhexidine (CHX) and alcohol-free Listerine on the microhardness of acrylic denture teeth.

Materials and Methods: In this in-vitro experimental study, 26 Major Plus teeth were randomly divided into three groups for immersion in 0.2% CHX, alcohol-free Listerine, and distilled water. Two teeth were not immersed in mouthwash to assess baseline microhardness. The teeth were mounted in wax blocks (20×20×6 mm), which underwent wax burnout and were replaced with heat-cure acrylic resin. The samples were immersed in the solutions for 120 minutes corresponding to 4 months of clinical service. They were removed from the solutions twice daily, each time for 30 seconds, rinsed with distilled water, and placed again in the solutions. Next, they were stored at room temperature for 24 hours. They were thermocycled and subjected to microhardness measurement at the incisal third of their labial surface using the Vickers test. Data were analyzed using t-test.

Result: The baseline microhardness (n=2) was 27.9±0.98. The microhardness of samples immersed in CHX was 12 units (36.8%) lower than that of samples immersed in distilled water; this difference was statistically significant ($P<0.002$). The microhardness of samples in Listerine was 7.4 units (29.4%) lower than that of samples in distilled water with no statistically significant difference ($P=0.1$).

Conclusion: Immersion of acrylic teeth in 0.2% CHX can significantly decrease their microhardness. The effect of non-alcoholic Listerine on microhardness is similar to that of distilled water.

Keywords: Non-alcoholic Listerine, Chlorhexidine, Hardness, Artificial Teeth, Acrylic Resins, Materials Testing

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Introduction:

The hardness of acrylic teeth and their wear resistance can significantly affect the longevity and clinical service of dentures. They can also affect the stability of the established occlusal relationship.(1) The low hardness of artificial teeth and instability of occlusal relationship can decrease the vertical dimension of occlusion, increase the risk of tissue damage, cause patient discomfort, and decrease the efficacy of mastication and facial esthetics. Thus, the selection of acrylic denture teeth with adequate hardness is highly important.(2)The type of artificial teeth, diet, masticatory forces, type of cleansing agents used, and parafunctional habits can all affect the microhardness of teeth.(3,4) On the other hand, cleansing of dentures plays a fundamental role in oral health and ensures the long-term clinical ser0.2% and 0.02% concentrations. vice of the denture. (5)

Mouthwashes are prescribed for many denture wearers to relieve mucosal inflammation. Chlorhexidine (CHX) is a commonly used antibacterial mouthwash, which is available inThe adverse effects of CHX, such as tooth discoloration (natural and artificial teeth) and dysgeusia, have been widely investigated.[6,7] Listerine is another commonly used antimicrobial mouthwash, which is available in alcoholic and non-alcoholic forms. However, studies on its effects on acrylic dentures, in comparison with CHX, are limited. Moreover, the effect of non-alcoholic Listerine and CHX after thermocycling on the microhardness of acrylic denture teeth has not been specifically evaluated. Considering the gap related to comparative studies on the effects of different mouthwashes on the microhardness of acrylic denture teeth and the controversies in this respect, this study aimed to assess the effect of 0.2% CHX and alcohol-free Listerine on the microhardness of Major Plus acrylic denture teeth.

Materials and Methods:

This in-vitro experimental study evaluated 26 size #11 mandibular central incisor Major Plus artificial acrylic teeth (Major Dental, Italy) that were randomly divided into three groups of 8 for immersion in 0.2% CHX (V-One, Tehran, Iran), alcohol-free Listerine (Johnson & Johnson, Sao Paulo, Brazil), and distilled water. Two teeth were not immersed in any mouthwash for the assessment of baseline microhardness.

The teeth were then mounted in a dental wax block (Cerewax, Istanbul, Turkey), measuring 20×20×6 mm, which was then flasked, subjected to wax burnout, and replaced with heat-cure acrylic resin (Acropars; Marlik, Tehran, Iran). This was done to simulate an actual denture in the clinical setting (Figure 1).

Figure 1. Samples after preparation

The samples were then immersed in distilled water at 37°C for 24 hours. The samples in the three groups were immersed in the respective solutions for 120 minutes corresponding to 4 months of clinical service (Figures 2 and 3).

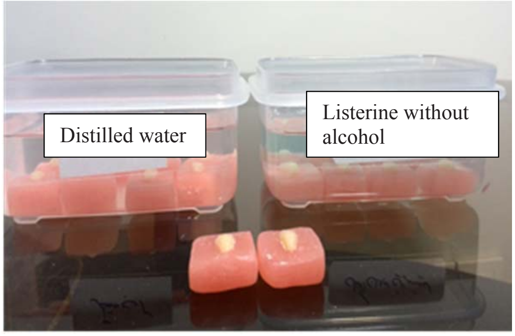

Figure 2- Immersion of samples in the solutions: Listerine without alcohol (right) and distilled water (left)

Figure 3. Immersion of samples in the solutions: Chlorhexidine (right) and distilled water (left)

They were removed from the solutions twice daily, each time for 30 seconds, rinsed with distilled water, and placed again in the solutions. This was continued for 120 minutes.[8] The two negative control samples did not undergo any intervention. After the completion of this period, the samples were dried with absorbent papers and stored at room temperature (25±1°C) for 24 hours. They were then thermocycled for 3000 cycles (each cycle lasted for 80 seconds) between 5-55°C with a dwell time of 20 seconds and a transfer time of 20 seconds (Figure 4).

Figure 4. Placement of samples in the thermocycling unit

Next, the microhardness of the incisal third of the labial surface of the samples was measured using a Vickers hardness tester (V-Test, Baresiss, Germany; Figure 5), and the microhardness values were analyzed and compared using t-test via SPSS version 22 (SPSS Inc., Chicago, IL, USA) with the significance level set at 0.05.

Figure 5. Placement of samples in the Vickers testing machine

Results

The two negative control samples had a baseline microhardness of 27.9±0.98. Table 1 shows the microhardness of the samples in the three experimental groups. As shown, the microhardness of samples immersed in 0.2% CHX was 12 units or 36.8% lower than that of samples immersed in distilled water; this difference was statistically significant ($P<0.002$). The microhardness of samples immersed in Listerine was 7.4 units or 29.4% lower than that of samples immersed in distilled water; this difference was not statistically **significant (P=0.1).**

Table 1. Microhardness of samples in the three experimental groups

Group	Microhardness
Distilled water	32.65±8.61
0.2% Chlorohexidine	20.60±1.42
Non-alcoholic Listerine	25.19±8.9

Discussion

This study assessed the effect of 0.2% CHX and alcohol-free Listerine on the microhardness of Major Plus artificial denture teeth. The results showed a reduction in the microhardness of samples after their immersion in 0.2% CHX and non-alcoholic Listerine for 120 minutes. However, this reduction, compared to distilled water, was only significant in the CHX group.

Suwannaroop et al evaluated the wear resistance and hardness of seven types of artificial teeth and showed that porcelain and composite teeth had a higher microhardness than other types.[2] However, their findings are not highly reliable since they did not perform thermocycling to simulate the clinical setting. In addition, they used a non-indentation system for the measurement of microhardness, which always shows higher values than the Vickers number and is usually used for composite resin teeth. Amin et al showed that immersion in 1% sodium hypochlorite (NaOCl) caused the greatest reduction in the microhardness of artificial teeth followed by 2% glutaraldehyde.[9] Immersion in distilled water caused a slight reduction in the bond strength. The crosslinks in acrylic resins play an important role in resin dissolution in organic solvents and resistance against cracks upon trauma or in response to heavy loads.[9] In our study, samples showed a higher microhardness following immersion in distilled water; this can be attributed to the evacuation of excessive methyl methacrylate from the acrylic resin following long-term immersion in distilled water, which can maintain or increase the level of microhardness. Sorgini et al assessed the adverse effects and complications of denture cleansers (mechanical and chemical) on polymethyl methacrylate and showed that all the selected toothpastes, except for Polident, increased the surface roughness of samples compared to distilled water.[10] The combination of mechanical and chemical methods decreased the amount of calculus and debris but did not affect the surface roughness.

Aydin et al examined the effect of distilled water, 0.2% glutaraldehyde, Hanks' balanced salt solution (HBSS; containing calcium and magnesium), 0.1% NaOCl, and 0.1% thymol solution on the microhardness of enamel and dentin of freshly extracted sound premolars and showed an insignificant reduction in microhardness after two months and a significant reduction after 12 months.[11] Their findings highlight the effect of continuous immersion in the solutions on the microhardness of samples. Also, it should be noted that the composition of natural teeth is different from that of artificial teeth. Yuzugullu et al evaluated the effects of three denture cleansers, including Corega tablets, NaOCl, and distilled water, on the surface roughness and microhardness of four types of artificial teeth for 180 days.[8] The results showed that NaOCl decreased the microhardness of all samples. The microhardness of acrylic resin teeth immersed in Corega was higher than that of teeth immersed in distilled water.[8]

This finding may be because teeth without crosslinks easily lose their plasticizers but samples with crosslinks experience a smaller reduction in their microhardness. The water present in the solutions is absorbed by samples containing crosslinks; this decreases their microhardness because the water replaces the plasticizer.[8] Amin et al reported the same results.[9] However, the aforementioned two studies were different from ours in that they did not mention how they measured the microhardness. In addition, they immersed the samples in the solutions continuously with no intervals, which can result in the cumulative effect of the solutions on the microhardness of the teeth. Gandhi et al assessed the effect of 2% glutaraldehyde, 1% NaOCl, and microwave on the microhardness of acrylic teeth from three different brands.[12]

They used a Vickers hardness tester and reported a slight decrease in the microhardness of teeth immersed in the respective solutions compared to the control (distilled water) group. The samples that underwent three microwave cycles experienced a significant reduction in their microhardness. They discussed that the increased temperature and the plasticizing effect of water present in cleansing and disinfecting solutions are among the most important factors responsible for the reduction in microhardness. On the other hand, temperature rise causes the movement of the crosslinks and increases the water sorption by acrylic resins, leading to a decrease in the microhardness of teeth.[12]

Another study evaluated the effect of three denture cleansers on the impact strength of heat-cure acrylic resins and showed significant differences among the groups such that Clinsodent caused a great reduction in the impact strength followed by Clanden and VI Clean. They explained that the plasticizing effect of the water present in denture cleansing solutions and its chemical interaction with methyl methacrylate, as well as the presence of alcoholic compounds (OH-bands), are among the main reasons causing a reduction in the impact strength of acrylic resins.[13] In our study, 0.2% CHX caused a significant reduction in the microhardness of samples. However, our results cannot be compared with those of the aforementioned study due to the different methodologies and types of mouthwash used.

The present study has many strengths, such as the simulation of the clinical setting by mounting the artificial teeth in wax, as well as flasking, mounting, and baking; these were not done by Suwannaroop et al and Gandhi et al.[2,12] Also, the immersion of samples in the respective solutions was scheduled according to the protocol for the elimination of inflammation, which is performed monthly for four months; 120 minutes corresponds to four months of clinical cleansing by the patient twice daily and each time for 30 seconds. Moreover, we immersed the samples in distilled water for 30 seconds at the immersion intervals, which was not done by Sorgini et al, Aydin et al or Yuzugullu et al.[8,10,11] Lack of rinsing of the samples at the intervals would cause the cumulative effect of the cleansing solutions and consequently intensifies their impact on microhardness. Furthermore, we thermocycled the samples. Last but not least, we only evaluated the microhardness of the incisal third of the labial surface of the teeth since the rate of crosslinks varies at different parts of an acrylic tooth and is higher at the cervical third compared to the incisal two-thirds. Different brands of acrylic resin denture teeth have different cycles of baking and subsequently different properties.

Conclusion

Considering the significant reduction in the microhardness of acrylic denture teeth following immersion in 0.2% CHX, its use is not recommended in the clinical setting unless necessary and for a short period. Non-alcoholic Listerine can serve as a suitable alternative since it did not cause any significant reduction in the microhardness compared to distilled water.

References

1. Shetty MS, Shenoy KK. An in vitro analysis of wear resistance of commercially available acrylic denture teeth. J Indian Prosthodont Soc. 2010 Sep;10(3):149-53.
2. Suwannaroop P, Chaijareenont P, Koottathape N, Takahashi H, Arksornnukit M. In vitro wear resistance, hardness and elastic modulus of artificial denture teeth. Dent Mater J. 2011;30(4):461-8.
3. Raptis CN, Powers JM, Fan PL. Frictional behavior and surface failure of acrylic denture teeth. J Dent Res. 1981 May;60(5):908-13.
4. Craig RG. Restorative Dental Materials. 10th ed. St. Louis, Missouri, Elsevier, 1996:584-83.
5. Klironomos T, Katsimpali A, Polyzois G. The Effect of Microwave Disinfection on Denture Base Polymers, Liners and Teeth: A Basic Overview. Acta Stomatol Croat. 2015 Sep;49(3):242-53.
6. Zanatta FB, Antoniazzi RP, Rösing CK. Staining and calculus formation after 0.12% chlorhexidine rinses in plaque-free and plaque covered surfaces: a randomized trial. J Appl Oral Sci. 2010 Sep-Oct;18(5):515-21.
7. Turgut S, Bagis B, Ayaz EA, Ulusoy KU, Altintas SH, Korkmaz FM, Bagis N. Discoloration of provisional restorations after oral rinses. Int J Med Sci. 2013 Aug 30;10(11):1503-9.
8. Yuzugullu B, Acar O, Cetinsahin C, Celik C. Effect of different denture cleansers on surface roughness and microhardness of artificial denture teeth. J Adv Prosthodont. 2016 Oct;8(5):333-8.
9. Amin F, Rehman A, Abbas M. Microhardness of heat cure acrylic resin after treatment with disinfectants. J Pak Med Assoc. 2015 Aug;65(8):834-7.
10. Sorgini DB, da Silva-Lovato CH, Muglia VA, de Souza RF, de Arruda CN, ParanhosHde F. Adverse Effects on PMMA Caused by Mechanical and Combined Methods of Denture Cleansing. Braz Dent J. 2015;26(3):292-6.
11. Aydın B, Pamir T, Baltaci A, Orman MN, Turk T. Effect of storage solutions on microhardness of crown enamel and dentin. Eur J Dent. 2015 Apr-Jun;9(2):262-6.
12. Gandhi N, Daniel S, Benjamin S, Kurian N, Varghese VS. Evaluation of Surface Microhardness Following Chemical and Microwave Disinfection of Commercially Available Acrylic Resin Denture Teeth. J Clin Diagn Res. 2017 May;11(5):ZC87-ZC91.
13. Ragher M, Prabhu UM, Ittigi JP, Naik R, Mahesh CS, Pradeep MR. Efficacy of Denture Cleansers on Impact Strength of Heat polymerized Acrylic Resins. J Pharm Bioallied Sci. 2017 Nov;9(Suppl 1):S241-S245.

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