

NASA Light-Emitting Diodes for the Prevention of Oral Mucositis in Pediatric Bone Marrow Transplant Patients

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ABSTRACT

Objective: The purpose of this study was to determine the effects of prophylactic near-infrared light therapy from light-emitting diodes (LEDs) in pediatric bone marrow transplant (BMT) recipients. **Background Data:** Oral mucositis (OM) is a frequent side effect of chemotherapy that leads to increased morbidity. Near-infrared light has been shown to produce biostimulatory effects in tissues, and previous results using near-infrared lasers have shown improvement in OM indices. However, LEDs may hold greater potential for clinical applications. **Materials and Methods:** We recruited 32 consecutive pediatric patients undergoing myeloablative therapy in preparation for BMT. Patients were examined by two of three pediatric dentists trained in assessing the Schubert oral mucositis index (OMI) for left and right buccal and lateral tongue mucosal surfaces, while the patients were asked to rate their current left and right mouth pain, left and right xerostomia, and throat pain. LED therapy consisted of daily treatment at a fluence of 4 J/cm² using a 670-nm LED array held to the left extraoral epithelium starting on the day of transplant, with a concurrent sham treatment on the right. Patients were assessed before BMT and every 2–3 days through posttransplant day 14. Outcomes included the percentage of patients with ulcerative oral mucositis (UOM) compared to historical epidemiological controls, the comparison of left and right buccal pain to throat pain, and the comparison between sides of the buccal and lateral tongue OMI and buccal pain. **Results:** The incidence of UOM was 53%, compared to an expected rate of 70–90%. There was also a 48% and 39% reduction of treated left and right buccal pain, respectively, compared to untreated throat pain at about posttransplant day 7 ($p < 0.05$). There were no significant differences between sides in OMI or pain. **Conclusion:** Although more studies are needed, LED therapy appears useful in the prevention of OM in pediatric BMT patients.

INTRODUCTION

ORAL MUCOSITIS (OM) is a frequent side effect of chemotherapy in preparation for bone marrow transplant (BMT). Ulcerations in the vulnerable oral mucosa produce severe pain, oral superinfections that may lead to systemic infections, and compromise oral hydration and nutrition.^{1–3}

Investigations into low-energy stimulation of tissues by lasers have shown increased cellular activity during wound healing, including increased collagen production^{4,5} and angiogenesis.⁶ The data suggest that monochromatic, near-infrared laser biostimulation produces its primary effect during the cell

proliferation phase,^{7,8} increasing mitochondria respiration through stimulation of cytochrome oxidase.^{4,5,9} Production increases have been seen in fibroblasts, collagen and procollagen, growth factors, lymphocytes, and extracellular matrix—as well as macrophage stimulation—with laser treatment.^{10–13} Optimal wavelengths for wound healing, as proven in previous laser studies, include 680, 730, and 880 nm.^{4,5,11,14} Additionally, previous studies have shown that use of helium-neon lasers in BMT recipients significantly decreases the severity and duration of ulcerative mucositis.^{15–17}

Recently, light-emitting diodes (LEDs) have been shown to be a safe, efficient, lightweight, and less-expensive alternative

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