TRANSVERSAL STRENGTH OF ACRYLIC RESIN PLATE REPAIRED BY VISIBLE LIGHT CURED AND HEAT CURED RESIN

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ABSTRACT

Studies on transversal strength comparison in acrylic resin repaired by visible light cured (VSL) and heat cured rounded resin had been performed. This study used laboratory experimental method. Analysis unit of materials comprised of heat-cured acrylic resin. These units were previously prepared with gypsum material, a large curvet, and master model from brass metals. Resulted printings were filled with acrylic resin mixture, followed by boiling for ± 60 minutes. Resulted analysis units were broken in middle part and shaped in rounded triangle, followed by repair with two types of resin, visible light cured (VLC) and heat cured resin. Repair by VLC resin applied ready-to-use VLC materials and were provided with lightning by means of VLC curing for ± 10 minutes, whereas heat cured applied acrylic resin mixture and boiled similar to the making of the units. The units were divided into 2 groups, each containing 15 units. The first group was repaired by VLC resin, whereas the second by heat cured acrylic resin. Measurement of transversal strength was tested by an autograph, and transversal strength differential between both analysis unit groups were determined using t-test statistic analysis with level of significance of 5%. The result indicated that the transversal strength for both groups were significantly different, in which transversal strength of acrylic resin repaired by VLC were lower compared to acrylic resin repaired by heat cured.

***Keywords**: transversal strength, acrylic resin, visible light cured, heat cured*

INTRODUCTION

Acrylic resins have been commonly used in medical field both as repair or implant materials for overall management in medicine or dentistry. Most commonly used acrylic resin includes head cured resin (polymethyl metacrylate), which is polymerized via boiling process. A new material, which is more effective and time-efficient, visible light cured (VLC) resin, has recently been offered. This material is polymerized by means of visible light. This material, the latest type in medicine, is developed by Dentsupply International USA. Polymerization technique by visible light using wavelength of 470 nm may be applied to repair various polymer types, both disposable and non-disposable in medical equipments. Many medical workers worldwide nowadays turn to use this material (Tavakoli, 2002). Alsawaf (1991) claims that VLC resin may provide several benefits such as high accuracy, simple in construction, extreme strength, and reliable dimensional stability.

Basic material of VLC resin is polyurethane. Most products available for commercial is polyurethane system with basic material of polyether or polyesther (Tavakoli, 2002). Resin materials also contains a photo initiator of camphoroquinone visible light-sensitive with short wave length of 400-500 nm. The light may penetrate until the depth of 5-6 mm for 10-25 minutes of lighting period (Ogle, 1986). In 2001, new type of polyurethane has been developed for biopsy management with basic material of hydrophilic polyurethane.

VLC resin materials include thermoplastic material. The material has a putty consistency at room temperature and may be formed with fingers or specific devices pressed according to the desired shape. This property is beneficial for various application procedure with good flow ability, thus VLC resin may adapt to different tissues it applied to. In a comparative study performed by Razavi and Khan (1990) between VLC resin and heat cured acrylic resin, it was found that VLC resin had higher attachment strength to meet the requirement for recommended clinical use.

Some physical properties of VLC resin according to American Dental Association (ADA) in number 12 specification are as follows: linear shrinkage of VLC resin was lower than heat cured acrylic resin, and tensile strength of VLC resin was higher compared to heat cured. Data from dimensional alteration test demonstrated that VLC resin had better accuracy than heat cured. In addition, VLC resin has more benefits as summarized in American Dental Association specification number 41, including non-irritating to oral mucosal membrane (in squirrels), not resulting sensitive reaction to skin (in guinea pig), and non-cytotoxic (in rat cells).

The material for comparison in this study was heat cured acrylic resin. Basic material for heat cured is

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polymethyl methacrylate polymerized via boiling (heat) process. Selection of heat cured was based on benefits of the material such as easy processing, small dimensional changes, low water absorption (Anderson, 1976). Acrylic resin consists of polymer (powder) and monomer (fluid), the chemical structure and basic material are as follows (Combe, 1986):

Polymer:
Polymethyl methacrylate
0.2 – 0.5% benzoil peroxide initiator as the first step in polymerization.
± 1% pigments admixture in polymer particle

Monomer:
Methyl methacrylate
± 0.006 Hydroquinone as a stabilitator

Cross linking material: ethylene glycol dimethacrylate or ethyl methacrylate to assist in repairing the two longest polymer molecules, thus resin became harder and stronger as well as resistant to etches and fractures.

Most commonly used repair material has been heat-cured acrylic resin, which in the making process requires several steps resulted in less efficient in time and energy. Given new innovation, VLC resin, it may be applied as an alternative repair material in clinical practice. As manufactures offer certain benefits of VLC resin compare to heat cured acrylic resin, the use of the material had beneficial effects in easiness to use and can be immediately made, as well as better esthetic and more efficient in time.

In performing repair there were various repair methods that can be applied, including round type repair. The study was conducted to find transversal strength comparison of repaired-acrylic resin by VLC resin and rounded heat cured. Selection of repair shape was aimed to increase repaired-area surface to support better attachment between analysis unit and repaired materials that will eventually elevate the transversal strength.

METHODS

This study used a laboratory experimental method with following steps: Analysis unit materials were made from heat cured acrylic resin. Analysis units were first made by gypsum material in a large curvet in coordination with master models of brass metal size of 65 x 10 x 2.5 mm. Then the resulted materials were filled with acrylic resin mixture consisting of powder and liquid in ratio according to manufacture's guidelines. Repair by VLC resin used application of ready-to-use VLC material and lighting with curing CLV device for ± 10 minutes. Meanwhile repair by heat-cured acrylic resin used acrylic resin mixture of powder and liquid, followed by boiling as for making of analysis unit. Transversal strength was measured using Autograph (Shimadzu AG-10TE, Japan) and estimated by the formula of McCabe (1985).

RESULTS AND DISCUSSION

Mean and SD (standard deviation) value of transversal strength in acrylic resin plate repaired by VLC resin and heat cured was shown in Table 1.

Table 1: Mean and SD value of transversal strength to examined analysis unit X ± SD (Kgf/mm^2)

Analysis unit groups	N	X	±	SD
I	15	0,0035	±	0,00051
II	15	0,0050	±	0,00044

Notes:
Group I : Acrylic resin plate repaired with VLC resin
Group II : Acrylic resin plate repaired with *heat cured* resin
N : Number of analysis unit
X : Mean of *transversal strength*
SD : Standard Deviation

Results of data analysis using "t-test" obtained a probability (p) = 6.179. The value was below degree of significance (a) = 0.05. This indicates that there were a significant difference in repaired-acrylic resin by VLC resin and rounded heat cured, where repaired-acrylic resin by VLC resin is lower than heat cured-repaired. The difference resulted from different type of VLC resin used to repair acrylic resin, particularly in mayor composition of acrylic resin, polymethyl methacrylate, whereas VLC resin consists of polyurethane

dimethacrylate. Physical chemistry bonding only work if it was mediated by agent bonding materials, where free radicals may form a chemistry bonding, thus acrylic resin repaired by VLC resin will attach one another. In study by Takahashi and Chai (2001), resin VLC produced better attachment with similar type of resin repair, as for different type of resin may result in relatively less bonding strength. Many factors may produce influence to resin bonding strength according to Minami and Suzuki in a journal published in 2004, including type of resin, temperature alteration, and treatment on surface of repair.

It has been demonstrated that during repair process with two types of materials, repair by heat-cured acrylic resin requires several steps, initiated by mixing acrylic resin powder and liquid for ± 60 minutes during boiling process. This technique needs accuracy and carefulness in manipulation as well as relatively more time and energy. In the other hand, repair by VLC resin only apply ready-to-use VLC material, followed by lighting with cured VLC for ± 10 minutes, thus the technique is more practice, effective, and efficient.

CONCLUSION

Results obtained in the study to measure transversal strength in acrylic resin plate repaired by VLC resin and rounded heat cured conclude that there was a significant difference between the two analysis unit groups, where transversal strength of repaired acrylic resin by VLC resin decreased compared to heat cured. VLC resin, however, had lower transversal strength although it has certain benefits such as more practice, effective and efficient in using, thus VLC resin may be applied as an alternative repair material in medicine.

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