

# Procedural options for acne scar rehabilitation

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**OUTLINE:** Improving acne scarring is potentially transformative given the psychological, physical and social burden many patients with acne scarring experience. Considerable advances in the development of procedural modalities for acne scarring have taken place over the last decade. Physicians have a vast array of treatment options available to them. Prior to managing patients with acne scarring practitioners need to be fully acquainted with all the procedural options for the different scar types to provide their patients with the best possible care.

**KEYWORDS:** acne scars, scar, filler, subcision, laser assisted drug delivery

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## Introduction

Acne scarring affects up to 95% of patients who have acne. Thirty percent have severe disease.<sup>1</sup> Managing acne scarring is not limited to adolescents. In our experience, a broad age range of patients present for treatment. Given acne scarring can become more apparent as the skin becomes lax with age, treatment can extend into adulthood. Managing acne scarring requires continuous planning, treatment adjustment and maintenance. Physicians need to be mindful that the psychological sequelae of acne scarring includes suicide, depression, poor self-esteem, social impairment, low academic performance and unemployment.<sup>2</sup>

Delaying treatment for scarring can have detrimental consequences. It is now considered safe to perform many scar treatments in patients on isotretinoin.<sup>3</sup>

Before embarking on managing acne scarring a broad understanding of the available procedural modalities is required. Treatment recommendations are adjusted depending on scar type and severity, skin type (colour, depth and morphology), available recovery time and affordability. To holistically manage patients all aspects of post acne sequelae need to be considered and addressed including surface issues such as post

inflammatory erythema (PIE), post inflammatory hyperpigmentation (PIH), hypopigmented scars, as well as contour defects including atrophic rolling scars, boxcars, ice pick scars and hypertrophic scars. Modalities for each of these vary in effectiveness, aggressiveness, cost and downtime. There are many moving parts to scar rehabilitation and skin reconstruction and hence treatment should not be considered in isolation, but rather as a combination to achieve the best possible outcome for patients. An appreciation for which treatments to combine cannot be obtained until a thorough understanding of the advantages and disadvantages of all treatment modalities is appreciated.

Available treatment options can be broadly categorised into energy based, non-energy based, injectable and surgical. We have presented an overview of these in Table 1. Part one of this paper is designed to familiarise the reader with the various procedural options for acne scar management. Part two of the paper brings the information together to demonstrate the importance of multimodal single session treatment and assists in the planning of such treatments so as to achieve more significant outcomes for patients.

**Table 1.** Overview of procedural options for acne scarring per modality

- +++++ Very effective
- ++++ Effective in most cases
- +++ Good option in some cases (often requiring combination with others)
- ++ Acceptable but inferior to other options
- + Not really a good option unless there is no better alternative available.

Energy-based treatments					
Treatment	Downtime	Cost	Effectiveness	Scar type	Additional information
<b>Ablative laser</b>					
<b>Traditional</b> CO2 10,600 nm Er:YAG 2940 nm	Moderate 2-3 weeks	\$\$\$	+++++	Shallow Deep atrophic	High risk of side effects Largely superseded by fractional ablative
<b>Fractional</b> CO2 10,600 nm Er:YAG 2940 nm Er:YSGG 2790 nm	4-10 days depending on modality, density and depth	\$\$\$	+++++	Shallow Deep atrophic Hypertrophic scar (+/- PDL, LADD)	Need more treatment sessions for same result Higher risk of PIH High-energy, low-density settings most commonly selected <sup>4</sup> Higher energies are used for deeper scars <sup>4</sup> More effective at treating rolling and boxcars compared to NAFL
<b>Non-ablative laser</b>					
<b>Fractional non-ablative resurfacing laser</b> 1550 nm Er-glass 1565 nm fibre lasers 1927 nm thulium	Mild-moderate 4-10 days	\$\$\$	+++++	Shallow atrophic	Not as effective as fractionated ablative Less incidence of side effects. Can use safely in darker skin types
<b>Traditional non resurfacing (see Table 2)</b> 1320 nm Nd:YAG 1064 nm Nd:YAG 1450 nm Nd:YAG PDL (585-600 nm) 675 nm 755 nm Alexandrite IPL (not a laser) Picosecond 755,1064 nm Fractional Nd:YAG 1726 nm	Minimal	\$\$-\$\$\$	Variable	PIE PIH Atrophic	Traditional are outlined in Table 2. Many of these are used for PIE and PIH 1726 nm is used for long-term improvement of inflammatory acne
<b>Hybrid lasers</b>	Moderate 4-10 days	\$\$\$	++++	Atrophic	Combine ablative and non-ablative technologies to enhance results

Energy-based treatments					
Treatment	Downtime	Cost	Effectiveness	Scar type	Additional information
Radiofrequency (RF)	Minimal	\$\$	++++	Atrophic	A good lower cost choice Safe in darker skin types RF microneedling is more effective but associated with longer recovery time
Laser-assisted drug delivery	Mild	\$\$-\$	++++	Atrophic (PLLA) Hypertrophic Hypopigmented	Ablative laser is used to enhance delivery and uniformity of drug penetration
Non-energy-based procedures					
Treatment	Downtime	Cost	Effectiveness	Scar type	Addition information
Subcision	Minimal (maybe moderate if treatment is aggressive)	\$	+++++	Atrophic Rolling	There are many devices and techniques for subcision Treatment can be focal to a more generalised cosmetic unit Side effects depend on how aggressive treatment is and the device which is used Can be combined with almost every other procedure
Microneedling	Minimal	\$	+++	Atrophic	Low cost, low downtime procedure, with comparable but slightly inferior results to RF
Dermabrasion and microdermabrasion	Moderate	\$	++	Atrophic	Largely superseded by other technology
CROSS	Moderate 7-14 days PIE and PIH possible	\$	+++++	Ice pick Some boxcar	High concentrations of TCA are applied with various described precision applicators into the scar
Chemical peels	Mild-moderate	\$	++	Atrophic PIH	Energy based devices are safer and likely more effective with less side effects especially in darker skin types

Injectables					
Treatment	Downtime	Cost	Effectiveness	Scar type	Addition information
Filler	Mild-moderate	\$\$-\$\$\$	+++++	Atrophic Some boxcar	Various injection techniques exist Skill and experience influences results Filler selection is important Hyaluronic acid is likely to be the best first line option
Intralesional	Minimal	\$	+++++	Hypertrophic	Dosage and drug used depends on the scars thickness and location Lower dosages are used on the face compared to back or trunk in general
Botulinum toxin	Nil	\$\$\$	+++	Dynamic scar appearance Hypertrophic	When scar appearance is exacerbated by tissue movement botulinum toxin can significantly improve appearance Intralesional and laser assisted application is a promising alternative for hypertrophic scars
Platelet-rich plasma	Minimal	\$\$-\$\$\$	++	Atrophic	Use is probably best in combination with other procedures to enhance healing
Autologous fat	Minimal to moderate	\$\$-\$\$\$	++	Atrophic	Longevity of result is questionable
Surgical reconstruction					
Treatment	Downtime	Cost	Effectiveness	Scar type	Addition information
Punch excision	7-10 days Residual erythema until it heals	\$	++++	Ice pick Some boxcar	Useful for ice pick and deep boxcars mainly <3 mm in size
Punch elevation	7-10 days Residual erythema until it heals	\$	++++	Boxcar	Excellent for shallow and deep boxcars with sharp edges and normal bases
Elliptical excision		\$	++++	Larger irregular deeper atrophic scars	For scars >3.5 mm
Facelift	3 weeks	\$\$\$	+++++	Severe atrophic due to skin laxity	Resolves laxity and hence stretches the scar

CROSS, chemical reconstruction of skin scars; Er:YAG, erbium yttrium aluminium garnet; Er:YSGG, erbium scandium gallium garnet; fCO<sub>2</sub>, fractional CO<sub>2</sub>; HQ, hydroquinone; IPL, intense pulsed light; LADD, laser assisted drug delivery; NAFL, non-ablative fractional laser; Nd:YAG, neodymium yttrium aluminium garnet; PDL, pulse dyed laser; PIE, post inflammatory erythema; PIH, post inflammatory hyperpigmentation; PLLA, poly-L-lactic acid; RF, radiofrequency; TCA, trichloroacetic acid

## Energy-based devices

Energy-based devices have transformed the ability to prevent and manage many aspects of acne scarring and are considered first line treatments for macular post acne skin discoloration, mild and moderate atrophic scarring.<sup>4</sup> Scar prevention with early intervention of medical and laser therapy is essential. Delaying energy-based devices treatment for patients within 6 months of isotretinoin treatment effectively delays treatment for a skin disease that has major physical and mental sequelae.<sup>4</sup> Device and treatment setting selection is highly influence by the scar (type, location and morphology), characteristics of the device type, brand and power, and patient factors (downtime, finances, tolerance of discomfort). Ice pick scars are the least likely scar type to respond to energy-based devices.<sup>4</sup>

### Ablative lasers

Ablative lasers target water and remove the thin outer layer of skin (epidermis) whilst heating the underlying skin (dermis), which stimulates the growth of collagen. Whilst there is still a place for fully ablative lasers, due to high complication rate and prolonged downtime, newer fractionated devices are largely adopted as they are considered safer with less downtime and side effects, however more treatments are required to achieve the same result. These lasers treat fractions of the skin by creating microscopic columns of thermal injury with intervening normal skin which enables a more rapid onset of healing and neocollagenesis. There is a large variation between power and depth of penetration of various brands of lasers. Whilst ablative laser is more effective than non-ablative laser for acne scarring<sup>5,6</sup> the downside of ablative laser is PIH in 73.2% of patients with skin type III-IV, mostly lasting less than 3 months<sup>7</sup>, and prolonged erythema.<sup>8</sup> Erbium more closely approximates the absorption peak of water at 2940 nm and enables increased absorption of energy higher in the dermis and decreased non-specific damage to the surrounding structures. This results in less heat diffusion, a narrower rim of coagulation and less post procedure erythema.<sup>9</sup> However, there is less haemostasis during treatment, so bleeding can be an issue when using this modality and it may produce a more moderate result on remodelling compared to CO<sub>2</sub>.<sup>4</sup> Fractional erbium yttrium aluminium garnet (Er:YAG) and erbium scandium gallium garnet (Er:YSGG) have shown comparable results to fCO<sub>2</sub> after multiple treatments.<sup>10,11</sup>

### Non-ablative lasers

Non-ablative lasers generally have faster post procedural recovery time and a better side effect profile than ablative lasers, but are not as effective as ablative lasers<sup>12</sup> for acne scarring and require more treatment sessions for the same result.<sup>8</sup> Non-ablative lasers are either resurfacing lasers or non-resurfacing. Fractional resurfacing non-ablative lasers (1540, 1550, and 1927 nm) work by creating microscopic columns of thermal injury with intervening normal skin stimulating collagen growth and scar repair and generally have more efficacy than in comparison to traditional non-ablative non-resurfacing lasers. Fractional 1927 nm was recently demonstrated to be equally effective to fractional 2940 nm in a comparative split face study.<sup>13</sup> A disadvantage of these devices is that they are expensive and often have consumables associated with them.

Non-resurfacing non-ablative lasers work by targeting tissue in the dermis by selective photo thermolysis of various chromophores. These also work to stimulate collagen and dermal remodelling. Non-resurfacing lasers are best employed for macular erythema, PIE and PIH. They may have some benefit for shallow boxcars and rolling scars, but fractionated resurfacing options are likely more efficient.

**Table 2.** Utility of non-resurfacing, non-ablative lasers and energy devices in acne scarring

<b>532 nm KTP</b>	Reduces vessels in the scar Helpful for macular erythema/PIE Also targets pigment 585/595 nm may be better <sup>4</sup>
<b>PDL (585-600 nm)</b>	Reduces vessels in scar and helps collagen remodelling response Helpful for macular erythema/PIE Better option for atrophic scars Also used for management of hypertrophic scars (+/- intralesional drug therapy or LADD) Early PDL may help reduce the incidence of atrophic acne scarring <sup>14</sup>
<b>675 nm</b>	Helpful for hyperpigmentation and scarring Stimulates collagen remodelling Well-tolerated with no significant side effects <sup>15</sup>
<b>IPL/BBL</b>	Results similar to PDL for macular erythema Allows a broader area to be treated <sup>16</sup> An increase in collagen and elastin in the papillary dermis has been demonstrated with 550 and 570 nm filter and hence may help atrophic scars <sup>17</sup>
<b>Nd:YAG 1064 nm long pulsed</b>	Beneficial for reducing erythema in darker skin types Benefits for atrophic scarring likely superseded by superior results of fractionated technologies
<b>QS 1064 nm Nd:YAG (nanosecond)</b>	QS Nd:YAG more commonly employed for hyperpigmented scars Has deeper dermal penetration Safe and effective for atrophic acne scarring Not as effective as fractional CO <sub>2</sub> More effective for PIH <sup>4</sup>
<b>Picosecond laser 755 nm and 1064 nm</b>	Delivered in ultrashort pulse durations Has a photoacoustic effect and causes less non-specific damage Fractional picosecond lasers are effective in acne scarring with minimal side effects <sup>18</sup> More safely employed for darker skin types to avoid PIH and also to address pigmentary dyschromia 755 nm demonstrates a 25-50% improvement <sup>18</sup> Fractional Nd:YAG 1064 nm is equivalent to fractional 1550 nm and is associated with less pain but more pinpoint bleeding <sup>19</sup> Need multiple treatments, and the costs of equipment is significant Picosecond lasers may have a prominent role in the management of PIH <sup>4</sup>
<b>1726 nm</b>	Specifically targets sebocytes within the dermis Because of the 1726 nm induced temperature rise in the dermis acne scarring is also improved due to induction of neocollagenesis. This has now been seen subjectively in laser-treated acne patients Current studies are being undertaken in adult patients with acne scarring who no longer have active acne

BBL, broad band light; IPL, intense pulsed light; KTP, potassium titanyl phosphate; LADD, laser-assisted drug delivery; Nd:YAG, neodymium yttrium aluminium garnet; PDL, pulse dye laser; PIE, post inflammatory erythema; PIH, post inflammatory hyperpigmentation; QS, Q-switched

## Hybrid lasers

Hybrid lasers are devices that deliver two different types of lasers at the same time during the treatment. Two examples are Sciton's Halo Hybrid™ laser delivering fractional non-ablative 1470 nm together with ablative 2940 nm, and the Alma Hybrid™ laser delivering fractional CO2 and 1570 nm together. These are thought to be more effective than single treatments alone, however larger studies are required. Results are impressive in clinical practice.

## Radiofrequency

Radiofrequency (RF) involves the use of electromagnetic energy to selectively heat the tissue at various depths causing neocollagenesis and skin contraction.<sup>8</sup> The idea is to limit the downtime by making the damage more dermally than epidermally placed. RF is associated with less expense, downtime, and pain, and lower incidence of PIH especially if the energy of the device is reduced compared to other devices.<sup>19</sup> Some devices have microneedles with tips that can be insulated or non-insulated enabling precise control of the depth at which the tissue is heated.<sup>20</sup> Due to the puncture of the stratum corneum there is some downtime for patients treated with microneedling RF and it can be painful. Of all the RF devices, fractional RF offers the best outcomes. Improvement of 25-75% can be expected after three to four sessions.<sup>8</sup> Four to five treatments are generally required. Nanofractional RF delivers energy in tiny areas and is thought to reduce the risk of PIH and has less downtime. Several treatment passes are likely to achieve better results.<sup>4</sup>

## Laser-assisted drug delivery

Laser-assisted drug delivery (LADD) enhances penetration and uniform distribution of topically applied treatments leading to enhanced delivery. Ablative lasers are used to create microscopic channels that enable drugs to travel through the epidermis. The depth and concentration of drug delivery is influenced by the laser parameters employed. LADD is mainly effective for the management of hypertrophic and keloid scars.<sup>21,22</sup> It has an emerging role in the management of other types of atrophic acne scars and hypopigmented acne scarring (Table 3).

## Non-energy-based procedures

### Subcision

Subcision is a well-tolerated and effective technique to free tethered subdermal fibrous bands that create scars.<sup>8</sup> This technique is less effective for deep boxcar and ice pick scars than rolling scars.<sup>8</sup> Several techniques and instruments are used, including 18-20G tri-bevelled hypodermic needles, 18G Nokor needles, blunt blades, cannulas and more. Tethered scars are disrupted, creating subdermal bleeding, and a subsequent blood clot is formed.<sup>27</sup> New collagen is

deposited as the clot heals, which results in a more even surface.<sup>27</sup> Subcision can be performed for single scars or more comprehensively over a wider area depending on the instrument used. Bi-level subcision refers to a two-depth technique whereby both the upper dermis and sub dermis are treated.<sup>9</sup> The best levels to perform treatment at are the deep dermis and the dermosubcutaneous junction. Care is required when subcising in deeper planes so as to not to disrupt the retaining ligaments (stable fibrous bands that attach the periosteum or deep fascia to the dermis). Disruption of these bands may result in facial sagging.<sup>28</sup> Blunt cannula subcision is associated with more favourable outcomes and less incidence of complication in comparison to Nokor needles.<sup>29</sup> Blunt blade subcision under tumescent anaesthesia has been demonstrated to be effective.<sup>30</sup>

Subcision can be combined with almost all other techniques to enhance results.<sup>9</sup> Subcision combined with hyaluronic acid filler gives better improvement than subcision alone.<sup>31</sup> Bilevel subcision combined with the injection of hybrid complexes of high and low molecular weight hyaluronan (Profilo®) using a three-step technique has recently been shown to be effective in a study of 82 patients.<sup>32</sup> Step one involves subcision with a Nokor needle using a fanning direction. Step 2 involved the injection of Profilo® at the scars atrophic dermal component with a 29G needle and third step involves the filling of the subcised space with Profilo®.<sup>32</sup> A recent study explored the use of endo-RF using a flex-RF probe in combination with subcision in nine adult patients demonstrating it is a safe and effective treatment for acne scars.<sup>33</sup>

When performing subcision in combination with energy-based devices in the same session, most experts prefer to subcise first.<sup>4</sup>

### Microneedling

Microneedling involves various devices (rollers, stampers and pens) with fine needles that create multiple punctures into the papillary and mid dermis of varying depth. Collagen production is stimulated.<sup>8</sup> Medical microneedling employs 1.5 mm-3 mm needles. Improvement has been demonstrated for superficial scars by up to 60%.<sup>34</sup> However, PIH and tram-track may occur in darker skin types.<sup>34</sup> It is considered a low cost, low downtime procedure, with comparable but slightly inferior results to RF.<sup>8</sup> There is a lack of standardisation of the depth of needles, number of passes, number of needles and post-treatment topicals applied.

### Dermabrasion and microdermabrasion

Whilst these options represent polar extremes of treatment intensity, in the authors' opinion there are other resurfacing modalities that offer fewer side effects and quicker recovery times e.g., fractional lasers, RF and microneedling. We do not tend to perform dermabrasion or microdermabrasion in our clinics.

**Table 3.** Laser-assisted drug delivery and scarring

Drug	Purpose
Triamcinolone	Hypertrophic acne scars
5-fluorouracil	Hypertrophic scars. Associated with less dermal atrophy and telangiectasia compared to triamcinolone <sup>22</sup>
Botulinum toxin	Hypertrophic scars <sup>23</sup>
PLLA	Atrophic scars <sup>24</sup>
Bimatoprost	Hypopigmented scars <sup>25</sup>
Hydroquinone	Hyperchromic scars (case report only) <sup>26</sup>

PLLA, poly-L-lactic acid

**Table 4.** Soft tissue fillers for acne scars

Soft tissue fillers	Duration of action	Composition	Comments
<b>Hyaluronic acid (HA) filler</b> Belotero, Restylane, Juvederm	3-12 months (perhaps longer)	Glycosaminoglycan polysaccharide (naturally occurring component of the body's connective tissue)	HA fillers differ in physical properties: degree of cross-links, HA concentration, particle size, hardness, cohesivity, and rheology (gel strength and flexibility)  Physical properties influences location of use with stronger, more cross-linked HA fillers often used for deeper filling and softer, less cross-linked fillers used for superficial filling  New hybrid complexes of high and low molecular weight hyaluronan (Profilo®) are an interesting option to consider <sup>32</sup>
<b>Calcium hydroxylapatite (CaHA)</b> Radiesse	1-2 years	Composed of 25-45 µm microspheres of synthetic CaHA in an aqueous gel.  Stimulates collagen production	In 10 patients with acne scars treated with 1-2 injections, at 1 year, 30% showed >75% improvement and 60% showed 50-75% improvement <sup>45</sup>
<b>Poly-L-lactic acid (PLLA)</b> Sculptra Newfill	1-2 years	Nonimmunogenic, biodegradable synthetic polymer  Induces production of collagen via increasing fibroblasts through a foreign body reaction, improving texture in time	More treatment sessions required than other fillers but produces more sustained results over 2 years <sup>8</sup>  Fractional CO2 laser assisted delivery of PLLA leads to a 33% improvement after a single treatment in 20 patients <sup>24</sup>
<b>Polymethylmethacrylate (PMMA)</b> Artecoll, Artefill, Bellafill	Permanent	20% PPMA microspheres, 30-50 µm, suspended in bovine collagen  Adds volume and stimulates collagen production	Cost saving method vs temporary fillers as only one treatment required  Patients with rolling scars with one treatment observed a 64% improvement <sup>46</sup>  Long term adverse effects to consider such as delayed nodules  Visible bumps may be evident if injected too superficially in the dermis <sup>32,42,43</sup>



## CROSS

Chemical reconstruction of skin scars (CROSS) involves high concentrations of trichloroacetic acid (TCA) applied with various described precision applicators into the scar. This technique is mainly used for ice pick scars but is also described for some boxcar and rolling scars. We prefer application with a fine paint brush as described by Sun and Lim<sup>35</sup> over toothpick application. Sun and Lim recommend the use of the Element Games Kolinsky Stubby Detail brush.<sup>35</sup> The trade off with TCA CROSS can be persistent PIE or PIH in darker skin types that can be managed with pre and post topical hydroquinone. Various concentrations of TCA penetrate to different depths. A 10%-30% concentration is superficial, 35%-50% is medium and >50% is deep penetrating. Optimal concentration and number of treatments is tailored to the patient, skin type and response. A 50%-70% concentration is reported as effective (>50% of patients have >50% improvement).<sup>35</sup> Sixty-five percent TCA has good to excellent result compared with 94% in the 100% TCA treated groups. A low complication rate is reported with this modality.<sup>36</sup>

## Chemical peels

Medium to deep peels are usually required for scars. Energy based devices are safer and likely more effective with less side effects especially in darker skin types. TCA 20%-35%, alpha-hydroxy acids, salicylic acids, and Jessners may help macular scars.<sup>37</sup>

## Injectables

### Fillers

Fillers are effective for atrophic scars<sup>38</sup> and work by adding volume and stimulating collagen production. Table 4 outlines soft tissue filler use for acne scars in more detail. A variety of methods such as droplet, linear threading, modified tower technique<sup>39</sup> and layered filling<sup>40</sup> have been described and are adapted according to the scar depth and type. Another study demonstrated the effectiveness of using a micro-injector to place 0.01 mL of hyaluronic acid repeatedly into the superficial dermis as being effective.<sup>41</sup>

Fillers are often combined with subcision to enhance results.<sup>38</sup> The more permanent fillers can be associated with more permanent adverse events<sup>42</sup> with delayed onset nodules reported as late as 10 years.<sup>43</sup>

There are no robust placebo-controlled trials for filler use in acne, but multiple small controlled trials indicate higher patient satisfaction with treatment and results.<sup>44</sup> Hyaluronic acid is a sensible first line choice. It is reversible, can be injected in the superficial dermis, and has a good safety profile. Whilst it is thought to last 3-12 months, recently it has been shown to last up to 10 years, particularly in areas of less movement.<sup>44</sup>

## Intralesional

Injection of triamcinolone (TAC) alone or in combination with lasers and other intralesional options such as 5-fluorouracil (5-FU) is an effective modality for the management of hypertrophic or keloidal acne scars.<sup>47</sup> We like to use insulin syringes for extra precision and comfort for patients. Red hypertrophic scars are usually first treated with vascular laser (pulsed dye laser) followed by intralesional therapy plus or minus fractionated laser. The dosage of intralesional used depends on the scar thickness and location. Lower dosages are used on the face compared to back or trunk in general. TAC and 5-FU can be used alone or in combination.

## Botulinum toxin

When scar appearance is exacerbated by tissue movement, botulinum toxin can significantly improve appearance, especially in the glabella, forehead and chin region.<sup>48</sup> Laser assisted delivery of botulinum toxin was recently demonstrated to be more effective for the management of hypertrophic scars than intralesional botulinum toxin.<sup>23</sup> This is thought to be due to the additional role of CO2 laser in improving scar outcome. It is postulated to work by minimising the growth of fibroblasts derived from the hypertrophic scar and altering the production of transforming growth factor.<sup>23</sup>

## Platelet-rich plasma

Platelet-rich plasma involves preparing and injecting the patient's own plasma to promote wound healing by delivering platelets, growth factors and cytokines to the target tissue. In the authors' opinion, the use is probably best in combination with other procedures to enhance healing. Further research and evaluation are needed to define its role in acne scar repair.

## Autologous fat transplant

Other non-filler agents include autologous fat transplant. The longevity of results of this is doubtful.<sup>9</sup>

## Surgical reconstruction

### Punch excision

Punch excision is useful for ice pick and deep boxcars mainly <3 mm in size. A punch biopsy is used to remove the scars, which need to be 4-5 mm apart. If not, then multiple sessions at least 4 weeks apart are required.<sup>8</sup> Elliptical excision is better for scars >3.5 mm.<sup>49</sup> We prefer to leave sutures in a little longer than normal for enhanced results. In practice this reduces a slight stretched appearance of the scar that may occur with early suture removal. Resurfacing laser enhances results and can be safely combined on the same day.<sup>50</sup>

## Punch elevation

Punch biopsy is used to excise the scar down to subcutaneous fat. This technique is excellent for shallow and deep boxcars with sharp edges and normal bases. Tissue is elevated to slightly above the plane of the skin and fixed with sutures or steristrips. Combination with fCO2 leads to better results than fCO2 alone.<sup>51</sup>

## Elliptical excision

Elliptical excision is useful for scars >3.5 mm. It may also be the best treatment for deep irregular scars in difficult locations.

## Facelift

Age related tissue laxity makes atrophic scarring more visible (especially rolling scars). A facelift can enhance the appearance of scars in this circumstance.<sup>52</sup>

## Conclusion

Advances in the array of treatment options available to physicians are considerable. These however are meaningless unless physicians can apply the correct treatments to their patients. Prior to managing patients with acne scarring practitioners need to be fully acquainted with all aspects of procedural options available to manage different types of acne scars. There are many factors to consider when performing scar rehabilitation. Single treatments are generally not performed in isolation, but rather as a combination to achieve the best and most efficient outcome for patients. This section of the paper was designed to familiarise the reader with all available procedural options prior to part 2 where we discuss the various nuances of how to bring the information together so as to design an effective single session multimodal treatment for patients.

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