Evaluation of difference in the dimensional change between PMMA versus two flexible denture base materials

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Submitted by

Danah Elsayed Abdelrahman

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Faculty of Dentistry

Mansoura University

Faculty of Dentistry
Ain Shams University

Supervisors

Prof. Dr. Hany Ibrahim Eid

Professor of Oral and Maxillofacial

Prosthodontics

Faculty of Dentistry

Ain-Shams University

Dr. Hebatallah Tarek M. Abdallah

Lecturer in Oral and Maxillofacial

Prosthodontics

Faculty of Dentistry

Ain Shams University

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Introduction

Significant number of patients throughout the world seeks treatment for edentulism. The trend toward tissue-integrated prosthesis has been a monumental step in restoring edentulous patients to function; however, this treatment can be out of reach for those who fail to qualify or those who do not have sufficient resources to afford it. In these cases, conventional dentures remain an important primary course of treatment. [1]

In late 1937s polymethyl methacrylate (PMMA) was introduced and became the major polymer to be used. It can be either heat, light or chemically activated based on the type of the activator used. [2]

Heat activated (heat cured) PMMA requires energy which most commonly provided in the form of a water bath, or less frequently, microwave oven and with the right polymer/monomer mixture, it's been noticed that polymerization shrinkage of approximately 7% has occurred (0.5% linear shrinkage) [3]

So, PMMA is far from a perfect denture base material. Due to the volumetric shrinkage during polymerization which leads to dimensional changes in the denture base produced from the primary wax pattern and more distortion and inaccuracies are introduced due to the high coefficient of thermal expansion exhibited by PMMA (approximately 80 ×10-6/oC) [3].

Since PMMA was introduced, most dental material research has focused upon creating materials with higher strength, lower levels of residual methacrylate monomer after processing, and better dimensional stability. The creation of the thermoplastic denture base materials in the 1950s opened the way for new type of dentures. Flexible dentures are currently a great alternative to conventionally used methyl methacrylate dentures . [(4)]

The main difference in composition of thermoplastic materials from the PMMA is the crystallinity which gives the thermoplastics the advantages of lack of solubility in solvents, high heat resistance, dimensional stability and high strength coupled with ductility. But since thermoplastics are insoluble in almost all common solvents it cannot be dough molded by conventional dental techniques. The technology of processing thermoplastics is based on the thermal plasticization of the material, without undergoing chemical reaction. Injection molding technology is not widely used in dental technique labs yet, but it has opened new perspectives in the technology of complete and partial removable dentures. [(5), (6)]

The use of thermoplastic resins in dental field is still growing, and different types of these materials are now available to fabricate denture bases, each claiming to produce more accurate denture base. So it is important to assess whether these claims are true and whether there is a substantial advantage between these denture base materials regarding the dimensional changes of denture at different stages of fabrication.[(7)]

Review of literature

Denture base function and requirements:

The Glossary of prosthodontic Terms defines a complete denture as a removable dental prosthesis that replaces the entire dentition and related structures of the maxilla or the mandible. Such prosthesis is composed of artificial teeth attached to a denture base. Consecutively, the denture base derives its support through contact with the underlying oral tissues, teeth, or implants. [8]

In order for the denture base to be successful, it must be made of materials which are acceptable for use by the dental technician, the dental surgeon and most importantly, the patient. To fulfil these requirements, the material must have the proper biological, chemical, mechanical, thermal and esthetic qualities.[9]

Biologically, it should be non toxic, non irritant and non carcinogenic. Chemically, it should be insoluble in the oral fluids or any other fluids being taken by the patient, as it shouldn’t absorb any oral fluids to avoid the dimensional change. Also it should adhere very well with the artificial teeth and liners. [10]

Mechanically, the modulus of elasticity should be high, to enable the denture base to be rigid against the masticatory forces. Resiliency should also be high to protect the underlying soft tissue by absorbing the masticatory forces. The elastic and proportional limits better be high to prevent permanent deformation under stress. The impact and fatigue strength are so important to resist the fracture under sudden load or repeated forces. Dimensional stability is very important plus having high abrasion resistance and low specific gravity (especially for maxillary dentures) [10]

As for thermal property, denture base should be a good thermal conductor, softening temperature should be more than the boiling temperature of water and the co-efficient of thermal expansion should match with that of the artificial teeth. On esthetic side which is a high demand nowadays, exhibiting translucency that match the appearance of the oral tissue is required, plus the denture base should be capable to be tinted or pigmented. [11]

I. Denture base materials:

1. Metallic denture base:

Several materials were used for metal denture bases. They have been evaluated for their retentive properties by Defurio and Gehl.[12] Cobalt-chromium was found to be most retentive, followed by aluminum and gold. Cobalt-chromium was most often used because the cost is reasonable and the technique is commonly used in most dental laboratories. Aluminum has the advantage of being less dense and therefore lighter. However, the construction techniques are less available and aluminum toxicity may be a contributor to, or a cause of, Alzheimer's disease. Gold