Effect of different palatal vault shapes and woven glass fiber reinforcement on dimensional stability of high impact acrylic denture base [part II]

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ABSTRACT

Background: Change in palatal vault shape and Reinforcement of high impact acrylic denture base resin may in turn affect the dimensional accuracy of acrylic resin and affecting the fitness of the denture. The aim of study is to evaluate the effect of fiber reinforcement for high-impact acrylic resin denture base with different palatal vault shapes on linear dimensional change and effect of palatal vault shapes on linear dimensional changes of non-reinforced and fiber reinforced high impact denture base acrylic resin

Material and method: Three different palatal vault shapes were prepared on standard casts using CNC (computer numerical control) machine. 60 samples of heat polymerized high impact acrylic resin maxillary denture base were fabricated onto each definitive cast according to manufacturer instruction. Samples divided into three main experimental groups represented the three different palatal vault shapes (20 samples for each main group); 1st rounded 2nd U-shaped and the 3rd groups V-shaped. Each main group divided into two subgroups (10 samples for each subgroup) representing non fiber reinforced high impact acrylic group as a control and the fiber reinforced high impact acrylic. The measurements of linear dimensional changes of denture bases done at two stages, 1st 24 hour after polymerization and 2nd measurement done after one month storage in distilled water at room temperature.

Results and conclusion: Linear dimensional changes of high impact acrylic denture base not affected by glass fiber reinforcement p-value in all reference lines ≥ 0.05, while topographical change in maxillary vault shapes effects on the linear dimensional changes in woven glass fiber reinforced high impact acrylic denture base p-value < 0.05.

Key words: High impact acrylic resin, topographical change in vault, woven glass fiber reinforcement. (J Bagh Coll Dentistry 2015; 27(1):92-95).

INTRODUCTION

Most fractures of maxillary dentures are caused by a combination of fatigue and impact which is reported more in case where maxillary denture base oppose the mandibular natural teeth. The fracture of denture bases when dropped is due to impact force and authors have suggested that repeated flexing from chewing ultimately fatigues the denture in the mouth, in most situations, fractures occur in the midline of the maxillary dentures [(1, 2)].

Considering only the strength though the incorporation of fillers like rubber and fibers to heat-cured poly methyl methacrylate resin improves the impact strength and fatigue resistance [(3)], improvement may in turn affect some of the properties of heat-cured poly methyl methacrylate resin such as dimensional accuracy, dimensional stability, water sorption, and affecting the fitness of the denture [(4)]. High-impact acrylic denture base is made by the heat-cured dough method; Impact resistance arises from the incorporation of rubber phase into the beads during their suspension polymerization [(5)], An alternative of the direct addition of elastomers is the use of acrylic/elastomer copolymers. These are, typically, methyl methacrylate-butadiene or methyl methacrylate-butadiene styrene copolymers which are now available in certain commercial products. [(6)] Dimensional changes caused by water uptake are influenced by the storage period and may compensate the polymerization shrinkage to a certain extent [(7)]. However, after 3 weeks of storage in water, no further significant dimensional changes were observed [(8)].

The aim of study is to evaluate the effect of fiber reinforcement for high-impact acrylic resin denture base with different palatal vault shapes on linear dimensional change and effect of palatal vault shapes on linear dimensional changes of non-reinforced and fiber reinforced high impact denture base acrylic resin.

MATERIALS AND METHODS

The study involves preparation of 60 samples of heat polymerized high impact acrylic resin maxillary denture base without artificial teeth onto definitive casts according to the recommendations of manufacturer, the samples divided into three main experimental groups represented the three different palatal vaults shapes (20 samples for each main group); 1st rounded, 2nd U-shaped and the 3rd groups V-shaped. Each main group divided into two subgroups (10 samples for each subgroup) representing the non-fiber reinforced high impact

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acrylic group (NF group) and the fiber reinforced high impact acrylic (WF group) (table 1). According to cross-arch forms three casts with

rounded palat vault	U-shape palatal vault	V-shape palatal vault
WFO 10	WFU 10	WFV 10
NFO 10	NFU 10	NFV 10

Table 1: Research methodology and grouping of the samples

According to anatomical land marks on the upper master cast four reference points (A, B, C, &D) were chosen and prepared using stainless steel round hand piece bur (018 size) (figure 1). Point (A) was marked in the center of incisive papillary region, points (B) and (C) were marked in the right and left anterior of maxillary tuberosity, and point (D) was marked in the fovea palatine area (Fig.2).

Denture base without reinforcement preparation

For denture base preparation in three different palatal vault shapes in non-fiber reinforced groups (NFO, NFU, and NFV) heat polymerized high impact acrylic powder and liquid was placed in clean, dry porcelain jar and mixed according to manufacturer instruction 10ml/21gm W/P ratio, mixing time 30 second until the monomer and polymer were thoroughly companied, the jar sealed and the mixture left for 5min at room temperature 22C° (±2) until reaching the dough stage. The resin removed from the jar, rolled and packed into the mold of each flask.

Denture bases with glass fiber reinforcement preparation

Reinforced high impact acrylic include groups WFO, WFU and WFV, woven type glass fibers were shaped to provide 2mm shorter border than

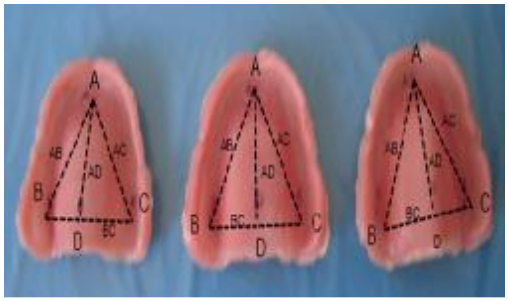

Fig. 2: Denture bases of high impact acrylic with four reference points

different palatal vault shapes were prepared by carving palatal vault of standard cast using CNC machine (Computer Numerical Control).

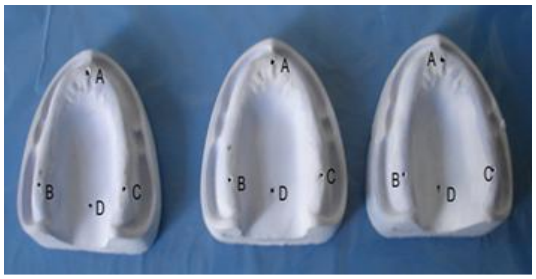

Fig. 1: Three maxillary casts with different palatal vault shapes each cast with four reference points (A, B, C, and D)

study recommended that woven glass fiber reinforcement should be placed on the tensile side of the specimens under loading resulted in considerably higher flexural strength and flexural modulus values [10]. As result, in clinical situations the fiber reinforcement in complete maxillary denture base should be close to the oral surface of the denture and perpendicular to the midline; so two layers of high impact acrylic resin precisely prepared to encase the woven glass fibers by using 2 and 3mm thickness record base. Finally for or all specimens (fiber reinforced and non-fiber reinforced high impact denture base) pressed in the hydraulic press under the load of 100 Bar for 5 min. the flasks then placed in clamp and immersed in water bath 70°C for 90 min then the temperature raised to100°C for 30 min according to manufacturer instruction. After curing the flask was left to cool on bench for three hours [11].

The samples detached from their corresponding casts and are kept in distilled water to be measured at two periods. The first measurement after one day (24h) then the second measurement done after one month storage in distilled water [12,13], and Measurement of linear dimensional change performed by measuring the distance between the reference points as follow AB, AC, AD, and BC (Fig. 2) using digital microscope at magnification 10X (Fig. 3).

Fig. 3: Measurement of linear dimensional changes using digital microscope

RESULTS

Mean difference between two measuring interval calculated (24hours and 30 days immersion in distilled water) for all lines**,** Standard deviation was examined for mean difference and subjected to statistical analysis (t-test, and ANOVA test). t-test for linear dimensional changes estimated between non-reinforced and reinforced high impact acrylic in Rounded, U-shaped, and V-shape maxillary vault shapes for four lines (table1). ANOVA test for linear dimensional changes affected by change in maxillary vault shape for all lines estimated between reference points in reinforced and non-reinforced high impact acrylic denture base. And when the difference was found to be statistically significant LSD test (least significant difference test) was used for examining differences between each 2 groups.

DISCUSSION

In the present study it was revealed that water storage of 30 days and fiber reinforcement have no significantly effect on the linear distance between references points marked on high impact acrylic resin bases in all experimental groups and this is agreed with others [14-16].

ANOVA test revealed highly significant difference in AC line, and significant difference in AD line, while no significant difference in both AB and BC lines (table 2). Consequently the difference in oral anatomy appear to have a significant effect to the size of the discrepancy level of fiber reinforced high impact acrylic denture base, and this is accepted with the study of Mehmet et al. [17]. It may be due to that distribution of linear dimensional changes of fiber reinforced high impact acrylic denture base affected by change in palatal vault shape and not equally distributed.

As conclusions

1. Linear dimensional changes of high impact acrylic denture bases stored for 30 days in distal water not affected by woven glass fiber reinforcement.
2. Topographical changes in maxillary vault shape not effect on linear dimensional change of high impact acrylic denture base.
3. Topographical changes in maxillary vault shape effect on linear dimensional changes of woven glass fiber reinforcement of high impact acrylic denture base.

Table 2: Linear dimensional changes in different palatal vault shapes between non-reinforced and fiber reinforced high impact acrylic denture base

Studied groups		No-fiber			With fiber			t-test		
		No.	Mean difference (mm)	±SD	No.	Mean difference (mm)	±SD	t	p-value	Sig.
O-Shape	AB	10	0.1	0.03	10	0.11	0.03	0.71	0.49	Non sig.
	AC	10	0.1	0.04	10	0.13	0.04	1.53	0.14	Non sig.
	AD	10	0.13	0.04	10	0.12	0.04	0.32	0.75	Non sig.
	BC	10	0.12	0.02	10	0.13	0.02	1.42	0.17	Non sig.
U-Shape	AB	10	0.09	0.01	10	0.12	0.05	0.78	0.578	Non sig.
	AC	10	0.21	0.01	10	0.18	0.04	0.77	0.452	Non sig.
	AD	10	0.13	0.03	10	0.15	0.02	0.73	0.475	Non sig.
	BC	10	0.12	0.02	10	0.13	0.02	0.58	0.388	Non sig.
V-Shape	AB	10	0.13	0.06	10	0.13	0.03	0.75	0.94	Non sig.
	AC	10	0.29	0.03	10	0.25	0.04	0.38	0.7	Non sig.
	AD	10	0.14	0.04	10	0.19	0.04	1.73	0.09	Non sig.
	BC	10	0.21	0.03	10	0.13	0.02	0.8	0.43	Non sig.

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Table 3: Linear changes for all lines in three different palatal vaults shapes (Rounded, U-shaped and V-shaped) in non-reinforced and reinforced high impact acrylic denture base

Studied groups		ANOVA							
		No fiber				With fiber			
		No.	Mean Difference (mm)	F-test	p-value	No.	Mean Difference (mm)	F-test	p-value
AB	O-Shape	10	0.1	1.13	0.34 Non sig. (p≥0.05)	10	0.11	0.25	0.78 Non sig (p≥0.05)
	U-Shape	10	0.1			10	0.12		
	V-Shape	10	0.13			10	0.13		
AC	O-Shape	10	0.01	2.62	0.09 Non sig (p≥0.05)	10	0.13	10.7	0.000 Highly sig. (p<0.01)
	U-Shape	10	0.21			10	0.18		
	V-Shape	10	0.29			10	0.25		
AD	O-Shape	10	0.13	0.4	0.67 Non sig (p≥0.05)	10	0.12	3.86	0.03 Sig (p<0.05)
	U-Shape	10	0.13			10	0.15		
	V-Shape	10	0.14			10	0.19		
BC	O-Shape	10	0.11	0.39	0.39 Non sig (p≥0.05)	10	0.13	0.01	0.89 Non sig. (p≥0.05)
	U-Shape	10	0.12			10	0.13		
	V-Shape	10	0.21			10	0.13		

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الخلاصه

المقدمه:دعم الاكلريلك عالي الصدمات المستخدم في قاعده الطقم ممكن ان يؤثر على الاستقرار البعدي للراتنج الاكليريك ويؤثر بالتالي على ثبوتيه الطقم

الهدف من الدراسه: هو بحث تاثير الياف االزجاج الداعمه وتاثير تغيير شكل القحف على الاستقرار البعدي للطقم العلوي المصنوع من راتنج الاكليريك عالي الصدمات

المواد والطرق المستعمله:تم تحضيرثلاثه اشكال من القحف للفك العلوي باستعمال جهاز النحتبالكومبيوتر الرقمي, ثم يستنسخ القالب الحجري باستعمال ماده السليكون الخاص للحصول على 60قالب صخري.60 عينه قاعده طقم علوي من ماده الاكليريك عالي الصدمات تحضر لكل قالب صخري حسب تعليمات المنشاء . تقيس التغير بالبعد الطولياو الخطي . تقسم العينات الى ثلاث مجموعات رئيسيه حسب شكل القحف وهي الدائري ,وشكل حرف- Vوحرف-U, ولكل مجموعه 20 عينه, ثم كل مجموعه رئيسيه تقسم لمجموعتين فرعيتين(10 عينات لكل مجموعه فرعيه): مجموعه فرعيهالاولى تستخدم الاكريلك عالي الصدمات غير المدعم والمجموعه الفرعيه الثانيه تستخدم الاكلريلك عالي الصدمات المدعم بالالياف الزجاجيه. كل القياسات للبعد الطولي تقاس لمرحلتين :المرحله الاولى بعد 24 ساعه من الطبخ والمرحله الثانيه للقياس تتم بعد 30 يوم من حفظ العينات بالماء المقطر بدرجه حراره الغرفه.

النتائج:الابعاد الخطيه في الاكريلك عالي الصدمات لاتتأثر بالدعم من الالياف الزجاجيه, وتغيير شكل القحف لايؤثر بالابعاد الخطيه ايضا. بالاضافه تغيير شكل القحف لايؤثر على الراتنج الاكريلك عالي الصدمات المدعم بالالياف الزجاجيه

الاستنتاج: تغيير بالابعاد الخطيه لايتاثرباستعمال الياف الزجاج الداعم, لكن تغيير شكل القحف يؤثر على الابعاد الخطيه في الاكلريلك علي الصدمات المدعم بالياف الزجاج.