Lasers Med Sci (2010) 25:559–569
DOI 10.1007/s10103-010-0761-5

ORIGINAL ARTICLE

Low-level Er:YAG laser irradiation enhances osteoblast proliferation through activation of MAPK/ERK

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Received: 1 October 2009 Published online: 26 February 2010

Abstract Although the use of high-level Er:YAG laser irradiation has been increasing in periodontal and peri-implant therapy, the effects of low-level Er:YAG laser on surrounding tissues and cells remain unclear. In the present study, the effects of low-level Er:YAG laser irradiation on osteoblast proliferation were investigated. Cells of the osteoblastic cell line MC3T3-E1 were treated with low-level Er:YAG laser irradiation with various combinations of laser settings (fluence 0.7–17.2 J/cm^2) and in the absence or presence of culture medium during irradiation. On day 1 and/or day 3, cell proliferation and death were determined by cell counting and by measurement of lactate dehydrogenase (LDH) levels. Further, the role of mitogen-activated protein kinase (MAPK) pathways in laser-enhanced cell proliferation was investigated by inhibiting the MAPK pathways and then measuring MAPK phosphorylation by Western blotting. Higher proliferation rates were found with various combinations of irradiation parameters on days 1 and 3. Significantly higher proliferation was also observed in laser-irradiated MC3T3-E1 cells at a fluence of approximately 1.0–15.1 J/cm^2, whereas no increase in LDH activity was observed. Further, low-level Er:YAG irradiation induced the phosphorylation of extracellular signal-regulated protein kinase (MAPK/ERK) 5 to 30 min after irradiation. Although MAPK/ERK 1/2 inhibitor U0126 significantly inhibited laser-enhanced cell proliferation, activation of stress-activated protein kinases/Jun N-terminal kinase (SAPK/JNK) and p38 MAPK was not clearly detected. These results suggest that low-level Er:YAG laser irradiation increases osteoblast proliferation mainly by activation of MAPK/ERK, suggesting that the Er:YAG laser may be able to promote bone healing following periodontal and peri-implant therapy.

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