ANALYSIS SORPTION, SOLUBILITY AND RESIN COMPOSITE COHESIVE STRENGTH LIGHT-CURED IN DIFFERENT LIGHT INTENSITIES

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Abstract. *The frequent use of battery power light curing devices requires caution of the professional to check if it is working appropriately. The aim of this study was to examine the sorption and solubility capacity and the cohesive strength of composite resins at different battery levels of curing unit devices. Composite resin discs were made of composite nanoparticle resin Z350 (3M ESPE St. Paul, MN, USA) and light-cured with LED Coltolux devices (Coltente, Feldwiesenstrasse, Switzerland). Three experimental groups were made with each unit (A, B and C) ranging the intensity of the emitted light and the level of the battery in 100% for G1 (n = 10), 50% battery charged for G2 (n = 10) and battery with less than 10% for G3 (n = 10). An analytical balance was used to weigh the samples (AG200 - GEHAKA, São Paulo, SP, Brazil) to obtain M1. Then, specimens were immersed in artificial saliva and stored at 37 ° C. Afterwards, samples were periodically weighed until its weight stabilization for M2. Subsequently the samples were brought to a desiccator containing silica gel at 37 ° C and weighed periodically until achieve constant weight for M3. Diametral tensile strength was then performed using 100N loaded cell at 0.5 cm / min speed . The G3 and G2 groups presented the highest sorption with (0.001) and (0.016) respectively. G3 group showed lower cohesive strength than G1 (0.028) and there was no significant difference between groups of solubility (P <0.05). Light curing of composite resin is hampered by low light intensity due to battery power drop resulting in higher sorption oral fluids and lower strength of the material*
Key-words*: Curing lights, Sorption, Solubility, Diametral tensile, Photoiniciator systems*

1. INTRODUÇÃO

Since 1980, light-activated composite materials are commonly used for tooth-colored restorations. The popularity of light-activated composites is due to their excellent esthetics, biocompatibility, and wear resistance and above all to their clinical use.

However, volumetric changes of light-activated composites, primarily volumetric shrinkage and shrinkage stress during polymerization process result in the development of tensile and/or shear stresses at cavo-restoration interface. The stresses and material flow during polymerization period may disrupt the adhesive joint of the composite restorative sys- tem to the cavity walls resulting in formation of contraction gap at tooth–composite interface Loss of dental structures either by caries, fractures, coronal preparations or non-carious wear is a key factor for altering the biomechanical behavior of teeth (Soares et al., 2008 e Ferracane et al.,2012). Therefore, restorative materials that present mechanical properties similar to dental tissues can be advantageous for repairing NCCLs and restoring the stress-strain pattern of sound teeth (Soares et al., 2013). Although several studies have analyzed and described restorative protocols for NCCLs, the literature is still missing deeper investigations considering the effect of different materials and restorative techniques for these lesions (Soares et al., 2013, Rahiotis et al., 2004, Sakaguchi et al., 1998).

Some light polymerization modes can now be used to start the resin composite polymerization reaction(Friedl et al 200). Modes that use high initial irradiance provide higher degree of conversion and better physical properties (Rueggeberg et al 2011). However, when resin composites are submitted to initial high irradiance, a higher shrinkage stress may be induced during the polymerization reaction, increasing marginal gap formation at the cavity wall-resin composite inter- faces(Bowen et al 1967).

In clinical practice, gradual polymerization modes have been introduced in an attempt to minimize the harmful effects of shrinkage stress developed by resin composites(Peutzfeldt et al 2005). These polymerization modes, in which the resin composites are first submitted to low irradiance followed by an increase in irradiance, allow shrinkage stress relief by polymer chain relaxation (Asikainen et al 1990).

2. METHODS AND MATERIALS

2.1. Sorption and Solubility

To obtain the sorption (SOR) and solubility (SOL) values, the specimens were separated according to the groups G1 (n=10), G2 (n=10) and G3 (n=10).

Initially, all the specimens were included in a desiccator with silica gel and maintained in an oven at 37°C for 24 hours. After this period, the specimens were weighed on an analytical balance (AG200 – GEHAKA, São Paulo, SP, Brasil), with a precision of a hundredth of a thousandth of a gram at intervals of 24 hours until a constant weight was obtained, which was considered m1. Then, the specimens were placed individually in plastic tubes (eppendorf) and immersed on 10 ml of artificial saliva (Table 1) and stored in the oven at 37°C. They were weighed at intervals of 1, 24, 48 and 72 hours to progressive scan of the sorption. Between the weighing, the specimens were immersed in media storage and kept in 37°C oven. After 7 days, the samples were weighed again and the obtained mass was considered m2. For this, after the removal of the storage medium, the excess liquid was removed by absorbent paper and the weight recorded. After the weighing, the samples were taken to the desiccator with silica gel in an oven at 37ºC for the elimination of absorbed water. The samples were again weighed daily to obtain constant mass, considered m3.

The major and minor diameters and thickness of the samples were measured at four points using digital calipers (CD6 CS, Mitutoyo Corp, Kanagawa, Japão), after final drying in m1, these values being used to obtain the volume (V) of each sample in mm and to calculate the sorption (SOR) and solubility (SOL) rates, according to the following formulas:

$Sor = (m2-m3)/V$ $\qquad$ $Sol = (m1-m3)/V$

where, ml is the mass of the specimen in µg before the immersion in liquid medium, m2 is the mass of the specimen in µg after the immersion in liquid medium over 7 days, m3 is the mass of the specimen in µg after being conditioned in desiccator with silica gel until constant mass and the volume (V) of the specimens in mm3 be obtained (Archegas et al., 2008).

2.2. Diametral tensile

DTS is the tensile strength of brittle materials generally determined by subjecting a rod, wire, or dumbbell-shaped specimen to tensile loading (Anusavice KJ: Phillips' Science of Dental Materials, (ed 11). St.Louis, MO, Saunders, 2003, pp. 73, 88).

The diametral tensile strength (DTS) test was performed using an EMIC 2000 DL (São José dos Pinhais, PR, Brazil) at a crosshead speed of 0.5mm/min. Specimens were positioned vertically on the testing machine base and subjected to compressive load until failure.

3. RESULTS

3.1. Sorption and Solubility

The groups G1, G2 e G3 did not show any statistical difference on solubility test. Sorption and diametral tensile strength results are presented in figures 1 and 2.

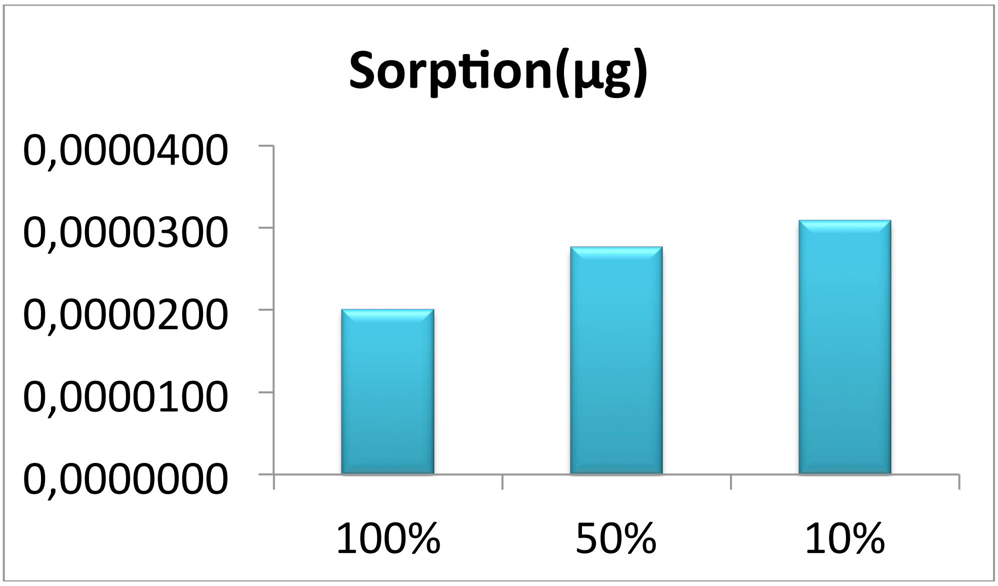

Figure 1 - Sorption (SOR) results showing the difference among the groups. The G3 and G2 groups presented the highest sorption G1 (0.001) and (0.016) respectively

3.2. Diametral tensile

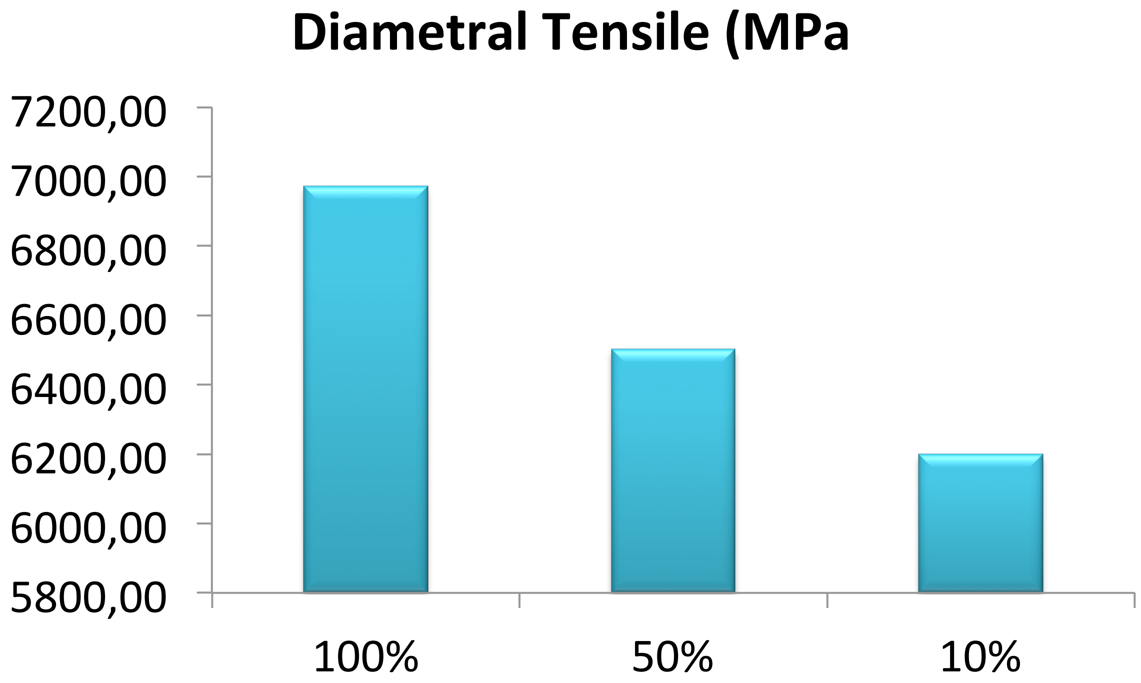

Figure 2 – Diametral tensile strength presenting G3 group with lower cohesive strength that G1 (0.028).

4. REFERENCES

1. Soares P, Santos-Filho P, Soares C, Faria V, Naves M, Michael J, Kaidonis J, Ranjitkar S, Townsend G. Non-carious cervical lesions: influence of morphology and load type on biomechanical behaviour of maxillary incisors. Aust Dent J. 2013 Sep;58(3):306-14.
3. Bowen RL. Adhesive bonding of various materials to hard tooth tissues. VI. Forces developing in direct-filling materials during hardening. Journal of the American Dental Association. 1967;74(3):439-45.
2. Lim BS, Ferracane JL, Sakaguchi RL, Condon JR. Reduction of polymerization contraction stress for dental composites by two-step light-activation. Dental materials : official publication of the Academy of Dental Materials. 2002;18(6):436-44.
12. Rueggeberg FA. State-of-the-art: dental photocuring--a review. Dental materials : official publication of the Academy of Dental Materials. 2011;27(1):39-52.
11. Friedl KH, Schmalz G, Hiller KA, Markl A. Marginal adaption of Class V restorations with and without "softstart-polymerization". Operative dentistry. 2000;25(1):26-32.
21. Soares CJ, Bicalho AA, Tantbirojn D, Versluis A. Polymerization shrinkage stresses in a premolar restored with different composite resins and different incremental techniques. J Adhes Dent. 2013 Aug;15(4):341-50.
8. Rahiotis C, Kakaboura A, Loukidis M, Vougiouklakis G. Curing efficiency of various types of light-curing units. European journal of oral sciences. 2004;112(1):89-94.
9. Sakaguchi RL, Berge HX. Reduced light energy density decreases post-gel contraction while maintaining degree of conversion in composites. Journal of dentistry. 1998;26(8):695-700.

5. ACKNOWLEDGMENTS

This study was supported by Coordination for the Improvement of Higher Education Personnel (CAPES) and the Minas Gerais State Research Foundation (FAPEMIG). The authors would like to thank the Integrated Dental Research Laboratory of the Federal University of Uberlândia (CPBio) for the structure to perform the strain gauge tests. The authors are indebted to dental technician, Mr. Marco Galbiatti, for processing the ceramic restorations.

6. ACCOUNTABILITY OF INFORMATION

All the authors are responsible for the information include on this paper.