Table 1 – Mean and standards deviations for Ca^{2+} release as a function of glass content and immersion period; for PO_4^{-} release, the results of the "material × time" interaction are shown. Similar uppercase letters in the same column and lowercase letters in the same row indicate lack statistically significant difference ($p > 0.05$).

Ca^{2+} (mmol/L)				PO_4^{-} (mmol/L)				
Glass fraction		Days		Days	Days		Glass fraction	
					0%	10%	20%	30%
30%	1.27 (0.61) A	7	0.39 (0.16) D	7	0.18 (0.02) Ca	0.11 (0.01) Cb	0.08 (0.01) Cb	0.10 (0.01) Cb
20%	1.20 (0.61) AB	14	0.80 (0.31) C	14	0.27 (0.03) Ba	0.17 (0.02) Bb	0.13 (0.02) BCb	0.16 (0.02) Bb
10%	0.96 (0.58) B	21	1.22 (0.45) B	21	0.34 (0.03) Aa	0.21 (0.03) Bb	0.17 (0.02) ABb	0.21 (0.03) Ab
0	0.63 (0.42) C	28	1.69 (0.61) A	28	0.38 (0.03) Aa	0.26 (0.04) Ab	0.21 (0.03) Ab	0.26 (0.04) Ab

Agilent Technologies). Data were analyzed by three-way ANOVA/Tukey test (immersion period, composite and pH as main factors, alpha: 5%) (Table 1).

Results: Cumulative calcium release increased with glass mass fraction and with immersion period ($p < 0.001$). For phosphate release, the interaction "material × immersion time" was statistically significant ($p < 0.05$). Overall, phosphate release decreased in the presence of the glass filler. Ion release was not affected by pH.

Conclusion: The presence of glass fillers significantly increased Ca^{2+} release and reduced PO_4^{-} release in ACP-containing composites (supported by FAPESP 2012/04532-4).

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Anatomy of secondary caries: The early stages

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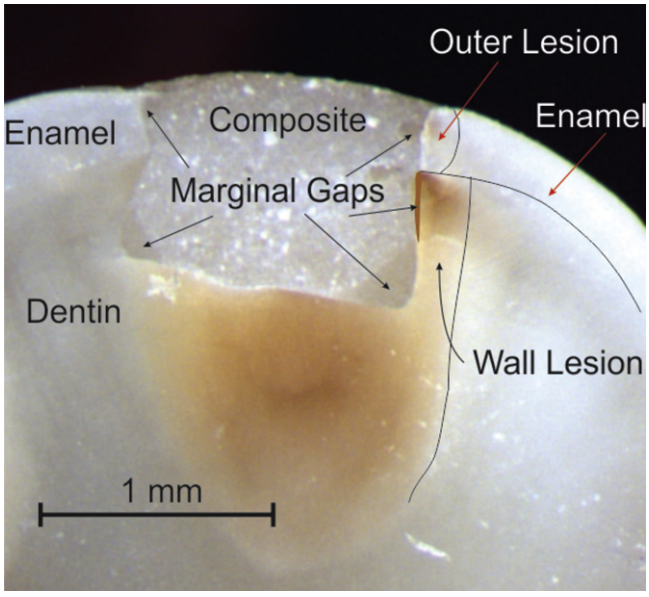
Purpose: Secondary caries has been defined as caries that occurs at the margin of an existing restoration. The mechanism for the demineralization along the margin of a restoration is not understood at this time. The purpose was to describe the physical features of secondary caries and introduce a mechanism for the early stages of demineralization that leads to clinical secondary caries.

Methods and materials: Terminology for describing secondary caries is shown in the figure. The cross-section of a small composite restoration of about 1.2 mm across and 0.8–1.3 mm deep is shown. Demineralization is on the right side and below the composite (tan areas). The demineralization in the enamel radiating away from the composite is called the 'Outer Lesion' and the demineralization paralleling the composite wall into the dentin is called the 'Wall Lesion'. Areas of separation between the composite and the tooth structure is called the 'Marginal Gap' – there are several Marginal Gaps in this photograph some associated with demineralization (right side of restoration) and others not (left side of restoration). The Canary Laboratory caries detection system was used to measure changes in mineral density around composite restorations as the tooth was subjected to demineralization as a function of time.

Results: Early in vitro results show that demineralization begins below the tooth surface in the first month after placement. The Canary number changed by 8.4 ± 3.5 adjacent to the restoration and 1.7 ± 2.9 ($p < 0.05$) 1mm away from the restoration in the first month. For demineralization to occur hydrogen ions (acid) generated have to be transported through the tooth to the area of demineralization to dissolve mineral. Dissolved mineral ions then diffuse out of the demineralized area. Both of these steps are not well understood. We hypothesize that the hydrogen ions can move through the tooth via proton hopping to be delivered to the zone of highest chemical potential. The zone of highest chemical potential is created by interfacial stresses from polymerization shrinkage, deformations from cyclic loading and oral thermal fluctuations. Diffusion of calcium and phosphate ions from dissolved mineral follows concentration gradients either moving towards the pulp or simply away from the area of demineralization to reprecipitate within the tooth structure, or a combination of both.

Conclusion: The earliest step for secondary caries is the acid dissolution of dentin mineral along the interface between the composite restoration and the tooth. Supported by NIH-NIDCR R01DE021391.



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