Nonlinear Imaging of Dentin-Adhesive Interface Treated by Cold Atmospheric Plasma

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The Nonlinear Laser Scanning Microscopy (NLSM) could be considered as a useful tool for the analysis of hard dental tissues, and tissue-material interfaces in dental medicine. Two-photon excitation fluorescence microscopy (TPEF) is able to detect the two-photon excited autofluorescence of dental tissues, and the second harmonic generation (SHG) can detect second-order nonlinear susceptibility of collagen type I, the most abundant dentinal organic substance [1,2].

The objective of this study was to microscopically test the effect of Cold Atmospheric Plasma (CAP) [3,4] on the morphology of the dentin-adhesive interface, using NLSM.

Human molar teeth were cut in half for the CAP-treated and control samples. The influence of CAP on standard etch-and-rinse (ER) or self-etch (SE) procedures was investigated. The following CAP configurations were used: feeding gas He, gas flow 1 slm, deposited power in the plasma power input 2 W, and tip-to-surface distance 2 mm. The CAP-treated ER group was firstly etched and treated by CAP, before adhesive application. The SE group was treated by CAP before the adhesive placement. The control groups underwent the same process omitting the CAP phase. NLSM was used to image the morphology of hybrid layers.

The results demonstrated that the CAP causes the removal of the smear layer and opens the tubules. The tubules are not only more open but changed by CAP regarding their surface properties so that the permeation of the adhesive is highly favored. Compared to the control groups of around 20-30 µm hybrid layers (Fig. 1,3,5,7), the length of resin tags in the CAP treated ER group was measured to even up to 600 µm (Fig. 2,4), and in the CAP-treated SE group they were extended up to 100 µm (Fig. 6,8)

CAP treatment of dentin drastically changes the morphology of the hybrid layer and the extension of resin tags. There is a need for additional analysis in the field to examine the influence of these changes on the quality of the dentin-adhesive interface.

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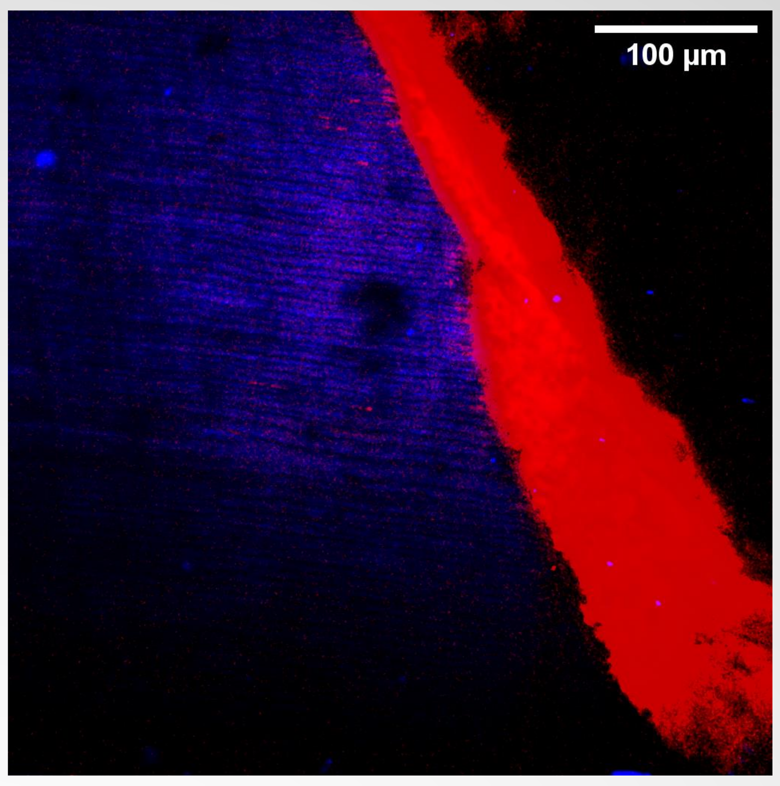


Fig. 1 Hybrid layer – etch&rinse_control

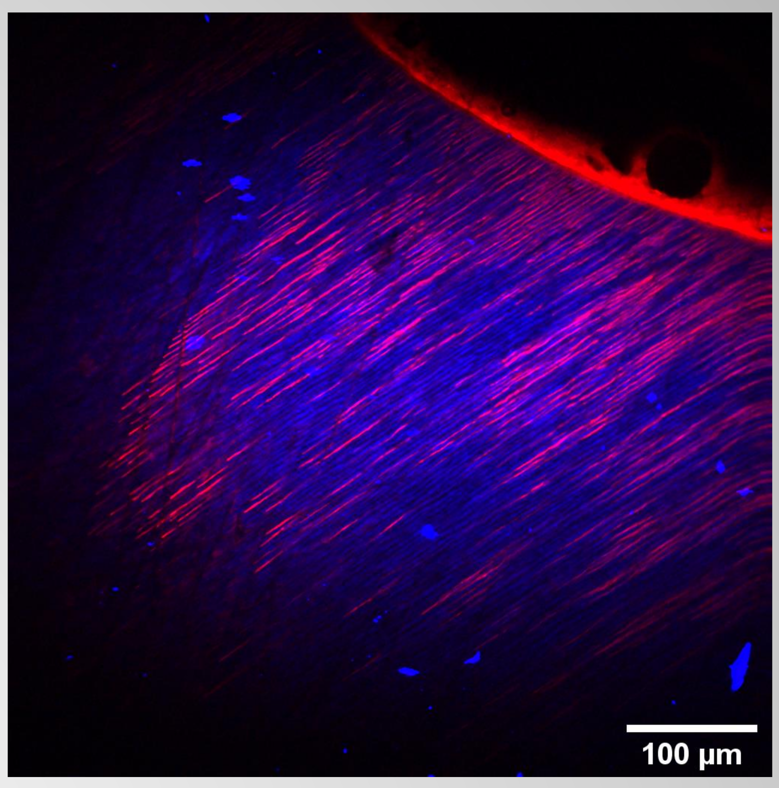


Fig. 2 Hybrid layer – etch&rinse_CAP treated

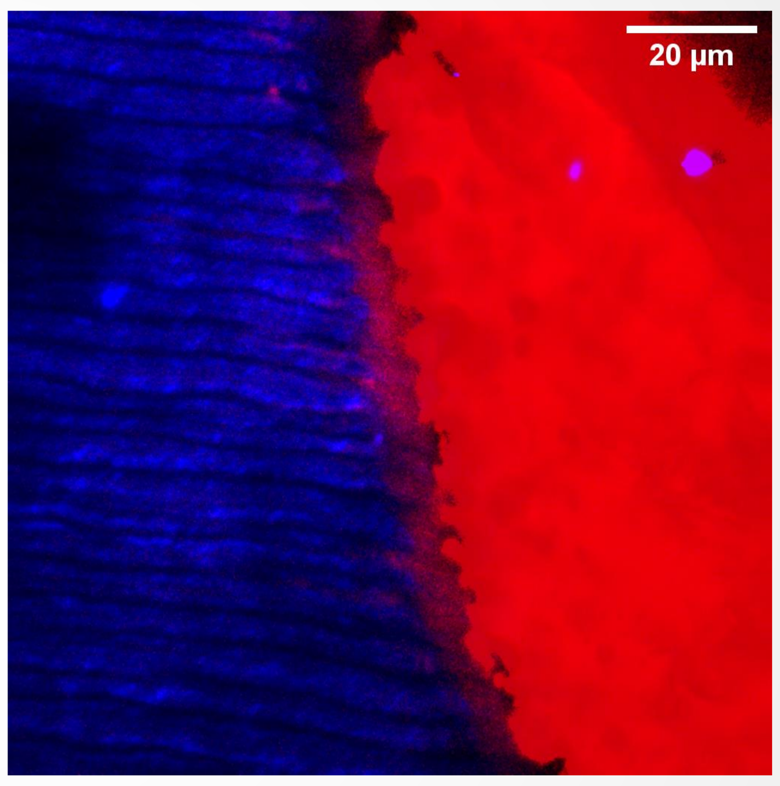


Fig. 3 Hybrid layer – etch&rinse_control

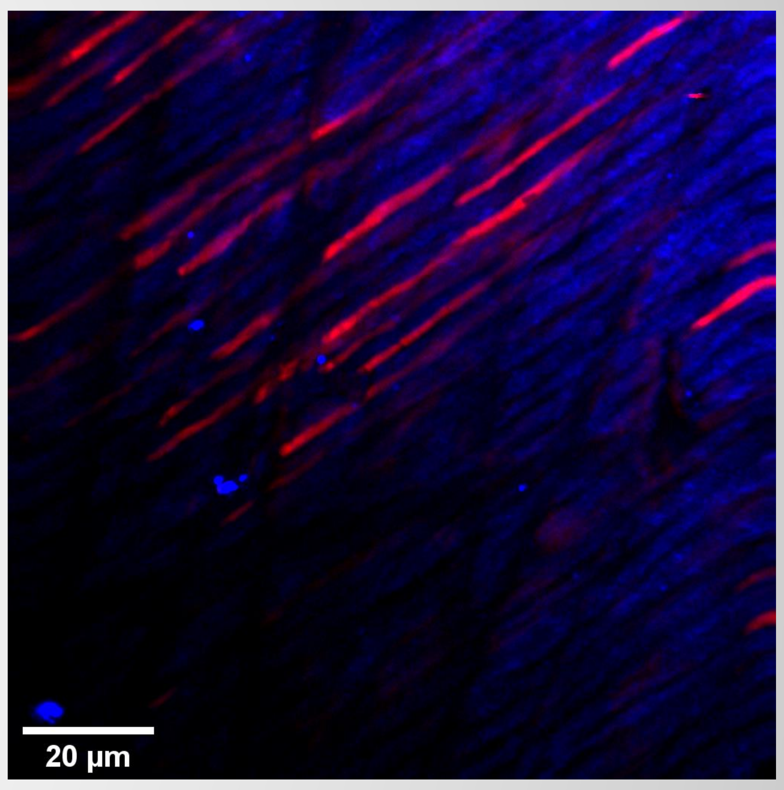


Fig. 4 Hybrid layer – etch&rinse_CAP treated

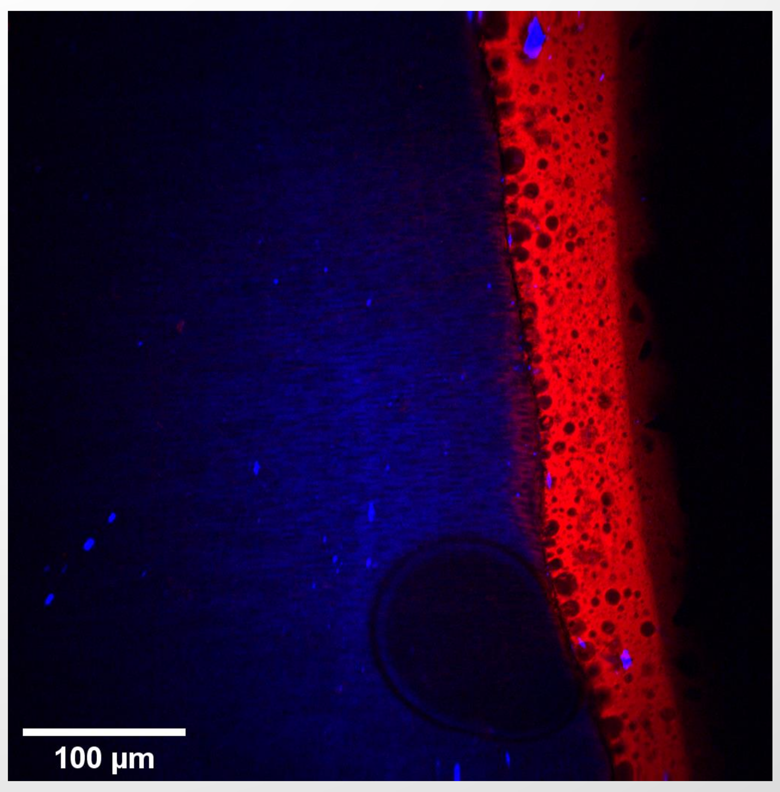


Fig. 5 Hybrid layer – self-etch_control

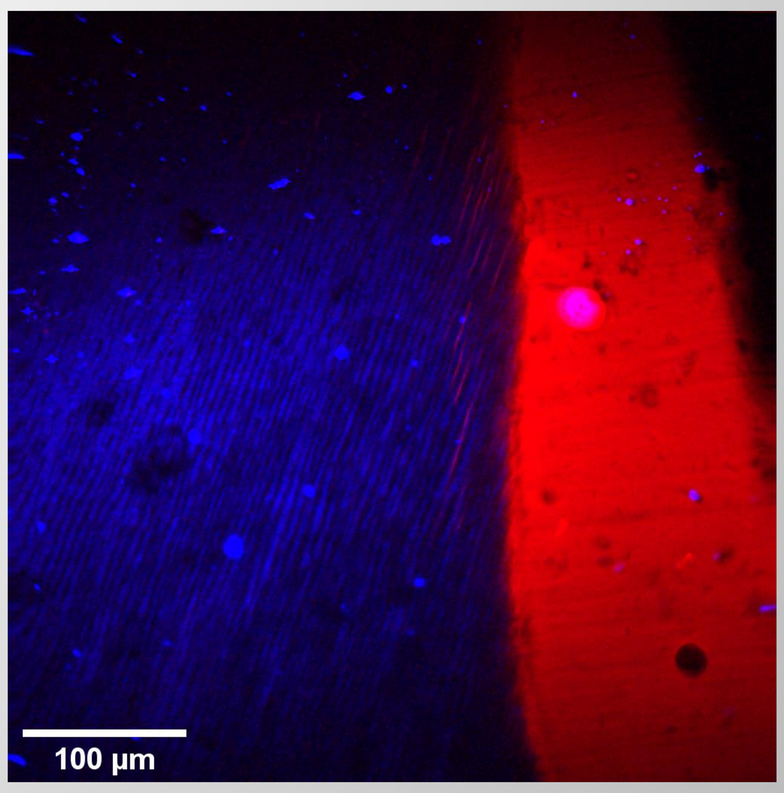


Fig. 6 Hybrid layer – self-etch_CAP treated

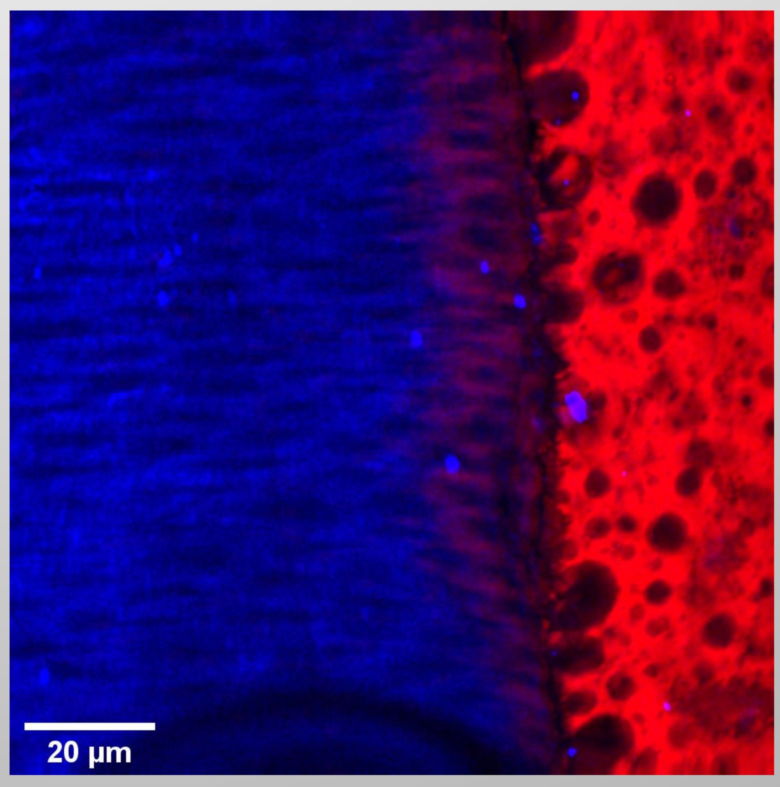


Fig. 7 Hybrid layer – self-etch_control

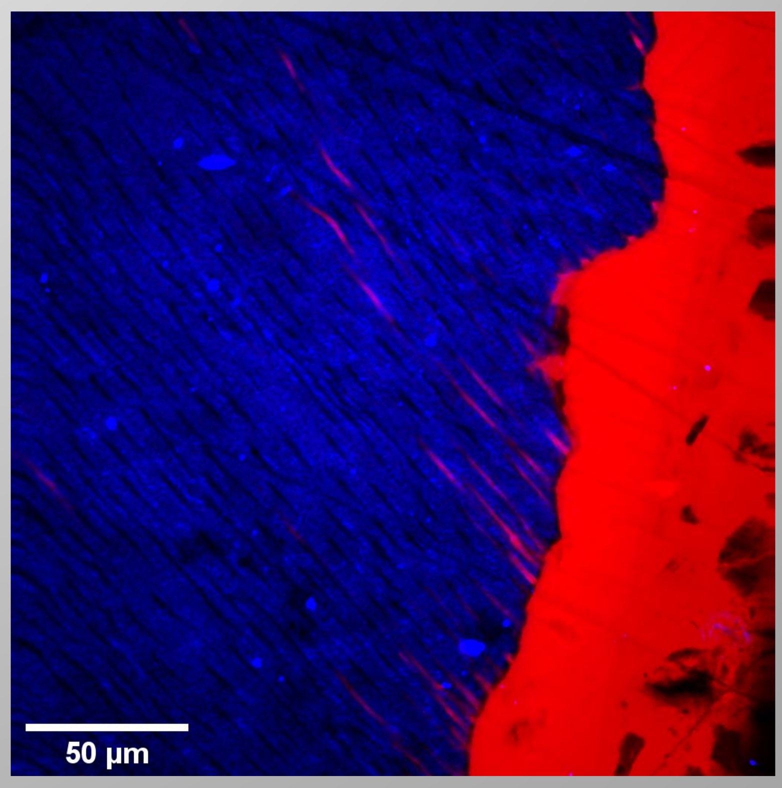
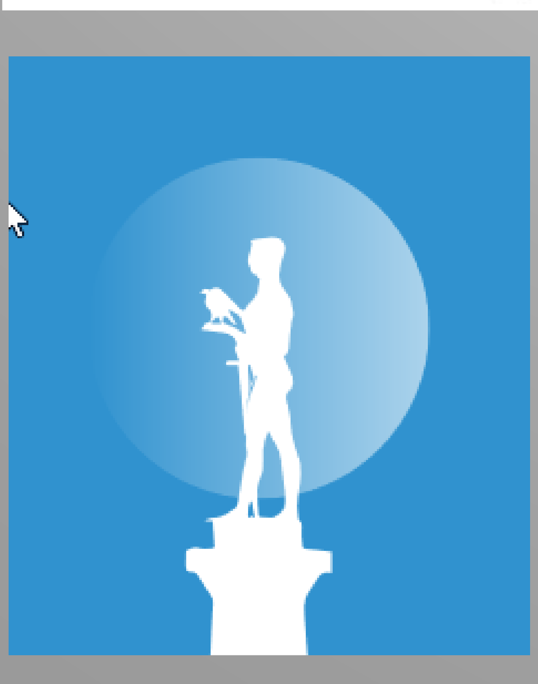


Fig. 8 Hybrid layer – self-etch_CAP treated



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