

NON SURGICAL FACIAL REJUVENATION

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Abstract : *Hope springs eternal in the human breast, more so concerning our desire to stay or appear young. Non surgical options for facial rejuvenation are fast emerging as quick, effective and simpler options to achieve the desired goal. Various options are now available for dealing with the myriad of aesthetic ageing problems of the face, including programs of topical lotions & creams, 'Botox' for reducing wrinkles, fillers to fill in the scars and fixed rhytides, thread lifts as a quicker option to conventional face lifts in selected patients, facial peels and / or laser resurfacing to achieve a smoother, tighter and more youthful skin, non ablative laser rejuvenation tackling the triad of vascular, pigmentary and laxity components of the ageing facial skin, and lastly, but not in the least mesotherapy, which may emerge as a revolutionary technique to rejuvenate the ageing skin.*

INTRODUCTION

The process of ageing is first reflected in the skin. While many of these age-related changes are inevitable, some can be reduced with healthy lifestyle choices and good skin care. Many people accept that changes to their skin are part of the normal ageing process. Rejuvenation of the face is basically concerned with partly undoing damage caused to skin by photoageing, and also to correct / improve changes which happen with ageing in general.

SIGNS OF AGEING

Skin thinning - The basal cell layer of the epidermis slows its rate of cell production and thins the epidermis. The dermis may become thinner. Together, these changes mean skin is more likely to crepe and wrinkle.

Sagging - Aged skin produces less elastin and collagen, which means it is more likely to sag and droop. Aged skin is particularly vulnerable to the effects of gravity – e.g., jowls along the jaw and bags under the eyes are simply examples of skin that has yielded to gravity.

Wrinkling - Reduced elastin and collagen fibres in the skin, along with thinning of skin result in wrinkling of those 'high movement' areas of the face (like the eyes and mouth) which are especially prone to these effects.

Age spots - The remaining pigment cells (melanocytes) tend to increase in certain areas and cluster together forming what's known as *age or liver spots*. Areas that have been exposed to the sun, such as the backs of the hands, are particularly prone to age spots.

Dryness - Aged skin has fewer sweat glands and sebaceous glands. This can make the skin more prone to dryness and lead to roughness and itching.

Broken blood vessels - Blood vessels in older, thinner skin are more likely to break and bruise. They may also become permanently widened/stretched.

RISK REDUCTION STRATEGIES

Limit actinic exposure - Sun exposure leads to premature ageing of the skin known as photoageing. This is easily proved if one compares the skin of hands with that of the buttocks. The exposure can be limited by wearing a hat, loose fitting clothes, sunglasses and by applying SPF15+ sunscreen lotions when outdoors. Sunbathing should be avoided.

Stop smoking - Smoking promotes skin wrinkling and is thought to accelerate the damage caused by sun exposure. The action of puckering up for each drag on a cigarette increases the likelihood of wrinkles around the mouth.

Healthy diet - A healthy, well-balanced diet is as important for healthy skin as it is for a healthy body. Antioxidants help in keeping the skin youthful.

Skin care - Harsh skin irritants, such as perfumed soaps, heavily chlorinated swimming pools and long hot showers should be avoided. Instead, neutral pH balanced soaps, body washes or equivalent should be used.

Moisturizers - Dry skin is more likely to show fine lines and wrinkles. Moisturizers should be used regularly especially on dry skin.

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ANTI-AGEING TREATMENTS (FACIAL REJUVENATION)

Currently the following anti-ageing treatment modalities are available.

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|------------------------------|-------------------------|
| (i) Topical lotions & creams | (v) Thread lifts |
| (ii) 'Botox' | (vi) Laser rejuvenation |
| (iii) Fillers | (vii) Laser resurfacing |
| (iv) Facial peels | (viii) Mesotherapy |

Topical Lotions and Creams

If used regularly, they have been shown to visibly reduce fine lines, improve the quality of skin and improve skin discoloration.

These can be broadly classified in to three groups.

- | | | |
|---------------|--------------|----------------|
| a) Exfoliants | b)Tighteners | c)Depigmenters |
|---------------|--------------|----------------|

Tretinoin (Retino A cream/ gel), Adapalene (Adafarin gel 0.1%) and alpha hydroxy acids like glycolic acid, kojic acid etc. act as *exfoliants* when applied to the skin over a period of time. Exfoliation helps in taking off dead cell layers from the top of the epidermis and cause a faster turnover of younger cells, making the skin clearer, fresher and smoother. Retino A is a strong exfoliant available in various concentrations, has a remarkable ability to modify collagen, thereby producing significant tightening and reduction in fine wrinkles of the face. The main disadvantage of Retino A cream is the photosensitivity it causes, which necessitates strict avoidance of direct sunlight and use of appropriate sun block creams (SPF 30 or more). It still will cause redness of the skin which lasts well beyond the period for which it is used. Newer retinoids like Adapalene cause much less photosensitivity but the exfoliant effect is also significantly reduced. Alpha hydroxy acids are good exfoliants without the undesirable effect of photosensitivity but they do not produce any skin tightening effect. These exfoliants are often used in conjunction with *lightening or depigmenting creams* like hydroquinone (Melalite 2%, Melalite forte 4%, Hyde lotion 5% etc.). Hydroquinone inhibits the conversion of tyrosine to melanin, inhibits the formation of melanosomes and increases their degradation. Hydroquinone also inhibits the DNA and RNA synthesis in melanocytes. Thus, it ensures that the new pigment which is appearing is lighter and uniform as compared to the pretreatment heterogeneous pigment. *Topical steroids* (Mometasone, desonide, fluticasone) act to reduce the inflammatory component of the pigmentary changes in the skin which are existing, or which get induced by strong exfoliation in sensitive skin. There are various protocols to achieve improvement of photodamaged skin in terms of both texture and pigmentation. One such protocol involves using Retino-A, hydroquinone and topical steroids.

'Botox' (Botulinum toxin Type A)

'Botox' is the brand name for botulinum toxin type A, nature's most potent blocker of nerve impulses. A registered trademark of the Allergan Corporation, 'Botox' is expensive probably due to the elaborate manufacturing process. Four botulinum toxin products are available - 'Botox' (type-A, 100 units/vial), Dysport (type-A, 500U/vial), Myobloc (type-B, 2500/5000/10000U/

vial) and the Chinese toxin. The other available brands, though less expensive, are less potent, have more localized effect and are more prone to cause adverse effects.

Dynamic wrinkles on the face are caused by contractions of the delicate underlying facial muscles each time one smiles, laughs and frowns. These emotional expressions gradually lead to deeper lines and wrinkles. 'Botox' injection is a simple and safe procedure, where a very small amount of the toxin is injected precisely into targeted locations on the face, blocking nerve impulses to the muscle under the skin in the treated area. 'Botox' partially blocks the nerve impulses to segments of the tiny facial muscles that are related to expression lines. This causes the muscles to relax. After full effect of the drug, the overlying skin will become smooth and unwrinkled while the untreated facial muscles continue to function normally.

This is a simple and safe procedure. The injection is made with a 30G needle for minimal discomfort. It also allows a greater precision in delivery of 'Botox' to the specified facial area. No sedation or anesthetic is required, and normal activities are resumed immediately. 'Botox' injection generally takes 2-4 days to show full effect, reflecting the time necessary to disrupt the synaptic process. 'Botox' injections are primarily used in the upper third of the face. Forehead lines, glabellar lines, and lines around the eyes ('crow's feet') respond favorably to 'Botox'. Frown lines (below the mouth) and chin creases may also be improved with a 'Botox' injection, but response varies among individuals. Results can last from three to six months. However, with subsequent injections the duration of effect increases. Most patients are candidates for this procedure if they have dynamic wrinkles and lines. Botulinum toxin has beneficial effects only on wrinkles caused by muscular contractions, and is not appropriate treatment for wrinkles caused by solar exposure or other degenerative processes of the dermal tissues. Other contraindications for this procedure are pregnant patients and those who have neurological problems.

'Botox' is also used for correcting masseteric hypertrophy which leads to a square jaw appearance. Recently, it is being used as a chemical brow lift to achieve desired height and shape of the eyebrows. Other indications are suborbital hypertrophic orbicularis, infraorbital crow's feet, nasal scrunch lines ('bunny lines'), nasal flare, nasolabial folds, perioral lip lines, marionette lines, mental crease marionette lines, mental crease, popply chin, platysmal bands, horizontal neck lines and facial asymmetry.

Potential side effects include brow ptosis, temporary swelling or bruising at local site, upper eyelid edema, headache and rarely diplopia. Patients are advised to avoid aspirin and NSAIDs before the injection.

Fillers

Fillers can be used for aesthetic purposes to reduce the effects of ageing and photoageing, and improve the appearance of scars. Fine wrinkles, grooves and folds arising from repetitive muscle action over years, along with depletion of dermal and subcutaneous volume need to be treated in order to rejuvenate the face. Fillers can work synergistically with surgical procedures like mini face lifts. They can also be combined with procedures like laser resurfacing, 'Botox' injections, peels or 'thread lifts' in patients not desiring surgery. Facial fillers are most useful in the middle and lower thirds of the face. Ideally a filler should be easy to use, long lasting, predictable in results and behaviour, injectable through a small needle, painless on injection, non allergenic, should not migrate, be non carcinogenic, non teratogenic, stable at room temperature, free of possible transmissible diseases, have a long shelf life, and not cause significant post-injection morbidity.

Before injection, the patient is asked to discontinue any 'NSAIDs' for at least two weeks. Several other parameters need to be decided before injecting a 'filler'. There are many 'fillers' available in the market and care has to be exercised in choosing the appropriate one depending on its properties, whether it is for deep or superficial rhytides and whether a temporary or a permanent filler should be injected. Other aspects to be decided are the amount of augmentation desirable and hence the amount of filler required, and the proper

plane and areas for injection, which is specific for each filler. Then the number of sittings and follow up visits are decided.

No anesthesia may be required for injections in very superficial locations in small amounts, but deeper areas and particularly the lips, require appropriate nerve blocks for adequate patient comfort. The buccal sulci and skin are cleaned and prepped with povidone iodine and alcohol swabs, respectively, before a nerve block. Patient should be sitting in a chair with his/her head supported. The smallest needle size is used, injecting in the superficial dermis for very fine creases, mid dermis for deeper folds and deep dermis or dermo-cutaneous junction to elevate deepest folds. The linear threading technique-depositing with continuous pressure as one withdraws the needle is a good way to deposit the 'filler' uniformly. In wider areas, one may use parallel deposits of the filler to achieve the desired result. Variations like the 'fan technique' or the 'cross hatching' technique are good for deeper augmentation. Massaging the area injected just after the injection can help spread 'filler' smoothly in the area. Follow up visit is scheduled at about two weeks and any touchup procedure carried out, if needed.

Non permanent fillers

'Zyderm' and 'Zyplast' are derived from bovine collagen. 'Zyderm' is used for superficial lines and 'Zyplast' for deeper folds. A skin test is done prior to injection to ascertain any sensitivity to the product, and the first sitting is scheduled after 6 weeks of the skin test. Some overcorrection is necessary with this product because it has to be diluted with saline which is absorbed over the next 24 hours. Disadvantages with this product are the need to refrigerate, possibility of an allergic reaction and a short duration of effect lasting only 3-5 months.

'Cosmoderm' and 'Cosmoplast' are purified collagen derived from cell cultures of human fibrocytes. These cell lines have been tested for viruses and teratogenicity. No skin testing is necessary and they can be injected without a skin test. Overcorrection is also necessary with these products. It is also possible to layer 'Cosmoderm' over 'Cosmoplast' for greater augmentation. Disadvantages are same as for 'Zyderm' and even flu like symptoms have been reported in 2-4% of patients.

Hyaluronic acid gel (Hylans) is a naturally occurring linear polysaccharide forming the matrix for collagen and elastin fibers in skin and other tissues. It is not immunogenic. 'Hylans' get swollen with water (95%) and show dynamic viscosity enabling injection through small needles. They are removed from the body by isovolemic degradation. They retain most of their volume (95%) till the last bit of it is removed from the body. In this group, 'Hylan B' (Hylaform) was the first preparation used for soft tissue augmentation. 'Hylan B' is derived from rooster combs purified and cross-linked with divinylsulfone. Mild redness, itching, swelling and pain have been reported with its use but these symptoms resolve within a week.

'Restylane' (Q med) is stabilized, partly cross-linked Hyaluronic acid gel produced from cultures of streptococcus equi. It is chemically stabilized through cross-linking and heat sterilized. It has a shelf life of 1.5 years. A study claims that its effect maintains 82% at 12 weeks, and 69% at 26 weeks¹. Another study compared 'Restylane' with 'Zyplast' for nasolabial folds and it found that 'Restylane' was better in 56.9% patients, equally effective in 33.6%, and 'Zyplast' was better in just 9.5% patients². Side effects from injecting 'Restylane' are transient and mild, and noticed in about 0.15% of 1,44,000 patients³. 'Hylans' are more painful to inject than collagen. There have been some instances of delayed reactions ranging from 0.4% to 3.7% of injected patients^{4,5}. 'Restylane Touch', 'Restylane' and 'Perlance' are three variants of 'Restylane', but the quantity of Hyaluronic acid remains the same in all types (20mg/ml). The difference is in the number of particles/ml of injection. 'Restylane Touch' is for fine lines and injected in the superficial dermis, 'Restylane' is for nasolabial folds and lip, and is injected in mid dermis, and 'Perlance' the most viscous variant is injected in deep dermis/dermo-cutaneous junction for deeper folds, and cheek and chin augmentation.

There is no need to overcorrect with hyaluronic acid injections and touchup injections, if needed, can be carried out 2-4 weeks later (figs.1 & 2).

'*Radiance FN*' has microscopic calcium hydroxyapatite particles suspended in a carboxymethylcellulose gel. It is FDA approved for dental use and bone augmentation. Its use as a 'filler' is 'off label' as yet. The gel is absorbed over a period of time and gets replaced by fibrous tissue which holds the correction in place. No prior skin testing is necessary as it is not of animal origin. Sometimes calcium deposits can form lumps in the skin. It is, therefore, to be injected deeply at dermo-cutaneous junction for correction of deeper folds, wrinkles and for lip enhancement.

Reviderm Intra (Rofil Medical International) consists of 40- to 60- μ m dextran beads suspended in hyaluronic acid gel of nonanimal origin. The proposed mechanism of action is an initial macrophage response followed by fibroblast



Fig. 1a. A 60 yr. female showing static wrinkles on her forehead.



Fig. 1b. Showing immediate post - injection result after hyaluronic acid (Restylane) injection in forehead wrinkles.



Fig. 1c. Showing the result at 3 months after hyaluronic acid (Restylane) injection. Note there is a mild residual wrinkling.

proliferation and new collagen formation. The electrostatically charged dextran microspheres stimulate the collagen synthesis on depletion of HA depots. Intradermal injection without overcorrection is used to treat rhytids, skin



Fig. 2a. & 2b. Oblique views of a 60 yr. female showing pre and post injection (hyaluronic acid) improvement of deep nasolabial groove.

surface irregularities (eg, atrophic scars) and, also used for lip augmentation. Compared to other temporary fillers, it is supposed to last longer, but not permanently as is completely biodegradable. It is not FDA approved so far. *Rofilan* is the hylan gel marketed by RMI.

'*Cymetra*' is micronized cadaveric acellular human dermis, and is reconstituted in 1 ml of saline or lidocaine. It is a soft implant without allergenic tendency. Its effect lasts slightly longer than collagen and it also requires refrigeration during storage.

'*Sculptra*' is an injectable form of polylactic acid (used in absorbable sutures). It is synthetic, and proven to be non toxic, immunologically inactive and biodegradable. It is approved in the USA by FDA for treating facial lipatrophy in HIV patients, and in Europe for treating scars and wrinkles. It should be injected into deep dermis or subcutis after local anesthesia. The diluent fluid is absorbed in a week but the improvement lasts for up to 96 weeks. '*Sculptra*' is thought to stimulate collagen growth. It does not need refrigeration or prior skin testing, but multiple sessions are needed at two week intervals. Granulomas have been reported with its usage.

Permanent fillers

These are designed to remain permanently at the implanted site but it does not mean that they give a better result. In fact, permanent 'filler' may be a disadvantage because if the patient is not happy with the result there is no way it can be corrected. It is always wiser to use a non permanent 'filler' in the first instance and if patient is satisfied with the result a permanent 'filler' can be used after the effect of first injection wears off. We know that facial contour changes with time, and therefore, an implant which can be modified subsequently would always be better.

'*Artecoll*' is 'permanent filler' with PMMA (polymethylmethacrylate) microspheres in 3.5% collagen. The latter gets degraded after injection leaving the PMMA spheres encapsulated by scar tissue which cannot migrate. It is injected deeply using the threading technique. If it gets injected intradermally, by mistake, the skin blanches and injection is terminated and the area is massaged. The patient is advised to minimize facial expressions for three days to reduce the risk of implant migration. Prior skin testing is necessary and the product also needs to be refrigerated. It is contraindicated in patients with thin skin. Granulomas and persistent redness has been reported with its use.

Sheba (Hans Biomed) is injectable, micronised human dermis which is processed by elimination of cells and then freeze dried to retain the collagen, elastin and laminin of bioactive protein, to provide revascularisation and cell repopulation. "*Sheba*" makes for a real tissue restoration agent as it is easily transplanted without rejection. It can also be used as substitute for autografts. It is supposed to produce long lasting effect as it becomes incorporated in the body. *Sheba* is at first absorbed and subsequently the surrounding cells enable its incorporation into the body. As *Sheba* is micronised, it needs to be rehydrated with 2% lidocaine and injected into the subdermal plane for best results. *Sheba* offers a near permanent solution to depressed scars, facial creases and lip restoration

'*Dermalive*' / '*Dermadeep*' is a semi-permanent, non animal product,

consisting of acrylic hydrogel which is used in intraocular lens implants. There are reports of granulomatous reactions to acrylic appearing as palpable nodules six months after injection. A skin test is not required. 'Dermalive' is the same as 'Dermadeep' except that particle size is larger in the latter. *Injection silicone* has been available for many years. The original silicone marketed by Dow Corning was of 350 centistokes density. This product had several problems as an injectable implant because of granuloma formation, infection etc. Problems in the past were also seen because of excess volume injected or because of adulteration with substances like mineral oil. Silicone which is used today is 'Silikon 1000' (Alcon Labs) and it has a density of 1000 centistokes. It is FDA approved for retinal detachment and has been used for correction of facial lipoatrophy in patients with AIDS. Its use in correcting scars and wrinkles is still 'off label'. 'Silikon 1000' is a clear and colorless gel with no additives or preservatives. A serial microdroplet technique is used for injecting it and multiple sittings are needed. It does not need prior skin testing. It is stable at room temperature and is not painful if used with EMLA, is inexpensive and has a long shelf life.

Skin Peels

Modern chemical peeling was introduced at the turn of the century by Mackie, a dermatologist who was using phenol to treat facial scars. Over the years, peeling has been popularized by lay operators rather than physicians. Eventually, these procedures began to attract widespread attention because of the remarkable results that were achieved. Scientific investigation was finally undertaken by plastic surgeons and dermatologists, who delineated the indications and limitations of these procedures, with improved safety and efficacy.

Several products are currently available for rejuvenating the skin, including over-the-counter superficial peeling agents, and deeper peeling agents that should be applied only by a physician in a controlled setting. These products have proven very successful in improving the quality and appearance of facial skin. The goal of chemical peeling is to remove a controlled and uniform thickness of damaged skin. Normal wound healing and skin rejuvenation follow, and complications of scarring and pigmentary changes are avoided. The epidermis regenerates from the epidermal appendages located in the remaining dermis. This process begins within 24 hours of the peel application and is usually complete in 7-10 days. The new epidermis shows greater organization and vertical polarity, with the disappearance of actinic keratoses and lentiginos. Dermal regeneration is slower, but is usually complete within several months. The regenerated dermis demonstrates less elastosis and improved organization, with compact horizontally arranged bundles of collagen interspersed with elastic fibers. The ground substance is decreased and telangiectasias get removed. The end result is soft and supple skin, which appears more youthful with fewer rhytides and dyspigmentation.

Some physicians prefer to pre-treat the skin with isotretinoin cream, with or without hydroquinone, for 4-6 weeks to improve the results and reduce the risk of PIH.

Patient selection

One must be aware of the different types of skin to be able to select patients carefully and avoid those at a high risk for post peel hyperpigmentation. The Fitzpatrick's scale of sun-reactive skin types from lightest to darkest is given below;

Patient Type	Skin Colour	Skin Character
I	Lightest	- Always burn and never tan.
II		- Tan with difficulty usually burn.
III		- Tan but sometimes burn.
IV		- Rarely burn and tan with ease.
V		- Tan easily and rarely burn.
VI	Darkest	- Tan very easily and never burn.

Patients with lighter skin types can expect to undergo peeling with minimal pigmentation, whereas individuals with darker skin are at a higher risk for post peel hyperpigmentation .

Cooperation and compliance with the post peel regimen is required to ensure normal wound healing and to avoid complications. Patients likely to be noncompliant or unable to avoid sun exposure because of occupation are unsuitable candidates. Men are less optimal candidates because of thicker, oily skin that risks uneven penetration of the peeling agent. Men are also less likely to be willing to use camouflage makeup in the event of post peel hyperpigmentation. Patients with a decreased number of epithelial appendages from prior radiation treatment, older patients or current isotretinoin (*Accutane*) use are also poor candidates because healing will proceed more slowly and scarring is more likely. It is advisable to wait at least 12 months after stopping *Accutane* to allow some regeneration of epithelial appendages prior to peeling. The technique of chemical peeling is relatively simple, the key to a good result being in the selection of a proper patient and peeling agent. The more severe the actinic damage the more aggressive the treatment approach. However, in darker skin types, as in a majority of Indian patients, the tendency to hyperpigment, along with a noncompliant patient will be a strong contraindication to peeling. Once the appropriate patient is selected to undergo a chemical peel, informed consent is obtained after a thorough discussion of possible complications.

Alfa hydroxy acid peel (AHA, Glycolic acid)

Glycolic acid is derived from sugar cane in concentrations of 50% or higher. Over-the-counter AHA products containing 3-10% glycolic acid or other naturally occurring organic acids (lactic acid, citric acid, tartaric acid, malic acid) cause exfoliation over several days or weeks. These are also used as a pre-peel primer to potentiate the effects of application of a higher concentration of glycolic acid. Unlike other peeling agents, penetration of glycolic acid is time dependent, and thus, the agent is applied for a specific amount of time and then neutralized. The systematic application of glycolic acid with a sponge typically proceeds from one facial region to another, dividing the face into 6-8 regions and treating each in succession. The length of time that glycolic acid is left on the skin relates to its concentration. Glycolic acid is removed by washing off the agent with water or neutralizing it with an alkaline solution such as sodium bicarbonate. It is used as a superficial peel.

Following application, there is an initial erythema which may become frankly red, and it is often accompanied by edema. White patches develop subsequently, indicating separation of the epidermis from the underlying dermis. Glycolic acid is generally used as a superficial peeling agent and development of a frost indicates destruction into deeper dermis, which is not desirable. Exfoliation occurs over several days, and re-epithelialization is complete within 7-10 days. Multiple treatments may be required to achieve desired results and should be spaced several weeks apart. Glycolic acid peels produce the least dramatic of results, but also have the lowest frequency of complications.

Trichloroacetic acid peel

Trichloroacetic acid (TCA) is typically used as an intermediate-to-deep peeling agent, concentrations ranging from 20-50%. Depth of penetration is increased as concentration increases, with 50% TCA penetrating into the reticular dermis. Concentrations higher than 35% are not recommended because of the high risk of scarring. TCA is a keratocoagulant that produces a frost or whitening of the skin, which is dependent on the concentration used. Vigorous rubbing of the agent, as compared to blotting, yields a deeper penetration. This technique is not time dependent, and the agent does not require neutralization. The systematic application of TCA with a sponge also involves treating the face in a succession of 6-8 regions. TCA application is associated with an intense burning that usually resolves within 30 minutes. Administer appropriate analgesia prior to the procedure and consider regional nerve

blockade with lidocaine. Patient comfort may also be improved by having a fan to cool the face and by applying sponges soaked in iced saline prior to moving from one facial region to another.

During the procedure, if the frosting is not uniform or complete, reapplication may be performed until frosting of a desired plateau is reached. The application of topical lidocaine 4% immediately following the peel decreases the burning sensation. Once completed, exfoliation proceeds for several days, and re-epithelialization is complete within 10-14 days.

Phenol peel

Phenol peels may be used in various ways; as pure phenol (88%) or phenol mixed with soap, water, croton oil, and sometimes olive oil. Baker-Gordon, Venner-Kellson, Maschek-Truppman, and Grade are a few of the combinations. The Baker-Gordon formula consists of (USP) phenol, tap water, liquid soap, and croton oil in fixed amounts.

Phenol causes keratolysis and keratocoagulation. In contrast to other agents, increasing the concentration of phenol actually decreases the penetration up to a point, because the ensuing destruction forms a barrier to further penetration. Pure phenol does not penetrate as deeply as the various formulations. Similar to TCA, the time spent applying the agent and the amount of sponge strokes used will be proportional to the depth of penetration. The addition of croton oil to the various formulations as a skin irritant also allows deeper penetration. Although phenol produces the most remarkable resolution of actinic damage and wrinkling among the various peels, it also possesses some of the more significant morbidities. Many have abandoned phenol in favor of other agents or laser resurfacing. Marked hypopigmentation may result following the use of phenol and is correlated to the depth of penetration, use of the Baker-Gordon formula, and the addition of croton oil. Hypopigmentation may occur in all skin types, noticeably lightening the skin of patients with darker skin and making lighter-skinned patients appear waxy or pale. A clear line of demarcation may be present between treated and untreated skin.

Phenol causes an intense burning upon application that may last 4-6 hours, which is much longer than the discomfort associated with other peeling agents. Administer appropriate analgesia prior to the procedure and consider regional nerve blocks. Patients also must be provided with sufficient oral analgesics and anxiolytics for use at home following the peel.

The toxicity of phenol may be significant. Phenol is absorbed through the skin, metabolized by the liver, and subsequently excreted by the kidneys. Some practitioners preload the patient with fluids to facilitate renal clearance. Overdose may injure the liver and kidney and may also lead to myocardial irritability, including arrhythmias. The face is again divided into 6-8 regions, but 20 minutes must be allowed to elapse between treating subsequent regions. This allows for some ongoing metabolism and avoids a toxic systemic dose. Post peel care involves applying a generous amount of any ointment (eg, white petroleum jelly, antibiotic mixed or plain) to the entire treated area and to reapply the ointment throughout the day, any time the face feels tight or dry. As the outer layers begin to shed, the patient is allowed to shower and gently wash the face with nonresidue soap using fingertips only. The face should be patted dry and a new coating of ointment applied. Instruct patients to not pick at the face during the recovery period. Examine the face every 48 hours till complete healing takes place.

Results and complications are generally related to the depth of injury, with deeper peels providing more marked results and a higher incidence of complications. Complications are also more likely with certain skin types and certain peeling agents.

Erythema generally subsides within 90 days but may become prolonged in form of hyperpigmentation. The application of topical hydrocortisone lotion and/or a short course of systemic steroids may lead to earlier resolution.

Following chemical peeling, the skin is very sensitive to the sun, which also may result in hyperpigmentation. Patient is instructed to use sunscreen daily for 6-12 months following a chemical peel. Hypopigmentation is the

result of melanocyte destruction or inhibition from too deep a peel, seen most frequently when phenol is used. Hypopigmentation is more noticeable on darkly pigmented patients. Hypopigmentation may be difficult to assess until erythema has subsided, at which point the condition unfortunately becomes permanent. The line of demarcation between treated and untreated skin is usually the most noticeable.

Delayed healing may lead to hypertrophic scarring, a complication which requires close follow-up and aggressive early treatment. Silicone sheeting, pressure application, and scar massage may improve outcome. Infectious complications are unusual but also demand vigilance and aggressive therapy with oral and topical antibiotics. Herpes exacerbations are treated with oral and topical acyclovir until resolution.

Thread Lift (APTOS, 'Contour threads')

The 'thread lift' is a non-surgical facelift procedure. Patients likely to benefit include all individuals with ageing signs of the face, including droopiness of the skin of the brow, cheeks, jowls and neck. Patients whose faces are very heavy or very thin are not ideal for this procedure. The 'thread lift' is a minimally invasive office procedure performed under local anesthesia that is designed to elevate, reposition and lift lax skin of the brow, face and neck without surgery. The 'thread lift' employs 'cogged'/'barbed' threads which are inserted painlessly under the skin (fig.3).

Under local anesthesia, the threads are passed into the droopy facial element

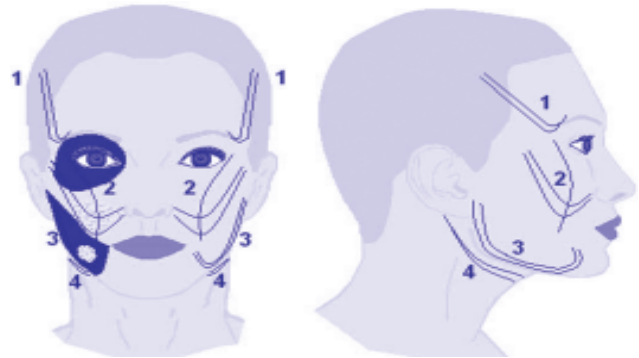


Fig. 3. Diagrammatic representation of the facial zones which are addressed during face-lift with 'Threads'. It also shows the number of 'Threads' and the direction of the insertion to obtain the proper vector for pull. (Photo courtesy: <http://www.facialplasticsurgery.net/forum/forum.php>)

with a special guide needle. Once all threads have been placed, they are tightened one by one. The threads are then able to grab on to the lax soft-tissue and muscle of the desired area to achieve the desired lift. The projecting extra lengths are then pulled and snipped off. Four to six threads will be necessary on either side for adequate correction of the entire face. The threads stay in position like all internal sutures and are well tolerated by the body. The procedure takes approximately 1-2 hours depending on the number of sites to be treated. The threads lift procedure is reliable and even reversible.

The effects of 'thread lift' can be noticed immediately. Patients can achieve 30-70% of what a surgical facelift may achieve, and well over 90% of 'thread lift' patients are very satisfied with the results. The 'thread lift' procedure can also be combined with a mini surgical face lift or any other non surgical rejuvenating procedure to obtain further skin tightening. The effect of a 'thread lift' procedure is expected to last 3-5 years and it can be repeated. Some patients may choose to have a surgical facelift in the next sitting.

The 'thread lift' has very minimal 'downtime' (the time a patient can not function normally). Most patients experience minimal bruising or swelling for 1-7 days. For first 2-3 days after the procedure the skin feels tight and swollen. The 'thread lift' is not a painful procedure and most patients can

return to normal activities, with makeup, the next day (fig.4a-c).

Laser Resurfacing

Advances in laser technology have allowed laser surgeons to improve appearance of skin, scars and wrinkles using ablative lasers. The lasers which are used are the carbon dioxide laser (both scanned and pulsed), the Erbium:YAG laser, or a combined CO₂:Er:YAG laser. Only fine to moderate rhytides (wrinkles) are likely to show improvement with this technique, and other modalities like 'fillers' or fat injection may be needed for more severe rhytides. Superficial pigmentary disorders like lentiginos, and superficial, atrophic, post acne or trauma scars can also be significantly improved. Earlier chemical peels were done to induce reepithelialization and neocollagen formation, but now laser resurfacing is considered more effective and a controlled alternative.

Laser resurfacing, like dermabrasion, relies upon the presence of skin appendages (e.g., sebaceous glands, hair follicles, sweat glands) as sources of epithelium that can migrate to reepithelialize the surface. Therefore, the greater the number of skin appendages per square centimeter of skin, the more rapid the healing and the less risk for scarring. For this reason, carbon dioxide laser resurfacing is largely limited to the face because it has large density of skin appendages. Resurfacing of the hands and neck has been successful, although, much greater risk for scarring exists when treating these areas. EMLA cream (lidocaine cream) and/or regional blocks, with/without sedation are adequate for full face resurfacing.

Carbon dioxide laser

The carbon dioxide laser became a popular tool with the laser surgeon, and its advantages and limitations are well documented. Although, long-term skin tightening and improvement of wrinkles is excellent, marked erythema persists for several weeks or months and the risk of hyperpigmentation occurring especially in darker skin types, deterred many from using it in their patients. Even without complications, the early period of recovery until full reepithelialization can take up to 2 weeks. The newer pulsed carbon dioxide lasers ablate tissue to a depth of 20-30 μm with each pass and cause collateral damage to a surrounding area of 20-70 μm . Collagen contracts by approximately 15-25% during carbon dioxide lasing, producing a shrunken form that serves as a template for tighter, more organized new collagen formation².

Various parameters using different lasers have been described for appropriate effect. In a study comparing scanned and pulsed CO₂ lasers it was observed that maximal skin shrinkage of $5.1 \pm 0.1\%$ per pass occurred using the scanned laser (Sharplan, Silk touch) at 5.9 J/cm^2 . Compared to this a pulsed laser (Coherent, Ultrapulse), achieved a maximal shrinkage of 3.6% at 2.5 J/cm^2 (220 mJ). Skin thermal denaturation, however, was shown to be a maximum of 25 μm with the pulsed carbon dioxide laser at 3.5 J/cm^2 (320 mJ) and 77 μm with the scanned laser at 9.1 J/cm^2 .^{3,4}

Erbium:Yttrium-Aluminum-Garnet (Er:YAG) laser

Other lasers were developed for resurfacing so that light energy could be delivered more selectively to the skin, resulting in less severe adverse effects from collateral damage. The erbium:yttrium-aluminum-garnet (Er:YAG) laser was introduced as a bone-cutting tool in the United States in 1996. The cutaneous absorption of the Er:YAG laser energy by water is 10-fold more efficient than that of the carbon dioxide laser, allowing for more superficial tissue ablation and finer control. Its chromophore (energy absorbing pigment) is water, similar to the carbon dioxide laser. However, the Er:YAG emits a wavelength of 2940 nm, which is absorbed efficiently by water because of water's 3000-nm absorption peak. The passes of Er:YAG laser penetrate to a depth of only 10-15 μm , and several passes only cause collateral thermal necrosis to a distance as thin as 20-50 μm . With the Er:YAG laser collagen contraction is 1-2% during lasing, and it may only reach 14% in the long



Fig. 4a. Front view of a 40 year female with mild sagging of malar fat pads and jowls.



Fig. 4b. Showing markings of proposed site of insertion of bidirectional 'APTOS' to achieve lift of sagging skin and fat pads.



Fig. 4c. Postoperative front view following insertion of 3 'threads' on each side of the face. Note the subtle elevation of the malar and jowl areas. This patient will further benefit from additional 'threads' in the jowl region and by injection of a 'filler' in the nasolabial folds.

term^{5,6}. There is no charring and only a transient white discoloration of the wound bed occurs. Dermal vessels treated with the laser dilate and cause transudation of fluid which in turn increases the water (chromophore) content in the treated area and allows for consistent ablation with each subsequent pass⁷. Spot size, fluence, and pulse repetition rate are the 3 parameters which have to be developed to get adequate ablation. Many laser surgeons use a 3- to 5-mm spot size, a pulse energy of 1-2 J, and a pulse repetition rate of 1-10 Hz. A fluence of 5 J/cm^2 per pass is usually used in delicate areas such as the periorbital and preauricular regions or for superficial lesions. Higher energies ($12-15 \text{ J/cm}^2$ per pass) are used in thicker, more heavily photodamaged or

scarred areas such as the cheeks, chin, perioral areas, and forehead. The epidermis can be completely ablated after 2 or 3 passes using a standard laser, although, severely damaged skin, deep rhytides or scars, and deep dermal growths may require as many as 20 passes⁸.

Combined lasers

Newer laser systems, such as the combined Er:YAG/carbon dioxide lasers and the high-energy variable pulse Er:YAG lasers are also available now. A dual-mode Er:YAG laser calibrated at a fluence of 22.5 J/cm², ablation depth of 90 µm, and coagulation depth of 50 µm is also used. The passes are overlapped 50% to vaporize the epidermis in a single pass. An additional 1-2 passes are applied to residual rhytides and scars. The final layer of desiccated tissue is left in place to serve as a biological wound dressing⁹.

Precautions and Prophylaxis

History of previous resurfacing, prolonged ultraviolet exposure, prior radiotherapy or 'deep peels' should be kept in mind before selecting a patient for laser resurfacing, as there is a possibility of delayed healing and scarring. Similarly, if a patient has been using oral isotretinoin there should be a gap of at least 6 months before starting laser resurfacing. Patients with a history of post inflammatory hyper pigmentation or showing a tendency towards keloid formation are cautioned about these risks post laser resurfacing. Routine prophylaxis against herpes simplex is advisable prior to laser resurfacing of the face.

Postoperative care

Postoperative care can be by an open or closed method. In the open method, which is preferred, application of copious amounts of topical emollients is carried out to promote rapid reepithelialization without risking prolonged occlusion and inability to observe the wound surface. Mild complications do occur occasionally and are of no serious consequence.

Laser Rejuvenation

The term 'rejuvenation' includes treatment of any or all of the characteristic elements of cutaneous 'photo damage'. It suggests a 'reversal' of the photo-ageing process. The name is a misnomer, as it is not the photo-ageing process that is reversed, but it is enhancement of the overall cosmetic appearance through elimination or masking of unwanted effects.

Non ablative laser rejuvenation procedures induce a dermal healing response without notable injury to the epidermis. Improving appearance of the skin without injury to the epidermis is a hallmark of non ablative skin rejuvenation. This is achieved by producing a sub-threshold laser-induced injury to the dermis and/or the dermal vasculature which results in a wound repair response by fibroblast stimulation and collagen reformation.

Coherent and non-coherent light-based laser devices have been used by various operators to perform rejuvenation. These may include several types of vascular and pigment lasers, as well as those that stimulate dermal fibroblasts to produce collagen. Increasing evidence suggests that lasers in the mid-infrared range of spectrum may be the best choice for safe non ablative resurfacing on a wide range of skin types, for e.g. the 1320-nm Nd:YAG laser (Cool Touch) and the 1064-nm long pulse Nd:YAG laser, the 1450-nm diode laser, the 1064-nm Q-switched Nd:YAG laser, and the intense pulsed light source. This field is rapidly evolving, and newer modalities are expected over the next few years. More recently, the use of intense pulsed light (IPL) technology has revolutionized photorejuvenation by its ability to address both the pigmentary and vascular components of photoageing, and fine wrinkling to a lesser degree. This is all performed with relative ease and efficiency, and minimal downtime.

In one study, 49 subjects with varying degrees of photo-damage were treated with a series of four or more full-face treatments at 3-week intervals using a non ablative, non laser, intense pulsed visible light source (IPL). Fluences superscript varied from 30 to 50 J/cm². All aspects of photodamage including

wrinkling, skin coarseness, irregular pigmentation, pore size, and telangiectasias showed visible improvement in more than 90% of subjects with minimal downtime and no scarring. Eighty-eight percent of subjects were satisfied with the overall results of their treatments.¹

In another comparative study patients on with perioral rhytides and Fitzpatrick skin types II and III treatments with the IPL using 590 and 755 nm cut-off filters, and the 1,064-nm Nd:YAG laser were evaluated. The subjects were evaluated at 2, 4, 8, 12, and 24 weeks after the final treatment for improvement in rhytides and presence of any side effects. At 6 months, the patient satisfaction score (1-10) was comparable in all three groups. Evaluator assessment of improved skin quality was also similar in all three treatment groups. Side effects such as blistering and erythema were most commonly seen in the subjects treated with the IPL. The least discomfort was seen with the Nd:YAG laser. It was concluded that although both non-ablative treatment systems improved facial rhytides presumably by causing a non-specific dermal wound, the Nd:YAG laser was better tolerated and produced fewer side effects.²

Mesotherapy

This is the latest modality in non surgical facial rejuvenation. It is a technique by which 'drugs' or 'nutrients' are injected in the skin and subcutaneous tissues to obtain a therapeutic effect. Various delivery methods, ranging from simple fine injection needles to a 'meso gun' are employed. The 'gun' ensures delivery of the required drugs into the tissues in precise amounts, uniformly all over the target area, in a rapid manner. The earliest indication for its use was for 'spot fat reduction' and the drug most commonly injected was phosphatidylcholine, used alone or in combination with other drugs in a cocktail. The therapy has still not received US FDA approval.

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