

Gap formation between dentin and restorative materials: a CLSM study

Language: English

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Objective

To visualize and to measure shrinkage related gap formations between dentin and restorative materials using confocal laser scanning microscopy (CLSM).

Materials and Methods

The cusps of 15 extracted human sound molars were cut to expose fresh dentin. The teeth were randomized and divided into 3 groups (n = 5). Cubic cavities (6 x 4 x 4 mm³) were prepared with a diamond bur (c-factors = 1.19 ± 0.16). The cavo-surfaces were etched for 15 s. In order to induce adhesive failures Eugenol was applied on one cavity wall, whereas the other cavity walls were left untouched. The cavities were filled with Composite (Spectrum), Compomer (Dyract AP) orOrmocer (Admira) using the recommended bonding agent. In order to enhance the contrast at the junction, the bonding agents were mixed with the fluorescent dye rhodamine B. All specimens were subjected to a thermo-mechanical cycling process of 1000 stress cycles (0 / 100N) as well as to 1000 temperature cycles (5° C / 55° C). The teeth were stored in saline at 20° C. Interfaces between cavity walls and restorative materials were inspected after 1 d, 14 d, 63 d and 144 d by confocal laser scanning microscopy (CLSM) in reflection mode under humid conditions. The gap widths (10 per tooth) were documented.

Results

In all specimens, measurable gaps could be found only at the Eugenol treated surfaces (Figures 1-6). After 1 d the gap width was 37.8 ± 4.6 µm for the Composite, 30.2 ± 9.9 µm for the Compomer and 34.4 ± 9.1 µm for the Ormocer. Statistical evaluation (ANOVA) showed a significant (p < 0.05) decrease of the gap widths only for the Compomer and not for Composite and Ormocer. Significant differences between the groups tested could only be shown after 14 d, 63 d and 144 d, the Composite/Ormocer being not significant however.

	1 d	14 d	63 d	144 d	ANOVA
Composite	37.8 ± 4.6	33.2 ± 10.3	33.7 ± 7.4	33.2 ± 6.3	p = 0.926
Compomer	30.2 ± 9.9	16.3 ± 6.7	11.5 ± 6.2	9.4 ± 4.4	p = 0.001
Ormocer	34.4 ± 9.1	34.9 ± 10.1	33.2 ± 8.6	35.3 ± 12.1	p = 0.391
	p = 0.067	p < 0.001	p < 0.001	p < 0.001	

Table 1: Statistical evaluation

Conclusion

It is concluded that (i) it is possible to visualize gaps down to 20 µm below the surface with CLSM and (ii) that for the compomer used in this study, gap width decrease with time.

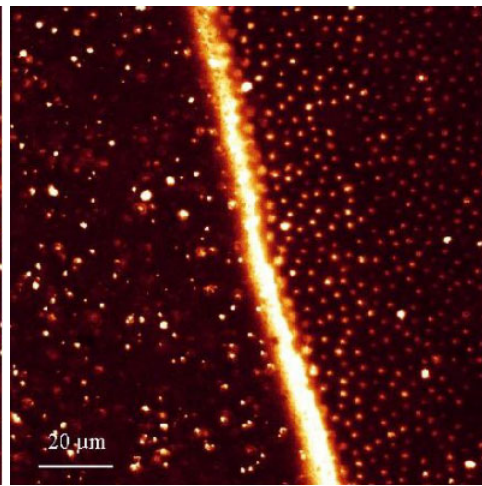
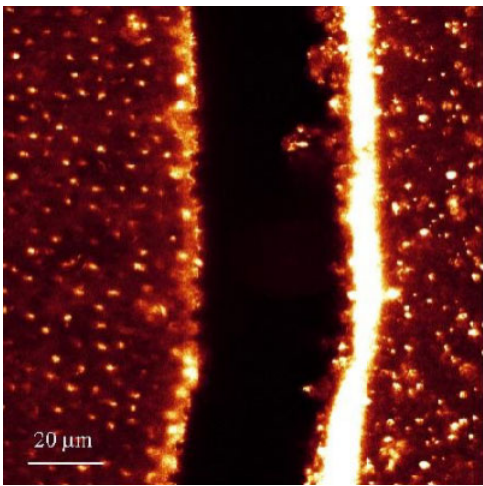


Fig. 1: Gap between dentin (left) and Composite (right) at Eugenol side

Fig. 2: No gap between dentin (right) and Composite (left)

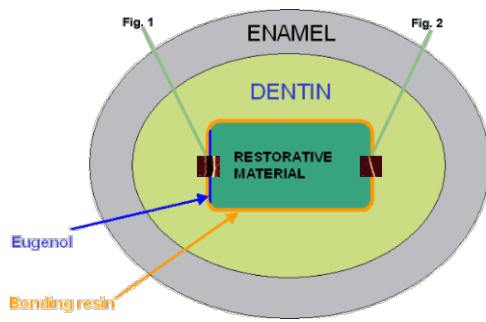


Fig. 1b

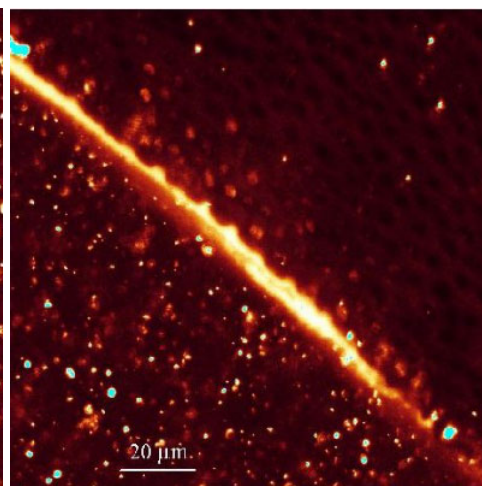
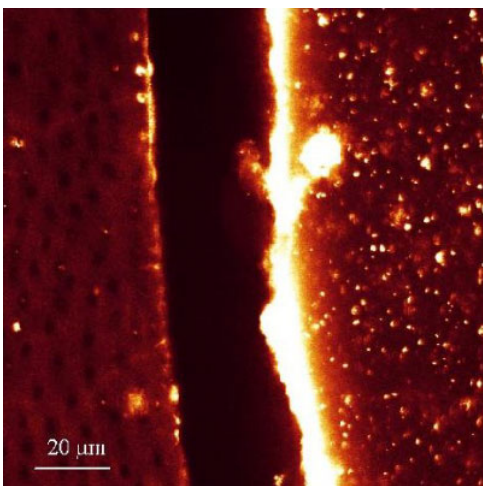


Fig. 3: Gap between dentin and Ormocere at Eugenol side

Fig. 4: No gap between dentin and Ormocere

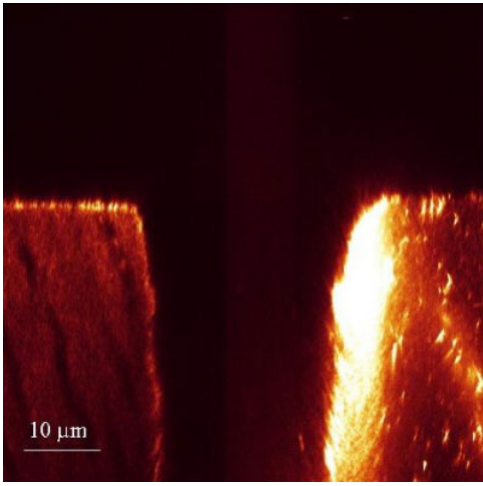


Fig. 5: x-z-optical section at the eugenol-treated side. The gap between restorative material (right) and dentin (left) can be visualized down to about 30 μm under the surface.

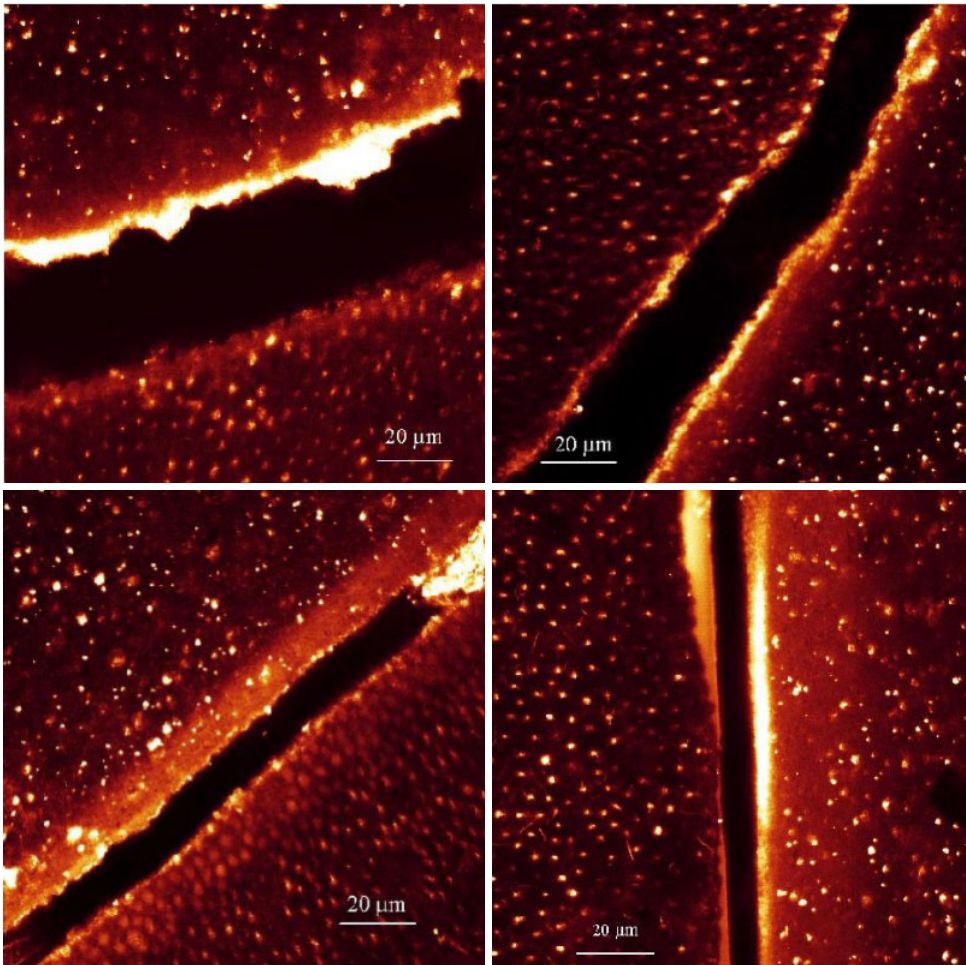


Fig. 6 a-d: Gap between Compomer and dentin after 1, 14, 63 and 144 d. Gap width decreased with time

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Poster Faksimile:

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Materials and Methods: The cusps of 15 extracted human sound molars were cut to expose fresh dentin. The teeth were randomized and divided into 3 groups (n = 5). Cubic cavities (6 x 4 x 4 mm³) were prepared with a diamond bur (c-flaccons = 1.19 ± 0.16). The cavo-surfaces were etched for 15 s. In order to induce adhesive failures Eugenol was applied on one cavity wall, whereas the other cavity walls were left untouched. The cavities were filled with Composite (Spectrum), Compomer (Dyract AP) or Ormocer (Admira) using the recommended bonding agent. In order to enhance the contrast at the junction, the bonding agents were mixed with the fluorescent dye rhodamine B. All specimens were subjected to a thermo-mechanical cycling process of 1000 stress cycles (0 / 100N) as well as to 1000 temperature cycles (5° C / 55° C). The teeth were stored in saline at 20° C. Interfaces between cavity walls and restorative materials were inspected after 1 d, 14 d, 63 d and 144 d by confocal laser scanning microscopy (CLSM) in reflection mode under humid conditions. The gap widths (10 per tooth) were documented.

Results: In all specimens, measurable gaps could be found only at the Eugenol treated surfaces (Figures 1- 6). After 1 d the gap width was 37.8 ± 4.6 µm for the Composite, 30.2 ± 9.9 µm for the Compomer and 34.4 ± 9.1 µm for the Ormocer. Statistical evaluation (ANOVA) showed a significant (p < 0.05) decrease of the gap widths only for the Compomer and not for Composite and Ormocer. Significant differences between the groups tested could only be shown after 14 d, 63 d and 144 d, the Composite/Ormocer being not significant however.

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Conclusion: It is concluded that (i) it is possible to visualize gaps down to 20 µm below the surface with CLSM and (ii) that for the compomer used in this study, gap width decrease with time.

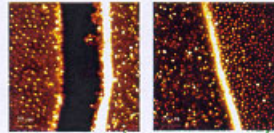


Fig. 1 Gap between dentin (left) and Composite (right) at Eugenol side

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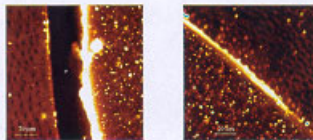
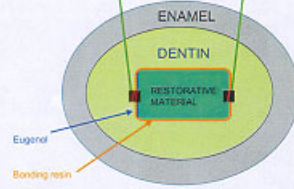


Fig. 3 Gap between dentin and Ormocer at Eugenol side

Fig. 4 No gap between dentin and Ormocer

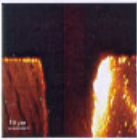


Fig. 5 x-z-optical section at the eugenol-treated side. The gap between restorative material (right) and dentin (left) can be visualized down to about 30 µm under the surface.

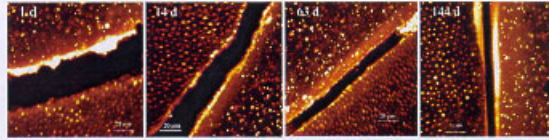


Fig. 6 Gap between Composite and dentin after 1, 14, 63 and 144 d. Gap width decreased with time