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Original Article

Pore and Acne Scar Treatment with a Q-switched Laser Using a Novel Fractional MDF (Multi-depth Focusing) Handpiece: A Pilot Study

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Background and Objectives

Although skin rejuvenation is not within the usual repertoire of the Q-switched 1064 nm Nd:YAG (Q-NDY) laser, the development of a multi-depth focusing (MDF) handpiece allowing user-selectable depths of focus has changed this. The current in-house pilot study was designed to assess the safety and efficacy of a Q-NDY laser fitted with an MDF handpiece in the treatment of enlarged pores and acne scars.

Materials and Methods

Ten patients with enlarged pores and acne scars were recruited into the study as volunteers. Clinical photographs were taken at baseline and then at six weeks (A1) and three months (A2) after the final treatment, based on which a quintile scale physician global assessment (PGA) was obtained at A2 scored by two independent blinded dermatologists. Patients subjectively scored their satisfaction with the treatment in a questionnaire at A2, also on a quintile scale.

Results

In general, patients showed a statistically significant improvement in both the pores and acne scars at both A1 and A2, with a trend towards continued improvement between the first and second assessments, more particularly for the acne scars. The average percentage improvements for the pores at A1 and A2 were 48.45 ± 16.1% and 57.8 ± 15.2% (p = 0.001 for both), respectively, for acne scars, the respective values were 27.8 ± 15.0% and 34.2 ± 24.3% (p = 0.0008 for A1, 0.0004 for A2). No difference was seen between the subjects who had three sessions and those who had four, suggesting that the 3-treatment protocol was ideal, although numbers were too small to make any generalization. The average PGA score was 3.3/4 and the average subject satisfaction score was 3.4/4. The average pain score was 3.7 (range 3-5), and no adverse events were reported during both the treatment and follow-up periods.

Conclusion

Further controlled studies in larger populations are warranted to confirm the optimistic results of this pilot study.

Key words

Enlarged pore; Acne scar; Q-switched Nd:YAG laser; Multidepth fractional focusing handpiece; Skin rejuvenation; Skin remodeling

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INTRODUCTION

Treatments for enlarged pores and acne scars are a very common request for the aesthetic dermatologist, and these conditions can present problems when they occur together. A variety of treatment modalities are available including fractional ablative or nonablative lasers (CO_2, Er:YAG, thulium or Er:glass),[1,2] fractional microneedling with or without radiofrequency,[3] CROSS (chemical reconstruction of skin scars) technique,[4] chemical peels and so on. All of these techniques involve some degree of pain during treatment and varying amounts of downtime from a few days to over a week, and there is some possibility of adverse events.[5] On the other hand, the growing trend amongst patients is the requirement to achieve the best possible results with reasonable discomfort and minimal downtime particularly in milder cases, in other words patients now demand "less pain and all gain".[6]

One laser that is not often associated with skin rejuvenation, including treatment of enlarged pores and acne scar revision, is the Q-switched 1064 nm neodymium:YAG (Q-NDY) laser. Recently, a novel fractional focusing handpiece has been developed for a new generation of Q-NDY laser and has become commercially available, which allows the clinician to change both the diameter of the treatment area and the depth of focus of the microbeams into the tissue: in short, a multi-depth, multi-focusing (MDF) handpiece. The benefits of fractionation of short pulsewidth laser energy in scar revision have been well proven,[7] and the technique of focusing the microbeams into the target tissue was previously developed for the picosecond and shorter pulsewidth laser,[8] and has been associated with the creation of thermally-initiated laser-induced optical breakdowns (Ti-LIOBs) in tissue.[9] The production of Ti-LIOBs in skin has been proven to induce collagenesis and elastinogenesis in the target tissue followed by remodeling to give good skin rejuvenation.[10] The new MDF handpiece used with the Q-NDY laser might therefore allow that system to be used for skin rejuvenation, including treating patients with enlarged pores and acne scars. The present pilot study was therefore designed to assess the safety and efficacy of the use of the Q-NDY laser and the MDF handpiece in the treatment of enlarged pores and acne scars in Asian patients.

SUBJECTS AND METHODS

Subjects

The study subjects comprised 10 volunteers with varying degrees of enlarged pores and acne scars occurring simultaneously. There were 7 males and 3 females, Asian skin type III-IV, ages from 23 to 53, mean age 33 yr). Subject demographics are shown in Table 1. Subjects were given a patient number, and, having had the treatment protocol explained to them including expected results and potential side-effects, gave written informed consent to participate in the pilot study and for the use of their clinical photography. Eight patients were assigned to be treated over 3 sessions and the other 2 (patients Nos 8 and 10) over 4 sessions, with a treatment interval of 4 weeks between sessions.

Laser system

The laser used was a new-generation Q-NDY system (HOLLYWOOD SPECTRA™, Lutronic Corporation, Goyang, South Korea) delivering a 5 ns pulsewidth at 1064 nm. This system offers some distinctive technologies. The first of these is a unique approach to ensuring a true

Table 1. Subject demographics, ANTERA 3-D Camera findings for pores and acne scars, pain score (VAS: 0 = no pain ~ 10 = worst pain), Physician Global Assessment (0, no change ~ 4, full improvement) and patient satisfaction score (0, totally dissatisfied ~ 4, highly satisfied)

	Demographics		ANTERA pores (volume in mm^3)			ANTERA acne scars (volume in mm^3)			Scoring		
No	Sex	Age	B/L	A1 (%)	A2 (%)	B/L	A1 (%)	A2 (%)	Pain	PGA	Pat SS
1	M	26	1.51	0.616 (59.2)	0.623 (58.7)	2.42	1.56 (35.5)	1.54 (36.36)	4	4	4
2	M	28	3.05	1.35 (55.7)	1.21 (60.3)	5.2	3.33 (36.0)	3.11 (40.2)	4	3	4
3	M	26	2.71	1.58 (41.7)	1.42 (47.6)	7.03	5.47 (22.2)	4.48 (36.3)	5	4	4
4	F	23	3.37	0.778 (77.0)	0.667 (80.2)	4.45	1.72 (61.3)	1.56 (65.2)	4	4	3
5	F	53	1.09	0.81 (25.7)	0.913 (16.2)	5.13	3.76 (26.7)	3.68 (28.3)	3	2	3
6	F	32	0.49	0.20 (59.2)	0.218 (55.5)	1.07	0.888 (17.0)	0.887 (17.1)	4	2	3
7	M	40	1.26	0.958 (24.0)	0.853 (32.3)	5.08	4.39 (13.6)	3.58 (29.5)	3	4	4
8	M	35	2.91	1.32 (54.6)	1.09 (62.5)	6.26	5.34 (14.7)	4.85 (22.5)	3	4	4
9	M	35	3.73	2.13 (42.9)	1.84 (50.7)	6.05	4.63 (23.5)	4.51 (25.5)	4	2	2
10	M	32	2.10	1.16 (44.8)	0.928 (55.8)	4.81	4.50 (6.4)	3.89 (19.1)	3	4	3

No, subject No; B/L, baseline score; A1, 6-week assessment; A2, 3-month assessment; (%) percentage improvement from baseline; PGA, physician global assessment; Pat SS, patient satisfaction score.

flat top beam through the use of radial micro-beam homogenization, which the manufacturers have called IntelliBeam™. This radial technique eliminates hotspots and ensures homogeneous energy across the entire beam. The second example is a new approach to cavity dynamics whereby the Q-NDY resonator delivers the bulk of the available peak power in the first one-third of the 5 ns pulse unlike conventional Q-switched lasers, where the ideal situation is to have even delivery of the output power over the entire pulsewidth. When this dynamic resonator approach is combined with the IntelliBeam technology discussed above, a "hypersurge" of power is developed which can photomechanically induce an undulation in the target tissue that has been clearly demonstrated in high-speed videography.

The third innovative tool developed by the manufacturers for the system is a novel multidepth fractional (MDF) handpiece based on microlens array (MLA) optics, which can be used with either 1064 nm or 532 nm. The MLA optics simultaneously fractionate the laser beam into multiple 100-150 μm microbeams at the skin surface (depending on the selected Step) and focus the microbeams to a very small beam waist into, rather than at the surface of, the skin, thereby targeting multiple skin layers according to the selected Step and fluence. What makes the MDF handpiece unique is that the diameter of the compound beam irradiated area can be adjusted between 4 and 8 mm in 1 mm increments, and the focal depth of the microbeams can be selected among deep, intermediate and shallow settings (Steps I, II and III, respectively), controlling where in the tissue the microbeam waists will occur. With the very fine focal waists, the power density at the beam waists is orders of magnitude higher than that in the unfractionated beam. Combined with the resonator technology these high irradiances at the beam waists exceed the tissue breakdown threshold and have been shown capable of creating thermally-initiated laser-induced optical breakdowns (TI-LIOBs).

Treatment protocol

Patients received either 3 or 4 treatment sessions 4 weeks apart with the MDF handpiece at 1064 nm and using the following settings per session (parameters varying depending on the severity of the target lesions): MDF handpiece Step III, 6-8 mm spot size, pulse energy of 1.1-1.5 J/cm^2, repetition rate of 10 Hz, delivered with 3-10 passes over the target lesions and surrounding skin with 2 shots stacked over the lesions. This was followed immediately by Step I 4-6 mm, 1.2-2.0 J/cm^2, 2 Hz, delivered with 3-5 passes targeting the lesions only. Nine percent lidocaine topical anesthesia cream was applied for 30 to 45 min, and the same clinician performed all of the treatment sessions.

Assessments

Photography and skin analysis

Clinical photography was taken at baseline then at 3 months (A2) after the final treatment. Straightforward digital images were captured with a professional skin image analysis system based on a Canon DSLR camera (Mark-Vu, PSIPLUS Co Ltd, Seoul, Korea). In addition, an ANTERA-3D Skin Analysis System (Miravex, Ltd, Dublin, Ireland) was used to capture images then analyze and compare the volume change in pores and acne scars (in mm^3) at baseline, A1 and A2. The ANTERA software created bar graphs from the values recorded from the images at each assessment point to enable quick visual analysis of any beneficial change among the two assessment points and baseline, and between A1 and A2 to record any continuing changes.

Pain score

Patients scored their pain during treatment on an 11-point VAS scale (zero, no pain; 10, worst possible pain).

Physician global assessment (PGA)

Two sets of images from the clinical photography at baseline and A2 were prepared with the order in which the photographs were taken not being disclosed to the assessors, two independent and blinded dermatologists. The assessors first determined which were the baseline and A2 images, then scored the degree of improvement at A2 on the following quintile scale: zero points, little or no change; 1 point, 15-35% improvement; 2 points, 36-50% improvement; 3 points, 51-75% improvement; and 4 points, 76-100% improvement. Scores were totaled to give the PGA. Accordance in scoring was reached following discussion between the assessors for any significant differences in scoring.

Patient satisfaction score

Patients subjectively scored their satisfaction with the result at A2 via a written questionnaire on a quintile scale as follows: Zero points, totally dissatisfied; 1 point, somewhat dissatisfied; 2 points, neither satisfied nor dissatisfied; 3 points, satisfied; and 4 points, highly satisfied. The questionnaire was handled by the same interviewer for each patient.

Adverse events

Any adverse events occurring during or after the treatments were recorded by both patients and the treating clinician, other than the expected mild erythema.

Ethics

This was an in-house study conducted with informed and consenting volunteers in the company clinic with all patients being treated by the same expert clinician. Approval to conduct the study was given by the in-house Laser Safety Committee, and the study was conducted following the precepts of the World Medical Association Declaration of Helsinki.

RESULTS

All 10 patients successfully completed their treatments, two follow-up sessions and both digital photography and 3-D skin analysis imaging with data analysis. From the ANTERA-3D findings, patients in general showed statistically significant improvement in the objective 3-D analysis of the volume in both pores and acne scars at both A1 and A2, with an interesting trend towards continued improvement between the first and second assessments, which was significantly so for the acne scars (Table 1). Average

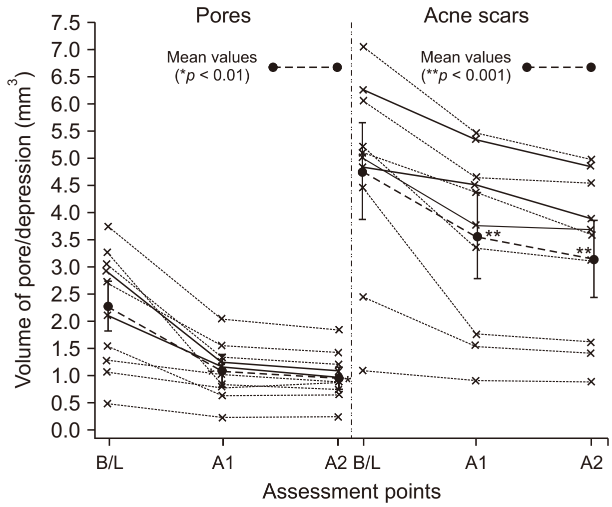

Fig. 1. Scatter graph showing the results for significant improvement in pores (left panel) and acne scars (right panel) for individual patients at baseline (B/L), 6 weeks after the final treatment (A1) and 3 months after the final treatment (A2). The 2 sets of heavier lines represent the two patients (Patients 8 & 10) who received an additional 4th treatment session, while the remaining individual patients are shown with fine dotted lines. Mean values with deviation are shown by closed circles with heavy dashed lines. See the text for details.

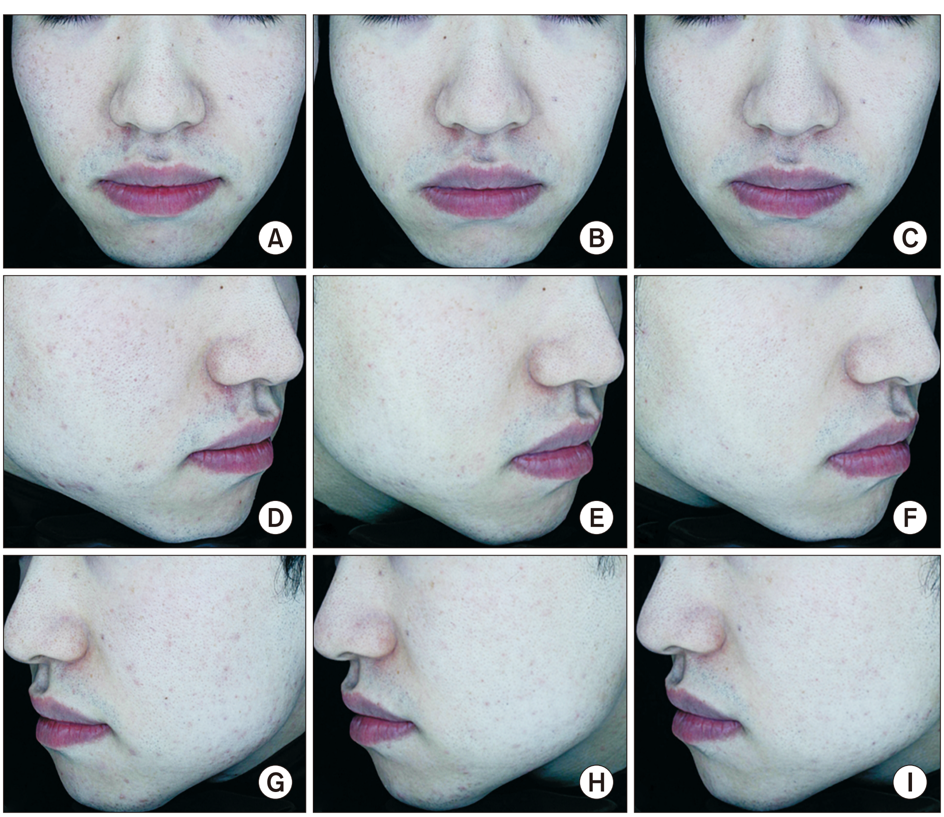

Fig. 2. A 26-year-old male (Patient no. 1) with acne scarring on the bilateral cheeks and nasal alae captured using a polarizing filter at baseline (A, D, G), at 6 weeks after the final treatment (B, E, H) and at 3 months after the final treatment session (C, F, I) demonstrating good improvement with no PIH. Redness bilaterally is additionally present at baseline, which improved over time (see also Fig. 4).

percentage improvements for pores at A1 and A2 were 48.45 ± 16.1% and 57.8 ± 15.2% (p = 0.001 for both), respectively: for acne scars the respective values were 27.8 ± 15.0% and 34.2 ± 24.3%, respectively (p = 0.0008 for A1, p = 0.0004 for A2). Individual data are shown as line graphs in Fig. 1, where an improvement at A1 is clearly seen, and in most cases a continued improvement was shown with no further treatment from A1 to A2.

Representative clinical photography at baseline, A1 (6 weeks after the final treatment) and A2, (3 months after the final treatment session), is seen in Fig. 2 which shows Patient No 1, a 26-year-old male with acne scarring on the bilateral cheeks and nasal alae, captured with a polarizing filter. The progressive improvement in the overall skin condition through the 3-month followup period compared with baseline was clearly visible. Excessive facial redness could also be clearly seen at baseline (Fig. 2A, D and G) which improved over the followup period. Patient No 8, a 35-year-old male, is shown in Fig. 3, also with acne scarring on the bilateral cheeks and nasal alae captured without any filter at baseline and at A2. A clear improvement was seen in the 3-month follow-up. Excessive facial redness was also noted in this patient, as in Patient No 1. Reduction of both the acne scars and oiliness of the skin was noted in both subjects.

As noted above, in two patients (Nos 1 and 3, same patients as depicted in Figs. 2 and 3), in addition to the clinical photography the ANTERA-3D system detected high levels of facial redness (ANTERA Haemoglobin setting) which were not seen in any of the other patients (Fig. 4). For Patient 1 the average hemoglobin level of the detected red areas at baseline was 1.559; 1.318 at the 1st assessment (A1); and 1.301 at the 2nd assessment (A2). The system also measured the variation between detected areas of redness which was 0.182 at baseline; 0.128 at A1; and 0.119 at A2. The corresponding data for Patient 3 were: 1.835, 1.608 and 1.578 for the average hemoglobin levels; and 0.189, 0.158 and 0.126 for the variation. Improvement was seen in both cases.

Representative images generated by the ANTERA-3D system demonstrating the reduction in the volume of both pores and acne scars are seen in Fig. 5 (Patient No 4, a 23-year-old female) showing the clear improvement at the 6-week followup, which was continued in the 3-month followup. In the case of the pores, the initial volume of 3.37 mm^3, had reduced at 6 weeks to 0.776 mm^3 and at 3 months to 0.667 mm^3: for the acne scars, the initial volume was 4.45 mm^3, which had dropped at 6 weeks to 1.72 mm^3 with continued reduction at 3 months to 1.55 mm^3.

As noted in the Subjects and Methods section, patients 8 and 10 received 4 sessions with the aim of seeing if the extra session would produce better results. These two patients are designated with thicker lines in the scatter graphs in Fig. 1, but as can be observed, no significant difference was seen between them and the other 8 patients which would suggest that the 3-session approach is ideal, the extra session not having delivered any significant improvement.

For the PGA scores, no patients were scored at zero or 1, three patients were scored at 2, one patient at 3 and six patients at 4, giving an average PGA of 3.33 out of a possible 4 (Table 1). Seven patients out of the 10 were therefore independently scored as having good or higher improvement in their pores and acne scars, and the remainder had at least some visible improvement. As for the subjective patient satisfaction scores, no patients scored their satisfaction at zero or 1, one patient scored it at 2, four patients at 3 and five patients at 4, Nine of the 10 patients were therefor satisfied or very satisfied, with only 1 patient being neither satisfied nor dissatisfied (Table 1).

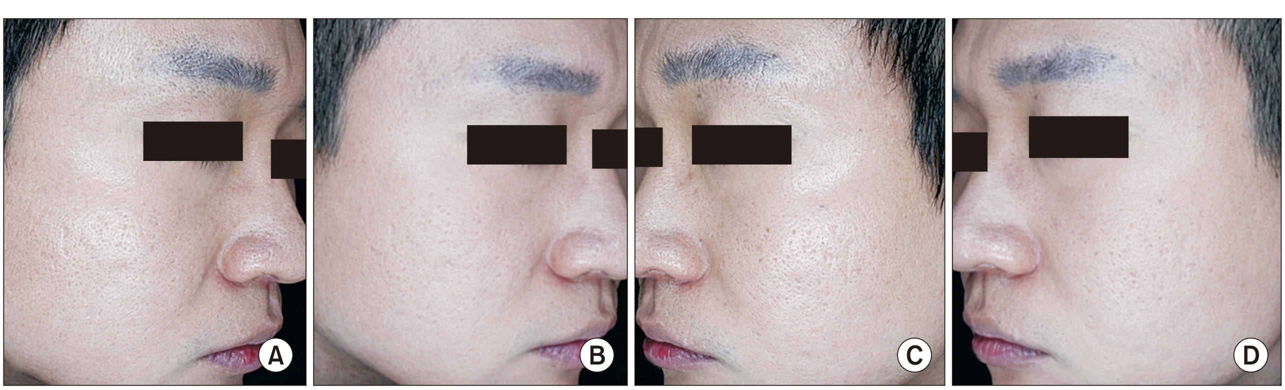

Fig. 3. A 35-year-old male (Patient no. 8) with acne scarring on the bilateral cheeks and nasal alae at baseline (A, C) and at 3 months after the final treatment session (B, D) demonstrating good improvement with no PIH. As with the patient in Fig. 2, redness present at baseline improved over the followup period (see also Fig. 5).

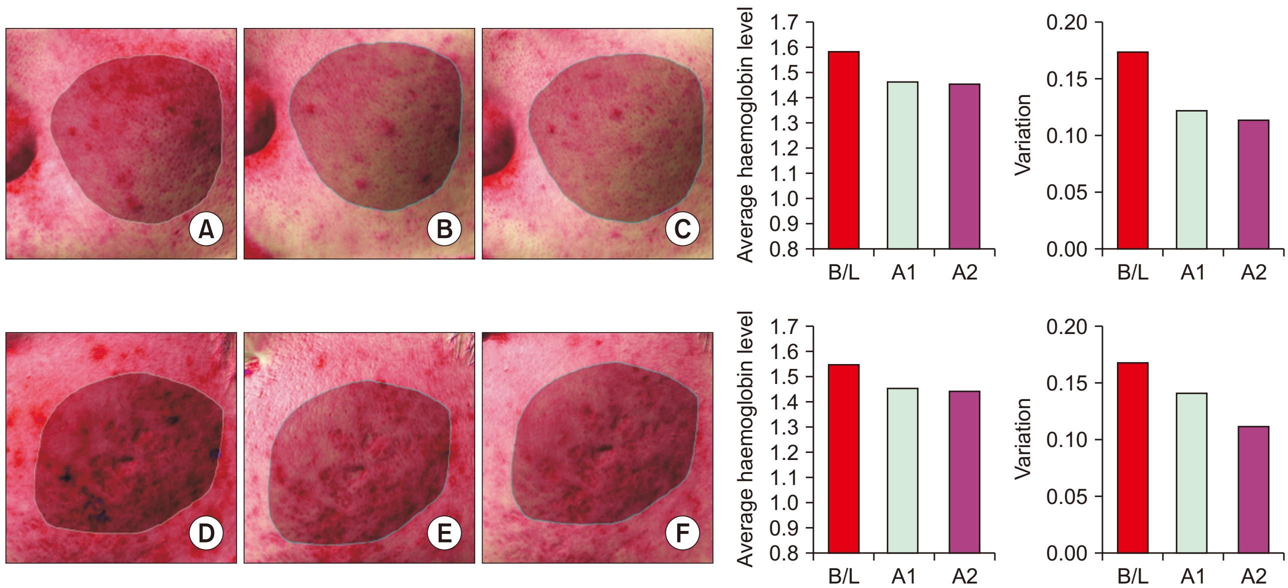

Fig. 4. ANTERA-3D image depicting area of redness (Haemoglobin setting) on the face of Patient 1 at baseline (A), 6 weeks after the 3rd treatment (B, C) 6 months after the 3rd treatment. (Right images) Graphs generated from the ANTERA-3D data showing on the left the average hemoglobin level (Baseline [B/L], 1.559; 1st assessment [A1], 1.318; and 2nd assessment [A2], 1.301), and on the right the variation between detected areas of redness (Baseline [B/L], 0.182; 1st assessment [A1], 0.128; and 2nd assessment [A2], 0.119). Redness has improved at A1, and has continued to improve at A2. ANTERA-3D image depicting area of redness (Haemoglobin setting) on the face of Patient 3 (same patient as seen in Fig 3) at baseline (A), 6 weeks after the 3rd treatment (B, C) 6 months after the 3rd treatment. (Right images) Graphs generated from the ANTERA-3D data showing on the left the average hemoglobin level (Baseline [B/L], 1.835; 1st assessment [A1], 1.608; and 2nd assessment [A2], 1.579), and on the right the variation between detected areas of redness (B/L, 0.189; A1, 0.158; and A2, 0.126). Redness has improved at A1, and has continued to improve at A2.

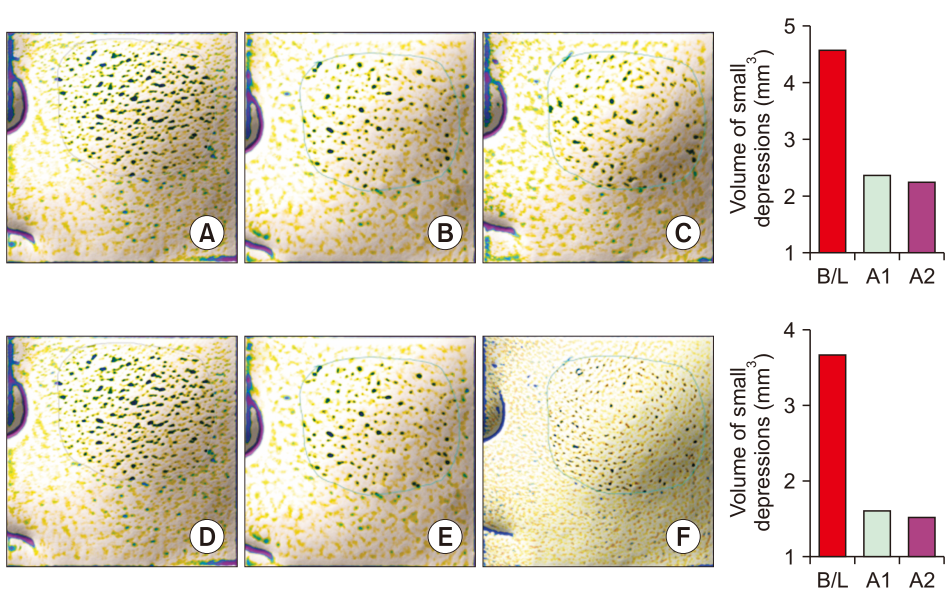

Fig. 5. ANTERA-3D images in a 23-year-old female (Patient no. 4) showing the calculated volume of pores (~0.5 mm diameter) in mm^3 at (A) baseline, (B) 6 weeks after the 3rd treatment and (C) 6 months after the 3rd treatment. (Right image) Graph generated from the ANTERA-3D data showing a mean volume at baseline (B/L) of 3.37 mm^3, at 6 weeks (A1) of 0.776 mm^3 and at 3 months (A2) of 0.667 mm^3. ANTERA-3D images in the same patient as in Figure 3 showing the calculated volume of mild acne scars (~1.0 mm diameter) in mm^3 at (A) baseline, (B) 6 weeks after the 3rd treatment and (C) 6 months after the 3rd treatment. (Right image) Graph generated from the ANTERA-3D data showing a mean volume at baseline (B/L) of 4.45 mm^3, at 6 weeks (A1) of 1.72 mm^3 and at 3 months (A2) of 1.55 mm^3.

As for the pain, the average pain score was 3.7, with 4 patients scoring 3, 5 patients scoring 4 and 1 patient scoring 5 (Table 1). The procedure was therefore reasonably well-tolerated with the application of topical anesthesia, and the patient scoring their pain at 5 did not wish to discontinue treatment. The only side effect was the anticipated mild erythema, and no other adverse events were reported by patients or the clinician treating them.

DISCUSSION

Treatment of acne scars and pores is not normally associated with the Q-NDY laser, with such treatment and other forms of skin rejuvenation being handled with laser systems or energy-based devices having a totally different coagulation-based action in the target tissue compared with the Q-NDY.[1-3] To achieve reduction in acne scars, even in fairly mild ones, it is necessary to induce tissue volume regeneration in the depressed part of the scar through remodeling of the somewhat convoluted fibrotic collagen in the dermis, while at the same time smoothing the sharp edges of the scar into the surrounding normal epidermis.[11] Up to the present, to achieve dermal volumization and remodeling, photothermal coagulative damage normally needs to be induced in the dermis which is followed by the wound healing process involving neocollagenesis and neoelastogenesis. In the case of lasers, pulsewidths significantly longer than the nanosecond domain are required to achieve the necessary photothermal reactions, whereas in the case of radiofrequency devices, an electrothermal reaction is necessary to elicit the wound healing process.

In the latter years of the 1990s, thermally-initiated laser induced optical breakdowns (TI-LIOBs) were found to occur in response to the production of high-enough irradiances at the laser beam waists to exceed the optical breakdown threshold of the target material,[12] resulting in athermal ionization with plasma formation that absorbs the incident laser energy like a black hole, which then shields the tissue beneath from any damage. A vacuole is almost instantaneously created in the target tissue delivering an osmotic shock wave to the tissue surrounding it. This was proved to happen with almost no increase of temperature, studies showing rises of 1°C or less.[13] More recently, TI-LIOB formation has been consistently and reliably recorded with pulsewidths in the femtosecond and picosecond domain with the use of a handpiece combining some form of simultaneous fractionation of the high-peak power beam and focusing of the microbeams into the tissue rather than at the surface of the target,[14] and was associated fairly early on (2012 onwards) with effective skin rejuvenation.[15] The early investigations required the building of experimental and cumbersome "bread board" optics, however, but more recent compact handpieces have been developed which achieve the same beneficial effect in the target skin, delivering what is referred to as "cold rejuvenation".[8-10] All of these and other reports have required pulsewidths in the picosecond domain or shorter.

The MDF handpiece used with the 1064 nm Q-NDY in the present study has been proven to deliver TI-LIOBs in a similar manner to the picosecond laser in fresh ex-vivo minipig skin, as illustrated in Fig. 6, comparing a single shot delivered with a 450 ps laser with a single shot delivered by the 5 ns 1064 nm Q-NDY used in the present study and fitted with the MDF handpiece at its deep focus setting (Step I). When sequential shots are delivered combining Steps I and III to target multiple skin layers, multiple TI-LIOBs could be seen with the upper set created by Step I at 1.0 J/cm^2, and the lower set created by Step III at 0.5 J/cm^2 (Fig. 7). Based on these histological findings it is clear that the MDF handpiece brings ps-domain laser rejuvenation capabilities to the Q-NDY. Moreover, the Q-NDY used in the present study delivered its Q-switched pulses with the unique cavity dynamics mentioned in the Introduction section, whereby a hypersurge technology

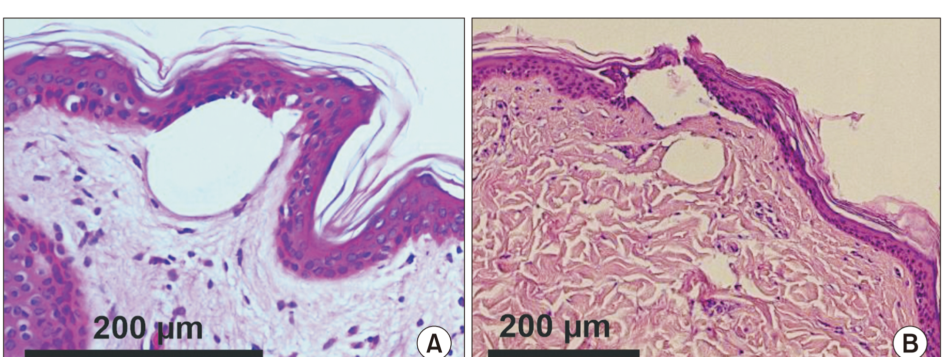

Fig. 6. TI-LIOBs created with a single shot at step 1 of the MDF handpiece with a 450 ps laser (A) and the 5 ns Q-NDY used in the present study (B). (ex vivo minipig skin, H & E stain, scale bars as shown).

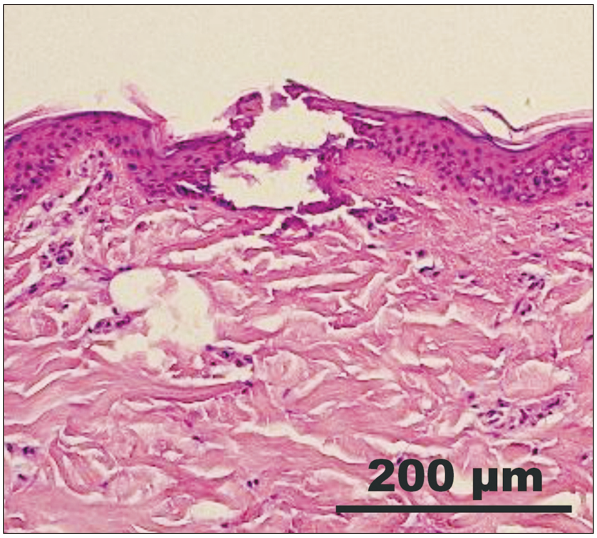

Fig. 7. Sequential shots delivered with the 5 ns Q-NDY used in the present study at Step I (upper TI-LIOBs, 1 J/cm^2) and Step III (lower TI-LIOB, 0.5 J/cm^2) of the MDF handpiece. (*ex vivo* minipig skin, H & E stain, scale bar as shown).

concentrates most of the power of each pulse in the first one-third of the 5 ns pulsewidth. This technology, through increasing the available peak irradiances, arguably further enhances the ability of the MDF handpiece to create multiple TI-LIOBs in the target skin to achieve effective cold rejuvenation. When multiple-pass treatments with the shallow setting of the MDF handpiece are followed immediately with passes at the deep setting and by manipulating the pulse fluence, multiple LIOBs can be created at different tissue levels in both the epidermis and dermis, stimulating collagenesis and skin rejuvenation. In addition, the hypersurge technology creates tissue undulation with each pulse: the creation of multiple osmotic shocks to the skin has been shown to activate fibroblasts to achieve favorable neocollagenesis.[16] This combination of the Q-NDY technology together with the MDF handpiece can explain the good results seen in the present study with the improvement of both mild acne scars, enlarged pores and facial redness.

The present in-house pilot study has limitations: the small number of patients which obviously limited the statistical power of the data analysis, and the fact that only the Q-NDY fitted with the MDF was used over the whole face of all the patients. To confirm the optimistic results of the present study, future studies will need larger patient populations, combined with a split-face comparison between the Q-NDY with MDF handpiece, or skin rejuvenation with a proven modality, *e.g.*, the 1927 nm fractional thulium laser.

Nevertheless, the objective ANTERA-3D imaging clearly demonstrated a significant reduction in the assessed volume of both the scars and pores at six weeks after the final treatment session. The fact that in the majority of cases this improvement continued to the three-month assessment points to the existence of remodeling which in turn can only occur in the presence of the second proliferative phase of the wound healing process. In addition, in the two patients with detected redness (Patients 1 and 3), not only did the treatment improve the redness at A1 with continued improvement at A2, but it also improved the homogeneity of the overall facial coloration as seen by the decreasing data for the variation among the areas (Figs. 4 and 5). The Q-NDY used in the present study and at the parameters stated, fitted with the MDF, therefore successfully delivered downtime-free cold rejuvenation. It was interesting that the two patients who received four treatment sessions compared with the others who received three sessions did not show any real difference in the efficacy of the treatment (Fig. 1). Although the small patient number does not allow generalization, this finding would suggest that the three-session regimen is ideal for effective improvement of mild acne scars, enlarged pores, facial redness and potentially general skin rejuvenation, meeting current patient expectations of achieving maximum gain with virtually no downtime.

The present in-house pilot study examined the use of a new Q-switched Nd:YAG laser fitted with a unique multi-depth, multi-focusing handpiece for the treatment of acne scars and enlarged pores. With the 3-session protocol and parameters used in the study, the safe and effective improvement of enlarged pores and acne scars was achieved in Asian patients with no PIH and almost no downtime.

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CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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AUTHOR CONTRIBUTIONS

Concept and design: JKH. Analysis and interpretation: HL. Data collection: JP. Writing the article: JKH. Critical revision of the article: JKH. Final approval of the article: JKH. Statistical analysis: JP. Overall responsibility: JKH.

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