

ORIGINAL ARTICLE

Skin hardening effect in patients with polymorphic light eruption: Comparison of UVB hardening in hospital with a novel home UV-hardening device

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Abstract

Background An effective prophylactic treatment of patients with polymorphic light eruption (PLE) consists of repeated low, gradually increasing exposures to UVB radiation. This so-called UV(B) hardening induces better tolerance of the skin to sunlight.

Objective SunshowerMedical company (Amsterdam) has developed an UV (B) source that can be used during taking shower. The low UV fluence of this apparatus makes it an interesting device for UV hardening. In a group of PLE patients, we compared the effectiveness of the irradiation with SunshowerMedical at home with that of the UVB treatment in the hospital.

Methods The PLE patients were randomized for one of the treatments. The hospital treatment consisted of irradiations with broad-band UVB (Waldmann 85/UV21 lamps) twice a week during 6 weeks. The home UV-device was used each day with the maximal irradiation time of 6 min. The outcome assessment was based on the information obtained from patients' dermatological quality of life (DLQI) questionnaires, the ability of both phototherapies to reduce the provocation reaction and from the patients' evaluation of the long-term benefits of their phototherapies.

Results Sixteen patients completed treatment with SunshowerMedical and thirteen completed treatment in hospital. Both types of phototherapy were effective. There was a highly significant improvement in DLQI with either treatment. In most cases, the hardening reduced or even completely suppressed clinical UV provocation of PLE. The patients using SunshowerMedical at home were, however, much more content with the treatment procedure than the patients visiting the dermatological units.

Conclusions Both treatments were equally effective in the induction of skin tolerance to sunlight in PLE patients. However, the home treatment was much better accepted than the treatment in the hospital.

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Conflict of interest

None.

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Introduction

Polymorphous light eruption (PLE) is the most common type of photodermatosis. In a recent investigation that included almost 7000 inhabitants from six European countries it has been shown that the average lifetime prevalence in Europe reaches 18%.¹ PLE

often negatively influences the well-being of the patients. This fact was confirmed by scientific research demonstrating that PLE had significant (seasonal) impact on quality of life.² Also the emotional status, like feelings of anxiety and depression, may be negatively affected.³

The PLE symptoms can differ among the patients, but are usually of one particular recurring type in each individual. They

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can vary from pruritic to non-pruritic erythematous papules to plaques or vesicles on sun exposed areas. Predilection areas are the neck, upper chest, dorsal side of hands or feet and the arms. The symptoms of the disease develop within several hours to few days after the first exposure to (usually more intense) sunrays. Patients with mild forms of disease have a pruritic rash that alleviates after days to weeks, if further sun exposure is avoided.

Despite its frequent occurrence, the pathogenesis of PLE is not entirely clear. However, the aetiological role of sun exposure facilitates some preventive measures. The most obvious one is the UV-avoidance, the use of protective clothing or sunscreens with a high protection factor. However, these measures may be counterproductive as they do not stimulate the skin adaptation to sun exposure.

Another form of prevention is a slow skin adjustment to UV radiation – UV-hardening. This therapy is based on low and gradually increasing doses of UV radiation that stimulate adaptation mechanisms. The patients need to come 2–3 times a week to dermatological units to receive this UV-hardening therapy. Although in some countries PUVA is still used as an effective prophylactic treatment in patients with PLE, it seems that UVB treatment has recently gained increase popularity because of several advantages: no need for protective sunglasses, ability to use in pregnancy, absence of risk of gastrointestinal upset. Probably the most important is a lower cancerogenic potential of UVB irradiation.⁴

Phototherapy is time-consuming and often impractical for patients as it is mostly given during the office hours. After the whole course of hardening treatments, patients should expose themselves regularly to natural sunlight to maintain the UV-hardening effect. This can be difficult for patients living in the more temperate climates. After several weeks without UV exposure, the hardening effect can be lost.⁵

Recently a new tanning device (class IIb) has been developed by the Dutch company SunshowerMedical (Amsterdam). The original version of this apparatus was developed for the wellness industry. The SunshowerMedical emits a low intensity of UVB radiation and it can be used at home while taking a shower. Its low UV fluence makes it an interesting device for UV hardening of PLE patients at home. The goal of this study was to compare the effect of this new home UV device with that of hospital-based UVB hardening in PLE patients.

Patients and methods

The study was approved by the Committee for the Medical Ethics of the Leiden University Medical Centre and was conducted according to Declaration of Helsinki principles. Only the PLE patients diagnosed at Leiden University Medical Centre and at the Free University Medical Centre in Amsterdam were invited to participate in the study. We contacted more than 90 clinically diagnosed patients; <50% reacted positively and 32 of them could be included on the basis of the inclusion and exclusion criteria. Excluded were the patients of age under 18 and above 70, preg-

nant women (risk of melasma), patients using immunosuppressives, patients with lupus erythematosus, or those spending their vacation in sunny areas over the last 3 months.

All patients signed an informed consent and were randomized (using numbers in envelopes) for UVB hardening in the hospital or at home. At the beginning of the study (March–April 2010), patients were asked to fill in different forms. A form with questions about the medical history provided us with general information about patient's prior medical history, medication use, prior hardening with UV and severity of and time since diagnosis of PLE. All patients were tested ANA-negative.

The Dermatology Life Quality Index (DLQI)⁶ is a validated questionnaire which reflects the impact of PLE on the quality of life our patients. Patients also filled in under supervision the Polymorphic Light Eruption Severity Index (PLESI) form. This is a standardized interview that provides an assessment of PLE gravity on scale 2–100.^{7,8} After the hardening, patients were asked to fill in the DLQI questionnaire once more. Two months after hardening (during the summer), patients were asked about their own experience with the hardening and its effect on the subsequent development of PLE. They also were asked to fill in the PLESI and DLQI forms again. The evaluation of the filled-in questionnaires was performed by a researcher blinded for the way of patients' UV-hardening.

Phototesting with a broad band using UVA source

We attempted to provoke the PLE skin reaction in the included patients. The higher probability of provocation reaction appears to be with UVA sources.⁹ Hence a facial tanner (Eurosolar 926, lamps Cleo Performance, 105W UV3) was chosen for the provocation testing. Twenty J/cm² of UVA radiation were applied on the inner side of the forearm. The skin reaction was assessed after 24 h. In healthy persons, this UVA dose did not cause any visible redness. For the evaluation of the positive provocation reaction in our patients, we utilized the following grading scale system: 0 – no reaction, 1 – diffuse erythema, 2 – erythema with (slight) oedema, 3 – papules, 4 – confluent papules and plaques, 5 – vesicles. The UVA exposures were repeated daily until a positive PLE response was obtained. If no lesions appeared after three provocations, the test was considered negative. The provocation testing was performed before and after the 6 weeks of hardening.

UV hardening

Hospital treatment We chose a broad-band UVB because SunshowerMedical is also a broad-band UVB source. Patients were treated twice a week with the Waldman apparatus equipped with 85/100W-UV21 lamps. The starting dose was 0.01 mJ/cm². After 6 weeks, the majority of patients could reach the final dose of 0.12 J/cm² (skin type I and II), or 0.17 mJ/cm² (skin types III and IV). When a patient developed a disturbing PLE skin reaction during the hardening, the subsequent UV dose was lowered (one

step back). The cumulative UVB dose in patients with the light skin was 0.78 mJ/cm².

Home treatment SunshowerMedical devices were installed in the showers of patients randomized for home treatment (Fig. 1). The SunshowerMedical has received Waterproof specification IPX5 (protected against water jets), and it has TUV and CE certificate. It, therefore, complies with the European requirements for quality and safety.

The apparatus emits 96.5% UV-A and 3.5% UV-B radiation and produces 0.054 W/m² (UVA) + 0.0616 (UVB) = 0.115 W/m² at a distance of 40 cm. One standard erythema dose (SED) will be accomplished after (100/0.115 s) 14.5 min. One standard erythema dose is the equivalent to an erythemal radiant exposure of 100J/m².

A typical light skin type needs approximately 2–2.5 SEDs to develop a minimal erythematous reaction or dose (MED). The apparatus is equipped with a timer allowing the maximum irradiation of 12 min.

The patients received a written directive about the daily use of the home UV device. They were instructed to start with slowly increasing irradiation time (increasing with 10 s daily; after reaching 1 min irradiation increments of 30 s were used). After 16 days, the majority reached 6 min of exposure which was determined as the maximum. The patients were instructed to turn around slowly

during the shower to expose each side of the body to low dose UV. The patients were advised to lower the subsequent dose (one step back) if they developed a PLE rash. After 6 weeks, the average cumulative UVB dose reached 0.64 mJ/cm². However, because the patients were turning around and the UVB radiation could reach only about 40% of the skin surface, the real cumulative dose of a piece of skin was only about 0.26 mJ/cm². After the UV hardening period, patients were advised to continue using SunshowerMedical when the weather conditions would not allow them natural sun hardening during the next 2 months.

All patients were asked to try to normalize their attitude to sunlight in the second half of the 6-weeks hardening procedure and also after the hardening was finished. At the end of the summer holidays (2 months after the hardening), the patients filled in the PLESI and DLQI questionnaires once more under supervision. Figure 2 shows the relative emission spectra of the two treatment methods.

Statistical analyses

In this investigatory study we chose for a 25% non-inferiority boundary with an expected success rate for both treatments of 90%. With a one-sided 95% confidence interval and with power 0.8 the calculated patients per group were 18.

The Student's *t*-test (paired and unpaired) was used for the statistical calculations; a value of *P* < 0.05 was considered significant. Results mentioned in the text are (Means ± SD).

Results

Thirty-three patients were included in this study and twenty-nine patients (three men and 26 women, median age 49, range 18–69 years, skin type II or III) completed the study, 16 in the group using the home UV-device and 13 who underwent the UV-treatment in the hospital. Four patients were lost to follow-up due to non-compliance (home treatment group), unrelated illness (hospital group), persistent headaches (home treatment group) and severe reaction of PLE during treatment (home treatment group). The evaluation of PLESI score showed that the average PLE severity in both groups was similar: UV home group 67.8 ± 11.1 points, UV hospital group 69.6 ± 13.2 points (*P* = 0.698).

The patients were asked to assess their quality of life before and after the hardening therapy. As can be seen in Fig. 3, the large majority of patients in both groups experienced improvement of their dermatological quality of life. Improvement of DLQI was statistically significant in both groups: the group using home UV device before the hardening had 15.3 ± 5.1 points, after the hardening 8.8 ± 6.7 points (*P* = 0.0001); the hospital group before the hardening 13.7 ± 6.1 points and after 5.3 ± 6.0 points (*P* = 0.0026). The improvement of the DLQI in both groups was not significantly different. In the UV home group the DLQI was improved by 6.3 ± 4.8 points; in the UV hospital group by 8.4 ± 7.3 points (*P* = 0.366). However, after two



Figure 1 The home UVB device installed in a shower.

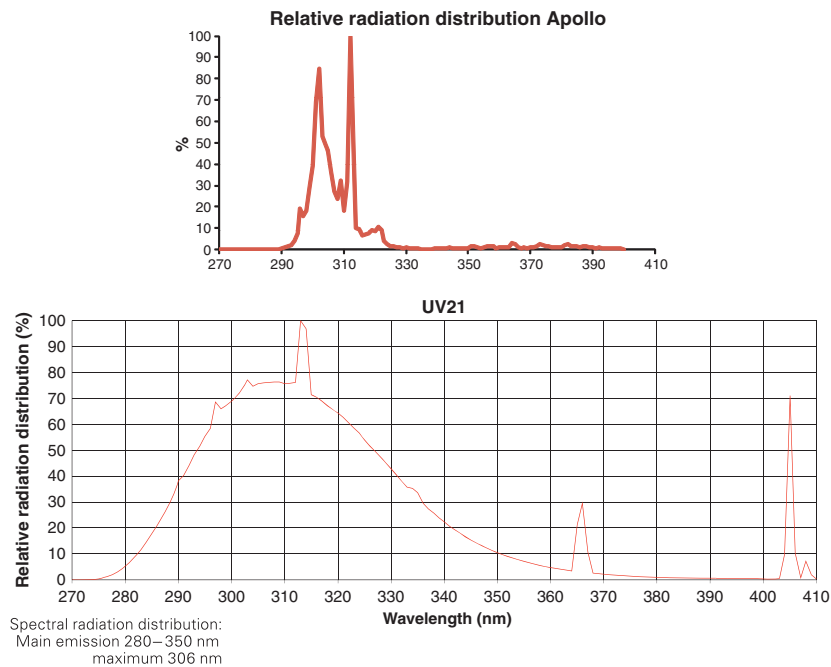


Figure 2 Relative emission spectra of SunshowerMedical lamps and Waldmann UV21.

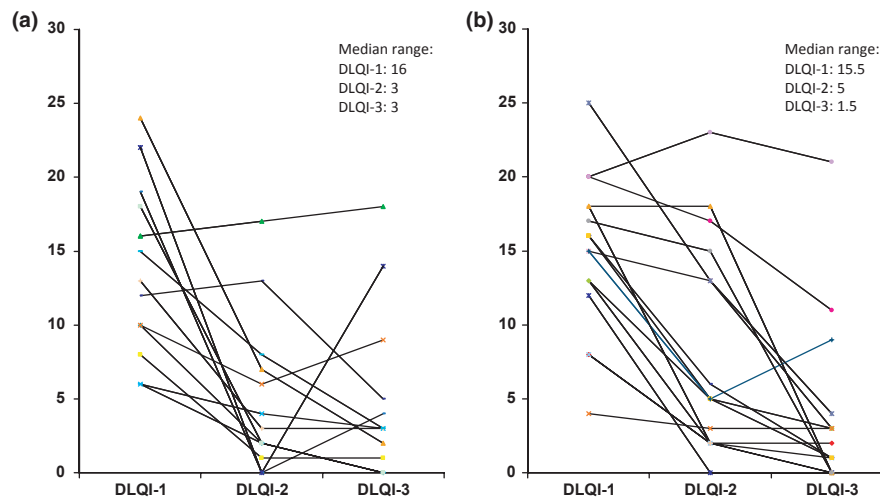


Figure 3 Changes in dermatological quality of life index (DLQI) in PLE patients as result of UV hardening. DLQI – before the hardening, DLQII – directly after the hardening, DLQIII – 2 months after the hardening. (a) hospital UVB treatment; (b) home UVB treatment.

summer months, the majority of patients reported an extra improvement of their dermatological quality of life. In the group originally treated at home it was in 76% of participants and in the UV hospital group 53.8%. In this case, the improvement of the DLQI was in the group using home UV device significantly better ($P = 0.045$).

We also asked patients specifically whether or not they felt they had any direct benefit from the hardening therapy. Their response

can be seen in Fig. 4. In the group treated at home 87% patients reported good to excellent (≥ 5 points) effect of the hardening. One patient was not able to estimate her benefit because she was not exposing herself to sunlight. In the group treated in hospital, 76% of patients were (very) satisfied with the effect of hardening. The quantitative evaluation, however, revealed no statistical difference between the groups (home treatment group 7.4 ± 2.2 points; hospital group 7.1 ± 2.3 points; $P = 0.664$).

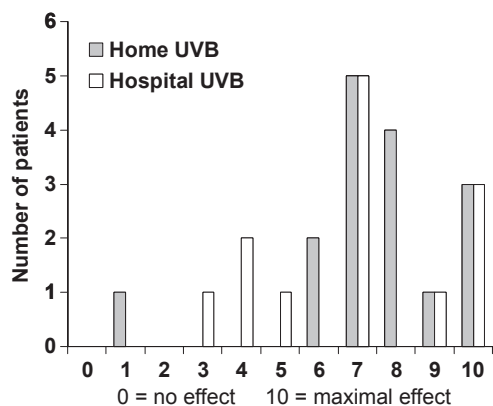


Figure 4 Subjective evaluation of the benefit from the hardening therapy in both groups of PLE patients ($P = 0.664$).

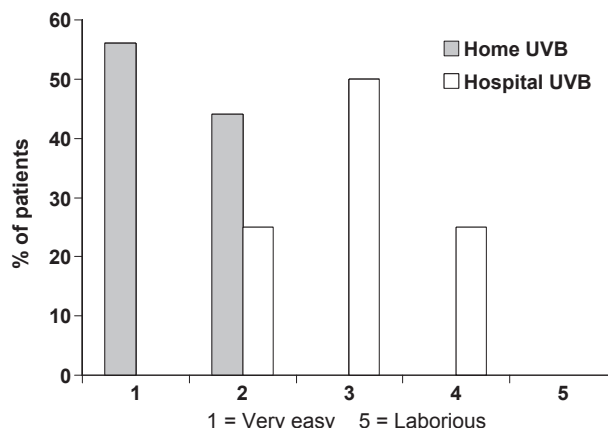


Figure 6 Subjective evaluation of satisfaction with the way of the hardening procedure.

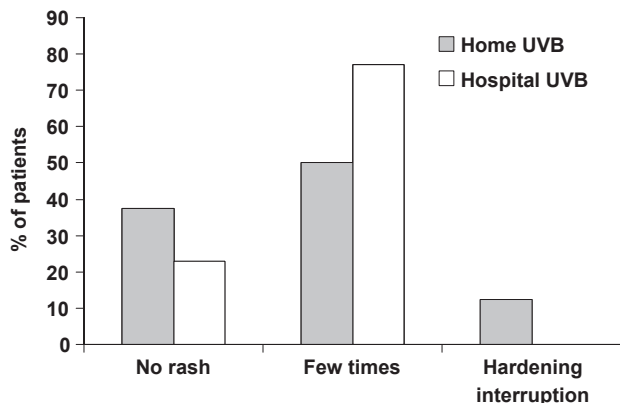


Figure 5 The percentage of patients who developed a skin rash during the hardening treatment.

Figure 5 shows that some of our patients developed skin rash during the hardening procedures. In the group treated with the home UV device, two of sixteen patients had to interrupt the treatment for 2–3 days.

We also examined the effect of hardening on the development of positive UV skin provocation. At the beginning of the study, we were able to provoke the skin rash in 68% of our patients (80% in the group treated at home and 46% in the hospital group). After the hardening, the provocation was improved (intensity or onset) in 100% of (previously induced) patients treated with the home device and in 71% of patients treated in the hospital. Several patients (67% of the home-treated group and 29% of the hospital treated group) could not be provoked after the hardening.

Patients were also asked about their satisfaction with the way of the hardening. Figure 6 shows that there was a large difference between the groups. On the scale of 1–5 for the laboriousness of the hardening, the treatment with the home device came out

significantly better than the hospital treatment (1.4 ± 0.5 points and 3.0 ± 0.8 , respectively; $P = 0.0001$).

We also wanted to know, whether or not the hardening therapy followed by the summer holiday, would alter the evaluation of PLE severity score in individual patients. The average decrease of PLESI in the group treated at home was 23.7% and in the hospital group 22.8%. This decrease of PLESI was in both individual groups statistically significant: the group treated at home scored before the hardening 67.8 ± 11.1 points and at the end of the study 44.6 ± 23.9 points ($P = 0.0006$), whereas the UV hospital group had before the hardening 69.6 ± 13.2 points and at the end of the study 43.8 ± 24.1 points ($P = 0.001$). However, there was no statistical difference between these two treatment modalities ($P = 0.838$).

Discussion

In this study we compared the effect of a newly developed home UVB device with that of broad-band UVB lamps that are sometimes being used in outpatient departments for the hardening of PLE patients.

Our results show that the benefits from both types of treatments are comparable. The majority of patients in both groups reported satisfactory to excellent treatment results with no significant difference between the groups. Also quality of life, measured by the DLQI, improved in both groups appreciably. Unfortunately we could not fulfil our power calculation of 18 patients per group.

The effect of the hardening was sustained during the 2 month follow-up in both groups. However, this prolonged hardening effect was significantly better in the group using the home UV-device. This difference could be explained by the fact that patients in the home-treated group were advised to continue using their device when the weather conditions were not favourable for natural hardening in the sun. We are aware of the fact that such comparison is not fair, however, we wanted to test whether or not the

use of the home UV-device can prolong the hardening effect when the weather conditions are not ideal for the natural UV hardening.

The evaluation of the PLESI score showed that the disease severity decreased in the large majority of the patients 2 months after the termination of the hardening. However, in this case, no significant differences between both groups were found.

The clinical provocation of PLE by UV radiation is the only measurement to objectively support the clinical diagnosis. However, the attempts to provoke PLE have had very variable success rates. In accordance with earlier reports, the recent article by Janssens *et al.* has shown that a broad-band UVA radiation caused markedly higher percentage of rash provocations than did a broad-band UVB radiation.⁹ Our percentage of positively provoked patients was not much different from the just mentioned reference, however, the low number of provoked patients prevented us from drawing firm statistically supported conclusions on the equivalence of both treatments. Nevertheless, it was interesting to see that after the hardening procedures, the likelihood of provocation reaction was clearly diminished in the large majority of patients. This confirms that the skin of the patients was indeed (partly) adapted and could better withstand the exposure to 20 J/cm² of UVA radiation.

Although no statistical difference in results was found in the above-mentioned parameters between the two treatment groups, the patients using the home UV-device were much more satisfied with the treatment procedure than the patients visiting the dermatological units.

With these results the conclusion can be drawn that patients can be effectively treated with both treatment options, but that the home-based UV-treatment is associated with greater ease and satisfaction. Since PLE is a chronically recurring disease, this is an important factor to weigh when deciding on the treatment modality. Home-based treatments are less disruptive for patients' daily routine, which is especially important if treatment is repeated yearly.

Four patients ended the study during the hardening procedure. One patient from the SunshowerMedical group, who also had the highest PLESI score (=92.5), stopped the treatment due to repeated severe PLE-eruptions. Another patient from the same group complained of headache (possibly migraine) while using the apparatus. This patient had the same symptoms in previous years when she underwent the UVB hardening in a dermatological unit. One patient from the home treatment group was excluded because of non-compliance. One patient from the hospital group was not able to finish the hardening procedure because of unrelated illness.

Patients allocated in the hospital-based treatment group were treated twice weekly with standardized fixed UV-starting dose

based on their skin type. Although this method is used routinely in our clinic, additional beneficial effect from MED-based UV-starting dose cannot be excluded.

The research dealing with the treatment of PLE patients encounters various difficulties. Owing to the seasonal character of PLE, the timing of the research is of essential importance. Moreover, the results of the investigation can be affected by weather conditions during the study. There are no absolutely valid and objective methods for the evaluation of treatment effects. Although there are some useful validated questionnaires, such as the DLQI and PLESI score, they are still largely dependent on patients' subjective judgements. The same holds true for differences in the attitude towards sun avoidance of individual patients. All these subjective factors may become a source of large variability in obtained results.

Our research was performed in the spring-summer (March–July 2010). There were many sunny days at the end of June. It could be possible that during a less sunny summer, the group treated with the home UV-device would have been better off, as the patients could have easily continued their hardening at home, whereas the outpatient group would have problems sustaining the effect of UV hardening.

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