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COMPARATIVE STUDY OF SOME PROPERTIES OF FLEXIBLE AND CONVENTIONAL HEAT CURED ACRYLIC RESIN DENTURE BASE MATERIAL

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ABSTRACT

Objective:The aim of this in vitro study was to compare some properties of polyamide(nylon) flexible and conventional heat cured acrylic resin denture base material. **Material and Methods:** 80 specimens were prepared according to the specific dimension for each test and allocated to two groups. Group (A) 40 specimens of conventional acrylic resin. Group (B) 40 specimens of polyamide denture base material. **Results:** Surface roughness and water sorption were tested for both groups. The data was collected and statistically analyzed. Conventional group showed significant higher roughness than polyamide group. Polyamide group showed non significant higher water sorption than conventional group. **Conclusion:** Polyamide denture base could be used as alternative material for conventional heat cured acrylic resin.

INTRODUCTION

Polymethyl methacrylate (PMMA) has been the most popular material used for denture fabrication since its introduction in 1937 [(1)].

It has several advantages such as an excellent esthetic characteristic, low water sorption and solubility, adequate strength, low toxicity, easy repair, and a simple molding processing technique, but it has some problems such as polymerization shrinkage, weak flexural, lower impact strength, and low fatigue resistance [(2)].

These often lead to denture failure during chewing or when fall out of the patient's hand. In order to enhance some properties of PMMA, various efforts have been taken including addition of metal wires or plates, fibers [(3)] and metal inserts [(4)].

Because of its good biocompatibility, reliability, dimensional stability, absence of taste, odor, tissue irritation and toxicity, [(5)] teeth adhesion, [(6)] insolubility in body fluids, relative ease of manipulation, good aesthetic appearance [(1)], and color stability[(7)], PMMA based materials are widely used as biomaterials.

Polyamide:

These polyamides are produced by the condensation reactions between a di amine NH2-(CH2)6-NH2 and a dibasic acid, CO2H-(CH2)4-COOH. [(8)]

It is reported that this material has several problems such as water sorption, surface roughness, bacterial contamination, warpage, color deterioration, and difficulty in polishing [(9)].

Processing the denture base materials produced unequal deformation in different dimensions .The magnitude of this dimensional change depends on the conditions of moulding, shape of the mould, and direction in which it is measured. [(10)]

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Flexibility can be advantageous in conditions when the buccal undercut on the maxillary tuberosity are present together with reduced width of the buccal vestibule [11]. Patient with systemic sclerosis and those who suffers from scarring in the oral and facial areas due to disease, trauma, or burning injuries, it is determined that long term comfort and function could be achieved only through the use of a flexible removable partial denture. [12].

MATERIAL AND METHOD

Two different denture base materials were used for this study:

(1) Polyamide (nylon) flexible denture base.

(2) Heat cured acrylic denture base.

Eighty samples; (n= 40 \ group) were prepared for each group.

Samples were distributed according to the type of test

Sample preparation:

Water sorption samples were fabricated of wax pattern with dimensions 20 mm diameter x 1 mm thickness and roughness samples were fabricated of wax pattern with dimension 20 mm diameter x 3 mm thickness. Investment of wax pattern in mold, wax elimination, mixing of polymer and monomer, packing of heat cured acrylic resin, injection of heat cured acrylic resin samples finally finishing and polishing of the samples [6].

Roughness measurement methodology

Specimens were photographed using USB Digital microscope with a built-in camera, connected with an IBM compatible personal computer using a fixed magnification of 120X at baseline, one week, two weeks and one month as they stored in different ph. The images were recorded with a resolution of 1280 × 1024 pixels per image. Digital microscope images were cropped to 350 x 400 pixels using Microsoft office picture manager to specify/standardize area of roughness measurement. The cropped images were analyzed using Wax software[13].

Water sorption measurement methodology:

After samples preparation, finishing and polishing. The samples were transferred into a glass desiccator containing dehydrated silica gel (Fischer Scientific, Leicester, UK) maintained at 37 ° C ± 1°C and stored for 1 h, then they were maintained for another hour at 23±1°C. The specimens were then weighed using an electronic balance with four digits precision. This cycle was repeated until constant weight was achieved i.e. dry weight or original weight. Then, each specimen was immersed in distilled water at 37°C ± 1°C in separate containers.

Water sorption was assessed by weight changes, which were measured in the following manner: after one day, one week, two weeks and one month. Water sorption was reported in weight percent (%). Wet weight was determined by the procedures described in the ADA specification number 27 for resin-based filling materials. Specimens were removed from water, blot-dried using filter paper and waved in air for 15 s to remove any apparent moisture. The final weight was taken 1 min from the time of removal from water. The water sorption percentage was computed as follows [14].

$$\text{Water sorption \%} = \frac{\text{weight gained x original weight}}{\text{original weight}} \text{ X } 100$$

RESULT

Total effect of denture base material on roughness

Regardless to different pH solutions or storage time, totally it was noted that conventional group recorded statistically significant higher roughness mean ±SD values (0.259301±0.001 Ra) than flexible group mean ±SD values (0.258601±0.0006Ra) as indicated by three-way ANOVA test followed by pair-wise Tukey's post-hoc tests ($p<0.05$) as shown in table (1) and figure (1).

Water sorption:

Water sorption (%) results recorded for both flexible and conventional groups as function of time are summarized in table (2) and graphically represented in figure (2).

Flexible vs. conventional; it was noted that difference between flexible and conventional groups was statistically significant at all storage time except after one day storage where the difference was non-significant as indicated by t-test, table (2) and figure (2).

TABLE (1) Comparison between total roughness results (Mean values ± SDs) as function of denture base material.

Variable		*Mean ± SD*	*Tukey's rank*	*Statistics*
Denture base material	***Flexible***	0.258601±0.0006	B	***P value***
	Conventional	0.259301±0.001	A	0.0464*

Different letter in the same column indicating statistically significant difference (p< 0.05)

**; significant (p< 0.05) ns; non-significant (p>0.05)*

TABLE (2) Water sorption results (Mean ±SD) for flexible and conventional groups as function of time.

Variables	***Storage time***				***Statistics***
	One day	***One week***	***Two weeks***	***One month***	***P value***
Flexible	3.690895±0.8	1.268216±0.1	3.067072±0.05	4.053045±0.09	<0.0001*
Conventional	3.738708±0.9	3.201324±0.8	0.959695±0.16	1.312533±0.2	0.0001*
P value	0.9466 ns	0.004*	<0.0001*	<0.0001*	

**; significant (p<0.05) ns; non-significant (p>0.05)*

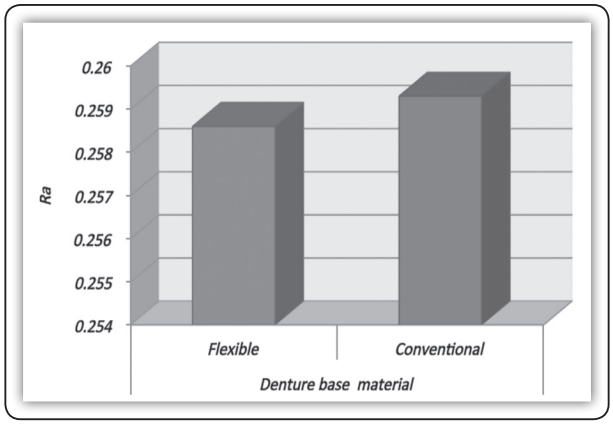

Fig. (1) A column chart of total roughness mean values as function of denture base material.

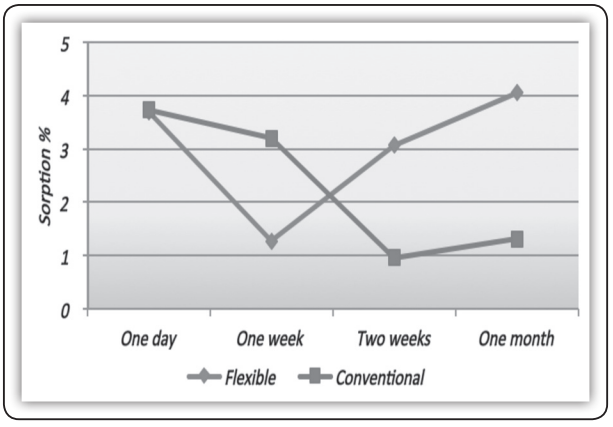

Fig. (2) Linear chart showing water sorption % mean values for flexible and conventional groups as function of time.

DISCUSSION

Roughness

Regarding to material it was noted that conventional group recorded statistically significant higher roughness than flexible group.

These results may be attributed to human factor (skills of technician, level of attention) or due to properties of the material. Also these results may be attributed to injection molding system using cartridge which eliminate dosage errors, ensuring long term stability of the shape, reduced contraction, as well as mechanical resistance with aging or it may be due to the recent modification in polyamide which improve the physical properties.

These results come in agreement with Mekkawy et al who compared surface roughness of polyamide, thermoplastic polymethyl methacrylate and acetal resin flexible denture base material and found that the least rough material was polyamide Breflex [15].

Water sorption

Regarding to material flexible group showed non-significant higher values of water sorption than conventional heat cure and this may be attributed to Polyamide-group denture base resins are subjected to water sorption between molecular chains due to the hydrophilicity of the many amide bonds that form the main chains of the resins, resulting in high water sorption rates [16].

These results come in agreement with Dae-Eun Jang et al [16] who studied Color stability, water sorption and cytotoxicity of thermoplastic acrylic resin for non-metal clasp denture and concluded that all types of denture base resin showed water sorption after 1 and 8 weeks immersion in coffee and green tea, with no significant difference between denture base resins.

CONCLUSION

The study was concluded that there is statistically non significant difference between surface roughness and water sorption of polyamide denture base material when compared with the same properties of conventional heat cured acrylic resin. So that polyamide can be used as alternative material to conventional heat cured acrylic resin.

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