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Characterization of Polymerization Shrinkage and Water Absorption of Low-shrinkage Light-polymerized Composite Resin Materials

Mayyadah Al-Mozainy
King Saud University, Saudi Arabia

Aim of this study: to compare the polymerization shrinkage and the water sorption values of different low shrinkage composite materials.

Materials and method: different commercially available composite resin materials were used in this study: Reflexions XP (BISCO, IL, USA), Kalore (GC CORPORATION, JP -Tokyo), AELITE LS (BISCO, IL, USA), Filtek P90 (3M, St. Paul, USA) and Tetric N-ceram (Ivoclar Vivadent, NY, USA). Ten specimens were prepared from each material (N=50). The composite specimens were light polymerized by LED light-curing unit (SmartLite IQ2, Dentsply, Model No. 200, USA) according to the manufacturer recommendation. The test configuration used is a stiff silicon mould (inner length 10.0 mm, width 5.0 mm, and height 2.0 mm), which circumscribed the composite specimens. A foil electrical resistance gauge was placed on the base of the silicon mold. Polymerization strain force measurement were recorded continuously by strain gauge monitor (DMD-22, portable, 10-channel, OMEGA Engineering, INC. Stamford, USA) during polymerization process strain force values were recorded at equal intervals every 5 seconds for the 1st minute. The composite specimens were then detached from the strain gauges and the initial weight was taken (after one hour) for each specimen using an electronic weighing scale (PRECISA 1600 C, Págoerlikon AG, Zurich, Switzerland). Then, the specimens were placed in vacuum desiccators using calcium sulfate. After 24 hours desiccation, the weight of the specimens was measured again. The specimens were then stored in distilled water at 37°C for 1 month. The weight of the specimens were taken during mg) and W0 is weight of specimen just before storing in 37°C distilled water (in mg). statistical software (SPSS, Version 16) was used. The data for the polymerization strain measurements were analyzed by two-way analysis of variance (ANOVA) and Tukey's HSD, followed by one-way analysis of variance (ANOVA) at 95% level of confidence. For comparing the mean of the strain of the tested materials, a non-parametric Kruskal-Wallis and post Hoc paired tests were used. The data for water absorption were analyzed by two-way analysis of variance (ANOVA), followed by one way analysis of variance (ANOVA) and Tamhane test at 95% level of confidence.

Results: Tetric N-ceram showed the highest polymerization strain mean (-12.52 ± 10.958) followed by Filtek P90 (-10.99 ± 9.188), Reflexions XP (-8.77 ± 6.662), GC Kalore (-5.20 ± 3.185), and the least polymerization strain was recorded for Aelite LS (-3.95 ± 2.717). Tetric N-ceram and Filtek P90 showed no significance between them. GC Kalore and Aelite LS showed no significance in comparison to each other with $P=1.00$, although they were significantly lower than the other tested materials ($P=.000$). However, Reflexions XP was significantly different from all the tested materials ($P=0.000$). During water storage, there were no significant differences in mean weight values within any group of the tested materials at any time interval. Filtek P90 showed the highest mean growth (5.21 ± 5.71) among the tested materials. Comparing the mean of water absorption percentages of the tested materials to each other, Filtek P90, Aelite LS and GC Kalore showed no significant difference to each other with $P=0.986$. AeliteLS, GC Kalore and Reflexions XP were also not significant to each other with $P=1.00$.

Tetric N-ceram and Reflexions XP were not significantly different from each other with $P=0.411$, although Tetric N-ceram was significantly different from all the other tested materials with $P=0.000$.

Conclusion: The results of the present study showed that the polymerization shrinkage for all the tested materials was the greatest during the light activation reaction and decreased after the curing light was turned off, and they all presented their highest readings during the first twenty seconds.

The highest polymerization shrinkage strain was recorded for Tetric N-ceram followed by Filtek P90, Reflexions XP, GC Kalore and Aelite LS.

During water storage, there were no significant differences in mean weight values within any group of the tested materials at any time interval.

Filtek P90 showed the highest mean growth among the tested materials, followed by Aelite LS, GC Kalore and Tetric N-ceram. Where Tetric N-ceram weight remained constant throughout the storage period.

mmozainy@yahoo.com