Treatment of atrophic acne scars with 1046 nm Nd:YAG and TCA CROSS technique

Zeinab Shahin[a], Sherine O. Tawfik[a], Naglaa S. Zaki[a], Mohamed H.M. EL-Komy[a] and Nermine Bedir[b]

[a]Department of Dermatology, Faculty of Medicine and [b]Student Hospital, Cairo University, Cairo, Egypt

Correspondence to Naglaa S. Zaki, MD, Department of Dermatology, Faculty of Medicine, Cairo University, Cairo, Egypt
Tel: +2010 9977707; fax: +20233052633;
e-mail: naglaa.sameh@midtap.com.eg

Received 20 August 2010
Accepted 25 September 2010

Journal of the Egyptian Women's Dermatologic Society 2011, 8:101–107

Background
Various modalities had been tried for treatment of acne scars. Both 1064 nm Nd:YAG laser and chemical reconstruction of skin scars (CROSS) using high trichloroacetic acid (TCA) concentrations have been used in the treatment of atrophic acne scars and depressed wrinkles.

Objective
To compare the effect of the nonablative 1064 nm Nd:YAG with the 100% TCA CROSS technique in the treatment of atrophic acne scars in patients with darker skin complexion.

Patients and methods
Twenty patients with bilateral postacne scars on the face were enrolled in this study. TCA 100% CROSS method was performed on the left side of the face, and nonablative long-pulsed 1064 nm Nd:YAG treatment was given on the right side of the same patient.

Results
There was statistically significant improvement ($P<0.001$) in the degree of scar severity in all patients according to the qualitative global acne scarring system grading. Comparing scar improvement of left with right sides of the face showed that, although scar severity improvement was slightly higher on the TCA CROSS side, yet, this difference was statistically insignificant ($P>0.05$).

Conclusion
Nd:YAG seems to be a safer method to treat atrophic acne scars, especially of the rolling type, than the high-concentration TCA CROSS technique.

Keywords:
acne scars, Nd:YAG, TCA

J Egypt Women Dermatol Soc 8:101–107

1687-1537

Introduction

Acne scarring is a consequence of abnormal resolution or wound healing after the damage that occurs in the sebaceous follicle during acne inflammation [1]. The two causes of acne scar formation can be broadly categorized as a result of increased tissue formation or, the more common cause, loss or damage of tissue that results in the atrophic type of scars [2]. The most widely used atrophic acne scar classification described by Jacob *et al.* [3] divides atrophic scars into three types: icepick, rolling, and boxcar scars.

Various modalities had been tried for treatment of such scars including punch excision, punch elevation, subcision, chemical peels, dermabrasion, filler materials, and both ablative and nonablative lasers [4]. However, no standardized method has ever been followed. As a result, it is impossible to compare treatment approaches [5].

Both 1064 nm Nd:YAG laser and chemical reconstruction of skin scars (CROSS) using high trichloroacetic acid (TCA) concentrations have been used successfully in the treatment of various types of atrophic acne scars and depressed wrinkles [6–12].

In this study, we examined and compared the effect of the nonablative 1064 nm Nd:YAG with the 100% TCA CROSS technique in the treatment of atrophic acne scars in patients with a darker skin complexion.

Patients and methods

Twenty patients with bilateral post acne scars on the face, recruited from Kasr Al Aini and Student's Hospital outpatient clinics of Cairo University, were enrolled in this study after approval from the dermatology research ethics committee of Cairo University. The duration of the study was 4 months.

Ten men and 10 women of skin types III and IV were included in this study. Inclusion criteria included bilateral atrophic acne scars and age above 16 years. Exclusion criteria included pregnancy, lactation, evidence of keloidal scarring, current or recent treatment with systemic retinoids or immunosuppressive drugs, photosensitive disorders or photoactive medications intake, and any koebnerizing skin disease or history of herpes simplex infection. Patients were allowed to continue previous acne medications during the

course of the study except for retinoids and medications known for their photosensitizing potential.

The following items were completed for all patients:

(1) An informed consent was obtained from all patients before enrollment.
(2) A complete history was obtained including history of keloidal scarring, herpes simplex, and warts.
(3) General dermatological examination for any associated skin disease.
(4) Scars and active acne lesions on both sides were assessed before starting treatment, at the beginning of every treatment session, and at each follow-up visit according to qualitative global scoring system and simple grading system of acne vulgaris [13].
(5) Facial photographs to both face sides using a Nikon Coolpix P5100 digital camera were taken before treatment and at each visit. TCA 100% CROSS method was performed on the left side of the face, and nonablative long-pulsed 1064 nm Nd:YAG treatment was given on the right side.
(6) Any observed side effects were recorded at every treatment session and at follow-up visits.
(7) Patients' self assessment of the whole procedure was obtained at the final visit and which technique they preferred.
(8) Besides the investigators, three blinded dermatologists and the patient himself evaluated the clinical response to treatment for each patient by commenting on side-by-side comparison of before and after treatment photos of both sides of the face. They were asked to record a percentage of improvement on a 0–4 scale (0 = no improvement, 1 = 1–25% improvement, 2 = 26–50% improvement, 3 = 51–75% improvement, and 4 = 76–100% improvement) for each side.

Methods

Wooden applicators' tips were sized to dull point approximating the size of the scars, and used to apply full concentration TCA (TCA was prepared to order by a local pharmacy). Focal pressing by the applicator to each scar was maintained till frosting appeared. Topical antibiotic was applied, followed by a sunscreen. The sessions were repeated every 4–6 weeks.

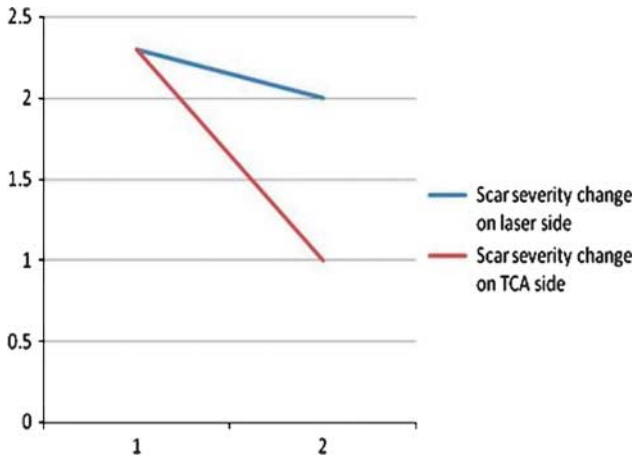
On the right side of the face, on the same treatment session, nonablative resurfacing was performed using long-pulsed 1064 nm Nd:YAG laser (DEKA Synchro HP device, Italy) every 2–3 weeks. Fluencies ranged between 50 and 70 J/cm^2, using 5–7 mm^2 spot size hand pieces, and pulse durations ranged from 55 to 78 ms (pulses were fractionated into three subpulses in a pulse train, with

Table 1. Grades of scars according to qualitative global acne scarring grading system before and after treatment and *P* values of both sides comparing before and after treatment, and comparing both sides after treatment evaluated by the investigators

Patient	Right side before laser	Right side after laser	Left side before TCA	Left side after TCA
1	4	4	4	2
2	3	2	3	2
3	3	2	3	2
4	3	2	3	2
5	3	1	3	2
6	3	2	3	2
7	3	2	3	2
8	4	3	4	2
9	4	4	4	2
10	4	2	4	2
11	4	0	4	1
12	4	3	4	2
13	3	3	2	2
14	2	0	2	0
15	2	1	2	1
16	2	2	2	2
17	3	2	3	2
18	4	3	4	3
19	3	2	3	2
20	3	2	3	2

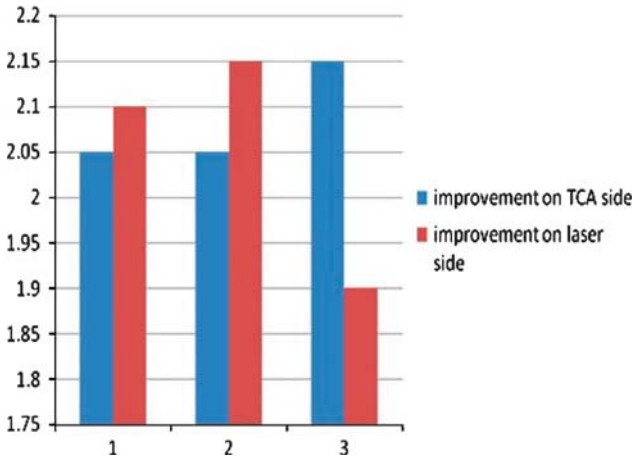
	Right side scars prelaser vs. postlaser	Left side scars pre TCA vs. post TCA	Right vs. left sides scars posttreatment
P value	<0.001	<0.001	0.248

Figure 1.



Scar severity according to the qualitative global acne scarring system before and after treatment.

Figure 2.



Average improvement on each side according to masked dermatologists.

Table 2. Observers' evaluation and patients' assessments and *P* values

	First observer		Second observer		Third observer		Patient assessment	
Patient	Right	Left	Right	Left	Right	Left	Right	Left
1	1	2	0	2	0	2	1	3
2	3	2	3	2	2	0	1	1
3	2	2	0	3	1	3	2	1
4	3	3	2	3	2	2	2	1
5	3	2	4	2	3	1	4	2
6	2	2	3	0	1	1	2	2
7	2	1	3	3	0	3	1	1
8	3	1	0	2	1	2	3	4
9	2	3	2	3	3	4	0	3
10	4	3	4	3	4	3	4	3
11	2	4	3	4	4	4	4	2
12	1	2	2	2	1	2	1	3
13	3	2	3	2	4	3	2	2
14	1	2	1	2	3	2	3	2
15	3	4	4	3	2	4	1	1
16	1	0	0	0	0	0	1	1
17	2	0	3	0	2	0	3	2
18	1	1	0	1	0	2	3	2
19	3	3	4	4	4	4	2	1
20	1	2	2	0	1	1	2	1
Laser vs. TCA evaluation	First observer		Second observer		Third observer		Patient assessment	
P value	0.842		0.782		0.446		0.493	

0, no improvement; 1, 1–25% improvement; 2, 26–50% improvement; 3, 51–75% improvement; 4, 76–100% improvement.

delay between the subpulses ranging between 20 and 25 ms). Two passes were performed in each treatment session. Ice packs were applied immediately posttreatment followed by mildly potent topical corticosteroid application and then sunscreens.

No earlier preparation for either each procedure was done and no topical anesthesia was applied. Endpoint of treatment for both modalities was either reaching five sessions or improvement (3 = 51–75%) of scar grading on the qualitative global scoring system.

Statistical analysis

Data were coded and entered to an Excel spread sheet, and then all data were transferred to the statistical package SPSS version 15 (SPSS Inc., Chicago, Illinois, USA) for analysis. Data were summarized using mean, standard deviation, and range for quantitative variables and number and percentage for qualitative variables.

Comparisons were made using McNemmar test and marginal homogeneity test for qualitative variables, whereas nonparametric Wilcoxon signed ranks test was used for quantitative variables. Correlations were made to test linear relationships between variables. *P* values equal to or less than 0.05 were considered to be statistically significant.

Results

Twenty patients, 10 (50%) men and 10 (50%) women, with bilateral atrophic acne scars completed this study. Five patients were skin type III and 15 were type IV. Eight patients had rolling type (40%), six (30%) had boxcar type, and six (30%) showed both types of scars. Age ranged from 17 to 42 years, with mean age of 24.7 ± 6.8 years. Patients had different degrees of acne

Figure 3.

Patient 10, atrophic acne scars before (a) and after (b) four sessions of nonablative Nd:YAG treatment.

Figure 4.

Patient 10, the same patient before (a) and after (b) the two sessions of full-concentration TCA chemical reconstruction of skin scars method.

Figure 5.

Patient 11, atrophic acne scars before (a) and after (b) four sessions of nonablative Nd:YAG treatment.

scars according to the qualitative global acne scarring grading system. All patients had similar degree of severity for both sides, one (5%) had mild, 12 (60%) had moderate, and seven (35%) had severe scars.

On the left side of the face, all patients received one–two sessions of TCA CROSS technique every 4–6 weeks. Endpoint was either reaching 75% improvement or on patients' requests, as they could not tolerate the downtime side effects compared with almost no downtime and minimal side effects on the right side. Laser 1064 nm Nd:YAG was applied on the right side of the face; all patients received two–five sessions every 2–3 weeks. Endpoint was either 75% improvement of scars or reaching five sessions.

Acne scars

At the end of follow-up, there was statistically significant improvement ($P < 0.001$) in the degree of scar severity in all patients according to the qualitative global acne scarring system grading (Fig. 1). Comparing scar improvement of left with right sides of the face showed that, although scar severity improvement was slightly higher on the TCA CROSS side, yet, this difference was statistically insignificant ($P > 0.05$) (Table 1).

Blinded dermatologists evaluation of scar improvement at end of follow up showed an overall improvement in scars with no statistically significant difference between both sides of the face (Fig. 2). Patients were asked to give a percentage of improvement for each side, and their percentages were also converted into the numerical evaluation scale (Table 2).

Moreover, to identify a preferred treatment option based on each patient scar characteristics, according to blinded physicians' evaluation, patients were classified into three subgroups corresponding to relative responses to therapy on both sides of the face, that is, 'TCA-superior', 'Nd:YAG-superior', and 'equivalent' groups (those who responded similarly to the two treatments) (Figs 3–8) (Table 3).

Active acne

At the end of follow-up, according to the acne simple grading system [13], there was statistically significant improvement ($P = 0.001$) in the severity of acne lesions on the right side of the face in the 13 patients who had active lesions before treatment. This was not observed on the left side of the face (Fig. 9 and Table 4).

Figure 6.

Patient 11, atrophic boxcar acne scars (a) before and (b) after two sessions of full-concentration TCA chemical reconstruction of skin scars method treatment.

Figure 7.

Patient 3, before (a) and (b) after (b) three sessions of 1064 nm Nd:YAG.

Side effects

For the TCA CROSS side, three patients had persistent erythema for 6 months. Postinflammatory hyperpigmentation occurred in 15 (75%) patients and lasted for an average of 2.6 ± 2 months. At the end of follow-up, three (15%) patients had persistent hyperpigmentation. History taken from the patients with persistent hyperpigmentation (one with skin type III, two with skin type IV) showed lack of adherence to postoperative avoidance of sun and heat exposure and also lack of adherence to sunscreen application.

All side effects on the Nd:YAG side were temporary. Pain during the session was perceived by all patients, and immediate erythema was observed in 19 (95%) patients that lasted for a mean of 21.75 ± 17 min. One (5%) patient developed a crust within 2 days that lasted for 7 days, followed by mild hypopigmentation after its desquamation that resolved completely in 6 weeks. This patient had 52 J/cm^2 using the 7 mm hand piece, and pulse duration was 35 ms (5 ms subpulse and 10 ms delay). Adjusting the delay time between subpulses in the pulse train (to 20 ms instead of 10 ms in that session) prevented further development of more crustation in this patient in the following sessions.

Discussion

The results of this split-face study show that both TCA CROSS and Nd:YAG are useful modalities for the treatment of atrophic acne scars. Although scars on the TCA CROSS-treated side of the face showed a better response than the Nd:YAG side, this difference was statistically insignificant at the end.

The 1064 nm Nd:YAG wavelength deposits nonselective heat into the dermis that is absorbed by melanin and hemoglobin. The optical penetration of the 1064 nm Nd:YAG laser is 5–10 mm, causing diffuse heating of the dermal tissue and an increased collagen formation at the level of the reticular dermis in porcine skin [6,8]. The efficacy of long-pulsed Nd:YAG in decreasing depth of atrophic acne scars and wrinkles has been recorded by several researchers [7,9,10].

Deep TCA peels lead to reorganization in dermal structural elements and an increase in dermal volume as

Figure 8.

Patient 3, before (a) and after (b) two sessions of full-concentration TCA chemical reconstruction of skin scars.

a result of an increase in collagen content, glycosaminoglycan, and elastin [14]. However, there is increased risk associated with the use of TCA for deeper peels, suggesting that peeling with higher TCA concentrations is very risky [12]. To maximize the effects of TCA and to overcome complications, such as scarring, hyperpigmentation, and hypopigmentation, Lee *et al.* [12] suggested focal application of higher TCA concentrations of up to 100% by pressing hard on the entire depressed area of atrophic acne scars using a sharpened wooden applicator (CROSS). Repeated CROSS application can normalize deep rolling and boxcar scars, and a similar result can be achieved for deep icepick scars [12].

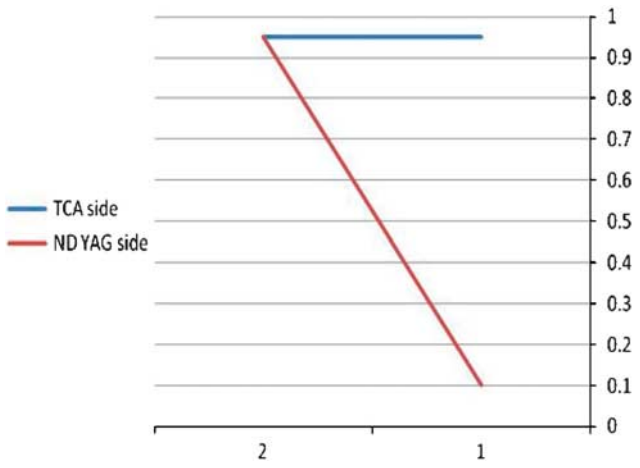
Blinded dermatologists' evaluation recorded a better response of boxcar acne scars to TCA CROSS in comparison with Nd:YAG treatments. However, Nd:YAG seemed to be superior to TCA CROSS for rolling acne scars. This may denote that TCA CROSS technique is associated with a higher degree of connective tissue remodeling and deposition. Treatment with Nd:YAG laser for longer periods may have improved the boxcar scars, but this was not addressed in this study. We used a maximum of 7 mm spot size in our patients; larger spot size with longer pulse durations at different fluences may also have a different effect on the amount of collagen remodeling in case of boxcar acne scars.

Active acne lesions improved significantly on the Nd:YAG treated side of the face ($P = 0.001$), and this was not noted on the TCA CROSS side. The Nd:YAG beneficial effect was also noted by Winstanley and Uebelhoer [15],

Table 3. Scar characteristics in patients responded better to each treatment modality

Scar type	Laser superior group	TCA superior group	Equivalent
Rolling	7	1	0
Boxcar	0	4	2
Mixed	1	4	1

Figure 9.



Active acne severity after treatment with both procedures.

Table 4. Active acne lesions before and after each treatment, *P* values comparing active acne lesions before and after both modalities and comparing both sides after treatment

Patient	Active acne before (both sides)	Active acne after laser	Active acne after TCA
2	2	0	2
3	1	0	1
5	2	0	2
6	1	0	1
7	1	0	1
10	2	0	2
12	1	0	1
13	1	0	1
14	2	0	2
15	1	0	1
16	1	0	1
17	2	0	2
19	1	1	1

	Acne before vs. after laser	Acne before vs. after TCA	Acne after laser vs. after TCA
P value	0.001	1.000	0.001

Graded using acne vulgaris simple grading system: 0 = no active lesions, 1 = mild acne lesions (scattered papules not seen at 2 mm distance) and 2 = moderate acne lesions (multiple papules and few pustules) [13].

who stated that their preliminary data for the treatment of acne using low-fluence 1064 nm Nd:YAG are encouraging. Patients have been treated at regular intervals using 10 J/cm^2 with a 12 mm spot, 20 ms pulse duration, and 4–5 pulses per lesion with visible improvement [15]. Although several studies have shown a beneficial effect of different lasers in the treatment of active acne vulgaris [16–20], the exact mechanisms by which laser treatments improve acne are still unclear. Infrared lasers might act through destruction of sebaceous glands or by 'normalization' of the keratinization process within the pilosebaceous unit [20].

We observed persistent post-CROSS hyperpigmenation in three (15%) patients by the end of the follow-up. A longer follow-up period may have proved an improvement in this pigmentation, as other side effects were transient and disappeared completely within 6 month of sessions. Apart from mild burning pain, transient postprocedure erythema, and crustations (only one patient), the Nd:YAG treated side of the face showed no side effects even in the three patients who developed persistent post-CROSS hyperpigmentation.

Conclusion

In conclusion, Nd:YAG seems to be a safer method to treat atrophic acne scars, especially of the rolling type, than high-concentration TCA CROSS technique, as most patients enrolled in this study preferred the nonablative rejuvenation with Nd:YAG on the right side of the face over the TCA CROSS technique on the left side. This is because of the slow downtime after TCA CROSS technique and the crusted lesions that persist for weeks. Longer follow-up periods, proper postprocedure care, and repeated sessions are needed to further evaluate the efficacy and outcome of our findings as final response is always latent. Continuing improvement over months occurs with nonablative long-pulsed 1064 nm Nd:YAG laser.

Therefore, nonablative rejuvenation is recommended for patients who cannot tolerate downtime and need to get back to social life as soon as possible. It is also suggested to measure effect on more scientific bases using histological examination of tissues preprocedure and postprocedure.

There is no conflict of interest.

References

1 Holland DB, Jeremy AH. The role of inflammation in the pathogenesis of acne and acne scarring. Semin Cutan Med Surg 2005; 24:79–83.

2 Rivera AE. Acne scarring: a review and current treatment modalities. J Am Acad Dermatol 2008; 59:659–676.

3 Jacob CI, Dover JS, Kaminer MS. Acne scarring: a classification system and review of treatment options. J Am Acad Dermatol 2001; 45:109–117.

4 Lee HS, Lee JH, Ahn GY, Lee DH, Shin JW, Kim DH, *et al.* Fractional photothermolysis for the treatment of acne scars: a report of 27 Korean patients. J Dermatolog Treat 2008; 19:45–49.

5 Kadunc BV, Trindade de Almeida AR. Surgical treatment of facial acne scars based on morphologic classification: a Brazilian experience. Dermatol Surg 2003; 29:1200–1209.

6 Dayan S, Damrose JF, Bhattacharyya TK, Mobley SR, Patel MK, O'Grady K, *et al.* Histological evaluations following 1064-nm Nd:YAG laser resurfacing. Lasers Surg Med 2003; 33:126–131.

7 Yaghmai D, Garden JM, Bakus AD, Massa MC. Comparison of a 1064 nm laser and a 1320 nm laser for the nonablative treatment of acne scars. Dermatol Surg 2005; 31:903–909.

8 Weiss RA, McDaniel DH, Geronemous RG. Review of nonablative photorejuvenation: reversal of the aging effects of the sun and environmental damage using laser and light sources. Semin Cutan Med Surg 2003; 22:93–106.

9 Lipper GM, Perez M. Nonablative acne scar reduction after a series of treatments with a short-pulsed 1064-nm neodymium:YAG laser. Dermatol Surg 2006; 32:998–1006.

10 Friedman PM, Skover GR, Payonk G, Kauvar AN, Geronemus RG. 3D in-vivo optical skin imaging for topographical quantitative assessment of non-ablative laser technology. Dermatol Surg 2002; 28:199–204.

11 Lee DH, Choi YS, Min SU, Yoon MY, Suh DH. Comparison of a 585-nm pulsed dye laser and a 1064-nm Nd:YAG laser for the treatment of acne scars: a randomized split-face clinical study. J Am Acad Dermatol 2009; 60:801–807.

12 Lee JB, Chung WG, Kwahck H, Lee KH. Focal treatment of acne scars with trichloroacetic acid: chemical reconstruction of skin scars method. Dermatol Surg 2002; 28:1017–1021.

13 Adityan B, Kumari R, Thappa DM. Scoring systems in acne vulgaris. Indian J Dermatol Venereol Leprol 2009; 75:323–326.

14 Butler PE, Gonzalez S, Randolph MA, Kim J, Kollias N, Yaremchuk MJ. Quantitative and qualitative effects of chemical peeling on photo-aged skin: an experimental study. Plast Reconstr Surg 2001; 107:222–228.

15 Winstanley DA, Uebelhoer NS. Future considerations in cutaneous photomedicine. Semin Cutan Med Surg 2008; 27:301–308.

16 Ballin JS, Uebelhoer NS. The use of the low-fluence 1064 nm Nd:YAG laser in a female with contraindications to systemic anti-acne therapy. J Drugs Dermatol 2009; 8:1025–1026.

17 Deng H, Yuan DF, Yan CL, Ding XA. Fractional 1320 nm Nd:YAG laser in the treatment of acne vulgaris: a pilot study. Photodermatol Photoimmunol Photomed 2009; 25:278–279.

18 Yeung CK, Shek SY, Yu CS, Kono T, Chan HH. Treatment of inflammatory facial acne with 1450-nm diode laser in type IV–V Asian skin using an optimal combination of laser parameters. Dermatol Surg 2009; 35: 593–600.

19 Jung JY, Choi YS, Yoon MY, Min SU, Suh DH. Comparison of a pulsed dye laser and a combined 585/1064-nm laser in the treatment of acne vulgaris. Dermatol Surg 2009; 35:1181–1187.

20 Orringer JS, Kang S, Maier L, Johnson TM, Sachs DL, Karimipour DJ, *et al.* A randomized, controlled, split-face clinical trial of 1320-nm Nd:YAG laser therapy in the treatment of acne vulgaris. J Am Acad Dermatol 2007; 56:432–438.