LED light therapy: the evidence behind the efficacy

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Abstract

The plethora of modalities available to improve skin health and appearance is greater than ever, with one of these options being LED light therapy. Various LED-based devices for dermatological and cosmetic usage have become widely available, but the average consumer or aesthetic practitioner may not be confident in their efficacy or safety. Francesca Ramadan summarises the latest evidence-based applications of LED phototherapy and the research supporting its benefit to the aesthetic practitioner's toolkit.

Key words

LED ▸ light therapy ▸ skin health ▸ dermatology ▸ skincare

The plethora of modalities available to the average consumer to improve skin health and appearance is greater than ever, owing to technological and medical developments and the role of social media in the normalisation and promotion of options that would not have been previously available outside of an aesthetic clinic.

Photobiomodulation (PBM), or photobiomodulation therapy (PBMT), which was discovered in the late 1960s, commonly defined as 'treatment using irradiation with light of low power intensity' (Tran et al, 2021), represents one of these options. Generally, PBMT can be divided into two modes, based on the duration of the wave light emitted by the device used: either pulsed or continuous (Tran et al, 2021). PBMT employs either non-coherent (light-emitting diodes (LEDs)) or coherent light sources (lasers), or a combination of both. The introduction of LED phototherapy aims to mitigate the disadvantages associated with lasers, such as issues related to safety and pricing (Tran et al, 2021). While lasers are often used in medical applications, LED light is typically preferred in dermatology and aesthetic medicine, due to the relatively large areas of tissue that require irradiation (Tran et al, 2021). Compared with laser devices, LED devices demonstrate several advantages, including ease of home use; irradiation of larger surface areas; increased capacity for wearable devices; greater cost-effectiveness; and enhanced safety (Tran et al, 2021). Therefore, various LED-based devices for dermatological and cosmetic applications have become widely available at reasonable prices (Tran et al, 2021).

LED phototherapy: a small but powerful intervention

There are different frequencies, or wavelengths, associated with LED light treatment. These include including blue (420–470nm), red (630–700nm), yellow (540–590nm) and 830nm and above (infrared) light frequencies, which do not contain ultraviolet rays and are readily absorbed into the skin (Ablon, 2018; Ngoc et al, 2023). The therapeutic principle of LED phototherapy is based on PBM reactions, in which the photons emitted by LEDs are absorbed by the chromophores of the skin (e.g., mitochondrial, cytochrome C, melanin and endogenous protoporphyrins), causing downstream alterations in its biophysiology, leading to changes

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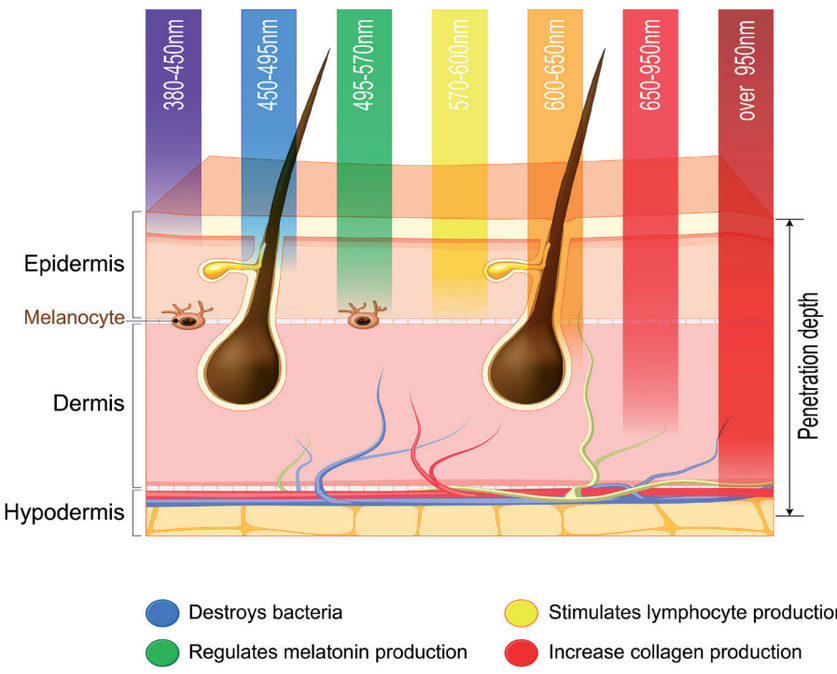
in cellular proliferation, migration, differentiation, inflammation and collagen production (Ngoc et al, 2023). Frequently used wavelengths range from 400–1200 nm; longer wavelengths are able to penetrate deeper into tissue (Sorbellini et al, 2018). Different cells and tissues absorb light at varying wavelengths, which is strictly related to the penetration that the wavelengths can achieve. For instance, red light is able to reach dermis-activating fibroblasts; blue light has a lower potential for penetration and is useful for skin conditions in the epidermis; yellow light is beneficial for skin conditions involving redness, swelling, and other effects related to pigmentation; and near-infrared light (700–1200nm) achieves maximum penetration in the skin, with in vivo studies demonstrating its effectiveness in wound healing (Sorbellini et al, 2018). The most common wavelengths for aesthetic applications are red and blue light, and further evidence on some of the more frequent presentations is presented below.

Acne vulgaris

In a systematic review and meta-analysis on the utilisation of LEDs for skin therapy, Ngoc et al (2023) found that the effects of LEDs on the treatment of acne vulgaris were reported in nine studies, most of which were conducted using blue or red LEDs. Two studies reported that blue LED light was effective at improving acne vulgaris after a follow-up period of 8–12weeks compared to a placebo group; in a placebo-controlled randomised control trial (RCT) of 30 participants, blue LED decreased the number of lesions by 35% after a short 2-week follow-up period (Ngoc et al, 2023). Regarding red LED-based acne treatment, one study demonstrated decreased acne lesion counts (52%) compared to the no-treatment group after an 8-week treatment period; another revealed that 14 participants with facial acne noticed a reduction of inflammatory acne (87.7%) after a 12-week follow-up treatment (Ngoc et al, 2023). Some in vitro studies have demonstrated a statistically significant inhibitory effect of red light (630 nm) on sebum production, while blue light (415 nm) has also showed a significant effect in acne treatment, acting in a dose-dependent manner in reducing human sebocyte proliferation (Sorbellini et al, 2018). Many studies also reported the beneficial effects of blue light treatments in acne vulgaris via the alteration of skin microbiome (Sorbellini et al, 2018).

Rosacea

Sorbellini et al (2020) reported the efficacy and safety of light-emitting diodes therapy combining blue (480nm) and red (650nm) light for the treatment of two patients with papulopustular rosacea: a 22-year-old Caucasian woman and a 68-year-old Caucasian man. Erythema, burning sensations and itching were assessed using a visual grading scale (0=no symptoms; 4=very severe); erythema and papules were subjectively assessed by a dermatologist, whereas the intensity of itch and burning sensations was reported by study participants (Sorbellini et al, 2020). A good response was obtained for both patients after ten treatments with LEDs. Both patients reported a reduction of certain symptoms, such as burning and itching; additionally, a reduction of



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erythema and papules was observed after five sessions of LED therapy (Sorbellini et al, 2020).

Skin rejuvenation

A clinical study demonstrated excellent dermatological tolerance and antiaging effectiveness of the Skin Light Dior × Lucibel mask after 1, 2, and 3 months of use (Couturaud et al, 2023). From the first month of use, a significant improvement in the following parameters was observed:

- 15.6% decrease in the depth of crow's feet wrinkle;
- Decrease of 5.4% of the clinical score of slackening of the oval of the face and 13.6% of the Ro value, translating a firming effect;
- 26.4% increase in dermal density;
- 6.8% decrease in cheek roughness and 28.5% decrease in pore diameter, indicating a smoothing effect;
- 34.9% decrease in the quantity of sebum (Couturaud et al, 2023).

After 2 months of use, a further improvement in the above parameters was noted, and a significant increase of 12.5% in skin elasticity and 32.7% in skin tone homogeneity were also observed (Couturaud et al, 2023). After 3 months of use, all the parameters analysed were improved (Couturaud et al, 2023).

Likewise, treatment of human skin cells with low-level red and infrared LED lights has been found to significantly increase hyaluronic acid synthase and elastin gene expression in human fibroblasts in as little as 3 days (Kim et al, 2019).

Conclusion

The literature demonstrates that LED phototherapy can significantly stimulate the production of multiple biomarkers associated with anti-aging skin in human skin, alongside inducing the reduction of sebum production and the symptoms of rosacea. Overall, these findings suggest that LED PBMT presents opportunities for regular clinic attendance or at-home treatments for patients with skin health and appearance concerns (Kim et al, 2019). JAN

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