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Laser treatment of superficial cutaneous vascular lesions

Margaret Stewart
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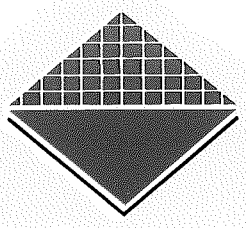

AUSTRALIAN INSTITUTE OF
HEALTH & WELFARE

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Australian Institute of Health and Welfare
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Summary

- This report consists of a review of the use of lasers in the treatment of superficial cutaneous vascular lesions, followed by details of the use of two types of yellow light lasers in Australia. A Candela pulsed dye laser was used at the Royal Prince Alfred Hospital, Sydney, and a Norseld copper bromide laser at Flinders Medical Centre, Adelaide.
- Yellow light lasers are a relatively recent approach to the treatment of port wine stains and other superficial vascular lesions. They offer advantages over earlier methods in having fewer adverse effects, particularly scarring, and often giving more complete removal of the lesion, especially in children with light-coloured lesions.
- Initial treatment involves checking the response of a small area of the lesion (a test patch) to the laser radiation. For patients with port wine stains, the Candela pulsed dye laser and the Norseld copper bromide laser gave similar results, with most responses being good or excellent.
- For 23 patients with port wine stain whose treatment with the Candela laser was completed, excellent or good responses were obtained in 20, two had a fair response and one person had poor results. Incomplete treatment results on 45 patients treated with the Norseld laser suggested that that system would also be effective in treatment of port wine stain.
- The Candela laser was also effective in treating a range of other conditions. Good or excellent results were obtained in the majority of patients treated for telangiectasia (46 of 48), spider naevi (25 of 26), rosacea (12 of 14) and other less common conditions (7 of 12).
- Most patients at the Sydney unit were satisfied with the results of treatment, as judged by their responses on a seven-point scale indicating the degree of happiness with outcome. On some occasions, the patient's perception of the final outcome varied substantially from that of the operator.
- Notional costs for a single 30-minute treatment session, excluding rental of premises, salary-related overheads and insurance, were estimated at $227 for the Candela pulsed dye laser and $110 for the Norseld copper bromide laser.
- On the basis of experience at Royal Prince Alfred Hospital, the total cost of treating a port wine stain in an adult with the Candela laser might range from $687 to $1,832, depending on the size of the lesion and the number of sessions required. It was not possible to estimate the total cost of treating a port wine stain with a copper bromide laser from the data available from the Adelaide study.
- Infrastructure requirements are modest for either type of laser if adults are being treated. Treatment of children usually requires a general anaesthetic which substantially increases the total cost.

- Treatment with currently available lasers is slow. Treatment of an area of 20 cm^2 takes about 10 minutes with the Candela or the Norseld devices. In most cases, patients will need to return for further treatment to achieve maximal fading, with an interval of several weeks between treatment sessions.
- At present, time to complete treatment with the Candela laser at the hospital is further increased because of limits to the number of clinics that can be offered. As a result, the waiting time for patients requiring follow-up treatment is substantially longer than appropriate.
- With present technology, it is unlikely that any one machine will meet all the requirements of a dermatology department. Ideally, access to more than one laser type would be needed to optimise treatment for each patient.
- Newer types of laser are becoming available which will offer the promise of reducing costs of treatment. When these are considered for acquisition, they should be critically assessed in terms of cost, speed of treatment, complications and patient outcomes.

Introduction

Superficial cutaneous vascular malformations and haemangiomas are common dermatological conditions. Until the advent of improved laser technology within the last decade, these lesions were often left untreated, or were treated with methods which frequently resulted in substantial scarring. In the mid-1980s, the introduction of yellow light lasers enabled some useful principles of laser treatment to be applied in the clinical setting.

The development of medical laser services in Australia has been slow, fragmented and uncoordinated. Laser technology is expensive and continues to change. Laser applications can readily be popularised before adequate evaluation of efficacy and costs has been established in relation to conventional therapy.

This report commences with a brief review of superficial cutaneous vascular lesions and approaches to their treatment. There is then a description of a study on the use of a Candela flashlamp pumped dye laser by the Dermatology Department, Royal Prince Alfred Hospital, Sydney, in the treatment of such lesions. Some details are also given on the use of a copper bromide laser manufactured by Norseld Pty Ltd. This device has been used in a study developed by the Australian Centre for Medical Laser Technology Inc., Adelaide, in conjunction with Flinders Medical Centre and the Royal Adelaide Hospital.

Details are included of the results of treatment at the Royal Prince Alfred Hospital of patients with port wine stains, telangiectasias, spider naevi and some other types of vascular lesion. Reference is also made to preliminary results with the copper bromide laser, obtained in the Adelaide study. Some comparative details on specifications of the lasers and of cost-related factors have also been included.

Overview

Superficial cutaneous vascular malformations and haemangiomas are common. Many are present at birth (e.g. port wine stains), but many are only apparent after birth—including 'strawberry' naevus, spider naevus, acquired telangiectatic naevus and facial telangiectasia. It is estimated that one in every three children will have a vascular abnormality of some sort, although many of these fade within the first months or years of life and require no treatment. Of those lesions that remain, either presenting in early childhood or developing later, many will be of sufficient functional and/or cosmetic significance to provide an impetus to seek treatment. Superficial cutaneous vascular abnormalities may also be associated with deeper vascular problems requiring separate investigation and management from the superficial component.[1,2]

A simple and very useful classification of vascular abnormalities distinguishes between an actively proliferating new lesion (haemangioma-lymphangioma) and a lesion where endothelial cell turnover is normal (malformation). This classification avoids the endless confusion generated by descriptive classifications and eponymous labels.

The lesions treated in the studies described in this report were all superficial as the depth of penetration of the laser beam is of the order of approximately 1 mm. Some of the lesions had both a superficial and a deep component but only the superficial component could be treated.

Port wine stains

True port wine stains are present at birth, occur equally in males and females, do not spontaneously resolve and thus remain present throughout life. They occur in 0.3% of the population and may vary from a small lesion in an inconspicuous site to an extensive lesion associated with soft tissue hypertrophy and multiple associated problems (such as epilepsy and glaucoma). Adjacent mucous membranes may be involved.

At birth, port wine stains are usually pink or red, macular and well defined. They only increase in area in proportion to growth. As time goes by, the stain often becomes darker in colour and raised, and ectatic vessels can develop on the surface. These latter lesions cause problems with bleeding. Pyogenic granulomas developing on the surface of the lesion can cause further problems with bleeding.

Port wine stains may be associated with abnormalities of the venous and lymphatic systems, underlying arteriovenous malformations, ocular abnormalities, and central and peripheral nervous system abnormalities as well as musculoskeletal and soft tissue hypertrophy. Associated glaucoma occurs in 45% of children with a port wine stain involving the area of innervation of the upper and middle divisions of the trigeminal nerve.

Histologically, a port wine stain shows capillary and venous ectasia in the papillary and upper reticular dermis. The endothelium of the blood vessels appears normal and cell turnover is normal, although there appear to be increased numbers of blood vessels in the dermis. The apparent increase in blood vessels may only represent ectasia and not a true increase in number. Diminished perivascular nerve density might relate to the progressive ectasia noted with ageing.[3]

Spider naevi and facial telangiectasia

Other conditions which can be treated with yellow light lasers are spider naevi and facial telangiectasia secondary to rosacea and/or sun damage.

Spider naevi

Spider naevi commonly occur on the face and arms and consist of a central arteriole with a corona of radiating efferent vessels. They occur in children very commonly but may fade around puberty. The adult incidence of 10–15% is approximately one third of the childhood incidence. These lesions commonly occur with pregnancy and can be associated with underlying liver disease.

Facial telangiectasia

Facial telangiectasia generally occurs on a background of easily incited blushing and flushing, often in a patient with fair skin, rosacea and/or sun damage. Rarer causes of telangiectasia such as carcinoid syndrome were not seen during the Australian studies.

Non–laser treatments

In the past, various treatments were used to either camouflage or remove the blood vessels contributing to a port wine stain. Destructive treatments such as excision and graft, cryotherapy, electrocoagulation and radiotherapy all result in scarring to a greater or lesser degree. Elimination of the blood vessels involves dermal damage which results in scarring. Camouflage over-tattooing produces a mask-like effect, with often relatively poor matching of skin colour. Camouflage make-up has been used, often successfully, but application can be time consuming, especially over large areas. This approach is expensive and also tends to produce a masked appearance.

Laser treatment

Early treatment of port wine stains is desirable, not only to try to minimise the psychological problems associated with being a 'marked child'[4] but also to minimise problems associated with tissue hypertrophy and bleeding vessels and

to reduce the amount of treatment needed overall. The smaller and more superficial the port wine stain, the less treatment is needed to maximally fade the lesion. A treatment which is safe, simple, cheap, painless and effective is highly desirable. The goal is a treatment which eliminates the abnormality (the blood vessels) without damaging surrounding structures, and results in skin of normal texture and colour. With the advent of newer laser technology, it seemed possible that this goal would be achieved.

The background of current laser therapy for cutaneous vascular abnormalities dates back to 1960 with the development of the first laser by Maiman. Initial clinical studies by Dr Leon Goldman and his associates in Ohio, treating vascular abnormalities with ruby, argon and neodymium lasers, stimulated other investigators to explore the ability of various laser systems to correct vascular abnormalities seen in practice. Much initial effort focused on the use of the argon laser, especially by Apfelberg and others at Palo Alto, California.

The application of laser technology to dermatological conditions in Australia started approximately 20 years ago with the use of the CO_2 laser for the ablation of tattoos. In general, opinion would not now favour use of this laser, particularly in children, because of the potential for scarring.[5] The argon laser was the treatment of choice for port wine stains until the late 1980s and was used following the experience gained in the USA. Generally, the availability of argon laser treatment in Australia was restricted to a few centres. Good responses to treatment were achieved in 60–80% of cases, with best results in those adults with purple port wine stains. Results in children were less satisfactory. Scarring was a disadvantage for all types of patient, and especially for children.[5]

Unfortunately, the development of laser treatment of skin conditions in Australia has not always been accompanied by an appropriate level of dermatological or surgical skills. Many patients treated with lasers have had a less than desirable outcome.

Not until the concept of selective photothermolysis was developed, and an appropriate laser system was built based on this principle, was it possible to approach the therapeutic ideal of elimination of the lesion without damage to associated skin structures. The Candela pulsed dye laser used at Royal Prince Alfred Hospital operates at 585 nm and has a very brief pulse duration. Both these factors contribute to the efficacy of treatment of superficial cutaneous vascular lesions. The limitations of treatment relate to the depth of penetration of the laser beam into the skin (0.75–1 mm) and the diameter of vessels which respond to treatment (<400 nm). The copper bromide laser operates at a similar wavelength (578 nm) but its pulse characteristics are different from those of the Candela laser.

Physics of laser treatment

The scarring associated with earlier types of laser treatment results from non-selective thermal damage of components of skin other than blood vessels. Non-response of blood vessels to incident laser light can relate to depth of penetration

of the laser beam and mismatch of the wavelength of incident light with the target chromophore and to size of blood vessel.

Newer laser systems, particularly those used for treating superficial pigmented and vascular lesions on the surface of the skin, rely on the principle of selectively matching the wavelength of the incident laser light with the two chromophores that absorb light in the skin (haemoglobin and melanin), and reducing non-specific heat damage to the skin.

In the treatment of vascular lesions, the target chromophore is oxyhaemoglobin. Yellow light lasers with wavelengths in the vicinity of 577–585 nm target this chromophore with less uptake of the laser energy by melanin, the competing chromophore. Thermal damage is limited by selecting a pulse duration shorter than the thermal relaxation time of the target tissue—the theory of selective photothermolysis discussed by Anderson and Parrish.[6,7]

Damage to the target tissue occurs either by microvaporisation or coagulation. Choice of wavelength has some bearing as to which effect occurs, but of more importance is the laser exposure duration (pulse width). The thermal relaxation time of tissue is the time taken for the tissue to cool by 50% from its heated state by diffusion of thermal energy to surrounding tissue. The thermal relaxation time of blood vessels of 10–50 nm diameter is 0.1–10 ms. If blood vessels can be heated sufficiently in that time to damage the vessel irreversibly, without damaging surrounding tissue by diffusion of heat from the target vessels, then selective damage occurs.

Microvaporisation occurs when a laser beam of appropriate wavelength with a pulse width less than or equal to the thermal relaxation time of the target blood vessel causes clumping and expansion of red blood cells and then vaporisation, with rupture of blood vessel walls and haemorrhage. This manifests clinically as immediate purpura. There appears to be an upper limit of diameter of blood vessels where this can occur, possibly in the range of 400 nm.

In the coagulation method, the pulse width is longer than the thermal relaxation time of the target blood vessels. The laser light is selectively absorbed by the blood-filled capillaries, and heating of the blood vessel walls and surrounding tissue occurs by diffusion. Skin blanching or whitening is seen clinically as the immediate effect because of protein coagulation. Lasers using the coagulation method are capable of destroying blood vessels larger than 400 nm, but there is greater risk of scarring and pigment damage because of non–selective heat effects.

Assessment of lesions

Persons presenting with superficial cutaneous vascular abnormalities may have one of a number of conditions, some of which might be associated with other abnormalities. Initial assessment should consider:

- Is the lesion proliferative or non-proliferative?
- Is a deeper component associated with the superficial change?
- Are there any underlying associations/complications?

- Are there any complications associated with the superficial component?
- Are there any contraindications to laser treatment?

After adequate history-taking and clinical examination, a diagnosis should be made. An examination of the depth and size of the abnormal vessels is a prerequisite to predicting response to treatment and what method of treatment should be chosen. Assessment of depth, size and type of vessel involved relies mostly on biopsy information. This, however, presents only a static picture and may not be truly representative of other areas in a large lesion. Many patients are reluctant to submit to one or multiple biopsies, all of which produce a scar.

Some proliferative lesions will regress spontaneously but may require laser treatment to prevent complications; for example, haemangiomas near the eye, nose or mouth, in the upper airways or threatening the integrity of mucous membranes. Non-proliferative lesions may be treated purely for cosmetic reasons or because of a combination of cosmetic and functional problems (e.g. bleeding ectatic vessels). Awareness of possible associated conditions, such as glaucoma with port wine stain of the upper face, should lead to appropriate investigation and treatment if necessary, but this does not necessarily interfere with treatment of the vascular problem. Contraindications to laser treatment are few and may be relative rather than absolute, but need to be considered. They can include photosensitivity, light-induced epilepsy, inability to understand treatment or to care for the treated areas, pain intolerance and predicted poor response.

Response to laser therapy depends on the colour of the lesion as well as the size and depth of the blood vessels involved. Colour assessment is difficult and very subjective at a clinical level and obviously can vary with ambient conditions. Photography is used as a clinical record, but it is difficult to reproduce conditions exactly over a period of time and textural changes in the skin are not recorded very well.

More objective methods of colour assessment are difficult and, to date, none has been used routinely in the clinical setting. In large lesions, the colour may vary from area to area and multiple measurements would be required. One method of colour measurement uses a skin reflectance spectrophotometer,[8] although this cannot indicate the contribution made by the different chromophores (haemoglobin and melanin). In practice, clinical assessment of the degree of fading after treatment is used, often based on crude scales of 0–25%, 25–50%, 50–75% and 75–100%. Pre-, intra- and post-laser treatment photographs are useful as a clinical guide to therapeutic response, but they provide only a two-dimensional static record and are limited by photographic variables associated with the film, camera, lighting, processing and printing, and the skill of the photographer.

The Australian studies

Organisation of laser treatment services

Sydney

A Candela flashlamp pumped dye laser was installed in the Dermatology Department, Royal Prince Alfred Hospital, in early 1990. Children's services requiring general anaesthetic facilities were funded in 1993 and became operational in 1994. Funds for purchase of the machine were provided by the Federal Government and those for maintenance and running costs by the New South Wales Government via the Central Sydney Area Health Service.

The aim was to provide access to laser treatment for superficial cutaneous vascular abnormalities within the public teaching hospital system as an alternative to existing, expensive services. Many patients were unable to pursue treatment outside the system because they could not afford it.

The secondary aim was for the Candela laser eventually to provide a nucleus for the development of further cutaneous laser services using other lasers (e.g. CO_2, Nd–YAG, ruby), and for a centre to be established for teaching and research. So far this has not occurred, chiefly due to financial constraints.

Adelaide

Development of a copper bromide laser has been undertaken in Adelaide by Norseld Pty Ltd. This laser is capable of producing approximately the same wavelength as the Candela laser (578 nm), but has lower capital and recurrent costs.

The Adelaide study, coordinated by the Australian Centre for Medical Laser Technology Inc., was intended to gain experience in the operation of the copper bromide laser and obtain indications of its efficacy in treatment of facial telangiectasias and of port wine stains. The machine was installed in the dermatology section at Flinders Medical Centre in 1990.

Details of the lasers

Specifications of the two lasers are shown in Table 1.

The Candela laser has been installed at a number of sites in many countries and there is now relatively lengthy operational experience with its use.[9] Two important features of this machine which place some constraints on operators are

the need for frequent changes of the dye solution, which is expensive, and the requirement for water cooling.

The Norseld copper bromide laser is intended to provide a flexible treatment system for dermatological applications and to be more reliable and easier to operate than flashlamp pumped dye lasers. The copper bromide laser is air cooled, and the costs associated with dye changes are avoided. There is no purpura response from treatment.

Table 1: *Specifications for yellow light lasers*

Specification	Candela	Norseld
Laser type	Flashlamp pumped dye laser(Candela SPTL–1)	Copper bromide vapour
Manufacturer	Candela Laser Corporation, USA	Norseld Pty Ltd, Adelaide
Dye	Rhodamine	–
Wavelength	585 nm	578 nm
Method of optical output	Lens coupled fibre optic	Fibre optic
Maximum energy density	10 Joules/cm2	13–30 Joules/cm2
Pulse duration	450μs	25–35 ms
Cooling system	Tap water	–
Power system	Single phase, heavy duty 30 amp	Standard outlet
Spot size	5 mm circle, 3 mm circle	0.7 mm
Dimensions of machine	135 cm H, 76 cm W, 102 cm D	120 cm H, 30 cm W, 30 cm D
Length of fibre optic	3–4 metres	5 metres

Patient selection

Sydney

Dermatologists in New South Wales were circulated with information describing appropriate conditions for referral. These included port wine stains, especially in areas not normally hidden by clothes, gross facial telangiectasia, prominent naevoid telangiectasia and a number of other rarer conditions associated with a real or apparent increase in number and/or size of superficial blood vessels in the skin. Prior assessment of the patients by a dermatologist was requested in order to avoid unnecessary referrals. Some patients had had previous treatment for their lesions.

A standard form was established for history-taking and record-keeping purposes (Appendix 1). At the time of initial assessment, a general medical history and a history pertinent to the problem were taken, diagrams were marked with the extent and location of the problem, and photographs were taken under as standard conditions as possible.

Adelaide

Subjects treated for port wine stains were outpatients of the Flinders Medical Centre. They were volunteers who were recruited through advertisements in local newspapers. Limited numbers were accepted in order to ensure that those participating in the study would receive treatment. All patients were

independently assessed by the Dermatology Department, Royal Adelaide Hospital. All had a port wine stain clearly visible at a distance of one metre. Patients who had had any prior form of treatment in an attempt to eradicate the port wine stain were excluded.

Those patients treated for telangiectasia were recruited in similar fashion. Their telangiectasias were clearly visible at a distance of one metre, in normal room lighting and ambient temperature. None of these patients had any prior form of therapy to attempt to eradicate these lesions, and persons with known medical causes for telangiectasia such as acne rosacea were excluded.

Patient treatment

Sydney

Treatment of each patient commenced by using the laser to irradiate an area of the lesion of about 1 x 1 cm (a test patch). Initially, one or more test patches were performed, with assessment of the outcome after three months. If the lesion was small, the test patch often represented the first treatment, especially for very small port wine stains and spider naevi.

As more patients were started on a treatment program, thereby limiting available appointment times for new patients, and as the clinical experience of the operators increased, test patches were often not performed and were replaced by a formal (although limited) treatment at the first visit.

A period of 4–12 weeks is necessary before the full fading effect from a particular treatment to an area can be assessed. The rapidity of fading varies with the type and location of lesion treated. Ideally, for the Candela laser, treatments are carried out every 2–3 months until maximal or complete fading has occurred. This may require on average anything between one and six treatments per area, depending on the type and location of the lesion treated.

Process details for the Royal Prince Alfred Hospital unit are shown in Box 1.

At the Royal Prince Alfred Hospital, the laser is physically located in the minor operations theatre in the outpatient section of the Dermatology Department. Adjacent to the theatre are various consultation and examination rooms, as well as a recovery and post-recovery area (used by children having general anaesthetic).

The room in which the laser is installed is air-conditioned and equipped with an operating light. Both these facilities are useful but not essential. There is a red warning light on the outside of the door, operated manually from inside the room, to warn that laser treatment is in progress. A laser warning sign is attached to the outside of the door during the operation of the laser clinic.

Patient scheduling and assessment

Sydney

Appointment times are at half-hourly intervals, but patients with large areas requiring treatment are often given a double treatment time. Beyond one hour, patient discomfort and operator fatigue can make longer treatment periods difficult to tolerate. Completion of treatment, especially for port wine stains, was restricted by patients being unable to obtain appointments within the desired 2–3 month period. Patients often had to wait many more months before receiving another treatment. Patients with large port wine stains required a number of treatment sessions before the stain had been completely treated once. Ideally, once treatment has been started, it would be preferable that treatment only occupy 1–2 years, but with the current rate of availability of appointments, many patients, especially those with large port wine stains, may still be coming for treatment for 3–4 years after their initial assessment and test patches.

Without an easy, standardised method for measuring skin colour related to ectatic or excess blood vessels in the skin, evaluation of results will be, to some extent, subjective. The composite scoring system (Appendix 1) was designed to evaluate how at least some of the common problems associated with port wine stains and other cutaneous vascular abnormalities responded to therapy. Final assessments of treatment outcomes were usually carried out three months after the last treatment. At that time, occasional hypopigmentation, hyperpigmentation and/or atrophy still would have some potential for improvement and this factor could reduce the overall score given at the end of treatment.

Evaluation of the colour change is probably the most subjective of assessments and can vary, particularly at the final assessment, because comparison between a pre-treatment photograph and post-treatment reality introduces inaccuracies related to memory, colour perception and overlay by treatment expectations. Photographic variables mean that only quite marked differences can be regarded as significant.

Adelaide

Process details for patients in the Adelaide study are shown in Box 2.

Patient numbers in the study were limited in order to ensure that they could be treated in 8-week rotations. Because of budgetary and time constraints, the number of treatments received was restricted. All patients were assessed prior to treatment, by independent clinicians not involved with the treatment, and two months after the last treatment. Patient assessments recorded prior to treatment were skin type (I–IV); previous sun exposure (low/medium/high); and description of the lesion including site(s), colour (pale pink through purple), and papular or macular.

Box 1: Process details for laser treatment, Sydney

- *GP–patient consultation*
- *Referral to dermatologist*
- *Diagnosis of lesion and assessment re suitability for treatment*
- *Referral to Laser Clinic, Dermatology Department, Royal Prince Alfred Hospital*
- *First visit:*
  - *assessment by dermatologist in laser clinic re suitability for treatment*
  - *history taken*
  - *explanation re treatment, potential complications*
  - *expected outcome, aftercare explained*
  - *consent signed, photographs taken*
  - *test patch(es) performed*
- *Second visit: (2–3 months later)*
  - *evaluation of test patches re efficacy, complications*
  - *photograph test patches*
  - *treatment delivered*
- *Third and subsequent visits: (2–3 month intervals best)*
  - *repeat treatment(s) until complete or maximal fading has occurred*
  - *intra-treatment photographs*
- *3–6 months:*
  - *final assessment and photograph*

Box 2: Process details for laser treatment, Adelaide

- *GP–patient consultation*
- *Referral to program, in response to advertisement*
- *Assessment by dermatologist at Royal Adelaide Hospital; explanation of treatment, expected outcomes*
- *If suitable, referred to Flinders Medical Centre*
- *First visit:*
  - *history taken*
  - *photographs taken*
  - *test patch(es) performed*
- *Subsequent visits:*
  - *evaluation of test patches*
  - *photographs taken*
  - *treatment delivered*

Clinical results

In this section, the clinical results obtained with laser treatment of a number of conditions are presented. Illustrations of some typical cases are given in Figures 1, 2 and 3 on pages 19–22. Further details of clinical results obtained with the copper bromide laser will be presented elsewhere.

Port wine stains

Results from test patches for Sydney and Adelaide patients are shown in Table 2. Many patients had more than one test patch performed. The best test patch results were used for assessment. Where the port wine stain involved more than one body part, the best test patch from each area was assessed.

The colour of the port wine stain before treatment is a subjective judgement by the assessing clinician under room temperature conditions which were relatively constant throughout the year. The only complications were approximately 10% temporary hyper- or hypopigmentation, all of which resolved over 3–6 months. Comparison of cases indicated that the test patches from the two centres were comparable with regard to the site treated and the colour of the lesions (Table 3).

Table 2: *Port wine stain cases—results of test patches, Sydney and Adelaide*

	Results	Sydney		Adelaide	
Adults	Excellent	26	19%	15	28%
	Good	70	51%	25	47%
	Fair	38	28%	13	25%
	Poor	2	2%		
	Unacceptable	0			
No. of patients		**130**	**100%**	**53**	**100%**
No. of tests		**136**			
(Global assessment, not just colour change)					
Children	Excellent	6	16%		
	Good	22	58%		
	Fair	10	26%		
	Poor	0			
	Unacceptable	0			
No. of patients		**37**	**100%**		
No. of tests		**38**			

Note: Best test patch result in each of the different areas recorded. This accounts for the discrepancy in the patient numbers against test patch results.

Table 3: *Comparison of port wine stain characteristics for test patches, Sydney and Adelaide*

	Sydney patients, Candela laser Per cent in category (n = 76)	Adelaide patients, Norseld laser Per cent in category (n = 53)
Site of lesion		
Face and neck	75	66
Arm and hand	11	13
Thigh, calf, foot	9	17
Trunk	5	4
Colour of lesion		
Pink	20	21
Red	25	15
Light purple	30	32
Dark purple	30	32

Results of completed treatment for patients at the Sydney unit are given in Table 4. The large majority of cases had good or excellent results.

Table 4: *Port wine stain cases—results of completed treatment, Sydney*

	Results	Completed treatment	
Adults	Excellent	16	70%
	Good	4	17%
	Fair	2	9%
	Poor	1	4%
	Unacceptable	0	
No. of patients		**23**	**100%**

Note: A large number of patients with port wine stains were having treatment at the conclusion of the study, hence the small number compared with test patch numbers. No children had completed treatment of their port wine stains at that stage.

Incomplete results for patients treated in the Adelaide study are shown in Table 5. These data give a general indication that the copper bromide laser can successfully treat port wine stains, but do not realistically reflect its efficacy as treatment was completed on only a few of these patients during the study. Some of the cohort had their treatment completed with copper bromide or pulsed dye lasers outside the study. Others were not satisfied with the degree of progress and declined further treatment. Those with 'fair' responses averaged 1.3 treatments, compared with 1.9 for those with good results. The implication is that better results would have been obtained had all cases proceeded to completion of treatment. These data are not directly comparable with those in Table 4.

Table 5: *Port wine stain cases—incomplete treatment results, Adelaide*

	Results	Incomplete treatment	
Adults	Excellent	4	9%
	Good	14	31%
	Fair	26	58%
	Poor	1	2%
	Unacceptable	0	
No. of patients		**45**	**100%**

A number of patients who had had a poor response to argon laser treatment and had developed obvious scarring had substantial or near-complete resolution of their port wine stain with Candela laser treatment. The scar tissue improved in texture and appearance—an unexpected and welcome benefit. Similarly, other patients who had excision and skin grafting or over-tattooing to parts of their port wine stains greatly benefited from resolution of the remaining lesion, following treatment with the Candela laser.

Resolution of the port wine stain without alteration in skin texture and pigment is the aim of treatment. In the few patients who developed atrophy and/or hyper- and hypopigmentation, the degree of skin damage was not enough to warrant cessation of treatment.

Telangiectasia

Patients at the Sydney unit with telangiectasia varied enormously in terms of the extent of their lesions. Many had telangiectasia secondary to solar damage, thus explaining the large number with lesions on the head and neck area. As a group, these patients tend to complete their treatment over a shorter time span than those with other types of lesion, as most areas respond completely, or almost completely, to one or two treatments per area. Even extensive facial telangiectasia may require only three or four 30-minute treatments over a 6–12 month period.

Results of test patches are shown in Table 6, and completed treatment results in Table 7.

Table 6: *Telangiectasia cases—results of test patches Sydney*

Results	Completed treatment	
Excellent	54	46%
Good	50	44%
Fair	11	10%
Poor	0	
Unacceptable	0	
No. of patients (included one child, who had a good result)	**115**	**100%**

Table 7: *Telangiectasia cases—results of completed treatment, Sydney*

Results	Completed treatment	
Excellent	34	71%
Good	12	25%
Fair	1	2%
Poor	1	2%
Unacceptable	0	
No. of patients (included one child, who had a good result)	**48**	**100%**

In Adelaide, the results of a pilot study on 20 patients with telangiectasia showed encouraging results (Table 8).

Table 8: *Telangiectasia cases—pilot study results, Adelaide*

	Number of cases	Per cent clearance	No. of treatments
Facial telangiectasia			
	1	90–100	2
	9	75–90	2.1
	5	50–75	2
	1	25–50	1
	1	0–25	1
Non-facial telangiectasia			
	1	25–50	2
	2	0–25	1

Source: Reference 10

Spider naevi

Spider naevi are common in adults and children and occur mostly on the face, hands and arms. Spider naevi are small and often respond to one treatment, so that 'test patch' results often represent the single treatment the patient received to the individual lesion. Where patients are entered into the completed treatment columns, this represents the necessity for further treatment after the test patch. Results are given in Tables 9 and 10.

Table 9: *Spider naevi cases—results of test patches, Sydney*

	Results	Test patches	
Adults	Excellent	9	43%
	Good	9	43%
	Fair	3	14%
	Poor	0	
	Unacceptable	0	
No. of patients		**21**	**100%**
Children	Excellent	8	67%
	Good	4	33%
	Fair	0	
	Poor	0	
	Unacceptable	0	
No. of patients		**12**	**100%**

Table 10: *Spider naevi cases—results of completed treatment, Sydney*

	Results	Completed treatment	
Adults	Excellent	14	88%
	Good	1	6%
	Fair	1	6%
	Poor	0	
	Unacceptable	0	
No. of patients		**16**	**100%**
Children	Excellent	9	90%
	Good	1	10%
	Fair	0	
	Poor	0	
	Unacceptable	0	
No. of patients		**10**	**100%**

Note: Two children had four treatments. Eight children had two treatments.

Rosacea

Rosacea is a condition seen in adults only, so no children are recorded in these results. Laser treatment affects only the persistent telangiectatic component of rosacea and does not alter the underlying blushing and flushing tendency.

A common comment made by patients after completion of their laser treatment was that the papular and pustular component of their rosacea seemed less of a problem than before treatment, but this detail was not specifically recorded. Treatment parameters are very similar to the telangiectasia group. Results are given in Tables 11 and 12.

Table 11: *Rosacea cases—results of test patches, Sydney*

Results	Test patches	
Excellent	7	28%
Good	12	48%
Fair	6	24%
Poor	0	
Unacceptable	0	
No. of patients (all adult)	25	100%
No. of test patch results recorded	25	

Table 12: *Rosacea cases—results of completed treatment, Sydney*

Results	Completed treatment	
Excellent	8	57%
Good	4	29%
Fair	2	14%
Poor	0	
Unacceptable	0	
No. of patients	14	100%

(a) Before laser treatment

(b) Nearing end of treatment

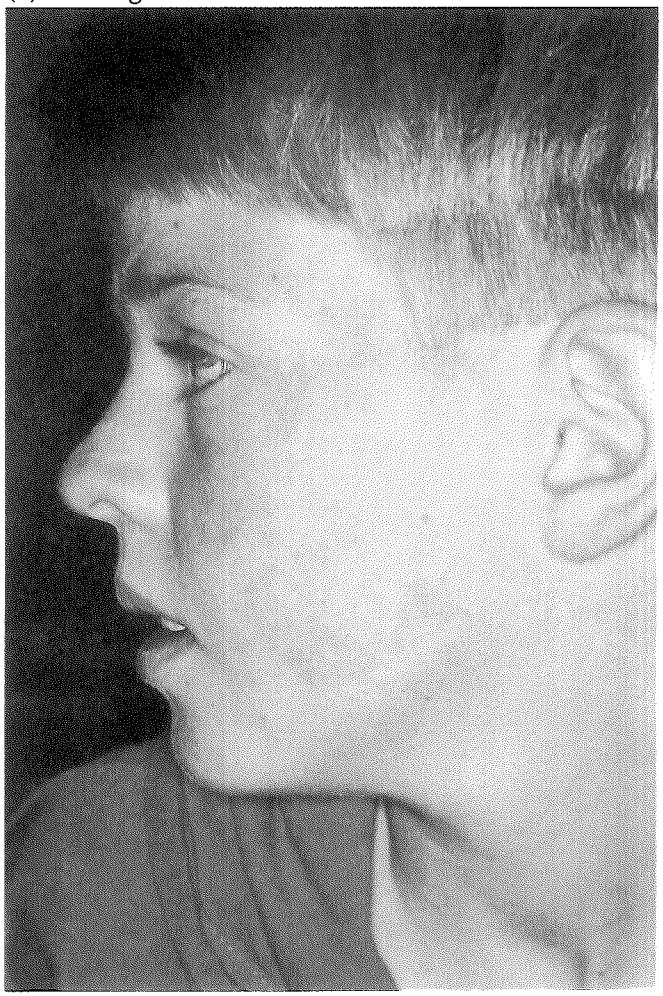


Figure 1: Facial port wine stain

(a) Before laser treatment

Figure 2: Port wine stain of hand and forearm

(continued)

(b) Nearing end of treatment

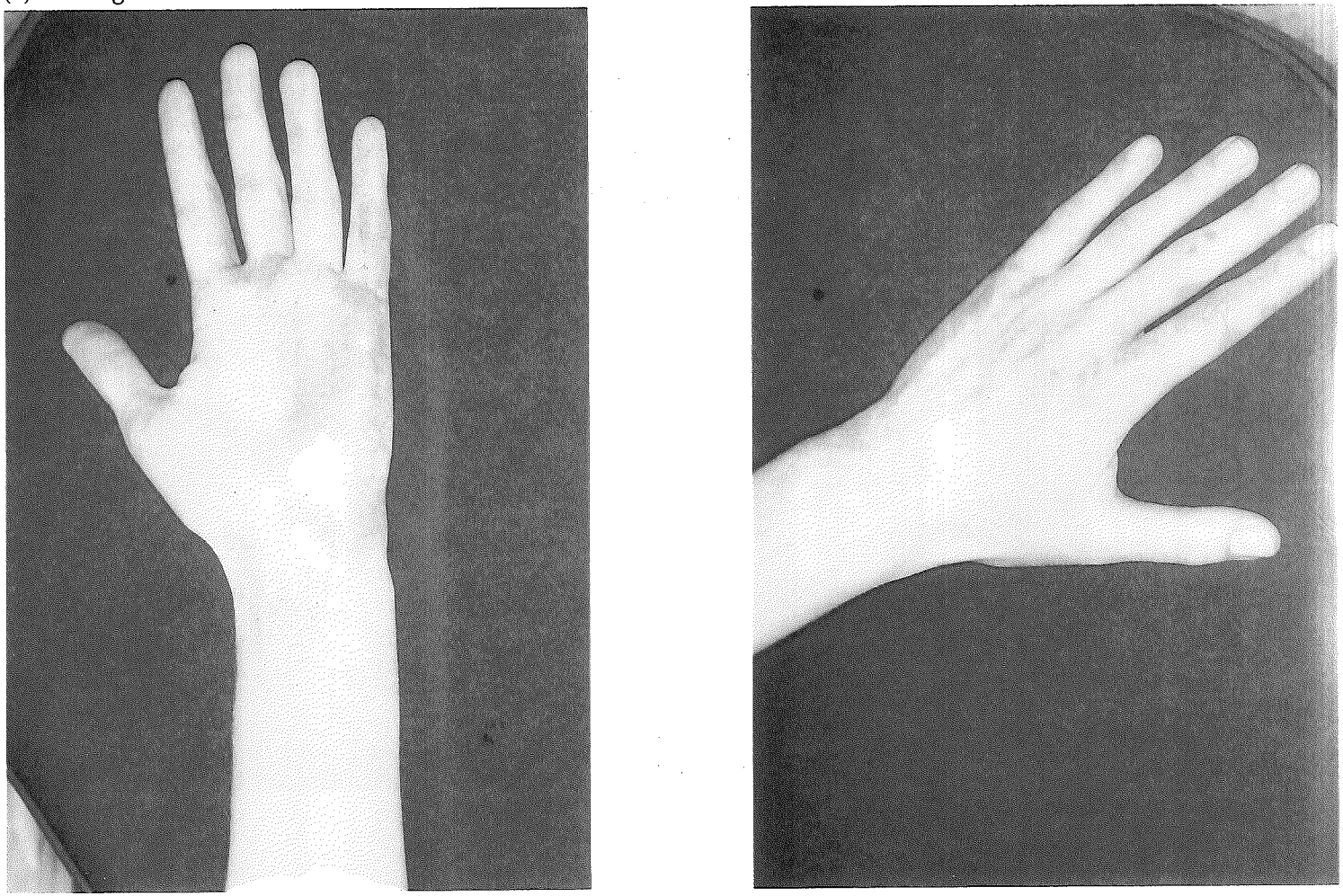
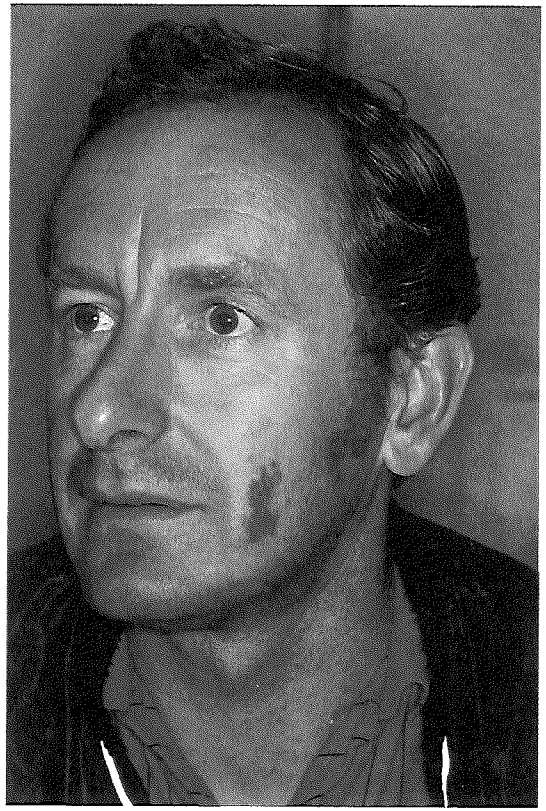
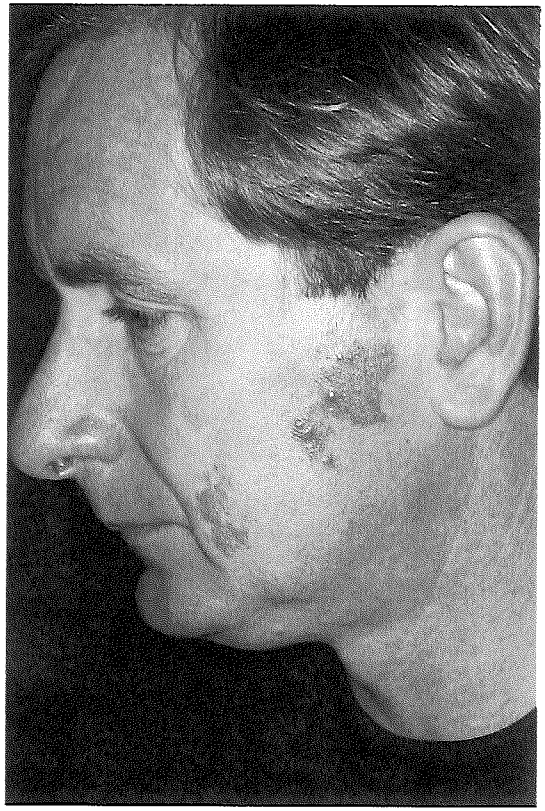


Figure 2 (continued): Port wine stain of hand and forearm

(a) Before laser treatment



(b) After two treatments



(c) After seven treatments

Figure 3: Facial port wine stain, with good early response but slower response of residual vessels

Other cases

These patients represent a heterogeneous diagnostic group. The conditions treated were all characterised by a real or apparent excess of vessels in the dermis. Diagnoses included post-radiotherapy telangiectasia, scar erythema, acquired telangiectatic naevus, venous lake, tuberous sclerosis, angioleiomyoma, angioma serpigenosum, glomus tumour, lymphangioma and tufted angioma.

Responses to test patches and treatment were variable (Tables 13 and 14) and depended largely on the depth of the blood vessels in the dermis and the size of the blood vessels. Generally, as in other conditions treated, the lighter the colour and the smaller and more superficial the blood vessels, the better the outcome. Further details of some unusual cases are as follows.

Post-radiotherapy telangiectasia

Three patients were treated in this category. One patient had fine telangiectases on the upper anterior chest wall on both sides. Sclerotherapy had been attempted with no response. The majority of the blood vessels disappeared after one treatment and the rest after two treatments. The other patients had not had any previous treatment to the blood vessels and both had 100% response after two treatments.

Scar erythema

Three patients with erythema on the edge of skin grafts had a 100% response after one or two treatments. One patient had a greater than 50% response after one treatment for post-cryotherapy erythema.

One patient with post-acne keloid scarring and erythema did not respond to one treatment (she said she got worse but there was no objective evidence to support this), whereas two other patients with the same problem improved by 50–75% after two or three treatments.

Acquired telangiectatic naevus

Three patients with this problem responded 75–100% after 1–2 treatments.

Venous lake (lower lip)

Two patients responded 75–100% after two treatments. This is a surprising response given the histology of this lesion, with the presence of a large dilated vein close to the surface of the lip epithelium. The response was similar to the patient with glomus body tumours (see below).

Others

There were one or two patients each with:

- Tuberous sclerosis: complete response of the angiomatous component, resulting in lightening and flattening of the lesions.
- Angioleiomyoma: no response.
- Angioma serpigenosum: 50–75% response after 1–2 treatments.
- Glomus tumour: one patient with a large, deeply placed, purple vascular lesion which showed approximately 50% fading after 4–5 treatments per area. This response was unexpected due to the size and depth of the blood vessels.
- Haemangio-lymphangioma: one patient with this problem had a partial flattening of the lesion. The degree of response probably relates to how much chromophore (oxyhaemoglobin) might be contained in the lesion.

Because the laser is a non-disease-specific treatment, any condition characterised by a real or perceived excess of blood vessels in the very superficial layers of the skin (<1 mm deep) can be considered for treatment.

Generally, lesions that are pink–light red in colour, with small-diameter blood vessels, on the upper part of the body would be expected to show some response to therapy. Lesions below the knee generally respond in an unpredictable manner, with an increased risk of non-response, hyper- and hypopigmentation, atrophy or scarring and post-treatment infection after abrasion of the treated area.

Table 13: ***Other cases—results of test patches, Sydney***

	Results	Test patches	
Adults	Excellent	8	28%
	Good	7	24%
	Fair	12	41%
	Poor	2	7%
	Unacceptable	0	
No. of patients		**29**	**100%**
Children	Excellent	1	14%
	Good	5	72%
	Fair	1	14%
	Poor	0	
	Unacceptable	0	
No. of patients		7	100%

Table 14: *Other cases—results of completed treatment, Sydney*

	Results	Completed treatment	
Adults	Excellent	3	33%
	Good	1	11%
	Fair	3	33%
	No change	2	23%
	Poor	0	
	Unacceptable	0	
No. of patients		**9**	**100%**
Children	Excellent	1	33%
	Good	2	67%
	Fair	0	
	No change	0	
	Poor	0	
	Unacceptable	0	
No. of patients		**3**	**100%**

Patient perceptions

Provision was made for patients to register their opinion of the test patch result and the completed treatment. This was simply done by having them mark symbolically, on a seven-point scale (A–G), their degree of happiness with the procedure and the treatment (Appendix 1).

At the Sydney unit, the vast majority of patients registered a 'B' reaction ('A' being happiest) for both test patch outcome and final outcome. They generally tended to give a more subjective appraisal, as would be expected, compared with that of the treating doctor. Many factors influenced their reactions, including degree of pain or discomfort experienced, time for purpura to disappear, length of time for treatment to be completed and availability of appointments.

On some occasions, the patient' perception of the final outcome varied significantly from the operator's perception. With port wine stains, even a small amount of fading was seen by many patients to be beneficial, whereas some patients with extensive facial telangiectasia were not happy unless every single perceived abnormal blood vessel had been eliminated. This might reflect how well expectations regarding outcome were met. Many patients with port wine stains had been told in the past that no effective treatment was available, and so their expectations were not high. With facial telangiectasia, expectations of outcome were generally high, possibly because of the perceived 'cosmetic' nature of the problem and the possibility of a 'quick cosmetic fix'. It is important in the preliminary consultation to explain the limitations of treatment, and for patients to have a thorough understanding of possible complications and reasons why treatment might not be successful.

The operator's assessment of final outcome was based on more objective factors, such as degree of fading and lack of complications. This can sometimes explain the disparity between a patient's final assessment compared with that of the operator.

Cost considerations

Laser treatment of vascular lesions is expensive. In addition to costs directly associated with the equipment, current technology is demanding of staff time and for many patients multiple treatments are required to achieve acceptable results.

Any appraisal of the true costs of a dermatological laser service needs to take account of a number of factors. In the following discussion, a definitive cost analysis has not been attempted. Rather, indications of levels of cost have been provided for a number of components with a view to drawing attention to significant issues and providing a basis for future work.

Notional costs have been assigned to the following categories:

Fixed machine costs

The capital cost of the Candela laser was $240,000 (1990 dollars) and the cost of the maintenance contract after the first year is $20,000 per year.

For the Norseld copper bromide laser, the capital cost is $83,000 and the annual maintenance contract is $15,000 after the first year.

If depreciation is calculated over five years, using a discount rate of 5%, the annual capital cost component for the Candela laser is $43,440 and that for the Norseld machine is $15,023.

Variable machine costs

For the Candela machine, a dye change is required every 5,000 pulses, at a cost of $2,200, and a flashlamp replacement every 50,000 pulses at a cost of $5,000. A notional cost of $2 per hour has been assumed for supply of water used to cool the machine. The Norseld laser requires a tube replacement every 1,000 hours at a cost of $7,000.

Electricity costs are assumed to be $2 per hour for the Candela laser and $0.5 per hour for the Norseld machine.

Other consumable costs

The major additional consumable cost is that for film and processing associated with photographing patients before and after treatment. A cost of $15 per patient is assumed. Use of local anaesthetic and syringes is minimal, and EMLA cream, if used, is purchased by the patients.

Staff costs

Staff costs are likely to vary considerably, depending on the arrangements made for provision of the services. At the Royal Prince Alfred Hospital, because of its nature as a teaching hospital, a registrar is in attendance at many of the clinics and takes an active role. Under current arrangements, 20–30 patients are treated each week at a total of 4–5 clinics. The patient interview, photography, recording of information and laser treatment are carried out by a Visiting Medical Officer (VMO), usually assisted by a registrar. In some clinics a registrar is not present due to other duties, in which case one or more of the nursing staff is involved, especially in the children's clinic. VMO session time is costed at $135 per hour, registrar time at $25 per hour, nursing time at $20 per hour and technician time at $15 per hour.

In the Adelaide study, interview, photography and treatment were carried out by a nurse. Laser treatment was carried out by a VMO. For the purposes of the cost comparison included here, the cost of VMO session time is taken to be $135 per hour, though actual rates are lower in South Australia than in New South Wales.

At both centres, secretarial/receptionist time is costed at $15 per hour.

Other items

Costs of housing the laser facility (rent of space), and of staff-related items such as workers' compensation and superannuation, have not been included here. These items will vary, some quite appreciably, depending on the location of the facility.

Costs associated with down time have not been calculated. Down time on the Candela machine has not been a major problem and may have resulted in approximately one in 20 clinics being cancelled. In Sydney, the response of the company with the maintenance contract has been prompt, usually within half to one day of a malfunction being reported, with longer delays when parts were unavailable and had to be obtained from the USA.

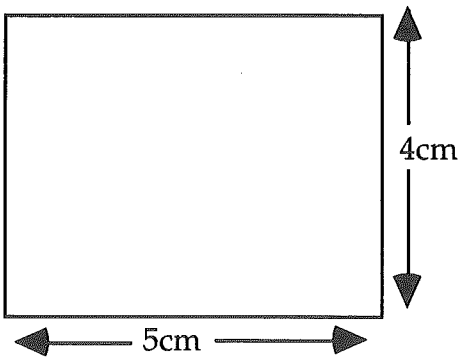
Younger children and some adults require a general anaesthetic facility with appropriate admission, recovery, post-recovery and discharge areas. This cost obviously adds substantially to the overall cost of treatment but is not included for this discussion. General anaesthetics can only be provided in an appropriate hospital or day surgery facility and the facility fee for the use of the necessary infrastructure also adds to overall cost. Where general anaesthetic facilities are not provided in association with laser use, the establishment costs for providing the service are considerably less.

Indications of cost per treatment

The cost of treatment could be based on the number of pulses used in treatment by working out the cost/pulse in a variety of treatment settings. Another way of costing is to work out the total cost of running a full-time service and

extrapolating cost/unit time. These and other methods have limitations. Treatment time is made up of patient consultation time (variable, depending on stage of treatment); time for photography; application of topical, local or regional anaesthetic, if necessary; and actual laser treatment time.

Indications of cost for the laser treatment component can be obtained by considering the time taken to irradiate an area of 20 cm^2:



With the Candela laser, such an area can be treated in approximately 10 minutes and requires 150–170 pulses depending on the degree of overlap of the incident laser beam. For a port wine stain, in order to achieve maximal fading three to eight treatments per area are required. A port wine stain involving most of one cheek (a common situation) would cover approximately 60 cm^2. Treating the entire area once would take approximately 30 minutes (excluding time taken for consultation, photography and recording patient details). Six treatments would thus occupy three hours in total, with treatments spaced 2–3 months apart and would consume 2,700–3,000 pulses. Table 15 gives notional costs of a single 30-minute treatment session for an adult, not involving a general anaesthetic.

The manufacturer of the copper bromide laser advises that it requires approximately 10 minutes to treat a 20 cm^2 port wine stain. Three to five treatments are required at intervals of about six weeks (P Davis, personal communication). Marginal cost per treatment would be higher for the Candela laser because of expenditure on dye solution and the need to replace the flash lamp.

Table 15: *Notional costs for a single treatment session ($)*

	Candela	Norseld
Fixed costs		
Depreciation(a)	30	10
Maintenance	11	8
Variable costs		
Dye consumption(b)	80	-
Flash lamp	16	-
Tube	-	3.5
Photography	3	3
Water and electricity	2	0.5
Staff costs		
VMO time	70	70
Registrar time	5	5
Secretarial time	10	10
Total	**227**	**110**

(a) Assumes 30 patients/week for 48 weeks/year.
(b) 160 pulses @ 50c/pulse.

The total cost of treating a port wine stain might range therefore from $687 to $1,832 for the Candela laser, on the basis of the experience at Royal Prince Alfred Hospital.

This cost does not take into account depreciation or repairs on camera, rent of space, workers' leave, compensation and superannuation, insurance and down time on the laser. These are all factors which would have to be considered when estimating the cost of providing this service in the private sector. When children are treated, a general anaesthetic is almost always needed.

It is not possible to estimate the total cost of treating a port wine stain with a copper bromide laser from the data available from the Adelaide study. Further study is needed to obtain realistic comparative treatment costs with the two types of laser under routine conditions.

Discussion

The results obtained with the Candela laser to date confirm results obtained from a large number of overseas studies. Port wine stains generally respond better when:

- sited on the upper rather than lower body;
- pink–light red rather than dark red or purple;
- the lesion has a more reticulate rather than solid appearance; and
- treatment is commenced in early childhood rather than later, because of the thinner epidermis seen in children, smaller diameter blood vessels and usually lighter colour.

Currently existing yellow light laser systems appear to be the treatment of choice at present for port wine stains and other superficial vascular disorders. The Candela laser has more recently been evaluated for two other therapeutic circumstances. One is for the treatment of recalcitrant warts where a success rate of 80% has been claimed after one or two treatments. The other, and probably more important, application has been its use in the treatment of rapidly proliferating superficial haemangiomas where complications arise due to the size and/or activity of the haemangioma, and the treatment of ulcerated haemangiomas to induce regression.

Further improvement in laser systems providing a greater depth of penetration of the laser beam without harming other skin structures and the ability to eliminate larger blood vessels are desirable future aims. A comparison between different delivery systems for yellow light lasers would be useful. Variations in factors enabling the delivery of the yellow light (such as spot size, exposure time and power) will influence the final outcome and the incidence of complications. Such comparisons are yet to be reported in any large series.

The model of the Candela laser currently in use at Royal Prince Alfred Hospital has been superseded by another model which treats at twice the pulse rate, with a spot size twice the area, enabling patient treatment time to be quartered. Dye kit changes are needed less often and the machine is air cooled. The cost is in the range of US$250,000.

Desirable, of course, is the development of an appropriate laser system which is cheap to buy, cheap to run, quick and easy to use and provides excellent results with few or no side effects. Reduction in cost and numbers of treatments necessary for maximal elimination of the lesion are also highly desirable. At present, such a device seems some way off.

The total treatment time for a port wine stain using a Candela laser can be very long. Duration of treatment is determined by the area of the lesion. Typically, port wine stains require three to eight treatments (each of 30 minutes' duration) for maximal resolution of the condition to be achieved. Operator fatigue and limited patient tolerance are significant factors after about an hour. This means that a

patient with a large port wine stain might require many treatment sessions to treat the whole area of the lesion just once. The machine is expensive to purchase, maintain and operate. Quicker, cheaper treatment is possible with newer types of machine.

Provision of further infrastructure, enabling more treatments in the public hospital system, would enable those seeking treatment better access to available services. Provision of more treatment centres would reduce some of the problems patients have regarding access to treatment. Funding constraints limit the ability to provide more clinics. Ideally, there would be less than a three-month waiting list so that further appointments for treatment could be made at the appropriate intervals (2–3 months), but because of demand on appointment times it has not been possible to do this. Many patients wait six months for an appointment for their next treatment.

The infrastructure required for treating adults is fairly simple and can be met in any outpatient or private practice facility that has a room of a suitable size, with appropriate power and water connections. Treatment of children requires a general anaesthetic and all the appropriate facilities of a short-term operating facility are needed. Use of general anaesthetic substantially increases the cost of treatment. In the case of younger children, this is counterbalanced a little by the fact that they have a smaller area that requires treatment and often have a better and faster response to treatment than adults.

Clinically, the results obtained with the Candela laser are impressive, particularly when individual patients who have previously had poor outcomes from laser treatments are seen. The more limited results available from the copper bromide laser also show promise. Such devices are a considerable improvement on earlier technology, both in terms of the degree of fading produced and the reduction in complications. However, treatment remains slow with laser systems that are currently available. Use of the laser is time consuming, and for most patients there will be substantial intervals between follow-up sessions. Attention needs to be given to the infrastructure of institutions offering dermatological laser services, if efficiencies are to be maximised.

Different types of laser devices, including the Candela and the Norseld machines, will have characteristic strengths and weaknesses. With present technology, it seems unlikely that any one machine will meet all the requirements of a dermatology department. Ideally, those treating superficial cutaneous vascular lesions would want access to more than one laser type, with different characteristics, so as to optimise treatment for each patient. Sometimes a combination of lasers will achieve a result that either alone could not achieve. Automated scanning devices are useful to speed up treatment time and reduce some complications, especially scarring. Newer types of laser are becoming available for use in dermatology. When these are considered for acquisition by health services there will be a need to critically assess these further developments in terms of their cost, speed of treatment, complications and patient outcomes.

Appendix 1 Data collection forms

Royal Prince Alfred Hospital, Department of Dermatology

CANDELA LASER TREATMENT

PATIENT'S NAME:

UNIT NO:

TICK BOXES BELOW WHEN EACH IS COMPLETED

ASSESSMENT	[ ]	DATE
PRE-TEST PATCH PHOTOGRAPH	[ ]	DATE
TEST PATCH	[ ]	DATE
TEST PATCH ASSESSMENT	[ ]	DATE
PATIENT POST-TEST SATISFACTION SHEET	[ ]	DATE
POST-TEST PATCH PHOTOGRAPH	[ ]	DATE
FIRST TREATMENT	[ ]	DATE
FIRST POST-TREATMENT ASSESSMENT	[ ]	DATE
POST-TREATMENT PHOTOGRAPH	[ ]	DATE
FINAL POST-TREATMENT ASSESSMENT	[ ]	DATE
POST-TREATMENT PATIENT SATISFACTION SHEET	[ ]	DATE

Royal Prince Alfred Hospital, Department of Dermatology

CANDELA LASER CONSULTATION

SURNAME: ADDRESS:

FORENAMES:

UNIT NO: REFERRING DR:

DOB: DATE OF REFERRAL:

PHONE NO: HM: LETTER:
WK: REFERRAL NO:

OCCUPATION:

==========

DIAGNOSIS: DATE OF CONSULT:

ONSET: CHANGES SINCE ONSET:

PREVIOUS TREATMENT: LASER: Type: No of treatments:

Hrs of treatment: % Fading: Complications:

EXCISION: XRT: CRYOTHERAPY: OTHER:

OUTCOME OR COMPLICATIONS OF PREVIOUS TREATMENT:

PAST HISTORY: FAMILY HISTORY:

SUN EXPOSURE: SCARRING TENDENCY:

OTHER DISEASES: CURRENT MEDICATIONS:

ALLERGIES: RACE: NATIONALITY:

SKIN TYPE:
I. always burns, never tans.
II. always burns, then slight tan.
III. sometimes burns, always tans.
IV. never burns, always tans.
V. heavily pigmented.
VI. black.

PHOTOGRAPHS: BEFORE TEST DOSE/TREATMENT YES/NO

BIOPSY: BEFORE TEST DOSE/TREATMENT YES/NO RESULT:

Royal Prince Alfred Hospital, Department of Dermatology

CANDELA LASER CONSULTATION

PATIENT'S NAME: DR:

UNIT NO: DATE:

==========

DESCRIPTION OF LESION: Entirely flat (macular):
Mostly flat with some papules (ectatic vessels):
Mostly papular:
Entirely papular:
Other:

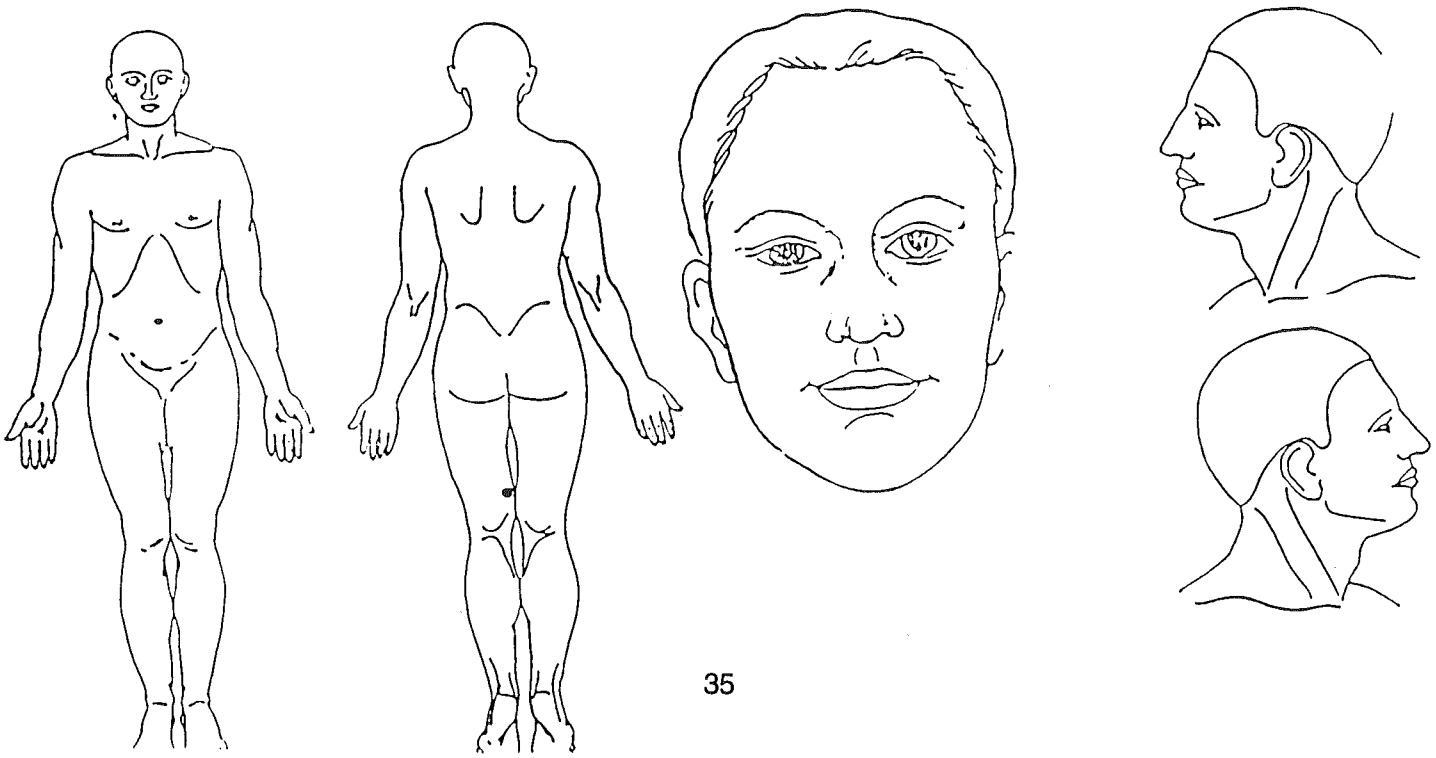
SCARRING: YES/NO

Cause:

COLOUR: Pale pink/red
Red
Light purple
Dark purple
Other

TEXTURE OF SKIN: Normal
Atrophic/thin
Course/thick

EXAMINATION OF LESION: Location: Dimensions:



Royal Prince Alfred Hospital, Department of Dermatology

CANDELA LASER TEST PATCH

PATIENT'S NAME: UNIT NO: DR:

DATE: TIME START: TIME FINISH:

ANAESTHESIA:

TOPICAL:
LOCAL:
REGIONAL:
NEUROLEPT/SEDATION
GENERAL:

PHOTO: Pre-test: YES/NO
Post-test: YES/NO

PURPURA RESPONSE:

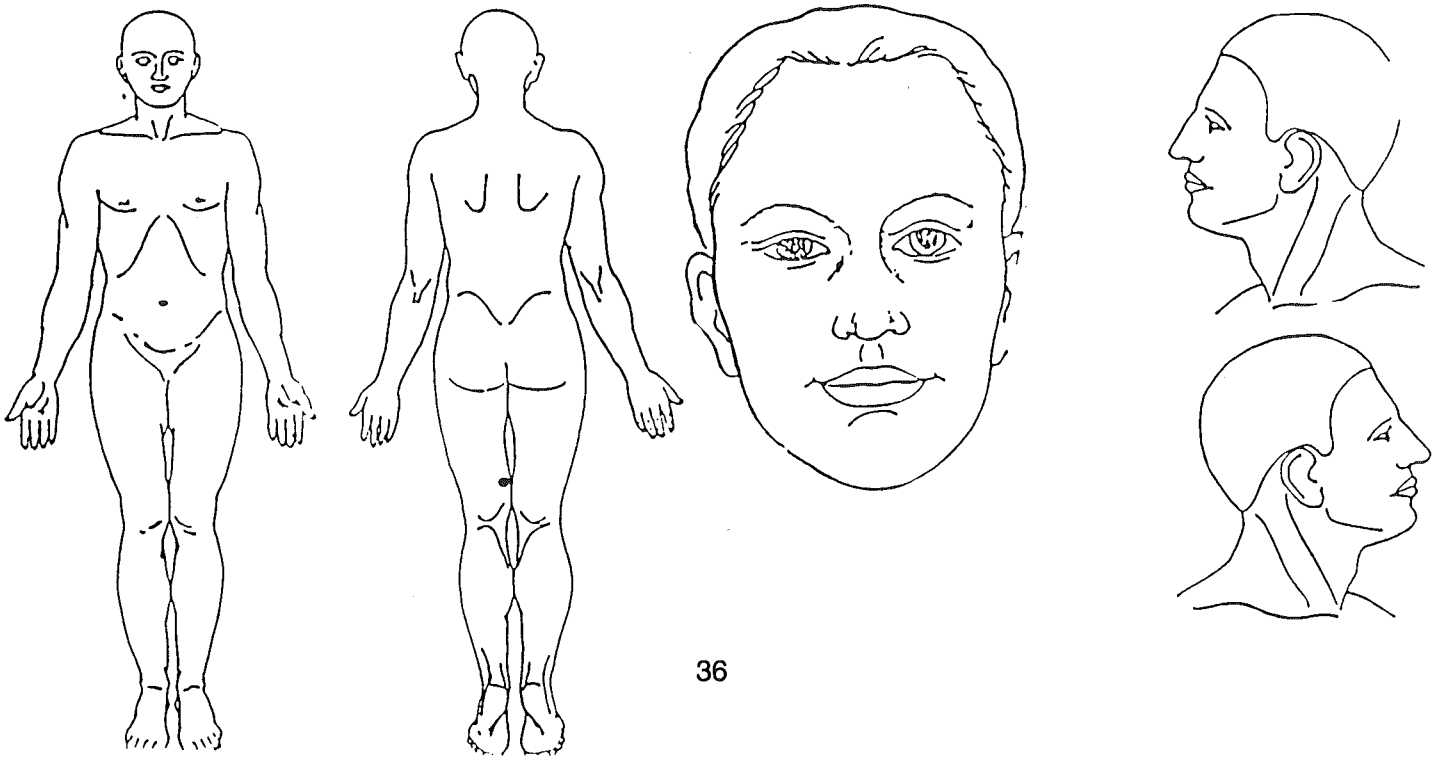
0 : NONE
1 + : MINIMAL GREY
2 + : GREY
3 + : PURPURA
4 + : DARK PURPURA
5 + : BLANCH

RESULT

FADING:
A. EXCELLENT >75%
B. SIGNIFICANT 25-75%
C. SLIGHT 25%
D. NO CHANGE
E. POOR RESPONSE:
depression
scar
texture change
hyperpigmentation
hypopigmentation

TEST SITE (SEE DIAGRAM)	AREA	ENERGY (J/CM^2)	NO. OF PULSES	PURPURA RESPONSE IMMEDIATE	PURPURA RESPONSE LATE	RESULT
1.						
2.						
3.						
4.						
5.						

PHOTOGRAPH OF RESULT: YES / NO



Royal Prince Alfred Hospital, Department of Dermatology

CANDELA LASER TEST PATCH ASSESSMENT
(to be performed 3 months after test patch)

PATIENT'S NAME: DR:

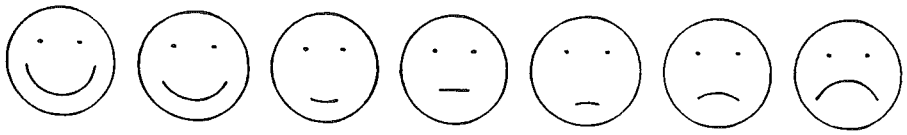
UNIT NO: DATE OF TEST PATCH: DATE:

PARAMETER	CHANGE	SCORE
COLOUR OF TREATED LESION	DARKER COLOUR	-1
	NIL - SLIGHT CHANGE (0-25%)	0
	MODERATE LIGHTENING (25-50%)	+1
	MARKED LIGHTENING (50-75%)	+2
	TOTAL OR NEAR TOTAL LIGHTENING (75-100%)	+3
MAKEUP (where applicable)	MORE DIFFICULT TO APPLY	-1
	NO CHANGE	0
	EASIER TO APPLY OR LIGHTER MAKEUP USED	+1
	NO LONGER USED TO HIDE LESION	+2
TEXTURE OF SKIN	WORSE	-1
	NO CHANGE	0
	BETTER	+1
SCARRING	HYPERTROPHIC	-2
	ATROPHIC	-1
	NIL	0
COLOUR OF SKIN	HYPERPIGMENTATION	-1
	NO CHANGE	0
	HYPOPIGMENTATION	-1

COMPOSITE SCORE		RESULT
With makup factor	Without makeup factor	
+4 to +6	+4 to +3	Excellent
+3 to +2	+2 to +1	Good
+1 to -1	0 to -1	Fair
-2 to -3	-2	Poor
-6 to -4	-4 to -3	Unacceptable

PATIENT SATISFACTION

Here are some faces expressing various feelings. Which face comes closest to expressing how you feel about your port wine stain after Candela laser treatment?



A B C D E F G

COMMENTS: _____

_____

Royal Prince Alfred Hospital, Department of Dermatology

CANDELA LASER TREATMENT NO:

PATIENT'S NAME: UNIT NO: DR:

DATE: TIME START: TIME FINISH:

ANAESTHESIA:

TOPICAL
LOCAL
REGIONAL
NEUROLEPT/SEDATION
GENERAL

PURPURA RESPONSE:

0 : NONE
1+ : MINIMAL GREY
2 + : GREY
3 + : PURPURA
4 + : DARK PURPURA
5 + : BLANCH

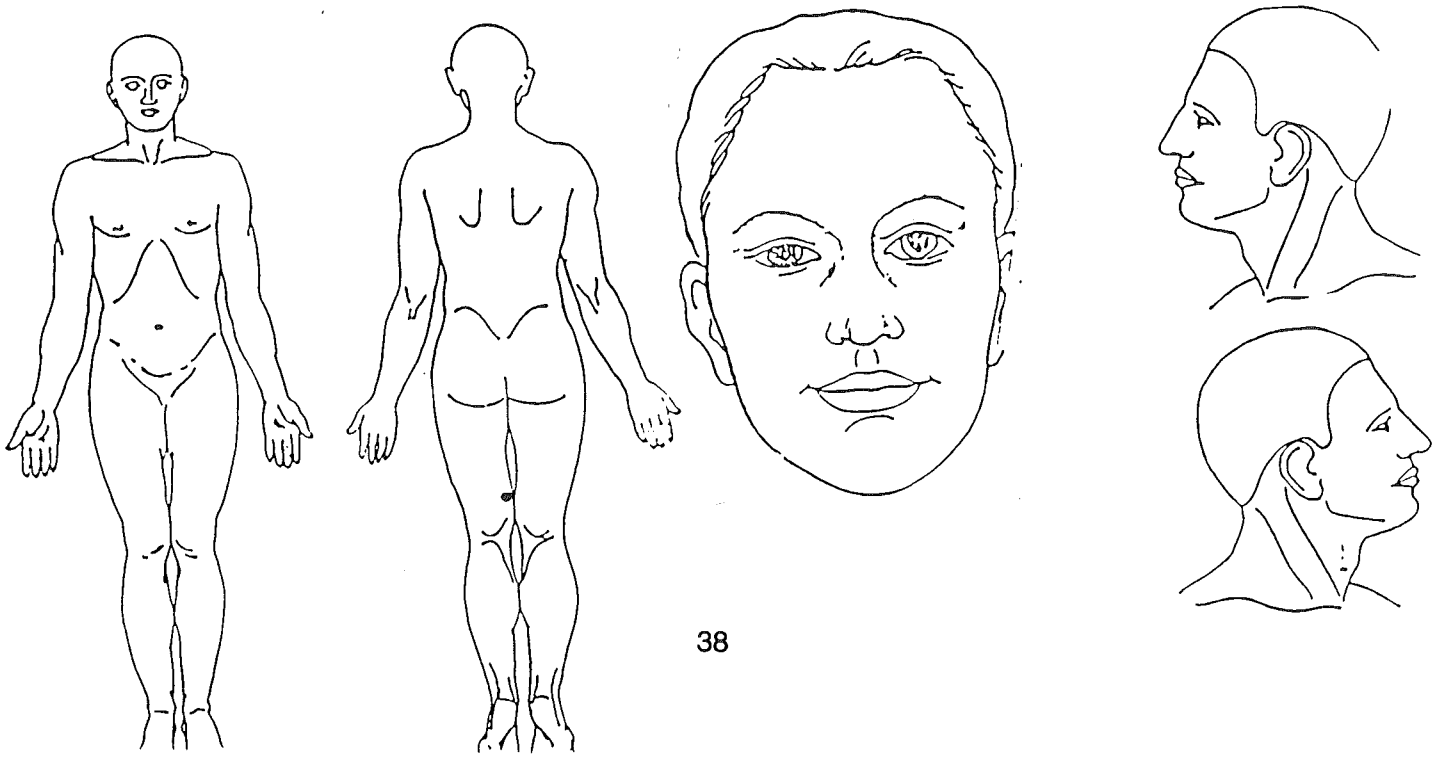
PHOTO: Pre-treatment: YES/NO
Post-treatment: YES/NO

RESULT

FADING:
A. EXCELLENT >75%
B. SIGNIFICANT 25-75%
C. SLIGHT <25%
D. NO CHANGE
E. POOR RESPONSE
depression
scar
texture change
hyperpigmentation
hypopigmentation

SITE	AREA	ENERGY (J/CM^2)	NO. OF PULSES	PURPURA RESPONSE IMMEDIATE	PURPURA RESPONSE LATE	RESULT
1.						
2.						
3.						
4.						
5.						

PHOTOGRAPH OF TREATMENT RESULT YES/NO



Royal Prince Alfred Hospital, Department of Dermatology

CANDELA LASER FINAL ASSESSMENT

(to be performed 3-6 months after final treatment)

PATIENT'S NAME: DR:

UNIT NO: DATE OF FINAL TREATMENT: DATE:

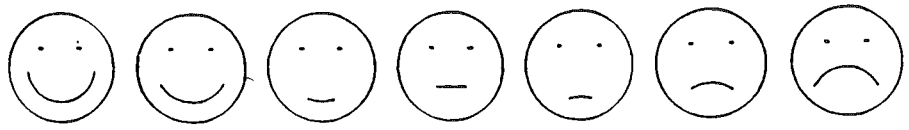
PARAMETER	CHANGE	SCORE
COLOUR OF TREATED LESION	DARKER COLOUR	-1
	NIL - SLIGHT CHANGE (0-25%)	0
	MODERATE LIGHTENING (25-50%)	+1
	MARKED LIGHTENING (50-75%)	+2
	TOTAL OR NEAR TOTAL LIGHTENING (75-100%)	+3
MAKEUP (where applicable)	MORE DIFFICULT TO APPLY	-1
	NO CHANGE	0
	EASIER TO APPLY OR LIGHTER MAKEUP USED	+1
	NO LONGER USED TO HIDE LESION	+2
TEXTURE OF SKIN	WORSE	-1
	NO CHANGE	0
	BETTER	+1
SCARRING	HYPERTROPHIC	-2
	ATROPHIC	-1
	NIL	0
COLOUR OF SKIN	HYPERPIGMENTATION	-1
	NO CHANGE	0
	HYPOPIGMENTATION	-1

COMPOSITE SCORE		RESULT
With makup factor	Without makeup factor	
+4 to +6	+4 to +3	Excellent
+3 to +2	+2 to +1	Good
+1 to -1	0 to -1	Fair
-2 to -3	-2	Poor
-6 to -4	-4 to -3	Unacceptable

PHOTO: YES/NO

PATIENT SATISFACTION

Here are some faces expressing various feelings. Which face comes closest to expressing how you feel about your port wine stain after Candela laser treatment?



A B C D E F G

COMMENTS:

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