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Efficacy of yttrium(III) fluoride nanoparticles for use in orthodontic bonding

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Investigating the adhesion strength and anti-bacterial effect of a conventional orthodontic composite resin blended with Yttrium Fluoride (YF3) nanoparticles. YF3 nanoparticles (NP) were added at 1%, 2% and 3% (w/w) to the conventional orthodontic composite resin (Transbond XT). The blended composite resin was labeled as NP1, NP2 and NP3, respectively according to w/w of NP's. A total of 60 extracted human premolars were randomly allocated into four groups of 15 (n=15). Orthodontic brackets were bonded using the conventional (control) and experimental composite resin (NP1, NP2 and NP3). The adhesion strength of the composite resin was determined by a universal testing machine. The debonding sites were assessed and scored using Adhesive Remnant Index (ARI). The antibacterial effect of Yttrium Fluoride (YF3) nanoparticles against *Streptococcus mutans* was assessed by viable cell counting method. For the same, a total of 40 composite discs specimen were prepared using the control and experimental composite resin (n=10). The data was analyzed by One-way ANOVA and Tukey's *post hoc* analysis. In all the tests, the significance level was determined to be 0.05. The highest adhesion strength values were found in control group (11.61 ± 0.23) and lowest values with NP3 group (10.49 ± 0.17). Significant difference was observed between control and experimental groups, NP2 and NP3 ($P < 0.05$). NP1 group showed insignificant ($P = 0.388$) adhesion strength values compared to control group. No significant difference in ARI scores of conventional and experimental groups was observed ($P > 0.05$). The highest colony forming units (CFU) were found in control group (75.85 ± 1.15) and the least CFU was found with NP1 group (2.24 ± 1.14). Significant difference in the mean CFU of the conventional and experimental composite groups was observed ($P < 0.05$). Despite higher anti-bacterial activity in NP1 group compared to NP2 ($P = 0.146$) and NP3 ($P = 0.117$), the difference was not significant. Similarly, no significant difference was observed between NP2 and NP3 groups ($P = 0.97$). Yttrium fluoride nanoparticles at 1% concentration demonstrated significant anti-bacterial effect without compromising the adhesion strength.

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