

COMPARATIVE STUDY OF SOFT TISSUE SURGERY BY VISIBLE AND INFRARED LASER RADIATION

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Lasers are widely used in surgery, including 532 nm KTP lasers in ENT surgery, and near infrared lasers in dentistry. Recently, relatively compact and powerful 445 nm lasers become available. However, in science literature there is lack of information on direct comparison of the effectiveness of these lasers in cutting soft tissues.

Thus, the purpose of this study to compare the efficiency of cutting blood rich tissues using lasers with 445 nm, 532 nm and 808 nm wavelengths using different methods of delivery radiation to the tissue.

Porcine heart section with dimensions 7 x 4 x 1 cm was used as a model of human soft blood rich tissue. Diode laser with wavelength of 808 nm (CW mode), diode laser with wavelength of 445 nm (CW mode), a neodymium solid-state laser with diode pumping (Nd:YAG) with frequency doubling (KTP) with a wavelength of 532 nm (emitting in Q-switching mode with pulse duration of 100-140 ns and frequency of 20 kHz) were used. The following methods of radiation delivery were used: contactless, focused by handpiece radiation with 600 μm beam size in focal plane; contactless, at a distance of 0.5 mm from the optical fiber tip (fiber core diameter 272 and 550 μm); in contact with the surface of the sample, when the optical fiber is deepened by 0.5 mm into the tissue (fiber core diameter 272 and 550 μm). All lasers were used with the same average power (2.3, 5, 10, 15 W). Fiber or handpiece was moved at a speed of 3 mm/s using motorized two axis linear translator. The evaluation of the cut parameters was carried out by optical microscopy (the preparations were stained with nitroblue tetrazolium chloride (NBTC)).

It was established that the greatest cut depth was observed for radiation with wavelength of 445 nm, the smallest with wavelength of 808 nm. At the same time the largest coagulation zone width was obtained with laser with wavelength of 532 nm. In purpose of effectiveness evaluation, the ratio of the cut depth to the width of coagulation was calculated for different cutting regimes and power of 10 W. The most effective laser according to this parameter is laser with wavelength of 445 nm laser, the least is laser with wavelength of 808 nm.

Among all prototypes presented in this study the highest efficiency was demonstrated for a laser with wavelength of 445 nm. The cuts obtained by this laser are characterized by the greatest depth in any cutting mode, with the lowest ratio of the depth of cut to the width of coagulation. The prototype with a wavelength of 532 nm allowed to cuts with less depth and wider coagulation zone. The lowest ratio of the depth of cut to the width of coagulation zone and lowest cut depth has a prototype with wavelength of 808 nm.