Evaluation of the Flexural Strength of Two Different Heat Cure Denture Base Resins after Prolonged Immersion in Artificial Saliva and Distilled Water

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ABSTRACT:
Aim: Aim of the present study was to evaluate the flexural strength of two different heat cure denture base resins after prolonged immersion in artificial saliva and distilled water.
Materials and Methods: Metal strips were coated with separation media and invested in large denture flasks using, the type 3 dental stone. Once the investing material was set, the flasks were opened and the metal strips removed, thus leaving a mold for preparing test samples of various denture base resins. A total of 80 samples were prepared from two different materials as follows, Group 1: Lucitone-199, Group 2: Trevalon HI. 40 samples in group 1 and group 2 were immersed respectively in artificial saliva and distilled water for a regular interval, i.e., 20 samples each at 15, 30 and 60 days. Flexural strength was assessed using the universal testing machine.
Results: Withlucitone material, the flexural strength was more in artificial saliva after 15 days (103.32±0.01) followed by 100.24±0.14 after 30 days and 99.18±0.04 after 60 days. After immersed in distilled water flexural strength was high after15 days (102.46±0.03) followed by 99.38±0.28 after 30 days and 98.84±0.11 after 60 days. With Trevalon material The flexural strength was more in artificial saliva after 15 days (101.04±0.16) followed by 98.31±0.01 after 30 days and 98.08±0.18 after 60 days. After immersed in distilled water flexural strength was high after15 days (98.46±0.02) followed by 97.16±0.19 after 30 days and 96.07±0.01 after 60 days. And there was no statistically significant difference found between the materials and different time interval.
Conclusion: The present study concluded that the flexural strength of heat cure denture base resins was slightly affected by prolonged distilled water immersion compared to artificial saliva immersion.
Keywords: artificial saliva, denture base resins, distilled water,flexural strength.

INTRODUCTION:

The heat cure denture base resins have been used for more than 60 years in the prosthodontic restoration of a completely or partially edentulous mouth due to its ease of manipulation, cost effective and good mechanical properties. A denture base polymer, apart from having acceptable mechanical properties, should also have good aesthetics with a smooth surface and be capable of matching the natural appearance of soft tissues.[1]

The mechanical properties of denture base resins are very important for the clinical success of multiple type of prosthesis. The strength properties of denture base acrylic resins ensure that the prosthesis serves its intended functions effectively, safely and for a reasonable

period of time. Acrylic resins must be strong and resilient so as to withstand impact. Most prosthetic acrylic resins consist of polymethylmethacylate (P.M.M.A.) resin and additional copolymers. Most of the manufacturers of PMMA based denture base resins refer to their products as high strength (impact) and claim new and improved strengthening properties.[2,3]

The acrylic resin's mechanical properties are affected by the effect of fluid plasticization on the matrix of the polymer, the polymerization technique and the pattern of the polymer matrix. The denture base resins are always in contact with either saliva or the storage solution or with the aqueous solution for cleansing. As a result of this contact, saliva or water may get absorbed by denture base resins eventually.[4] Water molecules occupy the vacant places between the polymethyl methacrylate polymeric chains, in turn, reduces the mechanical property of the denture base resin by acting as a plasticizer, restricting the polymeric chain movement.The suitable test to predict the clinical performance of any biomaterials used in dentistry is by measuring the flexural strength as it is influenced by the geometry of the specimen and loading conditions.[5] Hencethe present study was conducted to assess the flexural strength of two different heat cure denture base resins after prolonged immersion in artificial saliva and distilled water.

MATERIALS AND METHODS:

Preparation of samples:

Metal strips of the dimensions: 60mm (length) x 10mm (breadth) x 5mm (thickness) were coated with separation media and invested in large denture flasks using, the type 3 dental stone. Once the investing material was set, the flasks were opened and the metal strips removed, thus leaving a mold for preparing test samples of various denture base resins. A total of 80 samples were prepared from two different materials as follows,

Group 1: Lucitone-199

Group 2: Trevalon HI

Fabrication of test samples:

A thin film of alginate separating media was applied on all surfaces of the stone except in the mold space. Respective heat cure materials were used to fabricate denturebase resin samples. A combination of polymer and monomer, used in the ratio of 3:1 by volume was proportioned before mixing. Mixing was done in a porcelain jar and on achieving the dough consistency, it was packed into mold. After the flasks were clamped, closure was done under force of 20 KN and kept for 30 min. The flasks were then kept at room temperature for 1 h. The flasks were immersed in water in an acrylizer at room temperature; the curing was carried out as per the slow curing cycle,that is, at 700°C for 7 h followed by 100°C for 30 min to ensure complete polymerization. After curing of all the samples, the flasks were brought down to room temperature and deflasked.

Sample immersion in testing media and flexural strength assessment:

40 samples in group 1 and group 2 were immersed respectively in artificial saliva and distilled water for a regular interval, i.e., 20samples each at 15, 30 and 60days.

Using the universal testing machine, INSTRON, physical testing was conducted on samples with a 3-point-bending test at 2 mm/min crosshead speed and with a span of 50 mm

at each interval (15, 30 and 60days). The flexural strength was calculated using the below formula, the peak load was noted at the point where the sample fractures.

Flexural strength = 3/2 x pl/bd2, (p–peak load, l–span length, b–sample width and d–sample thickness)

STATISTICAL ANALYSIS:

Data was analyzed using the SPSS version 20.0. Calculation of the mean as well as standard deviation was performed. One-way analysis of variance (ANOVA) and the *post hoc* Tukey test was used. Statistical significance was set at p-value less than 0.05.

RESULTS:

Table 1 shows the flexural strength of lucitone heat cure denture base rein material after prolonged immersed in artificial saliva and distilled water. The flexural strength was more in artificial saliva after 15 days (103.32±0.01) followed by 100.24±0.14 after 30 days and 99.18±0.04 after 60 days. After immersed in distilled water flexural strength was high after15 days (102.46±0.03) followed by 99.38±0.28 after 30 days and 98.84±0.11 after 60 days.

Table 1: Flexural strength of lucitone heat cure denture base rein material after prolonged immersed in artificial saliva and distilled water

Time intervals	Artificial saliva (Mean±SD)	Distilled water (Mean±SD)
15 days	103.32±0.01	102.46±0.03
30 days	100.24±0.14	99.38±0.28
60 days	99.18±0.04	98.84±0.11

Table 2 shows the flexural strength of trevalon heat cure denture base rein material after prolonged immersed in artificial saliva and distilled water. The flexural strength was more in artificial saliva after 15 days (101.04±0.16) followed by 98.31±0.01 after 30 days and 98.08±0.18 after 60 days. After immersed in distilled water flexural strength was high after15 days (98.46±0.02) followed by 97.16±0.19 after 30 days and 96.07±0.01 after 60 days.

Table 2: Flexural strength of trevalon heat cure denture base rein material after prolonged immersed in artificial saliva and distilled water

Time intervals	Artificial saliva (Mean±SD)	Distilled water (Mean±SD)
15 days	101.04±0.16	98.46±0.02
30 days	98.31±0.01	97.16±0.19
60 days	98.08±0.18	96.07±0.01

Table 3 and 4 depicts the comparison of mean flexural strength of lucitone andtrevalon heat cure denture base rein materials but there was no statistically significant difference found between the materials and different time interval.

Table 3: Comparison of mean flexural strength of lucitone heat cure denture base rein material after prolonged immersed in artificial saliva and distilled water

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	7418.311	2	1148.124	3680.710	0.267
Within Groups	13.262	38	0.533		
Total	7431.573	40			

Table 4: Comparison of mean flexural strength of trevalon heat cure denture base rein material after prolonged immersed in artificial saliva and distilled water

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	7238.161	2	1108.262	2410.670	0.349
Within Groups	12.168	38	0.512		
Total	7250.329	40			

DISCUSSION:

Among various physical properties of denture base resins, the property of biocompatibility and esthetics are key for patient acceptance. Long term use depends more on mechanical properties which include strength to withstand functional and parafunctional masticatory forces. Flexion of the denture during function, apart from causing a mid-line fracture, also causes damage to the underlying soft structures leading to resorption of the residual alveolar ridge. Polymethylmethacrylate resin is commonly used for the fabrication of removable complete and partial dentures. More than 60% of dentures fabricated with polymethyl methacrylate resin, fracture within 3 years of fabrication due to poor physical and mechanical properties.[6]

The ultimate flexural strength of a material reflects its potential to resist catastrophic failure under a flexural load. High flexural strength is crucial to denture wearing success, as alveolar resorption is a gradual, irregular process that leaves tissue-borne prostheses unevenly supported. As a foundation, the acrylic resin materials should exhibit a high proportional limit to resist plastic deformation and also exhibit fatigue resistance to endure repeated masticatory loads.[7]The prime and most frequent site of fracture in the upper denture is in the medial line. During chewing, denture base material is subjected to flexural deformation.An acrylic resin capable of sustaining higher flexure in combination with high resistance to cyclic loading may be less prone to clinical failure.[8]

The residual monomer reduces the mechanical properties of the acrylic resins affecting adversely. The water uptake and the monomer release are a time-dependent process. Henceforth, the number of molecules within the denture base resin changes over the time and the denture polymer strength at a given time after immersion in water is also affected by the amount of the molecules present. The continued polymerization of the residual monomer in its active sites after the initial reaction counteracts the reduction in the mechanical properties,

thereby increases the mechanical properties and increase in the degree of conversion of acrylic resins on long-term immersion.[9,10]

The results of this study revealed that, the ultimate flexural strength of two groups of heat cure denture base resins reduced after long term water immersion. These results were similar to the results as shown by previous studies conducted by Vallittuet al[11] in 1998 for 48 weeksof water immersion and in 2000 for 10 years[12]of water immersion.

The limitations of this study are due to the fact that it is in vitro; despite trying to mimic the oral cavity and its conditions as much as possible, there are always differences. In future investigations, it will be important to perform a longterm follow-up in vivo study.

CONCLUSION:

The present study concluded that the flexural strength of heat cure denture base resins was slightly affected by prolonged distilled water immersion compared to artificial saliva immersion. Thus after long term water immersion, the denture base material becomes weaker and stiffer.

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