Short- and Long-term Side Effects of Non-ablative Fractional Laser Resurfacing in Koreans: Analysis of 286 Consecutive Treatments

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Background and Objectives

The objective of this study is to determine the safety of a non-ablative fractional laser resurfacing of the face.

Materials and Methods

This is a retrospective analysis of Korean patients treated with a non-ablative 1,550 nm fractional laser system for facial skin problems. Prevalence, types, and nature of side effects were identified and assessed. The safety data were analyzed according to the variables, including patient demographics, laser parameters, and adjuvant medication.

Results

A total of 286 consecutive treatment sessions in 119 patients (mean age 32.4) were included in the analysis; 159 treatments were applied for acne scars, 81 for prominent pores/wrinkles, and 46 for other facial scars. Erythema, edema, and dryness were significantly more evident and persisted longer in patients treated with higher densities. A total of 71 (24.8%) side effects were recorded. The most frequent complication was acne flaring. Other side effects included postinflammatory hyperpigmentation, herpes viral reactivation, aggravation of rosacea and melasma, and atrophic scarring. Two patients developed melasma after treatment. Side effects occurred more frequently in males than in females. Acne-prone patients were more likely to experience flaring of perioral acne, most commonly observed in the high energy treatment group. Postinflammatory hyperpigmentation and melasma were not observed in patients treated with lower densities.

Conclusion

Non-ablative resurfacing with a 1,550 nm fractional laser was associated with a relatively low rate of adverse effects. However, acne flaring was more common than previously reported. Both the energy and the density was the determinant of side effects. Increased density was more likely to produce pigmentary alterations in Korean patients.

Key words

Acne; Adverse effects; Asian; Fractional laser; Postinflammatory hyperpigmentation

INTRODUCTION

There was a rapid growth in both practice and research with more clinicians utilizing the technology for various dermatologic indications. Marketing tends to precede the availability of good information about their efficacy and safety. Side effect analysis is important for setting up the adequate parameters. By using adequate parameters, the risk of side effects (especially pigmentary alterations in dark-skinned patients) can be significantly reduced.

Researchers have been reporting the safety profile of the "representative" fractional resurfacing systems either on Caucasian¹⁻³ or Asian^{4,5} skin (Table 1), but there have been only a few such investigations on the newly developed devices. The aim of the study was to analyze the side effect profile of a commercial non-ablative 1,550 nm fractional laser in the treatment of facial scars and skin aging in Korean subjects.

MATERIALS AND METHODS

This study is based on the retrospective chart review of 286 consecutive treatment performed on the face of 119 Korean patients from November 2006 to October 2008.

Treatment

Skin preparation was carefully performed with

gentle cleanser to remove debris and makeup before treatment. A cream containing mixture of lidocaine 2.5% and prilocaine 2.5% was applied under occlusion for 60 minutes on the treatment sites. Water-based lubricating/cooling gel was applied to the laser handpiece to allow it to move smoothly over the treatment area. The laser system used in this study is a commercial non-ablative 1,550 nm erbium-doped fractional laser (MOSAIC HP™, Lutronic Corporation, Goyang, Korea). Fluence ranges from 4 to 120 mJ/cm² and coverage rate is 50-500 spots/cm². Fluences ranging from 6 to 25 J/cm² (mean 14 J/cm²) at a beam density of 150-2100/cm² were applied on the treatment areas. Ice pack cooling was applied to all patients immediately after laser treatment. All patients were followed-up 1 and 4 week(s) after each treatment session for the clinical progress and side effects check-up. Most patients were additionally followed at least 2 months after the final laser treatment.

Analysis

Medical records were reviewed to collect specific data, including patient age, sex, skin phototype, history of facial herpes simplex virus (HSV) infection, prophylaxis with antivirals, pre-existing facial acne, and the concomitant use of anti-acne medication. Patients were grouped as "high energy, high density group", "high energy, low density group", "low energy, high density group", and "low

Table 1. Summary of the published study on the adverse effects of non-ablative fractional laser resurfacing

Fisher and Geronemus ¹ (2005)
60 treatments, Caucasian skin
All patients had transient erythema (100%).
Transient facial edema (82%), dry skin (86.6%), flaking (60%), superficial scratches (46.6%), pruritus (37%), bronzing (26.6%)
Short-term increased sensitivity (10%), acneiform eruption (10%)
Wanner et al. ² (2007)
125 treatments, Caucasian skin
Erythema (100%), edema (68%), bronzing (38%), desquamation (34%), acneiform eruption (4%)
All side effects were transient.
Graber et al. ³ (2008)
961 treatments, Caucasian skin
Overall incidence of side effects was 7.6%.
Acneiform eruptions (1.87%), HSV outbreaks (1.77%)
PIH was more frequent in patients with dark skin.
Kono et al. ⁴ (2007)
60 treatments, Asians skin
Transient erythema and swelling (100%)
PIH (5%); no hypopigmentation, no scars
Increased density was more likely to produce swelling, redness, and PIH when compared to increased energy.
Chan et al. ⁵ (2007)
119 treatments, Asian skin
Clinically evident PIH incidence was 11.1%.
Higher density was the major risk factor for PIH.

energy, low density group". The number of treatment sessions delivered and laser parameters used were tabulated. Complications were identified by evaluation of clinic notes and included HSV outbreaks, acneiform eruptions, erosions, postinflammatory hyperpigmentation (PIH), prolonged erythema, dryness, dermatitis, etc. The postoperative day on which complications arose was recorded as well as the duration of the complications.

RESULTS

Demographic Data

A total of 286 patients (212 females and 74 males) were included in the study. Patients' age ranged from 15 to 64 years (mean 32.4) and most of the subjects represented skin phototype III or IV. Acne scarring (55.6%) was the most common condition to be treated, followed by wide pores and fine wrinkles (28.3%), and other types of facial scarring (16.1%).

Side Effects

Transient erythema and dryness were observed in most patients but tended to resolve spontaneously in a week. Erythema and dryness were significantly more evident and persisted longer in patients treated with higher density settings (Fig. 1).

Other than transient erythema and dryness, 71 (24.8%) side effects were recorded (Fig. 2). Side effects occurred more frequently in males (20/74, 27.0%) than in females (35/212, 16.5%). The most frequent complication was acne flaring and comedone formation ($n = 41$, 14.3%). Other adverse effects included erythema longer than 4 days ($n = 11$), PIH ($n = 8$), HSV reactivation ($n = 4$), aggravation of rosacea ($n = 3$), deterioration of melasma ($n = 2$), and

atrophic scarring ($n = 2$).

Patients with recent history of acne were more likely to experience post-laser acne aggravation, mostly on the perioral area. Acne flare was most commonly observed in the high energy setting group (24/133, 18.0%; Fig. 2B), whereas persistent erythema and PIH was more commonly found in the high density group (Fig. 2C, 2D).

Pre- or post-treatment oral antibiotics and/or steroids were not associated with lower prevalence of overall side effects (23.1% with medication vs. 22.5% without). No outbreak of HSV infection was noticed in patients to whom oral famciclovir was given before treatment.

DISCUSSION

There is wide variation in color and texture of the skin in individuals from Asian countries. Generally, skin pigmentation is darker in Asians originating from southern latitudes probably because of an adaptation to the climatic environment. In contrast, study results show that approximately 75% of individuals who originate from the northern and central latitudes of eastern Asia (Northern Chinese, Koreans, and Japanese) have relatively light-colored skin pigmentation.⁶

An increased risk of hyperpigmentation is probably the best -known characteristic of Asian skin. There are several other characteristic of Asian skin upon laser treatment. The dermis tends to be thicker and more fibrous in Asian skin. Increases in dermal thickness may account for a substantially lower incidence of fine wrinkles in East Asians than in comparably pigmented Caucasians, so their main concern is usually "wide pores" rather than fine wrinkles.⁷ Under such circumstances, fractional laser resurfacing, either non-ablative or

Fig. 1. Transient side effects after 1,550 nm non-ablative fractional laser resurfacing.

Fig. 2. Side effects other than transient erythema and dryness after 1,550 nm non-ablative fractional laser resurfacing.

ablative, is mainly used for the treatment of atrophic acne scarring in Asian patients,⁸ rather than fine wrinkles and photoaging.

The non-ablative 1,550 nm erbium-doped fractional photothermolysis system has been proven to be effective and generally well tolerated because it leaves an intact epidermal architecture surrounding each coagulated microthermal treatment zone, resulting in minimal recovery time. Numerous reports have demonstrated its efficacy in the treatment of a wide variety of dermatologic conditions including acne scars, but many laser surgeons have noted that multiple treatment sessions should be delivered to achieve a pronounced clinical improvement.⁸ Considering its relatively minute degree of clinical improvement and the need for multiple treatment sessions, the safety profile of non-ablative fractional laser resurfacing is clinically very important. Cho et al.⁸ have

shown that the mean duration of post-therapy crusting or scaling was 6.3 ± 3.0 days and erythema lasted 2.8 ± 4.6 days after ablative carbon dioxide fractional laser resurfacing on acne scars of Korean patients. The mean duration of post-laser erythema was 3.5 ± 1.5 days but no crusting occurred in our study using a non-ablative fractional laser system on similar indications, confirming that non-ablative fractional laser resurfacing is superior to its ablative counterpart in terms of downtime. It is noteworthy that transient post-laser erythema was more prominent and dryness lasted longer in patients treated under higher density settings in our study. The greater collagen density of Asian skin is manifested in a tendency toward a more vigorous fibroplastic response during wound healing, which may result in prolonged hyperemia after laser resurfacing. When the treatment density is too high, fractional laser irradiation will cause more bulk

heating rather than a true fractionated heating and this will lead to the prominent/prolonged erythema after laser treatment.

It is interesting that in our study, acne flare was the most common adverse events after non-ablative fractional laser treatment. Transient acneiform eruptions are quite common after traditional non-fractionated laser resurfacing, with up to 80% of cases developing acne flare, whereas the rates of acneiform eruptions are reported to be significantly lower (2-10%) with fractional skin resurfacing.⁹ Disruption of follicular units during laser treatment and subsequent aberrant follicular epithelialization during healing has been suggested to further induce acne exacerbation.⁹ It is unclear why the acne outbreak rate in our study is significantly higher than the previous reports. The relatively younger age and larger number of acne scarring patients in our study population may contribute to the higher rate of post-laser acne flaring. The finding that post-laser acne was more frequently observed in the high energy setting group in our study implies that higher beam energy is related with the deeper destruction of the follicular unit and triggers follicular inflammation in acne-prone patients.

Prolonged erythema has been defined as post-treatment erythema that persists longer than 4 days with non-ablative resurfacing and beyond 1 month with ablative treatment.⁹ Even non-ablative and fractionated laser resurfacing treatments can also increase the risk of prolonged erythema if multiple laser passes or inadvertent stacking is applied.¹⁰ Worsening of rosacea may share a similar pathophysiology with prolonged erythema after fractional laser resurfacing.

Persistent erythema and PIH were more frequently found in the high density group. Our finding confirms the conclusion of Chan et al.,⁵ suggesting that although both the density and energy of the treatment can increase the risk of PIH in Asian patients, density may be of particular importance. To minimize the risk of post-fractional laser hyperpigmentation, we recommend the use of low density treatment setting with moderate to high beam energies. If the patient has a subtle melasma, the lesion should not be treated aggressively using fractional lasers, because too much heat may cause activation of melasma in Asians.

The results of our study show that non-ablative

resurfacing with a conventional 1,550 nm fractional laser can be used with a relatively low complication rate. Both the energy and density may be the determinant of the side effects. Increased treatment density seems likely to produce prolonged erythema and PIH in Asian patients. The risk of post-laser acne flare should be taken into consideration when acne scar patients are treated with high energy fractional laser settings.

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