

# Evaluation of a novel 308-nm monochromatic excimer light delivery system in dermatology: a pilot study in different chronic localized dermatoses

F. Aubin, M. Vigan, E. Puzenat, D. Blanc, C. Drobacheff, P. Deprez, P. Humbert and R. Laurent

Photodermatology Unit, Department of Dermatology, University Hospital, 2 Place Saint-Jacques, 25030 Besançon cedex, France

## Summary

### Correspondence:

François Aubin.

E-mail: francois.aubin@ufc-chu.univ-fcomte.fr

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### Conflict of Interest:

This study was presented in part at the 12th Congress of the European Academy of Dermatology and Venereology, Barcelona, Spain, 15–18 October 2003.

**Background** Recently, units have been developed that are capable of delivering large fluences of narrowband ultraviolet (UV) B selectively to cutaneous lesions within a reasonable time.

**Objectives** To analyse the efficacy of a novel nonlaser 308-nm monochromatic excimer light (MEL) delivery system in various dermatoses usually treated by narrowband UVB phototherapy.

**Methods** Fifty-four patients with chronic and resistant localized dermatoses were enrolled in a prospective study: 17 with palmoplantar pustular psoriasis, seven with plaque-type psoriasis, four with nail psoriasis, eight with chronic atopic dermatitis of the hands, 10 with chronic nonatopic dermatitis of the hands and eight with alopecia areata. The 308-nm xenon chloride MEL delivery system (Excilite; DEKA, Florence, Italy) was used to produce an average incident dose rate of  $50 \text{ mW cm}^{-2}$  at a tube-to-skin distance of 15 cm and with a maximum irradiating area of  $512 \text{ cm}^2$ . The initial dose was based on multiples of a predetermined minimal erythema dose (MED), and subsequent doses were based on the response to treatment. Treatments were scheduled weekly for a maximum of 10 weeks. Clinical responses were evaluated using photographic documentation and (except for alopecia areata) clinical score.

**Results** The MED ranged from 250 to  $350 \text{ mJ cm}^{-2}$  (mean  $\pm$  SD  $318.2 \pm 28.4$ ). MEL at 308 nm was the most effective for palmoplantar pustular psoriasis with a mean improvement of 79% after a mean of 5.3 treatments and a mean dose of 11.8 MED per treatment. Plaque-type psoriasis was significantly less sensitive to treatment and nail psoriasis demonstrated no benefit from treatment. Chronic palmar atopic dermatitis was cleared in two patients and the mean improvement was 54% as compared with 46% in patients with chronic nonatopic dermatitis of the hands. Four complete regrowths among the eight patients with alopecia were observed after a mean of 5.1 treatments. The percentages of improvement had significantly decreased at the 6-month visit, and only four patients (24%) with palmoplantar pustular psoriasis still demonstrated a significant improvement. Common side-effects included intense erythema and, more rarely, blisters, but these were well tolerated.

**Conclusions** Our preliminary results confirm the efficacy of this novel 308-nm MEL delivery system, which appears to be effective and safe for palmoplantar pustular psoriasis. To a lesser extent, plaque-type psoriasis, chronic atopic and nonatopic dermatitis of the hands and alopecia may also benefit from this treatment.

Previous studies have established that psoriatic lesions can tolerate much more ultraviolet (UV) radiation than adjacent uninvolved skin and can clear even faster if higher doses of

UV are selectively delivered to the psoriatic plaques.<sup>1</sup> Recently, units capable of delivering large fluences of narrowband UVB selectively to the cutaneous lesions within a reasonable time

have been developed. The xenon chloride gas excimer offers a means for delivering larger fluences of narrowband UVB not far from 311-nm narrowband phototherapy. Two systems emitting high-energy monochromatic excimer light (MEL) have been developed: (i) laser technology, already approved by the U.S. Food and Drug Administration for psoriasis treatment, and (ii) a new nonlaser MEL technology. This new MEL is 17 times more powerful compared with a Philips UVB TL-01 source. The advantages over the laser system are low operating costs and the fact that a large area can be treated quickly. In contrast, the 308-nm excimer laser systems produce a small spot size which requires multiple treatments of adjacent areas to cover the lesional skin. These advantages led us to investigate the efficacy of this novel 308-nm MEL delivery system in localized T-cell-mediated skin disorders usually treated by narrowband UVB phototherapy.

## Materials and methods

### Patients

After approval of the study protocol by the institutional review board of the University Hospital, Besançon (France), 54 patients were enrolled in a prospective nonrandomized study. Informed consent was obtained before the start of the study. Adults with different stable chronic and resistant localized dermatoses were recruited. Stable chronic and resistant lesions were defined as having been present and unchanged for at least three consecutive months whatever the treatment (topical or systemic) used. Patients comprised 17 with palmoplantar pustular psoriasis, seven with plaque-type psoriasis, four with nail psoriasis, eight with chronic atopic dermatitis of the hands, 10 with chronic nonatopic dermatitis of the hands and eight with alopecia areata. Only one plaque (lumbar, buttock, four elbows and anterior lower leg) was treated in patients with plaque-type psoriasis. Patients were required to discontinue all topical therapies (other than white petrolatum) for at least 2 weeks, and systemic therapies for at least 8 weeks.

### Ultraviolet B source

The 308-nm nonlaser xenon chloride MEL delivery system (Excilite; DEKA, Florence, Italy) was used to produce an average incident dose rate of  $50 \text{ mW cm}^{-2}$  at a tube-to-skin distance of 15 cm and with a maximum irradiating area of  $512 \text{ cm}^2$  ( $32 \times 16 \text{ cm}$ , Fig. 1).

### Study protocol

Before the start of treatment, the 308-nm UVB minimal erythema dose (MED) was determined on unexposed and uninvolved skin. The MED was defined as the minimal fluence of monochromatic light capable of producing a well-defined macular erythema with distinct borders. The MED was determined with a geometrically increasing series of irradiation times (3, 5, 7, 9 and 12 s) corresponding to fluences of 150,



Fig 1. Excilite\* (DEKA).

250, 350, 450 and  $600 \text{ mJ cm}^{-2}$ , respectively. The MED readings were performed 24 h later. The initial dose was based on multiples of a predetermined MED, and subsequent doses were based on the response to treatment. The large irradiation field of  $512 \text{ cm}^2$  offered the possibility to treat large areas of lesional skin at a time (e.g. two palms, two soles or one psoriasis plaque). In no case was it necessary to irradiate two adjacent areas, and multiples of MED were administered in only one area, thus eliminating the risk of overlapping. Treatments were scheduled weekly for a minimum of 5 weeks and a maximum of 10 weeks. Based on the results observed by Asawanonda *et al.*<sup>2</sup> we chose to use a high fluence and a limited number of treatments. In addition to photographic documentation, each study lesion, except alopecia areata, was defined with a baseline score ranging from 0 (low) to 4 (high) according to the degree of induration (I), scaliness (S) and erythema (E). For psoriasis assessment, these three indices were added to form an ISE score. ISE scores were assigned before each MEL treatment and at 3-month and 6-month post-treatment follow-up visits. Improvement scores were calculated as:  $1 - (\text{post-treatment ISE}/\text{baseline ISE})$ . The effect of MEL on alopecia areata was evaluated by measuring the area of regrowth.

### Statistics

A t-test for dependent samples was used to test for significant improvement.  $P < 0.05$  was chosen to denote significance.

## Results

All patients completed the study. The MED ranged from 250 to 350 mJ cm<sup>-2</sup> (mean  $\pm$  SD 318.2  $\pm$  28.4). In all cases, clinical improvement was observed very quickly, even after one or two treatments. MEL at 308 nm was the most effective for palmoplantar pustular psoriasis (Table 1, Fig. 2), with a mean improvement of 79% after a mean of 5.3 treatments and a mean dose of 11.8 MED per treatment. Plaque-type psoriasis (Table 1, Fig. 3) was significantly less sensitive to treatment, with a mean improvement of 47% after a mean of 5.3 treatments and a mean dose of 13 MED per treatment. Nail psoriasis demonstrated no benefit from treatment. Chronic palmar atopic dermatitis (Table 1) was cleared in two patients and the mean improvement was 54% as compared with a mean improvement of 46% in patients with chronic nonatopic dermatitis of the hands. Four complete regrowths (90–100%) among the eight patients with alopecia (Table 1, Fig. 4) were observed after a mean of 3.1 treatments. No effect was observed in the remaining four patients with alopecia areata.

The percentage of improvement (Fig. 5) observed in patients with plaque-type psoriasis (47%), chronic atopic

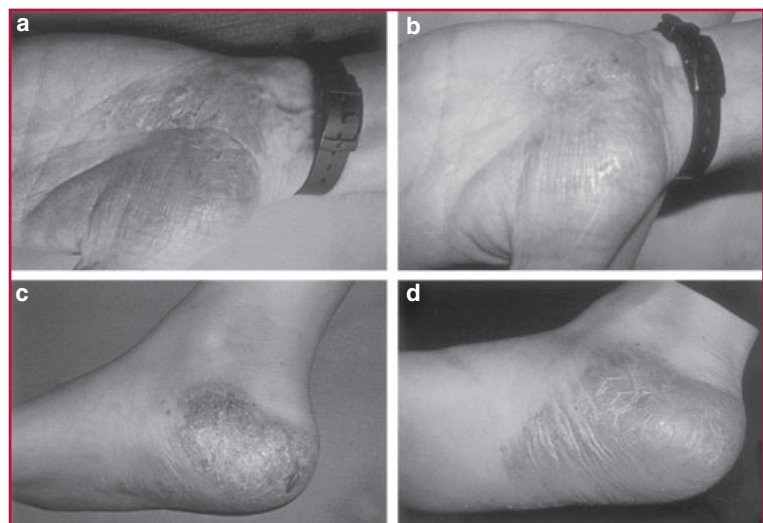
dermatitis of the hands (54%) and alopecia areata (47.5%) remained steady at the 3-month visit (44%, 45.7% and 47.5%, respectively), but significantly decreased at the 6-month visit (23%, 28.6% and 23.7%, respectively;  $P < 0.05$ ). In contrast, at the 3-month follow-up visit, patients with palmoplantar pustular psoriasis and chronic nonatopic dermatitis of the hands exhibited a significant decrease in the percentage of improvement ( $P < 0.05$ ), which was even greater at the 6-month post-treatment visit ( $P < 0.001$ ).

Thirteen of 17 (76%) patients with palmoplantar pustular psoriasis achieved at least 80% improvement after a mean of 3.7 treatments with a mean dose of 11 MED. Six months after treatment, four patients (24%) still demonstrated a significant improvement ( $> 75%$ ). The mean cumulative dose of UVB received by the cutaneous lesions, calculated using the mean MED value, ranged from 14.7 to 30.2 J cm<sup>-2</sup>. Common side-effects included erythema and, more rarely, blisters (two patients with plaque-type psoriasis and one with alopecia areata), but these were well tolerated and no scarring or pigmentation was observed at the 6-month follow-up visit. In addition, one patient with plaque-type psoriasis developed a Köbner phenomenon after a single treatment with MEL.

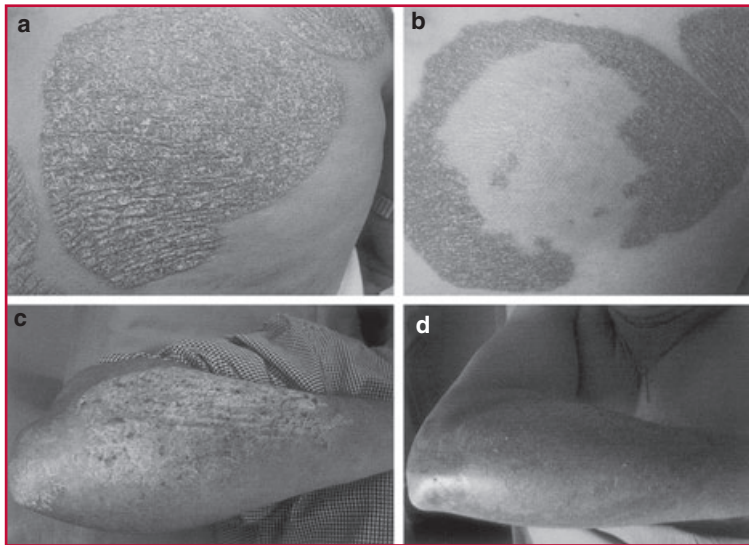
**Table 1** Efficacy of 308-nm monochromatic excimer light in different dermatoses

Dermatosis	Mean number of MED per treatment	Mean number of treatments	Mean improvement (%)
Plaque-type psoriasis (n = 7)	13	5.3	47%
Palmoplantar pustular psoriasis (n = 17)	11.8	5.3	79%
Chronic atopic dermatitis of the palms (n = 8)	13	7.3	54%
Chronic nonatopic dermatitis of the hands (n = 10)	8.4	12.5	46%
Alopecia areata (n = 8)	9.1	3.1	47.5%

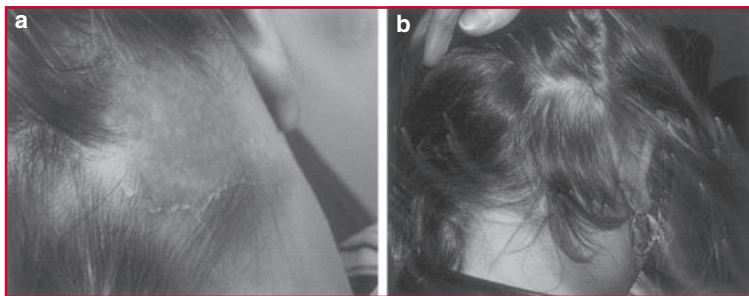
MED, minimal erythema dose. Improvement was calculated as: 1 - (post-treatment score/baseline score).



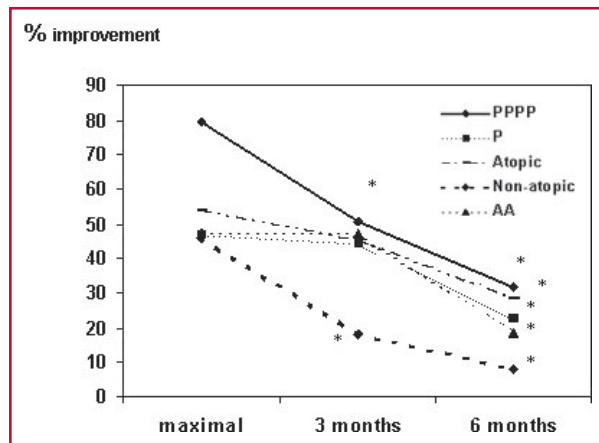
**Fig 2.** Palmoplantar pustular psoriasis. (a,c) Before 308-nm monochromatic excimer light treatment; (b,d) at the 3-month follow-up visit, after treatment with 10 minimal erythema doses (MED) weekly for 3 weeks (b) and 8 MED weekly for 2 weeks (d).



**Fig 3.** Plaque-type psoriasis. (a,c) Before 308-nm monochromatic excimer light treatment. (b) After treatment with 8 minimal erythema doses (MED) weekly for 2 weeks, clearing of the treated site was still persistent at the 6-month follow-up visit. (d) A 90% improvement was seen after 8 MED weekly for 6 weeks.



**Fig 4.** Alopecia areata. (a) One week after 308-nm monochromatic excimer light treatment with 7 minimal erythema doses (MED), showing intense erythema and peeling. (b) After an additional 6 MED weekly for 6 weeks, complete regrowth was observed and was still present at the 6-month follow-up visit.



**Figure 5.** Length of remission after treatment with 308-nm monochromatic excimer light. PPPP, palmoplantar pustular psoriasis; P, plaque-type psoriasis; Atopic, chronic atopic dermatitis of the palms; Non-atopic, chronic nonatopic dermatitis of the hands; AA, alopecia areata. \* $P < 0.05$  vs. the maximal percentage improvement observed after treatment.

## Discussion

Our results demonstrate that phototherapy with this novel nonlaser 308-nm MEL appears to be effective and safe for palmoplantar pustular psoriasis. To a lesser extent, plaque-type

psoriasis, chronic atopic and nonatopic dermatitis of the hands and alopecia may also benefit from this treatment. Previous studies using the 308-nm excimer laser have demonstrated its efficacy in localized plaque-type psoriasis<sup>2-6</sup> and in vitiligo.<sup>7-9</sup> Various protocols have been used, but all the authors demonstrated successful clearing of dermatoses in fewer overall treatments with a much lower cumulative UVB dose. As little as one single high-dose (8–16 MED) excimer laser treatment can be effective for localized plaque-type psoriasis.<sup>2,4</sup> In a dose-response study, Asawanonda *et al.*<sup>2</sup> demonstrated that high fluences produced significantly better results and longer remission time (3–4 months) than medium or low fluences. The authors concluded that fluence was the single most important determinant in the clinical clearing of psoriasis and that the number of treatments was not so important. These previous data led us to choose high fluence, from 8 to 25 MED, depending on the cutaneous lesions, and a limited number of treatments (five to 10).

We observed a direct correlation between increased overall psoriasis activity and a shorter remission period for the treated sites. In a previous study, Trehan and Taylor<sup>5</sup> observed a mean remission time of 3.5 months in 15 treated patients with plaque-type psoriasis. When comparing the effect of low (0.5 and 1 MED), medium (2–6 MED) or high fluence (8 and 16 MED), Asawanonda *et al.*<sup>2</sup> noted that 4 months after the last treatment, psoriatic plaques irradiated with < 8 MED all showed recurrence, whereas those treated with a single irradiation with 8

and 16 MED were still in remission. Despite the high-energy fluences delivered to the target lesion, limited side-effects were experienced and treatment was generally well tolerated.

A major advantage of this high-dose MEL treatment is that the overall treatment time necessary to treat the skin lesions is shorter than that for standard phototherapy, in particular in the case of resistant and localized lesions. The mean number of treatments and the mean cumulative dose required to achieve clearing in our study were approximately one-third of those used in standard narrowband UVB phototherapy. Indeed, standard narrowband UVB after 30 treatments may result in cumulative doses of 30–100 J cm<sup>-2</sup>.<sup>4,10</sup> This should be kept in mind when addressing the issue of the relative carcinogenicity of 308-nm MEL therapy. Although shorter wavelengths are believed to have greater risks of erythema as well as carcinogenesis, long-term patient follow-up studies regarding skin cancer development in subjects treated with narrowband UVB phototherapy are lacking. Furthermore, we do not have any information on DNA damage induced by this intense but short monochromatic irradiation. Given the lesional selectivity achieved by the 308-nm MEL, along with fewer treatments and lower cumulative doses, one thus might hope for lower long-term risks in terms of carcinogenesis.

Our preliminary results demonstrate that phototherapy with this novel 308-nm MEL delivery system has some effect in different chronic and resistant localized dermatoses, in particular in palmoplantar pustular psoriasis. However, optimum treatment procedure and dosimetry should be further defined in controlled studies to confirm its efficacy.

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