Non-contact electrical stimulation in burn wound healing

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Electrical phenomena of animals
„The Current of Injury“

Mid 1800 : electric currents in wounds

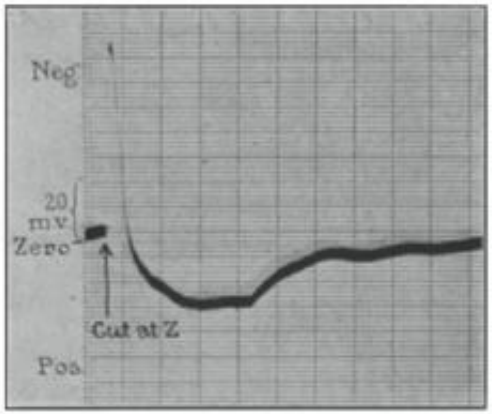
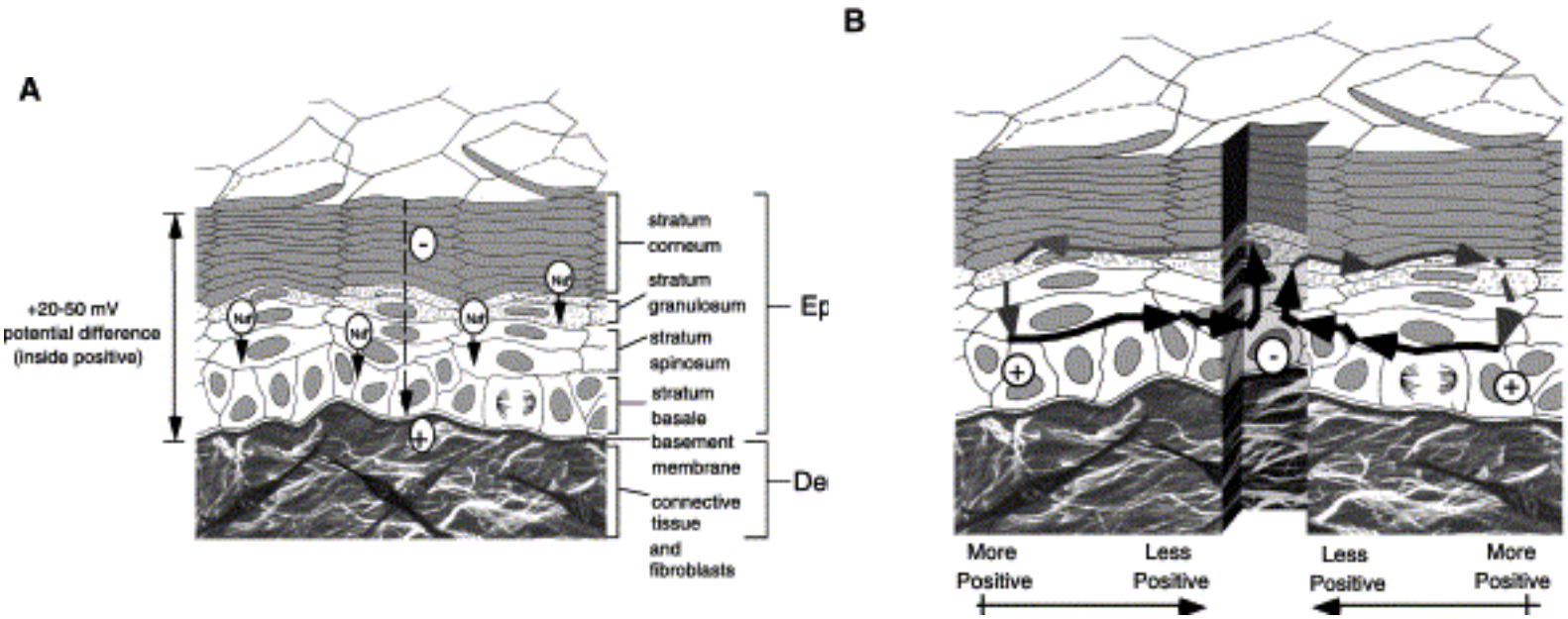


FIG. 2. Photographic record of potential differences, the experiment being arranged as in Fig. 1 with 0.001 M KCl at *A*, *C*, and *X*. When the left cell is cut at *Z* the curve (which records the state of *A* with reference to *C*) shows that *A* becomes more negative, then more positive, and that the electromotive force then approaches zero. The vertical lines represent 5-second intervals. Selected as typical from 10 experiments.

Du Bois-Reymond, Emil Heinrich

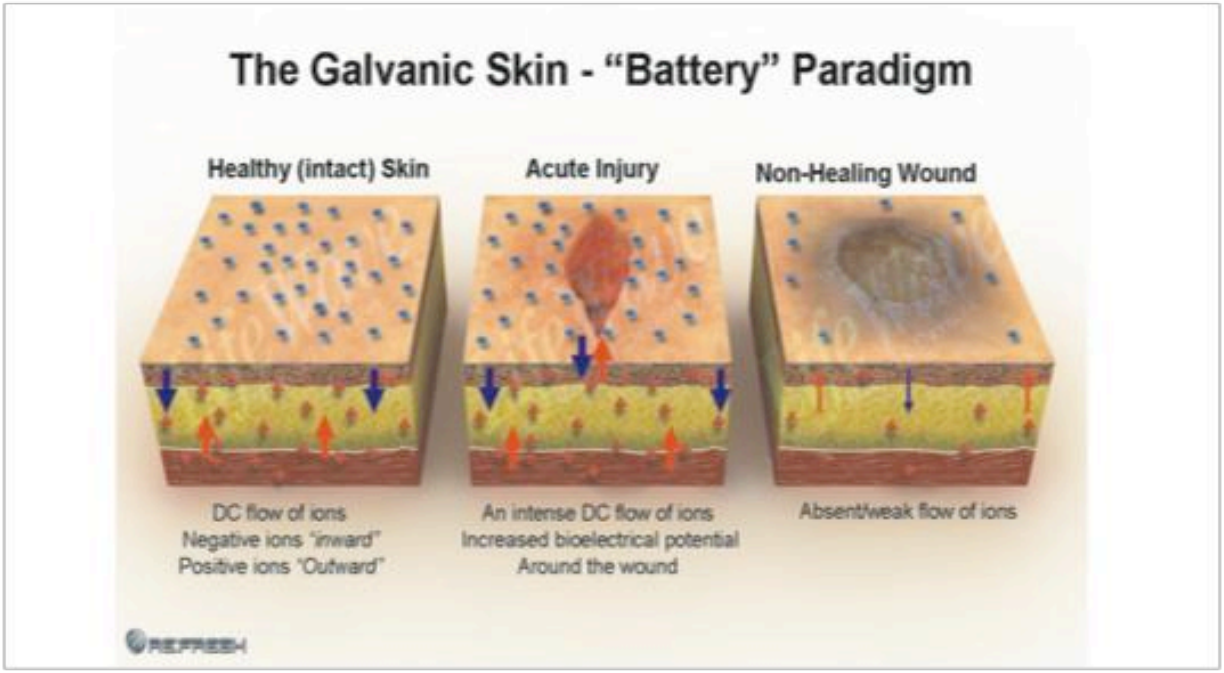
engraving, c. 1900
(Archiv für Kunst und Geschichte, Berlin)

„The Current of Injury“
Short-circuit upon epithelial injury



Nucitello R, A Role for Endogenous Electric Fields in Wound Healing, Current Topics in Developmental Biology, 2003

„The Current of Injury“



1. Kloth LC. Electrical stimulation for wound healing: a review of evidence from invitro studies, animal experiments, and clinical trials. *Int J Low Extrem Wounds*. 2005;4:23-44.

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Electrical signals control wound healing through phosphatidylinositol-3-OH kinase-gamma and PTEN.

Zhao M, Song B, Pu J, Wada T, Reid B, Tai G, Wang F, Guo A, Walczysko P, Gu Y, Sasaki T, Suzuki A, Forrester JV, Bourne HR, Devreotes PN, McCaig Penninger JM.

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Arteriosclerosis, Thrombosis, and Vascular Biology

JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association.

DC Electric Fields Induce Distinct Preangiogenic Responses in Microvascular and Macrovascular Cells

Huai Bai, Colin D. McCaig, John V. Forrester and Min Zhao

Research Article 4681

Nerve regeneration and wound healing are stimulated and directed by an endogenous electrical field in vivo

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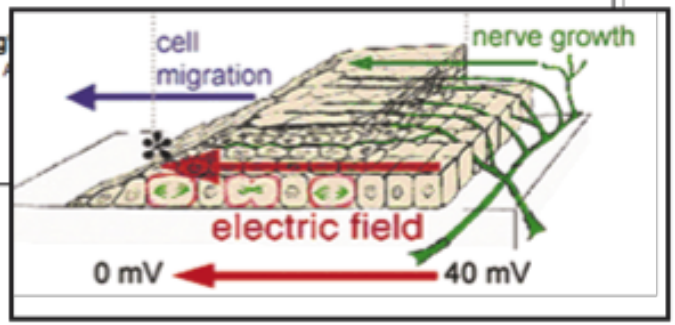
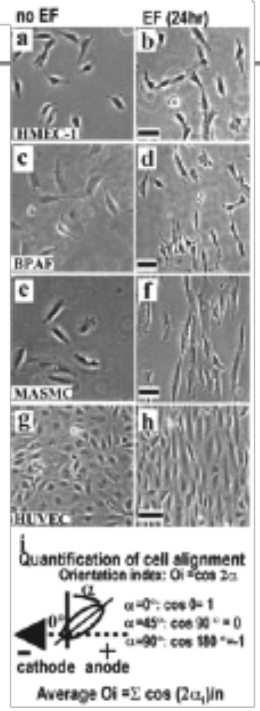
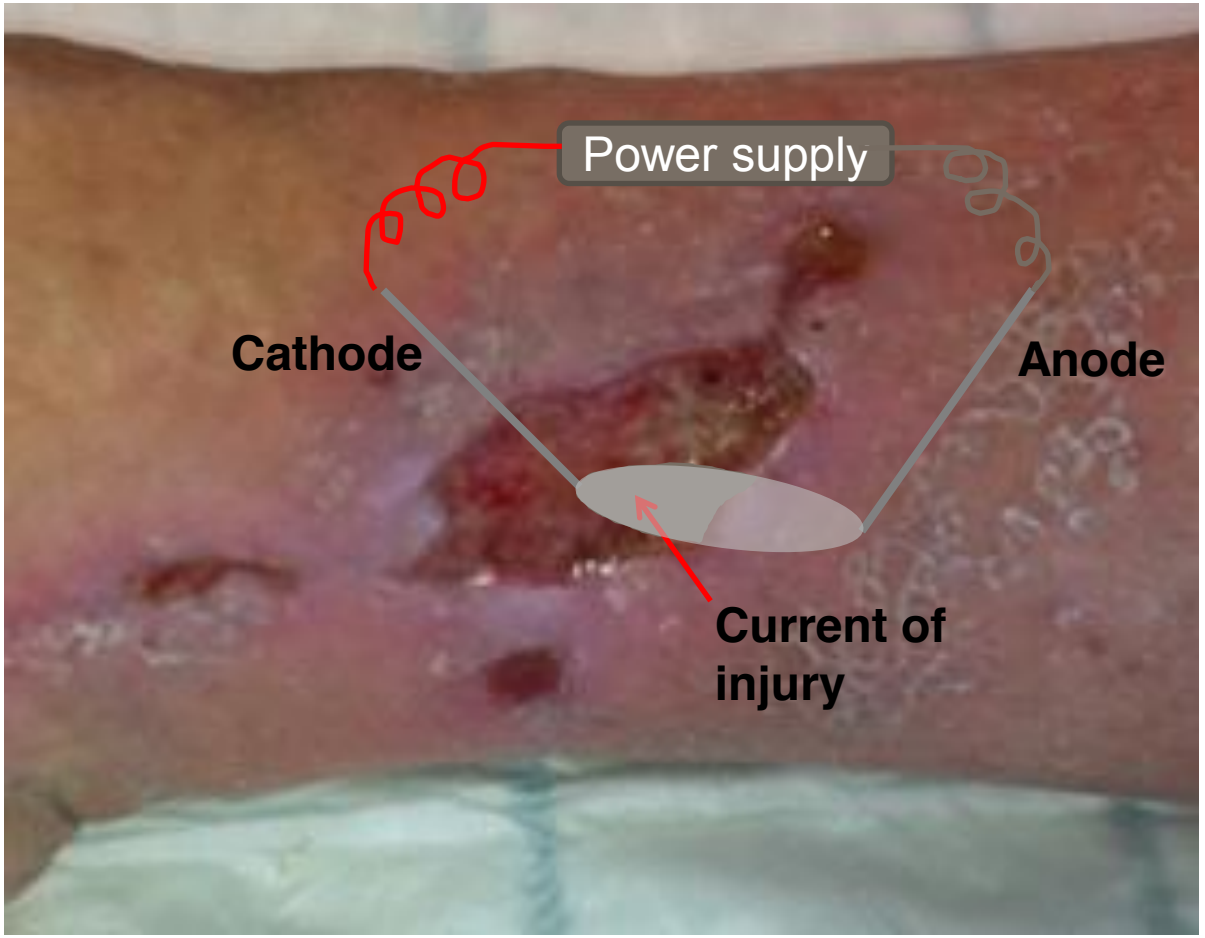
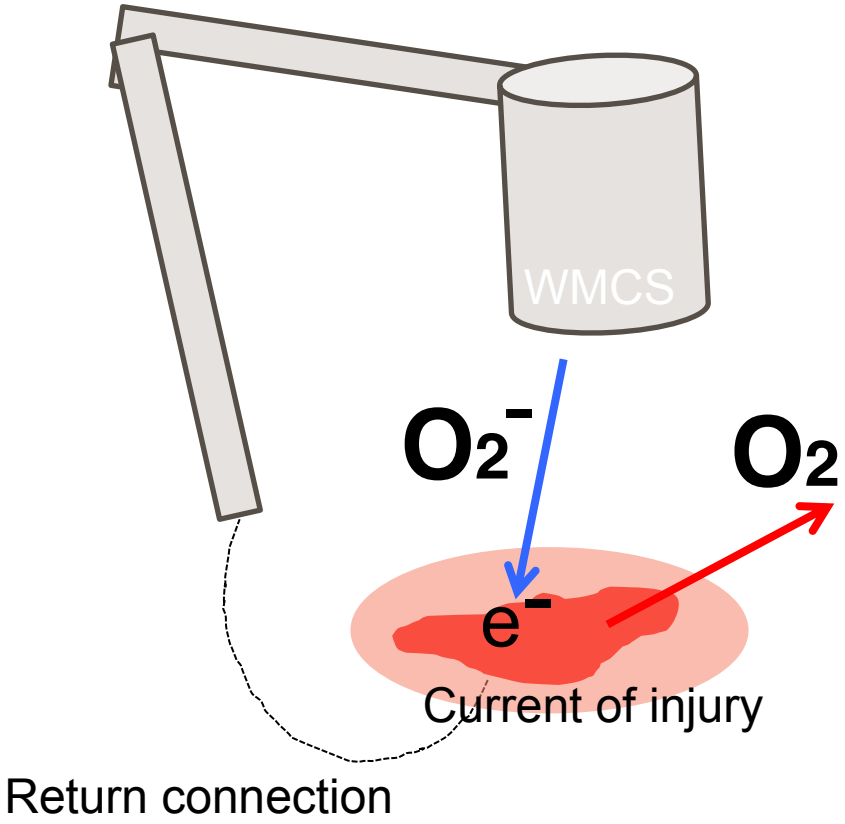




Limited clinical use of electrostimulation

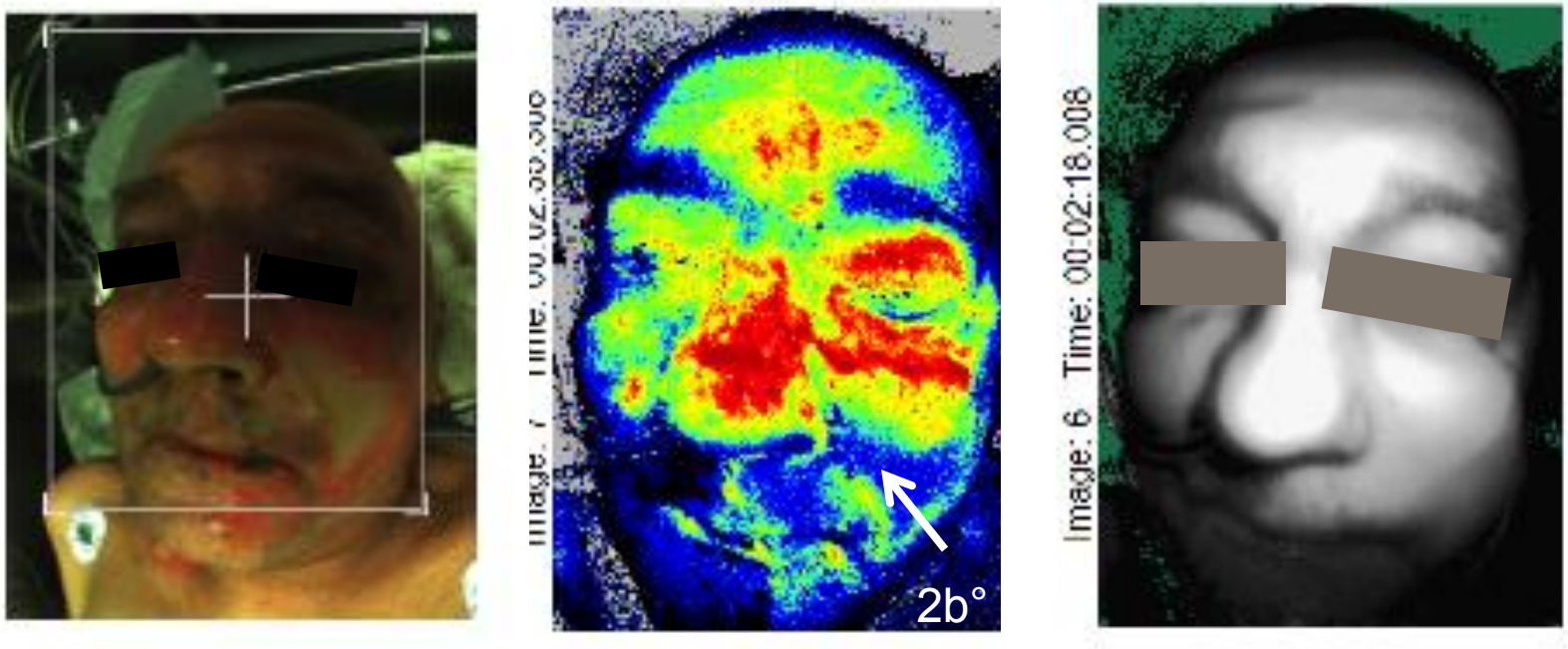


Non-Contact Electrical Stimulation (NCES) (Plateout effect)



Wireless microstimulator (WMCS, Wetling, Denmark)

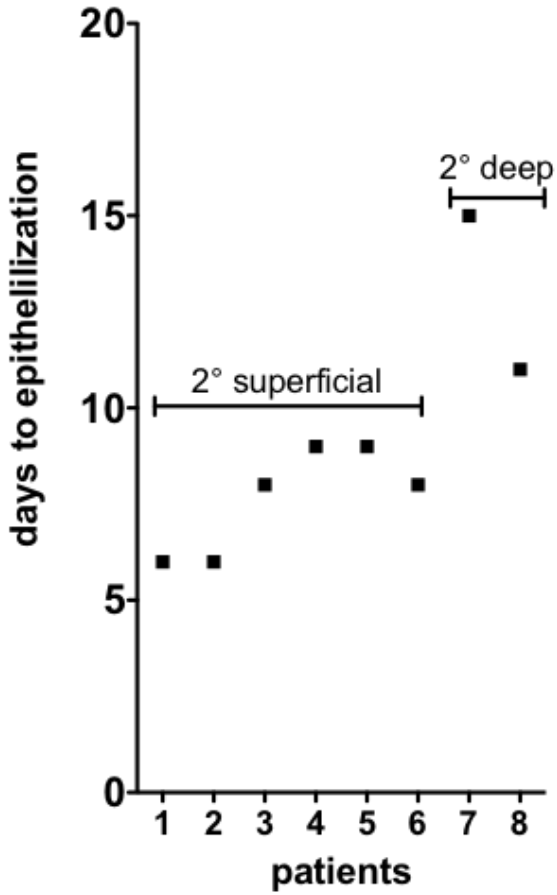
Patients with facial burns, clinical and perfusion based assesment of burn degree



(Laser Speckle Contrast Analysis (LASCA) PSI,(Perimed, Sveden)

Patients with facial burns, characteristics and time to wound healing

patient	facial burn	TBSA%	epithel. days
1	Ia-IIa	15	6
2	IIa	35	6
3	IIa	50	8
4	IIa	40	9
5	IIa	45	9
6	IIa	15	8
7	IIb-III	35	15
8	IIb (chem.)	30	12



Patients with superficial 2° facial burn

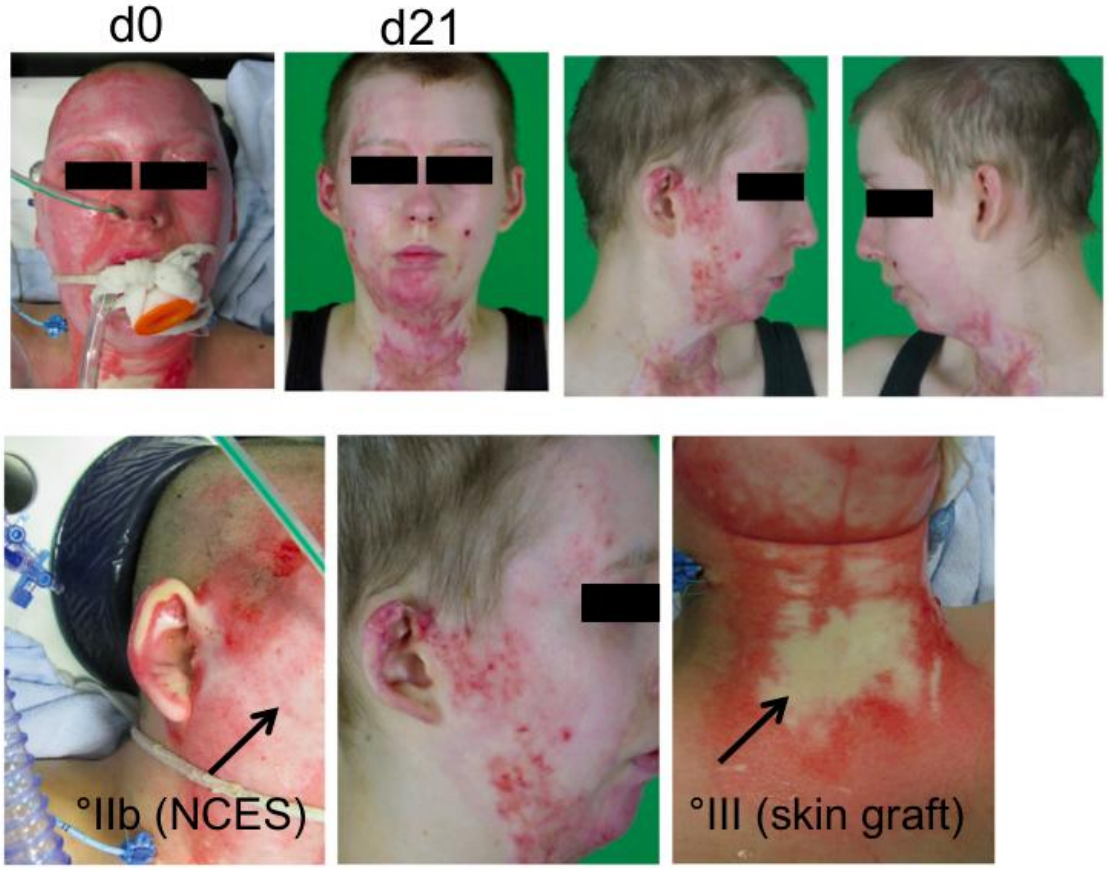
d0 d7 d21

54y male patient with °IIa burns

d0 d7 d21

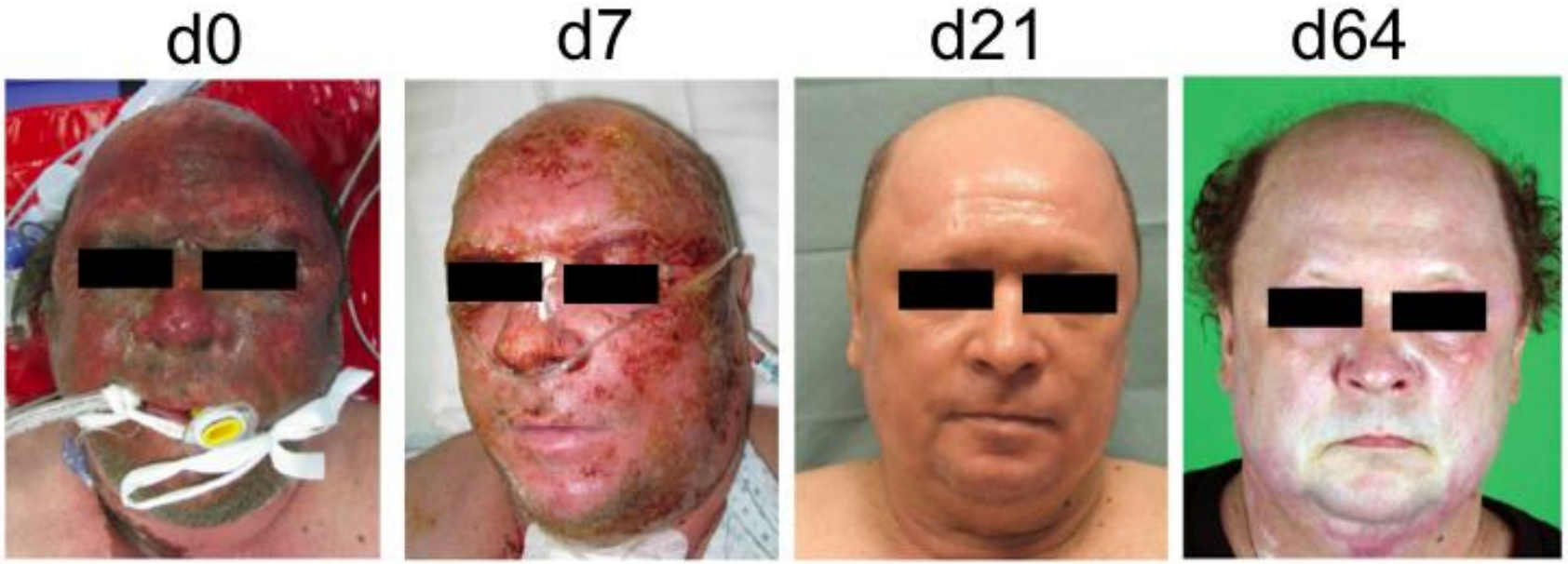
43y male patient with °IIa burns

Patients with deep 2° facial burn



19y female patient with °IIb -°III burns

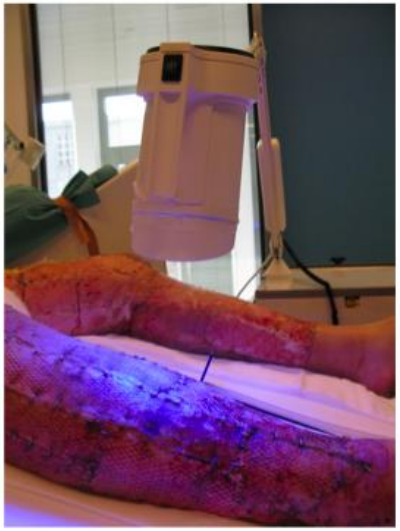
Patients with deep 2° chemical burn



56y male patient with basic chemical burn

Treatment targets in burn wound care

Autologous skin graft



Allogenic skin graft

Biosynthetic dressing

Summary

NCES allows safe treatment of patients (well tolerated no side effects)

„Airborne“ application does not increase risk of infections

In 2° facial burns it seems to accelerate epithelialization and improve cosmetic results.

May reduce the need of surgery in deeper 2° burns

May be beneficial in other settings of burn wound treatment
- Following autologous and allogeneic skin grafting
- Treatment of skin graft donor site
- Additional to biosynthethic wound dressings