PRELIMINARY EXPERIENCE IN FACIAL AND BODY CONTOURING WITH 1444 nm MICROPULSED Nd:YAG LASER-ASSISTED LIPOLYSIS: A REVIEW OF 24 CASES

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Background and Aims: Near-infrared laser-assisted lipolysis has claimed attention recently as a fast, safe and effective way to remove unwanted fat from various areas of the body. Removal of fat from the face has however proved more difficult. A novel 1444 nm line of the micropulsed Nd:YAG has recently been developed, offering superior duality of absorption in both fat and water. The present preliminary study was designed to assess the efficacy of the 1444 nm wavelength in facial and body contouring.

Subjects and Methods: Twenty-four informed and consenting female patients (ages ranging from 23 yr to 59 yr, mean age 32.38 ± 7.26 yrs) were recruited into the study. The laser used was a micropulsed 1444 nm Nd:YAG system. Following tumescent anesthesia, the tip of the optical fiber was placed in the subcutaneous fat via a cannula inserted through a small puncture wound, and lasing was commenced while the tissue over the end of the optical fiber was continuously palpated to check for excessive heat formation. Cold compresses were applied post-lasing. Patients were followed for at least 2 months with clinical photography at baseline, immediately post-treatment and at subsequent assessment points.

Results: All patients successfully completed the study. Patient subjective satisfaction was high, and an objective clinician assessment from the clinical photography showed good efficacy. There were no major adverse side effects. Minor side effects were transitory, all resolved spontaneously and good results were maintained during a 2 - 3-month follow-up.

Conclusions: The present study showed high efficacy for the 100 μ s micropulsed Nd:YAG laser at 1444 nm for laser-assisted lipolysis of both body and facial areas, with no adverse side effects and virtually no downtime. The high absorption rate of 1444 nm in both fat and water, coupled with the 100 μ s pulse, was believed to contribute highly to the success of the study and the satisfaction of the patients. Further larger studies are warranted.

Key Words: Laser-assisted lipolysis; laser-assisted facial contouring; thermal confinement; absorption coefficient; macrophage activity; skin tightening

Introduction

Optical fiber-delivered laser-assisted lipolysis at wavelengths of 980, 1064 and 1320 nm has claimed attention recently as a safe and effective way to remove unwanted fat from various areas of the body, with less downtime and fewer sequelae than conventional liposuction.¹⁾ Removal of fat from the face has however

proved more difficult with a higher tendency for post-treatment thermally-related damage due to the thinner subcutaneous fat layer and finer skin of the facial area. A novel 1444 nm line of the micropulsed Nd:YAG has recently been developed, offering superior duality of absorption in both fat and water, thus theoretically confining heat to the tissue immediately adjacent to the tip of the fibre.²⁻⁴⁾ Because of this phenomenon of thermal confinement, there was the possibility that this wavelength could allow more precise facial contouring with less chance of adverse thermally-related side

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effects. The present preliminary study was therefore designed to assess the efficacy of the 1444 nm wavelength in laser-assisted body and facial contouring.

Subjects and Methods

Twenty-four female patients (ages ranging from 23 to 59, mean age 32.38 ± 7.26 yrs), 13 patients requiring body contouring and 11 patients requiring facial contouring, were recruited into the study. There were 33 sites to be treated in the 24 patients, 17 on the body (upper arms, 3; abdomen, 4; flanks, 4; buttocks, 1; lateral thighs, 4; and calves and ankles, 1) and 16 on the face (infraorbital fat, 2; lower cheek, 5; nasolabial fold, 1; jowls, 4; and submental area, 4). Patient demographics are given in **Table 1**. The study was approved by the Ethics Committee of the HerShe Clinic, and all subjects, having been informed of the purpose of the

study and possible outcomes, gave written informed consent to participate in the study and for the use of their clinical photography.

The laser used was the AccuSculpt® (Lutronic Corporation, Ilsan, Korea), a micropulsed 1444 nm Nd:YAG system delivering a 100 μ s pulse, repetition rate 20-40 Hz, and pulse energy, 100-300 mJ. Following tumescent anesthesia with a saline/lidocaine+epinephrine/ NaHCO₃ solution (1.5 – 30 cc for facial sites and 40 – 60 cc per area for body contouring), the tip of the optical fiber was placed about 4 mm below the skin surface in the subcutaneous fat of the area of interest via a cannula inserted through a small puncture wound (an 18 G needle was used on the face), or for more delicate areas of the face, the bare fiber can also be used for laser-assisted facial contouring (LAFC). The visible red aiming beam can be clearly seen transilluminating the skin, and by keeping the perceived size

Table 1: Patient demographics

Body			Face		
Patient No	Age (yrs)	Area(s) treated*	Patient No	Age (yrs)	Area(s) treated*
1	30	LT	14	36	IO/NF
2	37	A/F	15	59	LC/J
3	38	U	16	23	LC/SM
4	33	LT	17	35	LC/J
5	24	LT	18	29	SM
6	24	A/F	19		LC
7	33	U	20	35	SM
8	28	U	21	28	IO
9	26	B	22		LC/J
10	34	CA	23	38	J
11	37	A/F	24	34	SM
12	27	A/F			
13	35	LT			

***Areas treated:**

Body: U, upper arm; A, abdomen; F, flanks; B, buttocks; LT, lateral thigh; CA, calf & ankle

Face: IO, infraorbital; LC, lower cheek; NF, nasolabial fold; J, jowls; SM, submental

Table 2: Patient subjective satisfaction grades, clinician efficacy grades and their explanation

Patient satisfaction grades		Clinician Efficacy Grades	
Grade	Description	Grade	Description
5	Highly satisfied	5	Excellent (>85% improvement)
4	Very satisfied	4	Very Good (65% -84%)
3	Satisfied	3	Good (45% - 64%)
2	Neither satisfied nor dissatisfied	2	Poor (0% - 44%)
1	Dissatisfied	1	Worse (increased girth)

and intensity of the beam constant, the fiber can be maintained at the ideal depth.

Lasing commenced in the usual pattern for lipolysis, keeping the cannula/fiber in continuously even motion and constantly palpating the tissue over the end of the optical fiber to check for excessive heat formation, particularly important on the face for LAFC. The total energy delivered per treatment area ranged from 5 J (infraorbital) to 2115 J (body contouring). The endpoint was lack of resistance of the lysed fat to progress of the fiber, and the appearance of lysed fat at the entry point following finger pressure on the area of interest. If the endpoint was reached before the rec-

ommended value for total joules, lasing was stopped. Lysed fat was aspirated together with the remaining tumescent solution, and the fat was allowed to settle and measured. Cooling was then applied, and the entry point covered with a small Tegaderm™ dressing.

Digital clinical photography (Canon 450D, Japan) was taken under as near identical conditions as possible at baseline (pretreatment), immediately after treatment, 1, 2, 4 and 7 days post-treatment and then at 2, 4, 8 and 12 weeks post-treatment. Patients assessed their satisfaction with the treatment on a 5-point scale immediately after treatment and at their final assessment session (**Table 2**). The clinical photography,

Table 3: Patient details: Aspirated fat, laser parameters, side effects, and subjective and objective assessments

Pat. No	Laser parameters				Asp. fat (ml)*	Side effects & grade [†]	F/U (wks)	Grading scores			
	P/W (mJ)	F (Hz)	O/P (W)	T/E (J)				Patient		Clinician	
								F	L	F	L
Body											
1	150	40	7	1230	700	p +; e ++; r +; i +; h -	8	2	4	3	4
2	175	40	7	1130	500	p -; e +; r -; i -; h +	8	3/4	5/5	3/4	4/5
3	175	40	7	2000	300	p -; e +; r -; i -; h +	8	3	4	4	4
4	150	40	6	1000	800	p -; e +; r -; i -; h ++	8	3	5	4	5
5	170	40	7	1320	500	p +; e ++; r -; i -; h +	12	4	5	4	5
6	170	40	7	1850	500	p -; e +; r -; i -; h +	12	4/4	4/5	4/4	5/5
7	175	40	7	2000	350	p -; e +; r -; i -; h +	8	4	5	4	5
8	175	40	7	3450	300	p +; e -; r -; i -; h ++	8	2	4	3	4
9	170	40	7	1550	550	p -; e +; r -; i -; h ++	12	4	5	5	5
10	150	40	6	2115	30	p -; e +; r -; i +; h ++	8	2	3	3	3
11	170	40	7	1650	500	p -; e +; r -; i +; h ++	8	4/4	5/5	4/5	5/5
12	170	40	7	1950	1500	p -; e -; r +; i -; h -	8	5/5	5/5	5/5	5/5
13	150	40	7	1250	550	p -; e +; r -; i -; h +	12	3	5	4	5
Face											
14	150	40	6.1	1032	5	p -; e +; r -; i -; h -	8	2/3	3/4	2/3	3/4
15	150	40	6.0	1258	12	p -; e +; r -; i -; h -	12	3/4	4/5	3/5	4/5
16	130	40	5.2	1316	12	p +; e -; r -; i -; h -	12	3/4	4/4	3/5	4/5
17	130	40	5.2	1250	13	p -; e -; r -; i -; h +	10	2/3	2/3	3/3	2/3
18	150	40	6.0	1540	5	p -; e +; r -; i -; h -	12	3	5	4	5
19	120	40	5.2	1052	6	p -; e +; r -; i -; h -	12	4	5	4	5
20	150	40	6.0	1418	10	p +; e +; r -; i -; h +	8	4	5	4	5
21	150	40	6.0	1032	10	p -; e +; r -; i -; h +	12	2	3	2	4
22	150	40	6.0	645	10	p -; e +; r -; i -; h -	12	3/3	4/5	3/4	4/5
23	175	35	6.1	797	15	p -; e +; r -; i -; h -	12	3	4	2	3
24	175	35	6.1	850	8	p -; e +; r -; i -; h +	8	2	4	3	4

P/W = Pulse width; F = Frequency; O/P = Output power; T/E = Total energy; Asp. fat = Aspirated fat;

F/U = follow-up; F = First assessment, immediately after 1st treatment; L = Final assessment;

*bilateral, where applicable

† Side effects & grade:

p, pain; e, edema; r, erythema; i, inflammation; h, induration; +++, severe; ++ moderate; + some; -, none.

which was not in chronological order, immediately after the first treatment and at the final assessment was assessed for efficacy compared with the baseline by 2 independent clinicians, who reached consensus where required following discussion, and who also rated the improvement on a 5-point scale (**Table 2**). The patient satisfaction index was calculated by the sum of the sites which patients scored as 4 or 5 expressed as a percentage of the total number of sites. Overall efficacy was calculated by the sum of number of sites scored by the clinicians as 4 or 5, expressed as a percentage of the total number of sites.

Results

All patients completed the study, but for reasons depending on their other commitments, 11 patients

completed the full 12-week follow-up, 1 patient completed 10 weeks and the remaining 12 patients completed 8 weeks. The shortest follow-up was therefore 8 weeks. The anticipated side effects, namely pain, edema, erythema, inflammation and slight induration, were mostly mild and all transitory, none lasting for more than 7 days (**Table 3**). No serious unexpected adverse side effects were recorded.

The laser parameters used for individual patients, the amount of fat aspirated and the results of the subjective patient and objective clinician evaluation can be seen in **Table 3** both immediately after the procedure and at the final follow-up. The amount of fat aspirated from the body ranged from 30 – 1500 ml (average 510.00 ± 357.28 ml) and from the face the range was 5–15 ml. In general, results tended to improve with the passage of time. For the sites on the body, 16 out of 17

Fig. 1: A 24-year-old female (Pat. No 6). (a): Pretreatment findings. (b): The excellent result 12 weeks after the 1444 nm body contouring treatment.

were scored as 4 or 5 by both patients and clinicians, and 12 out of 16 sites for the face, giving SI and overall efficacy values of 93% and 63% for the body and face, respectively. For the total sites, the SI and overall efficacy values were both 80%.

Representative cases

The following 4 cases, 1 for the body and 3 for the face, are presented as being representative of the treatment and its effectiveness.

Case 1:

Figure 1 shows a 24-year-old female (Patient No 6)

before (a, c) and 12 weeks after (b, d) body contouring with the 1444 nm interstitial laser. Five hundred milliliters of fat was aspirated. The excellent result of laser-assisted facial contouring (LAFC) is clearly visible, 12 weeks after the procedure.

Case 2:

The 23-year-old female seen in **Figure 2** (Patient No 16) required facial contouring of her lower cheeks and submental area. The baseline findings are seen in **Figure 2a and 2c**, and the final very good LAFC result at the 12-week follow-up is shown in **Figure 2b and 2d**.

Fig. 2: A 23-year-old female (Pat. No 16). (a) & (c): Pretreatment findings. (b) & (d): Very good result 12 weeks post-treatment for LAFC with the 1444 nm system. This is a very good example of slimming down of the typical Korean 'round face'.

Case 3:

Figure 3 shows a 27-year-old female (Patient No 19) who wanted facial contouring of her lower cheeks. The pretreatment condition is seen in **Figure 3a**, and compared with the 1444 nm LAFC result 12 weeks post-treatment in **Figure 3b**, the results are subtle but very good.

Case 4:

The 27-year-old female shown in **Figure 4** (patient No 22) required facial contouring of the lower cheeks and jowls. Pretreatment findings are seen in **Figure 4a and 4c**, and the excellent result at 12 weeks after LAFC with 1444 nm are seen in **Figure 4b and 4d**.

Discussion

Although near-IR energy at 980, 1064 and 1320 nm has been reported as working well for contouring of the body,¹⁾ the skin of the face is much more delicate and side effects have been greater in this area with these wavelengths. The development in 2008 of the unique 1444 nm line of the Nd:YAG offered a wavelength for laser-assisted lipolysis with excellent duality of absorption in both fat and water as illustrated in **Figure 5**^{3,4)} compared with the other wavelengths. In a recent study from Tark and colleagues,²⁾ 1444 nm was shown to be superior to 1064 nm from the point of lipolysis potential in an *in vivo* minipig and *ex vivo* human fat model, with lipolysis significantly better using the 1444

nm laser, so that the 1444 nm laser required approximately 5.2 times less energy than that needed by the Nd:YAG to produce the same degree of lipolysis. In a further comparative *ex vivo* study on fresh porcine fat by Youn and Holcomb,⁵⁾ the 1444 nm laser showed significantly better thermal confinement and higher lipolytic potential than the 1064 and 1320 lines of the Nd:YAG. Thermal confinement is the name given to the phenomenon whereby heat is confined to the tissue adjacent to the tip of the fiber due to the duality of absorption of 1444 nm in both fat and water, the high peak power and short pulse width. The laser energy is therefore almost instantaneously converted to heat in that small volume of tissue, and secondary thermal damage is prevented by the short 100 μ s pulse of the beam which is well below the thermal coefficient of relaxation of fat. This creates a purely radiant heat effect, nonselective photothermolysis, and with appropriate and continuously even movement of the cannula/fiber, secondary conducted heat is minimized thus helping prevent cutaneous overheating and potential burn damage. This is of particular importance for laser-assisted facial contouring (LAFC) where the fat layer and overlying skin are considerably thinner than in other anatomical areas of the body.

Fillers have achieved a degree of popularity for facial contouring, but very often the contouring required necessitates the removal of prolapsed fat rather than the addition of extra volume. Even in the case of nasolabial and melomental folds, lysis of pro-

Fig. 3: A 27-year-old female (Pat. No 19). The pretreatment condition is seen in Figure 3a, and compared with the result of the 1444 nm LAFC 12 weeks post-treatment in Figure 3b, the results are subtle but very good.

lapsed fat can dramatically reduce the depth of the fold, whereas filling the fold will also reduce the depth, but at the expense of adding more total volume: in any event, fillers are in many cases not a permanent solution.

Side effects following both facial and body contouring in the present study were as anticipated and mild, much milder than conventional liposuction which is not really well adopted for facial contouring. None lasted for more than 7 days, the majority spontaneously resolving within 2-4 days. Postoperatively, we always applied a cold compress, and then the entry wound was covered with a Tegaderm® dressing. Patient satisfaction was very high, and in addition to

the good results, they appreciated the minimum disruption to their lifestyle offered by this elegant approach.

Conclusions

Based on the 24 patients in this preliminary study, body contouring and laser-assisted facial contouring (LAFC) with the micropulsed 1444 nm Nd:YAG laser represent a novel, safe and effective approach to the removal of unwanted fat and restoration of a youthful body and face. The characteristics of the 1444 nm beam, with its high duality of absorption in both water and fat, extremely high peak power and 100 μ s pulse,

Fig. 4: A 27-year-old female (Pat. No 22). (a) & (c): The condition before treatment with 1444 nm interstitial laser-assisted LAFC. (b) & (d): The excellent result 12 weeks after the treatment.

mean that heat is well-confined to the target fat at the tip of the fiber, and with the appropriate movement of the fiber, secondary conducted heat is minimal. Results in the body can be very dramatic where there is more fat available for lysis, but LAFC with 1444 nm can also

produce results which range from subtle to very dramatic. The process is well-tolerated, effective and safe, and even in the case of LAFC, patients have virtually no downtime.

Fig. 5: The figure illustrates the water absorption and human fat absorption spectra. The lipolysis wavelengths currently used, namely 980 nm, diode laser, and the 1064 nm and 1320 nm lines of the Nd:YAG are compared with the 1444 nm line of the micropulsed Nd:YAG. Significantly superior duality of absorption in both fat and water is seen for the 1444 nm wavelength. The high fat absorption ensures efficient lipolysis, and the strong water absorption ensures confinement of the thermal reaction to the tissues around the tip of the optical fiber.

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