Section: **Future Emerging Technologies**

ID: 128

Abstract-Title:
ABLATION OF HARD BONE TISSUE WITH MINIMAL THERMAL SIDE EFFECTS USING A PULSED CO2 LASER

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Abstract-Text:
Laser ablation of hard bone tissue offers multiple advanced possibilities in surgical medicine e.g. in maxillofacial or ENT surgery. With the use of a laser as a cutting tool for osteotomies arbitrary complicated incision geometries can be realised with high accuracy and precision. This could offer completely new medical interventions. Promising results in this field have been achieved in experiments with pulsed CO2 lasers with simultaneous application of water. To achieve fast and deep in-vivo incisions with minimal thermal side-effects a better understanding of the ablation process and special irradiation techniques are needed. Our group has developed a multi-pass beam scanning technique for pulsed CO2 lasers in combination with a fine water spray which enables effective and gentle bone tissue removal for various purposes. The ablation process is based on the fast evaporation of the water content in the bone tissue. This results in a strong internal pressure build-up that tears the bone apart finally. With the ablation products excessive heat is removed from the tissue thus thermal damage to the surrounding tissue can be minimised. This talk will be focused on the analysis and practical optimisation of irradiation conditions, which have to be satisfied for efficient and “clean” ablation of bone tissue with IR laser systems. We present the characteristic of ablating bone with different CO2 laser systems. Histological examinations show only very minor thermal influence in a narrow 50 µm broad zone at the cut border. The thermal tissue damage can be kept very small even at pulse repetition rates of several hundreds Hz using the fast multi-pass beam scanning technique with a PC-controlled galvanic beam deflector. The possibility of guiding the laser beam easily with a beam deflecting device offers an excellent basis for the integration of the laser technique in surgical navigation and/or robotic systems. On the basis of these investigations we have constructed a prototype system of a mobile laser osteotome, which was successfully applied in several series of animal trials.

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