COMPARISON OF HARDNESS OF CONVENTIONAL HEAT POLYMERIZED DENTURE BASE RESIN WITH ADDITION OF ALUMINIUM OXIDE FILLER

Dr. SARITHA. M. K¹ & Dr. DEEPA. K²

¹Assistant Professor, Department of Dentistry, Chettinad Hospital and Research Institute,
Kelambakkam, Tamil Nadu, India

²Lecturer, Department of Prosthodontics, Chettinad Dental College and Research Institute,
Kelambakkam, Tamil Nadu, India

ABSTRACT

PURPOSE

“The aim of the present study was to compare hardness of heat polymerized denture base resin with addition of 15% aluminium oxide filler”.

MATERIALS AND METHODS

“A total of 30 specimens were prepared and divided in two groups. 15 samples were processed by conventional heat polymerized denture base resin. Another 15 samples were processed with modified heat polymerized denture base resin with addition of aluminium oxide filler. Hardness testing was conducted using a Vickers hardness tester. Data were analyzed using the independent sample t-test and differences were statistically significant at the 0.05 level”.

RESULTS

“The Vickers hardness numbers (VHN) was 21.8 ± 2.39 for control group and 22.18 ± 1.42 for modified heat polymerized denture base resin with addition of aluminium oxide filler, which was not significantly different ($p > 0.05$).

CONCLUSION

The hardness of conventional heat polymerized denture base resin and modified heat polymerized denture base resin with addition of aluminium oxide filler were not significantly different”.

KEYWORDS: Acrylic Resin, Surface Roughness & Aluminium Oxide

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INTRODUCTION

“Polymethylmethacrylate is the material of choice for denture base fabrication”.^{1,2} Introduced in 1937 by Dr. Walter Wright, “this material continues to be used because of its favorable working characteristics, biocompatible, stability in the oral environment, superior esthetics, processing ease, accurate fit and use with inexpensive equipment”.³

Hardness is defined as the resistance of a substance to irreversible indentation or penetration has been a sign of abrasiveness. The surface attributes of the denture base material can be affected by hardness, and which can be characteristic of this Simplicity of completing the substance and It's resistant to scratching through cleansing.⁴

The incorporation of ceramic particles is proven to be biocompatible, and in addition, it enhances mechanical properties. Additionally, the white colour of the ceramic powder does not undermine aesthetic looks^{5,6,7}. The mechanical properties of denture base materials should not get influenced from some other reinforcement procedures.

Aluminum oxide contains powerful ionic interatomic bonding. Even though it exists in many crystalline phases it moves into the most secure hexagonal alpha stage at elevated temperatures. The strongest and stiffest of this oxide ceramics is Alpha stage alumina. Its high hardness, exceptional dielectric properties, refractoriness, and great thermal properties which makes it the material of choice for many of software.⁸

Although the addition of aluminium oxide to PMMA increases strength properties, the surface properties of PMMA denture base material after such addition have not been investigated. Therefore, the aim of this study was to evaluate the effect of aluminium oxide incorporation in PMMA on hardness properties.

MATERIALS AND METHODS

A rectangular metal die specimen measuring $12 \times 12 \times 3$ mm was used to prepare 15 specimens each for both test groups. The impression of the metal die was made using elastomers. 30 wax specimens were prepared.

GROUP-A: “15 specimens of conventional heat polymerized denture base resin (Control group).

GROUP-B: 15 specimens of modified heat polymerized denture base resin with addition of 15% by wt. aluminium oxide powder”.

For compression molding technique, the wax specimens were invested and dewaxing was carried out. “The mould cavities got were employed to the preparation of oil resin evaluation specimens. The management group test specimens were made with standard heat-polymerized acrylic resin, DPI (Dental Products of India). For group B, 15% by wt. of aluminium oxide powder was combined with polymer of traditional heat polymerized denture base material”. The monomer and polymer have been blended and processing has been performed in accordance with manufacturer's directions. Finishing and polishing has been completed to acquire final evaluation specimens.

To determine Vickers hardness values, specimens were measured by applying a load of 30 g for 30 s using a digital hardness tester. Each specimen was exposed to 3 indentations (one on the middle, two on the boundary) and the normal value was calculated for every category.

The hardness between group-A and group-B was compared. Descriptive data was completed for each evaluation. Data were examined with the individual sample t-test. Differences were considered significant at the $p < 0.05$ level.

RESULTS

The mean, standard deviation values for Vickers hardness number (VHN) were calculated. (Tables 1)

The mean and SDVHN for group-A was 21.8 ± 2.39 , for group-B it was 22.8 ± 2.39 , which was not significantly different ($p = 0.6$).

Table 1: Mean Hardness Value (VHN) Standard Deviation for Both Groups

Groups	Mean	SD	p = 0.6
Group A	21.8	2.39	—
Group B	22.18	1.42	—

DISCUSSIONS

The objective of this study was to compare hardness between two types of denture base acrylic resins with addition of aluminium oxide filler. Based on the results of this study, the conventional heat polymerized acrylic resin had lower microhardness values when compared with modified PMMA with aluminium oxide addition. However, there was no significant difference observed between specimens ($p > 0.05$).

Hardness indicates the degree of resistance of the material when encountering plastic deformation. The surface hardness is related to the material's susceptibility to scratch or wear, which is a type of deformation; a harder material would be more resistant to the scratching or wear. PMMA resins have relatively low surface hardness and are in risk of being damaged by abrasion, causing accumulation of plaque and compromising color stability and even the longevity of the denture base.⁹ The Vickers hardness (VH) test is a frequently used method to evaluate the material's ability to resist penetration of certain load.

Heat polymerized acrylic resins have favorable working characteristics, biocompatible, stability in the oral environment, superior esthetics, processing ease, accurate fit and use with inexpensive equipment, so commonly used material for fabrication of dentures. In spite of these excellent properties, improvement is required in the physical properties of these materials.

Aluminum oxide contains powerful ionic interatomic bonding. Though exists in many crystalline phases, it extends to the stable hexagonal alpha stage at elevated temperature. Its durability, exceptional dielectric properties, refractoriness, and great thermal properties which makes it the material of choice for many of software.¹⁰

The reason for using ceramic filler rather than alloy filler is to reduce filler density. They do not change aesthetics of their denture foundation than are alloy powders.¹¹

"The reason for not much increase in hardness with addition of aluminium oxide powder may be attributed to presence of excess free monomer in resin matrix as 15% wt of resin powder was replaced by aluminium oxide fillers in resin matrix. Farnia et al have tested five types of acrylic resins: One type of microwave polymerized, one auto polymerized, and three conventional heat-polymerized. Their specimens were submitted to Vicker hardness testing with a 25 g load for 30s. Their investigation showed that conventional heat polymerized had a higher hardness value compared to the others.¹²

A few limitations of this analysis are throughout the specimen prep some variability may be introduced at the variety of these substances, storage of these specimens, polishing and finishing of these specimens. Intraoral states vary from vitro conditions".

CONCLUSIONS

In the current analysis, no statistical differences in hardness of management group and altered PMMA using 15% chromium oxide have been detected. A little, but not statistically significant growth, in hardness of modified PMMA using 15% aluminum oxide has been discovered.

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AUTHOR'S PROFILE

Dr. SARITHA M.K.

I Have Completed BDS From College of Dental Sciences, Davangere and MDS in Department of Prosthodontics in Prestigious Bapuji Dental College and Hospital, Davangere in the Year 2011. Secured 2nd Rank in University Postgraduate Exams in Prosthodontics. I Have 6 Publications in National and International Journals. Lifemember of Indian Prosthodontic Society

Dr. DEEPA K

I Have Completed BDS From Tagore Dental College, Chennai. Presently Working as Tutor in Chettinad Dental College and Hospital. Have 2 publications in international journals.