

## EVALUATION THE RETENTION OF UPPER COMPLETE DENTURE WITH DIFFERENT ACRYLIC DENTURE BASE MATERIALS

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### **ABSTRACT**

**Objective:** to evaluate the retention of thermoplastic upper complete denture versus heat cured upper complete denture

**Abstract:** Successful denture is affected by altered biomechanical phenomenon of support, stability and retention. Polymethyl-methacrylate (PMMA) has been used to construct the dentures for ages. Some problems were described with these prosthesis that lead to fracture and allergy to methyl methacrylate monomer. The introduction of the nylon-derived denture base materials in 1950s smooth the way for a new type of dentures. It was found that soft dentures are excellent alternate to traditional hard-fitted dentures. Several advantages to flexible dentures over the traditional rigid denture bases were noted like translucency of the material that picks up the underlying tissue tones.

**Material and methods:** Fourteen completely edentulous patients were randomly divided into two groups. Group I received thermoplastic upper complete denture. Group II received heat cured upper complete denture. a readymade metallic bar was attached to the contact area between upper second premolar and upper first molar bilateral using self-cure acrylic resin, its center coincide with the geometrical center of the denture. Retention was measured using digital force gauge Retention force was measured as the maximum force needed to completely dislodge the maxillary denture. This step was repeated three times, three readings were taken and the average was recorded for each patient in both groups. The measurements were taken after 1 week of denture insertion and repeated 1, 3, 6 months after denture delivery.

**Results:** group I showed a little increase in denture retention than group II at the time of denture insertion, 1 and 3 months after but after 6 months it showed marked decrease in the denture retention. On the other hand the group II showed increase in the denture retention at time of denture insertion, 1 and 3 months after with slight decrease after 6 months.

**Conclusion:** The use of thermoplastic and heat cured acrylic resin has no significant difference regarding the denture retention. The time intervals for denture retention showed increase in denture retention regarding the time factors .

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## INTRODUCTION

Edentulism is defined as loss of all permanent teeth. Complete dentures are a favorite treatment option for edentulous patients. Patients accept complete dentures as they provide a pleasing appearance, sustain normal speech, as well as support and adequate means for mastication of food. <sup>(1)</sup>

Deficiency of ideal denture supporting ridges with adequate bone height, flat crest, parallel or nearly parallel sides covered by firmly attached fibrous mucoperiosteum leads the need of pre-prosthetic surgical techniques. <sup>(2,3)</sup> severe resorption of the alveolar ridges makes it awkward for patients to wear conventional dentures due to the lack of retention and the instability of the denture. <sup>(4)</sup>

Denture retention is defined as Resistance of a denture to vertical movement away from the tissues and that quality is characteristic in the prosthesis acting to resist the dislodgment forces along the path of insertion. <sup>(5,6)</sup> Retention is considered as a property of the denture rather than of the patient. <sup>(7)</sup>

To achieve retention in complete denture desires first accurate fit of the denture base to the mucosa, second border seal which is done by extending the denture flanges to fill the sulci. <sup>(7)</sup>

There are several factors affecting retention of complete denture: Physical, physiological, anatomical, psychological <sup>(8)</sup>

Denture base is the part of a denture that rests on the foundation tissues and to which teeth are attached. <sup>(9)</sup>

Denture base material should have numerous properties like biocompatibility, good esthetics, radiopacity, high bond strength with denture teeth, ease of repair also must be strong enough to withstand functional and para functional masticatory forces. <sup>(10)</sup>

There are different acrylic denture base materials:

**Acrylic resin poly methyl methacrylate (PMMA)** was found to have a satisfactory combination of properties that accounts for its acceptance of use. Acrylic resins are synthetically obtained materials that can be molded, packed, or injected into molds which turn into solid by chemical reaction (polymerization). They may be heat cured, chemically cured or light cured. <sup>(11)</sup>

Advantages of PMMA include excellent esthetics, comparative lack of toxicity, ability to repair and simple processing techniques. <sup>(12)</sup>

Although all those advantages but the material does not fulfill the ideal requirements of the prosthesis. It has several drawbacks as low thermal conductivity, poor wear resistance, volumetric changes and low modules of elasticity which needs great bulk to produce adequate strength. <sup>(13)</sup>

Continuous efforts were made to raise the material strength to overcome the problem of denture fracture by reinforcement of denture materials. <sup>(14)</sup>

Polymerization of acrylic resins can be accomplished by many activation methods as chemical, visible light, heating activation using hot water or microwave energy. <sup>(15)</sup>

**Heat cured acrylic resin** was the most accessible denture base material for clinics during the past half century. It has excellent esthetic property, sufficient strength, free from toxicity, can be easily repaired, preserve indefinitely the details and can be used with a simple molding and processing technique for construction of denture bases. <sup>(16)</sup>

**Thermoplastic resins** have been used in dentistry for over 50 years. They have occupied place for making complete and partial dentures to overcome much of limitations found in the conventional resins. They presented better denture adaptation as well as denture retention because of their light weight and engaging more undercuts. <sup>(17)</sup>

They have high heat resistance, high strength, abrasion resistance. <sup>(18,19)</sup> In addition they provide

excellent esthetics with tooth and tissue colored materials, exceptional wear features and very comfortable for the patients. They are nonporous so no growth of bacteria, unbreakable, flexible with fracture resistance. They are more safe than the conventional resins because of very little or no monomer contented.<sup>(20)</sup>

#### **Thermoplastic resins can be classified into:**

**Thermoplastic acetal:** is very strong therefore used for pre-formed clasps for partial dentures, partial denture frameworks and occlusal splints.<sup>(21)</sup>, **Thermoplastic polycarbonate:** is also very strong similar to Acetal resin but is not appropriate for partial denture frameworks. It is more suitable for crowns and bridges.<sup>(22)</sup> **Thermoplastic nylon:** was used for restricted conditions due to some problems as tendency of the base color to weaken, stain, high water sorption and development of surface roughness after few weeks<sup>(23)</sup>, **Thermoplastic acrylic** is easy to adjust, handle and polish, repairable at the chair side and accessible in both tooth and gingival colors providing excellent esthetics with fracture resistance.<sup>(24)</sup> The material was established for making full dentures. It does not behave elastic but being a little elastic. It is practically unbreakable, it can be polished simply.<sup>(25)</sup>

There are various devices to evaluate the retention of removable prosthesis and to measure the force required to dislodge the prosthesis. Retention of removable prosthesis can be studied either in vitro or in vivo.<sup>(26,27,28)</sup> Strain gauge force transducer, Digital spring weighing machine, Specially designed testing device, Tensile tester and Digital force tester

#### **MATERIAL AND METHOD**

Fourteen completely edentulous patients were selected with age range 45 to 60, free from systemic diseases which can affect denture retention, have healthy mucoperiosteum without any signs of inflammation, patients free from any temporomandibular joint disorders.

For each patient primary impressions using alginate impression material\* of the upper and lower arches were made with properly modified suitable sized stock tray, impressions were poured with dental stone material \*\* to have dental casts upon which special trays were constructed using self-cure acrylic resin.\*\*\* Border molding was made using green stick compound \*\*\*\* then secondary impressions were made with zinc oxide and eugenol impression material.\*\*\*\*\*

The impression was boxed by applying a layer of sticky wax around the impression 3mm below the periphery, then beading wax was applied and sealed to the sticky wax on the impression to form the land. A sheet of pink boxing wax \*\*\*\*\* was wrapped around the beading wax to form a container. ALL joints were sealed with hot wax then dental stone was mixed and poured into the maxillary impression over the vibrator to obtain the master cast.

Occlusion blocks were constructed from self-cure acrylic trial denture base and wax rim. Upper occlusion rim was tried in the patients' mouth and checked for proper extension, retention and stability, then proper incisal and occlusal plane location and orientation were established, where the anterior occlusal plane was parallel to inter pupillary line and posterior occlusal plane was parallel to ala tragus

\* Cavex alginate, Cavex, Holland.

\*\* Lab Stone, Miles dental Product, Inc, South Blend, USA.

\*\*\* Auto polymerizing acrylic resin, Acrostone, Egypt.

\*\*\*\* Hiflex thermoplastic impression green Sticks, Prevesr Denpro, India.

\*\*\*\*\* Zinc oxide Eugenol, cavex, Holland Bv.

\*\*\*\*\* Base plate Modeling Wax, Cavex, Holland Bv.

line. Vertical dimension of occlusion (V.D.O.) was established and upper cast was mounted using face bow transfer. \*

Lower cast was mounted after recording centric occluding relation (C.O.R.). Centric jaw relation using wax wafer method was recorded.

The casts were mounted on semi-adjustable articulator. \*\* Setting up of suitable size artificial cuspid cross linked acrylic teeth \*\*\* was done following the lingualized concept of occlusion. The waxed up dentures were then tried on patient's mouth.

After try in stage patients were randomly divided into two groups (seven in each group)

**Group I:** patients in this group received thermoplastic \*\*\*\* upper complete denture.

**Group II:** patients in this group received heat cured \*\*\*\*\* upper complete denture.

The maxillary try in dentures for group II and mandibular try in dentures for both groups were processed in to heat cured acrylic resin which was carried out according to the conventional method.

The maxillary casts of group I were invested in a special flask which consists of two indexed halves and a round hole through which the injectable material was thermo-pressed.

Expansion stone \*\*\*\*\* was used as an investing material, after painting the flask with a separating medium. \*\*\*\*\* This stone was mixed and poured into the lower half of the flask then the cast was

pushed into the stone with its back edge facing the flask hole.

After setting of stone, a rod shaped was sprue was attached to the waxed up trial denture.

The stone in the lower half of the flask was painted with separating medium followed by pouring the stone in the upper half of the flask. The two halves were merged and the flask was closed and placed for wax elimination in boiling water. Base plate and modeling wax were removed after opening the flask and the mould was rinsed with clean boiling water.

The flask was dried and all surfaces except the teeth were treated with a separating medium \*\*\*\*\* suitable for injection technique.

Thermoplastic material (Breflex) in granular form "packed in metallic cartridges" was used for the construction of the final denture base.

Breflex was processed in the specially designed injection moulding machine \*\*\*\*\* (Thermopress 400). In which the preheated plastic (resin) material (Breflex) was injected into the hollow mould of the maxillary denture under very high pressure.

The flask was placed in the injection machine, and both the flask and the cartridges were heated up.

The material in the cartridge was injected automatically after preheating time (15 minutes) has elapsed at 280 °.

The molten resin was injected under pressure of 6 Bar into the preheated mold until it was filled for 1 minute. The pressure was automatically kept for another 1 minute.

\* Denatus facebow. Type AFB. Jakobsal. Svagen 14-16. S12653, Hagersten. Sweden.

\*\* Denatus articulator Type ARH Jakobsal. Svagen 4-16. S12653, Hagersten. Sweden.

\*\*\* Acrostone plas cross linked acrylic teeth, Egypt.

\*\*\*\* Bredent, senden/ wit zighausen, Germany.

\*\*\*\*\* Heat cure acrylic Resin, Acrostone dental, Egypt.

\*\*\*\*\* Expondo- rock (Ret 570 oeros).

\*\*\*\*\* Acrostone Seporting medium, England.

\*\*\*\*\* Bredent GmbH & co. Kg- Senden- Germany.

\*\*\*\*\* Bredent GmbH & co. Kg- senden- Germany.

After the flask was removed from the injection machine, the flask was left to bench cooling for at least 30 minutes.

Laboratory remount was carried out before finishing and polishing of dentures.

Special tools were used for finishing and polishing maxillary thermoplastic dentures.

The finished and polished thermoplastic maxillary and conventional mandibular dentures were checked in the patient's mouth to make clinical remount and perform the needed occlusal adjustments.

#### Patient's instructions:

All patients were instructed to come back for checkup after one week of denture insertion or if there was any complaint or any denture adjustment were needed before starting patient evaluation.

#### Method of evaluation:

For all patients a week after denture insertion, a readymade metallic bar was attached to the contact area between upper second premolar and upper first molar bilateral using self-cure acrylic resin, its center coincide with the geometrical center of the denture.

The geometrical center of the maxillary denture was determined by drawing intersection of two lines the first one (midline) extended between the incisive papilla anteriorly and fovea palatine posteriorly and the second line horizontally extended between the contact of second premolar and the first molar bilaterally.

Retention was measured using digital force gauge\* fig 1. The device was prepared first, the unit of measurement was chosen to be in Newton and the peak hold option was selected.



Fig. (1) Digital force gauge

The desired adaptor tension hook was attached to the sensing head. The display before each measurement was adjusted to be zero via the zero button.

The tested denture was rinsed thoroughly with water prior to its insertion. The patient was asked to rinse his mouth with water too.

The maxillary denture was inserted in the patient's mouth and allowed to remain for settling time of 5 minutes before the notch of the metallic bar was engaged. The tip of the metal rod of the guage was painted with pressure indicating paste.

The patient was seated upright in the dental chair with his mouth open and the lips relaxed, the palate and the maxillary ridge were nearly 45° to the horizontal plane and the mandible nearly parallel to the floor. The dislodging force was applied to the denture and increased gradually till the denture was dislodged.

Retention force was measured as the maximum force needed to completely dislodge the maxillary

\* HF- 50 Digital push pull Gauge Force Gauge HF- 50N.

denture. This step was repeated three times, three readings were taken and the average was recorded for each patient in both groups.

The bar was removed at the end of the visit and the denture was given to the patient.

The same measuring procedures were repeated 1, 3, 6 months after denture delivery.

Data collected was tabulated and statistically analyzed.

## RESULTS

All patients attended till the end of the follow up period. Patients in group I received complete thermoplastic denture and those in group II received complete heat cured denture.

### Statistical analysis:

Numerical data were tested for normality by checking the data distribution, calculating the mean.

Numerical data were presented by mean and standard deviation (SD).

**Independent t test** was used for comparison between groups and **anova** for repeated measures was used for comparison between follow up periods.

### Effect of time in retention on both groups

The effect of time on the follow up of denture retention within group I and group II is shown in the table

	1 week		1 month		3 months		6 months		P-value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Group I	34.4	5.8	37.8	4.21	42.21	4.47	25.82	3.51	0.004
Group II	32.4	4.9	36.6	4.10	40.7	5.03	40.2	4.83	0.015

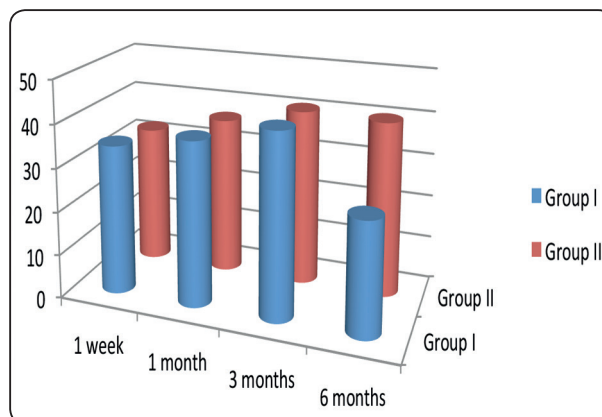


Fig. (2) Bar charts showing the effect of time on the follow up of denture retention within group I and group II.

## DISCUSSION

In this study it was found that group I showed a little increase in denture retention than group II at the time of denture insertion, 1 and 3 months after but after 6 months it showed obvious decrease in the denture retention.

On the other hand the group II showed increase in the denture retention at time of denture insertion, 1 and 3 months after with slight decrease after 6 months.

This increase in both groups accentuates the neuromuscular coordination, physical factors and effectiveness of posterior palatal seal. (29,30) Moreover, results showed that the denture retention increased by time of the follow up this could be clarified by the fact of the presence of additional means of retention in group I where the flexibility of the thermoplastic material that uses undercuts for retention. (12)

Denture retention decreased in the period from the third month to the sixth month group I this could be clarified by the fact that the flexural strength of the thermoplastic material declines by time as during mastication, oral cavity gets in contact with food of altered temperatures. (31)

The temperature may have an influence on the denture base as when chewing hot food and

drinking of cold fluids, the mechanical properties of the thermoplastic denture base may be affected by this variation in the temperature which results in reducing the denture retention by time due to leaking out of plasticizers. <sup>(32)</sup>

## CONCLUSION

The use of thermoplastic and heat cured acrylic resin has no significant difference regarding the denture retention.

The time intervals for denture retention showed increase in denture retention regarding the time factors.

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