Impact Strength of Poly Methyl Methacrylate Denture Base Resin of Different Thicknesses Reinforced with Glass Fibre- An Invitro Study

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Abstract :

The "impact strength" of acrylic denture base resin of two different thicknesses was evaluated by reinforcing it with glass fibres in different and same concentration using Charpy type plastic impact testing machine. A total of 80 specimens of DBR were used in the present study. All the specimens (unreinforced and reinforced) were put under the category A and B depending on their dimensions.To prepare the acrylic resin specimens wax blocks were made using the brass dies and were invested and acrylized. In the group A reinforced acrylic resin (with 3% glass fibres) specimen had the highest impact strength (5.49±0.93) followed by reinforced acrylic resin (with 2% glass fibres) specimen (5.20±0.88).In the group B reinforced acrylic resin (with 3% glass fibres) specimen had the highest impact strength (1.24±0.17) followed by reinforced acrylic resin (with 2% glass fibres) specimen (0.82±0.10).On applying ANOVA test to compare the groups of category A the result was showing very highly significant difference as the p-value was 0.000 (p> 0.001 -very highly significant) . Similar results were obtained for groups of category B.

Keywords : Glass fiber, Poly Methyl-methacrylate, Impact strength, Denture Base Resins.

Introduction

Denture base materials are extensively researched materials in the field of dentistry. Early 20th century sawintroduction of various newer materials like stainless steel, cobalt chromium alloys, acrylic resins(heat cure and self-cure) as DB materials.However, acrylic resin seems to be a material, which got more attention because it fulfils many of the desired properties like ease of processing, favourable working characteristics, accurate fit, stability in oral environment, superior aesthetics, use with inexpensive equipments and adequate mechanical properties.

The first plastic type acrylic resin i.e. poly (methyl methacrylate) was available under the name of "veronite". Rohm and Hass in 1936 introduced poly (methyl methacrylate) in the form of transparent sheet[1]. In 1937, Du Dout De Nemours introduced it in powder form[1]. Poly (methyl methacrylate) revolutionized the art of denture fabrication to the extent that by 1946, 95% of the dentures were made by it. However, research was still going on to improve certain properties of poly (methyl methacrylate). Late 20th century saw introduction of high impact acrylic resin (1967) and visible light cure acrylic resin (1986). Poly (methyl methacrylate) has been the denture base material of choice for more

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than 70 years from now and still it shows no signs of beingreplaced.

Breakage/ fracture may occur due to either impact failure or flexural fatigue. Accidental dropping of the denture during cleaning, coughing and sneezing may contribute to impact failure. Flexural fatigue, in complete maxillary denture, where continual flexing of the denture base during function leads to crack development and to the embarrassment and inconvenience of patient being suddenly deprived of their dentures.

The impact strength of poly(methyl methacrylate) can be increased either chemically or mechanically. Chemically it is increased by modification of poly(methyl methacrylate) through the addition of rubberin the form of butadiene styrene and mechanically by reinforcement with other materials such as carbon fibres, glass fibres and ultra-high modulus polyethylene, metal inserts (in the form of wires, meshes, plates), sapphire whiskers, silica fibres, aramid fibres, nylon fibres, poly(methyl methacrylate) fibres and beads of polyethylene and poly(methyl methacrylate)[1,2] .

Effective fibre reinforcement is dependent on many variables, including the type of the fibres, the percentage of fibres in the matrix, distribution of the fibres, fibre length, orientation, form, and the interfacial bond. Carbon-fibres have been added to acrylic resin in various forms, such as chopped or mat.Despite producing successful reinforcement, the black colour of the fibre, difficult handling characteristics and toxicity have restricted their use. The incorporation of Aramid fibres produced similar problems with respect to colour. The yellow appearance is difficult to mask within the denture, necessitating a thick layer of acrylic resin that adds significantly to the bulk of the denture. Polyethylene fibres are biocompatible, of low density and high modulus, aesthetically satisfactory and have been successfully incorporated into acrylic denture base with reported improvement in the mechanical properties of the resin. However, technical difficulties associated with the need of additional processing procedures have limited their use. Metal inserts in the form of wires, meshes and plates are still incorporated into dentures in an attempt to reinforce areas that are potentially vulnerable to fracture. Often, a metal insert acts only as an area of stress concentration and the tendency is to weaken rather than strengthen the denture base.

Reinforcement with glass fibres has given promising results in obtaining higher transverse strength, flexural modulus, fatigue strength and impact strength. Impact strength of the acrylic resin in different thickness and with different concentration of glass fibres was studied[1,2,3]. The present study aims to evaluate and compare the impact strength of acrylic resin of two different thicknesses and to evaluate and compare the impact strength of acrylic resin by reinforcing it with glass fibres in different and same concentration.

Materials and Method

A total number of 80 specimens of chosen acrylic resin denture base material were used in the present study. Charpy type plastic impact testing machine was used for testing the impact strength of the specimens. The data was analysed statistically. To prepare the acrylic resin specimens wax blocks were made using the brass dies and were invested and acrylized.

For preparation and standardizations of samples wax blocks were prepared pouring the molten wax into the brass dies of 56mm x

11mm x 11mm and 56mm x 11mm x 6mm internal dimensions (Fig.1). Upper member, the lid and lower member, the base of the die were in single pieces while the middle part of the die was in two pieces length wise for easy removal of the wax block. Upper member was having a 'V' shaped projection in the centre towards the die cavity. The base of the 'V'was 2.2mm and the height was 1/3 of the thickness of the specimen. Once the wax was hard, the blocks were recovered by de- assembling the die. Hundreds of such wax blocks were prepared. Care was taken to add more wax to compensate the shrinkage while the wax was hardened. Fifty blocks of dimensions 56mm x 11mm x 11mm and50 blocks of dimensions 56mm x 11mm x 6mm were thus prepared. Each block was having a notch of 1/3depth in the centre. The blocks were invested in dental flask using dental plaster (Fig.2). Dewaxing had been performed which left the mould cavity in the plaster. The plaster mould cavities were used to make the acrylic resin specimens. Almost equal numbers of un-reinforced, reinforced with 1% glass fibres, 2% glass fibres and 3% glass fibres acrylic resin specimens were made using the plaster mould cavities. For mixing, packing and curing the manufacturer's instructions were followed.

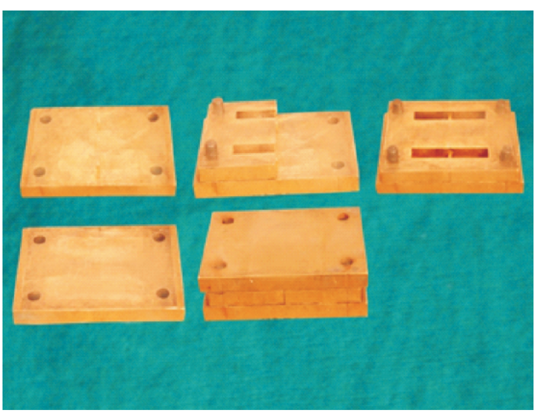

Fig. 1 : Brass dies for sample preparation

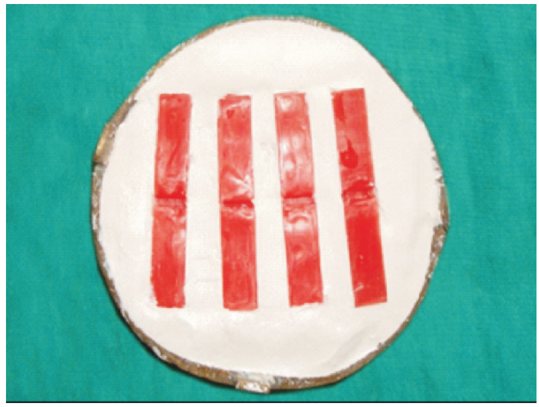

Fig. 2 : Investing of wax blocks

Unreinforced poly (methyl methacrylate) denture base resin (DPI-- Batch No. P-4112 L-4111) was used for making approximately 25% of the specimens (equal number of each size). Alginate separating medium was applied on the dental plaster mould cavity with the help of a brush and dried. Polymer and monomer were mixed in the ratio of 3:1 by volume (1.56:1 by weight). The mixture was kneaded and packed into the mould cavity in dough stage. Trial closure was carried out, the flask was opened, cellophane sheet was removed and excess material was trimmed using a BP knife. Final closure was done under pressure of 20 KN and kept for 30 min to allow proper penetration of monomer into the polymer. Curing cycle was followed according to manufacturer's recommendation. After the completion of the curing cycle, the flasks were allowed to bench cool to room temperature. Specimens were carefully removed from the mould cavity and the excess was trimmed and finished. These specimens were finally finished with silicone carbide paper, 120grits size. It was made sure that after finishing the dimensions of the specimen were 55x10x10mm and 55x10x5mm. The dimensions were checked using digital calliper (Mitutoyo, Japan) (Fig.3).

Reinforced acrylic resin denture base material specimens were fabricated in the same manner as described earlier by incorporating the glass fibres in the dough stage of the material during packing. The glass fibres were dipped in the monomer and air dried. To add exact amount of glass fibres, the weight of unreinforced specimens were measured and accordingly the amount of glass fibres were weighed and added during packing of reinforced specimens. The weight of unreinforced specimen was 11.20gm. So, 0.112gm, 0.224gm and 0.448gm glass fibres were added to make the 1%, 2% and 3% reinforced specimens respectively. For weighing, the amount of glass fibres electronic weighing machine (Japan) was used (Fig.4). Two layers of measured amount of glass fibres were added at a different level of thickness in the plaster mould cavity while packing the acrylic resin denture base material. Care was taken to spread the glass fibres homogeneously throughout the length. Same procedure was followed for making specimens of other dimensions i.e. 55x10x5mm. The weight of specimen of this dimension was 5.56 gm and accordingly 0.056 gm, 0.112 gm and 0.168 gm of glass fibres were added. In this way, the reinforced specimens were having two layers of glass fibres in between acrylic resin denture base material. All the specimens (unreinforced and reinforced) were put under the category A and B depending on their dimension 55x10x10mm and 55x10x5mm respectively.

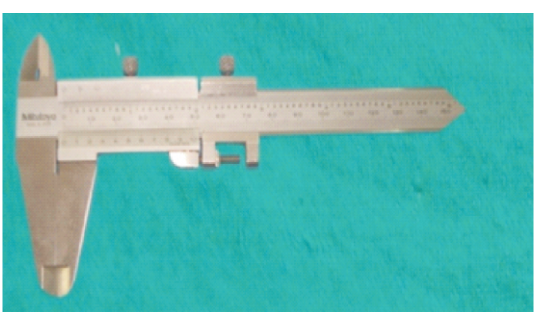

Fig. 3 : Digital caliper (Mitutoyo, Japan)

Fig. 4 : Weighing Machine

The specimens were grouped as follows:

1. Group 1A : Unreinforced acrylic resin specimens.
2. Group 2A: Reinforced acrylic resin (with 1% glass fibres) specimen. Category A
3. Group 3A: Reinforced acrylic resin (with 2% glass fibres) specimen.
4. Group 4A: Reinforced acrylic resin (with 3% glass fibres) specimen. 55x10x10mm
5. Group 1B: Unreinforced acrylic resin specimens. Category B
6. Group 2B: Reinforced acrylic resin (with 1% glass fibres) specimen.
7. Group 3B: Reinforced acrylic resin (with 2% glass fibres) specimen. 55x10x5mm
8. Group 4B: Reinforced acrylic resin (with 3% glass fibres) specimen.

All the specimens of different groups were stored separately in water at room temperature for two weeks before testing their impact strength. Impact strength test was carried out at Central Institute of Plastic Engineering and Technology (CIPET) (Deptt. of Chemicals and Petrochemicals, Ministry of Chemical and Fertilizer, Govt. of India) ISO 9001:2001 QMS, ISO/IEC 17020, Lucknow. Prior to testing, the specimens were wiped to remove water. The impact strength of the specimens was tested on Charpy type plastic impact testing machine (Tinius Olsen, USA) (Fig 5). This machine is capable of determining the impact strength using either Charpy or Izod configuration, without changing the pendulum. The user attaches the appropriate striking tup on the pendulum and the specimen clamp or anvils in the base of the unit, to test plastics in accordance with ASTM D6110 (Charpy Impact). The aerodynamically designed compound pendulum provides maximum rigidity in the direction of the impact and virtually eliminates any windage losses. Pendulum capacity is easily changed by adding on any one of seven optional weight sets. The energy absorbed in breaking the specimen can be configured in selectable energy units of J, in.lbf, ft.lbf, kgf.m and kgf.cm and is determined by an optical encoder mounted on the shaft of the machine. Pendulum capacity was configured initially with four kg and five and a half kg weights. Some of the specimens did not fracture with this configuration. So pendulum capacity was finally configured with seven and a half kg weights. The specimen was placed in the clamps and was adjusted. The specimen broke into two pieces as the pendulum hit it (Fig 6). The digital monitor displayed the impact strength needed to break the samples.

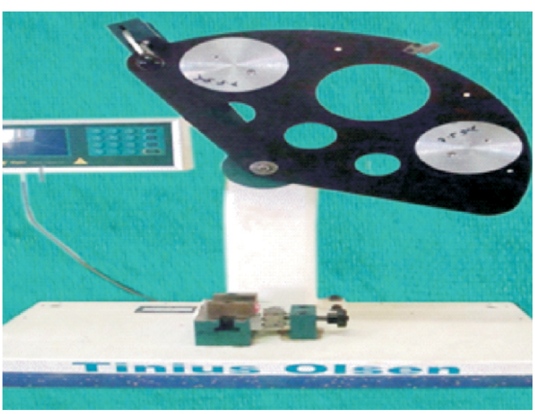

Fig. 5 : Charpy type plastic impact testing machine (Tinius Olsen, USA)

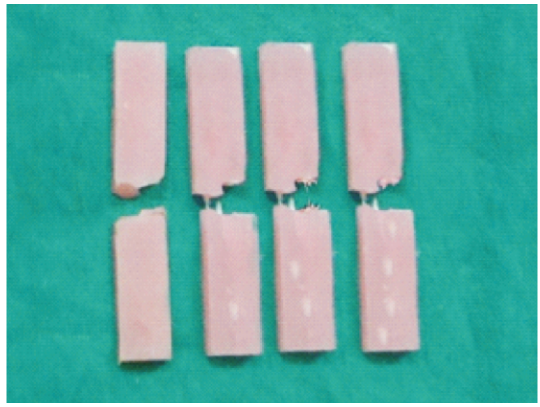

Fig. 6 : Fractured samples

Results

All the data were collected and statistically analysed. The results achieved were tabulated. Impact Strength of specimens in the both A and B groups were calculated (Table 1,2) and compared using SPSS (Statistical Package for the Social Sciences) statistical – version 16.0.

For finding out the significance between the Unreinforced acrylic resin specimens and glass fibre reinforced specimens ,the independent t-test was subjected in both groups at a significance level of 0.0001 (Table 3,4,5,6).In the group A Reinforced acrylic resin (with 3% glass fibres) specimen had the highest impact strength (5.49±0.93)followed by Reinforced acrylic resin (with 2% glass fibres) specimen (5.20±0.88).This shows that the impact strength is significantly altered with glass fibres reinforcement.In the group B Reinforced acrylic resin (with 3% glass fibres) specimen had the highest impact strength (1.24±0.17) followed by Reinforced acrylic resin (with 2% glass fibres) specimen (0.82±0.10).This shows that the impact strength is significantly altered with glass fibres reinforcement. The difference between the subgroups was statistically significant at the level 0.0001.On applying ANNOVA test to compare the groups of category A the result was showing very highly significant difference as the p-value was 0.000 (p> 0.001 -very highly significant) (Table 7). Similar results were obtained for groups of category B (Table 8). It shows that the groups are dissimilar as far as their impact strength is concerned. It means that adding glass fibres affects impact strength.

Table 1: Impact Strength of specimens in category A (in Joules).1A- unreinforced acrylic resin specimens; 2A- reinforced acrylic resin (with 1% glass fibres) specimen; 3A- reinforced acrylic resin (with 2% glass fibres) specimen; 4A- reinforced acrylic resin (with 3% glass fibres) specimen.

S .No.	GROUP 1A	GROUP 2A	GROUP 3A	GROUP 4A
1	0.3384	3.9024	3.5871	6.2219
2	0.1357	3.825	5.5479	5.2070
3	0.1029	3.9024	5.0321	6.7908
4	0.1595	3.6282	6.7663	4.9890
5	0.1440	3.5201	5.1261	4.7148
6	0.1564	4.0123	6.1802	4.2912
7	0.1742	3.5081	5.2551	4.3908
8	0.1379	2.8231	4.3214	5.3076
9	0.1401	4.0321	5.2216	6.2103
10	0.1395	3.0124	5.0333	6.7393
Mean	0.16286	3.61661	5.2071	5.4863
Standard deviation	0.06444	0.41525	0.8802	0.9379

Table 2: Impact Strength of specimens in category B (in Joules).

S .No.	Group1B	Group2B	Group3B	Group4B
1	0.0817	0.627	0.817	0.9943
2	0.0567	0.577	0.737	1.3040
3	0.0635	0.567	0.706	1.2236
4	0.0597	0.517	0.8667	0.9378
5	0.0498	0.439	0.7105	1.2036
6	0.0577	0.517	0.935	1.5432
7	0.0517	0.603	0.9245	1.2987
8	0.0547	0.597	0.7160	1.3024
9	0.0647	0.542	0.9650	1.3243
10	0.0438	0.565	0.8650	1.2349
Mean	0.05840	0.55510	0.82427	1.2367
Standard deviation	0.010325	0.054256	0.10105	0.17112

Table 3: Shows the result of unpaired Student t- test for groups 1A & 1B.

Group	N	Mean	Std. Deviation	t-value	p-value
1A	10	0.162860	0.064439	5.062	0.000
1B	10	0.058400	0.010325		

Table 4: Shows the result of unpaired Student t- test for groups 2A & 2B.

Group	N	Mean	Std. Deviation	t-value	p-value
2A	10	3.616610	0.415255	23.118	0.000
2B	10	0.555100	0.054256		

Table 5: Shows the result of unpaired Student t-test for groups 3A &3B.

Group	N	Mean	Std. Deviation	t-value	p-value
3A	10	5.207110	0.880211	23.118	0.000
3B	10	0.824270	0.101047		

Table 6: Shows the result of unpaired Student t-test for groups 4A & 4B.

Group	N	Mean	Std. Deviation	t-value	p-value
4A	10	5.486270	0.937956	14.095	0.000
4B	10	1.236680	0.171164		

Table7: Shows the result of One Way Analysis of Variance ANOVA test (Group A).

Group	N	Mean	Std. Deviation	F value	p-value
1A	10	0.162860	0.06443	130.73	0.000
2A	10	3.616610	0.41525		
3A	10	5.207110	0.88021		
4A	10	5.486270	0.93795		

Table 8: Shows the result of One Way Analysis of Variance ANOVA test (Group B).

Group	N	Mean	Std. Deviation	F value	p-value
1B	10	0.06	0.01034	229.8	0.000
2B	10	0.56	0.05425		
3B	10	0.82	0.10104		
4B	10	1.24	0.17116		

Discussion

Acrylic resin has been used extensively for the fabrication of denture base because they provide large number of advantages than any other material. However, one of the major drawbacks with the use of acrylic resin as denture base material is its susceptibility to fracture[4]. It is generally recognized that impact strength and fatigue strength of poly (methyl methacrylate) acrylic resin denture base material is not satisfactory[2,38].

Smith[4] analyzed the practical situation with respect to the fracture of dentures and showed two types of failure. i) Outside the mouth, caused by impact forces, i.e. a high stress and ii) inside the mouth, usually in function, which is probably a fatigue phenomenon, i.e. a low and repetitive stress. It has been shown that the "midline fracture" is a fatigue failure. It is characterized by a particular morphologic state on the fracture surface, which at low power magnification appears as a series of curved ridges concentric with a spot at the junction of the tooth and base material. This centre is the origin of the fracture[4].

Whether the denture fractures from accidental cause (impact failure) or from forces due to masticatory or gliding movements (fatigue failure), the "strength" of the denture has been inadequate in each case. The strength of a denture depends on the shape, residual stresses, and the conditions of loading and the mechanical properties of the material [4].

The importance of the shape of the denture can best be explained by the 'notch effect'. This effect is due to the production of a local stress concentration, i.e. concentration of internal forces at the base of the notch on loading. The notch effect is an illustration of the general principle that stress concentration occurs in a loaded part wherever the surface contour changes sharply. More abrupt the changes in contour, the higher the concentration of stresses. The same considerations apply to a hole inside the material (porosity) or an inclusion such as dirt or plaster[4]. This explains the preparation of notch in the specimen, which corresponds, to the notch in the denture. The specimen fractures at the notch because that area has maximum concentration of internal forces on loading.

The residual stresses reveal themselves by crack formation, so initiate fracture[4]. This principle explains that the specimens that did not fracture with the first pendulum capacity were discarded because the stresses that developed in the specimen after the first impact are considered as residual stresses. These residual stresses lead to crack formation and weaken the specimen. So those specimens could not be used for further testing.

The intrinsic strength of the material is affected by the composition, which depends partly on the curing technique used. The principal factor in this respect is the amount of un-polymerized monomer remaining after curing[8]. For this reason, the specimens were stored in water at room temperature for two weeks so that un-polymerized monomer might leach out to impart maximum intrinsic strength to the acrylic resin denture base material.

Hence, failure due to deficiencies in design and construction contribute equally in fracture of prosthesis as do the intrinsic strength of the material[4,5]. These factors should therefore be borne in mind in assessing the reason for fracture of prosthesis practically[7].

Reinforcement of acrylic resin with various fibres like carbon-graphite fibres[6,26,30], polyethylene fibres[12-14,16,26], ultra high molecular weight polyethylene fibres[12,14,16,26] glass fibres [11,15,17-22,25,27,28,31-36] etc. has been tried successfully. Dental applications of fibre-reinforced acrylic resin require a unique balance of properties like biocompatibility, aesthetics, the ability of the fibre to bond to the resin matrix, ease of laboratory manipulation and stability in the oral environment[35].

Reinforcement with glass fibres has been widely studied. Karacer (2003) studied the effect of length and concentration of glass fibres on mechanical properties of an injection and a compression molded denture base. They found that impact strength of injection molded denture base polymer increased significantly with the use of chopped E-glass fibres[34] . Sung-Hun Kim (2004) studied the reinforcement of acrylic resin with glass fibres. They were successful in enhancing the impact strength of acrylic resin by reinforcing with glass fibres [37].

In the present study, acrylic resin was reinforced with glass fibres in various concentrations and the impact strength was compared with unreinforced acrylic resin. Enough specimens i.e., 80 in number were prepared for the study. This number is statistically satisfactory[42] for such studies as well as comparable to the sample size taken in previous studies[12,16,35]. The number of specimens in each group also fulfils the statistical requirement. In previous studies, Jacob John et al and Ozgul K. et al. used ten specimens for each group.

The size of the specimen was decided as per the machine used for testing the impact strength. The machine (Charpy type plastic impact testing machine, Tinius Olsen, USA) accepts the specimens that are made in accordance with the specifications (ASTM A370, EN 10045, and ISO 148). For making acrylic resin specimens, the procedure followed was same as the procedure for construction of an acrylic resin denture i.e. investing, de-waxing, packing, curing etc. This procedure was followed so that we could closely resemble the procedure followed in denture construction. Other investigators in previous studies[30,31,35,38] followed same procedure. However, in some studies[9,11] specimens were processed directly in dies. In the present study, it was avoided, as there were chances of water sorption and dimensional changes[25]. In one of the studies[36], they used silicone mould for easy removal of specimens. Here, in this study split dies were used for easy removal of wax blocks. Pre-weighed glass fibres were added in concentrations of 1%, 2% and 3%. Reinforcement with different concentrations of fibres has been tried in different studies[31,33,34]. However, San-Yue Chen et al. (2001) have concluded that when polyethylene fibres incorporated were over 3% (w/w) the resin became difficult to manipulate and was aesthetically unpleasing[29] . H.D. Stipho (1998) concluded that excess of fibres lead to lateral spreading of fibres in the mould and no significant mechanical advantages were found by incorporation of higher than 5% glass fibres content[18]. Vallitu (1994) used glass fibres as acrylic resin strengtheners and varied the ratio of poly (methyl methacrylate) in the mixture and found that lesser the poly (methyl methacrylate) powder, weaker the resin[11]. Manufacturer's instructions were followed for mixing, packing, curing and cooling.

The observations obtained for impact strength of specimens of both the categories A and B were tabulated and were represented in table 1 and 2 respectively. The mean and standard deviation of impact strength of specimens were also seen in respective tables. This shows a trend of increase in mean impact strength of acrylic resin when reinforced with glass fibres in different concentrations of 1%, 2% and 3%. As the concentration was increased, it was observed that impact strength also increased. The observations of the study shows a general trend of increase in impact strength but statistical analysis is needed to further interpret its significance.

When the mean impact strength of unreinforced acrylic resin specimen of group 1A and 1B (different thicknesses) was compared using student t-test the result was showing very highly significant difference as the p-value was less than 0.001 (Table 3). However, the overall difference between the thicknesses of specimens of two categories was 2:1 but the point at which the specimens fractured was approximately 4:1 due to the similar notch size. The results show that thicker specimens had greater impact strength than specimens that had less thickness. Tarik Kassab Bashi et al (2008) in his study found a significant difference in the strength of 1.5mm, 2.5mm and 3mm notched specimens[39]. However, he tested the transverse strength of the specimens but it clearly shows that an increase in thickness increases strength of material. Similar results were obtained when mean impact strength of reinforced acrylic resin specimen of group 2A and 2B, 3A and 3B & 4A and 4B were compared using student t-test the result was showing very highly significant difference as the p-value was 0.000 (p> 0.001-very highly significant) (Table 4, 5 and 6 respectively). This can be explained by the fact that longer the polymer chain, greater the number of entanglements (temporary connections) that can form among chains. Therefore, the longer the chain length, the more difficult is to distort the polymeric material. Properties such as rigidity, strength, melting point increases with increase in chain length[41].

To further delineate the significant variation between the means of impact strength of different groups, the post hoc test (Bonferroni test) was performed (Table 9 and 10). Statistical analysis revealed that the mean impact strength is significantly increased with reinforcement of acrylic resin with glass fibres in concentrations of 1%, 2% and 3%. Even when the groups reinforced in different concentrations were compared to each other the results showed very highly significant difference. This means that specimens reinforced with 1% glass fibres vary significantly from the specimens reinforced with 2% and 3% glass fibres and vice versa holds true for every group. The results comply with the results of San-YueChenin et al. (2001) who concluded that 3% weight of polyethylene fibres could be added to acrylic resin without significantly altering the physical properties of acrylic resin[21]. The fibres incorporated adhere to the matrix of the acrylic resin and the stresses are transferred from the polymer matrix to the fibre. Various other factors like strength of the interfacial bond, the shear strength of the matrix and the tensile strength of fibres play an important role[21,26]. Gutteridge (1988)[8] found that incorporated fibres could not be added over 4% weight. He found that viscosity was increased with the amount of fibre incorporated and manipulation became difficult. Also the reduction could be the result of clustered fibres and void spaces that may act as stress concentration points in the polymer matrix and thus decrease the interfacial bonding between fibre and matrix. Higher glass fibre concentrations may have acted as inclusion bodies in the polymer and disturbed the homogenous matrix of the resin.

In the present study, we found that impact strength is reduced remarkably, when the thickness of acrylic resin specimens is reduced to half the original thickness. Impact strength is increased remarkably on reinforcing the acrylic resin with glass fibres. Maximum increase in impact strength is obtained when acrylic resin is reinforced with glass fibres in 3% concentration.

Table 9: Post Hoc Tests (Bonferroni) of category A specimen

Group	Groups	Mean Difference	p-value
1A	2A	-3.45375	0.000
	3A	-5.04425	0.000
	4A	-5.32341	0.000
2A	1A	3.453750	0.000
	3A	-1.59050	0.000
	4A	-1.86966	0.000
3A	1A	5.044250	0.000
	2A	1.590500	0.000
	4A	-0.27916	0.000
4A	1A	5.323410	0.000
	2A	1.869660	0.000
	3A	0.279160	0.000

Table 10 : Post Hoc Tests (Bonferroni) of category B specimen

Group	Groups	Mean Difference	p-value
1B	2B	-0.496700	0.000
	3B	-0.765870	0.000
	4B	-1.178280	0.000
2B	3B	-0.269170	0.000
	4B	-0.681580	0.000
	1B	0.7658700	0.000
3B	2B	0.2691700	0.000
	4B	-0.412410	0.000
	1B	1.1782800	0.000
4B	1B	0.496700	0.000
	2B	0.6815800	0.000
	3B	0.4124100	0.000

Conclusion

The present study was conducted to study the effect of glass fibre reinforcement in different concentration on impact strength of acrylic resin denture base material of various thicknesses.Based on the observations and the results, the following conclusion has been drawn:

- Impact strength is reduced remarkably when the thickness of acrylic resin specimens is reduced to half the original thickness.
- Impact strength is increased remarkably on reinforcing the acrylic resin with glass fibres.
- Maximum increase in impact strength is obtained when acrylic resin is reinforced with glass fibres in 3% concentration.

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Source of Support: NIL
Conflict of Interest: None Declared