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Microscopic Evaluation of Marginal Adaptation in Class II Composites

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Objectives Marginal adaptation is critical for the longevity of composite restorations. Marginal microleakage can lead to secondary caries, postoperative sensitivity, and restoration failure, making material selection crucial. Different filler technologies may influence polymerization shrinkage and marginal adaptation at the tooth–restoration interface. This study aimed to compare the marginal adaptation of three composites with different filler technologies in standardized Class II restorations under a microscope.

Methods Sixty extracted intact human third molars were prepared with standardized Class II cavities and randomly assigned to three groups ($n = 20$ per group). The materials tested were a nanofilled composite, Filtek Z350 XT Universal Restorative (3M); a nanohybrid composite, Tetric EvoCeram Direct (Ivoclar Vivadent); and a microhybrid composite, Herculite XRV Ultra (Kerr Corporation). All restorations used the universal adhesive Scotchbond Universal Adhesive (3M). Restorations were placed incrementally, polymerized with LED light, finished, and polished. Specimens underwent 5,000 thermocycles to simulate oral conditions. Marginal adaptation was evaluated using a silver nitrate dye penetration method under an endodontic microscope. Dye penetration was scored from 0 (no penetration) to 3 (penetration reaching the axial wall).

Results Most restorations (52/60; 86.7%) exhibited no dye penetration (score 0). Limited penetration (score 1) occurred in six samples, primarily in the microhybrid group. No specimens showed scores 2 or 3. Kruskal–Wallis analysis indicated a significant difference among the three groups ($p = 0.03$), with the nanofilled composite consistently demonstrating superior marginal adaptation. These results indicate a material-dependent effect on marginal sealing, with the nanofilled composite offering a potential clinical advantage in minimizing microleakage.

Conclusions All tested composites provided generally good marginal adaptation under standardized conditions. Nanofilled technology offers the most reliable marginal sealing, suggesting that filler type is a key determinant for restoration longevity. These findings provide guidance for clinicians in selecting composite materials, and further research may explore long-term effects under in vivo conditions.