

Treatment of hair loss with an LED device: the importance of the wave length

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Abstract

Hair loss is of a big concern in our society, concerning about 50% of the population at one time of their life. It impacts social integration and the feeling of well-being.

We will distinguish hair loss with and without inflammatory causes, both having to be treated differently. Number of sessions, wave lengths, and energy levels will be discussed. Red light (630 nm) alone will be used in hair loss without inflammation, such is seen in crash dieting, postpartum, or after chemotherapy. The combination of IR-red light is necessary to have conclusive results in the other case, such as alopecia areata. The presence of hair bulbs is necessary to achieve regrowth. Instead of biopsies in already scarce hair, I performed clinical photographs, always in the same position; one before treatment, one after 5 sessions, and one after ten sessions. If necessary, treatment could be continued once a month.

This is a retrospective review of more than 600 cases, successfully treated in my praxis. The effects are durable, in time except in pathologies with an inflammatory component where a couple of new treatment sessions are necessary.

Using this method in every day practice is very easy as treatment sessions take about 15 minutes and the method is very successful when applied correctly. The treatment is very safe with virtually no side effects and permits to reduce other medication used for this purpose.

Key words: hair loss, LED, 630 nm, 630/850 nm.

Introduction

Hair loss can be successfully treated with an LED device; about 80% of positive response when using the right wave lengths and energy levels.

We shall only discuss red and the combination of red/IR to treat the different disorders. Hair loss should first be divided into two groups; with or without inflammation of the scalp.(1) It is nothing else than a

perturbance of the primary hair cycle; anagen (I-IV), the growth phase which may last years and where the hair shaft receives its pigmentation from the melanocytes surrounding the bulb.(2)

The catagen, or intermediate phase, is much shorter and shows slower metabolism. The final, telogen phase where hair is shedding shows also no significant synthesis of DNA, RNA or proteins.(3) Therefore, factors, inducing the telogen phase, can be exogenous, involving a proteolytic event, like after pregnancy, crash dieting, etc. or endogenous, like in alopecia areata and androgenic alopecia, where there is inflammation around the hair bulb, which targets anagen follicles.

LED, 630 nm stimulates the anagen phase. It activates the ATP production via the mitochondria and boosts the cell metabolism.(4) At birth, we have 100.000 – 150.000 hair follicles. They have a cyclic activity (anagen, catagen, telogen), and require the presence of multipotent adult stem cells.

The melanocytic activity of the hair bulb is cycle dependent, retracting its dendrites at the end of each hair cycle.(2)

Since we can induce recoloration of white hair with red light, it means that we reinduce the passage from catagen/telogen to anagen.



Fig. 1 – Stopping artificial dying of the hair. Progressive repigmentation of the hair (irradiation 630

nm, 70 J/cm², 10 minutes, 1 treatment session a week). This proves that 630 nm alone includes the anagen cycle of hair growth.

We can therefore assume that red light also has a positive effect on the melanocytic unit of the hair bulb.

The red light alone has little to no effect on hair loss with an inflammatory background, like in androgenic alopecia. It could either reactivate a hair in the catagen/telogen phase or activate an underlying stem cell.

IR light also enhances the cell metabolism via photophysical mechanisms and has a positive effect on resolving inflammation. It can recruit fibroblasts and other inflammatory cells. The combination of R/IR (80%/20%) has long been used in dermatology to speed up the healing of wounds.(4),(5),(6)



Fig. 2 – Post traumatic wound of the palm (Ehlers Danlos syndrome) before and 24 hours later (630/850, 70 J/cm², 10 minutes) 1 session.

It does not recolor hair but has a positive effect on hair growth and density.

Over 600 different patients have successfully been treated safely with these different wave lengths. Results are durable in time but in case of underlying inflammation, treatment has to be continued once a month.

Materials and Methods

Data were collected from more than 600 patients, having been treated with at least 12 treatment sessions, over a period of 13 years. Included were adult males and females with different types of hair loss, consulting for hair loss. In women, biological screening for iron deficiency and thyroid function were tested when there was no notion of other concomitant diseases. Men mainly consulted for androgenic alopecia, some after chemo or radio therapy. The sessions were performed with an LED device (AÿØ Age in this case), using two different programs: one with only red (630 nm) light when there was no inflammation of the scalp, such as postpartum, after crash dieting, or chemotherapy. Red light showed little effectiveness in scalp disorders with inflammation, such as alopecia areata, androgenic alopecia, lupus erythematosus, psoriasis, or seborrheic dermatitis of the scalp. I used the combination of 630 nm/850 nm (80%/20%), well known for beneficial treatment in other inflammatory diseases.(7) I even had my own LED (Hair Booster) fabricated with the same energy parameters but, with an easier possibility to manipulate the headpiece of the machine.

Treatment sessions were performed once a week at 70 J/cm², delivered in 10 minutes to benefit completely from the energy delivered. The headpiece slightly inclined, and patients were treated around 180 degrees after 5 minutes, for a total treatment session of 10 minutes. Safety goggles for LED and lasers were worn during the sessions. Clinical photographs were taken, always in the same position, and if possible, with the same hair length, including the front inclined view, face, and back of the scalp. They were taken before treatment, after five sessions, and after one month. It is important to have an intermediate picture to ensure that there are still

hair bulbs and hair is growing back, thereby confirming the effectiveness of the treatment sessions. (8)

After ten sessions, treatment was continued once a month to obtain even better results. Patients were supplied with specific vitamins and amino acids, for a period of three months. Other treatments instituted by other practitioners, such as spironolactone and minoxidil, were very often stopped. Shampoo was mild and nourishing.

LED red and IR is a very safe treatment (approximately 60-100 W/cm²) where solar irradiation has an energy of 1.000 – 1.500 W/cm².

Results

Hair loss treated with red light (630 nm) alone showed progressive thickening, better quality and volume, and progressive repigmentation in the case of the presence of white hair.

Pictures were taken before treatment, after five sessions, after ten sessions, and once a month thereafter. This showed very good results in case of hair loss by crash dieting, regrowth after chemotherapy, and in postpartum.



Fig. 3 – Postpartum hair loss before and after 10 sessions (630 nm, 70 J/cm², 10 minutes)



Fig. 4 – Chronic shedding, no precise etiology (630 nm, 70 J/cm², 10 minutes) before and after 10 sessions



Fig. 5 – stimulation of hair growth after radiotherapy (630 nm, 70 J/cm², 10 minutes) after 10 sessions



Fig. 6 – Hair loss after general anesthesia, (630 nm, 70 J/cm², 10 minutes) before and after 10 sessions. Note: spontaneous repigmentation of white hair

Pathologies with underlying inflammation of the scalp did not respond convincingly.



Fig. 7 – Androgenic Alopecia treated with 630 nm alone (70 J/cm², 10 minutes per session, once a week). 7 sessions. There is no significant hair growth.

The combination of 630/850nm showed very nice results in androgenic alopecia, alopecia areata, lupus, psoriasis, and seborrheic dermatitis of the scalp. In case of scaling and redness of the scalp, an adjuvant treatment of a local steroid speeded up the healing process.

Regrowth showed to be possible as long as there were hair bulbs in reserve; explaining only partial remission in some cases of androgenic alopecia.

Interestingly, treatment of androgenic alopecia is successful, but relapses occur after stopping treatment sessions, indicating that the underlying mechanism is still present.

Women with AA showed better and long-lasting results.



Fig. 8 – Woman 75 years of age, chronic progressive female pattern alopecia. Before treatment, after 5 sessions, after 10 sessions (630/850 nm, 70 J/cm² delivered in 10 minutes).

No other adjuvant treatment.

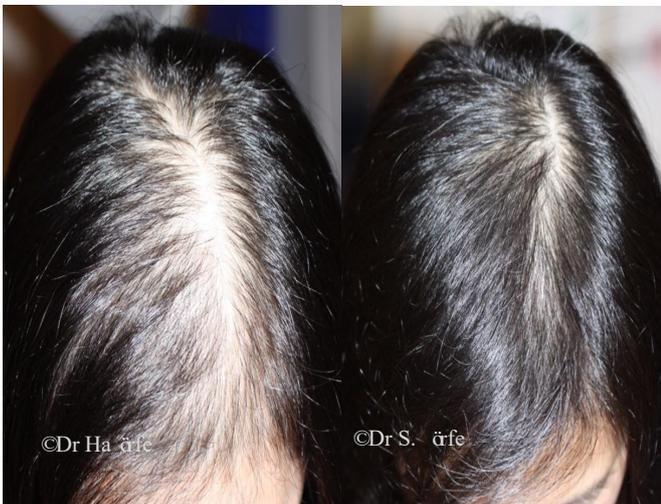


Fig. 9 – Androgenic Alopecia (female pattern hair loss) before treatment and after 10 sessions (70 J/cm² per session, 80% 630 nm, 20% 850 nm, 1 session per week). Hair density improved significantly, several treatment sessions followed once a month and have to be continued to maintain this result.



Fig. 10 – Woman of age 45 with progressive an-

drogenic alopecia. Before treatment, after 5 sessions, after 10 sessions (630/850 nm, 70 J/cm² delivered in 10 minutes).

No other adjuvant treatment.



Fig. 11 – Androgenic Alopecia, male pattern hair loss, before and after 10 sessions. (630/850 nm, 70 J/cm², 10 minutes).

Discussion

Understanding the different mechanisms underlying scalp disorders is therefore very important for successful treatment. We could divide hair loss basically into two categories, those presenting only a shift into the telogen phase, like in postpartum, crash dieting, chemotherapy, and after total anesthesia, and those with an inflammatory component. (9) These pathologies generally evolve in cycles, permitting remission in between.

630/850 nm can also be used before and after a hair graft, maintaining results for a longer period. The hair shaft unit is normally immune-privileged site. Lack of lymphatic drainage, immunosuppressive effects, and a low number of Langerhans cells are responsible for low antigen expression, immunosuppressive cytokines from the follicular epithelium induce peripheral tolerance.(10)

Opsins are light sensitive proteins, found in rods and cones as well as in the skin, which should be considered a peripheral neuroendocrine organ.(11)

With solar radiation, light can be scattered, absorbed, and provoke photochemical reactions by endogenous chromophores. UV and VL (visible light) are transformed into redox-active excited states and can damage proteins, lipids, and nucleic acids.

Compared to solar irradiation, emitting 1.000-1.500 W/cm², our LED devices deliver 70 J/cm², (69-100 W/cm²).

Red light (630 nm) can stimulate melanocytes and decrease melanin production by reducing tyrosinase.

The melanosome can absorb light and is a natural chromophore. Red light has deep penetration and the photoreceptor is the cytochrome C in the mitochondria. A photoreceptor is also in the melanosomes.(12)

There is increased melanocytic proliferation through the increase of $\alpha 2\beta 1$ integrin expression after 630 nm irradiation.(11)

It is interesting to note that it can also facilitate repigmentation in the case of vitiligo.(13)

Taking briefly into consideration the most common hair disorders, AA (androgenic alopecia) is a balding-androgenic dependent trait. Its prevalence is highest in Caucasians, with 80% in men and over 70% in women of over 70 years of age.

Hair follicles are progressively miniaturized with

periods of empty follicles increasing.

The follicle dermal papilla is the primary target of androgenic action.

Historically, we find a perifollicular lymphocytic infiltration around the infundibulum. This explains the rationale for after treatment options such as finasteride and minoxidil. Alopecia areata is mostly reversible in cases of patchy hair loss, with perifollicular and intrafollicular lymphocytic infiltrates involving only anagen follicles. It is considered a T-cell-mediated autoimmune disease, which explains the use of treatments like PUVA and sensitizers. Its prevalence is of 1.7%.(15)



Fig. 12 – Alopecia areata in a young patient of 18 years lasting already for 3 years; hair extensions visible in the first picture; refractory to all other treatments. (Treatment 630/850 nm, 70 J/cm², 10 minutes, 1 treatment session per week). Complete remission 3 months after. 10 sessions per week and after, 1 session per month. Slight hair loss after 2 years required a few maintenance sessions.

Psoriasis of the scalps shows acanthosis, suprapapillary thinning of the epidermis. These are neutrophilic forming spongiotic pustules in the epidermis and at superficial perivascular mixed cellular infiltrate. If there is significant erythema and scaling, the application of a local steroid is necessary at the beginning of treatment.

Seborrheic dermatitis shows parakeratosis, epidermal acanthosis, dermal oedema, and a perivascular lymphocytic infiltrate.

In the case of lupus (DLE), there is also a pronounced perivascular lymphocytic infiltrate.



Fig. 13 – Woman of 48 years of age, discoïd lupus (proven by biopsy). Before and after 5 sessions (630/850 nm, 70 J/cm², 10 minutes). (Local application of a steroid as adjuvant treatment)

Diffuse non-inflammatory hair loss, as seen in postpartum, crash dieting, anemia, thyroid diseases, and chemo- or radiotherapy, requires a blood sample to exclude underlying pathologies (CMV infection, iron, thyroid...).

Management of hair loss is dependent on the cause and underlying pathomechanism in relation to the hair growth cycle.(14)

Conclusion

Treatment of hair loss with a LED device is very effective when using the right wave lengths, number of sessions, and energy levels. It is safe, low cost, painless, and easy to use in everyday practice for dermatologists or, in fact, any doctor.

Furthermore, the fact that inflammatory scalp disorders should be treated in a combination of red

and infrared light (630/850 nm) to be effective should incite us to further research. It should lead to a better understanding of the complex mechanisms of action and function of the hair bulb unit.

Red light has a direct effect on melanocytes, the opsins for red light being situated in the melanosomes and should encourage further studies to come. It also has the effect of progressive repigmentation in vitiligo.(13) Further studies on opsins would help to better understand the complex mechanisms of the interaction of visible light and our cells.

Understanding the underlying processes of the pathologies we are treating is therefore crucial. Treating hair loss with an LED device using the right wave lengths and energy levels is thus a very interesting, helpful alternative for our patients.

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