Ablation of restorative materials with an Ultra Short Pulse Laser System (USPL)

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AIM OF THE STUDY

The aim of this investigation was to analyze the ablation of dental restoration materials using a new ultra short pulse laser system (USPL).

MATERIAL AND METHODS

The dental restoration materials composite resin (C) and phosphate cement (PC) were included. Ablation thresholds and laser tissue interaction were demonstrated on several laser and scanner parameters. The light source used for creating the cavities was a Nd:YAG laser with a wavelength of 1064 nm. Repetition rates varied from 100 kHz to 500 kHz. The pulses were very short with a length of 8 ps. In a series of various specimens over 70 cavities were analyzed. The cavity surfaces were evaluated using reflected light microscopy (fig. 1, 2). Laser ablation of PC resulted in cavities with a bubble formation and surface glazing. The created cavity surfaces in composite resins were smooth and precise.

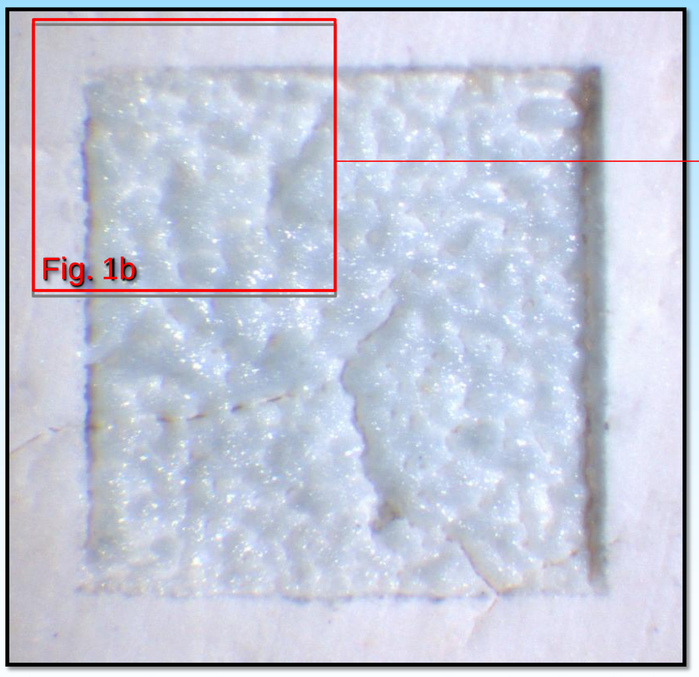

Fig. 1a : Phosphate cement cavity after irradiation
• Microscopically visible bubble formation

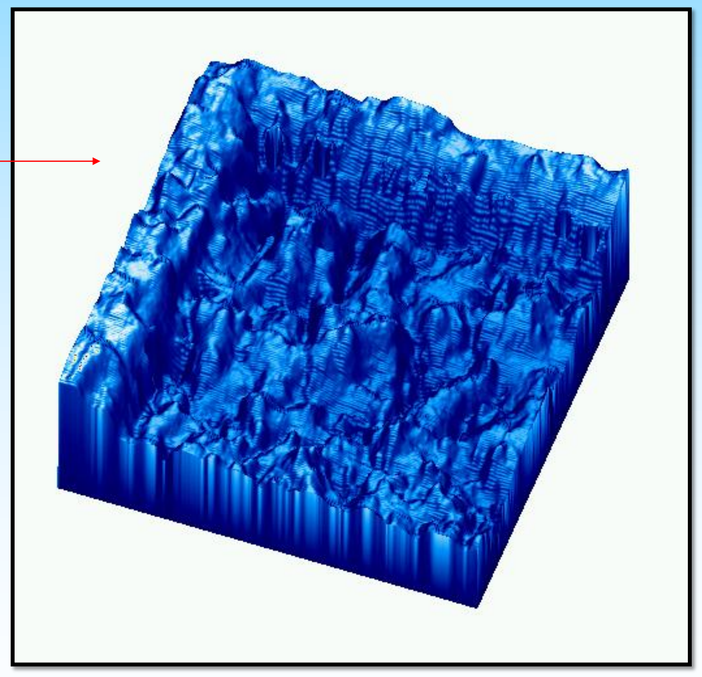

Fig. 1b: 3D cutout of figure 1a highlights the bubble formation of the surface

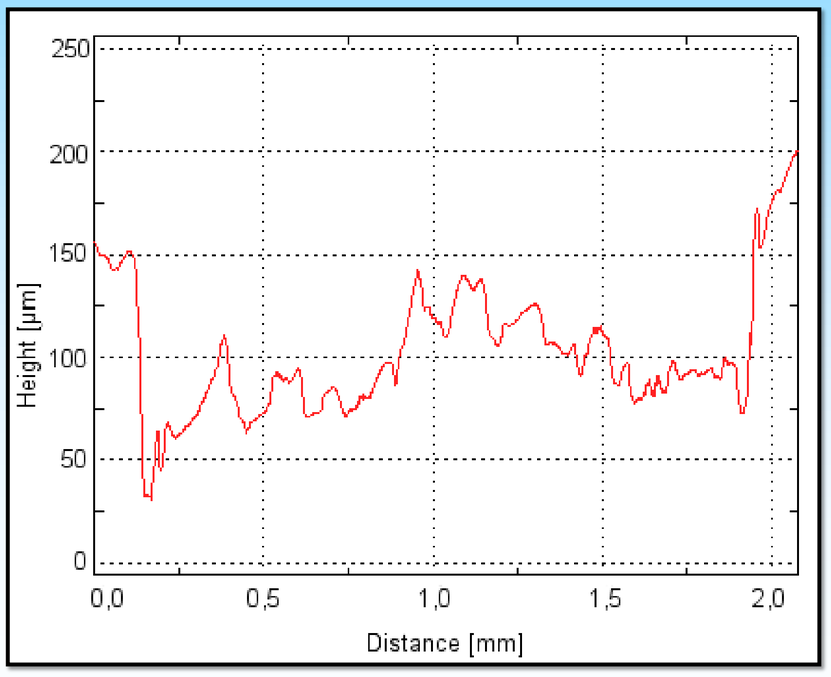

Fig. 1c: The profile analysis of figure 1a shows an uneven surface

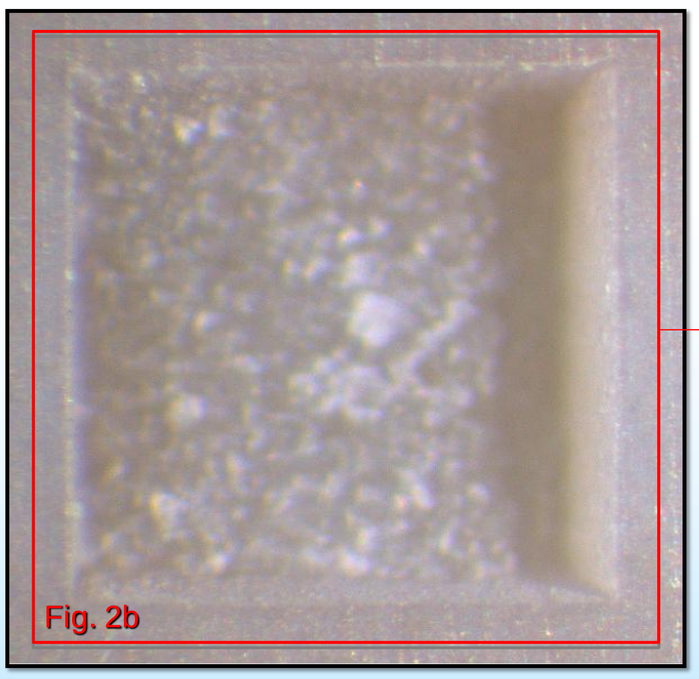

Fig. 2a : Composite cavity *after irradiation*
• Microscopically sharply defined cavity formation

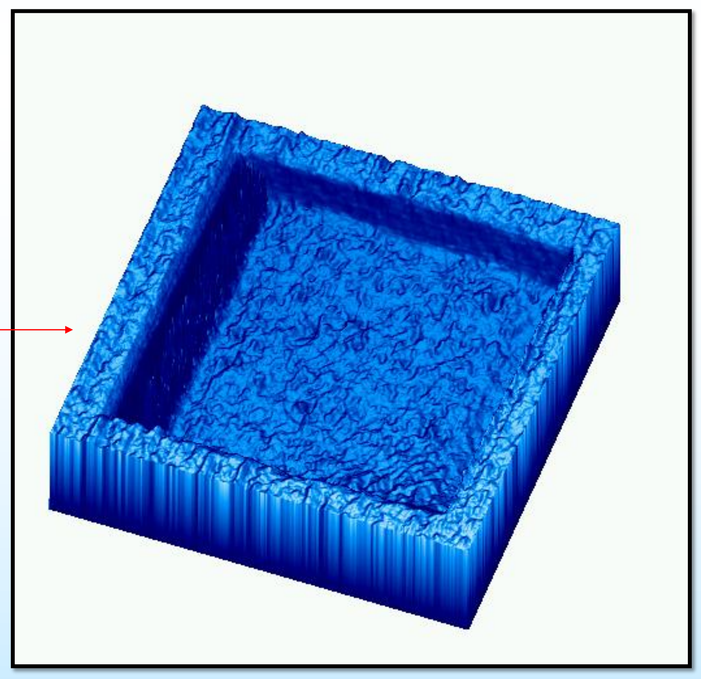

Fig. 2b: 3D assessment of figure 2a shows the cavity with sharply defined margins

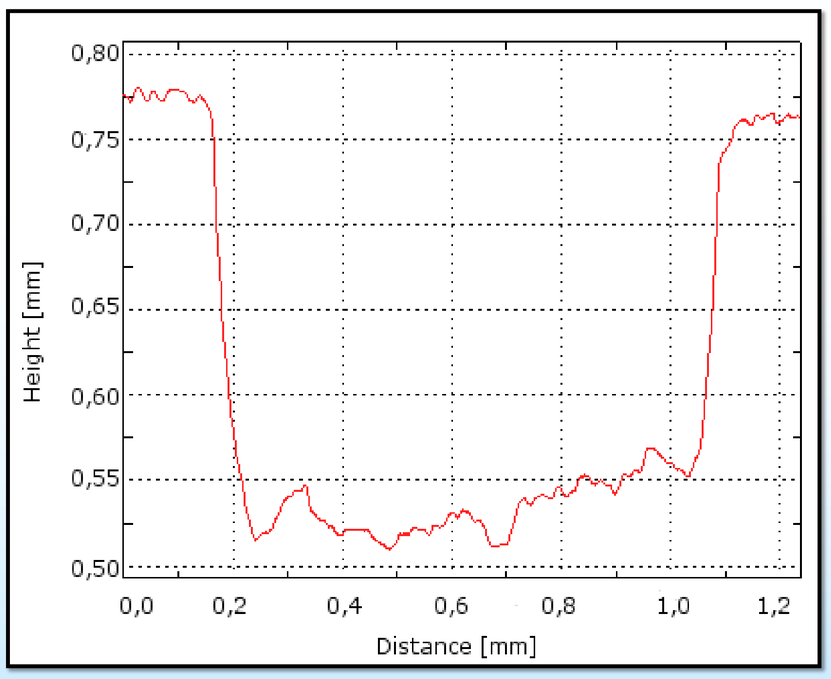

Fig. 2c: The profile analysis of figure 2a shows well defined and precise cavity outline

***Fig. 1 Parameters**: Rep. Rate 500 kHz, Time 2,1 s, Total Energy 15 J, Ablation volume 45,12 mm³ / min, Size 2,25 x 2,25 mm*

***Fig. 2 Parameters**: Rep. Rate 500 kHz, Time 0,67 s, Total Energy 4,032 J, Ablation volume 20,36 mm³ / min, Size 1 x 1 mm*

RESULTS

While USPL technology makes it possible to ablate as good as any given material, we could demonstrate severe side effects when ablating phosphate cement.

CONCLUSION

Further studies are necessary to determine laser and scanner parameters that minimize the thermal stress on the material during the ablation process.

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