LASER INDUCED OPTICAL BREAKDOWN WITH FRACTIONAL PICOSECOND Nd:YAG 1064 NM LASER IN VIVO ON PORCINE MODEL

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Picosecond lasers ranging in the infrared region use the theory of selective photothermolysis by creating zones of photomechanical (photoacoustic) trauma. As a result, the picosecond laser has a high specificity for its target but with less heat generation in the epidermal and dermal layers. Acoustic waves are produced due to rapid thermal expansion and result in mechanical destruction of surrounding structures creating vacuoles like structures by optical tissue breakdown (LIOB) [1]. LIOB uses spatially precise microscopic thermal wounds in the target tissue creating microthermal treatment zones or MTZ. Fractionated lasers create coagulative, fractional, located and epidermal necrosis on MTZs. They are non-contiguous, meaning, they are separated by zones of intact tissue cells, that migrate into the damaged areas accelerating the healing processes [2].

The initiation mechanism of picosecond LIOB, begins from the production of free seed electrons by a laser pulse via multiphoton absorption. The plasma formed at the focal point then expands vaporizing materials and creating cavitation bubbles that further expand outward to the co-located tissue to generate microscopic vacuolar tissue reactions [3]. Histologically, this translates as a column-like denaturation of the epidermis and dermis. Tissue surrounding the affected area remains intact and together with the surrounding healthy tissue provides migrating cells to the damaged area within the first 24 hours [4].

Depending on the extent of the laser treatment in the skin, selecting the correct operatic wavelength can greatly determine, which specific chromophores (melanin, hemoglobin and water) are targeted and defines the penetration depth. Fractionated laser modalities target water as their chromophore, which allows to target various water-containing structures, such as collagen, blood-vessels and epidermal keratinocytes [5].

In this study, we investigated the laser-tissue interactions brought by the picosecond domain Nd:YAG laser. The modality operates at two switchable wavelengths (1064/532nm), generating 250±20 mJ and 150 ps pulses. The effects of the ultrashort pulses are not currently described, and the area is absent of *in vivo* animal studies, that could correlate with human skin. *In vivo* studies with longer pulse duration than 150 ps, used in our study, conducted with patients demonstrated pronounced effect on new collagen formation with no pain, little to no side-effect, no social downtime[6].

For this purpose, we designed an experiment by using a *in vivo* porcine model, as it offers great similarity to human skin, as described in literature [7]. We analyzed the formation of the MTZ, microscopic epidermal necrotic debris, collagen, epidermal integrity staining and conducted macroscopic examination of the treated skin after 1 hour, 2 and 10 days.

No pigmentary changes, blistering, scarring or other side effects were observed in the treated area during the post-treatment follow-ups. The appearance of erythema and edema implied that the treatment was effective, and a skin healing response was expected to occur. The histopathological examination of the tissue samples was prepared using histochemistry and immunohistochemistry methods. They confirmed the formation of MTZs in the dermal-epidermal junction. Based on our finding, the Nd:YAG laser operating on 1064 nm wavelength and 150 ps, depending on the energy in use, is safe on *in vivo* porcine skin models and can be applicable generating reproducible dermal or epidermal lesions, where target depth is only defined by the focusing optics. LIOB could be applied for direct extracellular matrix remodelling, removal of senescent fibroblasts, addressing mast cells and resident cells related disorders, tattoo removal and sebaceous gland treatment.

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