Biological, mechanical and adhesive properties of universal adhesives containing zinc and copper nanoparticles

Gutiérrez M.F.

Alegría-Acevedo L.F.

Méndez-Bauer L.

Bermudez J.

Dávila-Sánchez A.

Buvinic S.

Hernández-Moya N.

Reis A.

Loguercio A.D.

Farago P.V.

Martin J.

Fernández E.

Objectives: To evaluate the effect of addition of zinc oxide and copper nanoparticles (ZnO/CuNp) into universal adhesives, on antimicrobial activity (AMA), cytotoxicity (CTX), water sorption (WS) and solubility (SO), microhardness (MH) and in vitro degree of conversion (DC), as well as resin-dentin microtensile bond strength (?TBS), nanoleakage (NL) and in situ DC. Methods: ZnO/CuNp (0% [control]; 5/0.1 and 5/0.2 wt%) were added in Prime&Bond Active (PBA) and Ambar Universal (AMB). The AMA was evaluated against Streptococcus mutans. For CTX, Saos-2 cell-line was used. For WS and SO, specimens were tested for 28d. For MH, specimens were tested after 24 h and 28d and for in vitro DC, specimens were evaluated after 24 h. After, the adhesives were applied to flat dentine surfaces, composite resin build-ups, specimens were sectioned to obtain resin?dentine sticks. It was evaluated in ?TBS, NL and in situ DC after 24 h of water storage. ANOVA and Tukey's test were applied (? = 0.05). Results: The addition of 5/0.2 ZnO/CuNp increase AMA and WS, but decrease the SO when compared to control ($p < 0.05$). The CTX and ?TBS were maintaining with

adhesive-containing ZnO/CuNp ($p > 0.05$). MH, in vitro DC and in situ DC was significant increase (AMB) or maintaining (PBA) with ZnO/CuNp addition. However, significantly lower NL was observed for ZnO/CuNp groups ($p < 0.05$). Conclusions: The addition of ZnO/CuNp in the tested concentrations in universal adhesive systems may be an alternative to provide antimicrobial activity and improves the integrity of the hybrid layer, without jeopardizing biological, adhesives and mechanical properties. Significance: This is the first study that demonstrates that the addition of zinc oxide and copper nanoparticles in concentrations up to 5/0.2 wt% in two universal adhesive systems is a feasible approach and may be an alternative to adhesive interfaces with antimicrobial properties and less defects in the resin-dentin interface.

Copper

Microtensile bond strength and nanoleakage

Nanoparticles

Universal adhesive system

Zinc oxide

copper

dentin bonding agent

nanoparticle

resin cement

tooth cement

zinc

chemistry

dental bonding

dentin

human

materials testing

metabolism

tensile strength

tooth disease

Copper

Dental Bonding

Dental Cements

Dental Leakage

Dentin

Dentin-Bonding Agents

Humans

Materials Testing

Nanoparticles

Resin Cements

Tensile Strength

Zinc