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RESEARCH ARTICLE

EFFECTIVENESS OF MICROWAVE STERILIZATION ON TENSILE STRENGTH OF POLYMETHYLMETHACRYLATE DENTURE BASE RESIN REINFORCED WITH GLASS FIBRES: AN IN VITRO STUDY

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ABSTRACT

Statement of problem: Glass fibres reinforcement and microwave polymerization, both has been suggested as a method to improve the mechanical strength of acrylic denture base. However the post polymerization effect of microwave sterilization on Polymethylmethacrylate Denture Base Resin Reinforced with Glass Fibre has not been investigated.

Purpose. The study analyzed the effect of microwave Sterilization on Tensile Strength of Polymethylmethacrylate Denture Base Resin Reinforced with Glass Fibres.

Materials and Methods: In this study Heat cure acrylic denture base resin material and loose glass fibres of diameter 12 microns and length 15 mm, were used. A total of 30 specimens were polymerized by conventional heat cure according to manufacturer's instruction and divided into 3 groups (N=10). Group A is control, Group B is acrylic resins reinforced with 5% glass fibres, and Group C is acrylic resins reinforced with 5% glass fibres, sterilized by microwave. Group C specimens were subjected to post polymerization sterilization in a microwave oven in power 800W and time setting of 5 minutes. Tensile strength load measurements were made using universal testing machine at a crosshead speed of 3 mm/min with a span of 10 mm. The tensile strength values were calculated in Newton/mm2. Data analysis included one-way ANOVA and independent t- test.

***Results:** The tensile strength of Group C with application of microwave irradiation for sterilization, demonstrated significant strength improvement with respect to Group B and Group A. There was a statistical significant difference seen in between the groups (p=0.001).

Conclusion: Microwave post polymerization irradiation for sterilization of acrylic resin prosthesis reinforced with glass fibres can be an effective method for increasing the tensile strength of acrylic resin.

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INTRODUCTION

Dr. Walter. H. Wright in the year 1937, invented acrylic resin, which has remained one of the most common materials being used in prosthodontics. Presently it is the most widely used denture base material (Frederick and Rueggeberg, 2002). Acrylic resin dentures have inherent disadvantage of low strength which causes them to fracture during service as a result of poor mechanical properties such as tensile strength, flexural strength, and fatigue failure etc. Failure occurs most often through impact as a result of dropping the denture during cleaning the denture, unsatisfactory occlusion, excessive biting force and/or poor fit of the prosthesis and accidental trauma are important factors for denture fracture (Keyf and Uzun, 2000). To overcome these shortcomings, mechanical reinforcement through the inclusion of -Metals in the form of powder, wires, and meshes and Carbon, glass, aramid, nylon and ultra high modulus polyethylene fibres (Uzun *et al*., 1999; O'Brien, 2002). Glass fibres are also used in dentistry due to the fact that they are superior in esthetics and excellent mechanical properties (John *et al*., 2001). Effective fibre reinforcement is dependent on many variables, including the type of fibres; percentage in the matrix; modulus; distribution of fibres; length; orientation and form (continuous parallel, chopped and woven) (Solnit, 1991). A study done by Carlos Eduardo, Rosangela and Jose Maricio, on flexural strength of autopolymerizing denture reline resins with microwave post

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polymerization treatment had shown it increased the flexural strength of resin (Carlos Eduardo Vergani *et al.*, 2005). But there are no studies done to find the effect of microwave sterilization on mechanical properties of heat cure denture base acrylic resin, incorporated with glass fibers. The aim of the present study was to find the Effectiveness of Microwave Sterilization on Tensile Strength of Polymethylmethacrylate Denture Base Resin Reinforced with Glass Fibres.

MATERIALS AND METHODS

For this study a stainless steel die of dimension 65mm×12.5mm×2.5mm was fabricated. The dies were invested in a brass flask for conventional heat polymerization. Acrylic resin was mixed and manipulated according to manufactures instruction, and as recommended by the ADA specification No. 12. Resin was mixed in ceramic jar according to manufacturer's recommended ratio (polymer and monomer 3: 1 by volume) with 5% of loose glass fibres pretreated with monomer, added in jar with tweezer. The resin was left in the mixing jar until it reached the dough stage, then mix was kneaded thoroughly to homogenous dough and packed in the mold space. Trial closure was done and flasks were bench cured for 30 minutes at room temperature. In the present study total 30 specimens were fabricated. The specimens were divided into 3 groups (10 specimens in each group). Group A is Acrylic resin without glass fibres, stored in distill water without microwave sterilization (Control Group), Group B Acrylic incorporated with glass fibres, without microwave sterilization .Group C is Acrylic incorporated with glass fibres subjected to microwave sterilization at 800w, 5min daily for 45 days. Group C specimens were placed in microwave oven and exposed to microwave energy directly. All specimens were stored in distill water at $37^0 \pm 1^0$ C.

Tensile strength test

All specimens were subjected to tensile strength testing in universal testing machine, at a crosshead speed of 3 mm/s. load was applied until failure and the fracture load was recorded in Newton. Tensile strength was calculated using formula: T.S =F(N)/A (mm)2, T.S = Tensile strength (N/mm2) or (Mpa). F= Force at failure (N).A= Cross sectional area at failure $(mm)^2$.

Statistical analysis

The data was evaluated statistically using One-way ANOVA to compare mean tensile strength among Group A, Group B and Group C, and independent t-test was used to evaluate mean tensile strength between two groups.

Table 1. One-way ANOVA analysis

One way descriptives Tensile						
	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Group A	10	32.1313	2.27759	.72024	28.99	35.04
Group B	10	38.1859	2.49481	.78893	35.18	42.28
Group C	10	43.6636	1.89642	.59970	40.42	46.38
Total	30	37.9936	5.25421	.95928	28.99	46.38

Table 2. Independent t-test between Group B and Group A

Group Statistics					
	GROUP	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
TENSILE	**Group B**	10	38.1859	2.49481	.78893
	Group A	10	32.1313	2.27759	.72024

Table 3. Independent t-test between Group C and Group A

Group Statistics					
	GROUP	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
TENSILE	**Group C**	10	43.6636	1.89642	.59970
	Group A	10	32.1313	2.27759	.72024

Table 4. Independent t-test between Group C and Group B

Group Statistics					
	Group	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
TENSILE	**Group C**	10	43.6636	1.89642	.59970
	Group B	10	38.1859	2.49481	.78893

RESULTS

Table 1 shows One-way ANOVA analysis , of tensile strength of Group A , Group B, and Group C and compares the mean tensile strength between Group A ,Group B , Group C. The mean ± standard deviation of tensile strength scores between the three groups A,B and C are 32.13±2.3, 38.19±2.5 and 43.66±1.9 respectively. There was a statistical significant difference seen in between the groups (p=0.001). Table 2 is independent t – test analysis of tensile strength of Group B and Group A. It compares the mean tensile strength between Group B and Group A. The mean ± standard deviation of tensile strength scores between groups B and A were, 38.19±2.5 and 32.13±2.3 respectively. There was a statistical significant difference seen in between the groups (p=0.001)
Table 3 is independent t- test analysis applied to compare the tensile strength between group C and A. The mean ± standard deviation of tensile strength scores between groups C and A were, 43.66±1.9and 32.13±2.3 respectively. This shows that there is significant increase of mean tensile strength in group C when compared to group A. There was a statistical significant difference seen in between the groups (p=0.001).

Table 4 is independent t- test analysis applied to compare the mean tensile strength between group C and B. The mean ± standard deviation of tensile strength scores between groups C and B were 43.66±1.9and 38.19±2.5 respectively. This shows that there is moderate increase of mean tensile strength in group C when compared to group B. There was a statistical significant difference seen in between the groups (p=0.001).

From the mean value data it can also be calculated that he percentage increase of mean tensile strength between Group A and Group B is 18.83% and the percentage increase of mean tensile strength between Group A and Group C is 35.89%, while the percentage increase of mean tensile strength between Group B and Group C is 14.35%.

DISCUSSION

The tensile strength testing conducted here is relevant because in dental prosthesis it comes into play during flexion of the prosthesis .The result from the present study demonstrated the effect of microwave post polymerization sterilization treatment on tensile strength of heat cure acrylic resin reinforced with glass fibres. The result showed that specimens exposed to microwave has better tensile strength than specimens not exposed to microwave. The findings are in agreement of results of those reported by Carlos Eduardo, Rosangela and Jose Mauricio[7]. In the present study specimens were exposed in dry conditions because uptake of water by the acrylic resin would lead to plasticization of resin making it more flexible and resilient. Since microwave generates heat inside the resin, the specimens exposed shown greater strength can be related to further degree of conversion, and there may be further increase in bonding between resin and fibres. It has been demonstrated that the rise in temperature increases as microwave power increases. Thus exposing these materials to microwave of 800W from lesser watts as 650 W could increase the rate of post polymerization reactions by free radical mechanism. The interpretation of the results made in this study must be made with caution. Considering that stresses can be released when the polymerized acrylic resins are subjected to further heating by microwave, additional dimensional changes may be expected. So the key is in knowing the power /time combination appropriate for the material used. It is important to note that clinical conditions and use were not simulated in this investigation. So further research should simulate the intraoral environment and evaluate the mechanical response of microwaved specimens.

Conclusions

Within the limitations of this in vitro study, the data obtained helped to derive the following conclusions:

1. The mean tensile strength of conventional heat cure denture base resin, processed by conventional heat was 32.13 N/mm^2.
2. The mean tensile strength of heat cure denture base resin reinforced with 5% glass fibres processed by conventional heat was 38.19 N/mm^2, which was 18.83% greater than the mean tensile strength of conventional heat cure denture base resin not reinforced with glass fibres.
3. The mean tensile strength of conventional heat cure denture base resin reinforced with 5% glass fibres processed by conventional heat, sterilized by microwave, 5 minutes daily for 45 days, was 43.66 N/mm^2, which was 35.89 % greater than unreinforced denture base resin processed by conventional heat and 14.35% greater than 5% glass fibres reinforced denture base resin, not sterilized by microwave.

Among all the specimens, heat cure denture base resin reinforced with 5% glass fibres sterilized by microwave, 5 min daily, for 45 days, had the highest mean tensile strength value. Whereas unreinforced heat polymerized specimen showed the least mean tensile strength value. Hence, it can be concluded that microwave post polymerization sterilization exposure of polymethylmethacrylate denture base resins reinforced with glass fibres is an effective method to further strengthen the prosthesis and increase the life of prosthesis.

REFERENCES

Beyli MS and Fraunhofer JA. 1981. An analysis of causes of fracture of resin dentures. *J Prosthet Dent*, 46: 238-41.

Carlos Eduardo Vergani, Rosangela Seiko, Ana Claudia. 2005. Flexural strength of autopolymerizing denture reline resins with microwave postpolymerization treatment. *J Prosthet Dent*, 93:577-83.

Craig RG. 2002. Restorative dental materials.11th edition, Mosby Year Book Inc.

David A Wagner, Donald J. Pipko. 2015. The effect of repeated microwave irradiation on the dimensional stability of a specific acrylic denture resin. *Journal of Prosthodontics*, 24: 25-31.

De Clerck JP. 1987. Microwave polymerization of acrylic resins used in dental prostheses. *J Prosthet Dent*, 57: 650-58.

Ertas N, Hersek N and Sahin E. 2001. Water sorption and dimensional changes of denture base polymer reinforced with glass fibers in continuous unidirectional and woven form. *Int J Prosthodont*., 13: 487-93.

Frederick A and Rueggeberg. 2002. From vulcanite to vinyl, a history of resins in restorative dentistry. *J Prosthet Dent*, 87: 364-79.

John J, Shivaputtrappa A, Gangadhar and Shah I. 2001. Flexural strength of heat polymerized PMMA denture resin reinforced with glass, aramid or nylon fibers. *J Prosthet Dent*, 86: 429-49.

Kanie T, Arikawa H, Fujii K. 2002. Mechanical properties of reinforced denture base resin. The effect of position and the number of woven glass fibers. *Dent Mater J*., 21: 261-9.

Keyf F and Uzun G. 2000. The effect of glass fiber reinforcement on transverse strength, deflection and modulus of elasticity of repaired acrylic resin. *Int Dent J*., 50: 93-7.

O'Brien WJ. 2002. Dental material and their selection. 3rd edition, Quintessence Publishing Co Inc.

Solnit GS. 1991. The effect of methylmethacrylate reinforcement with silane –treated and untreated glass fibers. *J Prosthet Dent*, 66: 310-14.

Uzun G, Hersek N and Tincer T. 1999. Effect of five woven fiber reinforcements on the impact and transverse strength of a denture base reins. *J Prosthet Dent*, 81 (5): 616-20.

Vallittu PK. 1999. Flexural properties of acrylic resin polymers reinforced with unidirectional and woven glass fibers. *J Prosthet Dent*, 81: 318-26.

Williamson DL, Boyer DB, Aquilino SA and Leary J M. 1994. Effect of polyethylene fiber reinforcement on the strength of denture base resin polymerized by microwave energy. *J Prosthet Dent*, 72: 635-8.

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