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Nanoleakage in single-step adhesives: what are we really testing?

F.R.TAY[1], A.ITTHAGARUN[1], Y.F.MAK[1]*, E.L.PASHLEY[2], D.H.PASHLEY[2]
([1]University of Hong Kong, HKSAR, China, [2]Medical College of Georgia, Augusta, USA)

Conceptually, single-step adhesives that etch, prime and bond simultaneously should not exhibit areas of incomplete infiltration within dentin hybrid layers. As minerals are either partially retained or re-precipitated in the bonded interfaces, they may be solubilized and manifested as artifactual porosities after immersion in mildly acidic silver nitrate ($AgNO_3$). This study examined nanoleakage patterns of four single-step adhesives, Prompt L-Pop (PL; ESPE), Etch & Prime (EP; Degussa), One-Up Bond F (OU; Tokuyama) and Reactmer Bond (RB; Shofu) using conventional (C; pH 4.2) and ammonical (A; pH 9.5) 50 wt% $AgNO_3$. The latter was prepared by precipitation titration of ammonium nitrate with $AgNO_3$, and contains larger chelated ammonical silver ions. Flat dentin surfaces were bonded with the adhesives and a lining composite. 0.8 mm thick slabs were coated with nail varnish applied 1mm from the bonded interfaces, and immersed in C or A for 24 h. After developing, undemineralized, unstained, epoxy resin-embedded sections were prepared for transmission electron microscopy. Hybrid layers in PL, EP, OU and RB were 3-5, 2-3, 0.2-0.5 and 0.5-1 μm thick. Nanoleakage patterns of the adhesives were different in the two types of $AgNO_3$. All adhesives in C and A exhibited: a) dendritic silver deposits within the hybrid and adhesive layers and resin tags; b) fine, baseline reticular patterns within the mineralized intertubular dentin. PL-A, EP-A and OU-A contained additional fine silver granules throughout the hybrid and adhesive layers. In RB-A, silver was localized around the hydrogel layers of ion-leachable fillers in the adhesive. It is hypothesized that nanoleakage in single-step adhesives represents areas of "under" polymerization that are caused by either incomplete water removal or lower degree of conversion of the acidic resin monomers. The latter probably also interacted with the basic $AgNO_3$.
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