Original paper

The effects of 755 nm alexandrite laser on skin dryness and pruritus

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Abstract

Introduction: The alexandrite laser (AL) is a very safe and effective treatment used for unwanted hair removal with a reported success rate of 40% to 80% at 6 months and after several treatment sessions. Although a diffuse variety of side effects has been observed during laser treatment, changes in skin dryness and pruritus before and after AL epilation have not been reported yet to the best of our knowledge.
Aim: To investigate the effects of 755 nm alexandrite laser on skin dryness and pruritus at the beginning and in the third and the sixth month after the treatment.
Material and methods: Forty three patients with Fitzpatrick skin types of II–IV aged 18–45 with leg hair were included in this prospective study. Patients were treated with 755 nm alexandrite laser with 10–12 mm spot size. According to the skin phototype, the settings of the laser were as follows: 12–22 J/cm² and pulse width of 3 ms. For self-assessment by the patient, the visual analogue scale (VAS) was used before, at the third and sixth month of the treatment as to skin dryness and pruritus. The patients were evaluated by the same dermatologist with the same VAS. The values were compared between before-at the third month, before-at the sixth month and at the third and at the sixth month of the treatment.
Results: Pruritus scores were statistically lower at the third month when compared with the baseline scores ($p < 0.01$). However, there was no difference between the third and sixth month of the treatment as to pruritus scores ($p > 0.05$). There was a statistically significant difference between the scores before the treatment and the scores at the third month and at the sixth month as to skin dryness ($p < 0.001$). However, the difference was not prominent between the third and sixth month scores of skin dryness ($p > 0.05$).
Conclusions: To the best of our knowledge, this is the first study researching the effects of AL on pruritus and skin dryness. Further studies with larger samples and longer follow-up periods will be able to better clarify the association.

Key words: alexandrite laser, skin dryness, pruritus, hair removal.

Introduction

Laser treatment has recently become a very popular treatment procedure for the undesirable hair in aesthetic and cosmetic practice. Several light and laser based photoepilation methods have been used as the treatment alternatives for unwanted hair removal. The red or near-infrared wavelengths which are available for photoepilation are about 600 to 1100 nm and include ruby laser (694 nm), Nd:YAG (neodymium-doped yttrium aluminium garnet) laser (1064 nm), diode laser (800–810 nm) and alexandrite laser (755 nm) [1]. In addition, intense pulse light (IPL) (590–1200 nm) systems are used for epilation although they are not true laser systems. The aim of the laser hair removal is the destruction of the follicular unit through thermal injury without damaging the surrounding skin. Laser hair removal targets melanin (absorbing chromophore) in the hair bulb and shaft. Thermal injury enlarges and results in the destruction of the progenitor stem cell [1–3]. The choice of the wavelength of the laser for hair removal varies among patients based on the skin type, ethnicity, hair colour and anatomical site [2]. The alexandrite laser (AL) is commonly used for hair reduction with a reported success rate of 40% to 80% at 6 months and after several treatment sessions

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[3, 4]. In general, laser hair removal remains a very safe and effective treatment; however transient or persistent side effects such as pain, erythema, oedema (10–17%), hypo-hyperpigmentation (14–25%), blistering, crusting (10–15%), erosions, purpura, scarring (0–5%) and folliculitis may be observed [5].

Besides, paradoxical hypertrichosis, superficial thrombophlebitis, hyperhidrosis, bromhidrosis, and leucotrichia have also been reported [6–9]. Although a diffuse variety of side effects has been observed, changes in skin dryness and pruritus before and after AL epilation have not been reported yet to the best of our knowledge.

Aim

Therefore, in this study, we aimed to investigate the effects of 755 nm AL (that is used for leg hair removal) on skin dryness and pruritus before, at the end of 3-month and 6-month follow-up.

Material and methods

Patient selection

Forty three patients with Fitzpatrick skin types of II–IV aged 18–45 with leg hair were included in this prospective study. All of participants signed the informed consent before starting any intervention. Exclusion criteria consisted of current and planned pregnancy, lactation, menopause patients with chronic systemic disease, patients receiving systemic medications, previous laser treatment for leg hair, dermatological disease located on legs, patients who have keloid history, infection at the treated area and tanned skin. Patients were treated with 755 nm AL (Light Age Inc, Epicare-LPX™, USA) with 10–12 mm spot size. According to the skin phototype, the settings of the laser were as follows: 12–22 J cm^2 and pulse width of 3 ms (repetition rate of 5 Hz). Cooling Device (Zimmer Cryo 6, Cold Air Device, USA) was used during the laser procedure. Patients were all evaluated by a dermatologist.

Treatments were given monthly. Fluency was increased if there were no side effects following the previous session. Pulse width remained constant.

For self-assessment by the patient, the visual analogue scale (VAS) was used before, at the third and sixth month of the treatment as to skin dryness and pruritus. The patients were evaluated by the same dermatologist with the same VAS. The patients were asked to quantify the presence of skin dryness and pruritus using VAS at 10 points (0 – no dryness, no pruritus and 10 – most severe dryness and pruritus). The physician also evaluated dryness only with the same VAS. The values were compared between before – at the third month, before – at the sixth month and at the third and at the sixth month of the treatment.

Statistical analysis

Statistical analysis was performed using SPSS 15.0 (SPSS, Inc, Chicago, IL, USA). Paired-samples *t* test and Wilcoxon signed-rank test were used to determine changes between baseline measures and those at the third and at the sixth month of the treatment. The association between parameters was assessed by Pearson's correlation test. The level of statistical significance was set at $p < 0.05$.

Results

Forty-three patients (women) were enrolled in our prospective analysis. The mean age was 32.34 ±87. The patients had mostly type II–III and IV of Fitzpatrick's skin phenotype.

Pruritus score was 1.88 ±2.48 before treatment and it was 0.005 ±0.30 at the third month. Pruritus scores were statistically lower at the third month when compared with the baseline scores ($p < 0.01$). However, there was no difference between the third and sixth month of the treatment as to pruritus scores ($p > 0.05$). Skin dryness was 0.67 ±1.08 before treatment and 2.35 ±2.21 at the third month and 2.33 ±2.25 at the sixth month. There was a statistically significant difference between the scores before the treatment and the scores at the third month and at the sixth month ($p < 0.001$). However, the difference was not prominent between third and sixth month scores of skin dryness ($p > 0.05$).

Also, the physician assessment revealed that skin dryness was significant at the third and sixth months of the laser treatment when compared with the baseline scores ($p = 0.001$). The maximum score of 7 was given in all of the groups. The results were summarized in Table 1.

Discussion

In this study, we investigated the effect of laser hair removal on skin dryness and pruritus to determine whether skin dryness is a newly reported adverse effect or not during laser treatment and to detect if AL can be used as a treatment model for the pruritus on legs. The assessments were done at the beginning, at the third and sixth month after the treatment. Pruritus scores at the third month were found as statistically lower than the scores at the beginning. A statistically significant difference was also detected between the skin dryness scores before the treatment and the scores at the third month and at the sixth month of the treatment ($p < 0.001$).

To the best of our knowledge, this is the first study researching the effects of AL on pruritus and skin dryness. We would like to attract attention to these rarely seen effects of a very common technique that is used in daily practice routinely and to alert our colleagues about this issue.

Table 1. The mean and median VAS scores

Variable	Pruritus, mean ± SD	Skin dryness, mean ± SD	Observer, mean ± SD
Before the treatment	1.88 ±2.48	0.67 ±1.08	0.91 ±1.17
Third month	0.05 ±0.30	2.35 ±2.21	2.63 ±2.16
Sixth month	0.03 ±0.30	2.33 ±2.25	2.67 ±2.14

Alexandrite laser was revealed as the most effective and painless photoepilation method according to the most of the results of the reported studies in the literature [5, 9]. Hyperpigmentation, hypopigmentation, erythema, crusting and oedema are transient and sometimes persistent common side effects of these laser systems [5, 6]. Other uncommon side effects include induction or aggravation of acne, rosacea-like rash, premature greying of hair, tunnelling of hair under the skin, prolonged diffuse redness and oedema of the face, and severe persistent urticaria [5–9]. In our study, skin dryness is newly diagnosed uncommon adverse effect. The mechanism leading to dryness cannot be exactly understood. However, the mechanisms proposed may be direct thermal injury of the skin or indirect stimulation by nerve fibres, laser penetration and parameters, skin type, body localization, seasonal changes, genetic factors and sun exposure. Thermal injury leading to destruction of the pilosebaceous unit and eccrine gland with secondary inflammation may be the other factor in the explanation of the skin dryness after laser treatment.

The pilosebaceous unit (PSU) and eccrine sweat gland (ESG) are classically described as completely independent skin appendages. The secretory segment of the ESG approximates the hair follicle in a position below the sebaceous gland. They are the major implications in supporting the humidity of the skin [10]. The best known diseases of the PSU and ESG are acne vulgaris, hidradenitis suppurativa, rhinophyma and syringocystadenoma papilliferum. Diode laser, pulsed dye laser and IPL were used to improve these diseases [10, 11]. However, the effect of AL on PSU and is not fully known.

The outgrowth of cells from ESGs is the major feature of repair in the skin. Reduced outgrowths of ESG, reduced cell-cell cohesiveness and reduced number of desmosomes delay wound closure, lead to a thinner epidermis and dry skin. Rittie *et al.* investigated the impaired wound closure and dryness in the elderly skin. They suggested that reduced cell cohesiveness of outgrowths from eccrine sweat glands delays wound closure and leads to the dryness of the skin compared with young adults [12]. We suppose that the effect of AL on skin dryness may be with the same mechanism as acting in the elderly skin. From this point of view, the histopathological examinations, immunohistochemical and electron microscopic studies should be done to rule out the dryness process before and after laser application on the skin.

Selective photothermolysis of melanin in hair follicles is the main principle for laser assisted hair depilation. However, the melanin in the epidermis must be protected. Dynamic cooling devices (DCD) are used for this purpose. These devices use tetrafluoroethane and have a boiling point of –26.2°C. The liquid cryogen drop sets undergo evaporation and cool epidermal temperature [13, 14]. We also used this kind of devices to protect epidermis in this study. We suggest that the fluctuations of the epidermal temperature may be the reason for the skin dryness that was reported in our study. Further studies comparing skin dryness in two groups composed of AL treatment with or without cooling systems are needed to support and clear this suggestion. Nahm *et al.* reported that cryogen usage during laser hair removal minimizes the pain and protects the skin [13]. In fact, the patients selected for epilation in this study consisted of mostly lighter skin phototypes. As we know, higher fluencies are used on lighter skin phototypes. As a result of the changes in laser settings, the thermal energy delivering to epidermis is more significant than darker ones. Our patient selection was also composed of lighter skin phototypes, therefore the studies together with darker skin phototypes should be organized for clarifying the effects of AL on skin dryness in all types of phototypes.

Alavi *et al.* evaluated the effects of AL on skin parameters such as melanin content, skin layer depth, elasticity, density and transepidermal water loss (TEWL) by biometric methods [15]. They revealed that four sessions (with 4-week intervals) of AL could decrease melanin content of the skin and make the skin thinner, however it could increase elasticity and density of epidermis and dermis by decreasing TEWL. Decreased TEWL signified the improved skin ability to retain its water and keep the skin barrier intact [16]. As the decrease in epidermis depth was especially caused by the decrease in stratum corneum, we suggest that in our study the skin dryness may be the result of the decreased layer of the epidermis, however to be able to have an assertive conclusion, we should perform a biopsy and examine the epidermis histopathologically during laser treatment. Unfortunately, we were unable to make pathological examination in our study. Besides there are also more objective and quantitative physical measurement systems such as capacitance measurement, infrared-spectroscopy, electrical resistance measurement, resonance frequency measurement, profilometry and scanning electron microscopy for determining the dryness of the skin. Further studies evaluating skin dryness with these methods will be much better to clarify the effect of laser treatment on the skin.

In addition, the skin dryness and pruritus should be evaluated and compared with other lasers that are used for hair removal. The patients in our study had no other side effects of laser treatment.

Current knowledge shows that dry skin is usually related with higher pruritus rates. However, our findings contradicted these data as skin dryness increased while pruritus was decreasing. Therefore, we can infere that something acts differently in the laser irradiated skin. These effects should be investigated to see if they are transient or persistent, therefore a long follow-up period will better illuminate these newly observed skin reactions.

The expressions of inflammatory cytokines with laser irradiation have been reported in various studies. Shiba *et al.* studied the Neodymium-daped yttrium-aluminium-garnet laser (Nd:YAG) on IL-6 levels with the activated protein kinase pathway resulting in the anti-inflammatory effect. Shiba *et al.* reported that the Neodymium-daped yttrium-aluminium-garnet laser (Nd:YAG) irradiation resulted in inhibition of the increase in IL-6 levels through the activated protein kinase pathway resulting in an anti-inflammatory effect [17].

Dang *et al.* revealed that 532-nm laser and 1064-nm laser accelerated collagen synthesis due to upregulation of transforming growth factor β (TGF-β), Hsp 70 and IL-6 levels. TGF-β was also found to be up-regulated with 800-nm diode laser in another study. As a result of these studies, we can conclude that laser irradiation influences the inflammatory responses of the affected skin [18, 19].

Fractional CO_2 and pulse dye laser were also reported as useful laser techniques used to improve intense pruritus in hypertrophic burn scars, which is an undesirable consequence of these methods [20]. The effect of AL on pruritus has not been reported in the literature until now. In our study, pruritus scores were significantly decreased compared to the baseline scores before the treatment of AL. Our findings suggest that the anti-inflammatory effects of lasers and the different distribution pattern of cytokines after laser irradiation may be the sources of the decreasing pruritus scores. In the light of these studies, AL can be a promising treatment method for the patients who are concerned about pruritus located on legs. However, additional studies are required in different sections of the body by using immunohistochemical methods concomitantly evaluating the patients with VAS to be able to measure local cytokine distribution of the affected skin and observe the changing profile of inflammatory reaction to the laser therapy. Son *et al.* suggest that dry skin is due to decreased bleomycin hydrolase expression and reduction in filaggrin degradation. Maintenance of water balance in the stratum corneum is determined by these factors and intercellular lipids in corneocytes [21]. Filaggrin degradation and intercellular lipid destruction after the application of AL may be a causative factor of skin dryness. However detailed studies are needed.

Consequently, laser treatment for hair removal offers a comfortable and pleasing service that increases quality of life. However, reported newly adverse effects have been increasing with each passing day. Therefore, clinicians should be alert and aware about these current skin reactions of this common procedure and inform the patients.

Besides, contributions to the improvement of pruritus are promising positive effects of AL on pruritus. Further investigations with larger samples and longer follow-up periods are required to be able to clear the accurate mechanisms causing these skin changes and this approach will be able to provide the effective usage of these devices.

Conflict of interest

The authors declare no conflict of interest.

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