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TWO-WAVELENGTH LASER FOR SOFT TISSUE COAGULATION

Task

To coagulate soft tissue or fix wound dressings, the laser wavelength should, if possible, be selected such that the optical penetration depth corresponds to the desired effective depth. During coagulation the thermal denaturation of proteins leads to structural changes that cause increased light scattering. As a result, there is an inherent mismatch of wavelength at the beginning or end of the process. On account of the multiple scattering of the radiation, the optical penetration depth can be reduced to such an extent that the laser cannot reach the desired and effective depth. Coagulation with constant depth in soft tissue requires, however, an adaption of optical penetration depth.

Method

To adjust the optical penetration depth and the absorbance, the wavelength is changed during the irradiation period. For this purpose, two diode lasers with different wavelengths, 980 nm and 1550 nm, are coupled in the optical fiber of the handpiece at the same time. The power control of the two laser sources is independent of each other so that either a gradual transition from one wavelength to another or quick switching is possible.

Result

The coagulation depths achieved are checked on a phantom model, which indicates denaturation as the light scattering changes when a temperature-time integral is exceeded, similar to what happens in soft tissue. By selecting different power distributions between both diode lasers, Fraunhofer ILT can set the resulting coagulation depth to values between both of these limits for each wavelength. This confirms that the basic approach, using commercially available diode laser modules, is viable.

Applications

This method has initially been considered for the coagulation of soft tissue with a controllable coagulation depth of about 1 - 5 mm. This way, the thermal cauterization of vessels or the fixing of dressings can be precisely controlled.

Moreover, the principle can be used for plastic welding to ensure that the penetration depth can be controlled locally during the manufacturing process.

Contacts

Dr. Martin Wehner
Telephone +49 241 8906-202
martin.wehner@ilt.fraunhofer.de

Dr. Arnold Gillner
Telephone +49 241 8906-148
arnold.gillner@ilt.fraunhofer.de

1 Laboratory sample of a handpiece for two-wavelength coagulation with integrated temperature measurement.

Fraunhofer Institute for Laser Technology ILT, www.ilt.fraunhofer.de
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