

Treatment of Alopecia with Low-Level Light Therapy

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ABSTRACT

Low-level light therapy (LLLT) is a safe, non-invasive treatment for various alopecias, offering an alternative or adjunct to pharmacologic therapies. By using specific wavelengths, LLLT releases nitric acid, increases blood flow, inhibits DHT, stimulates follicular cells, enhances mitochondrial activity, and modulates inflammatory pathways. In androgenetic alopecia (AGA), LLLT increases hair density and count, with combination therapy alongside minoxidil or finasteride showing enhanced outcomes. Evidence also suggests benefits in telogen effluvium (TE), alopecia areata (AA), and select cicatricial and traction alopecias, primarily through anti-inflammatory and follicular stimulation mechanisms. LLLT is well tolerated, and advances in at-home and dual-wavelength devices have improved accessibility and adherence.

BACKGROUND

Alopecia includes conditions that can significantly affect quality of life. While pharmacologic therapies remain standard, LLLT offers a safe, non-invasive alternative, stimulating hair follicle repair, prolonging anagen, and promoting regrowth. Advances in at-home and dual-wavelength LED devices have improved accessibility, and this review examines LLLT's mechanisms, efficacy, and clinical applications (Figure 1).

METHODS

A PubMed search using terms related to alopecia and laser/light therapy was conducted.

RESULTS & DISCUSSION

Androgenetic Alopecia: In AGA, LLLT, including lasers and LED, in at-home or in-office devices, stimulates follicular cells via mitochondrial activation, increased ATP,

RESULTS & DISCUSSION (CONT.)

anti-apoptotic signaling, improved microcirculation, and modulation of inflammatory mediators. may also reduce DHT production. A dual wavelength LED LLLT device (Revian System, Revian Inc.) has been shown to decrease DHT production via stimulated nitric oxide production within cells specific to hair growth. Clinical studies demonstrate improved hair counts and density, with combination therapy alongside minoxidil or finasteride showing synergistic benefits. LLLT is generally well tolerated, with transient scalp pruritus as the most common side effect.

Telogen Effluvium: LLLT may counteract premature follicular transition into telogen by enhancing mitochondrial activity and prolonging anagen. Small prospective studies report subjective improvements in density and reduced shedding, though objective hair count changes were modest and often not statistically significant. Nevertheless, most patients reported perceived benefit, suggesting value as an adjunct in chronic or recurrent TE.

Alopecia Areata: LLLT is thought to act through immunomodulatory and anti-inflammatory pathways. Early studies and case series demonstrate increased hair density, reduced perifollicular inflammation, and improved patient-reported outcomes following twice-weekly treatments. While evidence remains preliminary, the findings support further exploration of LLLT as a complementary approach to standard therapies.

Frontal fibrosing alopecia (FFA): Recent interest has emerged in LLLT as a potential adjunctive option to current therapies due to its ability to stimulate follicular stem cell activity, enhance mitochondrial function, and exert anti-inflammatory effects, which may benefit early-stage FFA where active inflammation precedes irreversible fibrosis.



Figure 1
Low Level Light Therapy Device for At-Home Use.

RESULTS & DISCUSSION (CONT.)

Central centrifugal cicatricial alopecia (CCCA): While the use of light-based therapy in CCCA is not well established, emerging interest in LLLT has prompted clinical exploration. Specifically, promising results from a dual wavelength LED device has opened a new avenue in the treatment for CCCA.

Traction alopecia: There is limited but emerging evidence that LLLT may play a supportive role in the management of early-stage TA. LLLT's mechanism of action (see prior sections) could be beneficial if active follicles remain.

Secondary scarring alopecia: Though not widely studied in secondary scarring alopecias, LLLT has shown early promise. A case report described significant clinical improvement in a patient with recalcitrant DLE treated with LLLT, noting reduced erythema and scaling, improved skin texture, and partial hair regrowth.

CONCLUSION

Low-level light therapy (LLLT) is a safe, non-invasive option that has demonstrated strong efficacy in androgenetic alopecia and growing promise in other alopecias. Evidence suggests it may enhance hair density, reduce inflammation, and improve outcomes when used alone or in combination with established treatments. While data in conditions such as telogen effluvium, alopecia areata, and cicatricial alopecias remain limited, early results are encouraging. LLLT therefore represents a valuable adjunct in the evolving management of hair loss disorders.

REFERENCES & DISCLOSURES

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