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Thermodynamic effects after Diode and Er:YAG laser irradiation of grade IV and V titanium implants placed in bone – an *ex vivo* study. Preliminary report

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Abstract: Many inserted implants are affected by peri-implantitis. The aim of our study was to evaluate increases in implant temperature, depending on the diameter and chemical composition of implants. In particular we measured the time it takes for the temperature of an implant to rise by 10°C and evaluated laser power settings required to prevent thermal injury when an implant surface is decontaminated during the treatment of peri-implantitis. The study analysed six implants placed in porcine ribs and divided into two groups according to their diameter and chemical composition (grade IV and grade V titanium). The implants were irradiated with Diode and Er:YAG lasers using different laser parameters. The temperature was measured with a K-type thermocouple. The temperature on the implant surface rose as the laser power increased and the implant diameter decreased. The time required to increase the temperature of an implant by 10°C was less than it was for titanium grade IV. The temperature gradient was below 10°C for all implants treated using a laser power up to 1 W. It is important to choose the correct laser parameters, depending on the chemical composition and diameter of the implant, so that decontamination of the implant surface is thorough, effective and safe.

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Introduction

Thanks to rapid advances in implantology over the last few decades, which has resulted in improvements in implant materials, designs and surface properties, achieving a tight connection between living bone and the implant surface, i.e. osseointegration, no longer poses a challenge. Clinical studies of 5-year implant survival rates show that 99.1% of implants in the mandible and 84.9% of implants in the maxilla become osseointegrated and represent a part of a fully functional prosthetic reconstruction [1, 8]. Implant osseointegration complication rates recorded in the literature vary considerably, with some researchers reporting 0% complications over a 5-year follow up period [56] while the highest rate in a 10-year follow up period being 29% [6]. However, numerous contemporary studies reveal that, despite correct implant osseointegration being achieved and proper oral hygiene being observed, many implants are still affected by peri-implantitis, which is one of the most common causes of implant loss [32, 45]. Recent studies indicated a peri-implantitis rate ranging from 11.3 to 47.1% after 8 years [22, 62]. Roos-Jansåker indicates that most inserted implants are affected by peri-implantitis after 9–14 years [44]. As a consequence, special attention should be paid to identifying effective and predictable methods of peri-implantitis treatment using modern medical technologies.

Peri-implantitis has a great deal in common with periodontitis. Nevertheless, there are some differences which require the use of a different and more complex technique to render the treatment effective [19]. Unlike a tooth, the surface of an implant is in direct contact with bone tissue. Around the implant there is neither periodontium nor cementum [30] and a constant physiological and homogenous distribution of masticatory forces is prerequisite

Reference:

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