

A Novel Approach to Make an Objective Evaluation of Photo Skin Rejuvenation with Intense Pulsed Light

Pyra Haglund, MD, PhD, Stureplanskliniken, Lastmakargatan 18, S-111 44 Stockholm, Sweden

Summary

Several studies have shown the effects of different lasers and intense pulsed light sources in photo skin rejuvenation. However, the evaluation of the effects has usually been subjective such as patient self-assessment or assessment from photos before and after, where discreet changes in elasticity due to new collagen formation is difficult to evaluate. For the purpose of getting an objective evaluation of the effect of IPL on skin rejuvenation, this study was undertaken where one half of the face was randomly chosen for treatment and the other half served as control. With a protocol of three treatments and evaluation one week after the last treatment, a skin rejuvenating effect of IPL with a lifting effect due to increased elasticity as well as diminishing of telangiectasias and pigment spots was clearly demonstrated.

Background

Various lasers have been used over the last years to achieve improvement of photoaging skin (1). In the last years, non-abrasive treatment with intense pulsed light sources have also been used to achieve photo skin rejuvenation. Light from an intense pulsed light source will be absorbed by target chromophores such as melanin and oxyhemoglobin and when light energy is transformed to heat a destruction of pigmented lesions and vascular lesions will take place. Serial treatments have been proposed to diminish pigment spots and superficial vessels (2). Several studies have reported effect on rhytides, fine wrinkles and general improvement of the appearance of the skin using subjective evaluation (3-6). The deep thermal effect of lasers and the light absorption of dermal vessels from intense pulsed light sources affects the epithelial cells of the dermal vessel walls. The epithelial cells release cytokines which in turn activate fibroblasts in dermis to produce new collagen. These histologic changes after IPL treatment have been studied using skin biopsies and microscopic examination as well as measurement of dermal proteins (7-9). An increased number of fibroblasts as well as an increased levels of collagen has been demonstrated in the dermis after IPL treatment. IPL is the first non-laser light source to display histological and clinical evidence of new collagen formation.

Multiple studies have shown photo skin rejuvenation to be effective using subjective assessment of results. Recently, one study has also shown long-term effects as judged by photos and patient self-assessment (10). Subjective assessment whether patient self assessment or photos before and after can be well suited for evaluation of clear-cut telangiectasias and pigment spots but they are not optimal for evaluation of the more subtle changes seen as a result of induced collagen synthesis i.e. increased elasticity with smoothing of pores, reduction of fine wrinkles, reduced oiliness and lifting effect. For the purpose of getting an objective evaluation of the effect of IPL on skin rejuvenation, this study was undertaken where one half of the face was randomly chosen for treatment and the other half served as control. A similar study protocol has been used to investigate the rejuvenating effect of vitamin C on photo damaged skin (11.)

All treatments were performed at Stureplanskliniken by dr Pyra Haglund, who has a vast experience of IPL treatment over the last seven years using several different IPL sources for skin rejuvenation, hair removal, hyperpigmentation, various vascular lesions such as spider veins, reticular veins, telangiectasias, rosacea, various hemangiomas and port wine stain.

Materials and Methods

For the study, female patients of skin types II and III were selected. They were all selected because they had some degree of sun damaged skin: loss of elasticity plus solar hyperpigmentation and/or telangiectasias of the face. The sun damage was of the same degree on both halves of the face. After consulting an expert on medical statistics, a number of seven patients was chosen.

Exclusion criteria were pregnancy, breast-feeding, photo sensitive medication, Roacutane treatment for the last year prior to the study, immuno deficiency, liver disease and pronounced tan. Patients with a history of basal cell carcinoma, squamous cell carcinoma, malignant melanoma or dysplastic nevus syndrome were also excluded.

The intense pulsed light source that was used was a Powerlite 600 EP from Preswede AB with a small yellow treatment head. It emits wavelengths of 540-950 nm in a pulse design of 2 ms pulse, 2ms delay and so on and where settings of 40-80 ms were used, i.e. 10-20 pulses in each treatment corresponding to energy levels of 15-25 J/cm².

Immediately before the first treatment, digital photos of patients in frontal and side position were taken. Whether treatment was to be on the right or left side of the face was decided by throwing a dice.

A cooling gel 1-2 mm thick was applied and one treatment passage was performed on the chosen half of the face. Treatment was slightly painful. After treatment, an aloe vera gel was applied for soothing.

Treatment of the chosen half of the face was repeated after one and two weeks and after three weeks digital photos were taken in the same positions as before treatment. Patients were then offered immediate treatment of the other side free of cost.

Evaluation of the treatment results was done from the photos in the computer by two physicians who had not been involved in the treatment and who did not know which side was treated. Evaluation was also done by the patients themselves and they were given the opportunity to study the photos before evaluating.

Results were graded in "worse", "unchanged", "slight improvement" and "great improvement".

Three aspects of skin rejuvenation were evaluated:

Effect on telangiectatic vessels

Effect on hyperpigmentation

Effect on elasticity (seen as tighter skin, less wrinkles and folds, smaller pores, a generally up-lifting effect with a higher brow, eye lid, cheek, oral commissure)

Results

A very slight erythema was sometimes present the first day after treatment. There was practically no residual heat even immediately after treatment. When hyperpigmentation was present, it became one shade darker immediately after treatment and then peeled off and disappeared or diminished within 10 days. Some patients found the treatment a little painful but anesthesia was not needed. No other side effects were seen.

Elasticity: Of the seven patients treated, five found a slight of great improvement of elasticity on the treated side. In the single-blind evaluation, one doctor felt it was impossible to make a correct judgement of elasticity from photos whereas the other doctor found improvement of elasticity in the treated side in four cases and in the untreated side in two cases.

Hyperpigmentation: Pigment spots were present in five patients and four of these found improvement. One doctor could not evaluate from photos and the other found improvement in four cases.

Blood vessels: Telangiectasias were present in one case and general erythema without visible vessels in one case. Improvement of telangiectasias was seen by the patients and by the two doctors. There was no effect on facial erythema.

Table 1. The result was graded as follows: worse/unchanged/slight improvement/great improvement (- / 0 / + / ++).

Patient	Self		Dr 1		Dr 2	
ELASTICITY	Treated	Untreated	Treated	Untreated	Treated	Untreated
1=AD	++	0	0	+	0	0
2=AS	0	0	+	0	0	0
3=IB	++	0	0	+	0	0
4=MB	0	0	+	0	0	0
5=MW	+	0	+	0	0	0
6=SG	+	0	0	0	0	0
7=YL	+	0	+	0	0	0
Patient	Self		Dr 1		Dr 2	
PIGMENT	Treated	Untreated	Treated	Untreated	Treated	Untreated
1=AD	0	0	0	0	0	0
2= AS	+	0	+	0	0	0
3= IB	0	0	0	+	0	0
4= MB	0	0	+	0	0	0
5= MW	+	0	+	0	0	0
6= SG	+	0	0	0	0	0
7= YL	+	0	+	0	0	0
Patient	Self		Dr 1		Dr 2	
VESSELS	Treated	Untreated	Treated	Untreated	Treated	Untreated
1=AD	0	0	0	+	0	0
2= AS	0	+	0	0	0	0
3= IB	0	0	0	0	0	0
4= MB	+	0	+	0	++	0
5= MW	0	0	+	0	0	0
6= SG	+	0	0	0	0	0
7= YL	+	0	+	0	++	0

Picture 1. before treatment to the left, after treatment to the right.

Patient 1=AD Patient's right side treated.

Patient 2=AS Patient's left side treated.

Patient 3=IB Patient's right side treated.

Patient 4=MB Patient's left side treated.

Patient 5=MW Patient's left side treated.

Patient 6=SG Patient's right side treated.

Patient 7=YL Patient's right side treated.

Discussion

Laser skin resurfacing is an established method for skin rejuvenation today where the epidermis is ablated and the thermal damage of the dermis initiates a remodeling with induced collagen formation. This type of treatment can lead to long-term adverse effects such as erythema, pigmentary changes and scarring. In addition, patient down-time during recovery is significant. Therefore, the intense pulsed light treatment where the light penetrates into the dermis to produce an inflammatory response and subsequent collagen remodeling while the epidermis is protected against thermal damage is an interesting alternative in skin rejuvenation. However, the clinical results are modest compared to traditional resurfacing lasers and difficult to measure with subjective assessment. This study was undertaken to make a single-blind evaluation with half-sided treatment of the face. Normally, a treatment series with four to six treatments three to four weeks apart is suggested for IPL skin rejuvenation and results are evaluated after six months and as late as five years post-treatment. Considering the stress of being treated in only half of the face, a compressed treatment scheme was designed with three weekly treatments and evaluation three weeks after treatment started. Even at this very short time interval an effect on elasticity, pigment and vessels was demonstrated. It is probable that the collagen effect will be even more pronounced over time since the inflammatory response evoked in the dermis activates the inherent repair system of the skin. It is noteworthy that the lifting effect was seen more easily by the patients themselves (five of seven reported an improvement) than by the observers who only had photos to evaluate. Patients were informed before treatment that elasticity was one of the parameters to be judged but they had no further information before evaluation as to which signs of elasticity to look for. When the patients came for evaluation one week after the last treatment, three told of comments from people in their surrounding (a son, a hairdresser and a friend) who all spontaneously commented on the lifting effect on the treated side. It is interesting to compare this live judgement with the comment from one of the doctors who did not find it possible to make a safe evaluation of elasticity nor pigment spots from photos and therefore only evaluated blood vessels. In a future study, it would be valuable to have the single-blind evaluation done live as well as from photos.

Solar hyperpigmentation was effectively treated in this study with an immediate color change to one shade darker, the appearance of very small black spots of condensed pigment on the skin surface from day two and subsequent clearing in seven to ten days with marked removal of pigmented lesions. These subtle changes are unfortunately seen more easily live than in photos and also more obvious to the patients themselves as they see their skin daily and not only for post-treatment evaluation. These findings are also in line with the author's experience that solar hyperchromia is very easily and effectively treated with IPL with good results after only one or two treatments.

As for cutaneous blood vessels, it is always easier to obtain good treatment results with clearly visible telangiectasias of greater diameter than with very thin vessels producing general erythema, since there is a higher concentration of the target chromophore (oxyhemoglobin). This was also the case in this study where two patients with visible telangiectasias showed improvement as judged by both the patients themselves and by the two observers whereas the one patient with general erythema showed no improvement.

Clinically, the treatment results with this machine are very similar to the results obtained with other IPL machines used by the author over the years. Technically, it can be noted that the number of pulses is even higher with the Powerlite but the total energy level is similar or a little lower than the settings usually used with e.g. Lumenis machines. This seems to have a clinical significance since the amount of residual heat and erythema after treatment was less pronounced after skin rejuvenation treatment with the Powerlite than after successful

treatment with other machines. A pulse design with more pulses, increasing the accumulated heat in the target chromophore in the dermis even more while allowing for epidermal thermal relaxation may be the answer to more effective treatments with lower total energy fluencies and thus less side effects.

In summary, this single-blind study with IPL skin rejuvenation shows improvement of elasticity seen as a lifting effect of one half of the face already three weeks after treatment as well as a clearing effect on hyperpigmentation and telangiectasias. The Powerlite 600 provides an efficient treatment of photo-damaged skin with minimal side effects as shown by half-sided treatment. Further studies should be undertaken with half-sided treatment for a longer period of time, up to six months and with live evaluation of the subtle effects on elasticity and hyperpigmentation to get an even more consistent evaluation of the remodeling activities taking place in the dermis following selective photothermolysis with intense pulsed light..

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