Scar revision costs

Christopher Stone looks at the treatments available and costs involved for scar amelioration

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Between 2008 and 2010, the UK market for cosmetic surgery is estimated to have grown by 17% to reach an estimated worth of £2.3 billion. A cosmetic surgeon can expect, on average, to receive a claim in negligence every two years (although around 70% of all claims are discontinued), and one quarter of all negligence claims are related to poor scarring. It is easy to appreciate the value of scarring to the claimant; between 1996 and 2005 £8.5m was paid in damages and legal costs, with individual claims attracting awards of up to £300,000.

In personal injury practice, a permanent scar is likely to factor in an even higher proportion of claims. Determining the quantum of general damages in relation to scarring relies upon consideration in expert evidence being given not only to the quality of the current scar, but also to the potential indications for, and associated cost of, remedial treatment.

Assessment of scar quality

A number of scoring systems have been developed for the assessment of scar quality. Of these, the Manchester Scar Scale has been validated for high inter-rater concordance, and is a useful system for the evaluation of most scars. Using this scoring system, a score of 5/18 represents a scar of best quality and 18/18 a scar of poorest quality based upon the clinical assessment of scar colour, texture, contour and distortion to surrounding structures. The Manchester Scar Scale, therefore, represents a quantitative tool that lends itself especially to the assessment of any change in scar quality, such as may occur during the maturation process or following remedial treatment. It does not, however, account for the size and site of the scar, nor the age or gender of the patient.

What makes a poor scar?

Most traumatic wounds heal satisfactorily following simple first aid measures or after treatment in the local Emergency Department. Scars mature gradually over a period of 12 to 18 months post injury, during which time they gradually lose their red appearance and become less lumpy. The maturation process, and flattening of a lumpy scar, can be assisted by topical massage with a silicone-based or other moisturising cream, while redness in the immature scar, due to inflammatory hyper-vascularity, gradually abates without treatment.

The mechanism of injury and the nature of the traumatic wound are often the most important factors in determining the quality of the final scar. Injuries resulting in significant tissue loss, including major burn injuries, are clearly likely to cause the worst scarring. However, the commonest scars encountered in personal injury practice are perhaps those that result from lacerating wounds, particularly to the face. Scarring may also be the result of surgical intervention, such as may be required to decompress a muscle compartment, fix a fracture or explore an intra-abdominal injury. Where soft tissue reconstruction is required using skin grafts or free flaps, secondary scarring, and potentially a functional deficit, is generated at the donor site.

The orientation of a linear facial scar, with respect to scarring, may be favourable or unfavourable, depending upon its relationship to the surrounding relaxed skin tension lines. Scars that parallel relaxed skin tension lines tend to heal well, while those orientated perpendicular to them are

likely to become lumpy. For example, a horizontal forehead scar is more likely to heal better than a vertically-orientated scar that transects the brow creases.

Curved or flap lacerations on the face may also become lumpy due to a pin-cushioning effect within their concavity. In time, interstitial oedema within the flap becomes replaced by fibrous scar tissue and the lumpiness becomes permanent. Some scars lie adjacent to structures such as the eyelids, nose and lips. Even small scars have the potential to distort the normal anatomy of those structures and cause a disproportionately worse cosmetic, and indeed functional, problem compared with what might be anticipated at other sites. Under these circumstances remedial surgery may need to extend beyond the site of the original injury, with the inevitable implications for the cost of treatment. Similarly, scars within hair-bearing skin (eyebrows, scalp, beard area) have the potential to become more obvious due to stretch and hair loss. Scarring on the scalp, in particular, may be easy to correct without fairly major surgical procedures.

The initial management of a traumatic wound is another factor in determining outcome. Some patients present with traumatic tattooing due to a failure to adequately removed particles of dirt or grit from the wound at the time of injury. The initial closure of a traumatic wound is undertaken in many Emergency Departments by junior staff working under difficult conditions of poor lighting, basic instrumentation, time pressures etc., all of which are likely to contribute to sub-optimal results.

When making an assessment of a poor scar with a view to surgical revision, it is important to consider the technique of primary wound closure; if the closure itself can be improved upon it provides scope for improvement of the scar itself. The choice of closure technique includes taping, the use of skin glue or suturing, while the aim of each wound closure technique is to accurately approximate the wound edges and to support the immature scar until such a time as the tensile strength of the skin is restored to as near normal as possible. In practice, this often requires a two layered closure of the skin with an absorbable suture used to support the dermal layer and a non-absorbable suture used to accurately align the epidermal layer of the skin. The choice of absorbable stitch and the timing of removal of non-absorbable sutures are therefore predictive of scar quality.

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Scars closed at sites of tension (scalp, back, limbs, etc) are prone to stretching if inadequately supported by a dermal suture or by taping during the first two months of maturation. Large sutures used to approximate wounds too tightly and left in situ beyond 7-10 days are liable to cause unsightly and permanent stitch marks while the use of small sutures, if removed too early without dermal suture support, will lead to stretching of the scar.

Infection is another determinant of a poor scar since it promotes wound breakdown and delayed healing. Patients who present with a poor quality scar on account of infection are likely to benefit from revisional surgery after a suitable period of scar maturation. In the revisional situation, the factors that potentiated wound infection after injury, including wound contamination and the persistence of devitalised tissue at the wound site, are negated.

Patient factors that adversely affect healing may or may not be controllable when undertaking revisional surgery. Smoking, immuno-suppression (including steroid medication), malnutrition and anaemia are all known to impair wound healing. The propensity to form hypertrophic or keloid scars may also be genetically-determined, confounding efforts to improve scar quality through surgical revision. Indeed, revisional surgery to stretched or hypertrophic scars risks a recurrence of that condition, especially where the wound is closed once again under tension. Similarly, excision of a keloid scar is likely to be followed by a re-growth of the keloid beyond the margins of the original scar, although there is some evidence to suggest that topical application of immune modulating agents such as Aldara or 5-fluouracil may reduce the recurrence of post-excisional keloids.

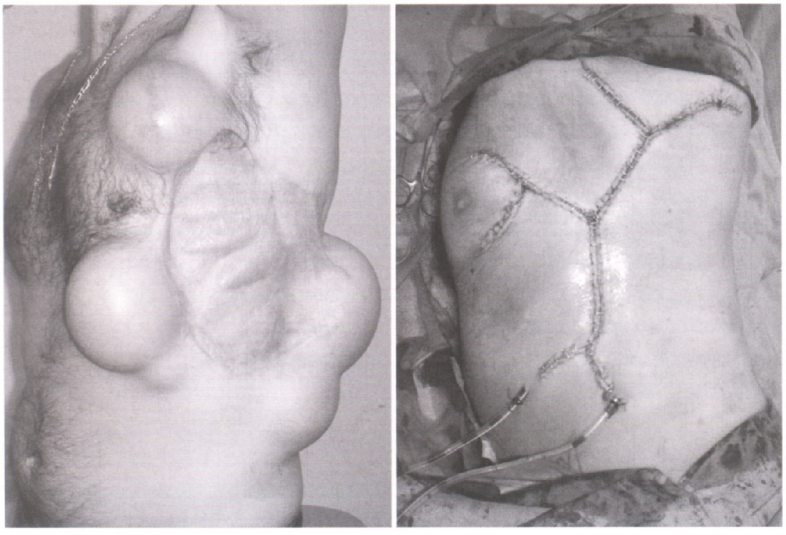

Figure 1: Use of tissue expansion to enable replacement of extensive skin graft scarring

Options for remedial treatment of poor scars

Plastic surgeons often refer to the 'reconstructive ladder' when considering options for soft tissue reconstruction, beginning with the easiest (direct closure) to the most complex (microsurgical free tissue transfer). A similar hierarchy of options exists for the management of scars, each of which will be discussed in turn.

Topical silicone moisturising massage
Topical application of silicone gel (Dermatix®) to both immature and fully mature scars has been shown to be effective in reducing scar elevation, itching and pigmentation. Used prophylactically within one week of surgery, Dermatix significantly reduces the incidence of hypertrophic and keloid scar formation at high-risk sites such as median sternotomy wounds.

The mechanism of action is not fully understood although it is believed to be through a combination of the pressure effect, scar hydration and the modulation of the collagen profile at the wound site. The cost of Dermatix as specified in the current edition (60) of the British National Formulary is £16 per 15g tube; the number of tubes required, and hence the overall cost, will depend upon the size of the scar and its response to treatment.

Intra-lesional steroid injections
The injection of a steroid, triamcinolone, into lumpy (hypertrophic) scars is useful in softening the scar, reducing scar height and ameliorating symptoms such as itching. A course of three injections spaced at six-weekly intervals is often required and may need to be repeated. Injections are usually performed under local anaesthesia although in children a general anaesthetic may be necessary. The cost of each injection in the private sector is approximately £100 although costs increase if a general anaesthetic is required. Where scars are symptomatic, but are unsuitable for intra-lesional steroid injections (for example if the scar is reasonably soft and flat), topical Axsain® cream, containing capsaicin, is often effective. Axsain® cream retails at £14.30 per 45g tube.

Laser therapies
Several studies have investigated the use of Pulsed Dye Laser (PDL) in the management of hypertrophic scars. PDL is generally considered to be effective in reducing the hyper-vascularity of red scars and in softening lumpy scars. Traumatic tattooing around scars has been shown to be completely eliminated using an Nd:YAG laser, which remains the first line treatment of choice for this condition. Laser therapies in the private sector are likely to cost around £150 per treatment. Several treatments may be required depending upon the response.

Dermaroller
Percutaneous collagen induction therapy using the 'microneedling' Dermaroller® device has been demonstrated to improve the appearance of atrophic facial scarring such as may occur in acne or post-trauma. This technique has also been used in combination with carbon dioxide laser resurfacing for the treatment of facial burn scarring. Dermaroller therapy is available in the private sector at a cost of around £1,500 for a course of five treatments.

Surgical revision
Surgical scar revision essentially refers to the surgical excision of a scar and re-suturing, usually by a plastic surgeon. For a given scar, the indications for revisional surgery may divide opinion among plastic surgeons. The main aims of surgical scar revision may be to improve cosmesis, release contracture and improve scar quality or stability, although adjunctive techniques can also be employed to re-orientate tissues and improve contour deformities.

Before embarking upon revisional surgery to scars, careful consideration should be given to the aetiology of the poor scar and the risks of surgical revision. A permanent scar will still remain and a period of scar maturation will be required before the final scar quality can be assessed. No guarantees can be given that overall scar quality will be improved and, in the event of a wound infection or dehiscence, there is a potential for the scar to be made worse. Ultimately, the balance of risks versus benefits of revisional surgery to any given scar must be carefully assessed by the surgeon and patient before proceeding.

The surgical revision of small scars can often be undertaken under local anaesthetic on an out-patient basis at a cost of around £1,000. Occasionally, as is the case in children or needle-phobic patients, a general anaesthetic may be required, significantly increasing the cost of private sector treatment to up to around £2,500. The cost of post-operative scar management using a combination of Micropore™ taping and topical silicone gel would also be incurred.

Post-surgical taping effectively splints the healing wound and dissipates tension over the area upon which the tape is applied. 5cm wide Micropore tape retails at £1.57 per roll and multiple rolls will often be required to maintain support for up to two months after scar revision. In areas where no such tension exists topical silicone therapy is likely to be preferred from the outset.

Plastic surgeons often refer to the 'reconstructive ladder' when considering options for soft tissue reconstruction.

Where scars are too wide to enable the surgeon to undertake excision with primary re-suturing as a single procedure, serial excision may be contemplated. This is often the case with stretched scalp scars or skin grafted fasciotomy scars on the forearm or lower leg. At each operation the scar is sequentially reduced in width according to what the local tissue tension allows. Between operations the tension of wound closure gradually reduces due to the elasticity of the skin and a process known as 'biological creep'. After three to six months there is usually

Figure 2: Secondary scarring on the back resulting from the transfer of a free scapular-parascapular flap to the lower leg for limb salvage following trauma

sufficient skin laxity to facilitate the next excisional procedure. The cost of serial excision is estimated simply by multiplying the cost of a single operation by the number of operations likely to be required.

Dermal replacement using MatriDerm®

Skin grafts have the potential to become hard, lumpy and inelastic due to the absence of a supportive and flexible dermal layer to the skin. MatriDerm is a commercially available collagen-elastin scaffold matrix that can be used to revise such scars and reconstitute the missing dermal layer.

A sheet of MatriDerm is placed between the wound bed and a thin overlying split skin graft is applied. The MatriDerm becomes incorporated into the wound to facilitate the in-growth of normal host collagen-producing cells and blood vessels. The resultant scar has greater pliability and is texturally more similar to the surrounding normal skin than graft alone, leading to an improvement in appearance, form and function.

The cost of treatment relates to the size of the wound and the cost of the MatriDerm product. Even for relatively small defects, with surgery undertaken under general anaesthesia, the cost of treatment is likely to approach £5,000.

Figure 3: Traumatic permanent tattooing and scar hypertrophy on the shoulder following a road abrasion

Tissue expansion

Tissue expansion represents an alternative option to serial excision for the removal of large, stretched or skin graft scars. At an initial operation, one or more expanders (effectively a balloon device incorporating an infiltration port) are inserted beneath the skin at a site adjacent or close to the scar. Over a period of weeks, patients attend at regular intervals for inflation of the expander with saline by percutaneous injection into the expansion port. As the expander gradually enlarges, the skin overlying it increases its surface area through a process of mechanical (essentially stretch) and biological creep. This is the same way that excess abdominal skin is generated during pregnancy.

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Once there is sufficient skin available, the scar is excised and the expanded skin is advanced into the defect. The aim is to replace scarred skin with normal skin although some scarring will persist at the margins of the excision and at the site of insertion of each expander. The process is lengthy and costs are incurred at each stage. Overall, the cost of treatment, including insertion of the expanders, inflation and the final scar revision, is likely to exceed £10,000.

Local, distant and free flap reconstruction

All scars undergo a degree of contracture as they mature. Linear scar contracture can become problematic across the flexor creases of joints, restricting functional extension, or where specialised anatomical structures, such as the eyelids, become distorted. Local flaps of skin can be raised and used to lengthen scars, re-orientate them or restore normal anatomical relationships. Many different flaps have been described for this purpose and are used interchangeably depending upon the site of their use and objectives. Lawyers will, perhaps, be most familiar with the 'Z-plasty' and its variations.

The cost of local flap scar revision will vary according to individual circumstances, but would generally be no less than £1,500 if performed under local anaesthesia and significantly more where general anaesthesia is required.

Occasionally, local tissues are inadequate for the reconstruction of sizeable or three dimensional soft tissue defects and tissue must be imported from distant sites. Blocks of tissue, including skin, fat and muscle, can be raised from one part of the body, where its removal can be accommodated without significant cosmetic or functional sequelae, and transferred to another. The blood supply to the flap is either retained via a vascular pedicle from its site of origin (distant flap), or is re-established by microsurgical anastomosis of the blood vessels belonging to the flap to an artery and vein of similar calibre at the recipient site (free flap).

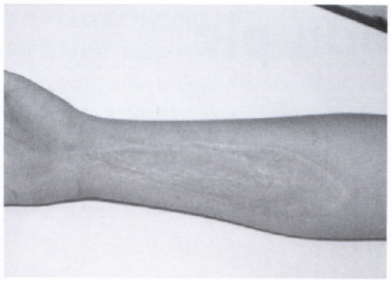
There are few indications for this type of major surgery in the name of scar revision, although an unstable scar overlying bone, such as may occur in the pre-tibial area, would be a familiar potential candidate. Other indications would be to improve cosmesis of a poor scar and to release an extensive contracture, especially in the context of burns scarring.

One inevitable disadvantage of major flap reconstruction, apart from the potential for failure of the reconstruction due to technical or patient factors, is the secondary scarring generated at the donor site. This scarring may, in itself, represent a significant problem that might require later revision. Owing to its complexity, the cost of this type of surgery is likely to far exceed a minimum of £10,000.

Liposuction and fat grafting

Fat is a tissue type that is sensitive to its blood supply. When subjected to blunt trauma, fat can become necrotic resulting in troublesome lumpiness or a depressed 'fracture' of the fat layer beneath the skin. Liposuction is a useful adjunctive technique for smoothing contour irregularities that may occur at site of trauma. In the private sector the cost of liposuction will depend upon the volume of fat that needs to be removed although in practice liposuction for the purpose of scar revision is usually of low volume.

Figure 4: Skin grafted forearm fasciotomy wound – suitable for revision by serial excision



Nevertheless, the cost of treatment is likely to start at around £3,000.

Conversely, at sites where traumatised necrotic fat has undergone resorption, the resulting deficit of subcutaneous tissue can be corrected by transplantation of fat from another area of the body, commonly the abdomen or buttocks. Autologous fat transfer aims to overcorrect the deficit in the first instance to allow for some resorption of the grafted fat, but it is an imprecise science. Consequently, more than one procedure, also at a cost of around £3,000, may be required to achieve the desired effect.

Melanocyte transfer

Depletion of the melanocyte population (pigment-producing cells) in the epidermis of the skin, as may be encountered most frequently with burns scars in pigmented skin types, is likely to lead to a hypo-pigmented scar. The colour mismatch with the surrounding skin renders the scar more obvious and is often a cause for significant self-consciousness of appearance. It is difficult to restore melanocytes once they have been lost, although techniques of melanocyte transfer, pioneered by dermatologists to treat vitelligo, may offer a remedy. Suction epidermal grafting can be performed as an outpatient to small areas of hypo-pigmentation at a cost of around £1,500.

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Conclusion

In personal injury practice, the medical expert must consider all reasonable treatment options that will assist the claimant in ameliorating the effects of scarring and return them to a position as close as possible to their pre-injury state. Many scars require little or no treatment while others demand complex surgery and ancillary procedures, with a commensurate increase in cost of treatment and hence quantum of damages. The expert has a duty to consider these treatment options impartially, whether instructed by the claimant or the defendant, and to approach the management of a given scar in exactly the same way as they would when faced with a patient in the outpatient clinic. ■