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# The Effects of Incorporating Some Additives to an Orthodontic Bonding Agent (An in Vitro Study)

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# Abstract

One of the most important complications of fixed orthodontic treatment is the formation of white spots, which are initial carious lesions. Addition of antimicrobial agents into orthodontic adhesive material might be wise solution for prevention of white spots formation. The aims of this study were evaluate the shear bond strength (SBS), the amount of adhesive material that would remain on the tooth surface, and the antibacterial properties of orthodontic adhesive system against *Streptococcus Mutans* after adding three different types of nanoparticles (Ag, ZnO, or $TiO_2$).

Forty-eight extracted upper premolar teeth were selected and randomly distributed into four groups, each group has 12 teeth, the enamel surface was etched for 30 seconds, then a thin coat of Transbond XT primer (before and after blending with Ag, ZnO, or $TiO_2$ Nanoparticles), was applied on each tooth surface and cured for 15 seconds. The brackets were bonded by Transbond XT adhesive past on the teeth surface, and after 24 hours of storage the specimens in normal saline in the incubator at 37°C, the shear bond strength was measured by Instron testing machine, after that the adhesive remnant index were examined under 10X magnification.

A group of 40 discs was prepared, 10 discs were made from the primer only (control), and 30 discs (10 discs for each test group) were made from primer after adding one of nanoparticles that were mixed with primer, and would be tested for antibacterial properties by quantifying the viable counts of *S.Mutans* colonies.

The results of this study showed that there were no significant differences between the groups for SBS values. In regard to adhesive remnant index of the four groups, there was a high significant difference between Control and ZnO,

and Control and $TiO_2$, while significant differences between Control and Ag, Ag and $TiO_2$, and ZnO and $TiO_2$; whereas a non-significant difference between Ag and ZnO. There was no adhesive remained on the tooth surface (score 0) was the predominant failure in Control group, and less than fifty percent of adhesive remained on the tooth surface (score I) was predominant failure in Ag and ZnO groups, while predominant failure in $TiO_2$ group was more than fifty percent of adhesive remained on the tooth surface (score II). In regard to the comparison of the antibacterial effect between control and other test groups, there was a high significant difference between the four groups, whereas $TiO_2$ Nps group, had the lowest value of colony forming unit, followed by ZnO and Ag Nps groups respectively, while the control group, had the highest value of colony CFU/ml.

In conclusion, adding of (Ag, ZnO, or $TiO_2$) nanoparticles to primer of orthodontic adhesive system will enhance its antibacterial effect, and this is depending on the size of nanoparticles (the smallest size of nanoparticles has highest antibacterial activity) without affecting the shear bond strength. In regards to ARI, a relative large amount of adhesive material remains on the enamel surface following the bracket removal in $TiO_2$ group compared to the tooth surface in the control, Ag, and ZnO groups, so more time would be required to clean the tooth surface in $TiO_2$ NPs group, on other hand, this would be advantageous because it would reduce the enamel damage after debonding.