ORIGINAL RESEARCH

Comparison of flexural strength in two types of denture base resins

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ABSTRACT

Background: The present study was conducted for assessing and comparing flexural strength in two types of denture base resins. **Materials & methods:** The goal of the current study was to evaluate and contrast the flexural strength of two different denture base resin types. There were 50 acrylic specimens manufactured in total using stainless steel dies. These stainless steel dies were used to create 20 acrylic specimens. To complete the flasking process, dental plaster was applied to the metal dies. For the purpose of making room in the mould for the acrylic specimen, the stainless steel dies were then removed. The following research groups were created by randomly selecting all of the specimens: 1)Conventional denture base resins fall under Group 1and glass reinforced denture base resins go under Group 2. For 28 days at room temperature, all twenty samples were submerged in distilled water to mimic the oral environment. The universal testing apparatus was used to determine the samples' flexural strength. The SPSS software was used to assess all the results, which were recorded in a Microsoft Excel spreadsheet. **Results:** Mean flexural strength of group 1 specimens was found to be116.9 MPa. Mean flexural strength of group 2 specimens was found to be153.6 MPa. While comparing the mean flexural strength between group 1 and group 2, statistically significant results were obtained. **Conclusion:** Glass reinforced denture base resins demonstrated higher flexural strength in comparison to conventional denture base resin.

Key words: Denture, Base, Resin

INTRODUCTION

The introduction of arelatively high satisfactory plastic denture base material occurred in 1937 when Dr. Walter Wright described the results of his clinical evaluation of methyl methacrylate resin.[1] Poly (methyl methacrylate) (PMMA) has many advantages, particularly its appearance and ease of manipulation, but it has certain poor mechanical properties. Fractures may occur in use because of its unsatisfactory transverse strength, impact strength or fatigue resistance. Attempts have been made to improve the mechanical properties of acrylic resin by using techniques such as A)giving maximum bulk to the material in the regions most heavily stressed,B) by copolymerization and cross-linking, c)reinforcement with carbon fibers.[2] The fracture of acrylic resin dentures is an unresolved problem in removable prosthodontics despite numerous attempts to determine its causes.[3]

Vallittu and Lassila[4] studied the effect of different metal and fiberstrengtheners on the fracture resistance of PMMA. Different types of commonly used metal wire and glass fiber, as well as carbon and aramid fibres, were used as strengtheners in test specimens. Each metal strengthener had a beneficial effect on the fracture resistance of the PMMA ($P < 0.001 – 0.01$). Some fibres, which were silanized for better adhesion, also had strengthening properties.

A similar study[5] tested the effect on the fracture resistance of acrylic resin test specimens with different amounts of glass, carbon, and aramid fibres. The results indicated that an increase in the amount of fibres enhanced the fracture resistance of the test specimens ($P < 0.001$). The scanning electronic microscope micrographs of transverse sections of test polymerized specimens revealed void spaces of different sizes inside the fibre. 1% glass fiber[6,7] concentration was found to give the best fracture strength and deformation results. Significantly higher glass fibre percentage was found to weaken the resin. Highly cross-linked reline resins[8] and the one that contained mainly PMMA and methyl methacrylate had a higher transverse bend strength and modulus of elasticity than the other reline resins.

Hence; under the light of above mentioned data, the present study was conducted for assessing and comparing flexural strength in two types of denture base resins.

MATERIALS & METHODS

The goal of the current study was to evaluate and contrast the flexural strength of two different denture base resin types. There were 50 acrylic specimens manufactured in total using stainless steel dies. To complete the flasking process, dental plaster was applied to the metal dies. For the purpose of making room in the mould for the acrylic specimen, the stainless steel dies were removed. The following research groups were created by randomly selecting all of the specimens:1) Conventional denture base resins fall under Group 1and 2)glass reinforced denture base resins go under Group 2. For 28 days at room temperature, all samples were submerged in distilled water to mimic the oral environment. The universal testing apparatus was used to determine the samples' flexural strength. The SPSS software was used to assess all the results, which were recorded in a Microsoft Excel spreadsheet.

RESULTS

Mean flexural strength of group 1 specimens was 116.9 MPa. Mean flexural strength of group 2 specimens was 153.6 MPa. While comparing the mean flexural strength between group 1 and group 2, statistically significant results were obtained.

Table 1: Comparison of flexural strength (MPa)

Group	Mean	SD	p- value
Group A	116.9	13.9	0.000
Group B	153.6	18.3	(Significant)

DISCUSSION

Flexural strength, (transverse strength/modulus of rupture) is essentially a strength test of a bar supported at each end, or a thin disk supported along a lower support circle, under a static load.[9] The flexural strength of a material is a measure of stiffness and resistance to fracture.[10] Flexural strength tests were undertaken as these were considered relevant to the loading characteristics of a denture base in a clinical situation. The strength of a material in bending, expressed as the stress on the outermost fibres of a bent test specimen, at the instant of failure.

The first use of polymethyl methacrylate (PMMA) as a dental device was for the fabrication of complete denture bases. Its qualities of biocompatibility, reliability, relative ease of manipulation, and low toxicity were soon seized upon and incorporated by many different medical specialties. PMMA has been used for (a) bone cements; (b) contact and intraocular lens; (c) screw fixation in bone; (d) filler for bone cavities and skull defects; and (e) vertebrae stabilization in osteoporotic patients. The many uses of PMMA in the field of medicine will be the focus of this review, with particular attention paid to assessing its physical properties, advantages, disadvantages, and complications. Although numerous new alloplastic materials show promise, the versatility and reliability of PMMA cause it to remain a popular and frequently used material.[11]

Hence; under the light of above mentioned data, the present study was conducted for assessing and comparing flexural strength in two types of denture base resins.

In this study, the mean flexural strength of group 1 specimens was 116.9 MPa. Mean flexural strength of group 2 specimens was 153.6 MPa.

In a study by Jaikumar R et al [12] ,a total of 30 specimenswere fabricated; the specimens were divided into three groups with 10 specimens each. They were Group 1 - conventional denture base resins, Group 2 - high impact denture base resins, and Group 3 - glass reinforced denture base resins. The specimens were loaded until failure on a three-point bending test machine. A one-way analysis of variance was used to determine statistical differences among the flexural strength of three groups. Data were analyzed by SPSSand the results were obtained. It was discovered that the flexural strength values showed statistically significant differences among experimental groups ($P <$ 0.005). Polymethyl methacrylate (PMMA) reinforced with glass fibers showed the highest flexural strength values, followed by PMMA reinforced with butadiene styrene, and the least strength was observed in the conventional denture base resins.

Ajinkya SK et al[13] carried out a comparative evaluation of flexural strength and impact strength of computer-aided design/computer-aided manufacturing (CAD/CAM) denture base resin with conventional heat cure resin fabricated by two different techniques.The study was carried out in three groups based on the manufacturing process of the dentures: Group I (n = 30)—control group containing specimens fabricated by conventional pressure-pack technique (polymer and monomer—powder and liquid, (DPI, Mumbai, India)); Group II (n = 30)—specimens fabricated using injection molding technique (SR—Ivocap High Impact, IvoclarVivadent, Liechtenstein); and Group III (n = 30)—specimens fabricated using CAD/CAM technology (Bloomden™, China). The values for flexural strength of each specimen were measured using a universal testing machine by a three-point bending test. Impact strength testing of the samples was done on the Izod impact testing machine with a pendulum of S2 scale in air at 23 ± 2°C. The mean values of the flexural strength and impact strength were calculated by the one-way ANOVA test and intergroup comparison was done using Tukey pairwise comparisons.The flexural strength (FS) and impact strength (IS) of CAD/CAM (FS = 93.16 ± 5.46 MPa and IS = 15.625 ± 2.512 kJ/m^2) samples were highest followed by injection molded samples (FS = 84.82 ± 5.30 MPa and IS = 12.511 ± 2.908 kJ/m^2) and

least for compression molded control group (FS = 74.70 ± 5.02 MPa and IS = 8.446 ± 0.937 kJ/m^2). It was concluded that CAD/CAM denture base resins have the highest flexural and impact strength compared to injection molded and compression molded heat cure denture base resins.

CONCLUSION

Glass reinforced denture base resins demonstrated higher flexural strength in comparison to conventional denture base resin.

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