# *Psoriasis treatment efficiency with XeCl-excilamp*

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***Abstract* – This paper represents the result of psoriasis treatment using DBD-driven XeCl-excilamp. These experiments demonstrate the positive therapeutic effect of UV exposure. According to the results the best effect is achieved for 30 cm distance from the lamp to the exposed surface and 4 min session time. Treatment with XeCl-excilamp forwards to remission of the disease. The maximum reducing of PASI value by 10 times is achieved after eight treatment sessions.**

***Keywords— Psoriasis, dermis, XeCl-excilamp, UV radiation, PASI.***

## 1 INTRODUCTION

Psoriasis is a long-lasting autoimmune disease characterized by the patches of abnormal skin. Psoriasis refers to papular-squamous dermatoses and has a chronic relapsing nature with the hyperproliferation of epidermal cells, violation of keratinization and inflammatory reaction in the dermis, cause changes in various organs and systems.

The most common method of treatment is to apply various ointments, but most of them only reduces the redness or itching and do not eliminate complete psoriatic plaques. The alternative treatment is using drugs but they have a number of side effects such as immunosuppression and negative effects on internal organs.

One of the most effective methods of psoriasis treatment is photochemotherapy based on the associative using of photosensitizer and ultraviolet radiation of the spectrum A (320-400 nm). In practice, this method is successful for 70–90% cases. It is less harmful than medicamental; however, it is not prescribed to children, elder peoples and patients with hypertension, stomach ulcers, tumors and liver diseases.

Selective phototherapy (280-320 nm) comparing to the previous techniques is harmless, albeit at a lower efficiency. But the most important is the patient does not suffer from negative feelings. One of the radiation source for the selective phototherapy is an excilamp on a mixture of xenon and chlorine, which has been studied by [1-5]. Excilamps have narrow band spectrum in comparison with luminescent lamps, widely used in phototherapy. The operation of light source is based on the principle of non-equilibrium radiation of excimer or exciplex molecules. Also, the advantages of ultraviolet radiation includes high energy photon (3.5-10 eV), high power density of radiation, a narrow band of radiation and the scalability. In addition, they have an advantage over the environmentally unsafe mercury lamps. Excilamps on different working molecules have a wide range of applications in medicine, technology decontamination of industrial waste, water, air, photochemistry and microelectronics. Some applications are described by [4-9].

The effectiveness of treatment with UV radiation can be characterized by changing Psoriasis Area Severity Index (PASI). This index determines qualitatively the severity and activity of the psoriatic process, combining the assessment of the degree of severity (redness, scaling, itching, thickening) with the assessment of the area in linear scale from 0 (no skin manifestations of the disease) to 72.

Paper [7] presented the results of the first usage of the XeCl-excilamp for the treatment of psoriasis. After 20 treatment sessions using XeCl-excilamp, the PASI values for 6 patients decreased from 17.2 to 7.5.

 

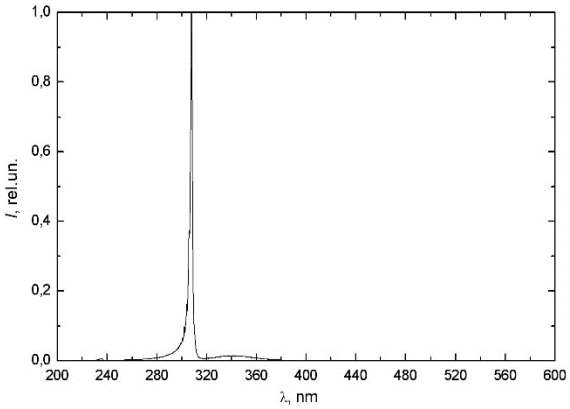


**Figure 1**. The emission spectrum of the barrier discharge XeCl-excilamp.

Presently we continue studying the effect of XeCl-excilamp on psoriasis lesion. The purpose of this research is to determine the dependence of the XeCl-excilamp psoriasis treatment efficiency on the distance between the radiation source and the psoriatic skin and treatment session duration. The barrier discharge excilamp made in the Institute of High Current Electronics SB RAS (Figure 3) was used. Excilamp radiant emittance on the output window was of 30 mW/cm$^2$.

## 2 DEPENDENCE OF THE XeCl-EXCILAMP TREATMENT EFFICIENCY ON THE DISTANCE FROM THE SKIN SURFACE

The treatment procedures were conducted with a group consists of four patients with areas of psoriasis on the different body surfaces. The first session was held with the irradiation time of 45 seconds; at each subsequent session the exposure time was increased by 20 seconds. Each of the patients received eight sessions. The distance from the excilamp to the psoriasis nidus for each patient was different.

Patient No 1 had coin-type psoriasis of 8 cm in diameter located on the lower forearm. The patient No 2 had several niduses of psoriasis mixed type: the coin-type (1-2 cm of diameter) and the drop-shaped located on the forearm near to elbow. The patient No 3 also had several niduses of the coin-type psoriasis of diameter of 2-5 cm and placed on the shoulders and shoulder-blades. The patient No 4 had several affected areas of the coin-type psoriasis of 1-3 cm in diameter with the location on the patient's leg.

To determine the effectiveness of patient treatment the following formula was used:

$$\Delta = \frac{\mathrm{PASI_I}}{\mathrm{PASI_{II}}},$$

where Δ is the ratio of the PASI values before irradiation ($\mathrm{PASI_I}$) and after 8 sessions of treatment ($\mathrm{PASI_{II}}$). The results of treatment are presented in Figures 2 and 3.

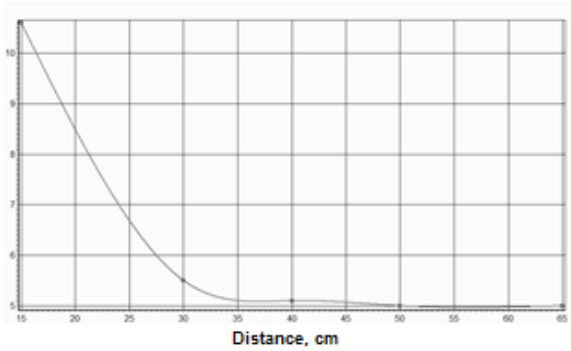


**Figure 2**. Dependence of effectiveness of patient treatment on the distance

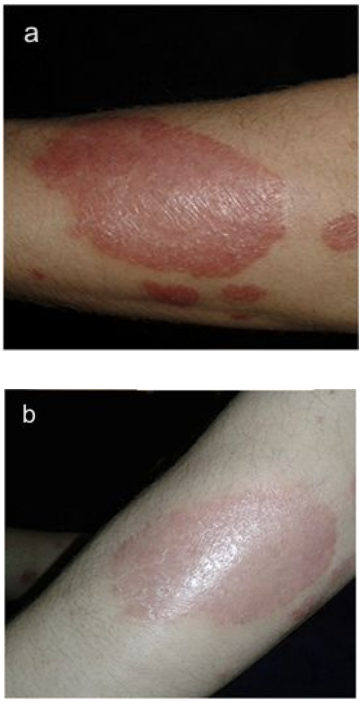


**Figure 3**. The results of treatment of the patient No 1 with the XeCl-excilamp at the 50 cm distance from the radiation source: a) before irradiation, b) after eight treatment sessions.

As it can be concluded from the obtained results, the highest efficiency of psoriasis treatment was obtained, when the excilamp is as close to the patient's skin. But the negative effect occurs at the small distance. The skin has become drier

because of the close excilamp exposure. Unfortunately, the dermatoses affected skin is not the best variant. The second effective option is the 30 cm distance. The dehydration is less than in case of 15 cm distance; however the effectiveness of treatment is rather high. The distances of 50 and 60 cm would be effective for larger areas of psoriasis. But according to the obtained data, they are less effective in comparison with the results obtained with patient No 3 where the treatment effectiveness is higher at the same exposure time. The distance of 15 cm is recommended for the small but much neglected psoriasis niduses with a small exposure time and after using moisturizing ointment.

## 3. DEPENDENCE OF THE XECL-EXCILAMP TREATMENT EFFICIENCY ON THE HOTBED OF DISEASE IMPACT TIME.

During the experiment the correlation between UV-rays effeciency of XeCl-excilamp and impact time on hotbeds diseases was established.

In the experiment three patients took part in the. The distance the source to the object was chosen according to result of previous experiment – 30 cm. To determine the effectiveness of patient treatment the following formula was used, and

$$\Delta_1 = \frac{\mathrm{PASI_I}}{PASI'_{II}} * 100\%, \quad (2)$$

where $\Delta_1$ is the ratio of the PASI values before irradiation ($\mathrm{PASI_I}$) and after 4 sessions of treatment ($\mathrm{PASI'_{II}}$).

$$\Delta_2 = \frac{\mathrm{PASI_I}}{\mathrm{PASI}_{III}} * 100\%, \quad (3)$$

where $\Delta_2$ is the ratio of the PASI values before irradiation ($\mathrm{PASI_I}$) and after 8 sessions of treatment ($\mathrm{PASI_{III}}$),. The calculation results are shown in Table 2.

The patient No 5

The psoriasis nummularis of 4 cm in diameter was located on the hip of the patient. PASI values before irradiation — 5,2. The minimum irradiation time was 45 seconds. The time was increased to 200 seconds.


**Figure 4.** The results of treatment of the patient No 5 with the XeCl-excilamp at the distance of 30 cm from the radiation source, from 45 to 200 seconds: a) before irradiation, b) after the four treatment sessions, c) after the eight treatment sessions.

We can see that the patient's improvement is already visible after the fourth session (where the session time was 125 seconds), peeling and redness became less pronounced. By eighth session we can see the reduction in the diameter of psoriatic plaques and no thickness.

The patient No 6

The several hotbeds of psoriasis nummularis of 3-6 cm in diameter were located on the on the elbow of the patient. PASI values before irradiation — 3,8. The minimum irradiation time was 45 seconds. The time was increased to 120 seconds.


**Figure 5.** The results of treatment of the patient No 6 with the XeCl-excilamp at the distance of 30 cm from the radiation source, from 45 to 120 seconds: a) before irradiation, b) after the four treatment sessions, c) after the eight treatment sessions.

On the time 80 seconds we can see the redness disappeared, but peeling was still the problem. In either, when each the session was 120 seconds the diameter plaque was still the same size, but the redness and thickness came down, the skin is smooth.

The patient No 7

The psoriasis nummularis of 4 csm millimeters in diameter was located on the on the elbow of the patient. PASI values before irradiation — 2,4.

The minimum irradiation time was 45 seconds. Constant irradiation time 45 seconds.

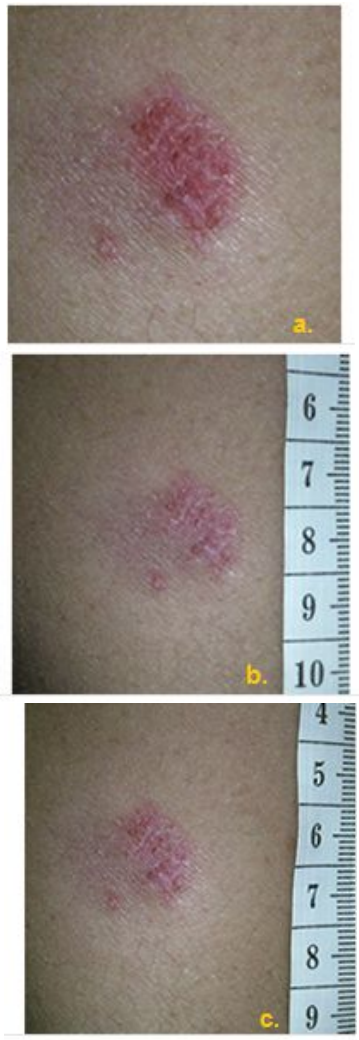


**Figure 9.** The results of treatment of the patient No 7 with the XeCl-excilamp at the distance of 30 cm from the radiation source, time 45 seconds: a) before irradiation, b) after the four treatment sessions, c) after the eight treatment sessions.

We can see on photographs, this method was the least efficient. It helped only to remove the redness and to decrease thickness, but in all the hotbed psoriasis remained unclenched.

**Table 2**. The results of studying the XeCl-excilamp.

| № | $PASI_I$ | $PASI_{II}$ | $PASI_{III}$ | $\Delta_1$ | $\Delta_2$ | $\Delta$ |
|---|---|---|---|---|---|---|
| 1 | 6 | 3,6 | 0,6 | 1,6 | 10 | 0 |
| 2 | 5,4 | 3,6 | 0,8 | 1,5 | 6,75 | |
| 3 | 1,8 | 1,2 | 1,2 | 1,5 | 1,5 | |

According the research we can state that the optimal time of impact is 4 min per one session. Irradiation is ratio of flux of radiation was incident on small side to the square of the whole side. If the flux of radiation is ratio of radiation energy to action time, the more time the flux acts, the more efficient its characteristics. So we can consider longer action time shows more efficient treatment results.

## 4 CONCLUSIONS

These experiments shows the efficiency of DBD-driven XeCl-excilamp radiation treatment of psoriasis. The optimal distance from the lamp to the exposed surface is determined to be 30 cm. At this distance the negative effects of the UV radiation exposure reduced and maintaining high treatment efficiency. The optimal harmless impact time is four minutes.

In all examined cases there was a positive therapeutic effect of UV exposure. After treatment it is observed almost complete disappearance of the bulges on the psoriatic plaques, so-called paraffin lakes (white or gray areas resembling congealed wax) and the almost complete disappearance of redness. The maximum reducing in PASI value by 10 times has been achieved after 8 treatment sessions.

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