学位論文内容の要旨

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学　位　論　文　題　名

The multiple evaluations of the influence of light conditions to "Touch and cure" resin cements - in terms of bond strength test, in situ microhardness test and Raman spectroscopy

"Touch and cure" システム型レジンセメントに対する光照射条件の影響についての多面的検討 - 接着試験，in situ マイクロ硬さ試験およびラマン分光法による重合測定を用いて

キーワード　MicroRaman spectroscopies, Microhardness, Degree of conversion, polymerization, Resin cement

Recently, the new and novel "Touch and cure" technology for dual-cured resin cement was developed and introduced. This new technology is claimed that the polymerization reaction would start immediately after the mixed cement touching dentin surface. This dentin surface is already applied with the primer, containing the new unique added chemical polymerization initiator, before activated by using the light-curing unit.

This study was aimed to evaluate effect of light and dark conditions to two "Touch and cure" type and one conventional type dual-cured resin cements, in terms of bond strength testing. Nanoindentaion microhardness and microRaman spectroscopies were also performed and analyzed to the light condition.

42 flat dentin surface polished with #600-SiC were prepared from caries-free human molars and premolars. Then randomly assigned into 3 test, 1) µTBS, 2) microhardness, and 3) DC analysis 30 molars

1) For µTBS ,30 molars were randomly divided into three groups: 1. G-CEM ONE (CS), 2. Panavia V5 (PV), both are "Touch and cure" resin cement, 3. RelyX Ultimate (RX); and further divided into two subgroups (n=5) according to light condition for cementation: 1. cement was light-cured from 5 directions for 20 seconds each (L), 2. cement was left in the darkroom for 30 min (D), auto-cured mode. 4-mm resin cement built-up and cured with each light condition (L or D). Teeth were keep at 37ºC , 24-h storage in distilled water, using a dark box for D-condition. 1 mm^2 non trimmed beams were tested for µTBS, expressed in MPa. The data were statistically analyzed by Games-Howell test (α=0.05).

2) For microhardness, premolars were cut, smear-layer prepared and cement built-up and 24 h-water storage same as the µTBS specimen preparation in L-condition previously described. The teeth were cut perpendicular to the resin-dentin interface, 1 mm-thickness slab, and polished with SiC paper and diamond paste down to 1 µm particle size. The microhardness data were evaluated by using the nanoindentation testing machine after specimens polishing 3 and 72 h. The indentation was tested four spots at each 20 µm interval distance from the resin-dentin

interfaces until 200 µm. Games-Howell test was used for analyzing means values from each group. (α=0.05)

3) For DC analysis by microRaman spectroscopy, the testing slabs were cut and prepared and tested at 3 and 72 h, the same as the microhardness specimens. Each specimen, three lines (1 µm apart) were employed for evaluation Each line started at 2 µm from the resin-dentin interface and tested twenty spots having 1-10µm intervals until 60µm interface distance. One-way ANOVA and Tukey test, was used for analyzing means values from each group (α=0.05). Correlation between DC and distance from the resin-dentin interface was analyzed by Spearman's and Pearson's correlation.

4) The fracture analysis of µTBS beams after testing was observed and analyzed by SEM. The resin-dentin interface was further investigated by SEM and TEM. Filler distribution of cement close to the interface was also analyzed by using SEM.

Results of this study revealed, in L-condition, the µTBS of all cements were not significantly different. Only the µTBS of CS was not affected by the darkroom (D-condition). The µTBS of PV and RX were significantly decreasing in D-condition, approximately 36% and 88%, respectively. There were three pretest failure beams of RX-D. The main failure in this study was mixed failure, except for CS in both conditions which were cohesive failure within cement. In general, we found that adhesive failure was increasing in D-condition.

For hardness and DC analysis results, CSL showed significantly higher values than PVL and RXL. in all testing times. Overall, means of hardness and DC values of each cement were not significantly different when comparing 3 and 72 h. Except for the hardness of CS at 72 h, was significantly higher than 3 h. Within 2-15 µm distance from resin-dentin interface, the DC analyses revealed CSL showed a strong positive correlation in both 3 and 72 h, contrast to those of RXL which showed the negative correlation. No correlation was found for PVL.

For correlation of resin filler distribution and the distance from the resin-dentin interface, CSL showed positive correlation, while RXL showed negative. No correlation was found for PVL.

From the results of this study, it might be concluded that the µTBS of "Touch and cure" type dual-cured resin cement is not affected by the dark condition, while the conventional type does, and showed the higher both microhardness and DC. It might estimate that the "Touch and cure" reaction of mixed cement might probably occur approximately within 15 µm from the resin-dentin interface.