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Les LED en 2015 : mise au point

Laurent Meunier, CHU Nîmes,
Université de Montpellier

Diodes électroluminescentes (DEL)

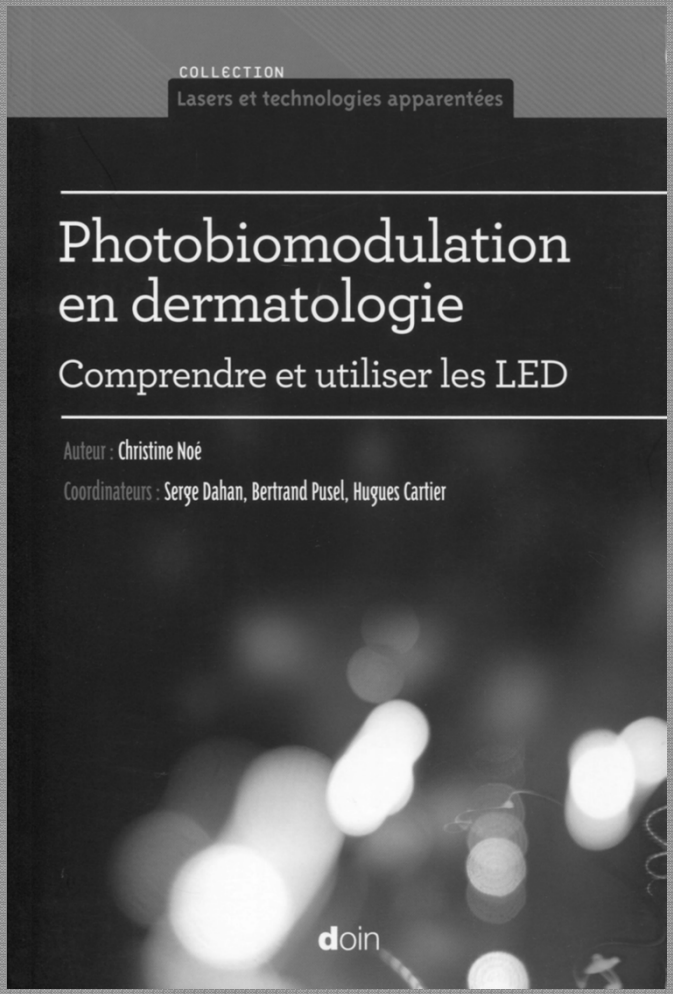
Light-emitting diodes (LED)

H. Cartier[a,*], A. Le Pillouer-Prost[b], C.Grognard[c]

Annales de dermatologie (2009) **136, supplément 6**, S351-S358

- Nombreuses publications avec résultats dans différentes indications : cicatrisation, rajeunissement, acné et PTD
- *« Ce n'est déjà plus un futur proche mais bel et bien une réalité thérapeutique… »*

2014: le livre du Groupe Laser



Avantages des LED

- Excellente résistance mécanique (chocs, écrasement, vibrations) donc transportable.
- Très faible consommation électrique (quelques dizaines de mw)
- Durée de vie beaucoup plus longue
- Taille beaucoup plus petite
- Fonctionnement en très basse tension
- Inertie lumineuse quasiment nulle
- Pas d'effet thermique

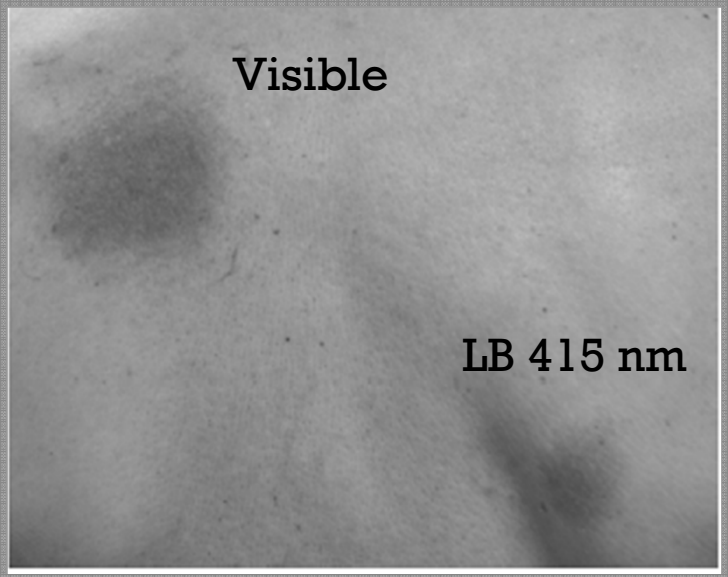
Inconvénients des LED

- LED bleues et blanches : danger pour la rétine
- Lumière bleue : perturbation du cycle du sommeil

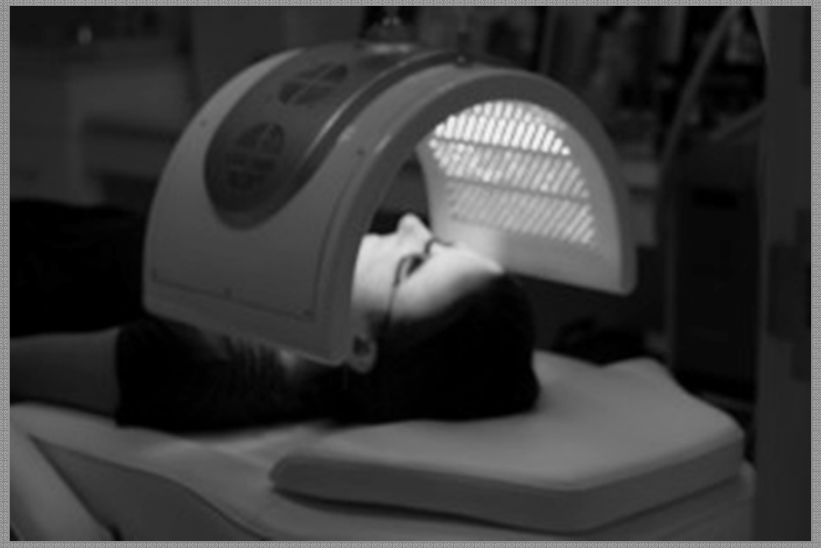
Solar urticaria to visible light triggered by light-emitting diode therapy

J Am Acad Dermatol
September 2014

- Une observation d'urticaire solaire déclenchée par le visible et la lumière bleue



LED et acné



Phototherapy and acne vulgaris

W.J.CUNLIFFE AND V.GOULDEN

Skin Research Centre, Department of Dermatology, Leeds General Infirmary, Leeds, U.K.

BJD Mai 2000

- Intérets alternatives thérapeutiques
- Rationel :
  - Destruction P Acnes par LB (production de coproporphyrine III par p acnes)
  - Effets anti-inflammatoires par LR
- Limites : acne du dos

British Journal of Dermatology 2000; **142**: 973–978.

Phototherapy with blue (415 nm) and red (660 nm) light in the treatment of acne vulgaris

P.PAPAGEORGIOU, A.KATSAMBAS* AND A.CHU

Unit of Dermatology, Imperial College of Science, Technology and Medicine, Hammersmith Hospital, DuCane Road, London W12 0NN, U.K.
**Adreas Sygros Hospital, Athens, Greece*

Accepted for publication 7 December 1999

- **Acnés** minimes à modérées (n=107)
- **Randomisation** en 4 groupes:
  - Lumière bleue (LB) (415 nm) + Lumière rouge (LR) (660 nm)
  - LB
  - Lumière blanche froide (LF)
  - Peroxyde de benzoyle 5%
- **Lampes portables**, 15 min/24h
- Evaluation toutes les 4 semaines

Table 2. Difference in mean percentage improvements in inflammatory lesions between treatments (95% confidence intervals)

	Blue–red vs. blue light	Blue–red light vs. benzoyl peroxide	Blue–red vs. white light
Week 4	15·6 (5·5–25·7)	9·6 (−0·4–19·7)	25·4 (15·2–35·6)
Week 8	15·6 (5·5–25·7)	15·7 (5·6–25·8)	45·1 (34·9–55·4)
Week 12	13·1 (3·0–23·1)	17·6 (7·5–27·6)	50·3 (40·1–60·5)

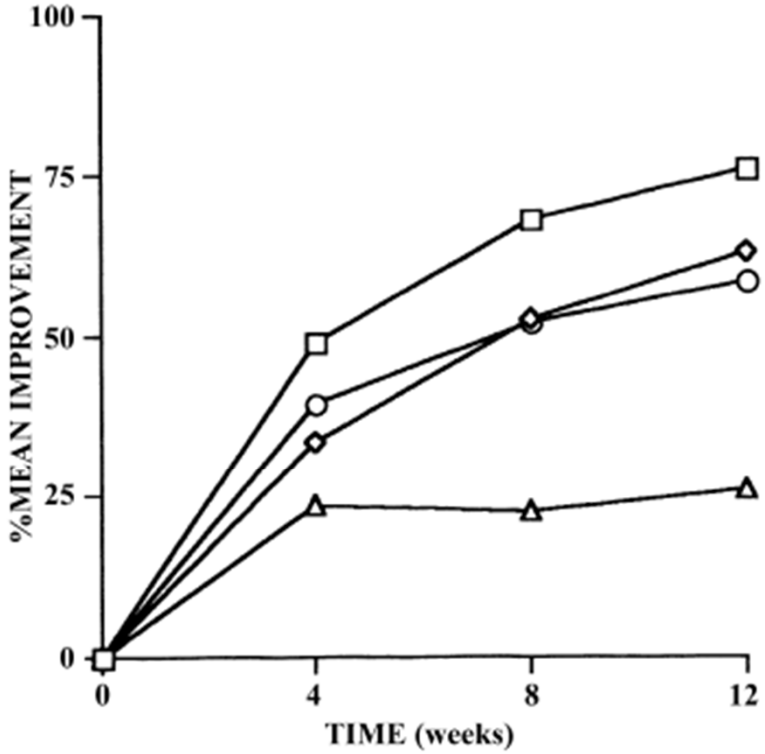


Figure 1. Inflammatory spot counts. □, Blue-red light; ◇, blue light; ○, benzoyl peroxide; △, white light.

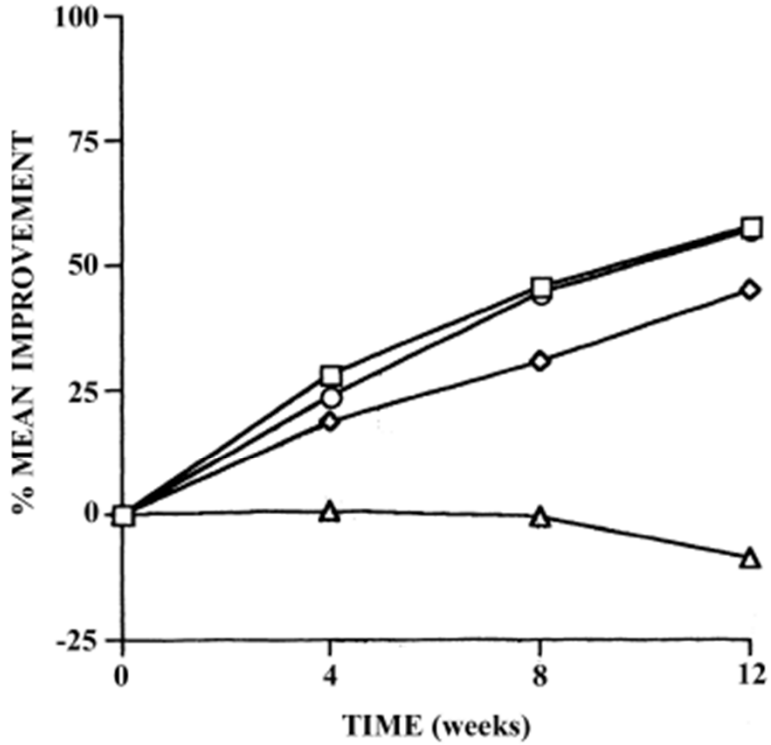


Figure 2. Comedone counts. □, Blue-red light; ◇, blue light; ○, benzoyl peroxide; △, white light.

Résultats

- A 12 semaines : meilleurs résultats avec **LB+LR** :
  - Réduction 76 % (lésions inflammatoires)
  - Réduction 58% (comédons)
- Mécanismes d'action synergiques:
  - Anti-inflammatoires (LR)
  - Anti-bactériens (LB)

THERAPEUTICS British Journal of Dermatology (2013) 168, pp1088–1094 BJD British Journal of Dermatology

The clinical and histological effect of home-use, combination blue–red LED phototherapy for mild-to-moderate acne vulgaris in Korean patients: a double-blind, randomized controlled trial

H.H. Kwon,[1,2] J.B. Lee,[3] J.Y. Yoon,[2] S.Y. Park,[1,2] H.H. Ryu,[1] B.M. Park,[3] Y.J. Kim[3] and D.H. Suh[1,2]

[1]Department of Dermatology, Seoul National University College of Medicine, Seoul, Korea
[2]Acne Research Laboratory, Seoul National University Hospital, Seoul, Korea
[3]Department of Dermatology, Chonnam National University Medical School, Gwangju, Korea

- Acnés minimes à modérées (n=25)
- Randomisation en 2 groupes:
  - LB (420 nm) + LR (660 nm)
  - Groupe contrôle
- Lampes portables, 2,5 min 2 fois par 24h pendant 4 semaines

Résultats

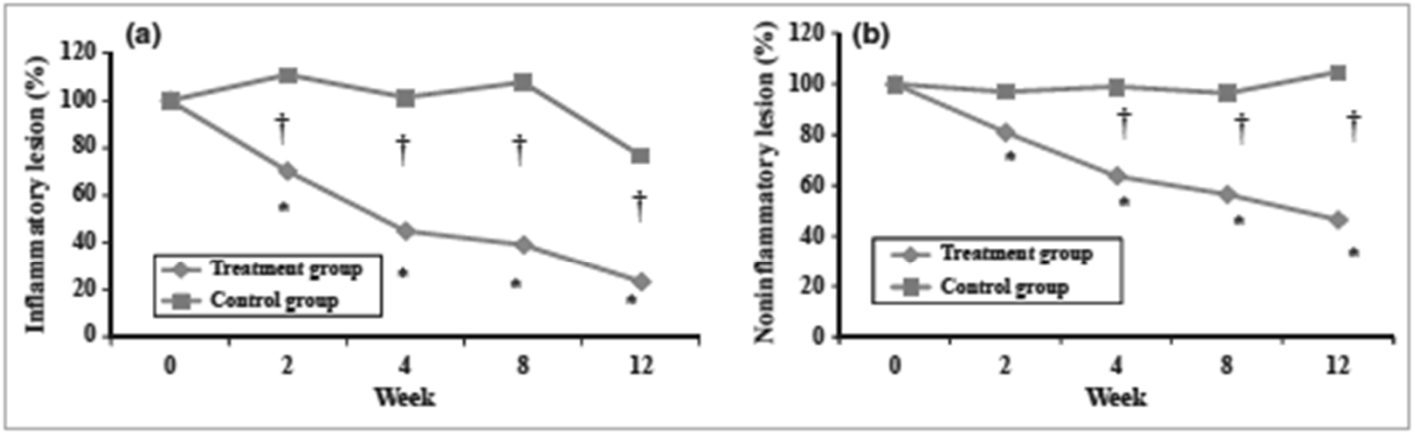


Fig 1. (a) Changes in inflammatory acne lesion counts with time. (b) Changes in noninflammatory acne lesion counts with time. *P < 0·05 vs. baseline; †P < 0·05 between treatment and control groups.

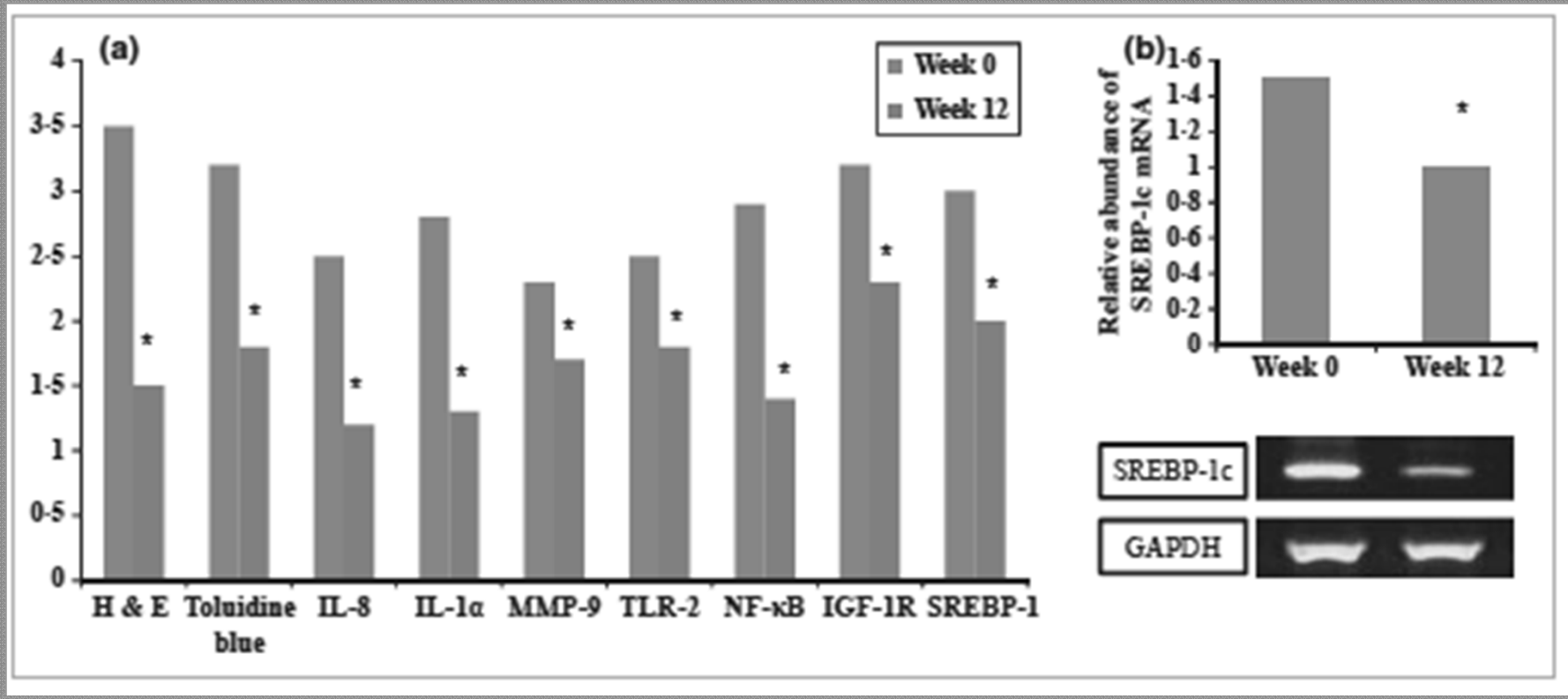
- A 12 sem : réduction lésions infl. (77%) et non infl. (54%)
- Diminution production sébum et taille des glandes sébacées

Mécanismes d'action ?

- **Effets anti-inflammatoires** : réduction IL-1, IL-8, NFkB

- **Effets anti-bactériens**: role IGF/IGFR et SREBP (sterol response element binding protein):

  P acnes ⇨ IGFR ⇨ SREPB ⇨ Sebum ⇧



(a) Histopathological inflammation severity and immunohistochemical staining intensities for the LED treatment group at baseline vs. 8 weeks after 4 weeks of LED treatments.

(b) Semiquantitative reverse-transcription polymerase chain reaction analysis of sterol response element binding protein (SREBP)-1c from frozen skin samples at baseline and at the final visit. GAPDH = glyceraldehyde 3-phosphate dehydrogenase

LED et acné

- Acnés minimines à modérés de la face (dos ?)
- Etudes ouvertes non contrôlées
- Conflits d'intérêt
- Lumière bleu (+ rouge ?)
- Récidives ?
- Intérêt en tant que traitement adjuvant ?

LED et cicatrisation

J Clin Laser Med Surg. 2001 Dec;19(6):305-14.

Effect of NASA light-emitting diode irradiation on wound healing.

Whelan HT[1], Smits RL Jr, Buchman EV, Whelan NT, Turner SG, Margolis DA, Cevenini V, Stinson H, Ignatius R, Martin T, Cwiklinski J, Philippi AF, Graf WR, Hodgson B, Gould L, Kane M, Chen G, Caviness J.

Author information

Abstract

OBJECTIVE: The purpose of this study was to assess the effects of hyperbaric oxygen (HBO) and near-infrared light therapy on wound healing.

BACKGROUND DATA: Light-emitting diodes (LED), originally developed for NASA plant growth experiments in space show promise for delivering light deep into tissues of the body to promote wound healing and human tissue growth. In this paper, we review and present our new data of LED treatment on cells grown in culture, on ischemic and diabetic wounds in rat models, and on acute and chronic wounds in humans.

MATERIALS AND METHODS: In vitro and in vivo (animal and human) studies utilized a variety of LED wavelength, power intensity, and energy density parameters to begin to identify conditions for each biological tissue that are optimal for biostimulation. Results: LED produced in vitro increases

J Clin Laser Med Surg. 2003 Apr;21(2):67-74.

Effect of NASA light-emitting diode irradiation on molecular changes for wound healing in diabetic mice.

Whelan HT[1], Buchmann EV, Dhokalia A, Kane MP, Whelan NT, Wong-Riley MT, Eells JT, Gould LJ, Hammamieh R, Das R, Jett M.

Author information

Abstract

OBJECTIVE: The purpose of this study was to assess the changes in gene expression of near-infrared light therapy in a model of impaired wound healing. Background Data: Light-Emitting Diodes (LED), originally developed for NASA plant growth experiments in space, show promise for delivering light deep into tissues of the body to promote wound healing and human tissue growth. In this paper we present the effects of LED treatment on wounds in a genetically diabetic mouse model.

MATERIALS AND METHODS: Polyvinyl acetal (PVA) sponges were subcutaneously implanted in the dorsum of BKS.Cg-m +/+ Lepr(db) mice. LED treatments were given once daily, and at the

J Clin Laser Med Surg. 2003 Oct;21(5):249-58.

Polychromatic LED therapy in burn healing of non-diabetic and diabetic rats.

Al-Watban FA[1], Andres BL.

Author information

Abstract

OBJECTIVE: We determined the effect of polychromatic light-emitting diodes (LED) in burn healing of non-diabetic and streptozotocin-induced diabetic rats.

BACKGROUND DATA: LEDs were used as the light source for phototherapy.

MATERIALS AND METHODS: The polychromatic LED is a cluster of 25 diodes emitting photons at wavelengths of 510-543, 594-599, 626-639, 640-670, and 842-879 nm with 272-mW output power. Age-matched, male Sprague-Dawley rats (n = 30) were used. Streptozotocin (70 mg/kg) was used for diabetes induction. Rat weight, hyperglycemia, and glycosuria were monitored for the first 3 days and weekly thereafter. Rats were anesthetized and shaved after 1 week of diabetes. Burn areas of 1.5 +/-.03 cm2 were created using a metal rod pre-heated up to 600 degrees C that was applied for 2 sec. Diabetic and non-diabetic rats were randomized into the following treatment groups: control, 5, 10, 20, and 30 J/cm2. Light treatment commenced after burn infliction and was repeated three times per week. Burn areas were measured daily.

RESULTS: Burn healing was impaired significantly during diabetes by -46.17%. Polychromatic LED treatment using 5, 10, 20, and 30 J/cm2 incident doses influenced healing by 6.85%, 4.93%, -4.18%, and -5.42% in the non-diabetic rats; and 73.87%, 76.77%, 60.92%, and 48.77% in the diabetic rats, relative to their controls, respectively.

CONCLUSION: The effect of polychromatic LED in non-diabetic rats was insignificant; however, it simulated the trend of stimulation and inhibition seen using low-level lasers. Significant stimulation observed in the diabetic rats demonstrated the usefulness of polychromatic LED in diabetic burn healing.

Journal of Photochemistry and Photobiology B: Biology 103 (2011) 118–125

Contents lists available at ScienceDirect

Journal of Photochemistry and Photobiology B: Biology

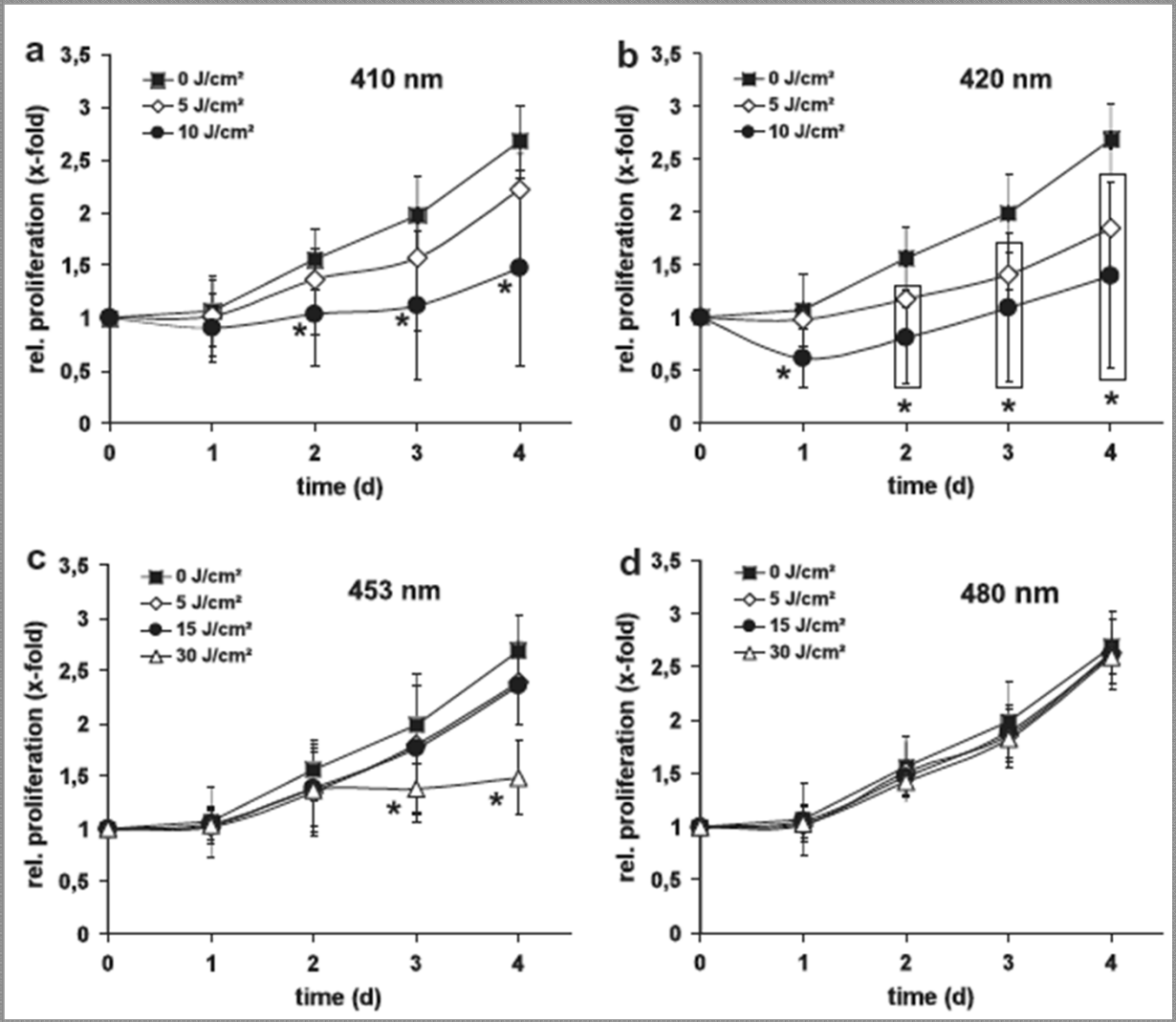
journal homepage: www.elsevier.com/locate/jphotobiol

Effects of blue light irradiation on human dermal fibroblasts ☆

Christian Opländer [a,*,1], Sarah Hidding [b,1], Frauke B. Werners [b], Matthias Born [c], Norbert Pallua [b], Christoph V. Suschek [b]

[a] Interdisciplinary Center for Clinical Research (IZKF), Medical Faculty, RWTH Aachen University, Aachen, Germany
[b] Department of Plastic and Reconstructive Surgery, Hand Surgery, and Burn Center, Medical Faculty, RWTH Aachen University, Aachen, Germany
[c] Philips Technology Research Laboratories, Aachen, Germany

Réduction prolifération fibroblastes



Blue light inhibits transforming growth factor-β1-induced myofibroblast differentiation of human dermal fibroblasts

Leonie Taflinski[1]*, Erhan Demir[2]*, Jens Kauczok[2], Paul Christian Fuchs[2], Matthias Born[3], Christoph V. Suschek[4] and Christian Opländer[4]

[1]Department of Plastic and Reconstructive Surgery, Hand Surgery and Burn Center, Medical Faculty, RWTH Aachen University, Aachen, Germany; [2]Department of Plastic Surgery, Hand Surgery and Burn Center, Merheim Hospital Cologne, University of Witten/Herdecke, Witten, Germany; [3]Philips Technology GmbH, Innovative Technologies, Aachen, Germany; [4]Department of Trauma and Hand Surgery, Medical Faculty of the Heinrich-Heine-University Düsseldorf, Düsseldorf, Germany

Experimental Dermatology, 2014, **23**, 240–246

- Rôle important de la transformation des fibroblastes en myofibroblastes dans la cicatrisation et la fibrose
- Le **TGFβ**induit la transformation des fibroblastes en myofibroblastes
- La LB induit un stress oxydatif et inhibe la transformation des fibroblastes en myofibroblastes induite par le **TGFβ**

Inhibition of Fibroblast Proliferation In Vitro Using Low-Level Infrared Light-Emitting Diodes

HADAR LEV-TOV, MD,*† NEIL BRODY, MD, PHD,‡ DANIEL SIEGEL, MD, MS,‡ AND JARED JAGDEO, MD, MS*†‡

Dermatol Surg 2013;39:422–425

BACKGROUND Scars, including hypertrophic and keloidal-type scars, may occur after burns, trauma, or surgery. Despite several treatment options available for scars, few effective, noninvasive modalities exist. Recently, a few small clinical studies revealed the possible benefit of red and infrared (IR) low-level light therapy (LLLT) in scar treatment. One of the important features of scars is proliferation of dermal fibroblasts, but in vitro data regarding the effects of light-emitting diode (LED)-generated IR light on human skin fibroblasts is lacking.

OBJECTIVE To evaluate the effect of IR LLLT generated using LEDs on fibroblast proliferation and viability in vitro.

METHODS AND MATERIALS Irradiation of normal human skin fibroblasts using IR LED panels was performed in vitro, and modulation of proliferation and viability was quantified using Trypan blue dye exclusion assay.

RESULTS Fluences of 80, 160 and 320 J/cm^2 resulted in statistically significantly less fibroblast proliferation than in controls, without statistically significantly less cellular viability.

CONCLUSION IR LLLT can effectively inhibit fibroblast proliferation in vitro without altering viability and holds promise for the treatment of scars.

Photomedex loaned the device used in the paper to the authors. Dr. Siegel is on the Photomedex Scientific Advisory Board.

Inhibition of Fibroblast Proliferation In Vitro Using Red Light-Emitting Diodes

Hadar Lev-Tov, MD,*† Andrew Mamalis, BS,† Neil Brody, MD, PhD,‡ Daniel Siegel, MD, MS,‡ and Jared Jagdeo, MD, MS*†‡

Dermatol Surg 2013;39:1167–1170

BACKGROUND Red light is part of the visible light spectrum. The effects of light-emitting diode (LED)-generated red light on human skin are not well-characterized.

OBJECTIVE To study the effect of red LED-generated low-level light therapy (LLLT) on fibroblast proliferation and viability in vitro.

METHODS AND MATERIALS Irradiation of normal human skin fibroblasts using red LED panels was performed in vitro, and modulation of proliferation and viability was quantified using trypan blue dye exclusion assay.

RESULTS Statistically significant decreases in cell proliferation were noted at the following fluences (time): 160 J/cm^2 (30 minutes, 34 seconds), 320 J/cm^2 (61 minutes, 07 seconds) and 640 J/cm^2 (122 minutes, 14 seconds) (Figure 1). Irradiation at the 160- (98.5 $\pm$ 1.2%) and 320-J/cm^2 (98.0 $\pm$ 3.1%) doses did not significantly alter viability.

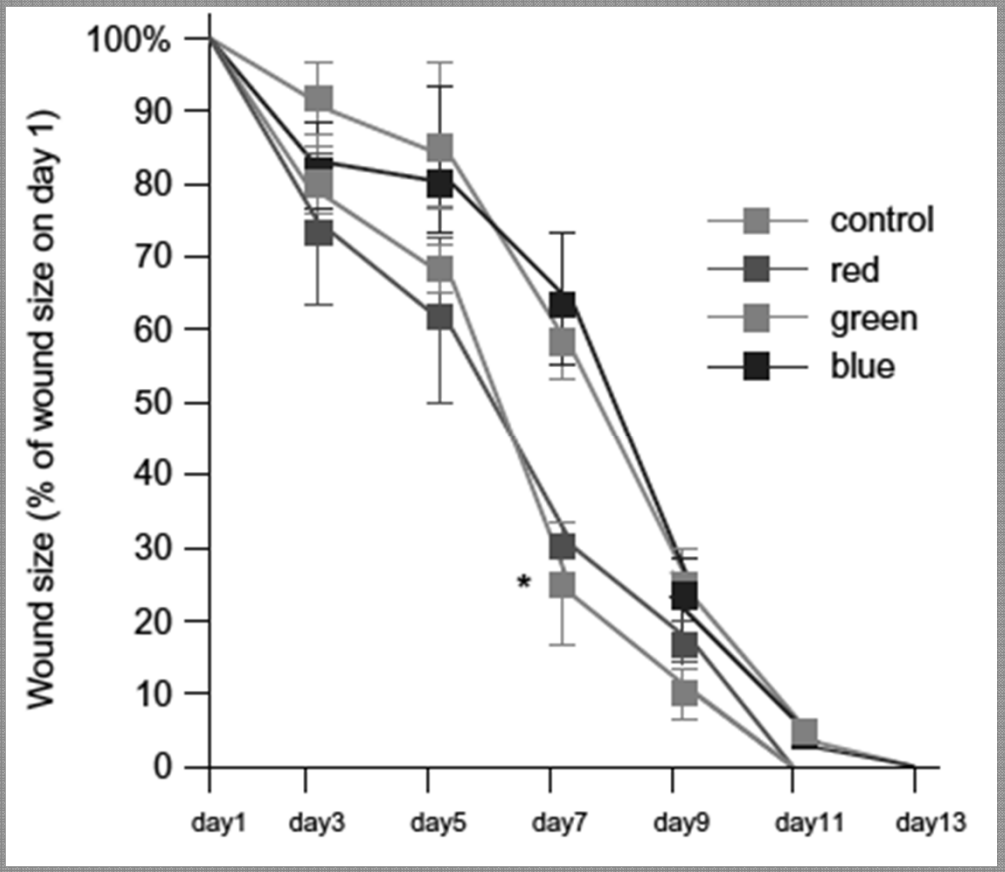
CONCLUSION At certain fluences, red LLLT can effectively inhibit fibroblast proliferation in vitro without altering viability and holds promise for the treatment of scars and other proliferative skin diseases.

Green light emitting diodes accelerate wound healing: Characterization of the effect and its molecular basis in vitro and in vivo

Tomohiro Fushimi, MD[1,2]; Shigeki Inui, MD, PhD[1]; Takeshi Nakajima, MD, PhD[1]; Masahiro Ogasawara, MD[3]; Ko Hosokawa, MD, PhD[2]; Satoshi Itami, MD, PhD[1]

1. Department of Regenerative Dermatology, Graduate School of Medicine, Osaka University, Osaka, Japan
2. Department of Plastic Surgery, Graduate School of Medicine, Osaka University, Osaka, Japan, and
3. Mignon Belle Clinic, Osaka, Japan

Wound Rep Reg (2012) 20 226–235 © 2012



Cicatrisation ↑ (souris)

- ELISA sur fibroblastes
- Stimulation
  - ✓ Leptine
  - ✓ IL-8
  - ✓ VEGF

Lasers Med Sci (2013) 28:981–987
DOI 10.1007/s10103-012-1187-z

ORIGINAL ARTICLE

Laser and LED phototherapies on angiogenesis

Ana Paula Cavalcanti de Sousa · Gardênia Matos Paraguassú · Nara Tayene Teixeira Silveira · José de Souza · Maria Cristina Teixeira Cangussú · Jean Nunes dos Santos · Antonio Luiz Barbosa Pinheiro

- Excisions dos rats
- Plusieurs groupes:
  - Contrôle
  - LED: bleu (460 nm), vert (530 nm), rouge (700 nm)
  - Lasers : 660, 790 nm
- Irradiations 1 j sur 2 pendant 7 jours
- Histo J8 : stimulation angiogénèse avec lasers, lumières verte et rouge

Wound Repair Regen. 2015 Feb 14. doi: 10.1111/wrr.12258. [Epub ahead of print]

Organic Light Emitting Diode Improves Diabetic Cutaneous Wound Healing in Rats.

Wu X[1], Alberico S, Saidu E, Khan SR, Zheng S, Romero R, Chae HS, Li S, Mochizuki A, Anders J.

⊕ Author information

Lasers Med Sci. 2015 Jan;30(1):421-8. doi: 10.1007/s10103-014-1687-0. Epub 2014 Nov 13.

Effects of red laser, infrared, photodynamic therapy, and green LED on the healing process of third-degree burns: clinical and histological study in rats.

de Vasconcelos Catão MH[1], Nonaka CF, de Albuquerque RL Jr, Bento PM, de Oliveira Costa R.

LED: cicatrisation/fibrose

- Arguments in vitro:
  - Inhibition prolifération fibroblastique
  - Stimulation angiogénèse ?
- Nombreuses études chez l'animal
- Effets chez l'homme ?

LED et vieillissement ?

LED et collagène

- Les LED stimulent la synthèse du collagène in vitro (cultures de fibroblastes) et in vivo (animal et homme).
- Métalloprotéases ?

Regulation of Skin Collagen Metabolism *In Vitro* Using a Pulsed 660 nm LED Light Source: Clinical Correlation with a Single-Blinded Study

Daniel Barolet[1,2], Charles J. Roberge[3], François A. Auger[3,4], Annie Boucher[1] and Lucie Germain[3,4]

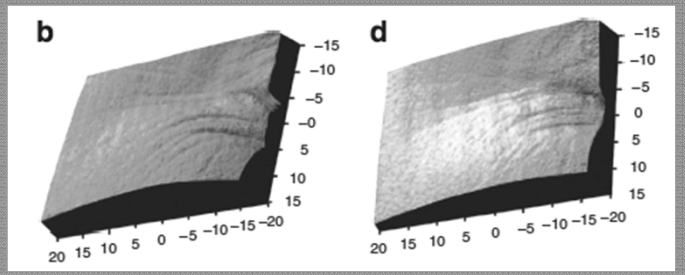
Journal of Investigative Dermatology (2009) **129,** 2751–2759

- Etude chez l'homme: LED 660 nm (3 séances par sem pendant 4 semaines)
- Réduction profondeur rides et rugosité

Table 1. Microtopographic profilometry analysis

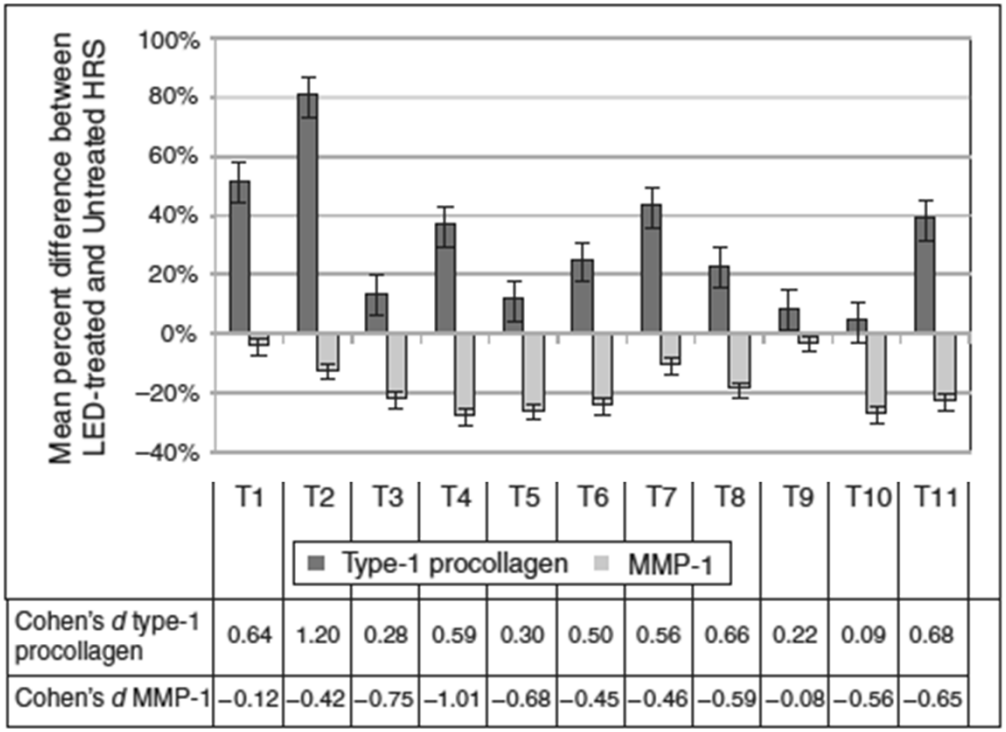
	Percent improvement post-treatment			Percentage of subjects with improvement	
	LED-treated	Untreated	*P*-value	LED-treated (%)	Untreated (%)
Ra	18.57 ± 2.41	3.73 ± 1.17	<0.0001	97	46
Rz	20.83 ± 2.26	7.43 ± 1.64	<0.0001	94	51

Values are mean ± SEM.



Peau reconstituée :

- ✓ Augmentation collagène I
- ✓ Diminution MMP-1



	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11
Cohen's *d* type-1 procollagen	0.64	1.20	0.28	0.59	0.30	0.50	0.56	0.66	0.22	0.09	0.68
Cohen's *d* MMP-1	–0.12	–0.42	–0.75	–1.01	–0.68	–0.45	–0.46	–0.59	–0.08	–0.56	–0.65

Figure 1. Increases in type I procollagen and concurrent reduction in MMP-1 levels in HRS after LED treatment. A cyclic pattern of alternating highs and lows was observed in response to the 11 consecutive treatments (T1–T11) for type 1 procollagen and MMP levels. Values are percent difference ± SEM ($n = 9$) between treated and untreated control HRS samples

Review

Light-emitting diodes: their role in skin rejuvenation

Daniel N. Sauder, MD, FAAD, FACP, FRCPC

International Journal of Dermatology 2010, **49**, 12–16

- *Few randomized controlled trials exist.*
- *Most reports are based on suggested mechanism extrapolated from limited observations and scattered anecdotal case reports.*
- *Thus, the true utility of these devices remains to be established.*

AUTRES INDICATIONS ...

Targeted phototherapy of plaque-type psoriasis using ultraviolet B–light-emitting diodes

L. Kemény,*† Z. Csoma,† E. Bagdi,‡ A.H. Banham,§ L. Krenács‡ and A. Koreck†¶**

*Dermatological Research Group of the Hungarian Academy of Sciences, Szeged, Hungary

†Department of Dermatology and Allergology, University of Szeged, Koranyi fasor 6, 6720 Szeged, Hungary

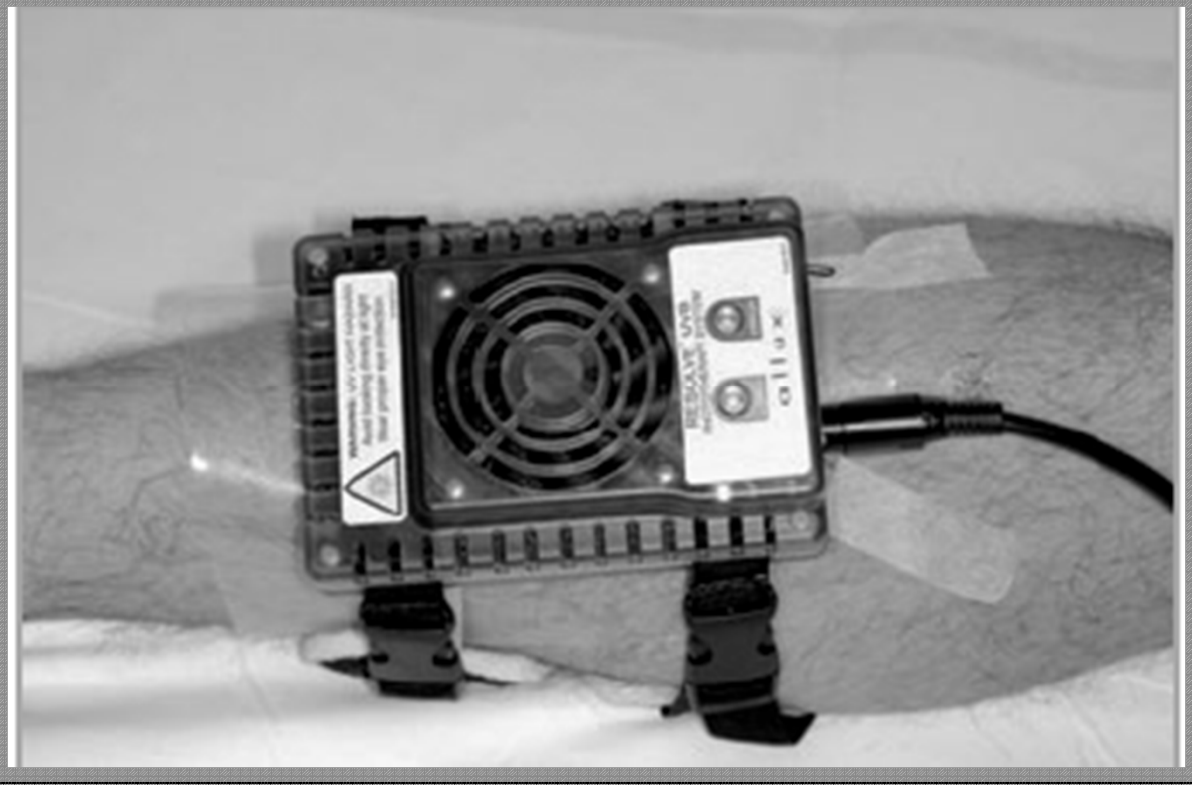
‡Laboratory of Tumour Pathology and Molecular Diagnostics, Szeged, Hungary

§Nuffield Department of Clinical Laboratory Sciences, University of Oxford, John Radcliffe Hospital, Oxford, U.K.

¶Department of Immunology, Victor Babes University of Medicine and Pharmacy, Timisoara, Romania

**Allux Medical Inc., Menlo Park, CA, U.S.A.

British Journal of Dermatology 2010 **163,** pp167–173



Background One of the major technological breakthroughs in the last decade is represented by the diversified medical applications of light-emitting diodes (LEDs). LEDs emitting in the ultraviolet (UV) B spectrum might serve as a more convenient alternative for targeted delivery of phototherapy in inflammatory skin diseases such as psoriasis.

Objectives We investigated the efficacy and safety of a new UVB-LED phototherapeutic device in chronic plaque-type psoriasis.

Methods Twenty patients with stable plaque-type psoriasis were enrolled into a prospective, right-left comparative, open study. Symmetrical lesions located on extremities or trunk were chosen; one lesion was treated with the study device, whereas the other lesion served as an untreated control. Two treatment regimens were used in the study, one with an aggressive dose escalation similar to those used for outpatient treatment and one with slow increase in dose, similar to those used for treatment at home.

Results Patients in both groups responded rapidly to the UVB-LED therapy. Early disease resolution was observed in 11 patients (seven in the first group and four in the second group). Overall improvement at end of therapy was 93% in the high-dose group and 84% in the low-dose group. Four patients from the high-dose group and five from the low-dose group were still in remission at the 6-month follow-up visit.

Conclusions These results suggest that this innovative UVB-LED device is effective in the treatment of localized psoriasis and may be useful in other UV-responsive skin diseases.

Dermatology. 2011;223(3):251-9. doi: 10.1159/000333364. Epub 2011 Nov 18.

Prospective randomized study on the efficacy of blue light in the treatment of psoriasis vulgaris.

Weinstabl A[1], Hoff-Lesch S, Merk HF, von Felbert V.

Author information

Abstract

BACKGROUND: Blue light has no known toxic effects on human skin, but reduces the proliferative capacity of keratinocytes in vitro. We therefore investigated the efficacy of blue light in the treatment of **psoriasis** vulgaris (PV).

METHODS: Forty patients with mild to moderate PV and bilateral plaques were assigned to two groups. Group 1 (n = 20) received irradiation at home with blue light (light-emitting diode, LED, emission maximum: 420 nm) once daily for 4 weeks. In parallel, group 2 (n = 20) performed irradiations with another blue light device (LED emission maximum: 453 nm). The contralateral control plaques remained untreated in both groups.

RESULTS: Thirty-seven patients completed the trial. The main study parameter, the difference of Local **Psoriasis** Severity Index (LPSI) scores of the irradiated plaques compared to the control plaques, showed statistically significant improvement after 4 weeks of treatment in both groups [group 1 (420 nm): n = 17, p = 0.04; group 2 (453 nm): n = 20, p = 0.04]. Accordingly, plaque status as assessed by both the physicians and the patients improved continuously during the 4 weeks of treatment and steadily declined thereafter.

CONCLUSION: Blue light appears to be a promising treatment modality in PV that warrants further evaluation in larger studies.

LED et douleur

- Stimulation régénération nerveuse in vitro
- Traitement des syndromes temporo-mandibulaires (LED 630, LED 850 nm)
- Traitement des douleurs post-zostériennes (LED 830 nm) (Park et 2013)
- LED et prévention des mucites : résultats discordants

Lasers in Surgery and Medicine 45:487–495 (2013)

The Growth of Human Scalp Hair Mediated by Visible Red Light Laser and LED Sources in Males

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Background and Objectives: Low level laser therapy (LLLT) has been used to promote hair growth. A double-blind randomized controlled trial was undertaken to define the safety and physiologic effects of LLLT on males with androgenic alopecia.

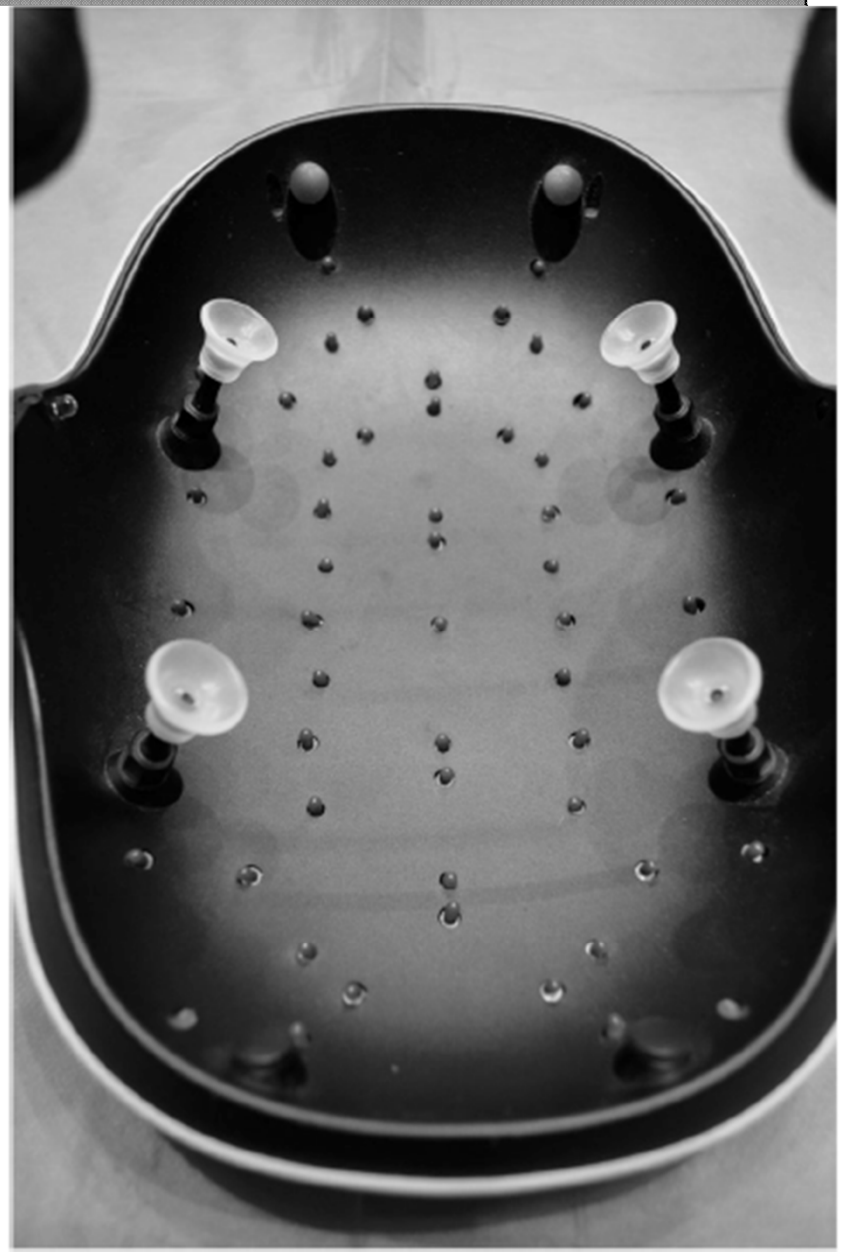
Methods: Forty-four males (18–48 yo, Fitzpatrick I–IV, Hamilton–Norwood IIa–V) were recruited. A transition zone scalp site was selected; hairs were trimmed to 3 mm height; the area was tattooed and photographed. The active group received a "TOPHAT655" unit containing 21, 5 mW lasers (655 ± 5 nm), and 30 LEDS (655 ± 20 nm), in a bicycle-helmet like apparatus. The placebo group unit appeared identical, containing incandescent red lights. Patients treated at home every other day × 16 weeks (60 treatments, 67.3 J/cm^2 irradiance/25 minute treatment), with follow up and photography at 16 weeks. A masked 2.85 cm^2 photographic area was evaluated by another blinded investigator. The primary endpoint was the percent increase in hair counts from baseline.

Results: Forty-one patients completed the study (22 active, 19 placebo). No adverse events or side effects were reported. Baseline hair counts were 162.7 ± 95.9 ($N = 22$) in placebo and 142.0 ± 73.0 ($N = 22$) and active groups respectively ($P = 0.426$). Post Treatment hair counts were 162.4 ± 62.5 ($N = 19$) and 228.7 ± 102.8 ($N = 22$), respectively ($P = 0.0161$). A 39% percent hair increase was demonstrated (28.4 ± 46.2 placebo, $N = 19$; 67.2 ± 33.4, active, $N = 22$) ($P = 0.001$) Deleting one placebo group subject with a very high baseline count and a very large decrease, resulted in baseline hair counts of 151.1 ± 81.0 ($N = 21$) and 142.0 ± 73.0 ($N = 22$), respectively ($P = 0.680$). Post treatment hair counts were 158.2 ± 61.5 ($N = 18$) and 228.7 ± 102.8 ($N = 22$) ($P = 0.011$), resulting in a 35% percent increase in hair growth (32.3 ± 44.2, placebo, $N = 18$; 67.2 ± 33.4, active, $N = 22$) ($P = 0.003$).

Conclusions: LLLT of the scalp at 655 nm significantly improved hair counts in males with androgenetic alopecia. Lasers Surg. Med. 45:487–495, 2013.

Alopécies androgénétiques (n=44)
Casque avec lasers et LEDs
A domicile : 1 jour sur 2 pdt 16 sem

bureau for Amgen, Galderma, and Abbott. R.J. Lanzafame has received consulting fees from Apira Science and fees for manuscript preparation. He is Editor-in-Chief of Photomedicine and Laser Surgery, on the Editorial Boards of General Surgery News, Journal of Laparoendoscopic Surgery, Journal of the Society of Laparoscopic Surgeons, and Lasers in Medical Science. He serves as a consultant to the General and Plastic Surgery Devices and other panels of the Medical Devices Advisory Committee of the FDA's Center for Devices and Radiological Health. He performs medicolegal consulting for various law firms and entities. He serves as a consultant for various companies, including Business and venture capital groups including Leerink Swan, GLG Councils and others. He is member of the Board of Directors and Director of Continuing Medical Education for the American Society for Laser Medicine and Surgery. He is a partner in Biomedical Gateway, LLC, which was formed to seek grants in HIT, medical device development, and research.



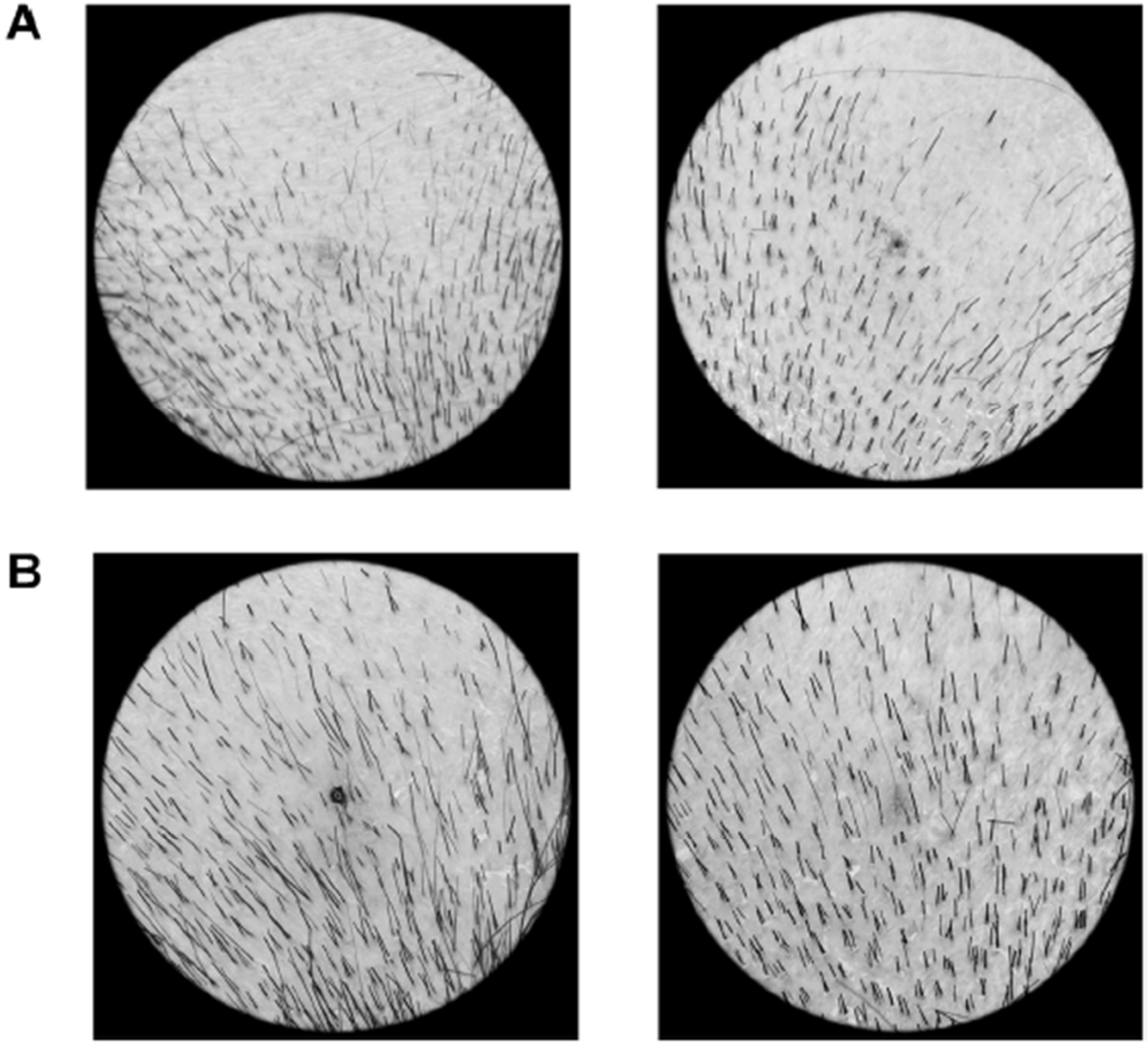


Fig. 4. Pre and post treatment image examples for active treatment group subjects. Pre-treatment and 16 weeks post-treatment photo pairs are shown for two active treatment group subjects. Hair counts were 140 at baseline and 280 at 16 weeks in subject 69 (**A**), and 143 and 322, respectively in subject 79 (**B**). Note that some of the hairs subjectively appear to be thicker and more deeply pigmented after treatment.

IS LIGHT-EMITTING DIODE PHOTOTHERAPY (LED-LLLT) REALLY EFFECTIVE?

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(Kim et al, Laser Ther 2011 vol 20 p205-215)

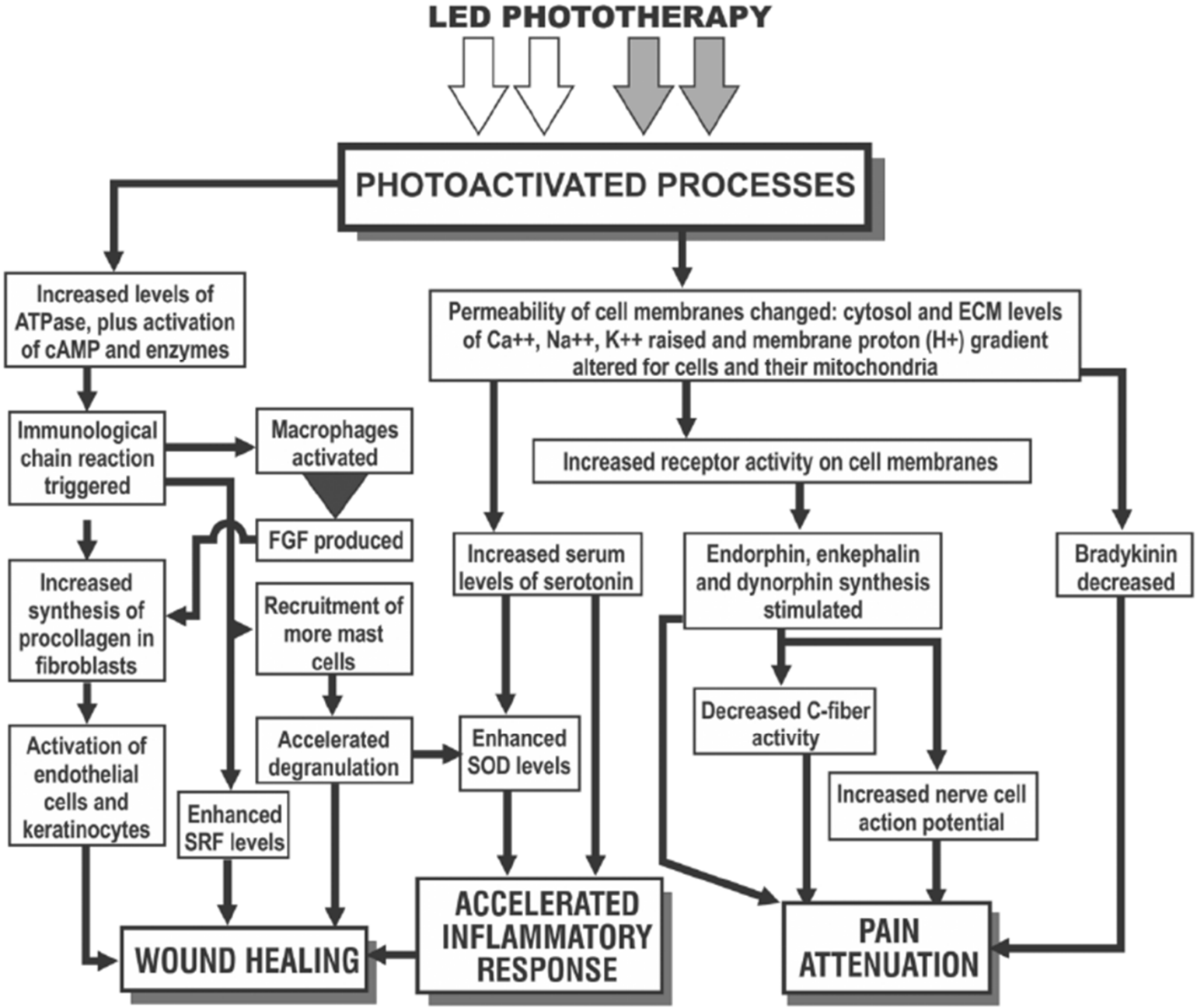
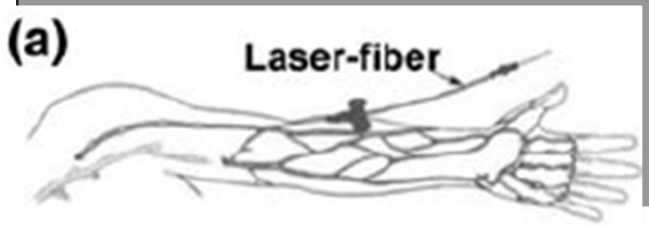


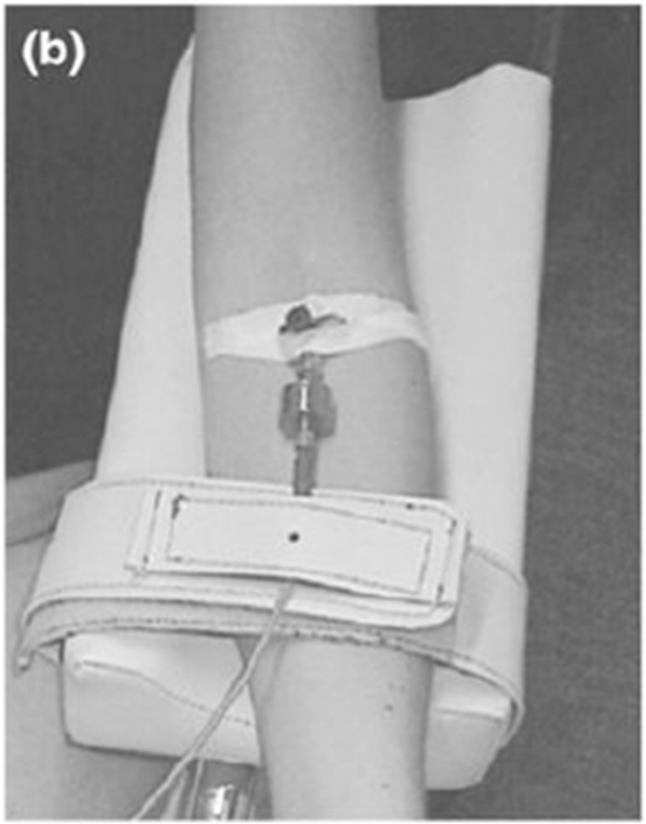
Fig. 4: Mechanisms underlying the three main LLLT endpoints, particularly associated with the wavelength of 830 nm, although 633 nm has beneficial effects as well.

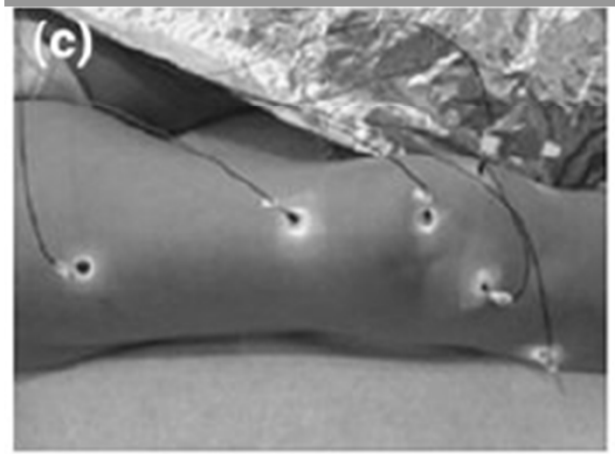
Table 2: Molecular level activation by LLLT with appropriate LEDs (From Ref 12)

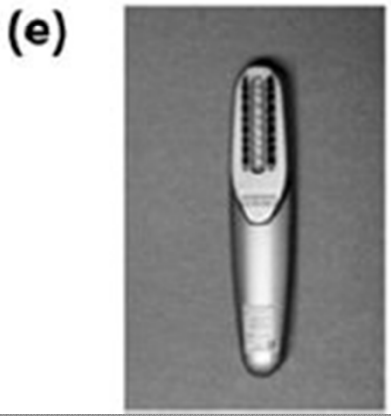
Classification	Molecules	LLLT-Associated Biological Effects
Growth factors	BNF, GDNF, FGF, bFGF, IGF-1, KGF, PDGF, TGF-β, VEGF	Proliferation Differentiation Bone nodule formation
Interleukins	IL-1α, IL-2, IL-4, IL-6, IL-8	Proliferation Migration Immunological activation
Inflammatory cytokines	PGE2, COX2, IL1β, TNF-α	Acceleration/Inhibition of inflammation
Small molecules	ATP, cGMP, ROS, CA^{++}, NO, H^{+}	Normalization of cell function Pain relief Wound healing Mediation of cellular activities Migration Angiogenesis

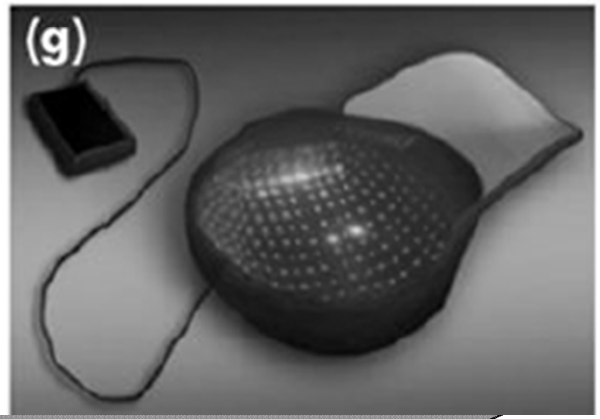
Ann Biomed Eng. 2012 February ; 40(2): 516–533.











Merci de votre attention