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Research Article

Effects of Magnetically Treated Water Mouthrinse on Elastic Deformation of Orthodontic Elastomeric Modules

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Abstract

Aims: The present study aimed to evaluate the effect of magnetically treated water as a mouthrinse on the elastic deformation (width, inner, and outer diameter) of the orthodontic elastomeric module and compare its effect to synthetic Ortho Kin mouthrinse.

Materials and Methods: One hundred twenty translucent modules were divided into three groups (40 modules each) based on the type of mouthrinse used: group1: washed with artificial saliva (control), group 2: washed with Ortho Kin mouthrinse, Group 3: washed with prepared magnetically treated water. Each group was further subdivided into 4 subgroups, 10 modules for each time interval (initially, one day, one week, and two weeks). Washing was done for 1 minute twice daily. The samples were incubated at 37°C. One hundred mL of distilled water was magnetized using 2430 (Gausses) neodymium magnets. The modules were stretched over hand-made stainless-steel dowels. Photographic images of modules were taken under 3X magnification using a hand-made view box for standardization, and the elastic deformation was detected via ImageJ software (ImageJ; U. S. National Institutes of Health). Measurement was done to the nearest thousandth of a millimeter. Descriptive statistics with mean elastic deformation differences from initial to final measurements for the modules were compared with the Mann-Whitney test. Kruskal-Wallis test was used to compare the mean of elastic deformation changes among the studied mouthrinses at $P \leq 0.05$.

Results: Magnetically treated water caused significantly higher elastic deformation (width, inner, and outer diameter) of elastomeric modules, especially at one and two weeks, while Ortho Kin caused a non-significant difference only at one day for width value and at one week and two weeks for inner diameter value. The artificial saliva group recorded intermediate values between magnetically treated water and Ortho Kin groups, especially at two weeks.

Conclusion: Magnetically treated water caused greater elastic deformation, especially in width and outer diameter values of orthodontic elastomeric modules, than Ortho Kin from one day to the end of two weeks.

Keywords: Elastic Deformation, Elastomeric Modules, Magnetic, Water Mouthrinse

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INTRODUCTION

Elastomer is a general term that embraces materials that, after substantial deformation, rapidly return to their original dimensions (1). Elastics in dentistry are not a new development. Two forms of elastics are used in orthodontics. The first is natural elastics, which are used in inter-arch mechanics and are usually referred to as "elastics." The second form is synthetic elastics, which are used in elastic threads, elastomeric modules, and elastic chains and are usually referred to as "alastiks" (2). Synthetic elastics are made mostly from polyurethanes (3).

To secure the orthodontic wires in the bracket slots, clinicians may use stainless steel ligation, self -ligating spring clips, or elastic modules. Some of the benefits of elastomeric modules include simplicity of application, patient relief, and accessibility in different colors. Their drawbacks include microbial backlog, absence of total seating of the wire in the slot, friction, and quick force decay, which leads orthodontists to change them at four-week intervals (4). Orthodontic elastomeric modules are elastomeric polymers and consist of materials that, after substantial physical deformation, quickly return to their original dimensions (5).

The elastic deformation performance of orthodontic elastic modules depends on environmental influences like temperature variations, environmental pH, mouthrinses, tooth movement, salivary enzymes, and mastication forces (6). Studies have shown that the elastic modulus tested in a moist medium undergoes higher deformation than that examined in a dry medium (7), causing inadequate tooth movement, triggering increased schedules for activating the appliance (6).

Inadequate oral hygiene is a main concern throughout orthodontic treatment. Orthodontic treatment with fixed appliances changes the oral situation; there is an increased buildup of plaque around the bands and brackets (8). Dentists recommend using mouthrinses during orthodontic treatment to encourage oral hygiene and decrease dental caries. Among these mouthrinses is Ortho Kin (OK), which has an ideal concentration of 500 ppm fluoride to aid in preventing caries and aid enamel remineralization while undertaking orthodontic treatment (9). Sodium fluoride (NaF) has benefits which could encourage remineralization and make the enamel resistant to acid. Sodium fluoride, as an ionized fluoride on the tooth exterior, causes calcium fluoride deposits on the enamel surface (10,6).

Magnetically treated water (MW) is an avant-garde technology by means of magnetic devices which make strong concentration of magnetic field (MF) over the tube wall to treat water and modify its properties. Treating water with magnetic forces is a controversial way believed to decrease the hard water properties by passing water over a magnetic field, which is a non- chemical way for water softening (11). When water passes over the magnetic field, it undergoes certain changes. The MF alters the electrical features of hydrogen ions as well as minerals. The bio south magnets aid in decreasing scale buildup. The bio north MW is used in the treatment of numerous diseases (12). When a permanent magnet is kept in contact with water continuously for a known time, the magnetic flux of the magnet affects the water and causes it to become magnetic, and it also acquires magnetic features. Better outcomes are obtained if the water is used directly after magnetic treatment (13).

Research directed by Goyal *et al*. (12) displayed that MW has improved activity in plaque in comparison with saliva. Shihab *et al*. (14) suggested applying MW as a good antibacterial irrigant solution for preservation of good oral hygiene. Also, Qassabbashe and Al-Hamdany (15) showed an antifungal efficiency of MW as a mouthrinse against *Candida albicans*. Meanwhile, Qassabbashe and Al-Hamdany (16) displayed the beneficial effect of MW as a mouthrinse, in comparison to chlorhexidine, upon the shear strength of attached orthodontic brackets. Furthermore, Al Zubaidy and Al Hamdany (17- 19) established a decrease in nickel and chromium ion liberation with fewer adverse effects on surface features of stainless steel and nickel titanium orthodontic archwires when applying MW as a mouthrinse in contrast to OK.

In contrast to the orthodontic elastomeric chain, limited studies were found in the literature dealing with elastic deformation of the orthodontic elastomeric modules. Thus, the present study aimed to evaluate the effect of MW as a mouthrinse on the elastic deformation (width (W), inner (ID) and outer diameter (OD)) of the orthodontic elastomeric module and to compare its effect to synthetic OK mouthrinse at various immersion periods (at initial (0), one day, one week and two weeks).

MATERIALS AND METHODS

One hundred twenty translucent elastomeric modules (IOS, Stafford, USA) were divided into three groups (40 modules each) based on mouthrinse used: group1: washed with artificial saliva (AS)(control), group 2: washed with Ortho Kin mouthrinse (LABORATORIES KIN S.A., Barcelona, Spain) (OK) with 500 ppm NaF mouthrinse, and group 3 washed with newly-prepared MW. Each group was further subdivided into 4 subgroups, 10 modules for each time interval (initially, one day, one week, and two weeks). Washing was done for 1 minute twice daily. The samples were incubated at 37 ºC. One hundred ml of distilled water had been magnetized using a locally prepared device. Neodymium magnets (K&J Magnetics, Ningbo, China) (2430 Gauss (Gs)) were used. The magnetic strength and polarity of the magnet were determined by a Gaussmeter (Lake Shore, 455 DSP, Westerville, USA). Two magnets were fixed around a glass container filled with 100 mL distilled water in a north-north repulsion manner (20) and were maintained for 48 hs at 37 ºC. The pH value and electrical conductivity for the MW were checked by a pH Meter and electrical conductivity meter (WTW Inolab, Germany) to ensure water magnetization (14).

Construction of stainless-steel dowels for testing the elastic deformation of the modules

To detect the elastic deformation of the modules, they were stretched over hand-made stainless-steel dowels (0.155 ± 0.0002 inches (3.937mm) in diameter (Figure 1). Each dowel was constructed taking in consideration that its circumference equals the length of a ligature wire (0.010 inches) (Dentarum, Ispringen, Germany) ligating a round stainless steel wire (0.018 inches) (Lancer orthodontics, Carlsbad, California, USA) inside the bracket slot of a stainless-steel bracket of the upper right maxillary central incisor (0.022 slot) (Dentarum, Ispringen, Germany).

Figure (1): Modules stretched over stainless-steel dowel

The mean of the five measurements of this length was 3.937 mm, representing the circumference of the dowel to be constructed, and by applying the equation of **a circle's circumference =** d*π (where d is the diameter of the circle and π is a constant= 3.14), the diameter of the circle (dowel) was obtained.

One end of the stainless-steel dowel was tapered to facilitate the application and the removal of the modules. Substituting the tapered dowels for brackets eliminates the effect of bracket design and the potential for overstretching the modules on application and removal.

Before testing, W, ID, and OD of all modules in the test group were measured using a millimetric ruler of vernia caliper (Richmeters, Ningbo, China), via capturing standardized photographs. Each module was measured to the nearest thousandth of mm. The photographs were analyzed with image analysis software (ImageJ; U. S. National Institutes of Health) loaded on an HP Pavilion X360 Lab Top.

Measuring the elastic deformation of the elastomeric modules

Photographic images of elastic modules were taken with an iPhone 14 Pro Max (California, USA) camera under 3X magnification using a hand-made view box for standardization (Figure 2). The distance from the lens of the camera at the top (highest point) of the box to the modules that were seated in the lowest point of the box was 86 mm. The elastic deformation was determined via ImageJ software loaded on an HP Pavilion X360 Lab Top. A millimetric ruler of Vernier caliper (Richmeters, Ningbo, China) was used during photographing (Figure 3).

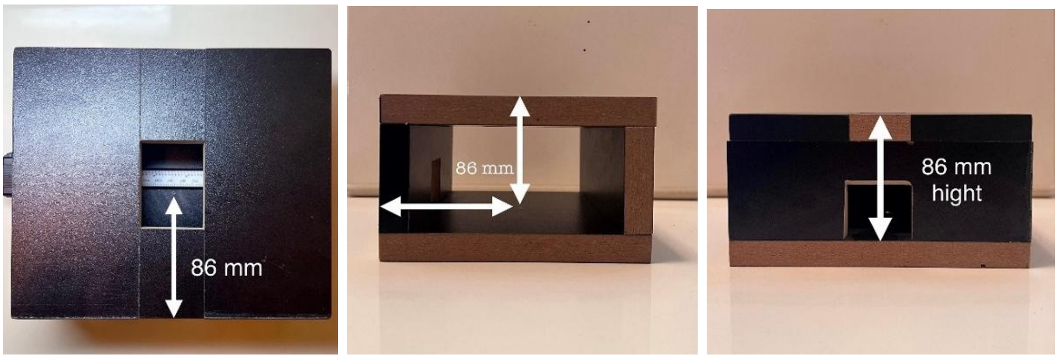

Figure (2): Hand-made view box for taking photographs of modules (Iraq, Kirkuk)

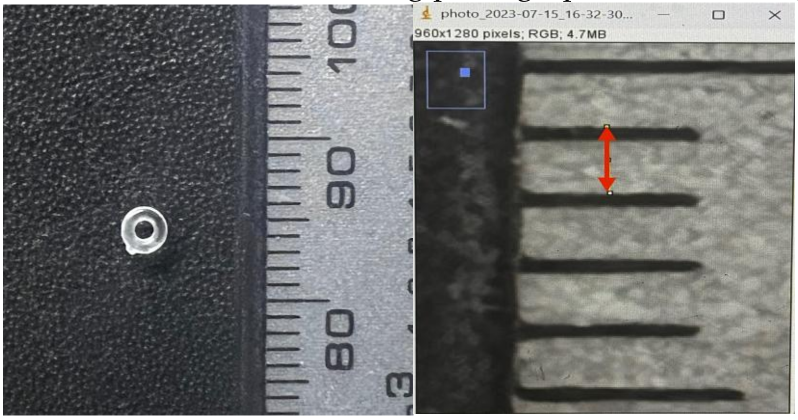

Figure (3): (A): Photographs using a millimetric ruler of vernier caliper (Richmeters, Ningbo, China), (B): pixel value of 1mm in the ImageJ software

Measurement was done to the nearest part of thousands of millimeter accuracy. A mean of three readings for (W, ID, and OD) parameters of the elastomeric module was measured, as shown in Figure 4, in pixels, then converted to mm by a simple equation comparing it to the pixel value of (1 mm) of the standard ruler of the digital vernier.

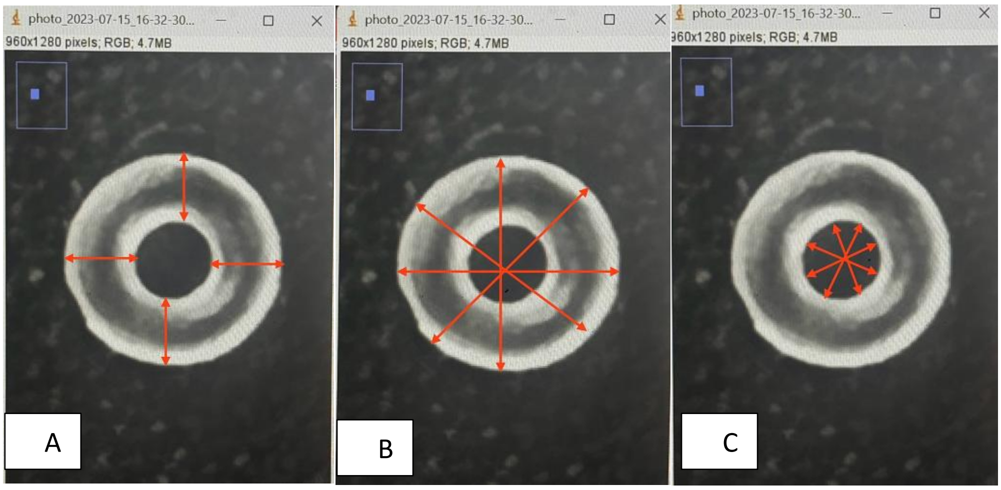

Figure (4): (A), the width; (B), outer diameter; and(C) inner diameter of elastomeric module in pixels as shown in the ImageJ software

Pilot Study

A pilot study was conducted to:

1- Determine the required sample size by finding the standard deviation (0.204) of the mean for measurements representing the elastic deformation of 10 elastomeric modules measured at room temperature and humidity. The sample size calculation was done based on the single mean formula [$n = (z\ r/D)^2$]. In which n is considered the number of sample subjects, z(constant) = 1.96 for 95% confidence, r (standard deviation) = 0.204, and D (precision) = 0.2 unit. The resulting number was (3.61). However, 10 elastic modules were used in each subgroup for more accurate statistical results.

2- Determine the time required to achieve maximum water magnetization, which is checked at different time intervals (1 hour, 2hours, 3hours, 6 hours, 12 hours, 1 day, 2 days, and 3 days). The maximum magnetization for water was achieved at 2 days.

Calibrations:

Elastic deformation (OD) of 10 randomly selected elastomeric modules was used to assess inter- and intra-examiner calibration via an intraclass correlation test. The measurements were repeated with a 10-day interval between the first and second readings to exclude memory bias. It was revealed that there was a high correlation (0.994) between the expert & the researcher (student) readings, and (0.970) between the first & second readings of the researcher (student) at $P \leq 0.05$.

Statistical Analysis

Shapiro-Wilk test was conducted to check the normality of the data. Descriptive statistics with mean elastic deformation (W, ID, and OD) differences from initial to final measurements for the modules were compared with the Mann-Whitney test. Kruskal-Wallis's test was used to compare the mean of elastic deformation (W, ID, and OD) changes among the studied mouthrinses at $P \leq 0.05$.

RESULTS

Test of normality for elastic deformation (W, ID, and OD) in all the groups at the studied time intervals showed significant statistical difference for most of the measurements at $P \leq 0.05$. Thus, non- parametric tests were utilized for statistical comparisons.

Table1 and Figure 5 reveal descriptive statistics of W, ID and OD deformation for AS, OK& MW groups. Initially, AS, OK and MW groups recorded the same measurements for W, ID and OD. For W deformation, the largest W values were recorded initially in the study mouthrinses, then W values decreased on the subsequent time intervals, with MW recording a higher score of W value in comparison to OK. AS group recorded intermediate values between the MW and OK groups at one day and two weeks, and lower than MW and OK at one week.

Table (1): Descriptive statistics of the elastic deformation for the study groups at the study time intervals

	Test Group	Initially Mean± SD	One day Mean± SD	One week Mean± SD	Two weeks Mean± SD
W	AS	0.83±0.01	0.57±0.03	0.52±0.04	0.56±0.03
	OK	0.83±0.01	0.55±0.03	0.54±0.05	0.55±0.04
	MW	0.83±0.01	0.59±0.02	0.60±0.02	0.58±0.01
OD	AS	2.76±0.05	4.35±0.13	4.20±0.13	4.39±0.15
	OK	2.76±0.05	4.56±0.09	4.24±0.05	4.49±0.11
	MW	2.76±0.05	4.11±0.14	4.20±0.06	4.38±0.04
ID	AS	0.98±0.01	3.19±0.04	3.35±0.05	3.62±0.04
	OK	0.98±0.01	3.17±0.08	3.22±0.04	3.53±0.06
	MW	0.98±0.01	3.00±0.11	3.53±0.06	3.64±0.06

W=width, OD=outer diameter, ID=inner diameter, AS=artificial saliva, OK= Ortho Kin, MW= magnetically treated water, SD= standard deviation.

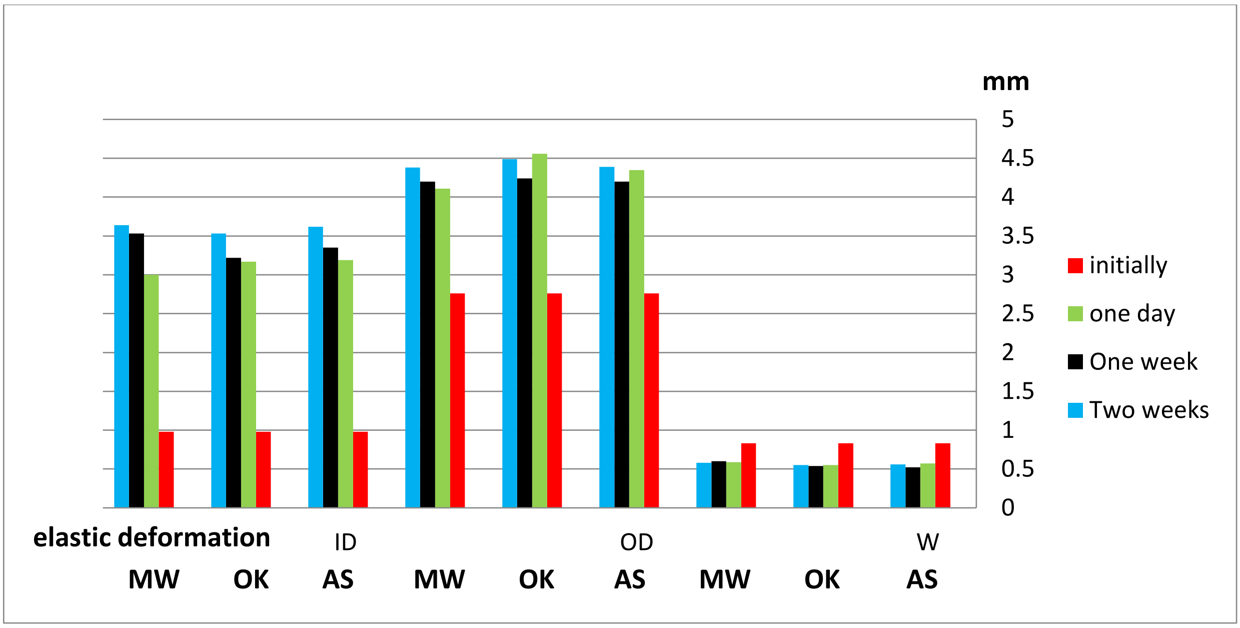

Figure (5): Histogram representing means of elastic deformation for the study groups at the study time intervals. (W=width, OD=outer diameter, ID=inner diameter, AS=artificial saliva, OK= Ortho Kin, MW= magnetically treated water).

Concerning OD, the lowest values were initially recorded in the AS, OK & MW groups; however, OD values increased in subsequent time intervals, with MW showing lower OD values than OK. The AS group recorded intermediate values between the MW and OK groups at one day and two weeks, and the same as the MW group at one week.

Regarding ID, the lowest values were recorded initially in the three study mouthrinses, then the ID values increased on the subsequent time intervals, with MW recorded higher ID values in comparison to OK at one and two weeks. AS group recorded higher values than OK and MW at one day and an intermediate value between the MW and OK groups at one week and two weeks.

Table 2 shows comparison of elastic deformation (W, ID and OD) between two-point time intervals of study groups among the study mouthrinses. For W deformation, the AS group revealed significant differences in the initial-one day and initial- two weeks comparisons. For the OK group, there was a significant difference in the initial-one day, initial- two weeks, and one day-one-week comparisons.

Concerning the MW group, there was a significant difference in the initial-one day and initial-two weeks comparison.

Table (2): Mann-Whitney test of elastic deformation between two-point time intervals of study groups among the study mouthrinses

	Time	AS	OK	MW
W	Initial-one day	**0.001***	**0.000***	**0.006***
	Initial-one week	0.182	0.278	0.146
	Initial-two weeks	**0.000***	**0.003***	**0.000***
	One day-one week	0.599	0.019	1.000
	One day- two weeks	1.000	0.846	0.714
	One week- two weeks	0.146	0.846	0.056
OD	Initial-one day	0.226	**0.000***	**0.015***
	Initial-one week	**0.000***	**0.001***	**0.006***
	Initial-two weeks	**0.000***	0.226	**0.000***
	One day-one week	0.146	1.000	1.000
	One day- two weeks	0.340	0.072	1.000
	One week- two weeks	1.000	0.599	1.000
ID	Initial-one day	0.500	0.146	0.500
	Initial-one week	**0.000***	**0.019***	**0.003***
	Initial-two weeks	**0.000***	**0.000***	**0.000***
	One day-one week	0.146	1.000	0.500
	One day- two weeks	**0.019***	**0.019***	**0.003***
	One week- two weeks	1.000	0.146	0.500

W=width, OD=outer diameter, ID=inner diameter, AS=artificial saliva, OK= Ortho Kin, MW= magnetically treated water, *significant level at $P \leq 0.05$.

Regarding OD deformation, the AS group showed significant differences in the initial-one week and initial- two weeks comparisons. For the OK group, there was a significant difference in the initial- one day and initial-one-week comparisons. Whereas the MW group revealed significant differences in the initial- one day, initial-one week, and initial- two weeks comparisons.

For ID deformation, the AS, OK and MW groups showed significant differences in the initial-one week, initial two-week and one day-two weeks comparisons.

Table 3 represents the comparison of the effects of mouthrinses on elastic deformation (W, ID and OD). In comparison to AS, MW caused higher elastic deformation, especially at one and two weeks, while OK caused a non-significant difference only at one day for W value and at one week and two weeks for ID values.

Regarding the comparison of MW to OK, MW caused significantly higher elastic deformation (W, ID, and OD) from one day to the end of two weeks, except for ID at 2 weeks, where there is no significant difference.

Table (3): Comparison of the elastic deformation for the study groups among the tested mouthrinses using the Kruskal-Wallis test

	Times	AS_MW	AS_OK	MW_OK
W	Initial	1.000	1.000	1.000
	One day	0.221	0.010*	0.000*
	One week	0.001*	1.000	0.001*
	Two weeks	0.000*	1.000	0.003*
OD	Initial	1.000	1.000	1.000
	One day	0.066	0.060	0.000*
	One week	0.005*	1.000	0.000*
	Two weeks	0.000*	1.000	0.002*
ID	Initial	1.000	1.000	1.000
	One day	0.000*	1.000	0.000*
	One week	0.007*	0.000*	0.222
	Two weeks	0.207	0.011*	0.833

W=width, OD=outer diameter, ID=inner diameter, AS=artificial saliva, OK= Ortho Kin, MW= magnetized water, *significant level at $P \leq 0.05$.

DISCUSSION

High incidence of dental and gingival diseases during the orthodontic treatment period makes the use of an adjunctive method for improving oral health unavoidable. The use of mouthrinse has been introduced as an effective way for reducing dental plaque accumulation. Among frequently used antiseptic mouthrinses is NaF, which is known as a potent mouthrinse agent. Currently, due to some undesirable side effects reported from synthetic mouthwashes consumption, the tendency to use natural mouthrinses has increased (21). Thus, MW was selected as a natural mouthrinse to check and compare its effect to synthetic OK mouthrinse on orthodontic elastomeric modules deformation in this research.

The largest W values were recorded initially in all groups before stretching the elastic modules on the dowels, then W values decreased on the subsequent time intervals with MW recorded higher score of W value in comparison to OK this can be explained due to stretching effect of modules on the dowel plus the added decreased surface tension of MW that increase the absorption and adsorption capabilities of water molecules that were magnetized. Treatment of water by a magnetic field can lead to modifications in the physicochemical, biophysical, physical, and chemical properties of the water (22). There is an alteration in water molecule size when water is putted for magnetization because of magnetic exposure (23). In general, H2O is the water molecule structure which attached as a regular triangle, with its upper angle being 104.5°. When normal water is exposed to a magnetic field, the bond angle is decrease under 104.5°. This decrease leads to changes in physical and chemical features of water (20). It was discovered that the MW has increased electrical conductivity, refractive index, and dielectric constant while decreasing its surface tension and increasing soaking degree and hydrophobicity to materials (24).

Concerning OD, the lowest values were recorded initially in the study mouthrinses at all time intervals before stretching the elastic modules on the dowels; then the OD values increased in the subsequent time intervals. This can be explained by the stretching effect of the modules on the dowel, with MW recorded less OD values in comparison to OK. The decreased surface tension of MW increases the absorption and adsorption capabilities of water molecules that were magnetized (20, 24).

Regarding ID, the lowest values were recorded initially in the study mouthrinses at all-time intervals before stretching the elastic modules on the dowels; then the ID values increased on the subsequent time intervals. This can be explained by the stretching effect of the modules on the dowel. MW recorded higher ID values in comparison to OK. The decreased surface tension of MW increases the absorption and adsorption capabilities of water molecules that were magnetized (20, 24).

For the effect of AS mouthrinse on elastic deformation, regarding the W value, there was a significant difference in this value between the initial-one-day and initial two weeks intervals. The OD and ID values reported significant differences over the study time. Taloumis (4) study came in accordance with the present study's results in those dimensional measurements of elastomeric module group in AS bath (at 37◦ C, pH 6.84 for 28 days) showed significantly difference after testing. This study used gray molded elastomeric modules of seven brands instead of translucent elastomeric modules of a single brand (IOS, Stafford, USA), and used AS only instead of AS, OK, and MW used in our study. Our study also was in agreement with Masoud (2) study, as they found significant differences at all-time points among thermoplastic and thermoset elastomeric modules in the percent change of OD, ID, and W values, and was in contrast to our study, as they found that width values of modules had no significant differences. This study used thermoset elastomeric modules instead of ordinary commercially available elastomeric modules of the (IOS, Stafford, USA) brand used in our study.

Concerning the effect of OK mouthrinse on elastic deformation, regarding W and OD values, there was a significant difference between initial-one day and initial-one week. The ID value reported a significant difference over the study time. In comparison to AS, OK caused non-significant differences only at one day for W value and at one week and two weeks for ID values. Mouthrinses like OK have a variety of concentrations of sodium fluoride, which in physiological media forms HF because all sodium salts are soluble in aqueous media. Fluoride solutions of varying pH can change mechanical properties such as friction coefficients, the superelastic behavior of orthodontic arch wires, and corrosion behavior (25). The fluoride ions are very aggressive with the oxide film of orthodontic wires (dowel in the present study), especially titanium dioxide.

Sufarnap (26) results disagreed with the current results, as they analyzed the effect of NaF in chlorhexidine mouthrinses on permanent deformation of orthodontic elastomeric chains. They didn't find any significant differences (p-value>0,05) among the three groups (control, chlorhexidine mouthrinse, and chlorhexidine +NaF mouthrinse) at 1 day, 7, 14, 21, and 28 days, respectively. However, this study used an elastomeric chain instead of elastomeric modules used in our study.

For the MW group, in comparison to AS, MW caused higher elastic deformation, especially at one and two weeks. Regarding the comparison of MW to OK, MW caused significantly higher elastic deformation (W, ID, and OD) from one day to the end of two weeks. This can be explained by the decreased surface tension of MW, which increases the absorption and adsorption capabilities of water molecules that were magnetized (20, 22, 24), causing more elastic deformation of orthodontic modules.

From the above-mentioned outcomes, the proposed null hypothesis was rejected as there were differences between MW and OK on the (W, ID and OD) deformation of orthodontic elastomeric modules at various immersion periods, as proved in the study.

CONCLUSIONS

Within the limitations of this study:
MW caused greater elastic deformation, especially in W and OD values of orthodontic elastomeric modules, than OK from one day to the end of two weeks.

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Authors' Contribution
The authors, Omer ZE and Al Hamdany AKh, designed the study; Al Hamdany AKh supervised the work. Omer ZE conducted the experiments, collected data, performed the data analysis, and wrote the manuscript. Al Hamdany AKh contributed by providing scientific information and assisting in the study.

Ethical statement:
The scientific committee registered the study. Ethical authorization was given by the ethical committee in the College of Dentistry, University of Mosul.

Conflict of interest
The author declares that there are no conflicts of interest regarding the publication of this manuscript.

Availability of data and materials: All data generated or analyzed during this study are included in this published article and its supplementary information files.

Declaration of Generative AI and AI-assisted technologies
The authors declare that no generative AI or AI-assisted technologies were used in the preparation of this manuscript. The authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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تأثير غسول الفم المعالج مغناطيسيًا على التشوه المرن لوحدات تقويم الأسنان المطاطية

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الملخص

الأهداف: هدفت هذه الدراسة إلى تقييم تأثير الماء المعالج مغناطيسياً كمضمضة للفم على التشوه المرن (العرض، القطر الداخلي، والقطر الخارجي) للوحدة المرنة لتقويم الأسنان ومقارنة تأثيرها .إلى غسول الفم الاصطناعي أورثو كين **المواد وطرائق العمل:** مائة وعشرون وحدة شفافة مقسمة إلى ثلاث مجموعات (40 وحدة لكل منها) على أساس غسول الفم المستخدم: المجموعة الضابطة 1: مغسولة باللعاب الاصطناعي، المجموعة 2: مغسولة بغسول الفم أورثو كين ، المجموعة 3 مغسولة بالماء المعالج مغناطيسيا .تم تقسيم كل مجموعة إلى 4 مجموعات فرعية، 10 وحدات لكل فترة زمنية (في البداية، يوم واحد، أسبوع واحد، وأسبوعين .(تم الغسيل لمدة دقيقة واحدة مرتين يوميًا لمدة أسبوعين .تم تحضين العينات عند درجة حرارة 37 درجة مئوية .تمت ممغنطة مائة مل من الماء المقطر باستخدام 2430 مغناطيس نيوديميوم غاوس .تم تمديد الوحدات على مسامير مصنوعة يدويًا من الفولاذ المقاوم للصدأ .تم التقاط صور فوتوغرافية للوحدات بتكبير 3 Xباستخدام صندوق للعرض مصنوع يدويًا للتوحيد القياسي، وتم اكتشاف التشوه المرن عبر برنامج (الصورةJ ؛ المعاهد الوطنية الأمريكية للصحة)تم إجراء القياس بدقة لأقرب جزء من الألف من المليمتر .وتمت مقارنة الإحصائيات الوصفية مع اختلافات التشوه المرنة من القياسات الأولية إلى القياسات النهائية للوحدات مع اختبار مان ويتني .تم استخدام اختبار كروسكال واليس لمقارنة متوسط تغيرات التشوه المرن بين غسولات الفم المدروسة .$P \leq 0.05$. **النتائج:** تسبب الماء المعالج مغناطيسياً في تشوه مرن أعلى بكثير (العرض ، القطر الداخلي، والقطر الخارجي) خاصة في أسبوع واحد وأسبوعين، في حين تسببت أورثو كين في فرق غير مهم فقط في اليوم الاول لقيمة العرض وفي أسبوع واحد وأسبوعين لقيم . القطر الداخلي **الاستنتاجات:** تسبب الماء المعالج مغناطيسياً في تشوه مرن أكبر، خاصة في قيم العرض والقطر الخارجي لوحدات اللدائن المرنة التقويمية مقارنة بقيم أورثو كين من اليوم الاول إلى نهاية الأسبوعين.

الكلمات المفتاحية: غسول الفم، مغناطيسيًا، التشوه المرن، تقويم الأسنان المطاطية.