# A Comparative Study of two acrylic resin flasking methods on the dimensional accuracy of denture base with using of commercial acrylic resin types[+]

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**ABSTRACT :**

The pressure of final closure may be released when the flask is removed from the press and placed in the clamp . This release in pressure may result in dimensional changes that distort the denture base .

The purpose of this study is to investigate the differences between the dimensional stability of standarized simulated denture bases processed by traditional moist heat-polymerization and those processed by the use of a new tension system with the use of many types of commercial acrylic resin .

The results showed that the acrylic which was packed by the new tension system had a smaller base distortion compared to the conventional packing method and also the results showed that the type of acrylic resin have a little effect on the dimensional accuracy of the denture base .

**INTRODUCTION :**

A critical factor in the retention and stability of the complete denture is the dimensional changes that occur during polymerization reaction [1,2] .

Acrylic resin denture bases are the most popular denture bases used in dentistry although it has a polymerization shrinkage which is more evident on the palate of maxillary denture which will be poorly compensated after resin base processing [3] .The combination of polymerization shrinkage and strain release later decrease the adaptation level of the support tissue influencing the base stability [4] .

To reduce the variables that alter the base stability some consider the most effective method is by using conventional curing cycle in a water bath at 65 $C^o$ for 9h[5,6] .

On the other hand some studies demonstrated that the base adaptation to the stone cast is un satisfactory and it is influenced by the base thickness , palate geometry and processing method without being influenced by different curing cycles [7,8,9,10,11] .

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[+] **Date received 28 / 11 / 2007 Date Accepted 19 / 4 / 2009**

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The combination of several factors such as polymerization shrinkage , thermal contraction by flask cooling and strain caused by stress release during deflasking causes diminished adaptation of the denture to the tissues .

The stress release, gain or loss of water and incomplete denture polymerization are factors responsible for the dimensional changes occurring after removal of the denture from the stone cast and the most likely causes for denture instability [12] . However the magnitude of these changes is not great and in almost all instance , it is within a range of 0.1 to 0.4% and according to patient reaction , these change do not significantly affect the serviceability of the denture [13].

Recently a new tension packing system was associated with decreased dimensional changes in the simulated maxillary denture bases of 3 commercial acrylic in the market processed with moist heat curing when compared to traditional spring clamps , the greatest denture base dimensional change was found on the palatal posterior seal area with all acrylic resin types , when the flasks were bench cooled [14].

The aim of the study is to verify the dimensional changes of the denture bases processed according to the conventional and new tension system packing method with the use of 3 different types of commercial acrylic resin .

## MATERIALS AND METHODS :

A total of sixty stone cast were prepared by using a rubber mould to pour stone casts from type IV (4) extra hard stone (Micromod - Italy) with a mixing ratio 22-23 ml of water to 100g . Powder according to the manufacturer instruction .

The stone cast is then removed from the mould when reached the final setting after 45 min .

The stone casts were randomly assigned into 2 groups of 30 specimens , each according to the conventional and a new tension packing method . In each method , the specimens were sub divided into 3 groups according to the type of acrylic that had been used [Ivoclar , Quayle dental , Akrileks] .

A sheet of wax (Poly wax IZ MiR Turkey) was adapted on each stone cast . A uniform denture base was made by the same technician and good adaptation on each stone cast with a 1.5 mm thickness plate wax was performed .

The conventional flasking for the complete denture was followed in the mould preparation and allowed the stone to be harden for 60 minutes before putting it in boiling water for 10 minutes to soften the base plate wax and wax elimination was done by conventional way and then packing of the 3 types of acrylic were done in a ratio of 1:3 by volume . The acrylic resin dough was packed into the mould in accordance with a group assignments , in the conventional flask pressure technique a second trial closure was performed and an intimate contact had been established and left under the pressure for 5 minutes before the clamping was done then the flask was placed in a flask clamp maintaining undisturbed pressure during the processing [15] . Then the flasks were immersed in a water bath at room temperature and polymerized at 70 $C^o$ for 7 hours and raised the temperature to 100 $C^o$ and maintain for 1 hour .

In the new technique group , the same trial pack at final closure was also accomplished with a hydraulic press and an applied load for 5 minutes . The flask however was positioned between the two plates of the new tension system (2 iron plates , each 150 × 50 × 10 mm) , A screw 14 mm in diameter was soldered into each end of the lower plate , 2 corresponding holes with across section diameter of 15 mm were present in the upper plate (Fig -1-).

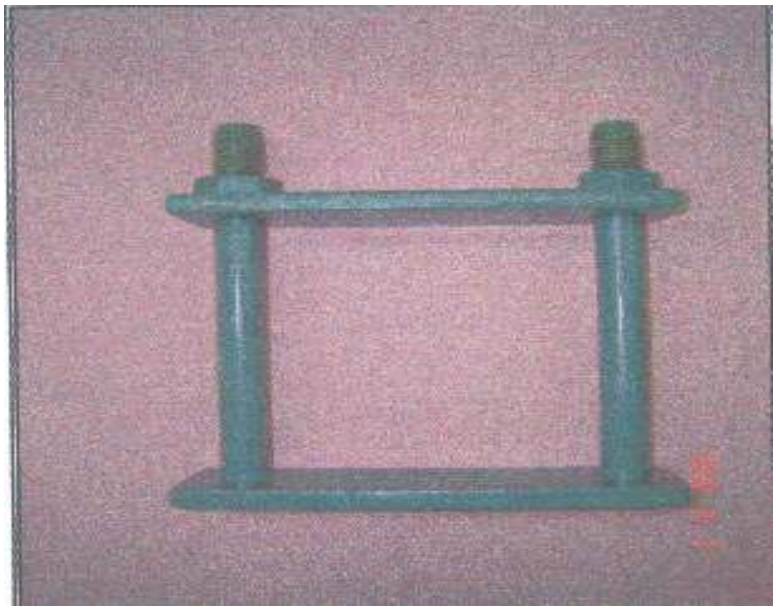

**Figure -1- : New tension device**

During the definitive flask closure , the screws of the lower plate were fitted into the holes of the upper plate and after a hydraulic flask pressure , the screw nuts were strongly tightened to screw until just one stop before press releasing .This procedure maintains a constant metal to metal contact on the flask halves , a condition sufficient to standarized the flask closing pressure . Then the flask is subjected to the same polymerization cycle of conventional method . These two methods are performed on each type of 3 commercial acrylic , that had been used [14] . Bench cooling was allowed for the flasks before the bases were deflasked , trimmed and fixed to their corresponding casts with an instant adhesive (Cynoacrylate adhesive , china) placed on the border of the base cast in order to prevent any movement during the cutting procedure .

The cutting was made on the fixer table under constant water cooling to prevent acrylic resin alteration .

The base – casts sets were transversally sectioned into 3 portions corresponding to the distal of canine (A) , mesial of first molars (B) and posterior palatal zone (C) (Figure -2-) .

**Figure -2- : Base cast sections**

In each section the base – cast discrepancies were measured at 5 locations : right and left ridge crests , posterior palatine midline and right and left marginal limits (Figure -3-) using an optical comparator microscope with a traveling stage calibrated to 0.001 mm (Figure -4-) , This device contains vernea that starts measurements from zero [16] .

The measurements was made 3 times at each 5 points on each of the 3 sections of each cast for a total of 45 measurement per cast . The procedure was repeated on each cast in each group for a total of 2700 individual measurement on the 60 base – cast sets .

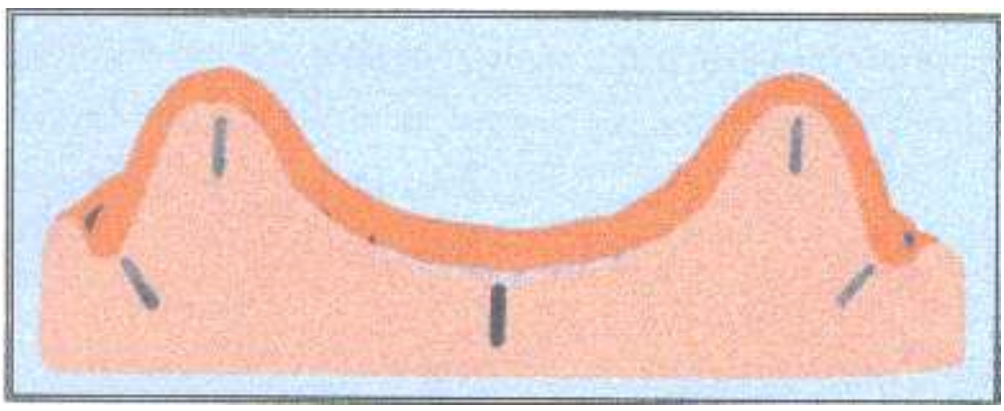

**Figure -3- : Points in the transverse sections used to determine the dimensional changes in the base – stone set .**

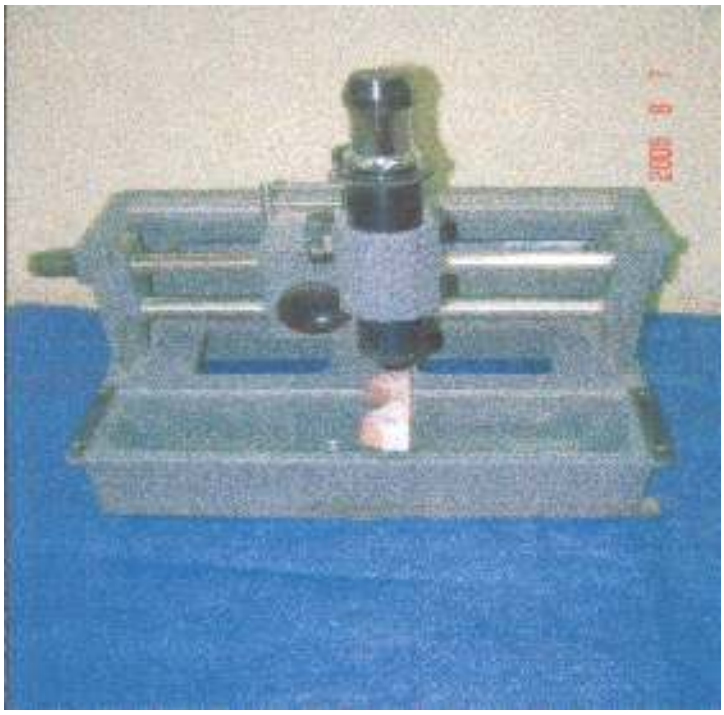

**Figure -4- : Traveling microscope device .**

The data were submitted to ANOVA and SPSS program with a significant level of 5% .

## RESULTS :-

Descriptive and inferential statistics for the dimensional changes of the conventional and new tension packing method of 3 types of commercial heat cure acrylic (Ivoclar , Quayle Dental , and Akrileks) were studied then a comparison between the results of them was done to evaluate the changes in dimension of the base in the following sections :

- **Section A (Distal of Canine) :**

The results have shown that the highest mean of dimensional changes values were obtained with the conventional Akrileks (0.158 mm) , while the lowest mean dimensional changes values were obtained with the new tension Akrileks (0.141 mm) Table (1) and Figure -5- .

**Table (1) : Mean , standard deviation and standard errors for dimensional changes in section A (distal of canine) according to the packing methods influenced by types of acrylic .**

| Studied groups | | NO | Means (Mm) | Standard deviation | Standard error | ANOVA (F-test) P-value |
|---|---|---|---|---|---|---|
| Conventional | Ivoclar | 10 | 0.151 | 0.008 | 0.002 | 0.536 Non Sig. (P>0.05) |
| | Quayle dental | 10 | 0.157 | 0.009 | 0.003 | |
| | Akrileks | 10 | 0.158 | 0.0098 | 0.0031 | |
| New tension system | Ivolcar | 10 | 0.151 | 0.051 | 0.016 | |
| | Quayle dental | 10 | 0.144 | 0.014 | 0.004 | |
| | Akrileks | 10 | 0.141 | 0.016 | 0.005 | |
| Total | | 60 | | | | |

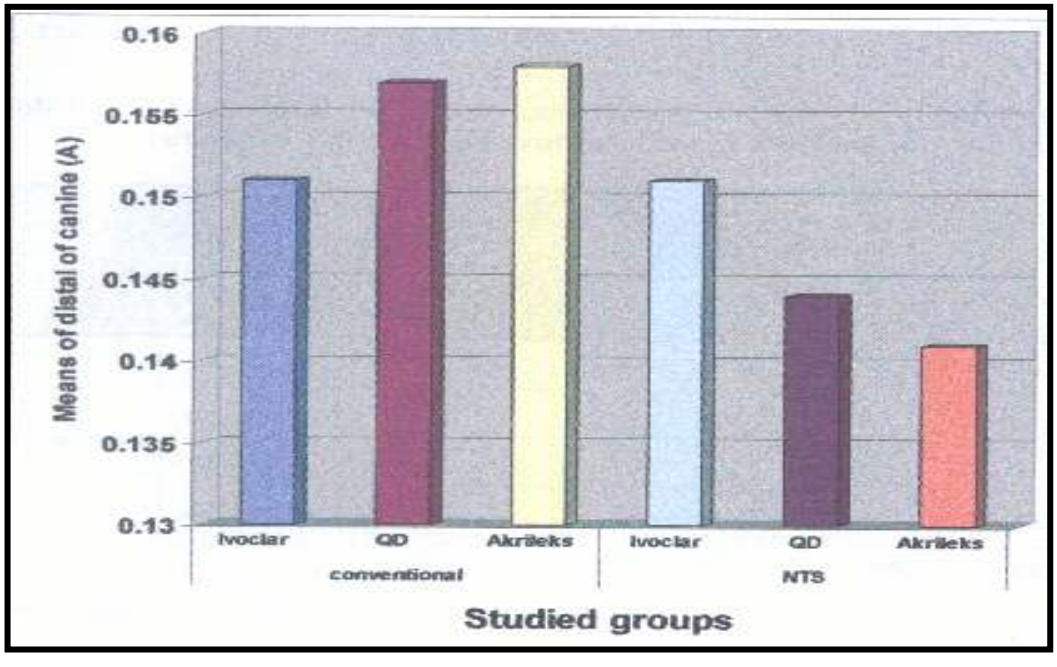

**Figure -5- : Bar chart of dimensional changes of distal of canine section .**

In table (2) one way ANOVA with least significant difference (LSD) of multiple comparison test between tested groups in section A (distal of canine) are indicated , the results showed a non significant difference at (P>0.05) between all different groups .

**Table (2) : Least significant difference (LSD) test for the dimensional changes between test groups in section A (distal of canine) .**

| LSD (F-test) | | Conventional | | | New tension system | | |
|---|---|---|---|---|---|---|---|
| | | Ivoclar | Quayle dental | Akrileks | Ivoclar | Quayle dental | Akrileks |
| Conventional | Ivoclar | - | NS | NS | NS | NS | NS |
| | Quayle dental | - | - | NS | NS | NS | NS |
| | Akrileks | - | - | - | NS | NS | NS |
| New tension system | Ivoclar | - | - | - | - | NS | NS |
| | Quayle dental | - | - | - | - | - | NS |
| | Akrileks | - | - | - | - | - | - |

**NS = Non significant difference (P>0.05)**

- **Section B (Mesial to the first molar) :**

Table (3) represents mean values , standard deviation (SD) , standard error (SE) and Figure -6- shows the dimensional changes of the two packing method for all acrylic material types in relation to the first molar section .

The results showed that the highest mean values obtained with the conventional Akrileks (0.187 mm) while the lowest mean values were obtained with new tension Ivoclar (0.168 mm) .

**Table (3) : Mean , standard deviation and standard error for dimensional changes in section B (mesial of the first molar) according to packing methods influenced by types of acrylic .**

| Studied groups | | NO | Means (Mm) | Standard deviation | Standard error | ANOVA (F-test) P-value |
|---|---|---|---|---|---|---|
| Conventional | Ivoclar | 10 | 0.179 | 0.018 | 0.0059 | 0.156 Non Sig. (P>0.05) |
| | Quayle dental | 10 | 0.185 | 0.020 | 0.0065 | |
| | Akrileks | 10 | 0.187 | 0.0181 | 0.0058 | |
| New tension system | Ivolcar | 10 | 0.168 | 0.019 | 0.0063 | |
| | Quayle dental | 10 | 0.170 | 0.016 | 0.0053 | |
| | Akrileks | 10 | 0.177 | 0.0196 | 0.0061 | |
| Total | | 60 | | | | |

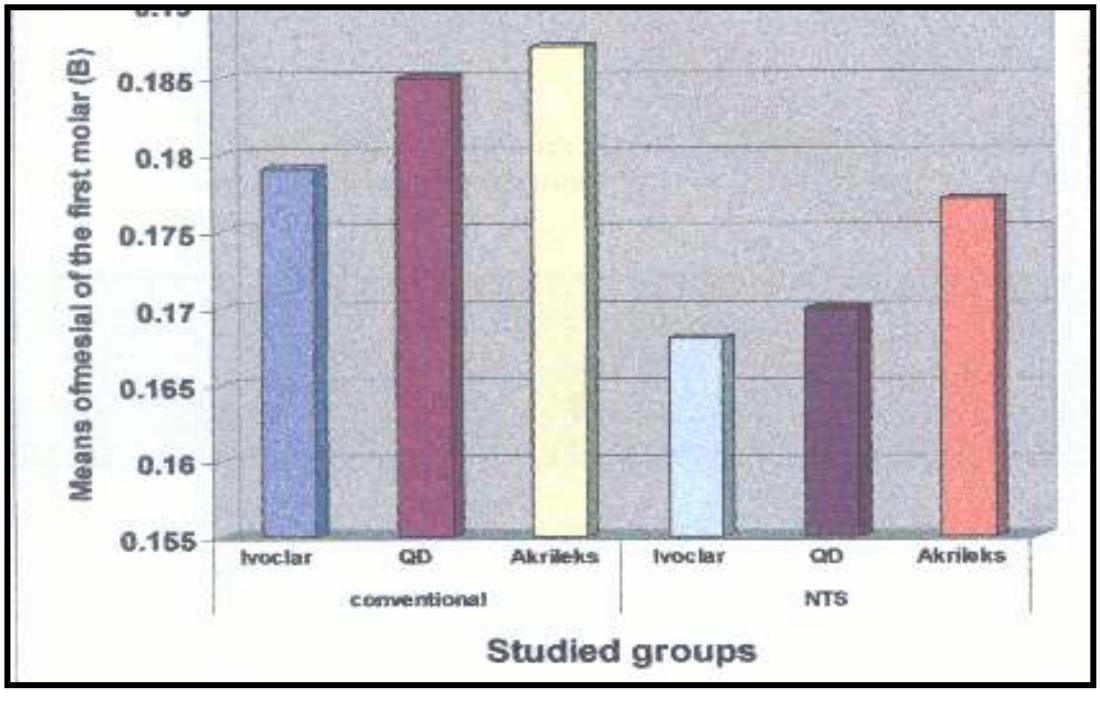

**Figure -6- : Bar chart of dimensional changes of mesial of the first molar section**

In table (4) one way ANOVA with LSD of multiple comparisons test between tested groups in section B (mesial of the first molar) are indicated . The results indicated anon significant difference at (P>0.05) between all groups , except a significant difference at (P<0.05) between the conventional Quayle dental with new tension Ivoclar , the conventional Akrileks with the new tension Ivoclar and conventional Akrileks with new tension Quayle Dental .

**Table (4) : LSD test for the dimensional changes between test groups in section B (mesial of the first molar) .**

| LSD (F-test) | | Conventional | | | New tension system | | |
|---|---|---|---|---|---|---|---|
| | | Ivoclar | Quayle dental | Akrileks | Ivoclar | Quayle dental | Akrileks |
| Conventional | Ivoclar | - | NS | NS | NS | NS | NS |
| | Quayle dental | - | - | NS | S | NS | NS |
| | Akrileks | - | - | - | S | S | NS |
| New tension system | Ivoclar | - | - | - | - | NS | NS |
| | Quayle dental | - | - | - | - | - | NS |
| | Akrileks | - | - | - | - | - | - |

**NS = Non significant difference (P>0.05)**

**S = Significant difference (P<0.05)**

**Section C (Posterior Palate) :**

Table (5) represents the mean values , standard deviation (SD) and standard error (SE) and Figure (7) shows the dimensional changes of the two packing methods for all acrylic types in relation to the posterior palatal section .

The results have shown that the highest mean values were obtained with the conventional Quayle dental (0.273 mm) and the lowest mean values were obtained with the new tension Ivoclar (0.226 mm) .

**Table (5) : Mean , standard deviation and standard errors for dimensional changes in sections (posterior palate) according to the conventional and new tension packing methods influenced by different type of acrylic .**

| Studied groups | | NO | Means (Mm) | Standard deviation | Standard error | ANOVA (F-test) P-value |
|---|---|---|---|---|---|---|
| Conventional | Ivoclar | 10 | 0.263 | 0.030 | 0.0096 | 0.00 Highly Sig. (P<0.01) |
| | Quayle dental | 10 | 0.273 | 0.024 | 0.0077 | |
| | Akrileks | 10 | 0.271 | 0.020 | 0.0063 | |
| New tension system | Ivolcar | 10 | 0.226 | 0.021 | 0.0066 | |
| | Quayle dental | 10 | 0.231 | 0.017 | 0.0055 | |
| | Akrileks | 10 | 0.228 | 0.025 | 0.0079 | |
| Total | | 60 | | | | |

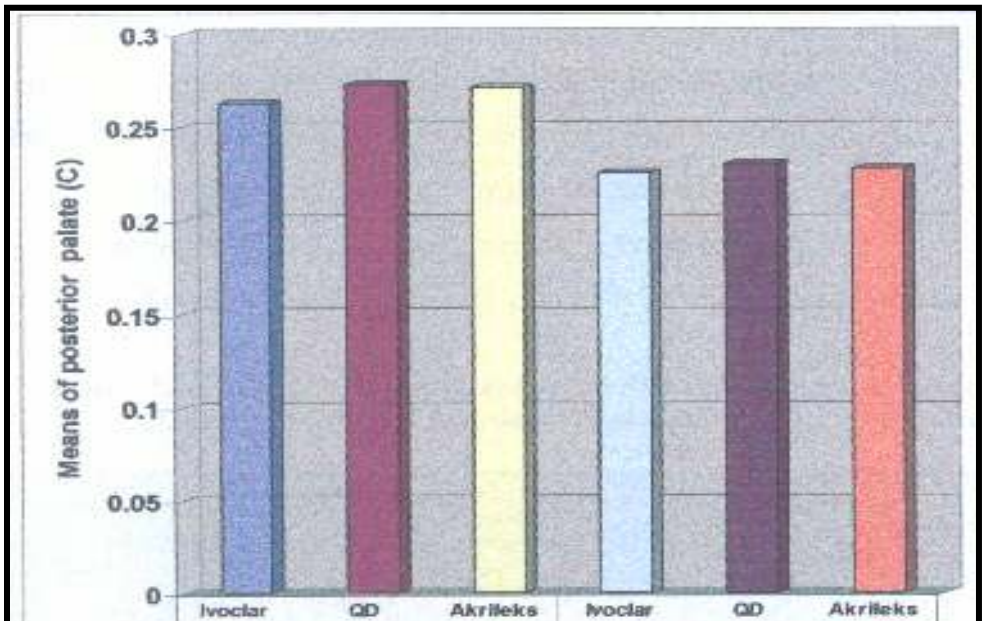

**Figure -7- : Bar chart of dimensional changes of posterior palate section**

In table (6) one way ANOVA LSD multiple comparison test between test groups in section C (Posterior Palate) are indicated , the results indicates a highly significant difference at ($P<0.01$) between all test groups except a non significant difference ($P>0.05$) between the conventional Ivoclar with the conventional Quayle dental , the conventional Ivoclar with the conventional Akrileks , the conventional Quayle dental with the conventional Akrileks , the new tension Ivoclar with the new tension Akrileks , the new tension Quayle dental with the new tension Akrileks and the new tension Ivoclar with the new tension Quayle dental .

**Table (6) : LSD test for the dimensional changes between test groups in section C (Posterior Palate) .**

| LSD (F-test) | | Conventional | | | New tension system | | |
|---|---|---|---|---|---|---|---|
| | | Ivoclar | Quayle dental | Akrileks | Ivoclar | Quayle dental | Akrileks |
| Conventional | Ivoclar | - | NS | NS | HS | HS | HS |
| | Quayle dental | - | - | NS | HS | HS | HS |
| | Akrileks | - | - | - | HS | HS | HS |
| New tension system | Ivoclar | - | - | - | - | NS | NS |
| | Quayle dental | - | - | - | - | - | NS |
| | Akrileks | - | - | - | - | - | - |

**NS = Non significant difference (P>0.05)**

**S = Significant difference (P<0.05)**

**HS = Highly significant difference (P<0.01)**

## DISCUSSION :

Effort trial to decrease the dimensional changes that occur during complete denture construction is continuous , so that the decrease in the magnitude of the gap between the base and the cast by using a new tension device is the main objective in this study , results showed that the base adaptation in all 3 measured sections were better .

Several variables may influence the amount of dimensional changes that occur in the denture base such as difference in base thickness between the marginal and central zones and the polymerization time .

In table (1) , (3) and (5) when a cut factor analyzed , the results showed that the discrepancy level was verified in section A and B with no statistical significant difference between the two packing methods conversely , the discrepancies promoted in section C were statistically significant between the two packing methods , this may be due to the tendency to promote discrepancy of different magnitude in relation to the base location which can be understood when one considers that section A is located in a restrictive topographic area resulting from cast anatomy which impedes resin expansion . The posterior palatal area is flatter and less restrictive and permits strain release , producing more evident distortion , so the distortion pattern demonstrated less discrepancy in cut A and more alteration in cut C whilest cut B had intermediary values , these results are in agreement with the result of (Wolfel et al. , 1965 ; Kawara et al. , 1998 ; Consani et al. , 2002) . [17,18,14]

Another explanation for the discrepancies recorded on the cast that taking place during denture base fabrication are not uniform and depend on it's location inside the flask , this agrees with the results of (Wolfaardt et al. , 1986) .[19]

An earlier study ( Chen et al. , 1988)[3] showed that discrepancy ranging from 0.23 to 0.58mm may not be easily corrected after base processing but in this study results with the new tension system were less than the range and this was also in agreement with the studies of (Firtell et al. , 1981 ; Polyzois , 1999 ; Consaniet et al. , 2002) .[20,21,14]

In table (2) , (4) and (6) when LSD was made with a multiple comparison between types of the commercial acrylic , the conventional technique have the same discrepancy in all of the 3 measured sections and can be considered non significant . The same conclusion appears for the new tension system , this means that the dimensional changes were not influenced by the type of commercial acrylic that have been used which is in agreement with the results of (Sanders et al. , 1991). [22]

This study showed that there was a statistically significant difference between the packing methods , with the best results for the new tension pocking method . The different commercial acrylic types did not influence the dimensional changes values of the denture base when the new tension system was used .

## CONCLUSION :

In both packing methods the worst adaptation was shown in the posterior palatal area , but the adaptation level in all 3 measured section was better when the new tension system was used .

The type of commercial acrylic did not influence the dimensional changes of the base , so the new system is better in adaptation level of all 3 types of commercial acrylics .

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