

# A Systematic Review and Meta-Analysis of the Effects of Low-Level Laser Therapy in the Treatment of Diabetic Foot Ulcers

The International Journal of Lower Extremity Wounds  
1–10

© The Author(s) 2020

Article reuse guidelines:

sagepub.com/journals-permissions

DOI: 10.1177/1534734620914439

journals.sagepub.com/home/ijl



**Cristiana Maria dos Santos, PT<sup>1</sup> , Rebeca Barbosa da Rocha, PT<sup>1</sup>,  
Fuad Ahmad Hazime, PT, PhD<sup>1</sup>, and Vinicius Saura Cardoso, PT, PhD<sup>1</sup>**

## Abstract

Diabetic foot ulcers (DFUs) are considered one of the most aggressive and expensive complications of diabetes. Low-level laser therapy (LLLT) has been highlighted as a potential modality of treatment to accelerate the healing of ulcers. This systematic review and meta-analysis aimed to investigate the efficacy of LLLT in the treatment of DFU and identify the LLLT application parameters recommended for the treatment of DFU over the past 10 years. A systematic search was conducted in PubMed, BVS, PEDro, Scopus, Web of Science, and CINAHL up to March 31, 2019. Following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines, randomized controlled trials (RCTs) that assessed the effect of LLLT on the treatment of DFU were included. Thirteen RCTs with a total of 361 participants were included in this review. Three RCTs reported a reduction in the percentage size of the ulcers and were included in the meta-analysis. The meta-analysis of the percentage size difference demonstrated a significant reduction in ulcer size in the LLLT group compared with controls (22.96 [95% confidence interval = 18.22-27.69;  $z = 9.51$ ,  $P < .0001$ ]). Treatment with 632.8 to 685 nm, 50 mW/cm<sup>2</sup>, 3 to 6 J/cm<sup>2</sup>, and irradiation for 30 to 80 seconds, 3 times weekly for a month is of benefit to patients with DFU. LLLT is effective and safe for the treatment of DFU. Additionally, well-designed, high-quality studies are needed to allow its ideal parameterization for clinical practice.

## Keywords

diabetic foot ulcer, low-level laser therapy, systematic review, meta-analysis

Type 2 diabetes mellitus is a chronic disease characterized by hyperglycemia associated with a combination of elevated cellular insulin resistance and a progressive reduction in insulin production.<sup>1,2</sup> According to the International Diabetes Federation, in 2017, the number of persons living with diabetes globally, in the 18- to 99-year-old age group was 451 million; however, it is estimated that by year 2045, this number will increase to 693 million.<sup>3</sup> The increasing prevalence of diabetes is accompanied by more frequent occurrence of complications such as leg ulcers and amputations, which may be the result of diabetic peripheral neuropathy and a consequent increase in plantar pressure, along with vascular dysfunction and traumatic lesions.<sup>4-6</sup>

Diabetic foot ulcers (DFUs) are considered one of the most aggressive and expensive complications of diabetes, and it is associated with high morbidity and mortality,<sup>7</sup> with a prevalence of 6.3%<sup>8</sup> and a life time risk of ~25%.<sup>5</sup> In 2014, it was estimated that in Brazil, the annual direct medical cost of DFU was US\$571338.30, while patients who had amputations spent about US\$114609.78 on follow-up care.<sup>9</sup> The annual costs of DFU was estimated in £983 million in the United Kingdom<sup>10,11</sup> and \$547 million in Canada.<sup>12</sup> Thus, management of DFU imposes a significant

burden on the economy and health systems worldwide. This necessitates the search for effective strategies to prevent and treat this health condition.

The standard care of DFU consists of surgical debridement, dressings, pressure offloading, vascular assessment, treatment of infection, glycemic control, and patient education.<sup>13,14</sup> Among the adjuvant therapies, low-level laser therapy (LLLT) has been highlighted as a potential modality of treatment to accelerate the healing of ulcers.<sup>15</sup> Numerous research have investigated the effects of LLLT on DFU with promising results. These include studies by Tantawy et al<sup>16</sup> and Feitosa et al,<sup>17</sup> which showed significant reduction in the size of the ulcer using LLLT with wavelengths of 632 nm (5 J/cm<sup>2</sup>; 20 mW)/904 nm (6 J/cm<sup>2</sup>; 20 mW) and 658 nm (4 J/cm<sup>2</sup>; 30 mW), respectively. Compared with controls, significantly greater reduction

<sup>1</sup>Federal University of Piauí, Piauí, Brazil.

## Corresponding Author:

Vinicius Saura Cardoso, BioSignal Laboratory, School of Physical Therapy, Federal University of Piauí, Avenue São Sebastião, 2819, Parnaíba-Piauí, CEP 64202-020, Brazil.  
Email: vsfcisio@ufpi.edu.br