Research Article ISSN 2690-537X

Dermatology Research

Photonic Signaling and Clinical Bio Modulation of Inflammation and Swelling due to Aesthetic Procedures by a LED Device

Susanne Hausdörfer, MD*

Clinical Dermatologist, Member of the superior Health Council in Belgium as a laser and LED specialist, Belgium.

***Correspondence:**
Susanne Hausdörfer, MD, Clinical Dermatologist, member of the superior Health Council in Belgium as a laser and LED specialist, Belgium.

Received: 01 Nov 2025; **Accepted:** 02 Dec 2025; **Published:** 13 Dec 2025

Citation: Susanne Hausdörfer. Photonic Signaling and Clinical Bio Modulation of Inflammation and Swelling due to Aesthetic Procedures by a LED Device. Dermatol Res. 2025; 7(2): 1-6.

ABSTRACT

Side effects of inflammation such as swelling, erythema and pain are quite a challenge in every day practice for dermatologists, plastic surgeons and general practitioners.

A new treatment using the combination of red (630 nm) and infrared (850 nm) to manage these, using efficient energy levels and number of sessions will be proposed.

Two different aspects will be described: one in the case of already existing cutaneous inflammatory diseases, accelerating healing and restoring the initial state of healthy tissue. Acute and chronic inflammatory disorders will be discussed. The other is the inhibition of the inflammatory cascade if there is simultaneous pretreatment with these wavelengths before inflicting physical damage to the tissues (trauma). Hundreds of patients have been successfully treated.

Inhibition of inflammation is a very big step in medicine, diminishing down time, swelling, redness and pain from two weeks to 48 hours.

Keywords

Red light therapy (630 nm), Infrared light therapy (850 nm), Photobiomodulation, Inflammation management.

Introduction

For the management of inflammation only 850 nm combined with 630 nm (red and infrared light), was used because of its capacity to penetrate deeper into tissues. LED's (light emission diodes) deliver cold light without any thermal energy and have other chromophore targets than lasers [1].

Conventional lasers target water, hemoglobin and melanin, whereas LLLT (LED's) use endogenous chromophores in the cells without any thermal effect. Both of them have a monochromatic or almost monochromatic wavelength [2].

In medicine, using LED's, it is very important to choose the right wavelength in order that the target tissue is reached without being absorbed by other substances (melanin, hemoglobin etc.). Only absorbed photons will have an effect.

The different wavelengths trigger different cells of the epidermis and dermis and induce cell responses by biochemical and physical mechanisms [1]. Energy levels used and number of treatment sessions will be discussed. These wavelengths can be used on existing wounds, where inflammation is present, and accelerate healing. Acute lesions will respond much quicker than chronic lesions and require less treatment sessions [3]. Pretreating areas before surgical or invasive laser procedures inhibits the inflammatory cascade, thus swelling mostly and therefore diminishes the down time of patients significantly [3-5].

Normally, as soon as there is skin injury by surgery, invasive lasers or trauma, the inflammatory cascade is declenched via the

secretion of peptides [6].

Inflammation is survival for the organism and can be triggered by injury or bacterial infection. This is followed by the secretion of DAMP (danger associated molecular patterns) peptides, and increase of inflammatory cells [7].

DAMP molecules can be nuclear or cytosolic proteins, once liberated from the cell and exposed to the surface are oxydated and quickly denatured. DAMP include a variety of molecules and induce the liberation of cytokines.

Follows an acute phase of inflammation, later a proliferative and remodeling phase to achieve complete wound healing.

Energy delivered has to be absorbed by the tissues and can be transformed into heat (lasers, thus protein denaturation), fluorescence generating other wavelengths (Kleresca treatment with safran and eosine) or after absorption by a chromophore result in a photochemical and/or photo physical reactions [7,28].

I have used de combination of 630/850 nm for many years in diverse cutaneous inflammatory diseases.

The combination of two wavelengths was superior to using 630 nm alone. Using LED treatment in hair growth disorders showed that 630 nm alone stimulates hair growth, quality and density but has little effect on inflammatory diseases such as androgenic alopecia [7].

Figure 1: Androgenic Alopecia treated with 630 nm alone (70 J/cm², 10 min per session, once a week), 7 sessions. There is no significant hair growth.

It promotes the spontaneous coloration of white hair thus inducing the anagen phase of hair growth cycle where melanin is injected into new hair [8,9].

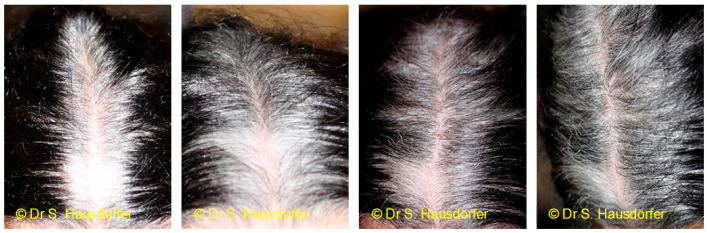

Figure 2: Stopping artificial dying of the hair. Progressive repigmentation of the hair (irradiation 630 nm, 70 J/cm², 10 minutes, 1 treatment session a week). This proves that 630 nm alone induces the anagen cycle of hair growth.

Combining 630 nm with 850 nm (20%) permitted durable healing or remission, or partial remission of hundreds of patients with inflammatory diseases.

Figure 3: Androgenic Alopecia (female pattern), before treatment and after 10 sessions (70 J/cm², 10 min per session, 80% 630 nm, 20% 850 nm, 1 session per week). Hair density improved significantly, on session per month and has to be continued to maintain this result [9].

Visible red light (630 nm) has an impact on the mitochondria of cells enhancing ATP production, thus upgrading the cell metabolism and an activity [1].

850 nm, infrared light, invisible to the human eye provokes a photo physical reaction in the outer cell membrane, changing its located transport mechanism (Na++/Ca++) and Na++/K++. This process induces changes in the cytosol of the cell, afterwards also resulting in the stimulation of the mitochondria and ATP production [1]. Both wavelengths help tissue repair and regulate inflammation [10,11].

Materials and Methods

As a laser specialist I frequently treated patients with an ablative radiofrequency (Legato II) which uses a micro plasma technology, charging the impact zones with electrons, for skin ablation and a thermal effect (non ablative) for a lifting effect [12-14].

The creation of micro channels was obtained by thermocoagulation. The size of those depend on the energy delivered, normally 100 – 200 µm deep, 80 – 120 µm wide. The lesions are comparable to those created by a fractional CO_2 laser (Fraxel restore, etc.), with a bigger amount of lifting effect (non ablative heating in case of the radiofrequency). Heating effects mostly fibroblasts, later inducing collagen production [14].

Included were only head and neck areas where swelling was more important than on other parts of the body and therefore impact social life.

Treatment procedure of the radiofrequency included 3 steps and local anesthesia was applied one hour before treatment:

1. Micro perforation and destruction of 20%of the area treated in 4 passes (ablative part)

2. Heating the dermis (non ablative radiofrequency) in 4 passes
3. Making active substances (such as hyaluronic acid, peptides, other) penetrate into the micro channels by means of an ultrasound device, enhances trans epidermic absorption of these drugs and accelerates wound healing. Adjuvant LED therapy was either, not used (first group), used after procedure (second group) or before treatment (third group). A rich moisturizer was applied afterwards.

The LED device used was an anti-Age, program leg ulcers, combining 630 nm and 20% of IR light (850 nm). Energy delivery 70J/cm² in 10 minutes. Distance irradiation was 7 – 10 cm, eye protection with opaque eye flaps. Any LED that has the same energy delivery can be used, I even produced my own LED device and calibrated numerous other LED devices to obtain these parameters.

Clinical evaluation was made before treatment, 24 – 48 hours after, and 1 month after treatment (photographs).

More than 100 patients could be included in my office since it was part of my every day practice.

Cutaneous biopsies using electron microscopy were effectuated 48 hours post treatment; one without LED adjuvant treatment, procedure followed by LED treatment and finally LED treatment preceding ablative fractional radiofrequency.

The first treatments were effectuated without LED's, swelling, pain, redness and crusting persisted up to 14 days. Downtime was the major issue, obliging patients to stay at home.

Figure 4: Neck area, before and 48 hours later no adjuvant LED treatment.

Using LED immediately after procedure, diminishes inflammation, lasting for 1 week. Several LED sessions could be necessary.

Figure 5: Face 24 hours and 48 after procedure, RF immediately followed by a LED session swelling diminished quickly.

Applying LED immediately before treatment session completely blocs swelling and the clinical outcome completely, patients being treated on a Friday and back to work at Monday [15].

Figure 6: Face before treatment and 24 hours later LED is preceding RF.

Figure 7: Full face treatment, before, 24 hours later and after one month.

Results, reevaluated after one month showed a very natural lifting effect after only one treatment session, with new firm skin, downtime was reduced to 24 - 48 hours, thus creating the first non-surgical weekend lift. Long positive, lasting, effects were present even two years later [15].

Figure 8: Full face before and 2 years after one session, natural, durable lift effect.

This is very important because we could think that the diminishing of inflammation could have a negative impact on the clinical response.

Swelling, crusting are only due to injury of the epidermis, such as can be seen after most invasive procedures as surgery, ablative and semi ablative lasers and radiofrequencies and peelings (TCA, phenol …) [16].

Oedema slows down the healing process and can also provoke scarring and necrosis. Electron microscopy effectuated via a punch biopsy (4 mm) 48 hours after procedure showed similar results in the first two groups but differed greatly with the third group (LED preceding treatment).

Electronic microscopy (biopsies at 48 hours)

a) Radiofrequency without adjuvant LED therapy

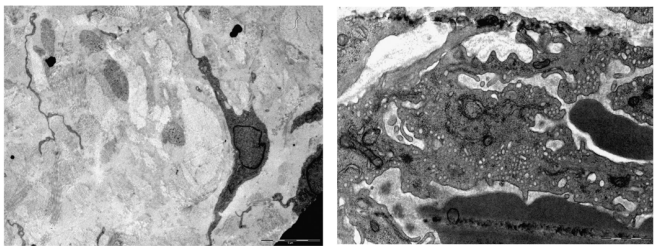

Figure 9a: Radiofrequency without adjuvant LED therapy: There are large amounts of fluid in the dermis dissociating collagen bundles. Fibroblast with homogenous chromatin and few vesicular components. A blood vessel containing a red blood cell and numerous vesicles of micropinocytosis [17].

b) Radiofrequency followed by LED treatment

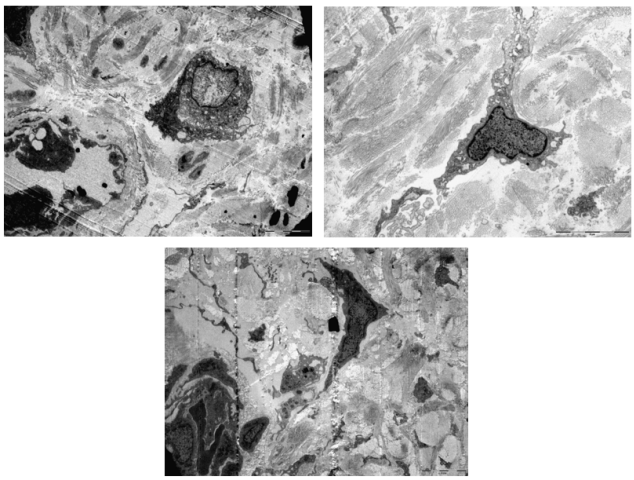

Figure 9b: Radiofrequency followed by LED treatment: There are less vesicles of micropinocytosis in the endotheliocytes, chromatin of the nucleus of the fibroblast is activated. There are some vesicles in the cytoplasm. Oedema dissociating the collagen bundles is much less [17].

c) LED preceding radiofrequency (pretreatment)

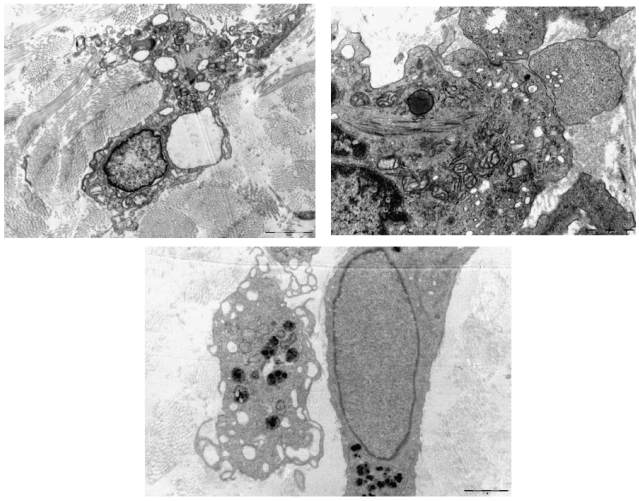

Figure 9c: LED preceding radiofrequency (pretreatment): The dermis shows nicely organized bundles of collagen bundles. The chromatin of a nucleus of a fibroblast is heterogeneous, thus activated. There are a large number of phagocyte vesicles in the cytoplasm. Their content varies in opacity [17].

Discussion

Pretreatment before injury of the skin is documented and has never been used in the combination of red (630 nm) and IR (850 nm).

A few studies using only red light before UV irradiation showed protection of the skin thus preventing sunburns and prevent hyperpigmentation after CO2 laser by diminishing erythema [18,19].

After discovering the benefits of pretreatment (630 nm / 850 nm) before physical impact (RF), it had a recurrent positive effect on all patients. The sequence protocol was first accidentally inverted.

The group of patients with LED after procedure showed less swelling than the group without LED, but clearly differed from the last patient group by longer downtime, 7 days instead of 48 hours. Somehow, there is one or several factors inhibiting the inflammatory cascade.

Looking at the electron microscopy, the only group showing tight conjunctive tissue and no vesicles of micropinocytosis in the endothelial cells was the one with pretreatment. Finding mostly fibroblasts with activated chromatin and phagocyte vesicles in the cytoplasm was first surprising. Since biopsies were effectuated 48 hours post impact I would have expected to see more inflammatory cells, as was illustrated with electron microscopy after 850 nm irradiation (Glen Calderhead) of healthy skin.

Forearm Baseline Histology | Histology 48-Hours after RF Irradiation

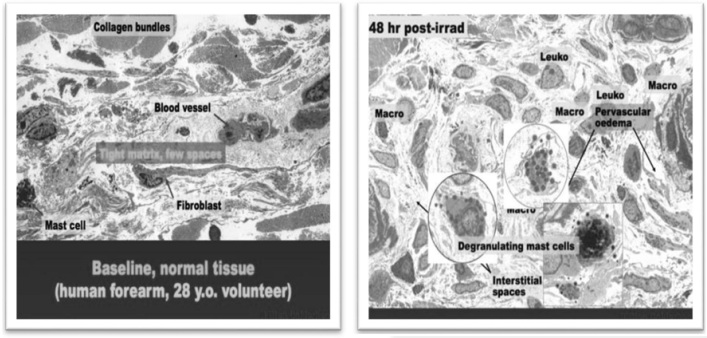

Figure 10: Dr. Glen Calderhead (IR 850 nm).

Recent studies focused more on the role of fibroblasts in immune reactions. They seem to play an important part in maintaining homeostasis in the dermis [20,22,24].

They can actually be up and downregulated, acting as inhibitors of inflammation or triggering it [21]. They are to play an important target and tool in medicine. Their capacity to phagocyte, normally performed by macrophages has also been described. Interestingly it has been shown that fibroblasts are attracted by IR light in vitro

[23]. The exact mechanism is still unknown, but could explain fibroblasts are present on site before physical impact and the liberation of DAMP molecules.

Conclusion

Many other studies should be effectuated, using also red and IR light emission separately. It would be very interesting to be able to analyze the content of the vesicles found in fibroblasts in case of pretreatment.

Only one session of LED pretreatment is necessary to inhibit the inflammatory cascade. Only inflammation is present several sessions of treatment are necessary to success fully achieve healing of tissues.

Irradiation with 630 nm increases the production of Claudin-1 and nitric oxide having an effect on the skin barrier [24-28] and oxidative stress on cells which opens another direction of research.

Clinically reliable and extremely relevant in medicine this is a new possibility to manage invalidating effects of invasive skin treatments.

References

1. Keyuan Navri. Springer Verlag 2011 Glen Calderhead 231-267- Chapt. 19: Light – Emitting Diode Phototherapy in Dermatological Practice. - Chapt. 20: Laser and Light for wound Healing stimulation. Navid Bonzari, Mohamed L. Elsaie and Keyuan Nauri 267-277 Lasers in Dermatology and Medicine. 2011.
2. Susanne Hausdörfer, Cathy Dierickxsens. LED and Clinical Applications LASER, Skin and Body Conference. 2018.
3. Susanne Hausdörfer. Inflammation, Healing and Photobiomodulation: a new Insight 4th Conference European LED Academy. 2013.
4. Susanne Hausdörfer. The First Non-Surgical Lift Societé de Medicine Esthétique, SBME Bruxelles. 2017; 28-29.
5. https://www.amwc-conference.com/en/home.html
6. Abduikhaleg IA, Assi HA, Rascdee Abdoullah, et al. The crucial roles of inflammatory mediators in inflammation: A review. Vet World. 2018; 11. 627-635.
7. Susanne Hausdörfer. How to manage Inflammation after Esthetic Procedures 7th 5CC (five continent congress). 2018.
8. Susanne Hausdörfer Physiopathologie de la chute des cheveaux et son traitement TAMAS (Tunisian Aesthetic Medicine and Anti-aging Society), Tunis. 2018; 23-24.
9. Susanne Hausdörfer. Pathologies courants de cuir chevelu et leur traitement European LED Academy. 2023; 10-11.
10. Susanne Hausdörfer. The First Non-Surgical Lift Societé de Medicine Esthétique, SBME Bruxelles. 2017; 28-29.
11. Susanne Hausdörfer. Photo stimulation of LED device 11th AMWC. 2013; 4-6.
12. Susanne Hausdörfer. Fractional ablative device: My personal experience with a very special Radio Frequency Bansko. 2015.
13. Susanne Hausdörfer. Fractional Radiofrequency: The non-surgical Lift, the Future 6th 5CC (five continent congress). 2015; 3-6.
14. Susanne Hausdörfer. Renouvellement cellulaire (rejeunissement) avec des appareils ablatifs et gestion des effets secondaires par photomodulation Cours Université Paris, via SOFMAA. 2017.
15. Susanne Hausdörfer. Photonic signaling and clinical biomodulation, management of swelling due to aesthetic procedures by a LED device RAD Conference (Radiation Research and Protection in Europe). 2017; 11-16.
16. Susanne Hausdörfer. Preparing the skin or repairing the skin, changes in cell signalization in function of the sequences of LED delivery, before and after the aesthetic procedure. 7th Edition F.A.C.E. 2 Annual International Aesthetic Congress. 2017; 15-16.
17. Jean-Marie. Scheiff Protocole microscopie electronique Université Catholique de Louvain (UCL), Bruxelles. 2013.
18. Eon-Chae Chio, Sorin Alin, Kyong – Ok Skin, et al. Protective Effect if Red Light Emmiting Diode against UV-B Radiation – Induced Damage in Sktt: HR-2 hailess mice. Curr Issues Mol Biol. 2024; 5655-5667.
19. Augustin C. Barolet, Dante Barolet. Reducing Carbon Dioxide Laser – Induced Postinflammatory Hyperpigmentation with Prophylactic Photobiomodulation Accuse study Photobiomodulation. Photobiomodul Photomed Laser Surg. 2024; 42: 339-342.
20. Antero Salminen, Hai Kaarnirauta, Ann Kauppinen. Tissue Fibroblasts are versatile immine regulators. An evaluation of their impact on the aging process. Ageing Res Rev. 2024; 37: 102296.
21. Kellen J. Cavaguero, Richard I. Gallo. Essential immune functions of fibroblasts in innate, host defense. Front Immunol. 2022; 1058862.
22. Eileen Uribe-Querol, Carlos Rosales. Phagocytosis: our current Understanding of a Universal Biological Process. Front. Immunol. 2020; 1066.
23. Alexander Wunsch. Entwicklung einer faseroptischen Anordnung zur automatischen vitalmikros optischen Untersuchung der Phototaxis von 3T3 Zellen der Mavs Institut für Anatomie (Dir. R.H.W. Funk), Doctoral Thesis, Dresden. 2017.
24. Dalla Torre Q. Role et mécanismes d'action des fibroblastes sur les macrophages dans la synouite villonodulaire. Revue du rhumatisme. 2022; 89: A12b.
25. Zhen Shen, Weigro Song, Lili Qian, et al. Effect of clauclin I on cell proliferation, migration and apoptosis in human cervical squamons cell carcinoma Spandidos Publications. Oncol Rep. 2020; 45: 606-618.
26. Barolet AC, Lucie Germain, Daniel Barolet. In vivo mesurement of nitric oxide release from human skin post

photobiomodulation using visible and near-infrared light: A hemiluminescence detection study. Jurnal of Photochemistry and Photobiology. 2024; 24: 100250.

27. Sophia Bergmann, Barbara von Brenau, SabineUidal-y-sy, et al. Claudin-1 increase impacts epidermal barrer function in atopic dermatitis lesions dose-dependently Scientific Reports. Nature Research. 2024.

28. Susanne Hausdörfer. Acne treatment with an Erbium Laser (1540 nm) in Combination with LED (470 nm / 630 nm); an Excellent Alternative to Isotretinoin 8 th 5CC (five continent congress). 2017.