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Review

Developments in low level light therapy (LLLT) for dentistry

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ABSTRACT

Objectives. Low level light/laser therapy (LLLT) is the direct application of light to stimulate cell responses (photobiomodulation) in order to promote tissue healing, reduce inflammation and induce analgesia. There have been significant studies demonstrating its application and efficacy at many sites within the body and for treatment of a range of musculoskeletal injuries, degenerative diseases and dysfunction, however, its use on oral tissues has, to date, been limited. The purpose of this review is to consider the potential for LLLT in dental and oral applications by providing background information on its mechanism of action and delivery parameters and by drawing parallels with its treatment use in analogous cells and tissues from other sites of the body.

Methods. A literature search on Medline was performed on laser and light treatments in a range of dental/orofacial applications from 2010 to March 2013. The search results were filtered for LLLT relevance. The clinical papers were then arranged to eight broad dental/orofacial categories and reviewed.

Results. The initial search returned 2778 results, when filtered this was reduced to 153. 41 were review papers or editorials, 65 clinical and 47 laboratory studies. Of all the publications, 130 reported a positive effect in terms of pain relief, fast healing or other improvement in symptoms or appearance and 23 reported inconclusive or negative outcomes. Direct application of light as a therapeutic intervention within the oral cavity (rather than photodynamic therapies, which utilize photosensitizing solutions) has thus far received minimal attention. Data from the limited studies that have been performed which relate to the oral cavity indicate that LLLT may be a reliable, safe and novel approach to treating a range of oral and dental disorders and in particular for those which there is an unmet clinical need.

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Significance. The potential benefits of LLLT that have been demonstrated in many healthcare fields and include improved healing, reduced inflammation and pain control, which suggest considerable potential for its use in oral tissues.

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1. Introduction

Low level light/laser therapy (LLLT) is the application of light (usually delivered via a low power laser or light-emitting diode; LED) to promote tissue repair, reduce inflammation or induce analgesia. LLLT has been the subject of several systematic reviews for a range of musculoskeletal pathologies with favorable outcomes reported in The Lancet [1], British Medical Journal [2], International Association for the Study of Pain [3] and the World Health Organization [4]. Unlike many other laser treatments LLLT is not an ablating or heating based therapy but is more analogous to photosynthesis in its mode of action. LLLT also differs from photodynamic therapy (PDT), which utilizes light indirectly to trigger photosensitive dyes to produce bactericidal molecules that kill infecting microbes that cause disease. Indeed, current data indicates that PDT appears to be a useful adjunctive tool for treating oral infections in the dental specialties of oral surgery, endodontics and periodontitis (e.g. Periowave™) [5,6]. In contrast, LLLT or photobiomodulation uses the action of light and light alone to directly stimulate host cells in order to reduce inflammation, relieve pain and/or promote wound healing.

Dental applications for LLLT are not well documented in comparison with musculoskeletal applications; however, more studies are now being reported. Indeed, there is now encouraging data for LLLT application in a wide range of oral hard and soft tissues and covering a number of key dental specialties including endodontics, periodontics, orthodontics and maxillofacial surgery as described below. LLLT has also been shown to have efficacy in managing chronic pain and non-healing bone and soft tissue lesions in the maxillofacial region.

The laser or LED devices applied in LLLT typically emit in the 600–1000 nm spectrum range (red to near infrared), with typical irradiance of 5 mW/cm^2 to 5 W/cm^2 and generated by devices with as little power as 1 mW, and up to 10 W. Pulsed or sometimes continuous beams are delivered. Treatment time is typically for 30–60 s per treatment point (see Glossary of terms for an explanation of "per-point"; Table 4) and as little as one treatment point or a dozen or more may be treated at a given time. For acute and post-operative therapy one treatment is all that is usually required however for chronic pain

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