EVALUATION OF THE EFFECT OF SOME DENTURE CLEANSERS ON THE HARDNESS OF TWO DENTURE BASE MATERIALS

Assit. Prof. NADIA TAWFIQ JAFFER and ALI KHALID ABDULLAH
Dept. of Conservative and Prosthodontics, College of Dentistry, University of Duhok, Kurdistan Region-Iraq

(Accepted for Publication: August 29, 2019)

ABSTRACT

Aim and background: The use of denture cleanser is mandatory in order to keep the denture hygienic and free of micro-organisms but should not have adverse effects on the properties of denture base material. This study aims to evaluate the effect of different cleansing solutions on hardness property of two denture base materials.

Materials and Methods: Seventy specimens have been prepared in dimensions(30*10*2.5)mm, length width and thickness respectively, from two denture base materials(heat-cured acrylic resin and flexible denture base materials). Each had thirty five specimens. These specimens were divided into three groups of cleansers (thyme oil+soda, vinegar+soda and commercial cleanser Kinpro tablet) along with a forth solution as a control group(distilled water). Each group had two immersion periods (thirty minutes and eight hours) in which the cleansers were daily exchanged for a month, while control group had 24 hours immersion and exchanged daily for a month. prior to immersion, hardness property was measured for each sample and after the end of the month, hardness was measured again using Shore D hardness tester. T-test and One Way Analysis of Variance were used to analyze data and determine the significance between the groups at P ≤ 0.05

Results: T-test analysis showed that there were insignificant differences between groups( before and after immersion) in all denture cleansers groups and in both denture base materials. Analysis of variance also showed insignificant differences between denture cleansers groups. In flexible denture base materials, the natural cleansers showed less hardness values than control group, while in heat-cured acrylic resin it was increased in relation to control group.

Conclusion: From the results of this study it was concluded that no significant change in mean hardness was observed and that eight hours immersion period showed higher hardness means than 30 minutes period except for clear vinegar+soda in flexible denture base material.

Keywords: Denture cleanser, Hardness, Denture base materials.

INTRODUCTION

Poly methyl methacrylate(PMMA) is one of the most widely used denture base materials due to its many superior properties(Annusavice, 1996). However, the material has some poor mechanical properties like poor fatigue resistance, and weak transverse strength which leads to fractures(Yazadin et al., 1989). Also it can be allergic for some wearers(Mabraden, 1988). In recent years nylon based denture base materials was introduced to overcome some of these challenges.

Flexible denture base material was first introduced in 1950s(Lowe et al., 2004). Flexible acrylic resin is a nylon based, very strong and hard to break thermoplastic material, usually pink color, and can be made very thin(Prashanti et al., 2010). The material offer more esthetic advantages, it goes well with the color of natural teeth and gum, the material also doesn’t need visible metal clasps(Budtz et al., 2000). It is also more comfortable to the patient, as it flexes with the contours of patient’s oral tissues and has a light weight(Yonus et al., 2005), (Negrutiu et al., 2005).

Daily use of the prosthesis will end up forming a thin layer of glycoprotein and immunoglobulins on surface of denture called Pellicle( Singh, 2011). This layer helps increasing bacterial aggregation and colonization, specially that the microporous nature of the denture base provide a suitable environment for such a process( Shay, 2000). This is very problematic for the wearer and has many consequences like denture stomatitis, halitosis, candidiasis, staining and appearance changes( Allis et al., 2012), thats why oral
hygiene and the use of denture cleanser daily is very important. The routine daily use of denture cleansers may have negative impact on denture physical and chemical properties (Petersen, 2005).

One of the important qualities of denture base material is its resistance to indentation, which is referred to as hardness and this property can be affected by daily cleansing routine (Salman et al., 2011).

An ideal denture cleanser should be non toxic, bactericidal, fungicidal and compatible with denture base (Sheen, 2000), i.e it must clean effectively without adversely affecting denture base material properties.

Denture cleaners can be classified according to their mode of action into chemical and mechanical, immersion in a chemical disinfectant is widely used among denture wearers (Craig et al., 1996).

This study aims to evaluate the effect of different cleansing solution on hardness property of flexible and heat- cured acrylic denture base materials.

**MATERIALS AND METHODS**

**Specimens Preparations:**
**A- Number and dimensions:**
Seventy specimens of (30*10*2.5)mm, (ADA, 1999) of two denture base materials were prepared, thirty five specimens from heat cured acrylic resins (Major Prodoti Dentari, Italy) and thirty five specimens of flexible denture base materials (Deflex Global, Spain) as shown in figure(2), samples were distributed evenly across cleansing solutions (10 for each solution divided on two periods of immersion evenly, control group had 5 samples).

**B- Mould preparation:**
Specimens replica of modeling wax were made according the required dimensions on a glass slab using a sharp wax knife as shown in figure(1). A dental stone type III was mixed with water in a ratio of 30 ml of water to 100 gm of stone (Craig et al., 1996) and was put in the flask. Wax specimens were cleaned, dried and placed over the stone in the flask to prevent air entrapment.

After the stone was set, it was painted with separating medium using a brush, and the upper half of the flask then was placed, poured and allowed to set before putting the flask in a boiled water for 10 minutes to eliminate the wax.

**C-Packing and Curing:**
**1-Flexible**
Flexible resin cartridges were inserted inside an electrical furnace to be plasticized at high temperature, according to manufacturer instructions, the device was set at 250°C for 20 minutes. Then the cartridges were removed and placed in the inlet of the flask and compressed using its lever in less than one minute, the pressure were maintained for 3-5 minutes, then the flask was put on bench to cool for 20 minutes (Paryizi et al., 2004). The sprue formers are cut with special type of knife and finishing is done with valcinate burs and green and pink mounted stones, usually used for porcelain finishing, using a rapid and light shaving motion. Then the specimens were polished using conventional polishing protocols.

**2-Heat cured acrylic resin**
According to the manufacturer instructions, powder/liquid ratio of 3:1 by volume of powder and liquid was mixed and left in a glass jar and covered until it reached dough stage, then it was inserted into the flask, and put under pressure for 5 minutes to ensure proper flow of material inside the flask. The flask was put then in a hot water at 74°C for 1.5 hours and then in a boiled water at 100°C for an hour (Craig et al., 1996). The flask was bench cooled for 20-30 minutes, after that the samples were retrieved from the flask. Then samples were finished and polished using stone bur at low speed and then by silicon carbide paper with continuous water cooling, and then the samples were polished with a rouge and wool brush on dental lathe (Hammoudi, 2006). A hole was made on each sample and labeled with numbers to identify them.

**Cleansing Solutions**
Three types of denture cleansers were used, two of them were prepared (thyme oil 3.57g + sodium bicarbonate 2g in 100 ml distilled water) and (clear vinegar 5 ml + sodium bicarbonate 7g in 100 ml distilled water) according to (Khalil, 2007), and one commercial cleanser (KinPro tablet in 100 ml of distilled water). Distilled water was used as a control group.

**Hardness Measurement**
Shore D (figure 3) device was used to record indentation hardness measurement. It is usually used for harder non metallic materials. The device has a stable platform on which samples are put to be held against the indenter which has a diameter of 1.25mm the distance between the sample and
the indenter is between 5-15mm. The samples were subjected to a minor load of 44.5 N and contact continued for 1 second according to manufacturer instructions.

Three different readings across the length of the sample were measured one on the center and two on each side of the sample, the mean was taken as a final record for each sample.

**Immersion Procedure**

After specimens were prepared, sampled were stored at 37°C for conditioning (Annusavice, 1996). Hardness measurement was recorded prior to immersion in denture cleansers for comparison purposes. Samples were divided according to the cleansers and duration of immersion, 70 glass containers were used to contain cleansing solution, each was labeled with a sticker on which the number of the sample was written. Each container contained one sample hanged with a string to ensure that all surfaces are properly exposed by preventing it from settling in the base of the container.

Each material (flexible and heat cured acrylic) had 35 samples, five samples immersed in distilled water as a control group, and fifteen samples were immersed for 8 hours a day and the other fifteen samples were immersed for 30 minutes a day. After that duration samples were removed from their cleansing solution and washed under distilled water, dried and collected in a distilled water container in which they were stored for the rest of the 24 hours. The procedure was repeated daily for 30 days. After the end of 30 days of immersion, hardness measurements were recorded again to compare the two readings (before and after immersion).

**Statistical Analysis**

Statistical analysis were done using student t-test to determine the comparative significant difference between two groups (before and after immersion) in denture cleansers. One-way analysis of variance was also used to determine the significance between groups at P-value ≤ 0.05.

![Fig. (1): showing waxed samples](image1)

![Fig. (2): showing final sample](image2)

![Fig. (3): showing Shore D device](image3)
RESULTS

Results for this study for flexible denture base materials revealed that there were insignificant differences between the two groups (before and after) immersion in all denture cleansers at eight hours and thirty minutes as shown in tables (1,2,3,4), also for heat cured acrylic resin denture base material, there was insignificant differences between groups in all denture cleansers except for (vinegar+soda) group at 30 minutes immersion period.

Table (1): student’s t-test of hardness measurements after 8 hours immersion in denture cleansers for flexible denture base materials:

| N | Mean | T  | std | Sig.(2-tailed) T-test( less than P value of 0.05 is significant) |
|---|------|----|-----|---------------------------------------------------------------|
| Pair 1 | Before thyme + soda | 5 | 88.000 | 2.250 | 3.2403 | 0.088 |
|       | After thyme + soda  | 5 | 86.200 | 3.56371 |                                                |
| Pair 2 | Before vinegar + soda | 5 | 84.000 | 0.930 | 4.06202 | 0.405 |
|        | After vinegar + soda | 5 | 83.200 | 3.34666 |                                                |
| Pair 3 | Before d water  | 5 | 86.200 | 0.343 | 2.1679 | 0.749 |
|        | After d water    | 5 | 86.000 | 1.41421 |                                                |
| Pair 4 | Before kinPro   | 5 | 87.800 | 0.408 | 1.92354 | 0.704 |
|        | After kinPro    | 5 | 87.400 | 2.70185 |                                                |

Table (2): student’s t-test of hardness measurements after 30 minutes immersion in denture cleansers for flexible denture base materials:

| N | Mean | T  | Std | Sig.(2-tailed) T-test( less than P value of 0.05 is significant) |
|---|------|----|-----|---------------------------------------------------------------|
| Pair 1 | Before thyme + soda | 5 | 84.600 | 1.238 | 5.079937 | 0.284 |
|       | After thyme + soda  | 5 | 83.400 | 3.04959 |                                                |
| Pair 2 | Before vinegar + soda | 5 | 86.2500 | 1.698 | 3.30404 | 0.188 |
|        | After vinegar + soda | 5 | 84.5000 | 1.29099 |                                                |
| Pair 3 | Before d water  | 5 | 86.200 | 0.0 | 2.1679 | 0.749 |
|        | After d water    | 5 | 86.000 | 1.4142 |                                                |
| Pair 4 | Before kinPro   | 5 | 87.400 | 0.0 | 4.335 | 0.189 |
|        | After kinPro    | 5 | 86.400 | 3.577 |                                                |

Table (3): student’s t-test of hardness measurements after 8 hours immersion in denture cleansers for heat cured acrylic base materials:

| Paired sample test | N | Mean | T  | Std | Sig.(2-tailed) T-test( less than P value of 0.05 is significant) |
|--------------------|---|------|----|-----|---------------------------------------------------------------|
| Pair 1             | Before thyme + soda | 5 | 82.600 | 1.58 | 2.50998 | 0.189 |
|                    | After thyme + soda  | 5 | 81.600 | 1 | 3.36155 |                                                |
| Pair 2             | Before vinegar + soda | 5 | 83.200 | 1.50 | 2.049 | 0.208 |
|                    | After vinegar + soda | 5 | 82.600 | 0 | 1.516 |                                                |
| Pair 3             | Before d water  | 5 | 78.000 | 0.40 | 6.906 | 0.704 |
|                    | After d water    | 5 | 77.800 | 8 | 6.220 |                                                |
| Pair 4             | Before kinPro   | 5 | 83.000 | 2.13 | 1.581 | 0.099 |
|                    | After kinPro    | 5 | 82.200 | 8 | 1.095 |                                                |
Table(4): student’s t-test of hardness measurements after 30 minutes immersion in denture cleansers for heat cured acrylic denture base material denture base materials:

| Paired sample test       | N | Mean | T  | Std  | Sig.(2-tailed) T-test( less than P value of 0.05 is significant) |
|--------------------------|---|------|----|------|---------------------------------------------------------------|
| Pair 1                   | 5 | 81.800 | 2.058 | 4.323 | 0.109                                                        |
| Before thyme +soda      |   |       |     |      |                                                              |
| After thyme +soda       | 5 | 80.600 |     | 3.361 |                                                              |
| Pair 2                   | 5 | 81.600 | 3.087 | 3.847 | 0.037                                                        |
| Before vinegar +soda    |   |       |     |      |                                                              |
| After vinegar +soda     | 5 | 79.800 |     | 2.774 |                                                              |
| Pair 3                   | 5 | 78.000 | -0.784 | 6.906 | 0.704                                                        |
| Before d water           |   |       |     |      |                                                              |
| After d water            | 5 | 77.800 |     | 6.220 |                                                              |
| Pair 4                   | 5 | 81.2000 | -0.784 | 2.949 | 0.477                                                        |
| Before kinPro            |   |       |     |      |                                                              |
| After kinPro             | 5 | 81.6000 |     | 1.949 |                                                              |

Analysis of variance showed non significant differences between groups in both denture base materials in all types of denture cleansers at two immersion periods, as observed in table(5, 6).

Mean values of hardness measurements in flexible denture base material revealed that commercial denture cleanser had the highest mean hardness at both periods of immersion in comparison to control group( distilled water) and thirty minutes immersion caused less hardness changes than eight hours immersion periods except for (vinegar+soda) group which showed higher changes after thirty minutes immersion than after eight hours immersion.

Mean hardness values for heat cured acrylic resin denture base(figure 4, 5) revealed that all cleansers groups had hardness values more than control group in both immersion periods and that the longer the period of immersion (eight hours) showed higher hardness mean than the short period( thirty minutes).

Table(5): Analysis of variance of hardness measurement after immersion in denture cleansers for flexible denture base material.

| Immersion period | Sum of squares | DF | mean square | F  | Sig. |
|------------------|----------------|----|-------------|----|------|
| 30 Minutes       | Between gps    | 22.957 | 2 | 11.479 | 1.352 | 0.299 |
|                   | Within gps     | 93.400 | 11 | 8.491 |       |      |
|                   | Total          | 116.357 | 13 |       |       |      |
| 8 Hours           | Between gps    | 54.060 | 3 | 18.020 | 1.825 | 0.173 |
|                   | Within gps     | 207.300 | 21 | 9.871 |       |      |
|                   | Total          | 261.360 | 24 |       |       |      |

Table(6): Analysis of variance of hardness measurement after immersion in denture cleansers for heat cured acrylic denture base material.

| Immersion period | Sum of squares | DF | mean square | F  | Sig. |
|------------------|----------------|----|-------------|----|------|
| 30 Minutes       | Between gps    | 105.040 | 3 | 35.013 | 2.474 | 0.090 |
|                   | Within gps     | 297.200 | 21 | 14.152 |       |      |
|                   | Total          | 402.240 | 24 |       |       |      |
| 8 Hours           | Between gps    | 8.133  | 2  | 4.067  | 0.535 | 0.599 |
|                   | Within gps     | 91.200  | 12 | 7.600  |       |      |
|                   | Total          | 99.333  | 14 |       |       |      |
DISCUSSION

The results of this study (table 1,2,3,4) showed insignificant differences hardness measurement in both materials across all solutions. In flexible denture base material there was a none significant decrease in surface hardness in (thyme oil +soda) and in (vinegar+soda) in 30 minutes, this agrees with (Neppelenbroek et al., 2005), who concluded that there is a decrease in surface hardness of denture base material after immersion in a disinfectants no matter the material used for construction of denture base. It also agrees with (Salman et al., 2011) who stated that indentation hardness did not have a significant change for nylon specimens.

The biggest change in hardness in flexible among two periods flexible samples were of those
immersed in thyme oil+soda, and samples immersed for 8 hours had higher changes in hardness values than those immersed for 30 minutes, this can be related to the slow absorption of disinfection solution in relation to water, this can increase elasticity and decrease hardness (Neppelenbroek et al., 2005). This decrease in hardness is higher in specimens immersed for 8 hours than those for 30 minutes which shows that time plays a role.

Clear vinegar+soda group in both immersion periods showed hardness means less than control(distilled water) and commercial groups this could be due to the chelating properties of sodium citrate which results from the reaction citric acid and sodium bicarbonate, this increases the rate of removal of organic and inorganic components. Acetic acid has a low PH which is less favorable than neutral PH, this leads to softening of the surface layer of resins (Machado – Silvereio et al., 2004) though acetic acid is considered a weak acid. This agrees with Khalil et al., 2007).

Kin pro tablets caused higher hardness means than other groups both(thyme+soda) and (vinegar+soda) and distilled water, which may be due to its action resulted from the oxidizing ability of the peroxide decomposition and the effervescing action of evolved oxygen (Khalil, 2007).

For heat cured acrylic denture base specimens hardness measurements were higher than control group(distilled water) in both immersion periods and this was in agreement with (Hatim et al., 2012), who stated that the hardness of resin can be increased by immersion in same natural disinfectants. Distilled water causes a decrease in hardness in different denture base materials after 90 days of immersion. (Pavarina et al., 2003).

CONCLUSION

relying on the results of this study it was concluded that:
- insignificant change in hardness between pre and post immersion was observed in both denture base materials and in all groups of cleansers
- the longer period of immersion increased hardness more than the shorter one(30 minutes) except vinegar+soda group in flexible denture base
- Natural cleansers caused hardness changes less than commercial one.

REFERENCES
1. ADA specification (1999) No.12 American dental associated specification no.12 for denture base polymer. Chicago: councilor dental material and device.
2. Allis T.J., Leopold D.A.(2012), Smell and taste disorders. Facial Plast Surg Clin North Am;20:93-111.
3. Anusavice K.J. (1996), Philips science of dental material. 10th ed., Philadelphia, W.B.Saunders Co.pp. 33-47, 211-271.
4. Budtz-Jorgensen E, Bochet G, Grundman M.(2000) Aesthetic considerations for the treatment of partially edentulous patients with removable dentures. Pract Periodontics Aesthetic Dent;12(8):765-774.
5. Craig R.G, O’brien W.J, Powers J.M. (1996) Dental Materials: properties and manipulation. 6th Ed. Mosby Co. Pp. 97-133, 242–265.
6. Hammoudi I.M.(2006), Evaluation the effect of polishing techniques on surface roughness and adhesion of Candida albicans to the Acrylic complete denture.[Master's thesis], Iraq: College of dentistry, University of Baghdad;58.
7. Khalil S.M. (2007) New denture cleansers. Thesis; College of Dentistry, University of Mosul.
8. Machado-Silveiro L.F, Gonzales-Lopez S, Gonzales U.E, Rodriguez M.P. (2004), Decalcification of root canal dentine by citric acid, EDTA.
9. Mabraden, J.K. (1988). Some aspects of the chemistry and physic of dental resins. Adv Dent Res; 2(1): 93-7.
10. Negrutiu M, Sinescu C, Romanu M, Pop D.(2005), Lakatos S. Thermoplastic resins for flexible framework removable partial dentures. Timisoara Med J.; 2(3) :1-5.
11. Neppelenbroek K.H, Pavarina A.C, Vergani C.E, Giampaolo E.T.(2005), Hardness of heat polymerized acrylic resins after disinfection and long term water immersion J Prosthodent Dent :: 93:171-176.
12. Parvizi A, Lindquist T, Schneider R, et al, (2004). Comparison of the dimensional accuracy of injection molded denture base materials to that of conventional pressure-pack acrylic resin. J Prosthodont. Jun;13(2):83-89.
13. Pavarina A.C, Machada A.L, Giampaldo E.T. and Vergani C.E. (2003) Effect of chemical disinfection on transverse strength of denture base acrylic resin. J Oral Rehabin. 30: 1085 – 1089.
14. Petersen P.E., Bourgeois D., Brathall D., Ogawa H. (2005) Oral health information systems – Towards measuring progress in oral health promotion and disease prevention. Bull World Health Organ.;83:686–93.
15. Prashanti E, Jain N and Shenoy V.K.(2010) Flexible dentures: A flexible option to treat edentulous patients J. Nepal Dent. Assoc, 2010; 11(1): 85-87.
لا خاصیه

الهدف: آن استفاده مناطق طقم الأسنان ضروریه للحفاظ على نظافة الطقم وضعه خالی من المیکروبات ولکن بنفس الوقت يجب أن لا فتوثر هذه المنطقات سلباً على خصائص قاعدة طقم الأسنان تهدف الدراسة إلى تقييم تأثیر مختلف مناطق اللطبخة على خاصیة الصلابة لموادن من طقم الأسنان

مواد وطرق العمل: تم تحضیر 70 بعینة (10*10*2.5) ملم (طول و عرض و سمک على التوالي) من مادتين من طقم الأسنان (الحرنة والطبخة حرارة) لكل مادة 35 عینة تم تقسیم هذه العینات إلى ثلاث مجموعات من مناطق الطقم (زیت الزعر + الصودا، الخل + الصودا، قرص التنظیف من نوع cin ) و مجموعة الاماء المقطع هي مجموعة السبیرة. كل نوع من المنطقات له فترتين غمس للسیویات 20 دقیقة، 8 ساعات حيث تم تغير المحالی يومیاً لمدة شهر انا مجموعة الاماء فقط تغیر الاماء يومیاً كل 4 ساعه لمدة شهر كامل. تم قیاس خاصیة الصلابة قبل غمس العینات في مجال الظفات وبعد انتهاء مدة الاماء ایضاً تم قیاس الخاصیه لكل عینة لتحدرس الاختلاف بین ANOVA وتحليل t-test ویحسن Som_D باستخدام جهاز. H0

نتایج: أظهر تحلیل t-test عدم وجود اختلاف معنیي بين المجامع (قبل وبعد الاماء) في مجموع

الاستنتاجات: حسب نتایج هذه الدراسة تم استنتاجات الاتی: عدم وجود تغیر معنیي في مقدار الصلابة لکلا المادتين ان فترة الاماء 8 ساعات أظهرت زيادة في معدل الصلابة مقارنة مع فترة 20 دقیقة بأستثناء مجموعة ( الخل + الصودا) في مادة قاعدة طقم الأسنان المرنة.

الکلامات المفتاحیة: مناطق الاطقم، الصلابة، مواد قاعدة طقم الأسنان

28

نامانج: کارنینان ن. قاپکرتن هم‌زمان تانگما دانسا یا ین‌دی‌فیه یو پارستانا دانسا ز میکروبان و د ههمان دهمدا ین‌دی‌فیه یو قاپکرتن کارنینان ن. لسر تاپی‌دنیین بینیانا تاخما دانسا نه‌گهت، نامانجین
مقاله و زیرگنجی بکارگیری ماده‌کنی: 70 سیمیل ب دورات (30 × 10 × 2.5) ملم هایتیه ناماده کنی زیایت ماده‌کنی تغییرات دانی‌پاتریا وان خور و پاک‌کردن گیری و آن هر دو ماده‌کنی تغییرات دانی‌پاتریا.

در هر گروپ یک دندان ده‌تیه‌کریکن لسر تایپت فاکتوریا وان خور و پاک‌کردن گیری و آن هر دو ماده‌کنی تغییرات دانی‌پاتریا.

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هایتیه بکارگیری ماده‌کنی دوست‌شان‌ژیادی پیکره‌کی ماده‌کنی گروپ‌یا کارایی کیفیت ماده‌کنی دوست‌شان‌ژیادی پیکره‌کی ماده‌کنی دوست‌شان‌ژیادی پیکره‌کی ماده‌کنی دوست‌شان‌ژیادی پیکره‌کی ماده‌کنی Duhok,

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هدارای گروه سینا وارکی: 29/3/2019

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هجیرت دندانه‌کنی دوست‌شان‌ژیادی پیکره‌کی ماده‌کنی دوست‌شان‌ژیادی پیکره‌کی ماده‌کنی Duhok,

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هدارای گروه سینا وارکی: 29/3/2019

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هدارای گروه سینا وارکی: 29/3/2019

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هدارای گروه سینا وارکی: 29/3/2019

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هدارای گروه سینا وارکی: 29/3/2019

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هدارای گروه سینا وارکی: 29/3/2019

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هدارای گروه سینا وارکی: 29/3/2019

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هدارای گروه سینا وارکی: 29/3/2019

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هدارای گروه سینا وارکی: 29/3/2019

\begin{align*}
\text{ANOVA} & \quad \text{پیمان} \\
\text{t-test} & \quad \text{پیمان}
\end{align*}

هدارای گروه سینا وارکی: 29/3/2019