Neutral Bay
Laser & Dermatology
Clinic

cosmeticlaser.com.au

# 2016

# Index of laser responsive skin conditions

Neutral Bay Laser & Dermatology Clinic

**Dr Terence Poon** M.B.B.S. (Hons), Ph.D. (Syd), F.A.C.D.
Dermatologist & Laser Specialist

In Association with
**Dr Marianne Nolan** B.Med, (Newc), MPH (Syd)
**Dr Helena Torpinski** M.B.B.S. (Syd), F.R.A.C.G.P.

## Acknowledgments

We would like to thank our friend and mentor Dr James Walter, who compiled previous editions of this Index and whose knowledge of all things laser is always greatly appreciated.

# Contents

# vascular lesions

| condition | response to laser | appropriate laser |
|---|---|---|
| **Telangiectasia** | | |
| **Face and Neck**<br>Usually due to genetic predisposition<br>Can also be secondary to actinic damage, rosacea, cushingoid changes etc.<br>Also post radiotherapy, post surgical and postinflammatory eg cutaneous discoid lupus | Responsive<br>1-4 treatments | Most vascular lasers are suitable for this task<br>Unless there is a benefit in using purpura-producing parameters, it is best to use a more gentle approach. Even so, oedema is often a problem which may take a few days to resolve.<br>The finer the vessels, the shorter the pulse width required and the greater the likelihood of oedema. With some lasers, 'pulse stacking' can be useful. (See notes on vascular lasers on page 5) |
| **Legs** | Superficial venous flares do well They do however often resolve spontaneously with time | Vascular lasers with longer wavelength/ high fluence/short pulse duration with pre and post cooling |
| | Deeper vessels less responsive | 1064nm Nd:YAG variable pulse width |
| | Sclerotherapy remains the gold standard for treatment of most superficial leg veins | |
| | Best response in combination with Ultrasound Guided Echosclerotherapy and Endovenous Laser Therapy (EVLT) for treatment of underlying incompetence of saphenous veins and perforators (See notes on page 6) | The 4 most common lasers are 810nm diode, 980nm diode and 1064nm and 1320nm Nd:YAG lasers |
| **Vascular Malformations** | | |
| **Capillary and Venous Elements**<br>eg. Port Wine Stain | 70-90% responsive<br>4-8 treatments may be required at monthly intervals<br>Better response if treated early<br>(See notes on page 5 on port wine stains)<br>Maintenance treatments may be needed as these tend to worsen with age, and some PWS develop age related plaques and nodules | Nd:YAG/KTP 532nm variable pulse width (VPW) lasers – (eg VersaPulse, Gemini and Aura), Pulsed dye laser (585/595nm), (eg V Beam etc)<br>Also near Infrared lasers – Alexandrite (755nm), Diode (810nm, 940nm, 980nm), and Nd:YAG (1064nm)<br>Also older lasers such as Argon, Krypton, metal vapour lasers<br>Intense Pulsed Light instruments – very effective. (See notes on page 25)<br>Larger vessels, nodular and hypertrophic components and vegetations do better with a combination of longer wavelengths, large spot size and longer pulse duration eg Altus Excel LongPulse 1064nm Nd:YAG, Gemini, Lyra etc |

| condition | response to laser | appropriate laser |
|---|---|---|
| **Vascular Malformations (cont.)** | | |
| **Venous**<br>eg. Blue Rubber Bleb Naevus | Responsive | Choice of laser depends on size of malformation with longer wavelength lasers being required for larger lesions |
| **Mixed**<br>eg. Cutis Marmorata | Partly responsive | As for port wine stains |
| **Arterial** | Laser usually not applicable | |
| **Spider Naevus** | | |
| | Responsive<br>1-3 treatments | As for telangiectasia |
| **Venous Lake** | | |
| | Responsive<br>1-3 treatments | As for vascular malformations |
| **Haemangiomas** | | |
| **Superficial**<br>eg. capillary, strawberry naevus | Majority resolve spontaneously<br>The papillary dermal component, if treated before it becomes enlarged, is likely to avoid atrophic cigarette paper scarring which can occur following spontaneous resolution<br>Treatment strongly recommended for flat, early haemangiomas on the face, neck and nappy area, as well as flat lesions on the arms and legs which are prone to ulceration<br>4-6 treatments (See notes on haemangiomas on page 5) | As for vascular malformations<br>Both Erbium:glass and $CO_2$ fractional resurfacing lasers (eg Fraxel lasers) useful for atrophic scarring and residual redundant skin after spontaneous resolution, prior to or as an adjunct to surgery<br>Infantile haemangiomas may require propranolol |
| **Deep** | Quite deep haemangiomas can be reached with the 1064nm Long pulse lasers<br>Very deep tumours may be out of reach of lasers | As for vascular malformations |

| condition | response to laser | appropriate laser |
|---|---|---|
| **Pyogenic Granuloma** | | |
| | Often responsive to vascular lasers<br><br>Cellular component may be suitable for ablative laser such as Erbium YAG or $CO_2$ | 1064nm Nd:YAG<br><br>(Curette/cautery or surgical excision required if unresponsive to laser) |
| **Angiolymphoid Hyperplasia** | | |
| | Usually responsive<br>(Alternatively, observation/SXRT) | Best treated with combination of vascular and $CO_2$ laser |
| **Diffuse Erythema** | | |
| | Diffuse facial erythema due to abnormal blood flow through normal vessels (flushing) eg histamine response, is minimally responsive to lasers | |
| **Rosacea** | | |
| **Erythemato-telangiectatic rosacea** | Responsive | Best treated with a pulsed dye laser either in purpuric mode or very short (millisecond) pulse widths |
| **Papular rosacea** | Recent results promising Concomitant treatment with oral or topical antibiotics also usually required | Vascular lasers or perhaps even better, Second Generation IPL instruments using very short pulse widths (eg 2.5ms)<br><br>Multiple treatments are required as well as follow up treatments eg 6-12 monthly |
| **Rhinophyma and other phymatous changes** | Responsive | Excellent cosmetic improvement achievable using $CO_2$ laser<br><br>In mild-moderate cases, fractional ablative laser appropriate |
| **Poikiloderma of Civatte** | | |
| **Vascular component** | Responsive<br>2-6 treatments | Pulsed vascular lasers or Second Generation IPL lasers give best results |
| **Melanin component** | Responsive | QS Alexandrite or appropriate IPL |
| **Large Visible Blood Vessels Around the Nose and Alar Areas** | | |
| | Responsive<br><br>These are often arterioles and, as such, are under a higher pressure with thick vessel walls.<br><br>Main risk is forming a ‘trough’ – experience required | Near-infrared lasers eg. 1064nm Nd:YAG |

# Notes on the laser treatment of vascular lesions:

A large number of permutations and combinations of vascular laser parameters are used in the treatment of vascular lesions. Each operator has his or her preference for parameters which give the best results, taking into account vessel size, depth and anatomical site.

There are now so many different brands of vascular laser and IPL instruments that although manufacturers usually publish suggested settings, treatments are very operator dependent. A photon is a photon whether it be delivered by a laser or IPL.

**IPL instruments** – Emit non-coherent intense light which can be used with filters for treating many vascular and pigmented lesions (see Appendix).

**Pulse widths** – Most new lasers have a very short pulse duration to limit thermal injury to the skin. Continuous wave lasers eg. Argon or Krypton lasers and quasi continuous lasers eg Copper Vapour lasers are suitable for microtracing capillaries and for treating some other vascular lesions. Continuous wave lasers are generally not suitable for treatment of telangiectasia of the neck and chest. These areas can be safely treated with lasers with cooling devices eg VersaPulse, V Beam, Gemini, etc and also the Second Generation I2PL instruments which do not require contact cooling.

**Diode lasers** – These are being used much more frequently. A diode is a small chip which emits light when a voltage is passed across it (akin to a laser pointer). Diode lasers have large banks of these all focused to a point, emitting the required wavelength.

**Number of treatments required** – Depends on the type of laser being used. Less treatments are usually required when using lasers with a very short pulse duration but, on the down side, oedema can last for 5 or 6 days and if the pulse duration is less than 1 millisecond with a sufficiently high fluence, purpura can result which can last for 7-10 days. Most patients are happy these days to have their telangiectasia treated more gently with a longer pulse width.

The skin on the neck and chest almost always develops some oedema for a few days following vascular laser or IPL treatments. This is also the area most prone to complications such as hypopigmentation and scarring and represents a high proportion of medico-legal litigation relating to lasers and IPLs in New South Wales.

Pulse stacking is a useful technique in enhancing the treatment of telangiectasia. The ‘greying’ seen after a pulse is due to the formation of methaemoglobin, which is also accompanied by changes in shape (elongation) of erythrocytes. In this state, they are more vulnerable to a second pulse and the final result is enhanced.

**Port wine stains and large haemangiomata** – Port wine stains are congenital progressive vascular malformations. They have extremely complex vascular geometry with much heterogeneity in blood vessel size, density and depth. This means that often different pulse widths are required to achieve effective clearance. Venous blood contains typically 70% oxyhaemoglobin (HbO2) and 30% deoxyhaemoglobin (Hb). Laser treatment typically also induces the formation of methaemoglobin (metHb).

**The long pulse Alexandrite** – (755nm) can be used to target Hb while the the LongPulse Nd:YAG (1064nm) can be used to target metHb. Work is being performed on the development of lasers which produce sequential wavelength delivery (eg 595nm followed by 1064nm) to take advantage of this change in haemoglobin.

In general terms, if complete blanching is the benchmark, this is only achievable in about 25% of patients. Most patients however, are happy with impressive fading of their port wine stains and we can achieve this in approximately 80% of patients.

Pulsed yellow and green light lasers are useful for superficial components of haemangiomata and port wine stains. A longer wavelength with a variable pulse duration is required for deeper components and the Excel, Lyra, Gemini, Sciton 1064nm lasers, and long pulse Alexandrite would appear to be the most effective recent developments in this area. It would appear that regeneration of port wine stains following treatment occurs from deeper vessels, hence reaching these vessels during a treatment is important in producing long term results. There is a deoxyhaemoglobin peak at around 755nm which makes the Alexandrite laser particularly useful in this regard. Quite obviously, there will be some very deep components, which will be out of reach of lasers. Port wine stains in children do best if they are treated early. The reasons are a smaller surface area, less melanin interference and probable greater vascular susceptibility. The most difficult areas are hands and feet (purple port wine stains) and in many cases, the central area of the face.

In the authors’ experience, the Second Generation Intense Pulsed Light instruments are even more effective in treating port wine stains than lasers. This may be because the spectrum of wavelengths covers all of the major haemoglobin absorption peaks. From a practical viewpoint, the IPL has another tremendous benefit in that it has a very large ‘footprint’ and it is possible to treat large areas of the body very quickly compared to lasers.

For more resistant areas, it would appear that in many centres, the V Beam, using purpuric settings, is the instrument which gives the best results.

Recent studies using 595nm pulse dye lasers with dynamic cooling for the treatment of infantile haemangiomata have shown complete or near complete clearance in 75% of superficial lesions and slightly less in mixed lesions. Relatively few adverse events

were noted in contrast to early studies which used the 585nm PDL without cooling. Haemangiomas should be treated frequently during the proliferative phase ie every 2 or 3 weeks, if possible.

Conservative measures (or perhaps not so conservative) include oral propanolol, oral steroids, intralesional steroids, interferon, vincristine and imiquimod.

Recent studies have investigated the use of adjunctive antiangiogenic agents such as rapamycin and photosensitisers such as the green dye indocyanine to increase the efficacy of laser treatment. Current basic research also involves the use of optical instruments and reflectance spectroscopy to quantitate tissue chromophores such as HbO2 and Hb and tissue oxygen saturation pre and post laser treatment. This would assist in the planning of treatment and in the measurement of efficacy of laser treatment of PWS.

Newer methods being currently investigated include the use of combination wavelengths such as PDL and 1064NdYag and PDL and 755nm alexandrite lasers for resistant PWS. Combination treatments with the adjunctive use of prothrombotic and/or antifbrinolytic drugs are also being investigated.

**Laser treatment of leg veins** – Leg veins are particularly difficult to treat by laser for several reasons. Firstly, they are under a higher pressure with thicker vessel walls, secondly they are relatively deep compared to facial telangiectasia, thirdly, they are often kept patent by underlying vascular pathology, and fourthly, the vessels vary greatly in size which makes it difficult to select appropriate pulse widths.

The laser used depends on the size of the vessel and the depth beneath the skin.

Fitzpatrick phototypes 4 to 6 should be triaged to sclerotherapy.

Telangiectatic matting of the legs appears to respond best to a spectrum of pulse widths between 6 and 20 milliseconds. Above and below this window would appear to be less effective. Occasionally, purpura and haemosiderosis occur which resolve after a period of time.

Venulectasia and reticular vessels require near infrared wavelengths to achieve adequate depth of treatment. These probably work as much by heating perivascular collagen as by selective photothermolysis.

In general, indications for lasers for leg veins are isolated telangiectatic vessels and venulectasia as well as vessels around the ankles and feet which do not do well with sclerotherapy. Patients with needle aversion or phobia are also candidates for laser therapy.

**Endovascular laser therapy** – A catheter wire is passed into a vein (endovascular cannulation) under duplex ultrasound guidance using a local anaesthetic (usually tumescent anaesthesia). It is then withdrawn using motorised pull back.

Historically, radiofrequency (480kHz) was used, or recently diode 940nm and 980nm and Nd:YAG 1064nm were found to be an improvement and more recently, the Cooltouch (1320nm) corresponding to a peak in water absorption has been found to be very effective.

EVLT techniques vary greatly throughout the world and the above description is merely intended as a brief summary of the situation at present. Correction of the venous pathology in the legs is not purely for cosmetic reasons, it obviously has a beneficial effect on related conditions such as stasis ulcers and stasis dermatitis.

It is interesting to note that the great majority of these treatments are performed by dermatologists in other countries such as the United States. Venous disease has always been treated by dermatologists and in fact ambulatory phlebectomy was invented by Muller who was a dermatologist.

# pigmented lesions

This list is comprised from the authors' experience and reading and is not intended to be comprehensive. There are no up-to-date textbooks which cover this area satisfactorily at present.

| condition | response to laser | appropriate laser |
|---|---|---|
| **EPIDERMAL** | | |
| **Melanocytic** | | |
| **Lentigo Simplex**<br>**Solar Lentigo** ('Liver spots') | 1-2 treatments | QS Nd:YAG (532nm/1064nm)<br>QS Alexandrite, QS Ruby<br>Picosecond Alexandrite<br>The above wavelengths using millisecond pulse durations also effective<br>IPL<br>PDL without skin cooling |
| **Melanotic** | | |
| **Pigmented Seborrhoeic Keratosis** (macular) | Responsive | As above plus Erbium:YAG<br>1064nm VPW |
| **Dermatosis Papulosa Nigra** | Responsive. Increased chance of post laser hyperpigmentation which is usually temporary. | Resurfacing lasers,<br>QS Alexandrite, 1064nm VPW |
| **Café au Lait Macule** | Responsive<br>May recur in 2-3 years requiring retreatment<br>Treatment can sometimes result in a speckled post-treatment pattern which is difficult to clear | QS Nd:YAG,<br>QS Ruby<br>QS Alexandrite<br>Picosecond Alexandrite |
| **Becker's Melanosis** | Poor response to laser therapy<br>(The hair component is responsive) | QS Alexandrite, QS Ruby,<br>QS Nd:YAG.<br>Resurfacing lasers |
| **Naevus Spilus**<br>(Speckled and Lentiginous Naevus) – melanotic component | 2-4 treatments | Pigment laser or IPL. |
| **Ephelides** (Freckles) | Responsive<br>2-4 treatments<br>Will recur after a period of time depending on sun protection | Any short pulse duration pigment laser<br>IPL usually better due to larger footprint |
| **Labial Melanotic Macule** | Responsive<br>1-2 treatments | QS Nd:YAG<br>QSRuby,<br>QS 1064nm, IPL |
| **Post Inflammatory Hyperpigmentation** | Variable response, often treated in combination with topical bleaching agents | QS Nd:YAG<br>QS Alexandrite<br>IPL |

| condition | response to laser | appropriate laser |
|---|---|---|
| **DERMAL** | | |
| **Melanocytic** | | |
| **Blue Naevus** | Variable response | QS Nd:YAG, QS Ruby, QS Alexandrite, 1064 nm VPW |
| **Naevus of Ota** | Usually responsive | QS Nd:YAG, QS Ruby, QS Alexandrite, Picosecond |
| **Naevus Fuscocaeruleus Zygomaticus** (Hori's Naevus) | Responsive<br>Usually 3-8 treatments | QS 755nm, QS 1064nm, Picosecond |
| **Naevus of Ito** | Responsive | QS Nd:YAG, QS Ruby, QS Alexandrite, Picosecond |
| **Acquired Melanocytic** | | |
| **Speckled and Lentiginous Naevus** (derived from epidermal melanocytes)<br>1mm-2mm studded areas Compound or Junctional Naevi histologically | Responsive<br>2-6 treatments | QS 532nm, QS 755nm, QS 1064nm, Picosecond<br>532nm, 755nm, 1064nm VPW pulse duration less than 1 millisecond preferable. |
| **Junctional Naevus** | 2-6 treatments<br>Sometimes recur<br>(See notes below re safety aspects of treatment) | As above |
| **Compound Naevus** | 2-6 treatments<br>Sometimes recur<br>(See notes below on safety aspects of treatments) | As above |
| **Dermal Naevus** | Best not treated by laser | |
| **Congenital Melanocytic Naevus** | Small lesions responsive to laser. Larger ones, laser treatment best avoided. (See notes below on safety aspects) | QS 532nm, QS 755nm, QS 1064nm<br>532nm, 755nm, 1064nm VPW pulse duration less than 1 millisecond preferable |
| **Haemosiderin Deposits** | | |
| Eg. following Sclerotherapy | Variable response | QS 532nm, QS 755nm, QS 1064nm<br>532nm, 755nm, 1064nm VPW pulse duration less than 1 millisecond preferable. |
| **Iron deposits** eg. resulting from iron injections intended for intramuscular absorption being placed too superficially | Responsive if superficial but sometimes too deep and out of reach of lasers | As above |

## Notes on safety aspects relating to treatment of pigmented lesions:

The treatment of congenital naevomelanocytic naevi and dermal melanocytic lesions by laser depends on the perceived risk of melanoma plus cosmetic and functional considerations. Strongly stated positions on both sides of the issue are reflected in clinical practice.

The darkly pigmented macules in naevus spilus are junctional or compound naevi. Histologically, melanoma has been seen in a relatively small number of cases of naevus spilus according to Fitzpatrick.

To our knowledge, there are no reported cases of melanoma developing in laser treated lesions. The risk would appear to be greater for large congenital melanocytic naevi than for smaller ones, and it is thought that the risk of melanoma increases after puberty.

There is no evidence to suggest that lasers can induce malignant change.

Our personal approach to this problem is firstly to avoid treating these lesions in patients with a family history of melanoma. If this is not the case, we have them sign a consent form stating that they understand there is a small risk of melanoma developing in these lesions in the future and that they undertake to keep the treated area under close surveillance in the future and report to a specialist dermatologist should anything unusual appear in the previously laser treated area. Each case however, has to be evaluated on its own merit with regard to cosmetic implications and other relevant factors.

| condition | response to laser | appropriate laser |
|---|---|---|
| **Melanotic** | | |
| **Melasma** (Chloasma) | Epidermal component – often responsive to pigment lasers but recurrence is common<br>Dermal component – usually unresponsive to pigment lasers<br>Important to emphasise that melasma is a chronic condition | IPL, QS Nd:YAG, QS Ruby, QS Alexandrite.<br>Low fluence QS Nd:YAG<br>All laser treatments should be preceded and followed by effective bleaching agents and advice on strict sun protection. |
| **Post Inflammatory Hyperpigmentation** | As above | QS Nd:YAG, QS Ruby, QS Alexandrite. |

## Notes on melasma:

This is a very common condition which can often be quite distressing for those affected. While most commonly affecting females, it can also be seen in male patients. Symmetrical areas of macular light to dark brown pigmentation often affect the forehead, cheeks and upper lip.

The mutifactorial aetiology results in a condition for which complete resolution is often the exception rather than the rule. Genetic and hereditary factors play a role as well as hormonal effects from pregnancy and the oral contraceptive pill. Sun exposure also plays a large role with many patients reporting exacerbations in summer or time spent outdoors. An episode of unprotected sun exposure or sunburn is often reported as an initiating event by many patients.

Many different light based therapies have been tried in the past, quite often with some improvement but with recurrence shortly after. We have found that in our hands a combination treatment utilising microdermabrasion and low fluence Q-switched Nd:YAG can over two or three sessions improve melasma appearance. There is little downtime with some mild erythema which can last for a few hours. Strict sunprotection is a given together with the use of a topical bleaching agents such as hydroquinone, kojic acid, azelaic acid and retinoids.

Patients may require treatments to maintain improvement but the effect appears more durable than treatments with other light and laser sources such as IPL, high fluence Q-switch laser and fractional non-ablative lasers. The role of picosecond laser in condition is currently being investigated.

Some patients may also present with a a vascular or telangiectatic component for which the addition of vascular laser can assist.

# tattoos

| | | |
|---|---|---|
| Professional | Organometallic dyes<br>Pigment usually deep dermal requiring:<br>6-20 treatments at 6 weekly intervals for Q-switched laser; or<br>3-6 treatments at 6 weekly intervals for picosecond laser | |
| Amateur | India ink<br>Depth of pigment variable<br>1-3 treatments usually sufficient | |
| Ink colour | **Black or blue ink** | **Appropriate laser:**<br>Picosecond Alexandrite<br>QS Alexandrite<br>QS Nd:YAG<br>QS Ruby |
| | **Green ink** | **Appropriate laser:**<br>Picosecond Alexandrite<br>QS Alexandrite<br>QS Ruby |
| | **Red ink** | **Appropriate laser:**<br>QS Frequency doubled Nd:YAG |
| Traumatic tattoos | These occur for a number of reasons including contact of the skin with asphalt during motor vehicle accidents, etc. Also other types of tattoos such as carbon from ruptured high pressure oil hoses and so on.<br><br>They are usually responsive to Picosecond and Q-Switched lasers but multiple treatments are required and the completeness of the clearance depends on the depth of the pigment in the dermis. | |
| Cosmetic tattoos<br>Eg. eyebrows, eyeliner, lipliner | Picosecond Alexandrite<br>QS Alexandrite<br>QS Nd:YAG | |

## Notes on tattoos:

- Different tattoo colours are treated with different laser wavelengths as outlined above. Pale colours absorb less laser energy and are more difficult to treat. There are some colours (such as yellow and white) for which there is no corresponding laser wavelength. These colours will fade but not disappear.
- New picosecond lasers are now the gold standard for tattoo removal. First commercially available picosecond laser is the Cynosure Picosure which is an alexandrite laser. These picosecond lasers utilise ultrashort pulse durations which exploit the photomechanical effect, as tattoo particles generally range in size from 40-300nm which correspond to thermal relaxation times mostly in the picosecond range. Such lasers are able to achieve greater tattoo fading with fewer treatments.
- Unfortunately newer permanent tattoo inks such as “Freedom ink” no longer available due to poor uptake by tattoo artists. Such inks were packaged within tiny beads called polymer microspheres. Each bead contained pigment which when treated with laser exploded releasing nano-sized particles which was absorbed by the body. Only a single laser treatment was usually necessary.
- Fractional ablative laser (such as Fraxel Repair) can be used to treat recalcitrant tattoos not responsive to Q-switched or Picosecond lasers.
- Multiple picosecond or Q-switched laser treatments on the same day can increase tattoo ink clearance and reduce the total treatment period required. The use of optical clearing agents such as perfluorodecalin can also enhance the effectiveness of tattoo removal treatments.
- Care must be taken when treating patients with known cosmetic tattooing. Skin coloured or white tattoos can contain pigments which can be oxidised by Q-switched laser treatment which can result in unwanted darkening or blackening of the tattoo. This darkening can then only be removed by many further Q-switched or picosecond treatments.

# scars and striae

| condition | response to laser | appropriate laser |
|---|---|---|
| **Erythematous Scars** | Responsive<br>1-4 treatments | All pulsed vascular lasers or IPL reasonably effective |
| **Atrophic Scars** | Responsive<br>Multiple treatments | Erbium:glass and/or $CO_2$ fractional resurfacing lasers<br>Induction of collagen neogenesis and re-creation of cutaneous rete ridge pattern. |
| **Pigmented Scars** | Variable response<br>1-4 treatments | QS Alexandrite<br>QS Ruby<br>QS Frequency doubled Nd:YAG |
| **Hypertrophic Scars** | Early erythema responsive to vascular lasers | All pulsed vascular lasers reasonably effective – the pulsed dye 595nm would appear to be particularly effective<br>Fractional ablative lasers can assist in the delivery of topical agents |
| **Keloid Scars** | Mature hard keloid scars are usually unresponsive to lasers | Intralesional corticosteroids or intralesional 5-FU in combination with a non-ablative laser such as 595nm PDL or 1450nm diode can improve appearance |
| **Striae Distensae** | Early erythema responsive to vascular lasers<br>Improvement now possible using fractional resurfacing lasers eg Erbium:glass 1540nm. | All pulsed vascular lasers or IPLs reasonably effective for erythema. Non ablative laser techniques have been used to reverse atrophy with minimal response.<br>Fractional resurfacing lasers (both Erbium:glass and $CO_2$) may produce results for older striae |
| **Post Traumatic Scars**<br>eg. following MVA | Raised scars responsive<br>Atrophic scars usually unresponsive | Carbon dioxide laser<br>Erbium laser, QS Nd:YAG.<br>Fractional non-ablative<br>Fractional ablative laser |
| **Post Surgical Scars** | Raised scars responsive<br>Hypertrophic and pincushion surgical flaps responsive<br>Atrophic scars usually treated with fractional resurfacing | Fractional nonablative and ablative lasers, Carbon dioxide laser, Erbium:YAG laser. |
| **Chicken Pox** | Deep punched out nature of scars makes laser treatment difficult – punch excision and suture preferable<br>More superficial scars respond to laser treatment | Erbium:YAG<br>Carbon dioxide<br>Fractional non-ablative and ablative<br>Non ablative lasers eg 1450nm diode. |

| condition | response to laser | appropriate laser |
|---|---|---|
| **Acne Scars** | Variable response depending on depth and type of scars. Ablative laser has superseded dermabrasion Often second treatment required after 3-6 months.<br><br>Erbium:glass fractional resurfacing lasers generally treatment of choice. Requires 3-5 treatments. $CO_2$ fractional resurfacing lasers also useful, requiring 1-2 treatments | Carbon dioxide<br>Erbium:YAG<br>Fractional non-ablative and ablative resurfacing lasers<br><br>See notes below for more information |
| **Hypopigmented Scars** | Previously unresponsive to laser treatment | Fractional non-ablative and ablative lasers show promise in stimulating repigmentation |

## Notes on acne scars:

There is a wide range of acne scars types including icepick, boxcar, rolling, atrophic, hypertrophic/keloid, hypopigmented and hyperpigmented morphologies. Patients generally have a combination of morphologies. Hence the treatment of acne scars almost always involves more than one modality. These may include punch excision, subcision, punch grafting, temporary or permanent fillers and in some centres, fat transfer. Hypertrophic and keloid scars may be treated with intralesional steroid injections and pulse dye lasers. Laser treatments are often used in conjunction with such procedures.

Ablative laser, while still the gold standard for acne scar resurfacing, is probably best avoided in patients with Fitzpatrick skin types 3 to 6 skin due to the higher probability of post laser hyperpigmentation. Fractionated non-ablative lasers such as the Fraxel re:store or Dual lasers are now first line laser treatment for acne scarring in all skin types. Fractionated ablative lasers such as the Fraxel re:pair can reduce the number of treatments required but with the tradeoff of longer post-laser downtime. Higher skin types require lower fluences and greater time between treatments. Between 3-5 treatments on average required when using fractional non-ablative lasers, which is equivalent to 1-2 treatments using fractional ablative resurfacing lasers.

It is important to ensure when treating acne scarring that patients are counselled to have realistic expectations. Even with the best technology available in the world at present, and with a great deal of experience using multiple techniques, we can still only on average, promise patients (with a few exceptions) between 30% and 70% improvement, (the degree of improvement of course being a very subjective experience).

See also Appendix M.

# hair removal

| condition | response to laser | appropriate laser |
|---|---|---|
| **Hirsutism**<br>• Racial<br>• Endocrine<br>**Folliculitis and Pseudofolliculitis barbae** | Responsive<br>Technology improving rapidly<br>Patient selection important. Best results with fair skin and dark hair (blond or grey hair unresponsive). Only anagen (growing) hairs are responsive<br>Occasional non-responders and also a very small percentage of patients paradoxically develop more hair following their laser treatments (usually dark skin patients with very fine hair) | LongPulse 1064nm Nd:YAG (eg. Altus and Lyra)<br>LongPulse Alexandrite (eg. Gentlelase)<br>Ruby laser<br>Diode laser etc.<br>IPLs with appropriate short wavelengths filters<br>The newer 1064nm lasers and Second Generation IPLs for dark skin types are best for hirsutism of racial origin in skin phototypes 3-6. |

## Notes on hair removal:

The exact mechanism for effectiveness of hair removal lasers is not understood. It would appear that there is damage to stem cells, papillary blood vessels and the hair bulb itself. The relative importance of these structures in terms of hair destruction is not yet completely understood.

More and more people are asking their family doctor for information and advice about the safety and effectiveness of lasers for removing unwanted hair.

As you know, there has been a proliferation of hair removal laser clinics over the past couple few years. Some of these are very ethical, but many are run by non-medical entrepreneurs and employ non-medical laser operators with little or no formal training.

There has been a huge number of IPL instruments sold to beauty therapists and hairdressers in New South Wales who have no formal training whatsoever.

The result is that we are seeing an increasing number of patients with problems relating to treatment such as burns and pigmentary disturbances.

We are also seeing a lot of patients who are disappointed because they have not received the results they were promised. The good news is that, performed by medically qualified practitioners, the benefits can be lasting and the complications negligible.

## Important considerations:

- Patients must have realistic expectations. Newspaper advertisements are often misleading. With present laser technology, it is possible to achieve long-lasting hair removal in 60-80% of treated hair on average, over the course of treatment. Any hairs remaining are thinner and finer and of less significance than pre-treatment.
- There is a large individual variation. In some cases the hair will stay away for years, in others, it will start to regrow within months.
- Multiple treatments are required. We usually tell patients that they will need between 3 and 8 treatments, spaced about 6 weeks apart. Some patients require more.
- Many of the larger laser clinics have use inappropriate lasers. The most common problem is that these clinics have only one type of laser/IPL which has wavelengths which are too short for safely treating patients with Mediterranean or Middle Eastern ancestry. These are often the patients who present for treatment of hirsutism which is a racial feature.
- For patients with Polycystic Ovary Syndrome where there is an androgenic drive for hair growth, the short term results with hair removal lasers are quite good, but as the hair follicles continue to exist in a hormonal milieu, ongoing treatments are usually required.
- Blonde or grey hair does not respond.

- Patients experience a prickly sensation during treatment that some find uncomfortable. When using the longer wavelength lasers such as the 1064nm LongPulse, pain can be a problem and local anaesthetic cream and a Zimmer cooling device can be used.
- If topical local anaesthetic cream is applied to large areas, especially under occlusion, care must be taken to avoid systemic reactions due to lignocaine absorption and lignocaine toxicity.

Despite these limitations, we find (and this is confirmed by our registered nurses who counsel patients and operate our hair removal lasers) that patient satisfaction is very high providing they are fully informed.

Lasers are still, by far, the best way to remove unwanted hair. They are less painful, less messy, less likely to cause small scars and are more permanent than conventional methods such as waxing and electrolysis.

There is an increasing trend, particularly in the United States, for home treatment of unwanted hair. These treatments ‘stun’ hairs and are more equivalent to waxing than effective permanent or semi permanent hair removal. Nevertheless, they will almost certainly be the way of the future. Low level 810nm diode lasers and pulsed-light devices are being developed for home use.

---

# benign skin lesions and conditions

| condition | response to laser | appropriate laser |
|---|---|---|
| **Acanthosis Nigricans** | Temporary improvement only<br>Treatment of underlying metabolic condition if present | Erbium:YAG laser |
| **Actinic Cheilitis and Leukoplakia** | Responsive<br>See Appendix C | $CO_2$ laser<br>Erbium:YAG laser<br>PDT also effective |
| **Actinically Damaged Skin Facial** | Responsive | $CO_2$<br>Erbium:YAG<br>Fractional non-ablative<br>Fractional ablative<br>IPL |
| **Other** ie. chest, neck, forearms and hands | Improvement is possible but less than with the face | IPL<br>Fractional non-ablative<br>Fractional ablative<br>Erbium:YAG<br>$CO_2$ lasers contraindicated for anything other than very small areas due to risk of poor wound healing |
| **Addison's Disease Cutaneous Pigmentation** | Responsive | Most pigment lasers |
| **Adenoma Sebaceum** | Responsive | Erbium:YAG laser |
| **Argyria** (caused by ingestion of colloidal silver) | Responsive | QS Alexandrite<br>QS Nd:YAG |
| **Dark Periorbital Circles** (a racial feature for which treatment is commonly sought) | Partially responsive<br>Often a multifactorial condition due to visible vascularity/pigmentation and the shadowing effect of prominent tear troughs | Vascular laser<br>Pigment laser<br>Often in conjunction with topical lightening preparations and dermal fillers |
| **Epidermal Naevus** | Responsive<br>May recur with time, particularly more verrucous lesions | Erbium:YAG laser<br>$CO_2$ laser |
| **Erythroplasia of Queyrat** | Responsive | Erbium:YAG laser |
| **Fibrous Papule** | Responsive | Erbium:YAG laser |
| **Glomus Tumours** | Responsive | 1064nm VPW |
| **Histiocytoma** | Unresponsive | |
| **Hydrocystoma** | Responsive | Erbium:YAG laser |
| **Keratosis Pilaris Rubra** | Responsive | Short pulse duration vascular lasers<br>IPL |
| **Lymphangioma Circumscriptum** | Responsive | Erbium:YAG laser |
| **Molluscum Contagiosum** | Responsive | Pulse dye laser (low energy, short pulse) |

| condition | response to laser | appropriate laser |
|---|---|---|
| **Morphoea** | Peripheral telangiectasia usually responsive<br>Marked clinical improvement of the plaques themselves (improved pliability and skin colour) with 4 successive laser treatments spaced 2 months apart. | Pulsed dye laser |
| **Naevus Sebaceous** | Responsive | Erbium:YAG laser<br>Carbon dioxide |
| **Neurofibroma** | Responsive | 1064nm LongPulse laser,<br>Erbium:YAG laser |
| **Open Pores** | | Fractional non-ablative and fractional ablative |
| **Pearly Penile Papules** | Responsive | Erbium:YAG laser |
| **Peutz-Jaeger** | Responsive | Q-Switched alexandrite and other pigment lasers |
| **Pigmented Purpuric Dermatosis** | Responsive | Vascular laser |
| **Pilonidal Sinus** | Responsive | Long pulse Nd:YAG hair removal |
| **Pseudofolliculitis Barbae** | Excellent | Any effective hair removal laser or IPL system |
| **Psoriasis** | Responsive | Excimer laser 308nm |
| **PXE** | Partly responsive | Recent studies using IPL |
| **Sarcoidosis** | Lesions of cutaneous sarcoidosis which present a problem cosmetically (eg on the nose & cheeks) respond well to laser | Erbium:YAG laser<br>Vascular laser |
| **Scleroderma – Mat Telangiectasia** | Responsive<br>Requires short pulse width and high fluence. | Vascular laser |
| **Sebaceous Gland Hyperplasia** | Responsive | Erbium:YAG laser<br>$CO_2$ laser<br>1450nm diode lase |
| **Seborrhoeic Keratoses** | Superficial – responsive | QS pigment laser<br>Erbium:YAG laser |
| | Thickened | Conventional non laser techniques as effective off-face<br>Laser presents lower risk of scarring and pigmentary disturbance on face |
| **Striae** | Partially responsive<br>The early vascular component of striae responds well to vascular lasers | Vascular laser<br>$CO_2$ and/or Erbium:glass fractional resurfacing lasers |
| **Syringoma** | Responsive | Erbium:YAG laser<br>$CO_2$ laser |
| **TMEP** | Responsive | Vascular lasers |
| **Trichoepithelioma** | Responsive | Erbium:YAG laser<br>$CO_2$ laser |

| condition | response to laser | appropriate laser |
|---|---|---|
| **Vitiligo** | Responsive | Excimer laser 308nm<br>UVA/UVB<br>Fractional ablative laser |
| **Warts**<br>• Verruca vulgaris<br>• Verruca plantaris<br>• Periungal warts<br>• Condyloma acuminata<br>• Recalcitrant warts | Variable response | Pulse dye laser<br>Erbium:YAG laser<br>Carbon dioxide laser |
| **Xanthelasma** | Moderately good response is possible but no better than trichloroacetic acid | Erbium:YAG laser |

# malignant skin tumours

| condition | response to laser | appropriate laser |
|---|---|---|
| **Basal Cell Carcinoma (BCC)** | Responsive, especially for superficial BCC.<br>Excision preferable for nodular, cystic and morphoeic BCC<br>Photodynamic therapy or Imiquimod for superficial lesions | Carbon dioxide<br>Erbium/YAG laser<br>MAL/ALA followed by 633nm red light source or IPL<br>See Appendix G |
| **Bowen's Disease** | Responsive | As above for superficial BCC |
| **Squamous Cell Carcinoma (SCC)** | Laser not indicated<br>Surgical excision preferable | |
| **Lentigo Maligna (Hutchinson's' Melanotic Freckle)** | Laser not indicated<br>Surgical excision preferable | |

# indications for the incisional mode of $CO_2$ laser

- Transconjunctival lower lid blepharoplasty
- Incisional upper lid blepharoplasty
- Laser assisted neck lift (see Appendix E)
- Excision of skin tumours including undermining of flaps

# wrinkles and scars

| condition | response to laser | appropriate laser |
|---|---|---|
| **Facial Wrinkles and Photodamage**<br>eg. rhytides on forehead, periorbital region, upper lip and perioral region | Very good response<br>May require second treatment after 6 months<br>Dynamic creases do not do so well eg frown lines and 'crows feet' which require Botox injections.<br>See footnote on facial resurfacing procedures below. | $CO_2$ laser, Erbium:YAG laser, Erbium:glass and/or $CO_2$ fractional resurfacing lasers.<br>Other wavelengths include Palomar 2940nm.<br>(Sciton LongPulse Erbium:YAG (1350nm) provides a compromise between $CO_2$ and short pulse duration Erbium:YAG with respect to thermal effect on reticular collagen.) |
| **Acne Scars** | Variable response depending on depth and type of scars. Laser has now superseded dermabrasion as modality of choice. Often second treatment required after 3-6 months.<br>Skin phototypes 4 through 6 usually better treated by fractional resurfacing due to the lower risk of post laser hyperpigmentation. | $CO_2$ laser, Erbium:YAG laser. Erbium:glass and/or $CO_2$ fractional resurfacing lasers.<br>Note: Subcision, punch grafting & both temporary and permanent fillers may be indicated and fat transfer is carried out in some centres. |
| **Post Surgical Scars**<br>**Post Traumatic Scars** | Variable response depending on depth, contour and site<br>Multiple treatments usually required.<br>Erythema of scars can be nicely addressed with vascular lasers although this neovascular proliferation usually resolves spontaneously after a year or two | $CO_2$ laser, Erbium:YAG laser, Erbium:glass and/or $CO_2$ fractional resurfacing lasers<br>Non ablative lasers such as 1320nm and 1450nm will give some improvement over a course of treatment |
| **Chicken Pox Scars** | Deep punched out nature of scars makes laser treatment difficult – punch excision and suture often preferred.<br>More superficial scars respond. | Erbium:YAG lasers, Erbium:glass and/or $CO_2$ fractional resurfacing lasers, non ablative lasers |
| **Keloid Scars** | Combination treatment with intralesional corticosteroid injections and a vascular laser to treat erythema and remodel collagen. Once scar is flatter, fractional resurfacing lasers can be used to further improve texture and appearance. Multiple treatments usually required. | 532nm, 595nm vascular lasers followed by Erbium:glass or $CO_2$ fractional resurfacing laser |
| **Atrophic/hypopigmented Scars** | Difficult to treat, however advent of fractionated non-ablative and ablative lasers have enabled treatment of these scars by laser | Erbium:glass and/or $CO_2$ fractional resurfacing lasers. |

## Notes on facial laser resurfacing:

Some facial creases obviously require a surgical procedure such as a formal face lift or fillers such as Restylane, Juvéderm or autologous fat transfer.

In the mid 1990's, a large number of patients underwent full face laser resurfacing with the pulsed Carbon dioxide lasers. This procedure is quite invasive, involves 7 to 10 days of healing and many, many weeks of post laser erythema. One unexpected complication which developed about 18 months later was hypopigmentation, particularly on the lower cheeks. The numbers of patients requesting this procedure diminished greatly, presumably due to these unpleasant complications and many operators in this field stopped doing this procedure.

More recently however, the numbers of patients requesting full face laser resurfacing have increased and we think it is safe to say that most of us who continue to perform this procedure, use much more conservative settings. Despite the invasiveness and down time, it does remain the procedure which gives the most striking improvement in the quality of facial skin, both in terms of textural improvement and removal of static wrinkles.

The procedure however, does not create any significant skin contraction and should not be seen as an alternative to a surgical face lift when reversal of ptosis is required.

The Erbium:YAG laser has a much lower ablation threshold (10% that of Carbon dioxide lasers) and it is much more suited to younger patients. Healing is more rapid and there is less morbidity, although the erythema produced by the Erbium:YAG laser can persist for as long as it does with the Carbon dioxide laser.

In some centres, the Erbium:YAG laser is used exclusively for resurfacing on the basis that the Carbon dioxide laser produces unnecessary thermal injury to the dermis. Experienced laser operators worldwide are polarised on this issue. Our personal view, and this is shared by many of our overseas colleagues, is that there are cases where some Carbon dioxide laser input is useful in achieving the best results possible in wrinkle and acne scar smoothing. In these cases, we do a few passes with the Erbium:YAG laser immediately following exposure to the Carbon dioxide laser. It has been shown in a number of split face studies, that when this is done, healing time is shortened and persisting erythema is lessened. (The theory is that this removes some of the zone of thermal necrosis which allows for more rapid healing).

The concept of Fractional Photothermolysis currently represents the forefront of laser technology. By using lasers that create vertical columns or Microthermal Treatment Zones (MTZs), only a fraction of the skin is treated. Hence islands of normal skin are spared from which healing occurs, resulting in reduced healing times and greater safety. These treatments are also less painful than ablative resurfacing and can be performed with a combination of topical, oral and inhaled anaesthesia. Another advantage of this system is that the aggressiveness of treatments can be adjusted depending on pulse energies (determining depth) and treatment levels (determining percentage area of skin treated). Treatments can thus be individualised depending on severity of condition being treated and down time acceptable to patient.

The $CO_2$ fractional resurfacing laser, Fraxel Re:Pair (10,600nm) is a fractional ablative laser. It is able to ablate vertical columns into deep dermis to a depth of approximately 1.6mm with a surrounding zone of thermal necrosis. The Erbium:glass fractional resurfacing laser (Fraxel Re:Store) (1550nm) is a fractional non-ablative laser as it produces columns of coagulated, rather than ablated tissue.

The $CO_2$ fractional resurfacing laser has now become the treatment of choice for mild to moderate facial photodamage, facial wrinkles and acne scarring. Additionally, it can safely be used off the face (particularly the neck) as a treatment for the same indication. All skin phototypes can be safely treated and there have not been any cases of hypopigmentation as described with traditional pulsed Carbon dioxide resurfacing. Down time with the $CO_2$ fractional resurfacing laser is also reduced with 2 days of pinpoint bleeding and serous ooze until re-epithelialisation occurs from the surrounding islands of spared epidermis. Approximately 5 days of desquamation then occurs and there is residual post laser erythema for a number of weeks after. Patients can however return to normal activities and work after this time using a tinted makeup.

An improvement in skin texture, rhytides and dyschromia is achievable together with some mild to moderate degree of skin tightening. Histological studies have shown an induction in heat shock proteins with resultant neocollagenesis. Most patients will require a single treatment however further improvement can be achieved with a second treatment a minimum of 3 months later.

The Erbium:glass fractional resurfacing laser remains the workhorse for acne scarring. Generally a series of treatments are required approximately a month apart. It is also useful for mild rhytides and dyschromia for those patients who require both facial and non-facial rejuvenation with minimal down time.

Purely in terms of improvement of skin quality and dyschromia, it achieves approximately 30% or 40% of the improvement which can be achieved using the ablative lasers.

See Appendix M for further information regarding fractional resurfacing. Also Appendices A and D.

# active acne vulgaris

| condition | response to laser | appropriate laser |
|---|---|---|
| **Active Acne Vulgaris** | Variable<br><br>Severe cystic acne and comedonal acne less responsive | Many lasers and IPL instruments have been claimed to be effective in treating acne.<br>• Blue Light/Red Light alone reasonably effective for mild to moderate acne, particularly inflamed acne lesions. 2 treatments per week for 4-6 weeks are required.<br>• The addition of ALA preceded by micro-dermabrasion or very light Erbium:YAG laser resurfacing to remove the upper layers of stratum corneum gives better results.<br>• 1450nm diode laser (Smooth Beam) appears to be effective in 15-50% of cases according to most studies. (Recent studies indicate that sebaceous glands are safe from permanent destruction which was a concern for some time.)<br>• IPL using short pulse widths to destroy Demodex and reduce vascularity. 3 or 4 treatments are required at monthly intervals and results are promising.<br>• Vascular lasers eg V Beam have also been used to treat superficial acne lesions.<br>• Kleresca biophotonic treatment |

## Notes on active acne vulgaris:

From the authors' experience and reading, it would appear that the above measures will control moderately severe acne for a period of time, but better results in severe cystic acne are obtained using Roaccutane.

The question is often asked 'why use light treatments when chemical treatments are available and less expensive?'. There has been a lot of discussion in the United States recently about the use of Accutane being curtailed. The reports are of an increasing number of 'Accutane babies' mainly in teenage girls, and the FDA is looking closely at the situation.

Furthermore, there is a public perception that depression is a major issue (not supported by clinical data) and an increasing number of patients are seeking alternative treatment modalities.

See Appendix G.

## Notes on Kleresca biophotonic treatment:

Many acne patients may not be suitable or prefer to avoid traditional treatments such as antibiotics, the "pill" or isotretinoin (Roaccutane). Kleresca is an innovative biophotonic treatment which has recently been TGA approved for the treatment of acne.

Patients undergo twice weekly treatments over 6 weeks. A brief procedure, photoconverter gel is applied to the skin, followed by multi-wavelength high intensity LED illumination for 9 minutes. No anaesthesia is required, it has a very good safety profile and patients can return immediately to school or work. Clinically significant improvement can be seen after 3-4 weeks of treatment and continues for some months following treatment.

As biophotonics is a very new field, studies continue into mechanisms of action. Killing of P.*acnes* within the pilosebaceous follicle as well as anti-inflammatory and wound healing responses have been demonstrated. Further studies are currently underway in the use of biophotonics in the treatment of diabetic and venous leg ulcers.

Unlike previous photodynamic therapies for acne, there is no incubation time and no uptake of the topical into the skin occurs. Treatments are painless unlike PDT and there is no residual photosensitivity post treatment. While some claims have been made in regard to improvement in acne scarring, I believe that our more usual treatments such as ablative (carbon dioxide) and fractional laser still remain mainstays of current acne scar treatment.

# appendix

## A. Erbium resurfacing

The Erbium:YAG laser is more appropriate for resurfacing procedures in younger patients. Advantages of the Erbium:YAG laser include shorter healing time, less persisting erythema and post laser pigmentation problems. For removal of superficial sun damaged skin, the Erbium:YAG resurfacing laser has the added advantage that no anaesthetic is required other than Emla cream and healing time is only 4-5 days. For older patients with more pronouced wrinkles and solar elastosis, there is a worldwide controversy as to whether the $CO_2$ or Erbium laser produces the better results.

## B. Laser resurfacing and Roaccutane

Patients who request ablative laser resurfacing for removal of acne scars should not be treated for at least 1 year following cessation of Roaccutane therapy. The reduced ability of the skin to re-epithelialise during this period leads to the risk of delayed healing and scarring.

However treatment of acne scarring with other lasers can commence at earlier following Roaccutane therapy. Vascular laser (such as the Pulse Dye laser) can be used judiciously while still on Roaccutane to reduce erythema. The fractional non-ablative lasers such as the Fraxel restore can be used three months after Roaccutane cessation.

## C. Actinic cheilitis

With reference to actinic cheilitis/leukoplakia, it is important, where possible, to avoid a scalpel vermilionectomy due to both cosmetic considerations and sensation problems. Both of these are minimised by treatment with laser in this condition.

## D. Resurfacing and collagen production

The so called laser resurfacing technique involves thermal ablation of the upper layers of skin, in some cases down to reticular dermis, using computerised scanning systems. If the epidermis has been removed, re-epithelialisation occurs from the appendages. Deep to the ablated zone, sub ablation thermal injury causes a zone of thermal necrosis (less with the Erbium:YAG laser than with the $CO_2$ laser due to the lower ablation threshold of the Erbium:YAG laser). Deep to this, is a zone of sub-denaturation thermal injury of collagen which results in a zone of collagen neogenesis. New collagen deposition occurs following laser resurfacing (as it does following dermabrasion and deep chemical peels) for 6 months or more.

## E. Laser neck lift

The laser neck lift involves, as part of the procedure, the application of mild thermal laser energy (using de-focused continuous wave $CO_2$ laser energy) to the underside of the dermis via a small submental incision causing the required collagen contraction.

## F. Non-ablative lasers

One of the most recent developments in laser technology is the use of non-ablative or sub-ablative lasers. Almost all laser wavelengths have been claimed to produce the desired effect which is either a sub-denaturation thermal effect on collagen initiating collagen tightening or collagen denaturation initiating collagen neogenesis. A cooling device is almost always used with these instruments, firstly to protect epidermal melanin (below 5°C) but more importantly, to cool the dermis down to avoid collateral damage and scarring. Cooling can be either an external source such as a Zimmer cooler, inbuilt into the laser handpiece, or a short burst of liquid nitrogen immediately prior to the laser pulse.

Intense Pulsed light instruments (IPL) as well as Nd:YAG (532nm and 1064nm), pulsed dye laser (595nm), Ruby, Alexandrite, diode (810nm or 910nm), 'Cool Touch' (1320nm), Smooth Beam (1450nm) and Erbium:glass fractional resurfacing laser (1550nm) have all been trialled and reported in journals. An analysis of data however, indicates that the average improvement over 6 treatments is only of the order of 15 or 30% which makes it (for most patients at least) not cost effective. Smooth Beam (1450nm) corresponds to a peak in water absorption in the mid infrared range, there being two other significant peaks, one at 1200nm and one at 1700nm.

Theoretically, the effect is a specific absorption of light in the blood vessels of the superficial dermis in the case of KTP and pulsed dye lasers as well as IPL instruments, resulting in the release of inflammatory mediators into the interstitium followed by stimulated fibroblast activity. One study showed an increase of 84% in Type 3 procollagen production rate compared to non treated control sites.

Presumably the longer wavelength visible light lasers and near infrared lasers have a direct effect on fibroblasts in reticular dermis following collagen denaturation.

More recently, there have been a number of instruments developed for inducing non-ablative collagen neogenesis. One is the Cutera Titan which has a spectrum of wavelengths in the infrared spectrum (1100nm to 1800nm), the other is the Thermage 6MHz radiofrequency device. The results which these new instruments can achieve by way of skin tightening are demonstrable but the degree of improvement is unpredictable. Whereas the Cutera Titan, being a mid infrared IPL, causes controlled thermal injury to the reticular dermis, the Thermage radiofrequency instrument also causes thermal injury to fibrous septae in fat. Fat has a higher impedance and the theory goes that the Thermage causes more contraction in the fat compartment than in the dermis, resulting in a better improvement in ptosis. It would appear that the Thermage is probably superior to the Titan, and the areas where it is mainly useful are the brow where it can achieve a 1mm or 2mm non surgical lift, lifting of the jowl area and also tightening of the crepiness on the abdomen, upper arms and other areas. In one well controlled trial, 90% of patients who had treatment with Thermage were satisfied with their treatment. Some of these achieved good improvement, others were much less impressive.

Patients who respond best to non ablative skin tightening procedures either with lasers or radiofrequency tend to be a younger age group, female, non smokers and minimally sun damaged.

It is of interest that the makers of Thermage have identified about 100 patients who were treated over the past 4 years who developed fat atrophy presumably due to excessive radiofrequency energy used. These patients have been treated at the company's expense with various filling agents and the parameters being used now appear to be much safer as there have been relatively few complications reported over the past year. Much lower energy levels are being used with multiple passes. It would appear that there are large individual differences between individuals, what one might call genetic polymorphism in the way in which collagen responds to thermal injury. Some patients are relatively thermo-stable and could be classed as poor responders, where some have collagen both in the dermis and in fibrous septae in fat which is much more thermo-sensitive, and these are the ones who respond better to treatment. The amount of discomfort experienced during treatment is proportional to the impedance and this also appears to be a relatively individual characteristic. The aim of treatment is to use parameters which are adjusted to the patients pain threshold (relating to impedance) to a point which is almost pain free but which actually does achieve demonstrable results in the majority of patients.

The fractional resurfacing lasers (Fractional Photothermolysis), although not entirely non ablative, do fit best into this category (see Appendix M).

---

## G. Photodynamic therapy

This is one of the most rapidly advancing and exciting frontiers in dermatology. The discussion which follows is not meant in any sense to be exhaustive, it is a summary of the salient features and includes some of the new directions which PDT is taking.

**Summary:**

Photodynamic Therapy (PDT) involves the application of agents such as Amino Levulinic acid or Methyl Amino Levulinic acid which is converted by the body to a photoactive porphyrin. After an interval, light of an appropriate wavelength is applied to the skin creating reactive oxygen species, predominantly singlet oxygen, which results in specific damage to the lesion.

The benefits of PDT are that it is relatively selective, thus preserving healthy tissue, non invasive, has an excellent cosmetic outcome, and allows multiple lesions to be treated during one session.

It has a very wide range of applications in dermatology, including non melanoma skin cancers, acne, and photorejuvenation. The light source can be quite specific eg Blue Light (approx 417nm), Red Light (approx 690nm) or a spectrum of light such as IPL instruments which cover most of the absorption peaks of ALA. IPL also covers the four Q-bands which are important in treating deeper lesions.

The treatment of superficial BCCs and Bowen's Disease is quite painful, especially using the longer wavelengths, requiring anaesthesia. Also, the jury is still out regarding the efficacy of this modality of treatment compared to other treatment options available. There appears to be a growing concern amongst dermatologists that PDT for superficial non melanoma skin cancers has been greatly over-rated and, in fact, little better than 5-Fluorouracil which was trialled for these lesions about 30 years ago. In general terms, PDT is not acceptable for use in treating squamous cell carcinoma regardless of the depth.

ALA/PDT is also useful for treating non hypertrophic solar keratoses on the face and particularly on the scalp. Most dermatologists regard hyperkeratosis on the face and scalp as being a generalised condition with focal areas which are thicker, and treating the whole of the face (and scalp if necessary) with this technique gives very nice results which last for a number of years in most cases. The skin is first cleansed with soap and water then with acetone, sometimes preceded by microdermabrasion or very light Erbium:YAG laser using a defocused beam to remove about 5 microns of the stratum corneum to disrupt the skin barrier before applying ALA.

ALA is suitable for all skin types.

Photodynamic Therapy treatment of acne is very effective. It would appear that ALA accumulates in the sebaceous glands which become the target for the photochemical reaction, thus reducing the sebum excretion rate; also Propionibacterium acnes produces porphyrins and irradiation with an appropriate light source will be absorbed by the porphyrins and kill the bacteria.

Long remissions have been recorded using this method for quite severe acne. The main type of acne which does respond is inflamed acne. Severe cystic acne and comedonal acne is less responsive. The efficacy of treatment can be increased by firstly using microdermabrasion with a 20% glycolic acid peel or even better, very light Erbium:YAG resurfacing in defocused mode to remove the upper layers of the stratum corneum. This does not require any topical anaesthesia.

The biggest problem is to make sure that patients do not receive any sun exposure at all for 36 hours following treatment. Most of the complications attributed to PDT for any condition relate to unintended sun exposure following treatment.

In recent studies, PDT shows promising results in the treatment of a number of superficial lesions including plane warts, molluscum contagiosum, striae, sebaceous hyperplasia, actinic cheilitis and actinic keratoses (some studies show 90% clearance with 2 treatments, 1 week apart).

Recent studies have also shown that using 0.5 to 1% 5-ALA in a liposomal solution followed by Intense Pulsed Light gives a much better photorejuvenation of the face, neck and chest than non-ablative wavelengths alone.

---

## H. Fillers

There are many different dermal and sub dermal fillers available in Australia with varying degrees of duration. There are said to be over 100 different brands of filler approved in Europe. Most doctors use only a limited number of the fillers available.

**Hyaluronic acid fillers** consist of non-animal, stabilized hyaluronic acid. They are used for lip augmentation, wrinkle correction and volume restoration and are injected in the mid and deep dermis.

Common fillers in use include Juvederm and Restylane. These fillers last approximately 6-12 months. They are now available in combination with lignocaine which allows for treatment without topical anaesthesia or nerve blocks.

Common side effects include swelling, temporary discomfort, erythema and lumpiness. Rarer side effects include infection, hypersensitivity, granuloma, superficial necrosis and urticaria.

**Sculptra** is a synthetic filler made from polylactic acid (found in Vicryl sutures). This filler works differently to others in that it stimulates neo-collagenesis. It is often used in patients with advanced HIV, in which there is compromised immunity. It has recently been shown that in patients who have normal immunity, allergic granulomas are relatively common and these can arise up to 12 or 18 months following injection of the substance. In patients who do not develop allergic granulomas, it is said to last for several years.

**Summary:**

The authors' view is that, apart from a few exceptions such as acne scars and facial atrophy associated with HIV, it is better to use temporary fillers than permanent fillers. As the saying goes 'the complications of temporary fillers are temporary, the complications of permanent fillers are permanent'. Infections and granulomas which develop in permanent fillers are extraordinarily difficult to treat and if the filler is inexpertly placed for cosmetic reasons causing asymmetry or over-correction, the patient is committed to many years of misery.

## I. Botulinum toxin

Botulinum toxin Type A is an exotoxin, derived from the bacteria Clostridium botulinum. It is commonly used to treat a variety of neuromuscular disorders such as strabismus, blepharospasm, hemifacial spasm and torticollis, but is also a safe and effective treatment for facial rhytides, and is now approved by the TGA for treatment of glabella rhytides.

The most common cosmetic indications for Botulinum toxin are glabella lines, 'crow's feet' lines (hypertrophic orbicularis oculi), and horizontal forehead lines (frontalis muscle). Other cosmetic uses of Botulinum toxin include eyebrow lifts (1-2mm of lift), perioral rhytides (orbicularis oris), mental crease (mentalis), 'bunny lines' on nose (upper nasalis), peau d'orange chin (mentalis) and platysmal bands.

Botulinum toxin is available in Australia under three trade names, the well-known Botox brand and the newer Dysport and Xeomin brands. The Botox and Xeomin brands of product are supplied in crystalline form in vials containing 100 units of toxin. Dysport comes in vials containing 500 units. Botox and Xeomin units are interchangeable. It is important to note that Botox units and Dysport units are not interchangeable.

Botulinum toxin is diluted with 2-10mls of unpreserved normal saline depending on the practitioner's preference. Once reconstituted, the solution should be refrigerated and Allergan recommends that the solution be used within 4 hours, although in practice, Botulinum toxin maintains its activity for at least one month. The reconstituted Botulinum toxin is injected either intradermally, subcutaneously or intramuscularly. All 3 techniques appear to be effective for targeting the required muscles.

It takes 3 to 4 days for the relaxation of the muscles to start to become visible with an optimal result obtainable 2 weeks post treatment. The duration of effect lasts between 3 to 4 months when the injections need to be repeated.

Botulinum toxin is contraindicated in patients with myasthenia gravis and amyotrophic lateral sclerosis and in pregnant and lactating patients. The possibility of drug interactions exists and patients taking aminoglycoside antibiotics should receive lower doses of Botulinum toxin.

Most side effects result from undesired muscle weakening caused by diffusion of the toxin to non-targeted muscles in close proximity to the injection site (eg eyelid ptosis when frown lines are injected). These side effects can usually be avoided by carefully targeting each injection and by using concentrated doses of Botulinum toxin to limit its diffusion. No long term adverse effects of Botulinum toxin have been reported.

### Other uses of Botulinum toxin

#### Masseter Hypertrophy

Some patients exhibit a squarish jawline due to masseter hypertrophy (more prevalent in Asians), which may even be asymmetrical. Botulinum toxin can be employed to minimise this, resulting in a more oval facial appearance which is regarded as more attractive by these people. The effect lasts 3 to 9 months. Side effects are rare and include reduced ability to chew hard foods.

#### Axillary and Palmar Hyperhidrosis

Excessive sweating which is mediated by Acetylcholine responds well to Botulinum toxin blockage at the sweat gland level. The injections are made intradermally 1cm apart in the skin and anaesthesia using Emla cream beforehand is usually all the analgesia that is required. This treatment is particularly popular with business people with hyperhidrosis who may have one or both hands done to reduce the embarrassment of offending people when shaking hands, or in musicians and computer users who find sweaty palms a problem. The dryness of the treated area lasts from 3 to 9 months.

There is now recognition that axillary hyperhidrosis can be quite a distressing medical condition in many people with the application of a Medicare rebate for axillary hyperhidrosis. This has certainly made the use of Botulinum toxin more accessible for many patients and is available on a 4 monthly basis.

#### Botulinum toxin for 'Mouth Frown'

'Mouth frown' can make a person look unhappy or grumpy even when they are perfectly content. In some people a sad looking mouth can be treated by injecting Botulinum toxin into the DAO (depressor anguli oris) muscle which pulls down the edges of the mouth.

This procedure can be done quickly and only involves two small injections. Results take three to seven days to start and patients receive benefit for three to six months.

## J. Intense Pulsed Light (IPL)

Unlike lasers, Intense Pulsed Light instruments emit non-coherent light with a spectrum of wavelengths. China alone has more than 100 IPL manufacturers who are exporting to the Western world, partly used by beauty therapists and hairdressers, but also some higher output instruments for use by medical practitioners.

The older types of IPL instruments had various filters which filtered out the shorter wavelengths to protect epidermal melanin. Wavelengths below 450 or 500nm are eliminated by an internal filter overlying the flash lamp. The newer or second generation IPLs (I2PL) also have water surrounding the flash lamp to prevent wavelengths greater than 950nm being emitted. This has the distinct advantage that absorption by water is minimised, making it much safer. In the older IPLs such as the Photoderm, the longer wavelengths were filtered out by a thick film of ultrasound gel. There were many medico-legal cases where patients had sustained scars and damage to epidermal pigmentation because these longer wavelengths were not filtered out adequately.

In more modern IPLs with dual mode filtering, ultrasound gel is used for optical coupling rather than to absorb the longer, more harmful wavelengths.

There are many, many IPL machines now available on the market, each promoted with reference to different spectra which they emit.

Many beauty therapists and hairdressers are buying IPL instruments for hair removal and also for treating pigmented lesions. They commence using these instruments with as little as 30 minutes training given by the IPL salesperson. When this trend first occurred, we were concerned that there would be a large number of cases where people were damaged by inexperienced operators. Fortunately, this has not occurred to any significant extent, and this is primarily due to the fact that the lasers have very low energy and the parameters are pre-set. These machines will not treat telangiectasia and are not very effective at removing pigmented lesions either. We are aware of many cases where beauty therapists and hairdressers have caused problems with these IPL units and most of them have to do with pigmentary disturbances, eg hyperpigmentation and hypopigmentation in dark skinned individuals where the fluence used has been excessive for the skin phototype being treated. Fortunately, most of the pigmentary upsets have been reversible with treatment and the passage of time.

There are however, some more serious problems being caused by IPL instruments in the hands of untrained operators. These include damage to the ciliary body due to the near infrared wavelengths in IPLs being used to shape the medial parts of eye brows with inadequate intra-ocular shields. There have also been several reported cases where beauty therapists have given multiple treatments to pigmented lesions, not having the clinical expertise to realise that what they were treating was actually malignant melanoma.

Severe complications to the neck and upper chest caused by the more powerful IPL instruments used by non laser trained medical practitioners, still represent the major cause of litigation in the laser/IPL area.

IPL instruments work, as do lasers, on selective photothermolysis. In many ways, they are more effective than lasers because it is possible to have a spectrum of wavelengths which covers, for example, a number of oxyhaemoglobin absorption peaks rather than simply one wavelength. Similarly, the applicators used for treating pigmented lesions (in the Scanmedics IPL which I use) have a spectrum of wavelengths from 400nm to 700nm which, being in the area of very high melanin absorption, is extremely effective in targeting pigmented lesions.

IPLs are also extremely effective for treating vascular malformations such as port wine stains. It is possible also to treat conditions such as Poikiloderma of Civatte, removing both the vascular and melanin components extremely effectively over 3 to 5 treatments spaced about 6 weeks apart.

One of the biggest problems however, is that the learning curve in becoming competent and safe with IPL instruments is much steeper than for lasers, particularly in sensitive areas, such as the neck and decolletage areas. Even in experienced hands, it is extremely easy to overstep the mark and cause problems.

IPLs work by excitation of Xenon by electric current. The ideal wave form is a square one with uniform output over the spectrum. All brands of IPLs however, have their own spectral distribution graph with resulting differences in IPL-tissue interaction for a given fluence. This is one of the reasons why competency on one type of IPL instrument does not necessary imply competence on another maker's brand. This fact, in combination with the very small therapeutic safety margin with IPLs (and lasers for that matter), sets a stage for complications when an inexperienced operator changes form from one brand of IPL to another, as is common in the beauty therapy world.

Most Second Generation IPLs have default settings which appear on the computer screen once patient parameters have been entered. It is extremely important not to go purely by these suggested parameters but by end points relating to erythema or 'greying' (methaemoglobin) which is almost immediate, and darkening of pigment which takes between 5 and 10 minutes following exposure.

In conclusion, IPL instruments, particularly the second generation IPL, are very effective in treating vascular and pigmented lesions, as well as excelling in the area of photorejuvenation. They are suitable for most tasks for which lasers have been used in the past with very few exceptions, three of which are tattoos, Naevus of Ota and Café au Lait macules which still require a Q-Switched or Piocosecond laser with a nanosecond or picosecond pulse durations.

## K. Appendageal tumours

Almost all appendageal tumours occupy the full thickness of the dermis. Their removal by ablative lasers (usually the Erbium laser in this practice) involves vaporisation by direct visualisation under magnification to a depth which enables the skin to re-epithelialise burying the lesions. In the fullness of time (depending on the nature of the benign tumour) they will eventually re-present at the surface and require retreating.

The Erbium:YAG laser is preferable to the Carbon dioxide laser by virtue of its low ablation threshold.

Quite obviously scalpel excision offers a more definitive but less cosmetically acceptable treatment.

## L. UVA/UVB applications

Lumenis, Equipmed and others have developed an instrument emitting UVB and UVA in various ratios which are purported to treat a number of dermatologic conditions. These include vitiligo, acne, striae, psoriasis and hyperpigmentation.

The instruments have a reasonably small spot size (2.5cm x 2.5cm) and the claim is that these instruments enable localised lesions to be treated with high intensity UVB/UVA light without risking irradiation of the whole body as in PUVA/narrowband UVB cabinets.

Despite intensive sales promotions of these instruments, to my knowledge there are no dermatologists in Australia who have purchased one and can give a positive report card on them.

## M. Fractional non-ablative and ablative laser

### Fractional Photothermolysis

The concept of Fractional Photothermolysis was devised by Dieter Manstein and Rox Anderson in 2003. The first fractionated lasers were fractional non-ablative lasers.

Presently best known as '**Fraxel**' (1550nm) [Solta Medical]. This wavelength is not necessarily specific for this modality of treatment, and a number of similar wavelengths are now available such as 1064nm (Iridex), 1320nm, 1440nm (Cynosure), 1540nm (Palomar) and 2790nm (Cutera) would give similar outcomes.

These lasers produce multiple Microscopic Treatment Zones (MTZs) which each affect a fractional volume of tissue, with a surrounding zone of thermal necrosis. Different methods have been employed to create the MTZs using both rolling or stamping methods.

Wounds <250 microns in diameter are created surrounded by a zone of viable tissue.The stratum corneum between the wounds is intact (usually 80% of the treated surface area is not involved) and collagen is denatured between 500-1400 microns. No exudate occurs. The microscopic wound size and viable tissue allow rapid re-epithelialisation (usually within 24 hours).

Relatively high energies are used (up to 70mJ). Up to 2,400 MTZs/$cm^2$ can be achieved without any significant risk on the face. No greater than 1,000 MTZs/$cm^2$ have been proven safe on the neck and chest.

The collagen denaturation from papillary dermis into mid reticular dermis creates a minimally invasive outcome in terms of skin rejuvenation. Results are probably better than a mid strength chemical peel with its attendant risks and down time, but not as good as the more invasive ablative laser resurfacing procedures.

Multiple treatments can be performed 2 to 4 weeks apart with minimal down time. In Asians, with their sensitive melanosome complexes, lower fluence is required as well as a longer interval between treatments.

Its biggest application is for sensitive areas such as the neck, chest, backs of hands and legs which are, in most cases, off limits for ablative lasers.

It is useful in treatment of acne scars and current figures worldwide are a 40 to 50% improvement over 3 to 5 treatments spaced 1 month apart. This compares favourably with other existing forms of acne scar treatment. There have been no reported cases of persistent hypopigmentation following fractional resurfacing laser treatment in phototypes 1 to 4.

Fractional resurfacing appears to be one of the few modalities available which can give a significant and measurable improvement in texture of the skin of the neck and chest. (Other modalities which can give a demonstrable textural improvement in these sensitive areas are 5% ALA/IPL, and if used extremely carefully, Carbon dioxide laser using well hydrated skin and very low densities).

Other indications for fractional resurfacing are scars, melasma (including dermal melasma), open pores, hypopigmentation, including hypopigmentation which sometimes remains following tattoo removal and tissue redundancy following resolution of haemangiomas of infancy, scars.

Most common short term side effects are erythema, oedema, acne flares and post inflammatory hyperpigmentation. No permanent or long term side effects such as scarring or hypopigmentation have been reported. Acne flares are a result of dermal swelling and topical preparations causing follicular occlusion. They generally settle with the use of lighter emollients and occasionally a short course of oral antibiotics.

Treatments are well tolerated requiring topical and oral analgesia. The use of cold air cooling (eg Zimmer cooling) alleviates both pain and protects the skin from collateral thermal injury.

The results obtainable by fractional resurfacing laser treatments would appear to be very operator dependent.

Histological studies show reduction in solar elastosis and wrinkle improvement as a result of collagen neogenesis. Improvement in fine lines, depth of rhytides and reduced skin roughness. Thermal damage is evident 24 hours after treatment, with new collagen formation at 3 months.

There appears to be a direct correlation between the depth of penetration of the coagulated fractional columns with increased pulse energy.

A recent review of 877 fractional resurfacing laser cases over an 18 month period treated skin phototypes 1-6. Most consistent results were with acne scars, surgical scar and facial/off face resurfacing for Glogau 2-3 patients. Most variable results were for melasma and deep rhytides. Most common side effects included erythema, oedema, acne flares and post inflammatory hyperpigmentation. No permanent hypopigmentation or scarring was reported.

### Fractional ablative resurfacing

The most significant recent advance in fractionated laser technology has been the $CO_2$ fractional resurfacing laser. This is a fractional ablative laser as the Microscopic Treatment Zones (MTZs) are in fact cleanly ablated columns with a surrounding zone of thermal necrosis. There is actual tissue removal as opposed to the older fractional non-ablative lasers where tissue was coagulated.

It would appear that immediate skin contraction is strongly associated with the density of the MTZ pattern with focal inflammation and new collagen observed at the sites of the MTZs. Histological studies have demonstrated an upregulation in Heat Shock Proteins which in turn stimulate the production of both Procollagen 1 and 3 and subsequent neocollagenesis. Inflammation peaked at 6 hours postoperatively and was persistent at one month. Zones of new collagen can be seen alternating with existing solar elastosis.

The $CO_2$ laser has now become the treatment of choice for moderate photodamage and rhytides and moderate acne scarring. A single $CO_2$ fractional resurfacing laser treatment would appear equivalent to 3 to 5 fractional non-ablative resurfacing laser treatments. The trade-off is a longer period of down time with 2 days of oozing and pinpoint bleeding which is replaced by desquamation until approximately one week postoperatively. All skin types can be treated (as opposed to the older $CO_2$ ablation) however persistent erythema can be a problem in higher skin types and off-face. In such cases the use of lower energy levels minimises these problems. Treatments are performed with a combination of topical anaesthesia, nerve blocks and Penthrox.

Significantly, after approximately 5 years of experience worldwide there have been no cases of permanent hypopigmentation reported. In fact the $CO_2$ fractional resurfacing laser has been shown to be useful in the treatment of hypopigmented and atrophic scars (and other scars such as burns scars) involving the re-formation of the rete ridge system evident after treatment. Further studies are being performed in the area of $CO_2$ fractional resurfacing laser and scars.

### Laser assisted drug delivery

The ablative channels produced by this laser can be used to assist in the delivery of drugs such as steroid suspensions for the treatment of hypertrophic scars from burns, trauma or surgery and the delivery of topical PDT agents. Much research is being focussed on this area currently.

### Focused Ultrasound Skin Tightening

Ulthera has developed a machine which uses focused ultrasound beams to create precise focal areas of tissue denaturation in the deep dermis. Small microthermal lesions at precise depths up to the fibromuscular layer to 7-8mm deep cause collagen contraction, tissue coagulation and collageneogenesis. The aim is to create zones of tightening and hence producing a non-surgical tissue lift for lax skin. As ultrasound is used which is independent of skin colour all skin types can be safely treated. Significant eye brow lifts can be achieved with a single treatment.

### Cryolypolysis

The application of cold to subcutaneous fat (using warmer temperatures than conventional cryosurgery and temperature sensors) to selectively induce damage to the fat layer causing lipolysis and fat removal.

## N. Recent developments

### Picosecond lasers

Lasers with picosecond pulse durations have been in development for many years. They have however only become commercially available very recently due to the difficulties in achieving a stable system. Cynosure has marketed the first system as the Picosure alexandrite laser. More recently commercially available systems from Cutera and Syneron-Candela have picosecond 532 and 1064nm wavelengths.

A picosecond is a billionth of a second as opposed to the nanosecond pulse durations achieved by Q-switched lasers. The advantage of a shorter pulse duration is that laser energy is delivered in a much shorter space of time meaning that more significant photomechanical and photoacoustical effects can be obtained. In practical terms these lasers are used to treat pigmentary disorders and tattoos.

The initial applications utilising picosecond laser technology has been in the field of tattoo removal. As a result, tattoo ink can be shattered into much smaller particles which are more readily phagocytosed by dermal macrophages. The majority of professional tattoos can now be effectively removed over a course of 3-6 treatments generally at 6 weekly intervals. When this is compared to previous treatment with superceded Q-switched technology requiring anywhere between 10 and 30 treatments, the time saving is obvious. Treatments with the picosecond laser are also less painful compared to previous Q-switched treatments with ice packs or forced cooled air (Zimmer) being sufficient anaesthesia for most patients.

The use of picosecond laser technology for other skin related conditions is now being investigated. These include other pigmentary issues such as pigmented birthmarks benign pigmented lesions. Use of a novel diffractive lens array results in Laser Induced Optical Breakdown (LIOB) zones which are areas of dermal injury. This has been show to result in an increase in dermal mucin, collagen and elastin. The clinical applications for this technology is photorejuvenation of facial actinic damage, dyschromia and acne scarring. It has the advantage of beinig a very low downtime treatment as well as being sutiable for all skin phototypes.

# glossary

| | |
|---|---|
| 5-ALA | 5-Aminolevulinic acid |
| $CO_2$ | Carbon dioxide |
| Er:YAG | Erbium Yttrium Aluminium Garnet |
| Fd:Nd:YAG | Frequency Doubled Neodymium Yttrium Aluminium Garnet (532nm) |
| IPL | Intense Pulsed Light |
| I2PL | Second Generation IPL with dual mode filtering |
| KTP | Potassium Titanyl Phosphate |
| Nd:YAG | Neodynium Yttrium Aluminium Garnet |
| PDL | Pulsed Dye Laser |
| PDT | Photodynamic Therapy |
| QS | QS = electronic jargon for nanosecond pulse duration<br>eg Q-Switched Nd:YAG laser; Q-Switched Alexandrite laser |
| VPL | VersaPulse Laser |
| VPW | Variable Pulse Width |

Neutral Bay
Laser & Dermatology
Clinic

**Neutral Bay Laser & Dermatology Clinic**

Suite 202, 156 Military Rd
Neutral Bay NSW 2089
Australia

Phone 02 9953 9522
Fax 02 9953 7750
Email info@cosmeticlaser.com.au

**www.cosmeticlaser.com.au**