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Photobiomodulation with 635 nm diode laser stimulates osteoblast differentiation via Akt signaling activation

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Low Level Laser Therapy (LLLT), more recently termed photobiomodulation (PBM), has been used for bone regenerative purposes in different fields of medicine and dentistry [1,2]. However, at present, univocal standardized guidelines for its use PBM are not available. This is mainly due to the variety of wavelenghts, light source types used, disparate energy output modes and setting parameters, which have produced many different treatment protocols with different and sometimes contradictory outcomes hampering meaningful comparison of the results and demanding a skeptical look for the promising and potential beneficial effects of this approach [2,3]. In addition, the molecular mechanisms by which PBM induces different biological responses have not been fully clarified [4]. In this in vitro study we evaluated the PBM potentiality by 635±5 nm diode laser operating in continous wave with a 0.4 J/cm2 energy density to influence osteoblast progenitor cell viability, proliferation, adhesion and osteogenic differentiation. Red light did not alter viability (PI/Syto16 and MTS assays). Confocal immunofluorescence and RT-PCR analyses indicated that photobiomodulation by 635 nm increased vinculin-rich clusters, osteogenic markers expression (Runx-2, alkaline phosphatase, osteopontin) and mineralized bone-like nodule structure deposition. Interestingly, osteoblast responses to 635 nm laser treatment were mediated by Akt signaling activation which seems to positively modulate reactive oxygen species (ROS) levels. Although within the limitations of an in vitro experimentation, this study may suggest PBM by 635 nm laser operating as indicated, as a potential effective option for promoting/improving bone regeneration.

References

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Key words

Photobiomodulation (PBM), low level laser therapy (LLLT), osteoblasts, bone regeneration, Runx-2, ostepontin, Akt signaling, ROS.

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