

# A new removable orthodontic and orthopedic appliances cleanser

Mohammed Thanoon Younis Ahmed<sup>1\*</sup>, Safwan Mohsen Al\_Aubadi<sup>2</sup>, Omar Khalid Mohammed<sup>3</sup>

P.O.P Department, College of Dentistry, University of Mosul, Iraq<sup>1,3</sup>  
Prosthetic dentistry, College of Dentistry, University of Mosul, Iraq<sup>2</sup>

Corresponding author: 1\*



---

## Keywords:

new removable orthodontic;  
orthopedic appliances cleanser.

---

## ABSTRACT

Because numerous various germs are discovered on their surface during orthodontic treatment, detachable orthodontic and orthopedic appliances cleaner demands careful hygiene. About 60 samples with dimension (45\*10\*1.5mm length, with thickness) were used for the color test by spectrophotometer device, and 60 samples with dimension (30\*10\*3mm length width thickness) were used for the hardness test by shore A hardness device. The orthodontic appliance should be cleaned after each meal time for about half an hour three times per day to stay clean without stain, food accumulation, and to keep consequences of stained appliance away like gingivitis and candidiasis sore throat, So to make the cleaning simulation cycle, we soaked these samples in cleanser solutions for ½ hour three times per day after each cleaning once we put the samples in r.o. water. every day we repeat the cleaning procedure for about two months. For the color test, We measured the absorbance at the beginning of the study, and after two months maximum absorptions of visible light by acrylic resin occurred at the wavelength (345nm).so, for the hardness test we measure it after two months and compare it with the control solutions. The experimental results showed that the Interquartile range at the Preclean color for (hydrogen peroxide 6%) was 0.32 compare to water and tablet (0.11, 0.10) respectively, compare to the Post-clean color (0.28, 0.20), So the results showed the Interquartile range of Hardness about (4.71, 3.95) respectively for two groups (4gm soda+ 4.5 g citric and 2gm soda+ 6.14 g alum), whilst 3.15 for three groups (2gm soda+ 4.5 g citric, 1gm soda + 6.14 g alum and 50%H2O2), When the comparison of (precleaning and post-cleaning color) by using Wilcoxon signed ranks test between all groups, as well as results showed (P-value <0.05) for all groups except water as (P-value >0.05), so results of the current study showed significantly (p<0.05), when Comparing solution post-cleaning color with water and tablet by using of Mann whitney test.so the tablet versus water there was a change in color and the difference was statically significant (p-value = 0.07 > 0.05). Color: Soda+ citric acid solutions of different conc. Of soda have no diverse effect on the color of acrylic resin. Soda + alum increase color density, H2O2 decrease color density (bleaching effect), In comparison with water and tablet. Hardness: Both of them (Soda +citric, Soda+alum) have no diverse effect on hardness of acrylic resin, H2O2 increase hardness of acrylic resin because leach out of plastisizer. The best

cleanser solution that have no effect on the color and hardness of acrylic resin specimen is (soda + citric acid) with different conc.



This work is licensed under a Creative Commons Attribution Non-Commercial 4.0 International License.

---

## 1. Introduction

More and more people use removable orthodontic appliances (ROA), to align crooked teeth. Those who have had traditional braces often use removable appliances, like a retainer, to maintain alignment after braces are removed. Early orthodontic intervention treatment even uses removable appliances, removable orthodontic appliances are frequently used in daily orthodontic practice, either as the only necessary means of treatment or as the first intervention that will be followed by fixed appliances. Microbiological changes that take place in the oral cavity as long as the removable orthodontic appliances are being used justify the need for rigorous oral hygiene instructions [1]. Particularly in patients with compromised immune systems, good care of removable orthodontic equipment can lower the incidence of cavities, Candida-associated stomatitis, and halitosis while also preventing ROA re-infection. However, cleaning for ROA can be very challenging [2].

Studies on the impact of various cleaning procedures for acrylic removable orthodontic appliances have already been carried out, and they may also assist to lower the risk of dental diseases associated with biofilm buildup. Denture cleaners, enzymatic solutions, chlorhexidine, sodium hypochlorite, or "homemade" solutions incorporating vinegar or citric acid are just a few of the several techniques that have been discussed [2], It has also been mentioned how orthodontists use professional techniques like ultrasounds [3]. Therefore the aim of the current study (the first study in Iraq) was estimation the performance of the five different solutions of cleaning as a new removable orthodontic and orthopedic appliances cleanser, using Soda; Citric; alum; water, and H<sub>2</sub>O<sub>2</sub>.

## 2. Material and methods

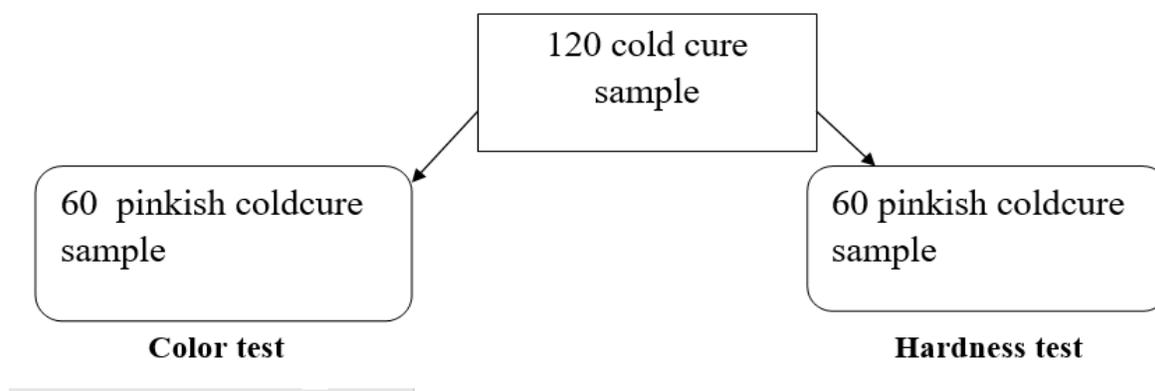
In the current study we used the Digital electronic balance; Ph meter device; Spectrophotometer device and Shore A hardness measuring device (Figure -1); Calibrated cylinder; Metal flask; Dental stone; Pinkish color orthoresin cold-cure; baking soda; alm; citric acid kin tablet cleanser as well as used three concentration from hydrogen peroxide gel as (6, 9 and 50) %.



**Figure (1):** A-Spectrophotometer B-Shore A hardness measuring device

### 2.1 Samples group

About 120 cold cure samples were divided into two groups, a color test group including 60 pinkish cold-cure samples and the hardness test group of 60 pinkish cold-cure samples (Figure -2).



**Figure (2):** Samples group

Sample dimensions: the color test sample dimension is 45\*10\*1.5 mm, it represents the length\* width\* and thickness, these dimensions of the sample are chosen to fit the quartz cell of the spectrophotometer device that is used to measure the absorbance of visible light through the sample, as well as the Hardness test sample dimension is 30\* 10 \* 3 mm, It represents length \* width \* thickness

Cleanser solutions: We divided the homemade cleanser solution into four groups:

Group No.1: consists of three solutions of (soda + citric acid), Different concentrations of (soda), and a

fixed concentration of citric acid.

Group No.2: consists of three solutions of (soda + alum), Different concentrations of (soda), and a fixed concentration of (alum)

Group No. 3: consists of three different concentrations of hydrogen peroxide gel (6%, 9%, 50%)

Group No. 4: control solutions include oxygen-releasing cleanser (kin tablet) and reverse osmosis water. (R.O.water). all these groups fixed the PH as declared in the table (1).

**Table (1):** PH for groups of cleanser solutions (homemade cleanser solutions) that were used in the current study.

No	Solution	PH
1	1g soda + 4.5 g citric	4.2
2	2g soda + 4.5 g citric	6.4
3	4g soda + 4.5 g citric	8.0
4	1g soda + 6.14 g alum	3.8
5	2g soda + 6.14 g alum	4.4
6	4g soda + 6.14 g alum	7.8
7	6% H <sub>2</sub> O <sub>2</sub>	7.35
8	9% H <sub>2</sub> O <sub>2</sub>	7.6
9	50% H <sub>2</sub> O <sub>2</sub>	7.7
10	Kin tablet	8.5
11	R.O.water	6.7

## 2.2 Methods

About 60 samples with dimension (45\*10\*1.5mm length, with thickness) were used for the color test by spectrophotometer device, and 60 samples with dimension (30\*10\*3mm length width thickness) were used for the hardness test by shore A hardness device. The orthodontic appliance should be cleaned after each meal time for about half an hour three times per day to stay clean without stain,, food accumulation, and to keep consequences of stained appliance away like gingivitis and candidiasis sore throat, So to make the cleaning simulation cycle, we soaked these samples in cleanser solutions for ½ hour three times per day ...after each cleaning once we put the samples in r.o.water .every day we repeat the cleaning procedure for about two months.

For the color test, We measured the absorbance at the beginning of the study, and after two months

maximum absorptions of visible light by acrylic resin occurred at the wavelength (345nm).so, for the hardness test we measure it after two months and compare it with the control solutions.

### 2.3 Statistical analysis

Statistical data analysis with the SPSS version 18 software (SPSS Inc., Chicago, IL, USA), We used the median and interquartile range to portray the data because they were not normally distributed. Comparisons were made using non-parametric statistical tests, such as Kruskal-Wallis, Wilcoxon signed-ranks, and many Whitney tests. A difference was considered significant when the P-value was lower than 0.05.

### 3. Results

The experimental results showed that the Interquartile range at the Preclean color for (hydrogen peroxide 6%) was 0.32 compare to water and tablet (0.11, 0.10) respectively, compare to the Post-clean color (0.28, 0.20).

So results in table -2 showed the Interquartile range of Hardness about (4.71, 3.95) respectively for two groups (4gm soda+ 4.5 g citric and 2gm soda+ 6.14 g alum), whilst 3.15 for three groups (2gm soda+ 4.5 g citric, 1gm soda + 6.14 g alum and 50% H<sub>2</sub>O<sub>2</sub>).

**Table (2):** Preclean color, Post-clean color, and Hardness for different solutions

Solution	Preclean color		Post-clean color		Hardness	
	Median	Interquartile range	Median	Interquartile range	Median	Interquartile range
1gm soda +4.5 g citric	1.456	0.21	1.332	0.26	84.6	2.3
2gm soda+ 4.5 g citric	1.625	0.25	1.341	0.32	83.6	3.15
4gm soda+ 4.5 g citric	1.691	0.23	1.548	0.28	84	4.71
1gm soda + 6.14 g alum	1.639	0.25	2.297	0.23	85	3.15
2gm soda+ 6.14 g alum	1.710	0.20	2.567	0.13	86.3	3.95
4gm soda +6.14 g alum	1.502	0.30	2.604	0.24	85.3	2.35
6% H <sub>2</sub> O <sub>2</sub>	1.268	0.32	1.226	0.48	80	2.35
9% H <sub>2</sub> O <sub>2</sub>	1.262	0.28	1.251	0.42	86	1.85
50% H <sub>2</sub> O <sub>2</sub>	1.262	0.29	1.287	0.26	88	3.15
Kin tablet	1.75	0.10	1.463	0.20	84	1.15
Water	1.495	0.11	1.448	0.28	85	2.5

When the comparison of (precleaning and post-cleaning color) by using Wilcoxon signed ranks test between all groups, results showed (P-value <0.05) for groups (1gm soda +4.5 g citric; 2gm soda+ 4.5 g

citric ; 4gm soda+ 4.5 g citric ; 1gm soda + 6.14 g alum ; 2gm soda+ 6.14 g alum ; 4gm soda +6.14 g alum ; H<sub>2</sub>O<sub>2</sub>( 6; 9; 50)% and tablet) except water as (P-value >0.05).

**Table (3):** comparison between Preclean color, Post-clean color, and Hardness for different solutions

Solution	P value
1gm soda +4.5 g citric	P <0.05
2gm soda+ 4.5 g citric	P <0.05
4gm soda+ 4.5 g citric	P <0.05
1gm soda + 6.14 g alum	P <0.05
2gm soda+ 6.14 g alum	P <0.05
4gm soda +6.14 g alum	P <0.05
6% H <sub>2</sub> O <sub>2</sub>	P <0.05
9% H <sub>2</sub> O <sub>2</sub>	P <0.05
50% H <sub>2</sub> O <sub>2</sub>	P <0.05
WATER	p> 0.05
tablet	P <0.05

In table -4 showed significant (p<0.05), when Comparing solution post-cleaning color with water and tablet by using of Mann whiteny test.

**Table (4):** Comparison between solution post-cleaning color with water and tablet by using of Mann whiteny test.

Solution	tTablet	Water
1gm soda +4.5 g citric	p>0.05	p>0.05
2gm soda+ 4.5 g citric	p>0.05	p>0.05
4gm soda+ 4.5 g citric	p>0.05	p>0.05
1gm soda + 6.14 g alum	p<0.01	p<0.01
2gm soda+ 6.14 g alum	p<0.01	p<0.01
4gm soda +6.14 g alum	p<0.01	p<0.01
6% H <sub>2</sub> O <sub>2</sub>	p<0.05	p<0.05
9% H <sub>2</sub> O <sub>2</sub>	p<0.05	p<0.05
50% H <sub>2</sub> O <sub>2</sub>	p<0.05	p<0.05

The tablet versus water there was a change in color and the difference was statically significant(p-value = 0.07 > 0.05)( as resulted in table-5).

**Table (5):** Hardness with used tablet versus water.

Solution	Tablet	Water
1gm soda +4.5 g citric	p>0.05	p>0.05
2gm soda+ 4.5 g citric	p>0.05	p>0.05
4gm soda+ 4.5 g citric	p>0.05	p>0.05
1gm soda + 6.14 g alum	p>0.05	p>0.05
2gm soda+ 6.14 g alum	p>0.05	p>0.05

4gm soda +6.14 g alum	p>0.05	p>0.05
6% H <sub>2</sub> O <sub>2</sub>	p<0.05	p<0.01
9% H <sub>2</sub> O <sub>2</sub>	p<0.01	p<0.01
50% H <sub>2</sub> O <sub>2</sub>	p<0.01	p<0.01

#### 4. Discussion

Due to insufficient resin polymerization, porosities will develop on the acrylic baseplate surface, preventing daily cleaning of the device and even harboring hazardous bacteria in resin pores [4]. A further crucial point that needs to be brought up is that the polymethylmethacrylate exhibits long-term water sorption as a result of water molecule diffusion, which disperses the macromolecules [5]. As a result, the acrylic foundation serves as a microorganism reservoir. Numerous studies have recommended keeping Mutans *Streptococci* on the surface of acrylic baseplates [6]. In addition, using ROA has been linked to a rise in the density of candida at mucosal locations [7]. In order to prevent inflammatory reactions, orthodontists should set a standard of oral cleanliness.

Geographic localization was the subject of five studies: three in Brazil [8- 10] two in Malta [11]; one each in China and the USA [12], [13], and one in [14], When all studies were taken into account, 318 participants in total, as well as 318 acrylic removable orthodontic equipment, were studied.

#### 5. Conclusion

- ❖ Interquartile range at the Preclean color for hydrogen peroxide 6 percent was 0.32 compared to water and tablet (0.11, 0.10), respectively, compared to the Post-clean color according to the testing data (0.28, 0.20).
- ❖ When the comparison of (precleaning and post-cleaning color) by using Wilcoxon signed ranks test between all groups, as well as results, showed (P-value 0.05) for groups except water as (P-value >0.05), the interquartile range of hardness, was about (4.71, 3.95) respectively for two groups (4gm soda+ 4.5 g citric and 2gm soda+ 6.14 g alum), while 3.15 for three groups (2gm soda+ 4.5).
- ❖ Tablet in comparison to water the color changed, and the variation was statistically significant (p-value = 0.07 > 0.05).

#### 6. References

- [1] Tsolakis ,Apostolos I.; Kakali,L; Prevezanos,P.; Bitsanis,I. and Polyzois, G.Use of Different Cleaning Methods for Removable Orthodontic Appliances: A Questionnaire Study. Oral Health Prev Dent 2019; 17: 299–302.
- [2] Eichenauer J, Serbesis C, Ruf S. Cleaning removable orthodontic appliances. J Orofac Orthop 2011;72:389–395.
- [3] Muscat Y., Farrugia C., Camilleri L., Arias-Moliz M.T., Valdramidis V., Camilleri J. Investigation of Acrylic Resin Disinfection Using Chemicals and Ultrasound. J. Prosthodont. 2016;27:461–468. doi: 10.1111/jopr.12511.
- [4] Lessa F, Enoki C, Ito I, Faria G, Matsumoto MA, Nelson-Filho P. In-vivo evaluation of the bacterial contamination and disinfection of acrylic base- plates of removable orthodontic appliances. Am J Orthod Dentofacial Or- thop 2007;131:705.e11–17.

- [5] Khurana M, Martin M. Orthodontics and infective endocarditis. *Br J Orthod* 1999;26:295–298.
- [6] Vizitiu TC, Ionescu E. Microbiological changes in orthodontically treated patients. *Therapeutics, Pharmacology and Clinical Toxicology*, 2010;14: 283–286.
- [7] Arendorf A, Addy M. Candidal carriage and plaque distribution before, during, and after removable orthodontic appliance therapy. *J Clin Periodontol* 1985;12:360–368.
- [8] Lima E.M.C.X., Moura J.S., Cury A.A.D.B., Garcia R.C.M.R., Cury J.A. Effect of enzymatic and NaOCl treatments on acrylic roughness and on biofilm accumulation. *J. Oral Rehabil.* 2006;33:356–362. doi: 10.1111/j.1365-2842.2005.01564.x.
- [9] Lessa F., Enoki C., Ito I.Y., Faria G., Matsumoto M.A.N., Nelson-Filho P. In-vivo evaluation of the bacterial contamination and disinfection of acrylic baseplates of removable orthodontic appliances. *Am. J. Orthod. Dentofac. Orthop.* 2007;131:705.e11–705.e17. doi: 10.1016/j.ajodo.2006.09.042.
- [10] Peixoto I.T.A., Enoki C., Ito I.Y., Matsumoto M.A.N., Nelson-Filho P. Evaluation of home disinfection protocols for acrylic baseplates of removable orthodontic appliances: A randomized clinical investigation. *Am. J. Orthod. Dentofac. Orthop.* 2011;140:51–57. doi: 10.1016/j.ajodo.2009.12.036.
- [11] Vento-Zahra E., De Wever B., Decelis S., Mallia K., Camilleri S. Randomized, double-blind, placebo-controlled trial to test the efficacy of nitradine tablets in maxillary removable orthodontic appliance patients. *Quintessence Int.* 2011;42:37–43.
- [12] Fathi H., Fathi H., Martiny H., Jost-Brinkmann P.-G. Efficacy of cleaning tablets for removable orthodontic appliances: An in vivo pilot study. *J. Orofac. Orthop. Fortschr. Kieferorthopädie.* 2015;76:143–151. doi: 10.1007/s00056-014-0277-x.
- [13] Liu S.Y., Tonggu L., Niu L.N., Gong S.Q., Fan B., Wang L., Zhao J.H., Huang C., Pashley D.H., Tay F.R. Antimicrobial activity of a quaternary ammonium methacryloxy silicate-containing acrylic resin: A randomised clinical trial. *Sci. Rep.* 2016;6:21882. doi: 10.1038/srep21882.
- [14] Jagannathan J., Kaniappan A.S., Raveendran A., Shekhar S. Comparison of Antimicrobial Efficacy of Natural Extracts as a Disinfectant for Removable Orthodontic Appliances: An Ex Vivo Study. *Int. J. Clin. Pediatr. Dent.* 2021;13:640–643. doi: 10.5005/jp-journals-10005-1850.
- [15] Decelis S., Camilleri S., Zahra E.V., Scerri E., De Wever B. The effect of NitrAdine on the Candida levels of maxillary removable appliances. *Quintessence Int.* 2012;43:239–245.