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Microleakage under Orthodontic Brackets Bonded with Three Different Adhesive Systems after Different Aging Conditions

(An *In Vitro* Comparative Study)

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Abstract

The polymerization shrinkage of adhesive material, the intraoral thermal fluctuations or fluid exposure are the main factors contributing to the microleakage which can lead to caries development in the form of so-called ‘‘white-spot lesions’’ under and around the bracket margins and bond failure especially with regard to long-term fixed orthodontic therapy.

This study was designed to evaluate and compare the microleakage under bracket-adhesive and enamel-adhesive interfaces and at occlusal and gingival sides of Sapphire and Stainless-steel orthodontic brackets bonded with three different orthodontic light-cure adhesive systems and after different aging conditions, thermocycling with two different water storage durations.

Ninety-six extracted sound human upper first premolars were selected and distributed randomly into two main equal groups of 48 samples, representing the two types of orthodontic brackets; Stainless-steel and Sapphire (monocrystalline ceramic) brackets. Each group was further subdivided randomly into three equal subgroups of 16 samples each according to the type of light-cured adhesive systems (Transbond ^{TM} XT light-cure system, Transbond TM Plus Self-Etching adhesive system (3M Unitek, Monrovia, Calif), RMGIC (GC Fuji ORTHO LC) adhesive system (GC Corporation Tokyo, Japan). Following the bonding procedure and the incubation in distilled water for 24 hours, all samples subjected to 500 thermal cycles. Then, half of the samples in each subgroup (8 teeth) were tested immediately after 24 hours’ water storage duration and thermocycling and the remaining half were tested after thermocycling and 2 months’ water storage duration.

A dye-penetration method was used to evaluate the microleakage after each storage duration. The samples were sealed with two layers of nail varnish, immersed in 2% methylene blue dye solution for 24 hours, sectioned

longitudinally and examined under a stereomicroscope. The microleakage was evaluated quantitatively with an image analysis software (ImageJ) with regard to the “bracket-adhesive” and “enamel-adhesive” interfaces at both the gingival and occlusal sides of the bracket. Statistical analysis was performed using the Kruskal-Wallis test and the Mann- Whitney U-test and Wilcoxon signed rank test.

The result of this study revealed that; after both storage durations, all tested samples exhibited various degrees of microleakage, highly significant differences were showed among the three tested adhesive systems at both adhesive interfaces and at both bracket sides. GC Fugi ORTHO LC demonstrated the highest value of microleakage. The gingival side exhibited higher value than the occlusal one for all tested subgroups with significant differences in most interfaces. The microleakage under sapphire brackets less than that under stainless steel brackets and it was statistically significant for GC Fugi ORTHO LC subgroups. The microleakage increased after thermocycling and two-months’ water storage duration but without significant differences for all tested subgroups.

In conclusion, the type of adhesive systems may play an important role in the microleakage event. The conventional Transbond XT adhesive system exhibited the lowest microleakage value. More microleakage was seen gingivally than occlusally, microleakage under sapphire brackets less than that under stainless steel brackets. Also, the thermocycling with 2 months’ water storage duration did not significantly increase the microleakage for all tested samples.