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Reviews

Laser Photobiomodulation of Wound Healing: A Review of Experimental Studies in Mouse and Rat Animal Models

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Abstract

Objectives: This investigation reviewed experimental studies of laser irradiation of wound healing in mice and rats published from 2003 to August 2008, respectively, to assess putative stimulatory effects of this treatment. ***Background:*** Animal models, including rodents, attempt to reflect human wound healing and associated problems such as dehiscence, ischemia, ulceration, infection, and scarring. They have played a key role in furthering understanding of underlying mechanisms involved in impaired wound healing, and in testing new therapeutic strategies including laser irradiation. ***Method:*** Original research papers investigating effects of laser or monochromatic light therapy on wound healing in mice and rats and published from January 2003 to August 2008 were retrieved from library sources, *PubMed* and *Medline* databases, reference lists from retrieved papers, and hand searches of relevant journals. Papers were selected for this review with regard to specific inclusion and exclusion criteria. Studies were critically reviewed in terms of study design, methodology, and appropriateness of laser irradiation parameters. ***Results:*** The literature search identified eight studies in mice and 39 in rats. A variety of wound models were investigated, including acute-wound, impaired-healing, and chronic-wound models. Considerable variation was observed in research design, methodology, and irradiation parameters employed, limiting comparison of research findings between studies. Inadequate reporting of key experimental details, or errors in specification and/or calculation of key irradiation parameters was also found. Evidence from the studies reviewed suggested that use of red or infrared wavelength at a range of dosage parameters (median 4.2 Jcm^{-2}) results in significant benefits in measured parameters of wound healing. Interestingly, coherence does not seem essential to the photobiomodulatory effects of 'laser' phototherapy. ***Conclusion:*** Studies reviewed consistently demonstrated the ability of laser or monochromatic light to photobiomodulate wound healing processes in experimental wounds in rats and mice, and strongly support the case for further controlled research in humans.

Introduction

Low level laser therapy (LLLT)[1] has been used clinically to stimulate the healing of a variety of musculoskeletal injuries such as tendinitis and soft tissue injuries, as well as open skin wounds, and in the treatment of various skin conditions such as psoriasis and acne.[2] To date, most of the controlled research to investigate the effects of laser irradiation in wound healing has been performed in animal models, mainly with rodents such as the mouse and rat. Previous reviews have summarized this work up to 2003 in animal models and in humans.[3–7]

In general, animal models attempt to reflect human wound healing and associated problems such as dehiscence, ischemia, ulceration, infection, and scarring.[8] These have played a key role in furthering understanding of the underlying mechanisms involved in impaired wound healing, and also have a critical role in the testing of new therapeutic strategies including LLLT. However, with the exception of acute models, studies with animal models will at best only provide approximations of clinical problems owing to differences in tissue architecture, immune system function, physiology, and other healing responses among species.

Rodents are attractive for wound healing studies because of their availability, low cost, and ease of handling. Murine models of wound healing offer several advantages over models in other species. Mice are inexpensive, thus allowing studies to be performed with large sample sizes. Furthermore, there currently

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