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ORIGINAL ARTICLE

Treatment of terminal and vellus non-pigmented hairs with an optical/bipolar radiofrequency energy source—with and without pre-treatment using topical aminolevulinic acid

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Abstract

Objective. The present study compares the 6-month hair removal efficacy of a combined pulsed light bipolar radiofrequency device with and without pre-treatment using topical aminolevulinic acid.

Materials and methods. Fifteen adult females, skin phenotypes II–IV were entered into the study. Ten subjects were determined to have white terminal hairs; an additional five females presented with fine facial vellus hairs. Unwanted facial hair was treated twice at 4–6 week intervals with a combined optical bipolar radiofrequency source. At each treatment half of the treatment area was pre-treated with topical aminolevulinic acid; the other half was not. Follow-up visits were undertaken at 6 months after the second treatment. Hair counts were obtained before treatment and 6 months after the final treatment.

Results. An average terminal white hair removal of 35% was observed at 6 months after treatment with the combined pulsed light bipolar radiofrequency device. When pre-treatment with topical aminolevulinic acid was provided the average hair removal of terminal white hairs was found to be 48%. None of the five subjects with vellus hair were noted to respond to either treatment.

Conclusions. Combined radiofrequency and optical light treatment leads to effective hair removal of terminal white hairs. This improvement is increased with pre-treatment use of topical aminolevulinic acid. Vellus nonpigmented hairs did not respond to treatment

Key words: *Hair removal, non-pigmented hair removal, photodynamic therapy, PDT*

Introduction

Effective laser hair removal of pigmented hairs can be accomplished with a variety of melanin absorbing wavelengths. Such effective systems include 694–1064-nm laser systems and a variety of light based technologies (1–11). An alternative approach, albeit experimental in nature has been to pre-treat unwanted hair with a light-absorbing photosensitizer and/or photo-absorbing agent. Topically applied aminolevulinic acid has been shown to promote photoepilation (12).

The purpose of this study was to determine: 1) if adding bipolar radiofrequency to the delivered optical energy may improve the success of hair removal in nonpigmented hairs; and 2) if pre-treatment with topical aminolevulinic acid potentates the effect of optical/radiofrequency treatment of unwanted nonpigmented hairs.

Materials and methods

Fifteen female subjects with non-pigmented facial hair were entered into the study. Subjects were between 45 and 65 years of age, Fitzpatrick skin types II–IV. Ten subjects were clinically determined to have white terminal hairs; the remaining five were noted to have fine, nonpigmented vellus hairs. All subjects had bilateral facial hair that could be counted before and after treatments. Study exclusions included oral retinoid use within 1 year of study treatments, recent ultraviolet exposure, intake of photosensitizing drugs and a history of laser, light or electrolysis as a depilatory method to the treatment area for 1 year prior to treatment. A signed informed consent, approved by the Institutional Review Committee of Pascack Valley Hospital, Westwood, NJ, was obtained from all subjects prior to

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treatment. Topical anesthetic cream (L-M-X™ 4, Ferndale Laboratories, Ferndale, MI) was provided to each patient prior to treatment. All study subjects received two treatment sessions at 4–6 week intervals. Hair counts from standardized digital photos were obtained before and 6 months after the final treatment. A thin layer of transparent gel was applied prior to treatment. Light pressure with a contact cooling handpiece tip (4°C) was provided during all treatments. The utilized optical bipolar radiofrequency device (Aurora, Syneron, Israel) delivered wavelengths between 680–950 nm, producing optical energies as high as 35 J/cm^2 with pulse durations up to 120 ms. The associated bipolar radiofrequency device can generate radiofrequency (RF) energy as high as 20 J/cm^3 with a pulse duration as long as 120 ms designed to deliver RF electrical current at a depth of 4 mm. The level of RF energy was set at a constant 20 J/cm^3 for all study subjects. Chosen optical fluences varied between 24–30 J/cm^2 and were delivered in a short pulse profile mode. The chosen range of fluences was based on previously published data evaluating the use of a combined optical bipolar radiofrequency device for the removal of unwanted hair (13). Pulses were delivered in an attempt to minimize overlap. One to three passes were undertaken with a desired endpoint of erythema. Half of the face was treated in this manner. The remaining half of the face was pre-treated with a 20% solution of 5-ALA (Levulan, Dusa Pharmaceuticals, Toronto, Canada) 1 hour prior to treatment with the optical bipolar radiofrequency device. Chosen parameters were otherwise the same in both the ALA pre-treated side and the side not pre-treated with topical ALA.

A baseline hair count was determined by two -non-treating physicians who magnified a pre--determined 3-cm^2 region. Reference landmarks, as have been previously described, included the mid-philtrum of the lip, mid-mandibular notch of the chin and vermillion border of the mid-lower lip. Percentage hair reduction was defined as the average number of terminal or vellus hairs present at each defined time interval compared with the average number of similar hairs noted at baseline. Similar counts were taken 6 months after the final treatment. Subjective patient evaluations and adverse effects were also recorded at each follow-up visit. A patient satisfaction scale was instituted at the last follow-up visit. The following scale was utilized: grade I=no improvement in perceived hair loss and decreased hair thickness; grade II=mild improvement in perceived hair loss and decreased hair thickness; grade III=good improvement in perceived hair loss and decreased hair thickness; grade IV=excellent improvement in perceived hair loss and decreased hair thickness.

Results

After the first treatment no subjects were noted to have any improvement irrespective of whether topical ALA was applied. However, 6 months after a second treatment, improvement was noted in all ten subjects with terminal hairs. Hair loss of 35% was observed at 6 months month after treatment with the combined pulsed light bipolar radiofrequency device. When pre-treatment with topical aminolevulinic acid was provided, the average hair removal of terminal white hairs was found to be 48% (Figures 1 and 2). Equally as important was the observation that subjects treated with the combined pulsed light bipolar radiofrequency alone described their improvement as grade II–III (mild to good improvement in perceived hair loss and decreased hair thickness). In contrast they described the side pre-treated with topical ALA 1 hour before treatment with the combined pulsed light bipolar radiofrequency treated as being grade III–IV (good to excellent improvement in perceived hair loss and decreased hair thickness). Of note, not a single subject with clinically described nonpigmented vellus hairs responded to treatment with the

Figure 1. Before treatment of terminal white hairs. Right side of subjects chin pre-treated with ALA; left side of chin was not pre-treated with ALA.

Figure 2. Six months after treatment of terminal white hairs. Right side of subjects chin pre-treated with ALA; left side of chin was not pre-treated with ALA. Both sides are improved, but greater hair loss noted on ALA pre-treated side.

combined optical radiofrequency device irrespective of whether pre-treatment with topical ALA was provided (Figures 3 and 4).

No long-term pigmentary changes were noted; 20% of subjects reported mild erythema lasting less than 24 hours on the facial side solely treated with the combined optical radiofrequency device and 60% of subjects noted mild erythema lasting 48–72 hours on the facial side pre-treated with topical ALA. No blistering or scarring was noted in the study in any treated subjects.

Discussion

Hair color is genetically determined by the presence of either eumelanin (brown or black in color) or pheomelanin (red in color). These melanins absorb light throughout the visible to near-infrared range of light (14,15). Thus, it is not surprising that nonpigmented hairs have shown great resistance to laser and light source hair removal. Sadick recently reported success in using a combined RF and optical energy device for the purpose of removing white and blond hair (13). The similarities and differences between our data and that of Sadick are worth noting. Our results using the combined optical RF device without pre-treatment with ALA were not as good as those reported by Sadick. However, in the Sadick study, subjects were treated four times in contrast to our subjects only being treated twice. It is now well established that increasing numbers of treatments lead to better clinical results. Had we treated our subjects more times, we could reasonably have expected similar data to that reported by Sadick.

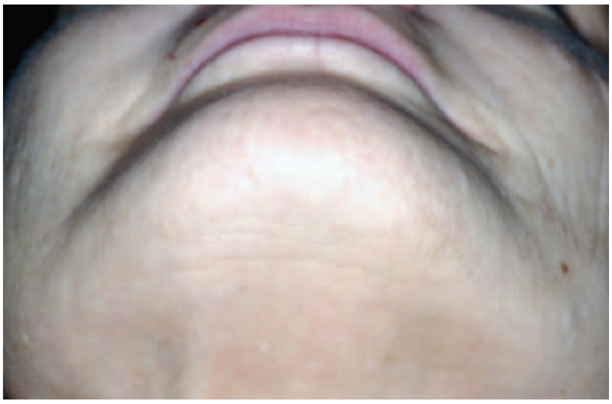

Figure 3. Before treatment of vellus hairs. Right side of subjects chin pre-treated with ALA; left side of chin was not pre-treated with ALA.

Figure 4. Six months after treatment of vellus hairs. Right side of subjects chin pre-treated with ALA; left side of chin was not pre-treated with ALA. No improvement noted on either side of chin.

Sadick attempted to provide an explanation for the observed clinical improvement after treatment of nonpigmented hairs with the combined optical RF device. He noted that in general, laser and light sources heat the hair follicle from the inside with subsequent spread of that heat to outer portions of the follicle (13). In contrast, he noted that RF energy heats the hair follicle from the outside in and requires no melanin chromophore. Thus he suggests that there is nonspecific heating of the nonpigmented portion of the follicle which then acts as a macroscopic light absorbing structure. The preheating, in theory, reduces the impedance and facilitates the concentration of RF current within the outer layers of the follicle. This progression of outward to inward heat transfer, he suggests, is likely responsible for the injury ensuing to the germinative area of the hair follicle which results in the subsequent loss of hair. Although this is undoubtedly true from a mechanistic view, our data on vellus hair suggest that melanin within the hair follicle still plays an all-important role. It is known that white hairs often do contain some melanin within the follicular structure, albeit not within the actual follicle itself. It may still be that this melanin is absorbing the optical energy delivered by the combined optical RF device. It may also be that, because of the RF, the efficacy of this optical energy delivery is improved. This would explain two noted findings. First, vellus nonpigmented hairs generally contain no pigment either within the hair or the actual follicle. Therefore, these hairs in our study did not respond to treatment even when pre-treatment topical ALA was provided. Second, it is unlikely that the RF energy in itself plays any major role in removing hair; as such hair removal has never been noted with any other monopolar or bipolar RF devices. It is, in our view, the symbiotic effect of optical energy and bipolar RF that leads to improvement in what appears to be clinically white hairs (yet still contain some melanin within their follicles). Of note is the even better clinical efficacy seen both in terms of hair loss and subject perception of a decrease in hair thickness when subjects were pre-treated with topical ALA.

Clinically nonpigmented hairs remain difficult to treat. It should not be expected that such hairs will respond as well as pigmented hairs—simply because their melanin content is clearly less. Another technique used to treat nonpigmented hair involves the application of melanin encapsulated liposomes. Here, an exogenous chromophore is applied to nonpigmented hairs. However, our clinical impressions and the results of others (T. Alster MD, personal communication) do not show that this method uniformly leads to long-term hair removal. The results of our study would appear to confirm the data observed by Sadick. Nonpigmented hairs can successfully be removed with a combined optical bipolar radiofrequency source. The results are further improved with the pre-application of topical ALA. However, our findings also suggest, that although responding hairs may lack melanin, the follicle itself must still contain some residual melanin for optimal results. Nonpigmented fine vellus hairs did not respond to treatment.

Finally, although we did not quantify the subjective perception of a decrease in post-treatment hair thickness, patients often base their happiness with treatment not only on a decrease in objective quantifiable hair counts, but also on their perception of a decrease in hair thickness. Our treated subjects noted an even greater decrease in hair thickness when their unwanted hairs were treated with topical aminolevulinic acid prior to treatment with optical bipolar radiofrequency energy.

Conclusions

Our pilot study confirms that a combined optical bipolar radiofrequency device can be used for effective removal of terminal non-pigmented hair. Of even greater interest is the notion that hair removal efficacy can be improved with topical ALA, an exogenous chromophore that targets the pilosebaceous apparatus. Further larger studies are required to confirm our findings. In the future investigations are required to compare the hair removal efficacy of a variety of lasers or lights sources when topical ALA is used before treatment.

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