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ORIGINAL RESEARCH

A Novel Treatment of Acne Vulgaris Using a 1927 nm Fractional Thulium Laser: A Case Series

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Background and Aims: Acne vulgaris remains one of the most common and problematic dermatological conditions. Recently, a fractional 1927 nm thulium laser has been developed with specific water absorption characteristics which may be of interest in the treatment of acne.

Subjects and Methods: Nine consecutive Korean subjects, 6 females and 3 males, ages ranging from 13 to 33 yr, presented with a mixture of inflammatory and noninflammatory acne. Baseline clinical photography, image analysis and lesion counts were performed. A fractional 1927 nm thulium laser (FTL) delivered 6 treatment sessions in 5 subjects and 5 sessions in 4 subjects, 4 weeks between sessions. Pain during treatment was assessed. At 32 weeks after the last treatment session, an independent Investigator Global Assessment (IGA) performed lesion counts and graded the severity of the acne at baseline and the final assessment on a quintile scale. Data were analyzed statistically.

Results: All 9 subjects completed the study with significant reductions in the inflammatory and noninflammatory lesions (P values 0.0012 and 0.0081, respectively) with overall lesion counts at the final assessment ranging from 60% to 97.1%, and acne grades in the IGA dropping by an average of 1.67 (range 1 to 3 grades). There was no significant difference in lesion counts or acne grades between the subjects who had 6 treatments and those who had 5 (P = 0.7695). Mild pain was reported during treatment, and no adverse events were reported by either the subjects or investigator.

Conclusions: The FTL at the parameters used in the present study caused disruption to the upper portion of the affected follicles and sebaceous glands under an intact stratum corneum, thereby destroying or damaging the causative *Cutibacterium acnes*. The superficial controlled coagulation additionally induced follicular remodeling and tissue regeneration, potentially contributing to the noticeable results in inflammatory and noninflammatory acne lesions.

Keywords: *Cutibacterium acnes*, thulium laser, infundibulum, sebaceous glands, follicular remodeling, selective photothermolysis

Introduction

Acne vulgaris, both inflammatory and noninflammatory, remains one of the most common dermatological conditions negatively affecting patients and practitioners alike. The recognized rate of incidents amongst preteens and teens is over 85%, and even for adults over 25 years of age, 50% are liable to develop some form of acne.[1,2] The condition is not only unsightly but can also negatively and psychosomatically affect the quality-of-life of the affected patient. Concomitantly with the large number of cases, there is a plethora of treatment modalities with topical and oral medications being the most adopted first-line treatment. The medical approach with historically the best efficacy is oral isotretinoin, but the associated side-effects can be prohibitive, particularly regarding liver function amongst young children.[3] A major setback with both oral and topical approaches is the necessity for prolonged use, as recurrence of the acne is almost inevitable once medical intervention is stopped. Another problem with conventional treatment is the growing resistance of the causative bacterium, *Cutibacterium acnes* (*C. acnes*, formerly known as *Propionibacterium acnes*) to an increasing number of drugs. This has led to the development of alternative or complementary approaches from the early 2000s onwards.[4] Chemical peels have gained popularity and proved reasonably effective, possibly because of their higher concentration of salicylic acid compared to facial scrubs and creams, but required an expert hand to ensure optimal

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results with minimal side-effects. At the same time, "optical treatments" were suggested but were relegated to the category of complementary alternative medicine (CAM).[2] As the understanding of laser–tissue interaction has improved, the use of lasers and other light sources gradually attracted more and more attention.[5] The 1064 nm neodymium:YAG (Nd:YAG) laser at appropriate parameters showed efficacy in dealing with both inflammatory and noninflammatory lesions, and proved superior to intense pulsed light (IPL).[6] The fractional carbon dioxide (CO_2) laser was tried for active acne, but the downtime due to erythema was longer than optimal. However, it has become one of the best approaches for remodeling atrophic acne scars.[7] There is limited evidence to support the use of potassium titanyl phosphate (KTP) 532 nm lasers, and non-ablative fractional lasers around 1540 nm.[5] One wavelength, which has however attracted attention has been 1726 nm, and diode lasers at this wavelength have proved efficacious in the treatment of acne vulgaris.[8] At this wavelength, the sebaceous glands become the main target resulting in mild selective photothermolysis of the glands and destruction of the *C. acnes* in that portion of the follicle. Photodynamic therapy (PDT) has also proved effective with the application of an exogenous photosensitizer such as aminolevulinic acid (5-ALA), the porphyrins created by which are activated with low levels of visible red light.[9] When *C. acnes* is active, it has levels of endogenous porphyrins which can be activated by low-level light therapy with light-emitting diodes (LED) photobiomodulation therapy for endogenous PDT with a combination of consecutive visible blue and red light. This destroys the target *C. acnes* through oxidative stress-induced apoptosis and has proved surprisingly effective.[10,11]

Recently, the fractional thulium laser (FTL) at 1927 nm has attracted a great deal of attention for its minimally ablative approach to skin rejuvenation and mild scar revision.[12,13] At this wavelength, the main chromophore is tissue water with the low absorption in melanin and blood. Histology of a typical FTL impact on normal skin revealed a disrupted but intact stratum corneum, a temporarily disrupted stratum spinosum and dermoepidermal junction, with mild coagulation in the very superficial papillary dermis surrounded by normal unaffected tissue (Figure 1). Recovery is therefore very swift, resulting in minimal downtime. In common with the report of Huang et al on the 1927 nm wavelength for the treatment of active acne,[14] the author postulated that the depth of penetration of the coagulative damage into the dermis of an FTL impact to a depth of around 400 μm would be sufficient to involve the infundibulum of affected sebaceous follicles, including the sebaceous glands, thereby destroying or damaging the *C. acnes* in inflammatory and noninflammatory acne and resulting in follicular remodeling during the repair process. Because the delivery of the laser energy is fractional, treatment of the whole face would also involve surrounding nonlesional skin with the potential of inducing mild collagenesis followed by dermal remodeling, adding the potential for overall improvement of the skin condition in addition to treating the acne. The present case series was designed to explore this concept.

Subjects and Methods

Subjects

Nine Korean subjects with bilateral inflammatory and noninflammatory acne vulgaris were consecutively enrolled in the study, six females and three males, with ages ranging from 13 to 33 yr, average 21.56 ± 7.55 yr. Four and five subjects had Fitzpatrick skin types (FST) III and IV, respectively. After having had the aims of the study and treatment protocol explained to them, including any necessary clarification, the anticipated result and potential side-effects, subjects gave written informed consent to participate in the study, including the use of their clinical photography. For patients under the age of 19, a parent or guardian gave the written informed consent on their behalf. The study design and execution followed the precepts of the World Medical Association Declaration of Helsinki (7th revision, 2013). The study was approved by the Ethics Committee of the Chun Aesthetic and Laser Clinic. Patient demographics are seen in Table 1, and bilateral noninflammatory and inflammatory lesion counts at baseline can be seen in Table 2.

Fractional Thulium Laser (FTL)

The device used in the present study was the LaseMD Ultra^{TM} (Lutronic, Goyang. South Korea). This is a thulium-doped fiber-based system which emits laser energy at a 1927 nm wavelength, with laser energy being delivered through a flexible optical fiber via a fractional handpiece which fractionates the main laser beam into myriad microbeams. Two tips are available: a 4 mm × 10 mm tip delivering 200 μm microbeams, or a 6 mm × 10 mm tip delivering 350 μm

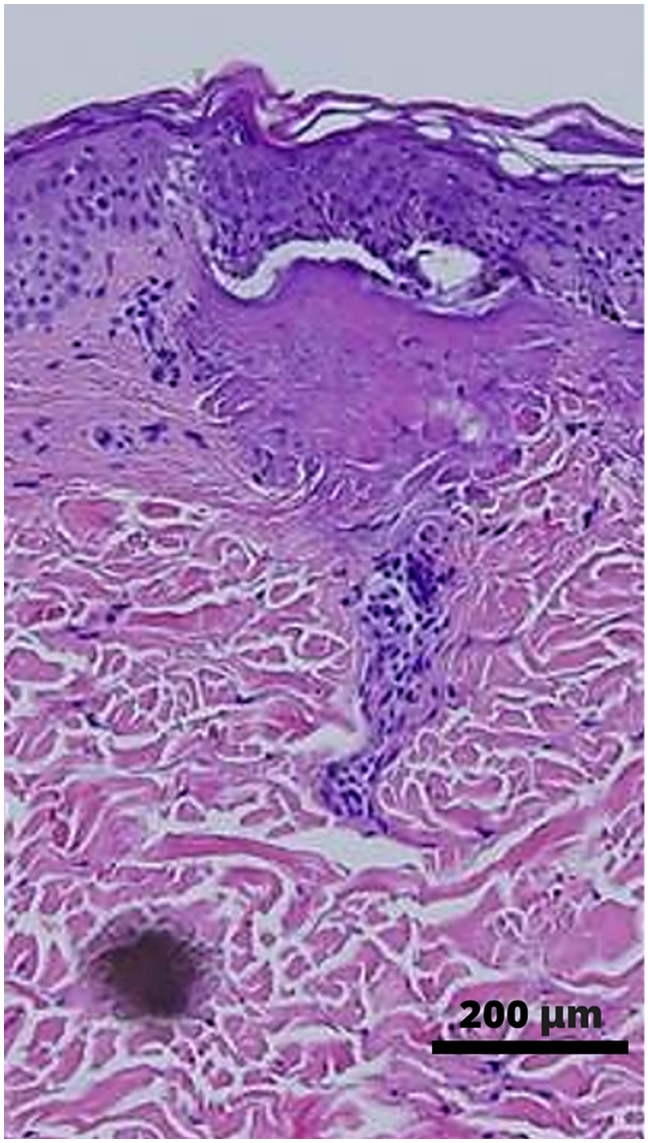

Figure 1 Hematoxylin and eosin-stained specimen of normal human skin immediately after irradiation with a subablative 1927 nm thulium laser showing a typical impact from a fractional microbeam. The stratum corneum is disrupted but not damaged. The stratum spinosum is denatured, with loss of adhesion of the tight cell-cell adhesion. There is transient vacuolization at the dermoepidermal junction over a controlled area of mild coagulation in the superficial dermis. The laser-affected area is surrounded by normal undamaged skin. (Scale bar: 200µm ; courtesy of Lutronic pathology laboratory).

microbeams. The handpiece is able to deliver energy in either a dynamic rolling mode or a static stamping mode. In the rolling mode, the handpiece utilizes a magnetic roller-operated tracking system which delivers laser pulses in a consistent manner irrespective of the scanning speed of the handpiece across the target tissue, resulting in the same treatment result no matter the scanning speed and avoiding over- or under-treatment. A random mode is available whereby each microbeam per pulse is delivered as far as possible from the previous one to help prevent heat stacking between microbeams. The microbeam density is adjustable between 25/cm² and 225/cm². Power of the device is adjustable by the user from 5 W up to a maximum of 20 W. The energy per pulse is adjustable from 1 mJ up to 20 mJ.

Treatment Protocol

Following thorough cleansing of the face for all subjects, a topical anesthetic cream was applied (Lidocaine 9.6%) which was left in place for 30 to 50 minutes, depending on the severity of the acne, under clingfilm occlusion. At the end of the

Table 1 Subject Demographics, Pain Score and Energy Level per Session in kJ. Note That Subjects 1–5 Received 6 Treatment Sessions Whereas Subjects 6–10 Received 5 Sessions

PAT No	Sex/age	FST	VAS Score	Session number and Total Energy (kJ)/session					
				1	2	3	4	5	6
1	F/16	III	3	0.712	0.753	0.77	0.852	0.734	0.85
2	M/15	IV	4	0.423	0.352	0.415	0.415	0.351	0.249
3	F/19	IV	3	0.411	0.435	0.514	0.504	0.352	0.366
4	F/16	III	4	0.325	0.246	0.249	0.203	0.203	0.196
5	F/13	IV	4	0.686	0.575	0.696	0.4	0.409	0.535
6	M/27	III	4	0.494	0.46	0.458	0.428	0.432	N/A
7	F/32	IV	4	0.496	0.486	0.552	0.242	0.347	N/A
8	M/33	IV	4	0.575	0.449	0.615	0.436	0.435	N/A
9	F/23	III	3	0.436	0.402	0.227	0.192	0.304	N/A

Abbreviations: FST, Fitzpatrick skin type; VAS, visual analog scale 0 (no pain) – 10 (worst possible pain).

Table 2 Inflammatory and Noninflammatory Lesion Counts per Subject at Baseline and 32-Week Follow-Up, Ratio Between Inflammatory and Noninflammatory Lesions and Number of Grade 3 and Grade 4 Acne Lesions According to the Investigator Global Assessment (IGA)

Pat No	Type	B/L		Post-Tx		Item	B/L	Post-Tx	G3/G4 (IGA)	
		R	L	R	L				B/L	Post-Tx
1	Inf	80	40	3	2	Total Inf	120	5	4	1
	Non-Inf	89	165	16	20	Total Non-Inf	254	36		
						Inf:Non-Inf	32.1%	12.2%		
						Δ LC	−95.8%			
2	Inf	60	96	8	4	Total Inf	156	12	4	1
	Non-Inf	49	48	19	9	Total Non-Inf	97	28		
						Inf:Non-Inf	61.7%	30.0%		
						Δ LC	−92.3%			
3	Inf	49	62	5	7	Total Inf	111	12	3	2
	Non-Inf	95	145	30	18	Total Non-Inf	240	48		
						Inf:Non-Inf	31.6%	20.0%		
						Δ LC	−89.2%			
4	Inf	16	14	4	8	Total Inf	30	12	3	2
	Non-Inf	52	30	15	27	Total Non-Inf	82	42		
						Inf:Non-Inf	26.8%	22.2%		
						Δ LC	−60.0%			

(*Continued*)

Table 2 (Continued).

Pat No	Type	B/L		Post-Tx		Item	B/L	Post-Tx	G3/G4 (IGA)	
		R	L	R	L				B/L	Post-Tx
5	Inf	109	75	19	20	Total Inf	184	39	4	2
	Non-Inf	201	222	55	36	Total Non-Inf	423	91		
						Inf:Non-Inf	30.3%	30.0%		
						Δ LC	−78.8			
6	Inf	7	19	1	1	Total Inf	26	2	3	1
	Non-Inf	35	11	3	1	Total Non-Inf	46	4		
						Inf:Non-Inf	36.1%	33.3%		
						Δ LC	−92.3%			
7	Inf	24	38	4	4	Total Inf	62	8	3	1
	Non-Inf	41	47	19	4	Total Non-Inf	88	23		
						Inf:Non-Inf	41.3%	25.8%		
						Δ LC	−87.1%			
8	Inf	19	41	4	1	Total Inf	60	5	3	1
	Non-Inf	13	30	4	7	Total Non-Inf	43	11		
						Inf:Non-Inf	58.3%	31.3%		
						Δ LC	−97.1%			
9	Inf	39	21	2	2	Total Inf	60	4	3	2
	Non-Inf	60	56	9	9	Total Non-Inf	116	18		
						Inf:Non-Inf	34.1%	18.2%		
						Δ LC	−93.3%			

Note: Post-Tx=32 weeks after final treatment.
Abbreviations: B/L, Baseline; Inf, Inflammatory lesions; Non-Inf, Noninflammatory lesions; Δ LC, Lesion change rate.

incubation time, the clingfilm was removed, any excess anesthetic cream was carefully removed and the skin thoroughly dried as any water left on the skin would act as a competing chromophore for the 1927 nm wavelength.

Each treatment session with the FTL device comprised three steps. The first step was completed by treating the full face (lesional and nonlesional skin) with a roller tip (microbeam diameter of 200 μm), setting the device to random mode, energy of 7–10 mJ/pulse, and delivering 1 pass in a horizontal direction and 1 pass in a vertical direction. The next step focused on treating the areas with enlarged pores and acne with the same roller tip in random mode, 7–10 mJ/pulse, but this time completing 5 passes over the same area while moving the handpiece along the same linear pathway each time in a painting or planing technique. The final step of the treatment involved spot treatments of the pore areas and acne lesions in a static manner with the 350 μm tip at a microbeam density of 144/cm^2 with an energy setting of 5–7 mJ with 1 pass over the pores and an additional pass over the acne lesions. The endpoint for treatment was diffuse erythema and mild edema with a mild feeling of heat persisting in the skin following treatment. Subjects 1 to 5 received 6 treatment sessions, whereas subjects 6–9 received 5 sessions. Sessions were separated by approximately 4 weeks.

Air cooling was applied throughout the treatment, and ice packs were applied immediately following treatment to provide additional comfort followed by a moisturizing cream applied over the treatment area. The patients were asked to

avoid scrubbing their faces for at least 48 hours after the treatment but were permitted to gently wash their face as needed. All subjects were requested to continue with their daily skincare regimen and were asked to include daily application of a moisturizer and UVA/B sunscreen (minimum SPF 30) if not already part of their daily regimen.

Note that no form of treatment, topical or otherwise, was performed other than the 1927 nm FTL during the laser sessions, or was allowed between the laser sessions and during the 32-week follow-up period with the exception of washing gently with hypoallergenic soap in order to accurately assess the results of the 1927 nm FTL treatment for inflammatory and noninflammatory acne.

Assessments

Clinical photography was taken throughout patient participation from baseline to the final assessment around 32 weeks after the final treatment. Straightforward digital color images were captured with a Canon DSLR camera in addition to image analysis of the inflammatory state of the acne lesions with a professional skin image analysis system (Mark-Vu, PSIPLUS Co Ltd, Seoul, Korea). Images were captured at baseline before any treatment with the FTL device, before and after each treatment session, as well as at the final 32-week assessment visit. The clinical photography was reviewed by two independent dermatologists to count the total number of inflammatory and noninflammatory acne lesions for each patient to obtain an Investigator Global Assessment (IGA). To calculate the potential efficacy of the treatment, the total number of both types of lesions, the ratio of lesion occurrence, and any improvement were assessed based on the IGA. Furthermore, the severity of the acne for each patient was graded at baseline and at the final assessment based on the IGA on the accepted 5-point scale as follows.[15]

Grade 0: No acne, clear skin.

Grade 1: Simple noninflammatory acne – comedones (closed or open).

Grade 2: Comedones and appearance of some papules.

Grade 3: Larger inflammatory papules, appearance of some small pustules and a few cysts.

Grade 4: Even more severe cysts becoming confluent and large infected pustule formation, with potential for residual scarring.

Adverse events and unexpected side effects were evaluated throughout the duration of the study, with skin assessments being made both before and after each treatment in addition to asking the patient for anything untoward they may have noticed. The primary adverse events during the study comprised unwanted pigmentary and textural changes and any additional erythema or edema outside of the anticipated mild erythema during and immediately after the treatment itself. Patients were also asked to rate their overall level of pain during the treatment on an 11-point visual analogue scale (VAS) where a maximum score of 10 indicated the worst possible pain, while a zero would indicate the patient experienced no pain during treatment.

All recorded data were tabulated and examined for statistical significance. A paired Student's *t*-test compared the baseline total lesion counts between the left and right sides of the face, and between the baseline and final results for total lesion counts. An unpaired Student's *t*-test was used to examine the results for the reduction of total lesion counts between the group who had 6 treatments and those who had 5 (IBM SPSS Inc, Chicago, Il, USA).

Results

All subjects successfully completed the study as planned, in the 32-week follow-up after the final treatment session. No adverse events were reported by either the subjects or the investigator, and the pain score during treatment was 3 in 3 subjects and 4 in the remaining 6 (Table 1), so discomfort was mild. All subjects were satisfied with the result at the final assessment, and all subjects would be happy to recommend the treatment to friends or relatives who had moderate-to-severe acne.

The total energy delivered per session per patient (in kJ) is shown in Table 1, from which it can be seen that the required energy tended to decrease over the sessions, with the exception of Subject 1 in whom an increase was seen.

At baseline, there were just under twice as many noninflammatory compared with inflammatory lesions with no significant difference in the total lesion counts between the left and right sides of the face (P = 0.3413, paired *t*-test). A highly statistically significant decrease was seen in all inflammatory and noninflammatory lesion counts between the

baseline and final 32-week assessment. The mean value for the total number of inflammatory lesions (right plus left) was 89.9 at baseline and 11.0 at the final assessment, with P = 0.0012. For noninflammatory lesions the baseline count was 154.3 which decreased to 33.4 at the final assessment (P = 0.0081, paired *t*-test for both types of lesion). The rate of lesion reduction expressed as a percentage of the final assessment versus the baseline values ranged from −60,0% to −97.1%. Interestingly, there was no statistically significant difference in the change rate in the total lesion count between the group that received six treatment sessions and that which received five sessions (P = 0.2609, unpaired *t*-test). The IGA-based acne grade decreased in all subjects, with a reduction of 3 achieved in 2 subjects, 2 in 4 subjects and 1 in 3 subjects (Figure 2). The above data are summarized in Table 2.

Clinical Photography

Representative clinical photography at baseline and the 32-week assessment can be seen in Figures 3 and 4. The upper images were color photographs captured with a digital single lens reflex camera, and the lower images were captured with the image analysis system to show the decrease in inflammation. A 16-year-old female with grade 4 acne at baseline is seen in Figure 2a, with the result in Figure 2b showing significant reduction in the lesions and a drop in the acne grade from 4 to 1 which was echoed in the reduction of inflammatory lesions in the image analysis. Figure 3a shows a 15-year-old male with severe acne grade 4 at baseline, which had improved significantly as seen in Figure 3b with a drop in acne grade to grade 1. The reduction of inflammatory lesions from baseline to final assessment was also seen in the image analysis.

Discussion

This case series study has one very major limitation, namely the extremely small number of subjects. This means that it is very difficult to extrapolate the results into the general population, therefore a larger scale study is obviously required. However, it should be noted that all of the 9 subjects achieved significant clearance of both inflammatory and noninflammatory lesions concomitantly with a high percentage of change in lesion count and with a reasonably long-term follow-up. In addition, future studies should also consider a comparative approach to evaluate the efficacy of 1927 nm fractional thulium laser against other established laser treatments for acne, especially the lasers with similar mechanisms.

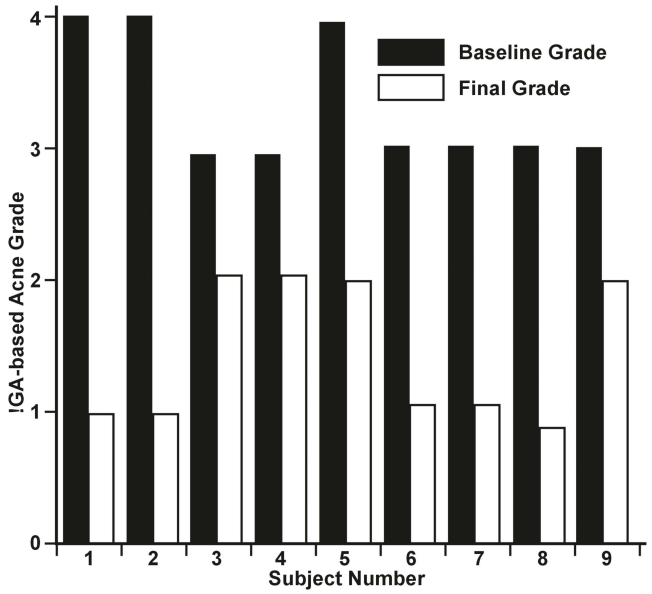

Figure 2 Bar graphs illustrating the changes in the Investigator Global Assessment-based acne grades for each patient. For an explanation of the grades, please refer to the text.

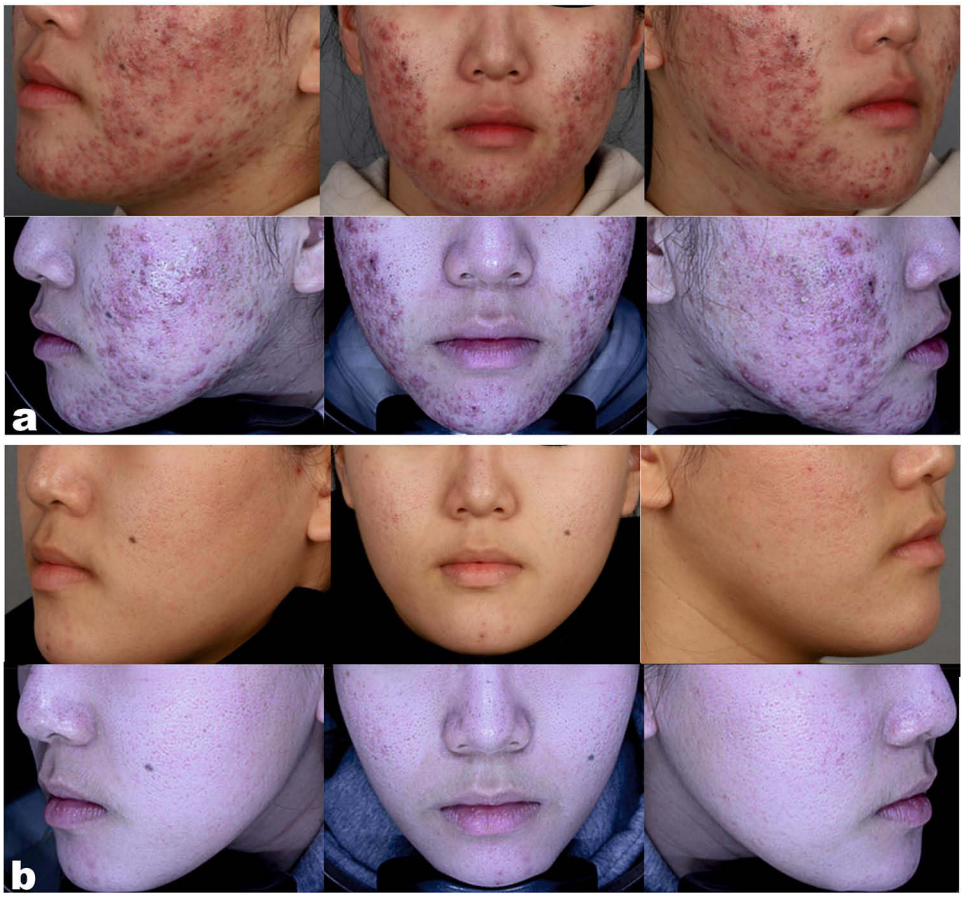

Figure 3 Clinical photography of Subject 1 (16-year-old female) at baseline (**a**) and at the 32-week final assessment (**b**) showing an excellent improvement in the acne lesions. Upper images are captured with a digital SLR camera, while the lower images are obtained from the image analysis system showing the improvement in the inflammatory component of the acne lesions.

Cutibacterium acnes in normal skin is a commensal bacterium which exists in the stratum corneum, where it metabolizes sebum, releasing free acids, acting to inhibit *C. acnes* colonization and aiding in binding together the keratin plaques making up the stratum corneum, thereby helping to maintain the first line of defence of the skin barrier function. Four main pathological factors are recognized as being involved in the development of acne: over-production of sebum; irregular shedding of follicle walls; proliferation in the follicle and sebaceous glands of *C. acnes* under anaerobic conditions; and the development of an inflammatory response as the larger numbers of *C. acnes* run out of sebum to metabolize and start to digest and cause damage to the follicular walls.[16] Added to this process is a recent understanding of the key role played by activation of the immune system by phylotypes of *C. acnes* in advancing the development of acne and establishing a vicious circle involving *C. acnes*, inflammation and the immune response,[17,18] It therefore makes sense to regard *C. acnes* as the major bacterium in the development of acne lesions, and therefore to make it the target of treatment approaches, either medical or others such as laser energy, and furthermore to make robust eradication of *C. acnes* the main goal of treatment to eliminate inflammation and calm down the immune system response. While oral and topical approaches work, they only work as long as they are applied and do not often offer a permanent or even a semipermanent solution. On the other hand, a resurgence of interest in laser treatment appears to offer a longer-term solution.

An article on a new diode laser delivering a 1726 nm wavelength has been published on the treatment of acne vulgaris, which demonstrated long-lasting results that persisted for up to 6 months post-treatment.[8] This study involving 104 subjects reported that 87% of the population exhibited at least a 50% reduction in the number of active acne inflammatory lesions. The average pain score reported by the patients in this study was 5.6/10 during the first treatment.

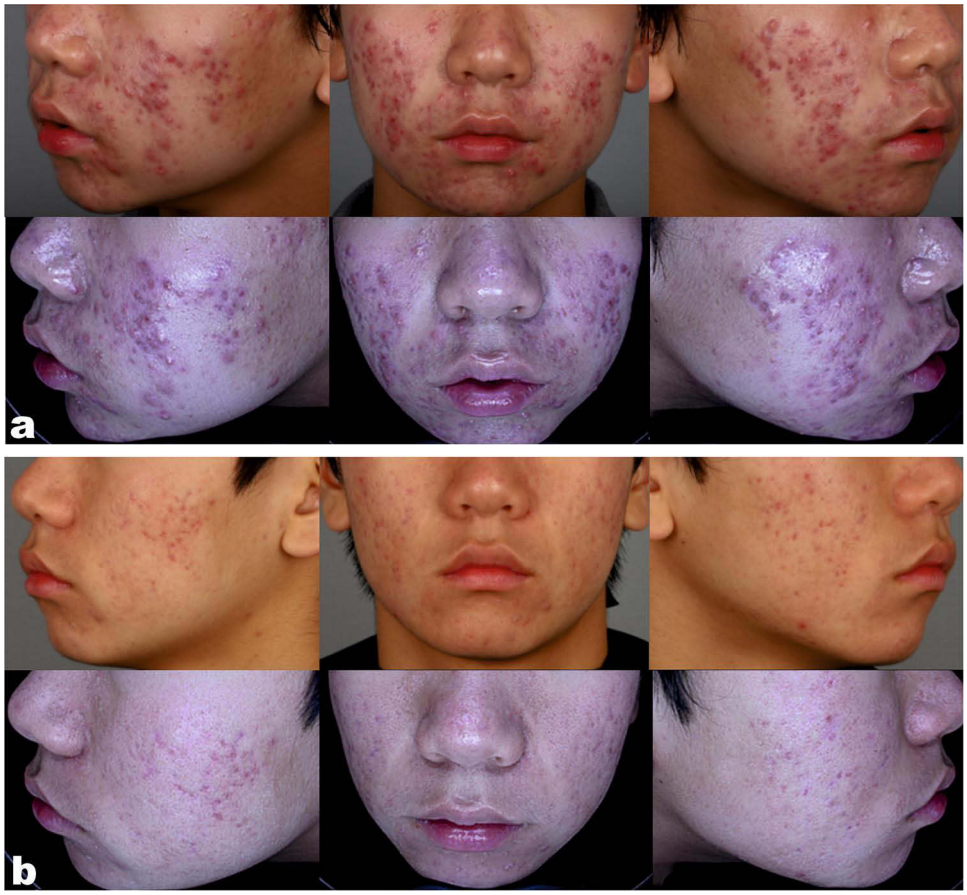

Figure 4 Clinical photography of Subject 3 (15-year-old male) at baseline (**a**) and at the 32-week final assessment (**b**) also showing an excellent improvement in the acne lesions. Upper images are captured with a digital SLR camera, while the lower images are obtained from the image analysis system showing the improvement in the inflammatory component of the acne lesions.

According to the authors, the device works by disrupting the sebaceous glands and sparing the surrounding tissue. This allows the device to treat the source of the acne while minimizing the overall thermal effect in nearby tissue.

While it appears that the recent 1726 nm devices are able to prove the efficacy and safety required for acne treatments, it is important to evaluate the effectiveness of the device and consider the acne sufferer's overall experience in regards to treatment pain. Whereas the 1726 nm wavelength has a specific affinity for sebaceous glands and can therefore damage or destroy *C. acnes* through this route, the 1927 nm laser has an affinity for tissue water. On the water absorption curve, the 1927 nm laser is more effective than the 1540 nonablative Er: glass systems, but is absorbed much less in water than the fully ablative 2940 nm Er: YAG and 10,600 nm CO_2 lasers [Figure 5]. Through leveraging this specific water absorption characteristic at 1927 nm, a consistent histopathological pattern is seen for FTL impacts in tissue, as demonstrated in Figure 6 showing an FTL impact over a sebaceous follicle. The depth of mild and controlled coagulation is around 400 μm under mild but transient disruption of the dermoepidermal junction and stratum spinosum. The stratum corneum, on the other hand, is intact owing to its low water content. This acts as a biological dressing and allows swift wound repair to occur under it. This 1927 nm FTL water-based tissue reaction involving not only the sebaceous glands but also surrounding tissue can explain why efficacy was seen in both inflammatory and noninflammatory lesions, the latter often proving more difficult to treat than the former.

A recent study assessed the efficacy of the 1927 nm thulium laser with or without 30% salicylic acid on active acne and acne scars in 33 patients.[9] In both groups, there were significant improvements in the active lesion and scar scores at 18 weeks post-final treatment. The authors also mentioned inhibition of sebaceous gland secretion, and bactericidal effect as mechanisms which may be considered. The findings of the present study corroborate these findings by Huang and et al.

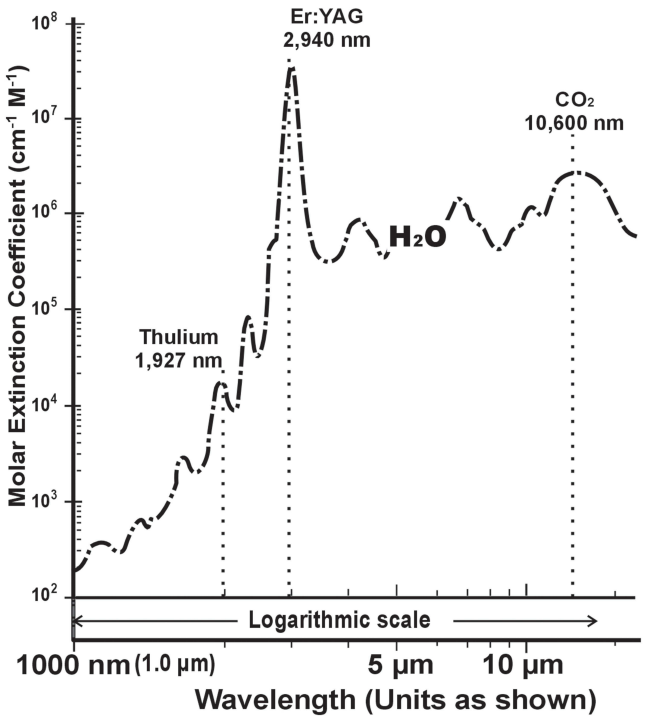

Figure 5 Absorption curve for tissue water in the near and mid-infrared wavebands, comparing the lower absorption coefficient in water of the 1927 nm thulium laser with the much higher absorption of the Er:YAG and CO_2 lasers.

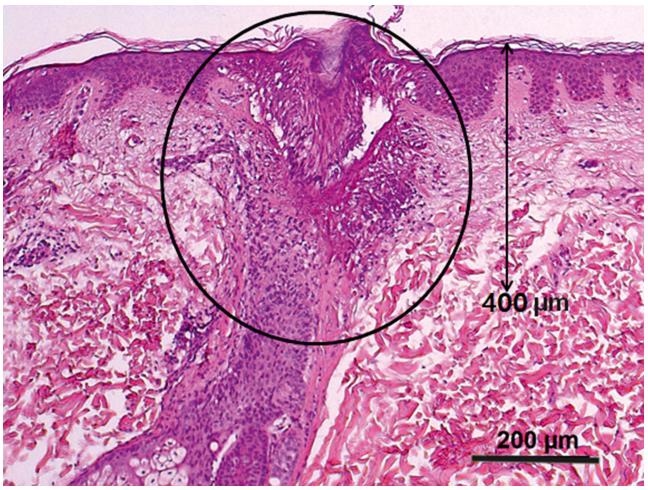

Figure 6 Light microscopy photomicrograph depicting selective photothermolysis of the infundibulum of a sebaceous follicle to a depth of 400 µm from the skin of Subject 1 immediately after a treatment session with the 1927 nm fractional thulium laser. Note the reasonably intact stratum corneum which will act as a biological dressing under which wound healing and follicular remodeling can occur. (hematoxylin and eosin staining, human skin: courtesy of Lutronic pathology laboratory).

1927 nm lasers have been found to be highly versatile and have shown efficacy in the treatment of general rejuvenation, pigmented lesions, hair regrowth, and minor textural improvements.[19–22] The results from these articles and from his own experience with the 1927 nm wavelength[23] prompted the author to consider the 1927 FTL approach for the treatment of acne. This was based on the anatomy of the sebaceous follicle, in particular the infundibulum reaching from the surface of the skin down to the sebaceous glands and their openings into the follicle: these structures are usually at a depth of around 400 µm, which is the depth of coagulative damage achieved by the 1927 nm FTL (Figure 5). If this is the case, then a controlled zone of coagulative damage will encompass the target follicular infundibulum, with repeated treatment sessions at approximately four-week intervals gradually damaging the large majority of the *C. acnes* in the

target area and, as seen from the present study, offering good clearance up to 32 weeks after the final treatment for either five or six treatment sessions. This controlled coagulative damage is potentially followed by follicular remodeling. All of the nine subjects in the present study achieved a lesion reduction rate of at least 60%, with 97% being achieved in the most effective case. It should be noted that this efficacy was achieved in both noninflammatory and inflammatory lesions, suggesting that the 1927 nm approach is more effective than the 1726 nm wavelength in the treatment of both types of acne. In addition, the pain score was less with the 1927 nm laser than the 1726 nm system (3.67 compared with 5.6).

Moreover, the entire face was treated with two passes in the first stage of each treatment session, including nonlesional skin, before concentrating the 1927 nm laser energy over the affected pores and acne lesions in stages two and three, as explained in the Subjects and Methods section. This means that mild and superficial controlled coagulation was delivered to the entire skin of the face in a fractional manner, leaving areas of undamaged tissue in between the subablative FTL impact zones. These controlled zones of superficial dermal coagulation could potentially induce the wound healing process with collagenesis and elastinogenesis followed by tissue remodeling.[24] Thus, in addition to treating the acne lesions, it is possible that the overall skin condition of the subjects was improved. This is an added benefit for acne sufferers associated with 1927 nm FTL treatment.

Apart from the anticipated transient erythema, mild pain and edema, no other side effects were recorded. In other reports with other approaches, mild acneiform eruption is often noted as a side effect which did not appear in the present study. However, that may be a consequence of the small number of subjects, so it has to be noted that acneiform eruption may appear as a side effect in future studies with much larger populations.

Conclusions

The 1927 nm fractional thulium laser used at the parameters and with the protocol discussed in the present study achieved robust reduction of both inflammatory and noninflammatory acne lesions over a long-term eight-month follow-up in a safe and effective manner, with mild pain and no adverse events. Further studies with much larger patient populations are required to confirm the optimistic results of the present study.

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Disclosure

The author reports no conflicts of interest in this work.

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