



Pulsed dye laser therapy for rosacea[☆]

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Summary Rosacea is a chronic and progressive inflammatory skin disorder affecting the facial convexities for which no curative measure is currently available. Forty consecutive patients with rosacea were treated with the Cynosure PhotoGenica V pulsed dye laser. The improvement following laser therapy was assessed according to a sliding scale: 1 (worse after treatment), 2 (no improvement), 3 (slight improvement), 4 (moderate improvement), 5 (marked improvement). Following an average of 2.4 (range 1-10) laser treatments, a mean score of 4.4 and 4.3 for overall improvement was achieved as judged by the patients and independently assessed by a family member or a close friend of the patients, respectively. The response of erythema and telangiectasia to laser therapy, evaluated by an independent panel of 10 members, showed a mean score of 3.7. Three patients experienced an exacerbation of rosacea during the treatment period requiring antibiotic therapy. During the follow-up period of 6.0-55.5 (mean, 23.3) months after completion of laser therapy, no patient (including 13 patients in whom papulation and pustulation which were amongst the presenting symptoms) required medical treatment. Six patients developed post-inflammatory hyper-pigmentation necessitating skin bleach but no other complication such as scarring was observed. Three patients reported that the residual erythema had progressed after an initial improvement during follow-up periods of 52.4, 15.8 and 6.0 months. All patients felt that laser therapy was worthwhile. We conclude that pulsed dye laser therapy is a useful treatment for rosacea.

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Rosacea, characterised by frequent flushing, persistent erythema and telangiectasia, is a chronic and progressive inflammatory skin disorder affecting the facial convexities in a symmetric distribution.^{1,2}

During the episodic inflammation, additional features such as swelling, papules and pustules may also occur.¹⁻³ The disease was originally called *acne rosacea*, a misleading term that has unfortunately persisted.⁴

Rosacea commonly affects fair-skinned individuals of northern and western European descent, particularly Celtic, English, Scottish or Scandinavian.⁵ It has been called the *curse of the Celts*!² Little is known about the exact incidence of rosacea. Some estimates show at least 13 million Americans are affected⁶ although this condition is

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rare in African and American Blacks.⁷ A Swedish study of 809 randomly selected clerical workers (average age, 46 years) shows a prevalence of 14% in women and 5% in men.⁸ Although women are more often affected than men, they seldom suffer the gross tissue and sebaceous gland hyperplasia of rhinophyma.²

Even though persistent erythema and flushing reactions commonly affect the face, particularly the nose, cheeks, chin and forehead,^{1,2,5} rosacea may involve extra-facial sites such as the retro-auricular region, the V-shaped area of the chest, neck, back, scalp and extremities.⁹ Variable incidence and degree of ocular involvement, termed *ocular rosacea*, are also well documented.^{5,10}

There is no effective therapy for eradicating rosacea. Although various treatments including dermatologic agents (such as oral Isotretinoin¹¹ and topical retinoids^{3,11}) and spironolactone¹² have been used for treating rosacea, topical antibiotics¹³⁻¹⁸ either administered singly¹⁷ or in combination with systemic antibiotics^{6,10,16,19-21} are the mainstay treatment for acute episodes of rosacea or to maintain remission. Whilst these agents are moderately successful in controlling the inflammatory component of rosacea, relapse usually occurs on cessation of therapy. As well, they have little effect on reducing the erythema, telangiectasia and flushing reactions commonly present in rosacea patients.^{1,22}

Although CO₂ laser has been used for treating rhinophyma associated with rosacea^{23,24} the role of pulsed dye laser (PDL) in this condition has not been well studied. Lowe et al.¹ in a preliminary report with a limited follow-up shows a good to excellent reduction of erythema and telangiectasia in 24 of 27 patients. We present here our experience with PDL therapy for rosacea.

Patients and methods

Over a 5-year period to June 2001, 40 consecutive patients (11 males, 29 females), aged between 17 and 83 (mean 43.5) years, who had a minimum follow-up of 6 months after completion of PDL treatment for rosacea, were included in this study. The diagnosis of rosacea was based on the clinical criteria previously described.^{2,5,25} The presenting symptoms included facial erythema ($n = 40$) requiring camouflage with make-up amongst the female patients ($n = 29$), facial flushing ($n = 40$), papulation and pustulation ($n = 12$) and self-consciousness ($n = 40$). Prior to PDL therapy, 23 patients had received other treatments including topical ($n = 9$)

and systemic ($n = 9$) antibiotics, Roaccutane ($n = 2$), diathermy ($n = 5$), cryotherapy ($n = 1$), copper bromide laser therapy ($n = 1$), accupuncture ($n = 1$), Chinese medicine ($n = 2$), steroid therapy ($n = 1$) and dietary modification ($n = 1$).

Technique

In all but one patient PDL therapy was performed routinely as an office procedure under EMLA (Astrazeneca, North Ryde, Australia), which was applied 45-60 min prior to each treatment. One patient with rosacea involving the whole face (Fig. 1) received two treatments under general anaesthesia. The affected areas were treated with the Cynosure PhotoGenica V (Boston, MA) PDL at 585 nm, pulse width of 0.45 ms and fluences of 5.4-6.5 J/cm² using a spot size of 5 or 7 mm. The spots were overlapped by 1 mm. In addition, discrete areas of telangiectasia were covered with a further pass using the 3 mm spot size with fluences of 6.5-7.5 J/cm². Post-operatively Aloe Vera gel (Healthways Holdings Ltd, NZ) was applied to the treated areas. In some cases a simple dressing was added which was removed within 24 h. Typically there was marked bruising of the treated areas that resolved within 7-10 days.

Assessment

Photographs were obtained in all patients prior to laser therapy. The patients were reviewed at 2-6 monthly intervals to assess the response to treatment, which was repeated as necessary. Complications such as post-inflammatory hyperpigmentation, scarring or progression of the condition, if present, were also recorded. Similarly, the requirement of any medical treatment including antibiotics and the effect of PDL on the occurrence of papulation and pustulation were noted. At the end of the follow-up period all patients were invited to return for post-operative photographs taken under similar pre-operative conditions.

To further assess the overall effectiveness of laser therapy, each patient was sent a postal questionnaire which was scored (considering all the presenting symptoms) by the patient and also independently by a family member or a close friend of the patient, using the following scale: 1 (worse after treatment); 2 (no improvement); 3 (slight improvement); 4 (moderate improvement); and 5 (marked improvement). The results of laser treatment on erythema and telangiectasia were also evaluated by showing the pre- and post-operative photographs simultaneously to a panel consisting of



Figure 1 This 36-year-old woman previously underwent diathermy (without effect) for erythema and telangiectasia and facial flushing associated with rosacea affecting the whole face (A,B). Residual erythema 52.4 months following the last of the two PDL treatments performed under general anaesthesia (C,D). This patient achieved an overall score of '4' judged both by the patient and a close friend. The panel gave an average score of '3.9'.

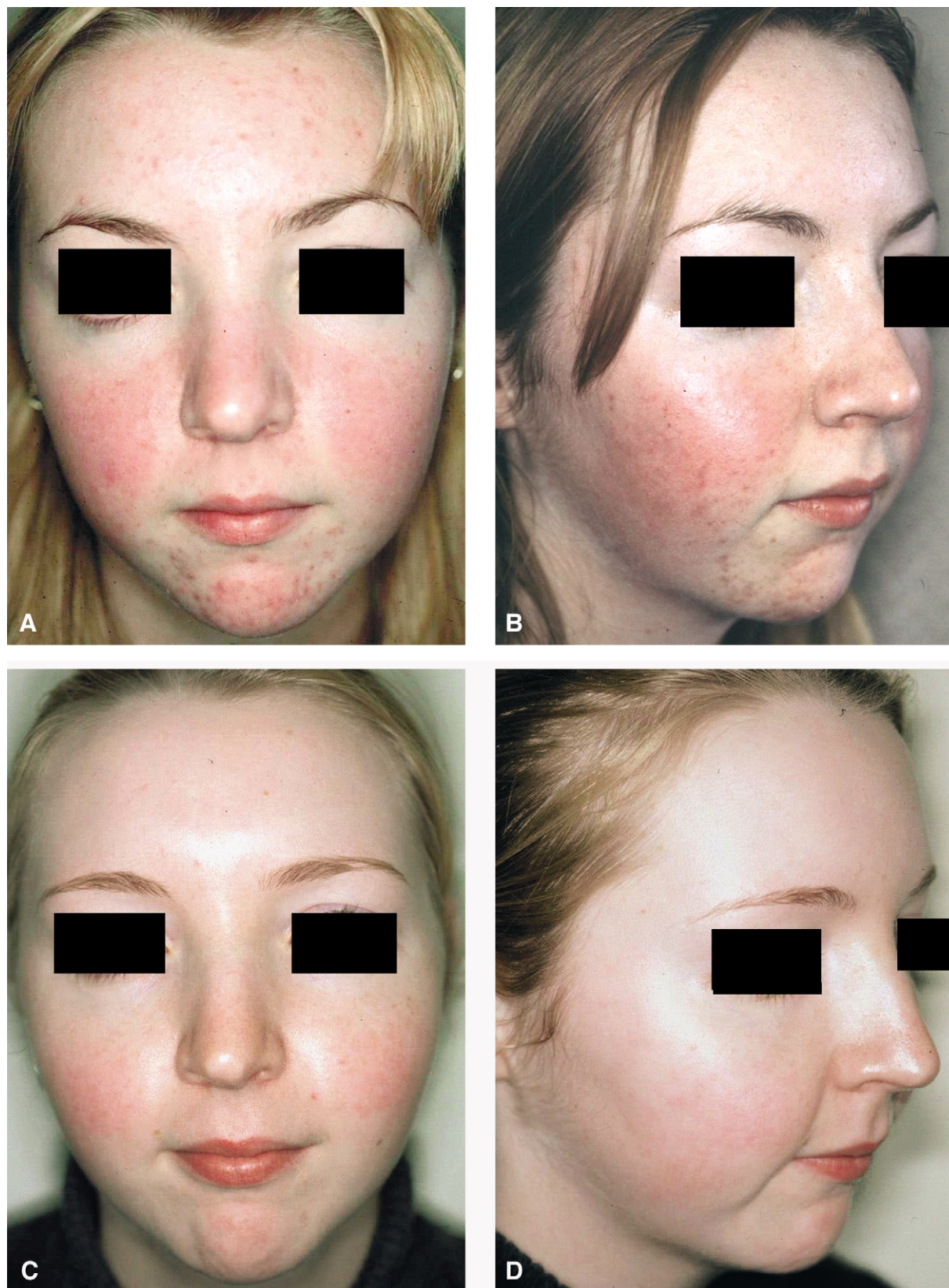


Figure 2 An 18-year-old woman with erythema, facial flushing, papulation and pustulation associated with rosacea affecting the cheeks, nose and chin (A,B). The patient was very self-conscious about her appearance and had previously received multiple courses of Minomycin therapy and Rosex gel with modest result. At the time of referral Roaccutane was being considered. She underwent laser therapy under EMLA. Results 42.5 months after the final of the four PDL

10 hospital staff, not involved in the patients' treatment. No indication was given to the panel, which was the pre- or post-operative photograph. Each member of the panel was asked to score the difference using the above-mentioned scale.

To assess the patients' overall satisfaction with PDL therapy, the patients were also asked if they thought the treatment was worthwhile and whether they would have laser treatment again should the need arise in the future.

Results

Forty consecutive patients who underwent PDL therapy for rosacea and had a follow-up of at least 6 months after the final treatment session were included in this study. The average follow-up period was 23.3 (range 6.0-55.5) months. In these patients rosacea involved the nose ($n = 31$), cheeks ($n = 38$), chin ($n = 14$), forehead ($n = 7$), neck ($n = 1$) and ears ($n = 1$). In 32 patients rosacea affected more than one anatomic site. Two patients had ocular involvement. The average number of treatment was 2.4 (range, 1-10) per patient. Six patients developed post-inflammatory hyper-pigmentation, which resolved following application of 5% hydroquinone and 2% hydrocortisone ointment.²⁶ Three patients experienced an episode of exacerbation of rosacea during the treatment period that resolved with a 2-week course of oral Minomycin. During the follow-up period, associated papulation and pustulation that were present pre-operatively in 13 patients improved markedly to negate the need for antibiotic therapy (Figs. 2 and 3).

All but five patients (88%) returned the questionnaires and they re-presented for post-operative photographs, which were available for panel assessment. The remainder were interviewed by a telephone survey.

The overall result of laser therapy was scored as '4' or '5' in 37 patients (93%) (average score, 4.4) as judged by the patient and in 33 patients (83%) (average score, 4.3) as judged by a family member or a close friend of the patient (Figs. 1-4). All the remaining patients had a score of '3'.

In 35 patients both the pre- and post-operative photographs were available for panel evaluation of the response of erythema and telangiectasia to PDL. The panel gave an average score of 3.7. Three patients who gave a final score of '4' or '5' in whom

the facial erythema improved but remained after receiving 3, 2 and 1 treatments, respectively, reported that the residual areas had progressed during a follow-up period of 52.4, 15.8 and 6.0 months, respectively. All the patients felt that PDL therapy for rosacea was worthwhile and they would receive further laser treatment should the need arise in the future.

Discussion

The aetiology of rosacea has been attributed to a combination of a genetic predisposition and provocative environmental factor.²⁵ Patients with rosacea tend to have a fair complexion. They have a tendency to flush frequently in response to emotional (such as excitement, anxiety or a hurried feeling), environmental (such as heat or cold), and physiologic (such as ingestion of alcohol or spicy foods or postprandial fullness^{15,25}) stimuli.

Demodex folliculorum and *Demodex brevis*, normal inhabitants of the human skin, have been implicated²⁷ in rosacea. It has been suggested that these mites or their products may cause the condition by provoking an allergic or an inflammatory reaction and mechanically blocking the hair follicles or by acting as vectors for micro-organisms.²⁷ A comparative study has shown similar results between Metronidazole (a common topical treatment for rosacea) and Premethrin (a topical treatment for *Demodex*) after 7-10 weeks of treatment.²⁸ However, there is yet no conclusive evidence that these micro-organisms cause rosacea.

More recently, gastric colonisation by *Helicobacter pylori* has also been postulated to play a role in rosacea.²⁹⁻³¹ It has been suggested that infestation of *H. pylori* leads to synthesis of gastrin, which stimulates facial flushing. Although some authors have shown modest improvement of rosacea following eradication by triple therapy^{30,31} the role of *H. pylori* in rosacea remains disputed.³²

Psychogenic factors have also been frequently implicated in rosacea but there is no convincing evidence that the condition is associated with a particular personality type or is precipitated by emotional disturbance.^{2,10,25}

While the aetiology of rosacea remains speculative, it is not surprising that treatment has been empirical. Preventative measures include reduction

treatments (C,D). The patient had markedly improved self-confidence with reduced facial erythema and flushing, as well as infrequent papulation and pustulation negating the need of antibiotic therapy. The overall result was judged as '5' by the patient and '4' by a family member. The panel gave an average score of '4.8'.



or avoidance of known stimuli such as consumption of alcohol and spicy foods and lessening emotional distress. Currently the mainstay treatments for rosacea are topical^{13-16,18} or systemic^{6,16,19-21} antibiotics or dermatologic agents such as oral Isotretinoin¹¹ or topical retinoids.^{3,11} The most commonly used topical measure is Metronidazole gel^{14,15,17} which is often used in combination with oral tetracyclines¹⁰ for treating acute episodes of rosacea or used in isolation¹⁷ to maintain remission. Although these agents are moderately successful in controlling the inflammatory component of rosacea, cessation of treatment inevitably leads to relapse and they have little effect on reducing the erythema, telangiectasia and flushing reactions commonly present in rosacea patients.^{1,22,33}

Histopathologic findings associated with rosacea include vascular dilatation, dermal oedema, perivascular infiltration of histiocytes, lymphocytes and plasma cells and even granulomas in long-standing papules.³⁴ It is believed that an inflammatory response triggers a vascular instability with subsequent leakage of fluid and inflammatory mediators into the dermis in the affected area.¹⁰

There has been a suggestion that a basic defect is dermal vascular hyper-responsiveness with a tendency to recurrent dilatation and flushing with formation of papular inflammatory lesions and pustules.¹ Thus selective destruction of the hyper-responsive dermal microvasculature associated with rosacea appears to be a reasonable proposition. Results of this study confirm one previous preliminary report on the effectiveness of PDL in treating rosacea.¹

The advantage of PDL is the absence of dermal scarring,³⁵ however, the purpuric reaction that lasts 7-10 days represents a significant morbidity particularly in men who do not normally wear make-up. However, application of the long pulse dye laser (e.g., 1.5-20 ms)³⁶ has been shown to reduce purpura. This, coupled with the use of a dynamic cooling device³⁷ may allow higher fluences to be used, without an increased risk of scarring.

The progression of residual facial erythema following an initial improvement by PDL in three

Figure 3 A 61-year-old woman with facial erythema and flushing reactions, papulation and pustulation associated with rosacea involving the cheeks, nose and chin (A). She previously underwent repeated cryotherapy and received Rosex gel with little effect. The patient underwent PDL treatment under EMLA. Residual erythema 55.5 months following one laser treatment (B). The overall result was scored as '5' both by the patient and a family member. The panel gave an average score of '4'.



Figure 4 A 56-year-old woman with facial erythema, telangiectasia, flushing reactions associated with rosacea involving the cheeks and nose (A). She had previously undergone diathermy in four occasions with little effect. Twenty-eight months following the last of the two PDL treatments (B). The final overall result was scored as '4' by the patient and '5' by a close friend. The panel gave an average score of '4.6'.

patients with rosacea highlights the progressive nature of the condition. It is difficult to objectively assess the result of laser treatment of rosacea as there are several facets of the symptomatology in this condition. Employing a sliding scale, we have attempted to evaluate the outcome objectively by assessing the overall results, which were scored by the patient and by a family member or a close friend of the patient, considering all the presenting symptoms. As well, the effect of PDL on erythema and telangiectasia was assessed by an independent panel. The results in this study and the patients' satisfaction indicate that ablation of the superficial hyper-responsive dermal microvasculature using the PDL is worthwhile even though the treatment may not be curative for rosacea.

References

1. Lowe NJ, Behr KL, Fitzpatrick R, Goldman M, Ruiz-Esparza J. Flash lamp pumped dye laser for rosacea-associated telangiectasia and erythema. *J Dermatol Surg Oncol* 1991;17:522–5.
2. Jansen T, Plewig G. Rosacea: classification and treatment. *J R Soc Med* 1997;90:144–50.
3. Thiboutot DM. Acne and rosacea. New and emerging therapies. *Dermatol Clin* 2000;18:63–71.
4. de Barsaques J. Historical notes on (acne) rosacea. *Eur J Dermatol* 1995;5:16–22.
5. Litt JZ. Rosacea: how to recognize and treat an age-related skin disease. *Geriatrics* 1997;52:39–47.
6. Bikowski JB. Treatment of rosacea with doxycycline monohydrate. *Cutis* 2000;66:149–52.
7. Rosen T, Stone MS. Acne rosacea in blacks. *J Am Acad Dermatol* 1987;17:70–3.
8. Berg M, Liden S. An epidemiological study of rosacea. *Acta Derm Venereol (Stockh)* 1989;69:419–23.
9. Ayers SJ. Extrafacial rosacea is rare but does exist. *J Am Acad Dermatol* 1987;16:391–2.
10. Browning DJ, Proia AD. Ocular rosacea. *Surg Ophthalmol* 1986;31:145–58.
11. Ertl GA, Levine N, Kligman AM. A comparison of the efficacy of topical tretinoin and low-dose oral isotretinoin in rosacea. *Arch Dermatol* 1994;130:319–24.
12. Aizawa H, Niimura M. Oral spironolactone therapy in male patients with rosacea. *J Dermatol* 1992;19:293–7.
13. Mills OHJ, Kligman AM. Topically applied erythromycin in rosacea (Letter). *Arch Dermatol* 1976;112:553–4.
14. Bleicher PA, Charles JH, Sober AJ. Topical metronidazole therapy for rosacea. *Arch Dermatol* 1987;123:609–914.
15. Lowe NJ, Henderson T, Millikan LE, Smith S, Turk K, Parker F. Topical metronidazole for severe and recalcitrant rosacea: a prospective open trial. *Cutis* 1989;43:283–6.
16. Wilkin JK, DeWitt S. Treatment of rosacea: topical clindamycin versus oral tetracycline. *Int J Dermatol* 1993;32:65–7.
17. Dahl MV, Katz HI, Krueger GG, et al. Topical metronidazole maintains remissions of rosacea. *Arch Dermatol* 1998;134:679–83.
18. Breneman DL, Stewart D, Hevia O, Hino PD, Drake LA. A double-blind, multicentric clinical trial comparing efficacy

- of once-daily metronidazole 1 percent cream to vehicle in patients with rosacea. *Cutis* 1998;**61**:44–7.
19. Sneddon IB. A clinical trial of tetracycline in rosacea. *Br J Dermatol* 1966;**78**:649–52.
 20. Pye RJ, Burton JL. Treatment of rosacea by metronidazole. *Lancet* 1976;1211–2.
 21. Torresani C, Pavesi A, Manara GC. Clarithromycin versus doxycycline in the treatment of rosacea. *Int J Dermatol* 1997;**36**:942–6.
 22. Wilkin JK. Oral thermal-induced flushing in erythematotelangiectatic rosacea. *J Invest Dermatol* 1981;**76**:15–18.
 23. Simo R, Sharma VL. Treatment of rhinophyma with carbon dioxide laser. *J Laryngol Otol* 1996;**110**:841–6.
 24. Karim-Ali MK, Streitmann MJ. Excision of rhinophyma with the carbon dioxide laser: a ten-year experience. *Ann Otol Rhinol Laryngol* 1997;**106**:952–5.
 25. Thiboutot DM. Acne rosacea. *Am Fam Phys* 1994;**50**:1691–7.
 26. Kligman AM, Willis I. A new formula for depigmenting human skin. *Arch Dermatol* 1975;**40**:41–8.
 27. Bonnar E, Ophrh MC, Eustace P, Powell FC. The *Demodex* mite population in rosacea. *J Am Acad Dermatol* 1993;**28**:443–8.
 28. Signore RJ. A pilot study of 5 percent permethrin cream versus 0.75 percent metronidazole gel in acne rosacea. *Cutis* 1995;**56**:177–9.
 29. Sharma VK, Lynn A, Kaminski M, Vasudeva R, Howden CW. A study of the prevalence of *Helicobacter pylori* infection and other markers of upper gastrointestinal tract disease in patients with rosacea. *Am J Gastroenterol* 1998;**93**:220–2.
 30. Szlachcic A, Sliwowski Z, Karczewska E, Bielanski W, Pytko-Polonczyk J, Konturek SJ. *Helicobacter pylori* and its eradication in rosacea. *J Physiol Pharmacol* 1999;**50**:777–86.
 31. Utas S, Ozbakir O, Turasan A, Utas C. *Helicobacter pylori* eradication treatment reduces the severity of rosacea. 1999; 40: 233–5.
 32. Herr H, You CH. Relationship between *Helicobacter pylori* and rosacea: it may be a myth. *J Korean Med Sci* 2000;**15**:551–4.
 33. Borrie P. The state of blood vessels of the face in rosacea. *Br J Dermatol* 1955;**67**:5.
 34. Fitzgerald FT. When flushing or 'sunburn' may be sight-threatening. *Consultant* 1996;**36**:1399–404.
 35. Levine VJ, Geronemus RG. Adverse effects associated with the 577- and 585-nanometer pulsed dye laser in the treatment of cutaneous vascular lesions: a study of 500 patients. *J Am Acad Dermatol* 1995;**4**:613–7.
 36. Berstein EF. Treatment of resistant port-wine stain with the 1.5 ms pulse duration, tunable pulsed dye laser. *Dermatol Surg* 2000;**29**:1007–9.
 37. Waldorf HA, Alster TS, McMillan K, Kauver AN, Geronemus RG, Nelson JS. Effect of dynamic cooling on 585-nm pulsed dye laser treatment of port wine birthmarks. *Dermatol Surg* 1997;**23**:657–62.