

## RESEARCH ARTICLE

### Photobiomodulation in Dermatology: Harnessing Light from Visible to Near Infrared for Medical and Aesthetic Purposes

#### Author

Daniel Barolet, MD FRCPC <sup>a,b</sup>

#### Affiliations

<sup>a</sup> Dermatology Division, Department of Medicine, McGill University, Montreal, Canada

<sup>b</sup> RoseLab Skin Optics Research Laboratory, Laval, Canada

#### Correspondence

Daniel Barolet, MD FRCPC

E-mail: [daniel.barolet@mcgill.ca](mailto:daniel.barolet@mcgill.ca)

#### Abstract

Photobiomodulation (PBM), the therapeutic use of low intensity light, typically in the visible and infrared (IR) wavelengths, has been demonstrated to be efficacious in the treatment and prevention of numerous skin conditions. The PBM biological response begins with chromophores, photon accepting molecules which convert light into signals that can stimulate certain biological processes. Important chromophores initiating the PBM response are Cytochrome C Oxidase (CCO), with absorption peaks in the red and near IR wavelengths, opsins absorbing blue and green wavelengths and intracellular water acting at specific sites in the cell. PBM can activate cell signaling processes. The increase in electron transport, oxygen consumption, mitochondrial membrane potential, and ATP synthesis, particularly in hypoxic or stressed cells, can lead to the up-regulation of cell repair and survival pathways. In PBM, the light delivery parameters which maximize the therapeutic response are defined within specific ranges, with total fluence and irradiance being of particular importance. PBM emerges as a valuable complementary treatment modality in dermatology. In terms of tissue repair, wound healing is accelerated by PBM. Cutaneous wounds, erosive mucositis in oncology, leg ulcers, as well as burns and radiodermatitis all benefit from PBM treatment. Widely used to accelerate healing after aggressive aesthetic treatments, PBM reduces inflammation following treatments like skin resurfacing, vascular and benign pigmented lesions, or chemical peels. It has also been shown to be effective in treating dyspigmentation. In the case of hyperpigmentation, melanin synthesis is inhibited with IR light. Additionally, PBM has shown benefits in the treatment of acne and the prevention / treatment of hypertrophic scars. It has shown promise in skin rejuvenation, the treatment of alopecia, cellulite, as well as other skin diseases. The discovery of new applications for PBM, already an effective form of treatment and prevention for many skin conditions, is continually expanding.

#### Keywords

Photobiomodulation, low-level laser therapy, LLLT, laser, LED, light emitting diodes, chromophores, cytochrome c oxidase, clinical trials, treatment, complementary, skin, dermatology, cutaneous, phototherapy.