VOLUME - 10, ISSUE - 08, AUGUST- 2021 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Dental Science

COMPARATIVE EVALUATION OF FLEXURAL STRENGTH OF HEAT POLYMERIZED DENTURE BASE RESINS WITH AND WITHOUT REINFORCEMENT WITH FIBERS: AN IN-VITRO STUDY

Manju Choudhary MDS, (Prosthodontics), Asst. Professor, Dept. of dentistry, K.M Medical college & Hospital ,Mathura.(UP).

ABSTRACT

Introduction: Acrylic-based resins are intensively used in dental practice as denture base materials. As its resistance to impact and its fatigue failure are somewhat poor, thus fracture of acrylic resin denture bases is a continuing problem in Prosthodontics. This study was an in-vitro study done to evaluate and compare the flexural strength of heat polymerized poly methylmethacrylate denture base resins on reinforcement with Glass fibers.

Method: A stainless steel die was used as a standard die and a total of 20 heat cured PMMA resin samples were fabricated using the same die and divided into 2 groups, having 10 samples in each group. The samples were tested on universal testing machine & three point bending test was done. Then flexural strength of each sample was calculated. Mean value of flexural strength of each group was used for statistical analysis.

Results: Results showed that the mean flexural strength of the unreinforced PMMA samples was 55.78N/mm2. Mean flexural strength of the reinforced PMMA for 4% glass fiber it was 73.67 N/mm2 . One-way analysis of variance showed that the fibers significantly affected the flexural strength of PMMA.

Interpretation and Conclusion: Glass fibers had a marked improvement in the flexural strength of PMMA as compared to unreinforced PMMA

KEYWORDS : Reinforcement with fibers, Flexural strength, Glass fibers.

INTRODUCTION

Edentulism can have obvious negative esthetic, functional (speech, chewing/eating) and psychological consequences. Edentulism is closely associated with socioeconomic factors and is more prevalent in poor population and in women.[1-2] For edentulous patients complete denture is the standard treatment of choice in which dental implants have been deemed inappropriate by patient and/or doctor because of financial constraints or a medically compromised status.

Poly Methyl Metacrylate (PMMA) was developed 70 years ago, and is still the major material for fabrication of denture bases due to its esthetic characteristics, high processing and polishing abilities, relining and rebasing possibility and low cost. In 1937, Dr. Walter wright [3] and Vernon Brothers in Philadelphia introduced polymethyl methacrylate (PMMA) resin (acrylic resin). Its resistance to impact and PMMA resin's fatigue failure are somewhat poor, thus fracture of acrylic resin denture bases is a continuing problem in Prosthodontics. Predisposing factors for fracture of dentures include any areas of stress concentration (large frenal notch), dentures with thin or under extended flanges, lack of adequate relief (in case of a prominent torus palatinus), improper occlusion, previous repair of dentures, poor clinical design etc.[4-5] Flexural fatigue and impact forces are the two important factors responsible for fracture of dentures. Fatigue occurs after repeated flexing of a material. Impact failures usually occur out of mouth as a result of sudden blow to denture or accidental dropping while cleaning, coughing or sneezing [5]. Fractures can be prevented by improving the strength of the PMMA. Strengthening by fiber reinforcement is based on the principle that a relatively soft ductile, polymer matrix is fully capable of transferring an applied load to fibers via shear forces at the interface [6]. Fibers will be the main load bearing constituents while the matrix forms a continuous phase to surround and hold the fibers in place. Reinforcement of PMMA with fibers increases the abrasion, tensile and transverse strength, bending and elasticity modulus. So this study is a comparative study of PMMA reinforced with glass fibers and without reinforcement.

AIM & OBJECTIVE:

To evaluate the Flexural strength of denture base resins fabricated by reinforcement with glass fibers and compare it with denture base resins without reinforcement fabricated by conventional method.

MATERIALS & METHODOLOGY:

For the purpose of this study heat cure clear acrylic resin material DPI was taken, which was reinforced with GLASS FIBERS. A stainless steel die was used as a standard die and a total of 20 heat cured PMMA resin samples with dimensions (70×40×3) mm were fabricated and divided into 2 groups, having 10 samples in each group. Test groups were reinforced with 10-15 microns thick and 6mm long fibers. The samples were kept in distilled water for 7 days to get rid of unreacted monomer. The samples were tested on universal testing machine & three point bending test was done. Then flexural strength of each sample was calculated. Mean value of flexural strength of each group was used for statistical analysis.

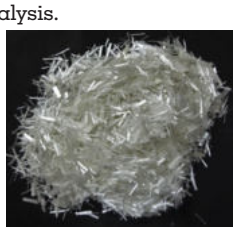

Fig.1: Glass fibers

Fig.2: Investing

Fig.3: Packing sample with fibers

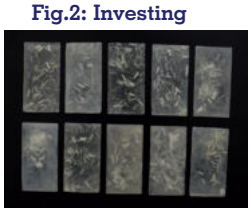

Fig.4: Processed samples with fibers

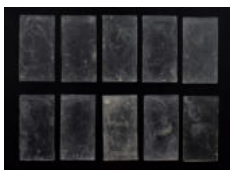

Fig. 5: Processed unreinforced samples

Fig 6: Load applied on the specimen

RESULTS:

Mean of all the groups were statically evaluated and one way ANOVA was performed,"F" ratio and "P value were calculated. Post hoc Tukey HSD test was done to evaluate and compare between two groups. Group A -Control Group:

Unreinforced PMMA. Group B- PMMA denture base resin reinforced with 4% Glass Fibers.

Table: Comparative Evaluation of Flexural Strength (in N/mm2) of Heat Polymerised Denture base Resin after Reinforcement with fibers.

GROUPS	N	MEAN	STD. DEV	ONE WAY ANOVA		TUKEY HSD TEST*	
				'F' RATIO	'P' VALUE	GROUP MEAN	'P' VALUE
Group A (Control)	10	55.78	2.02			M1&M2	<0.001 (S)
Group B	10	73.67	6.78				

The flexural strength has shown a increase of 17.89 N/mm2 when the PMMA samples were reinforced with 4% glass fibers when compared with control group.

DISCUSSION:

Whether the denture fracture occurs accidently, because of an impact or from forces due to masticatory or gliding movements, the "strength" of the denture has been inadequate in each case [7]. Therefore to overcome such disastrous eventualities many modifications in the conventional denture base resin to improve its strength were introduced [8-10]. This In-vitro study was therefore conducted in order to determine the flexural strength of the denture base material reinforced with glass fibers. Flexural strength was tested to get an understanding of how denture base resins hold up under function.Wright et al (1979) used untreated randomly organized short fibers and observed 17% increase with 1% GF reinforcement, and 24% increase with 4% GF reinforcement [11]. More than 4% is not incorporated in our study as fiber concentration above 4% resulted in dry, fragile dough [12] and the resin became difficult to manipulate and was aesthetically unpleasing. Gutteridge (1988)[12] found that incorporated fibers could not be added over 4% weight. He found that viscosity was increased with the amount of fiber incorporated and manipulation became difficult. All the samples were subjected to flexural strength, crack line on the samples i.e. the fracture was of repairable type. In the present study the fibers used were in 6 mm lengths. All the specimens were made according to the manufacturer's instructions. Split dies were used to reduce the chances of water sorption and dimensional changes [13]. Long curing cycle of 8 hours at 740C with a terminal boiling for 1 hour was proposed for this study[14]. The flexural strength of a material is its ability to bend before it breaks[15]. Flexural strength (T) = 3pl / 2bd2 (ADA specification No. 12, 1999). The study results shows the flexural strength of glass fibers more than control group (Unreinforced PMMA) and is statistically significant ($p<.05$). Reinforcement of PMMA with fibers is an attractive option as it does not require any new equipment outlay. Other advantage is that, if the matrix should fail catastrophically then the fractured portion is likely to remain in close proximity, held together by the fibers [17]. Reinforcement also decreases the chance of failure and may decrease patient discomfort and unscheduled appointments [16]. This study suggested that dentures with glass fibers reinforcement might have clinical success.

CONCLUSION:

Within the limitations of study, it was concluded that:

1) Denture base reinforced with glass fibers has higher flexural strength than the unreinforced denture base resin, and denture base resin reinforced with Glass fibers consequently increasing the life span of the prosthesis during clinical use.
2) The difficulties in finishing and polishing of fibers can be overcome by sandwiching the fibers in between the two layers of acrylic resin during processing of the dentures. Glass fibers also has excellent aesthetic appearance.

REFERENCES:

1. Millar WJ, Locker D. Edentulism and denture use. Health Reports, 2005; 17(1): 55-58.
2. Reddy NS, Reddy NA, Narendra R, Reddy SD. Epidemiological Survey on Edentulousness. The Journal of Contemporary Dental Practice, July-August 2012; 13(4): 562-570.
3. Peyton FA, History of resins in dentistry, DCNA 1975; 19: 211-222.
4. Clarke DA, Ladizesky NH and Chow TW. Acrylic resins reinforced with highly drawn linear polyethylene woven fibres.1. Construction of upper denture bases. Australian Dental Journal 1992; 37:394-99.
5. Jagger DC, Harrison A and Jandt KD .The reinforcement of dentures. Journal of Oral Rehabilitation 1999; 26:185-94.
6. Sir Hao Foo, Tahry J, Lindquest, Effect of polyaramid fibers reinforcement on the strength 3 denture base PMMA resin, J Prosthet 2001; 10:148-153
7. Smith DC, The acrylic denture: Mechanical evaluation midline fracture. Br Dent J 1961; 110: 257-267.
8. Vallittu PK. Comparison of the in vitro fatigue resistance of an acrylic resin removable partial denture reinforced with continuous glass fibers or metal wires,J Prosthodont 1996;5 :115-21
9. Solnit GS. The effect of methyl methacrylate reinforcement with silane treated and untreated glass fibers. J Prothet Dent 1991;66;310-4.
10. Ladizesky NH, Chow TW, Cheng YY. Denture base reinforcement using woven polyethylene fiber. International Journal of Prosthodontics, 1994; 7:307.
11. Pekka K. Vallittu–Overview of fiber - reinforced denture base resins JPD 1996;5:270-276
12. Gutteridge DL. Reinforcement of poly (methyl methacrylate) with ultra-highmodulus polyethylene fiber. J Dent 1992;20:50-4
13. Stipho HD Effect of glass fiber reinforcement on some mechanical properties of autoploymerizing polymethyl methacrylate. J Prosthet Dent 1998;79:580-4
14. Phillips' Science of Dental Materials :12theditionChapter 19, Page 482
15. Anusavice KJ. Recent developments in restorative dental ceramics. J Am Dent Ass 1993; 24: 73-84. [16] Tamer A, Hamza Stephen F, Rosenstiel Mohmed Elhosary and Rabab Ibrahim – Fracture resistance of fiber reinforced PMMA interim fixed partial denture. JPD 2004;91:258-64
16. Paul Franklin, David J Wood, Nigel L. Bubb Reinforcement of polymethyl methacrylate denture base with glass flake, Dental materials, 2005; 21; 365-370