

Clinical Surgery

PLASTIC SURGERY

CONSULTANT EDITOR

R. J. V. BATTLE

CLINICAL SURGERY — 4

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CLINICAL SURGERY

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PREFACE

This volume is entirely devoted to plastic surgery, its problems and treatment. It should, wherever possible, be read in conjunction with *Operative Surgery* by the same Editors.

All the authors are British and trained in this country and have been selected for their special knowledge and experience of the subjects with which they are dealing.

The 132 illustrations have been carefully selected for their clarity and detail.

It must be remembered that no surgeon can become any kind of a specialist simply by reading a book. With experience it will be found that this volume will increase in value. It should, in my opinion, be helpful at all stages of a career in plastic surgery.

October, 1964

R. J. V. BATTLE

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CHAPTER 1

GENERAL PRINCIPLES AND SURGICAL TREATMENT OF SCARS

MICHAEL N. TEMPEST

INTRODUCTION

The presence of a scar whose ugliness is usually obvious, but sometimes exaggerated and occasionally imagined, is one of the commonest reasons for seeking the advice of the plastic surgeon. Such scars will usually be found on the conventionally exposed parts of the body, the face, neck, arms and legs, but patients (and parents) may often be anxious about the appearance of scars elsewhere.

The management of these scars is sometimes difficult. Although it may be in the patient's best interest to advise against any form of surgical intervention it is not always easy to convince the patient of the wisdom of this decision. The surgical treatment of a scar may not always be as simple as it seems and even the most expert plastic surgeon would hesitate to predict a perfect result in every case. Some scars can be corrected at a single operation, but others may require a whole series of carefully staged procedures. This should be explained clearly to the patient in advance not only to enlist his co-operation, but also to allay misgivings. Indeed the management of the patient is just as important as the management of the scar.

AETIOLOGY

Scars are the result of many different types of injury to the surface tissues of the body and to simplify management can be classified along the following lines.

Accidental trauma

Accidents at home, at work and on the roads produce wounds which vary in severity from the minor cut on the forehead or abrasion over the knee to the massive torsion-avulsion degloving injury of the limbs. Most accidental wounds are deeply ingrained with grit and gravel, and in mining accidents with fine particles of coal dust. These scars may range from a small pigmented abrasion on a child's knee to the extensive anthracotic staining seen on the face of a miner who has been involved in a shot-firing accident.

As a general rule, the incised, clean-cut or "tidy" wound will leave a far more satisfactory scar than the lacerated, contused or "untidy" wound. Important exceptions are the multiple small wounds on the face caused by flying glass in motor-car accidents, which although clean cut, leave particularly objectionable scars. The edges of these wounds are not perpendicular to the

GENERAL PRINCIPLES AND SURGICAL TREATMENT OF SCARS

skin surface, but bevelled. As healing occurs contraction of the scar causes the skin level on one side of the scar to become heaped up. This produces an unpleasant contour defect, and one which is very difficult to treat surgically.

“Deliberate” or surgical trauma

Some surgical operations, even in the most expert hands, leave external scars of which few surgeons could be proud. Such scars are frequently the result of haematoma formation and wound sepsis, but may be due more often to badly planned incisions, badly sutured wounds, particularly wounds closed under tension. Ugly stitch marks may be left by sutures tied too tight, left in place too long and by carelessly placed stab wounds used for the insertion of drains.

The plastic surgeon too may be so carried away by enthusiasm in the closure of the primary defect as to forget the disfigurement of the secondary defect which may be more objectionable than the original scar or lesion. Lack of care in choosing suitable donor sites for split-skin grafts may produce an extremely embarrassing disfigurement, particularly if fairly thick split-skin grafts have been taken.

Infections

Serious scarring and deformity may be produced by the spontaneous drainage or the deliberate surgical evacuation of acute abscesses; discharging tuberculous and mycotic lesions; destructive skin diseases such as acne, smallpox and cancrum.

Burns

Some of the most unpleasant scars are the result of thermal injury. The degree of disfigurement depends not only on the extent and the depth of burning but may be aggravated by the method of treatment used. The small scars are sometimes more objectionable than the larger ones—a feature seen particularly on the face and neck after scalding accidents in young children. The scars may vary from a flat, papery-thin, hairless patch often seen over the scalp, to the broad raised hypertrophic scar producing contractures and the ugly itching keloid.

Results of therapy

The treatment of benign lesions such as angiomas or warts by carbon dioxide snow, thorium X or radiotherapy may leave objectionable scars on the surface, often associated with considerable loss of substance of the adjacent supporting tissues. Permanent telangiectasia and occasionally radionecrosis may follow radiotherapy at the site of the applicator or the port of entry of the radiation beam. This may be a small price to pay if the treatment is given for an underlying malignant condition, but if the lesion is benign, such as sycosis barbae or pruritus, then the consequences may be very serious indeed and include the possibility of malignant change in the scar tissue.

Vaccination

Ugly scars are very common at the site of vaccination against smallpox and occasionally complicate inoculation with B.C.G. vaccine. These scars are

INDICATIONS FOR TREATMENT

usually the result of secondary infection associated with a faulty vaccination technique. It is indeed very unfortunate that the outer surface of the upper arm should still widely be regarded as the site of election for these procedures.

Tattooing and tribal marking

Tattooing in the white man is usually carried out as an act of bravado when the victim's judgment is dulled by overindulgence in alcohol or on individuals showing definite psychopathological tendencies. In the white-skinned races keloidal changes after tattooing are fortunately rare. The patient usually seeks to have the offending design or word removed in later life for social and domestic reasons.

In the negro races, tribal scarification is frequently carried out as a ritual in infancy. The design of some of these markings may be extremely beautiful and the technical execution brilliant. Scarification is also used in many tribes by the native doctor as a therapeutic weapon in the treatment of illness. Keloid changes are common and sometimes may be produced deliberately with astonishing regularity in certain tribes (Morel-Fatio, 1956). Ritual scarification is now illegal in many countries and increasing numbers of victims of the former régime are now seeking surgical treatment.

INDICATIONS FOR TREATMENT

Scars which require treatment can be grouped in the following way.

Scars which are cosmetically objectionable

Pigmented scars.—These may range from a fine linear scar to massive anthracotic staining of the face.

Depressed scars.—On the face these scars may be visible only from certain angles; they are sometimes more prominent in daylight than in artificial light. On the limbs depressed scars are usually more obvious since they may produce considerable contour defects.

Raised, hypertrophic and keloidal scars.

Scars producing distortion of normal tissues

Distortion of the alae of the nostril, the angle of the mouth and the eyelids is an extremely common complication of facial burns and injuries. On the trunk the most commonly seen distortion is probably that of the breast following extensive burns of the chest wall and the axilla.

Scars which limit normal function

Limitation of normal function is particularly liable to occur if incisions are made and scars are produced across natural flexion creases and over joints. Contractures due to scars are particularly common in the hand, wrist, elbow and popliteal fossa. To a lesser extent, they are seen in the axilla and in the groin.

GENERAL PRINCIPLES AND SURGICAL TREATMENT OF SCARS

Scars associated with persistent pain

Nerve endings and sometimes a nerve itself may become entangled in a healing wound and trapped in scar tissue. This is more often seen when the scar itself is adherent to bone. Such cases must be assessed very carefully before operation and the indications for surgery clearly established. In the tropical disease known as ainhum there is progressive constriction at the base of the toe, usually the little toe. The cause of the affliction is unknown, but the disease is usually slowly progressive and in the most severe cases the toe undergoes spontaneous amputation. Before this stage is reached, however, the patient often complains bitterly of pain in the toe. This is probably due to ischaemia, for once the constriction ring is broken up by means of a Z-plasty the pain immediately and dramatically disappears.

Unstable scars which are adherent to deeper structures

Scars which are adherent to deeper structures such as muscle, tendon or bone are very prone to recurrent breakdown as a result of repeated movement or minor trauma. Good examples of this type are scars adherent to the tendo Achillis and scars adherent to the anterior surface of the tibia.

Children who have had amputations of the limbs performed in early childhood may develop painful adherent scars over the stump as the underlying long bones continue to grow. They may need repeated revision of the amputation stump and in certain cases further skin replacement as they grow older.

Scars showing evidence of malignant degeneration

In 1848, Jean N. Marjolin, in a study of various types of ulcer, devoted special attention to those resulting from malignant changes in scars. Since then it has been the custom to refer to cancers arising in burn scars as "Marjolin's ulcer" though in fact none of this type was originally described by Marjolin himself. Nevertheless, the greatest proportion of those scars which show malignant change do in fact arise in burn scars. There may be a very long latent period between the accident and the epithelial metaplasia. Careful study of the history will usually reveal that the original burns were slow to heal, were probably never skin grafted and that there has been repeated breakdown in the centre of the block of scar tissue (Mouly, 1960). The growth of these tumours is slow so long as the lesion is confined to the area of scar, but once the growth extends beyond this limit to invade relatively normal skin, growth will be rapid and the regional nodes will show early involvement.

Summary

Most of the indications listed above are clear cut. The physical disability and the disfigurement are equally obvious to surgeon and patient alike. The difficult problems are those in which the physical scarring is minimal and perhaps may not be noticed at all by the observer. Most patients will accept the advice that nothing can be done surgically to improve the condition, but a certain number will persistently exaggerate their imagined disfigurement and plead with the surgeon to operate on them. The wise surgeon will learn to be his own psychiatrist and constantly bear in mind that the more

THE PREVENTION OF BAD SCARS

insignificant the lesion the more considered must be the decision to interfere surgically, however attractive the immediate financial inducements might be.

THE PREVENTION OF BAD SCARS

Many bad scars could be avoided by more careful treatment of the original wound and by better placing of the skin incisions in standard surgical operations.

In the management of trauma, the more efficient and skilled the primary treatment of the wound, the less will be the ultimate disfigurement. This is particularly the case with facial injuries, but the principle is equally valid for certain wounds in other parts of the body.

All dirt should be removed from abrasions and superficial wounds by firm scrubbing with a hard brush, by scratching with a sharp instrument or by abrasion with coarse sandpaper. The fact that this may require a regional block anaesthetic or even a general anesthetic and full theatre facilities is no excuse for not doing it. Comparatively minor abrasions over the forehead and face may leave permanent heavily ingrained scars unless this is done. There is very little truth in the popular belief that grit and gravel will work their way out to the surface with the passage of time.

Once the wounds have been cleaned thoroughly it may be found possible to close the defect by fine interrupted black silk sutures, but if this cannot be done it is better to leave the wound open, apply a firm pressure dressing and review the position some 7–10 days later. By this time oedema will have subsided and there may, in fact, be very little loss of tissue. Some of these wounds can then safely be closed by secondary suture or by skin graft.

In the closure of any wound it should be unnecessary to restate the importance of accurate apposition of the skin edges without tension, obliteration of dead space and the immobilization as far as possible of the affected area until the wound is properly consolidated.

In the performance of standard surgical operations the careful placing of the skin incision will do a great deal to produce a good scar. In certain abdominal operations this may not be possible, but there seems to be little justification for making a vertical incision in the neck for tracheotomy or vertical incisions over the popliteal and antecubital fossae when exploring the underlying structures. The description of some of the classical approaches may arise from uncritical acceptance of the sanctity of "Langer's lines" (*Figure 1*). These lines were produced as a result of an experiment on cadavers and bear no relationship whatever to many of the natural flexion creases of the human body in life. Many books show illustrations purporting to show "Langer's lines" but these bear no resemblance to those originally described by Langer (1861) himself, and slavish adherence to the so-called "Langer's lines" will often land the surgeon in trouble (*Figure 2*). The best line for any surgical incision is in a natural skin crease. This has been fully discussed by several authors, notably by Cox (1941), Rubin (1948) and Kraissl (1951).

Just as the placing of an incision may be important, so may the way in which skin grafts are laid and flaps designed in plastic surgery. For example,

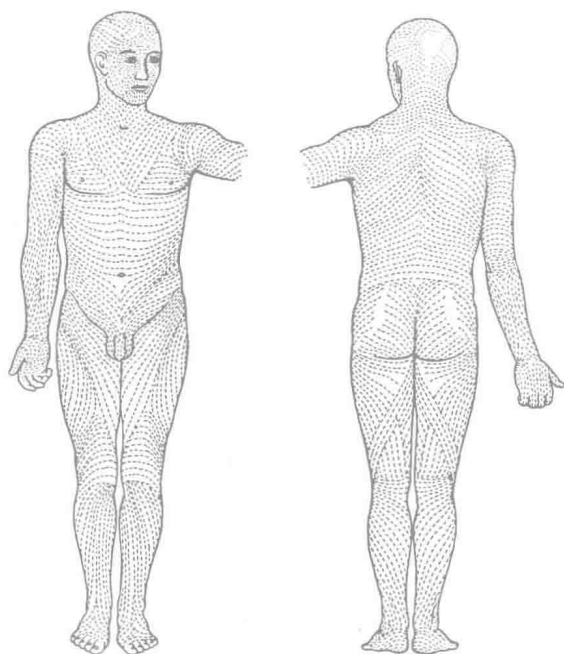


Figure 1. — "Langer's lines" as originally described by the author in his original paper published in 1861. (By courtesy of Williams and Wilkins.)

Figure 2. — "Langer's lines" on the face in closer detail. It will be observed that these lines bear little resemblance to the natural flexion and wrinkle creases. For instance, the natural crease lines on the upper lip are vertical: those just below the vermilion on the lower lip are transverse and the natural creases at the outer canthus should radiate outwards rather like the spokes on a wheel. Scars made in these flexion or wrinkle creases will be almost invisible; scars made along the lines in this diagram will be unsatisfactory. (By courtesy of Williams and Wilkins.)



PRINCIPLES OF THE SURGICAL TREATMENT OF SCARS

in split-skin grafting of burns, it is better to lay the skin in strips or sheets parallel to the natural flexion creases: patch grafting should be relegated to history books and pinch grafts would be better forgotten completely.

In the excision of a wound or lesion the margins should be so placed as to allow no line of possible subsequent contracture to cross a natural flexion crease even though this may involve the sacrifice of some normal healthy skin. Only too often a beautiful skin graft is marred by ugly scarring at the edges, a defect that could have been avoided by more meticulous attention to detail at the time of the original excision.

In taking split-skin grafts care should be taken not to cut more skin than is absolutely necessary and to choose the least visible donor site compatible with the needs of the repair.

PRINCIPLES OF THE SURGICAL TREATMENT OF SCARS

Once it has been decided to treat a patient surgically the lesion must be analysed carefully so that an adequate excision and repair can be planned. Two fundamental questions must be answered. (1) Is there any loss of tissue or are the tissues merely displaced? (2) If there is loss of tissue, which tissues and to what extent?

In considering any repair the surgeon must train himself to visualize the original defect and in certain cases he must deliberately recreate that defect surgically before undertaking the repair. This basic principle was repeatedly stressed by the late Sir Harold Gillies (1920) and its validity has been amply proved over the years. In his book on plastic surgery published just after World War I will be found numerous illustrations of this approach to the surgery of repair and surgical results as good as (if not better than) many of the so-called "miracles" of plastic surgery today.

SCARS WITH LITTLE OR NO LOSS OF TISSUE

A very large number of the scars that require operation fall into this group. Usually simple excision of the scar and careful closure of the wound in layers will suffice. This procedure is perfectly adequate for the narrow depressed scar, the pigmented linear scar, the scar that is slightly raised or in which the skin lies at different levels on each side of the scar. Care must be taken that the final scar after closure of the wound does not lie in an unfavourable position and produce secondary distortion of local structures as healing becomes consolidated. This complication is liable to occur after simple excision of vertical scars on the upper and lower eyelids, scars on the cheek which cross the nasolabial fold to the side of the nose, and oblique scars of the cheek which cross the lower border of the mandible into the neck. In these cases multiple small interdigitated flaps or a simple Z-plasty will break up the line of the scar and prevent subsequent contracture. On the eyelids, a more complicated manoeuvre such as the "halving and stepping" procedure may be required.

SCARS IN WHICH TISSUE HAS BEEN DISPLACED

Wounds which either by accident, design or neglect have not been closed by suture will heal by granulation leaving a broad and usually depressed scar.

GENERAL PRINCIPLES AND SURGICAL TREATMENT OF SCARS

Typical examples of this group are the multiple shredded wounds of the face that occur in patients with a severe head injury and who are not fit at the time for any immediate surgical procedure; wounds following deliberate surgical decompression of limbs whose viability is being threatened by oedema after a crush injury or a constricting burn; wounds following the deliberate exposure and guttering of a bone in the treatment of certain forms of osteomyelitis.

At first sight, the tissue loss appears enormous, but in fact the skin has simply fallen apart at the time of the original incision and has remained in this position as healing of the wound proceeded by epithelial ingrowth from the wound edges. In these cases, provided the skin edges are cleanly incised and very wide undermining is carried out (if necessary even encircling the whole limb), it will be found a relatively simple matter to close the wound without tension.

Wounds of the face which have been badly sutured or perhaps not even sutured at all at the original injury may show scars with startling distortion of nose, eyelids and lips. Here again, if the scar is radically excised and the original defect recreated, it will often be found that there is little or no loss of tissue and that it is quite a simple matter to close the wound in layers without tension and without recourse to other more complicated techniques such as local advancement and rotation flaps.

SCARS ASSOCIATED WITH EXTENSIVE LOSS OF TISSUE

The greater the loss of tissue, the greater will be the subsequent deformity and distortion. Very careful assessment and several staged operations using a variety of different techniques may be required before a cosmetically and functionally acceptable result is achieved. If the loss of skin and subcutaneous tissue is relatively localized it may be possible to correct the contour defect and the surface scar by relatively simple methods.

Mobilization of local fat flaps

After excision of the scar it is sometimes possible to dissect out flaps of subcutaneous fat in the immediate neighbourhood of the excised scar and infold these in such a way as to build out the original depression at the site of the scar. To minimize fat necrosis care should be taken to leave the fat flap with as broad a pedicle as possible. This manoeuvre is particularly useful in dealing with the depressed scars that follow glandular tuberculosis in the neck.

Shaving off the epithelial elements of the scar and burial of the dermal elements

This procedure was suggested as being a simple method of dealing with a depressed scar and building out the contour (Reid, 1952). It was felt that the idea of burying the scar was theoretically sound since scar tissue does not contain hair follicles, sweat glands or sebaceous glands and is essentially inactive tissue. Unfortunately, the method carries a real risk of epidermoid inclusions producing chronic discharging sinuses and has not proved as successful as was originally hoped. Another valid objection is that frequently the buried scar is not sufficient in amount to build out the contour defect.

PRINCIPLES OF THE SURGICAL TREATMENT OF SCARS

Implantation of free fat-dermis grafts

The use of free fat grafts has been superseded by the use of a composite free graft containing fat attached to the deeper layers of the dermis. Free fat grafts are very unsatisfactory since some fat necrosis in the implant is inevitable and its degree is always unpredictable. With the composite type of graft, a thin split-skin graft is cut over the donor site and left attached to the skin at one end. From the denuded area enough dermis and underlying fat is then "quarried" in one piece to make good the contour defect. The sheet of split skin is then replaced, sutured and a suitable pressure dressing applied. For larger quantities of tissue the buttock is an excellent donor site and has the additional advantage that the skin wound can be closed quite easily by primary suture. For smaller quantities of fat and dermis another useful and almost invisible site is the submammary fold.

The dermal "backing" of the free fat-dermis graft has several important advantages. It enables an accurately fitting graft to be cut; it is easy to introduce the graft into the wound and to tack it into proper position with interrupted sutures; the dermal layer gives the graft some rigidity and probably accelerates the process of revascularization of the transplant. This may be the main reason to account for the minimal degree of fat necrosis shown by these composite grafts. A good review of the whole problem of fat grafts and dermis-fat grafts was given by Watson (1960).

Implantation of autogenous material

Cancellous bone chips, costal cartilage either in strips or in diced particles, pieces of fascia or tendon can all be used in certain cases to restore contour. Diced cartilage, however, may show considerable absorption. The most durable of these substances is cancellous bone though its inherent rigidity often precludes its use.

Excision of the scar and application of a free skin graft

If a great deal of skin has been lost and replaced by scar, as is frequently the case after burns and major avulsion injuries, it may be desirable to excise the damaged skin and resurface the area with a free split-skin graft. The thickness of the graft used, its colour and the choice of donor site must be assessed carefully to suit the given problem. It may be disastrous, for instance, to graft hair-bearing skin into a normally non-hairy part of the body. A good example of the problem is the repair of ectropion of the eyelids following burns. Ectropion of the lower eyelid is often corrected quite adequately by excision of the scar and insertion of a post-auricular full-thickness (Wolfe) graft. Ectropion of the upper eyelid, however, is associated with a far greater loss of skin and is best corrected using a free skin graft of split skin taken from the hairless inner aspect of the upper arm and applied in excess using the stent mould "outlay" technique.

Excision of the scar and pedicle flap repair

If the loss of subcutaneous tissue is considerable, repair by a free skin graft may be quite unsuitable and even technically impossible. In these cases pedicle grafts composed of skin and subcutaneous tissue with its vascular

GENERAL PRINCIPLES AND SURGICAL TREATMENT OF SCARS

supply are used to close the defect and restore contour. Such a flap may be fashioned from local tissues and take the form of an advancement, rotation or transposed flap. Alternatively, tissues may have to be imported from a distance and in these cases a tubed flap or marsupial flap may be brought to the defect in stages using an intermediate carrier attachment. In other cases, the flap may be applied directly and examples of this are cross-arm, cross-finger and cross-leg flaps.

In certain parts of the body flaps may be fashioned based on a single well-defined artery such as the superficial temporal artery. These arterial flaps were first described by Esser (1917) and have been modified by subsequent workers. A good example of a flap based on an artery is the Abbe flap used to repair full-thickness defects of the upper or lower lips. Similar flaps may be based not so much on a particular artery but rather on a broad band of subcutaneous tissue which contains sufficient vascular attachments to feed the transplanted segment of skin. These subcutaneous pedicle flaps have been used extensively in the face and provide a good method of supplying lining to the mouth in extensive facial reconstruction after cancer surgery. A good review of the use of arterial and subcutaneous pedicle flaps was given by Kernahan and Littlewood (1961).

SPECIAL TECHNIQUES FOR CERTAIN TYPES OF SCAR

Abrasion or drilling

Abrasion of the skin with sandpaper was originally described by Iverson (1947) as a simple method of removing ingrained pigment from skin and scars. This method which is rather tedious and messy has been replaced by the technique of surgical planing using a cylinder coated with abrasive material, attached by a suitable handpiece and flexible cable drive to an electric motor. Abrasive wheels, brushes and drills of various complexity have been designed and patented, but the standard dental engine along with a selection of dental burrs, drills and cutting wheels will be found perfectly adequate. It will be found helpful to infiltrate the subcutaneous tissues with local anaesthetic or saline solution in order to make them relatively hard and to help reduce blood loss. Alternatively, the skin can be frozen with an ethyl chloride spray or one of the newer aerosols. If very extensive abrasion is contemplated, hypotensive anaesthetic techniques are essential if accurate abrasion in a bloodless field is desired. This is an important point, for abrasion carried too deeply may leave scars more objectionable than the original lesion.

It is not always possible to remove all the pigmentation at one operation and the procedure may have to be repeated on several occasions. Abrasion is useful for multiple shredded pigmented wounds, diffuse skin staining following pit explosions and gun-shot wounds. The late scarring of acne and small-pox can often be improved dramatically by levelling off the peripheral contour of the craters and so producing a more even facial contour.

An important criticism of the technique of abrasion is that it may leave behind an extremely hyperaemic area for many months which may cause the patient considerable pain and embarrassment. In dark skin races, a residual pale skin patch may be extremely disfiguring. Keloid changes have not so far been reported as a complication, but patches of abraded skin may