BRITISH JOURNAL OF HOSPITAL MEDICINE

CORE TRAINING FOR DOCTORS

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Please close this skin wound

Introduction

Acute cutaneous wounds following trauma are commonly encountered in the emergency department. This article explains the principles of their closure and provides advice on optimal management. Wound healing occurs in four phases: haemostatic, inflammatory, proliferative and maturation (Janis et al, 2010). The guidance below is based on the authors' personal practice, designed to promote transition through these stages and result in optimized healing with minimal scarring. It is intended to guide the reader through what can be a daunting prospect for many doctors in training: the acute closure of simple wounds.

Types of wounds

It is important to understand the nature of the wound and mechanism of injury, as these generate differing extents of tissue damage and contamination (*Table 1*). Clean wounds, and those from low energy trauma with minimal tissue loss, heal quickly with minimal scarring and low risk of secondary infection. In wounds that are dirty, have ragged edges, result from higher energy trauma, or are more than 12 hours old, healing occurs more slowly and is associated with significant scarring (Singer et al, 2002). These need to be treated with greater attention.

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Initial assessment

What needs to be done first?

Following initial resuscitation, patients should be examined to exclude damage to muscles, tendons, vasculature, nerves and skeletal structures (Singer et al, 1997). Informed consent for examination and any procedure should be obtained, and full aseptic technique should be practiced. Both patient and doctor should be positioned comfortably, with a light source that allows good visualization of the wound.

In order to allow accurate assessment, it may be helpful to create a dry surgical field. This could involve application of tourniquets on limbs, or use of surgical drain or glove material applied at the base of a digit to create a finger tourniquet, using a mosquito or surgical clip to hold it. Any digital tourniquet must be applied in such a way that it is not possible to dress the wound with the tourniquet still applied; the (historical) common practice of rolling the finger from a surgical glove down the digit to create a tourniquet is not advised. Failure to remove such a tourniquet may cause digital ischaemia and loss of the digit, deemed indefensible in the UK.

Table 1. Mechanisms of injury and relevance to wound healing

Type of injury		Tissue damage	Considerations for healing
Sharp	Incision (e.g. knife wound)	Minimal	May heal well by primary intention unless delayed or contaminated
Blunt	Abrasion	Partial or full dermal loss	Need to remove debris. Heals with washing and appropriate dressing if at least deep dermis present
	Laceration	Ragged edges	Needs debridement to create even wound edge
	Crush	Extensive tissue damage	Should be regularly reassessed for viability before and after closure
	Degloving	Flap of skin lost or undermined with bruising or oedema	Necrosis of raised skin can occur. May require specialist review
	High energy (e.g. gun shot)	Extensive tissue damage and/or cavitation	Usually mandates specialist review

Infiltration of wound edges with local anaesthetic containing adrenaline to cause vasoconstriction can be highly effective, but caution is required to avoid ischaemia in territories supplied by end-arteries. Check whether the wound is clean, contaminated or even infected. The presence of foreign bodies should be excluded with plain radiographs: glass and metal are usually radio-opaque (Levine et al, 2008), but if any doubt exists ultrasound assessment may be indicated.

The wound must be thoroughly washed (if necessary under local anaesthetic), blood and debris removed, and its site and size assessed. High quality photographs should be taken where possible: these provide a record of the initial injury and can be used for subsequent specialist referral and for medicolegal purposes.

Potential tissue loss must be documented, bearing in mind that tissue elasticity will always cause an apparent deficit which must be distinguished from the real deficit. This may be approached by attempting to return the remaining tissue to its original anatomical position, as this will help reveal any true skin deficit. Also consider wound depth: abrasions with purely epithelial or superficial dermal loss rarely require operative management as they usually heal without a scar; scarring is a result of dermal healing (not epidermal) and therefore superficial wounds heal with less scarring (Yamaguchi and Yoshikawa, 2001). Exceptions include heavily contaminated wounds, animal and human bites, and those with pigmented substances embedded in the dermis in which there is a risk of tattooing (the commonest example being road debris); these often benefit from surgical debridement.

Can I close this wound myself?

The answer is probably yes, if:

- The wound is not infected or highly contaminated
- Other structures are intact and further exploration by specialist surgeons is not required
- There is minimal tissue loss and therefore adequate tissue to allow approximation of wound edges
- There is no significant skin tension. For example, pre-tibial lacerations are sometimes more difficult to close for this reason (note that pre-tibial haematomas are a very different type of injury)
- The wound location is within the logistical and technical competence of the department and individual physician. Wounds over particular areas of the body, such as the eyelid, are usually best managed by a surgeon from the dedicated specialty.

As with everything, if you are not certain, ask advice from your seniors or the relevant specialist team.

How should the wound be closed?

Numerous factors influence successful healing with minimal scarring (Singer et al, 2002). The most important are accurate approximation of clean, viable wound edges, prevention of infection, and avoidance of haematoma.

Approximation of clean wound edges

While assessment of the skin viability can be challenging, indicators include local capillary refill and fresh bleeding from wound edges. Wounds with severely crushed, ragged, necrotic or damaged edges require debridement as these tissues will not survive and will result in wound dehiscence or secondary infection (Haury et al, 1978; Edlich et al, 1988). When the injury is at a site where debridement and closure could lead to potential disfigurement (e.g. on the face), removal of tissue should be conservative. If there is any doubt regarding contamination or tissue viability in such areas, patients benefit from early specialist referral, as dictated by the location of the wound and associated injury (Singer et al, 2002).

Excision of the wound edge should be performed using a sharp blade to create vertical edges: this allows better approximation. Scissors are not suitable as they may shear tissue. Skin edges should be minimally handled, using toothed forceps or skin hooks. These cause less crushing of the skin edge than non-toothed forceps and consequently less risk of necrosis, wound infection and dehiscence.

It is important to have clean dermal edges that oppose well. This provides optimum conditions for a successful proliferative phase of the wound healing process as it facilitates vascularization and consequent delivery of oxygen, nutrients and growth factors to permit deposition of new collagen and ground substances (Martin, 1997).

Prevention of infection

To minimize wound infection and unsightly skin tattooing, all foreign material must be removed by thorough washout with copious volumes of sterile liquid, and if necessary by brushing with the back of a scrub sponge or sharp instrument (Hollander et al, 2001). Savlon (especially for blood), aqueous iodine, chlorhexidine and saline are all suitable cleaning fluids (Dire and Welsh, 1990; Howell and Chisholm, 1992; Janis et al, 2010).

Early irrigation and wound closure are key to avoiding infection, which otherwise causes delayed healing and worse scarring as a result of prolongation of the initial inflammatory phase and resulting tissue destruction by protease secretion (Orgill and Demling, 1988; Kawaguchi et al, 1995).

Tetanus vaccination status should be determined and human tetanus immunoglobulin and/or a booster dose administered if indicated (Department of Health, 2006; Miyagi and Shah, 2011).

Prevention of haematoma

Large haematoma may cause wound dehiscence or become infected. Their formation can be avoided by achieving good haemostasis, either by application of pressure, suturing, ligating bleeding vessels, or using diathermy if available. In the emergency setting, application of pressure is usually the method of choice. When considering vessel ligation, great caution should be exercised to avoid inadvertent inclusion of important neurovascular structures. Using pressure dressings post-procedure may also reduce risk.

Preparing the wound for closure

When closing wounds, identify landmarks on either side of the edges that align well anatomically, and mark them with a sterile marker pen or ink. Key sutures must be placed on these points before the rest of the wound is sutured. One area of the body worth highlighting is the mucocutaneous junction, or vermilion border, of the lip.

Here, it is particularly advisable to mark the site before injection of adrenaline-containing anaesthetic, as resulting pallor may render this junction difficult to assess. For accurate opposition, the suture should be placed adjacent to and not directly over the junction to give a better cosmetic result.

Following acute trauma, the dermis normally contracts and becomes oedematous. This often makes it difficult to close wound edges. If there is tension across the wound, edges can be undermined to create some advancement and laxity. In the scalp, this plane is between the galea aponeurotica and the pericranium. However, if there is substantial skin loss and the defect cannot be closed directly or without significant tension, a specialist opinion should be sought.

Thin skin on elderly patients may contract rapidly and roll off the wound surface following an acute laceration. Once underlying injury has been excluded and the wound cleaned, viable skin can often be rolled back carefully into its original place and closed with Steri-strips.

Method of closure

Wounds can be closed using Steri-strips, tissue glue or sutures. It is advisable to select non-absorbable sutures if there is a risk of wound contamination. Also, the finer the sutures used, the less the scarring (Singer et al, 1997).

When suturing the wound, edges must be everted and the suture placed into the skin at right angles to the surface. It should be placed through the full thickness of the skin to prevent formation of dead space in the dermis under the wound where serous fluid or blood can collect (*Figure 1*). Gaps in the dermis are healed by scar tissue, so the broader the gap the greater the scarring (Yamaguchi and Yoshikawa, 2001). Also, if only the superficial layers are closed leaving a larger underlying defect in the deep dermis, although it may not be visible immediately there will be deeper, wide scar tissue that will become visible later in the wound healing process and can lead to a weakened stretched scar. This is a particularly relevant when using glue or Steri-strips as these only hold the epidermis together. As a result, if there is significant tension, while the epidermis may remain intact the deeper dermis may open up and result in increased scarring.

To facilitate wound closure, skin can be closed in two layers, with deep dermal interrupted sutures placed before the 'skin' suture (be it interrupted, continuous or subcuticular). Undyed absorbable sutures such as Vicryl, PDS or Monocryl should be used, and their knots cut short and buried (Singer et al, 1997).

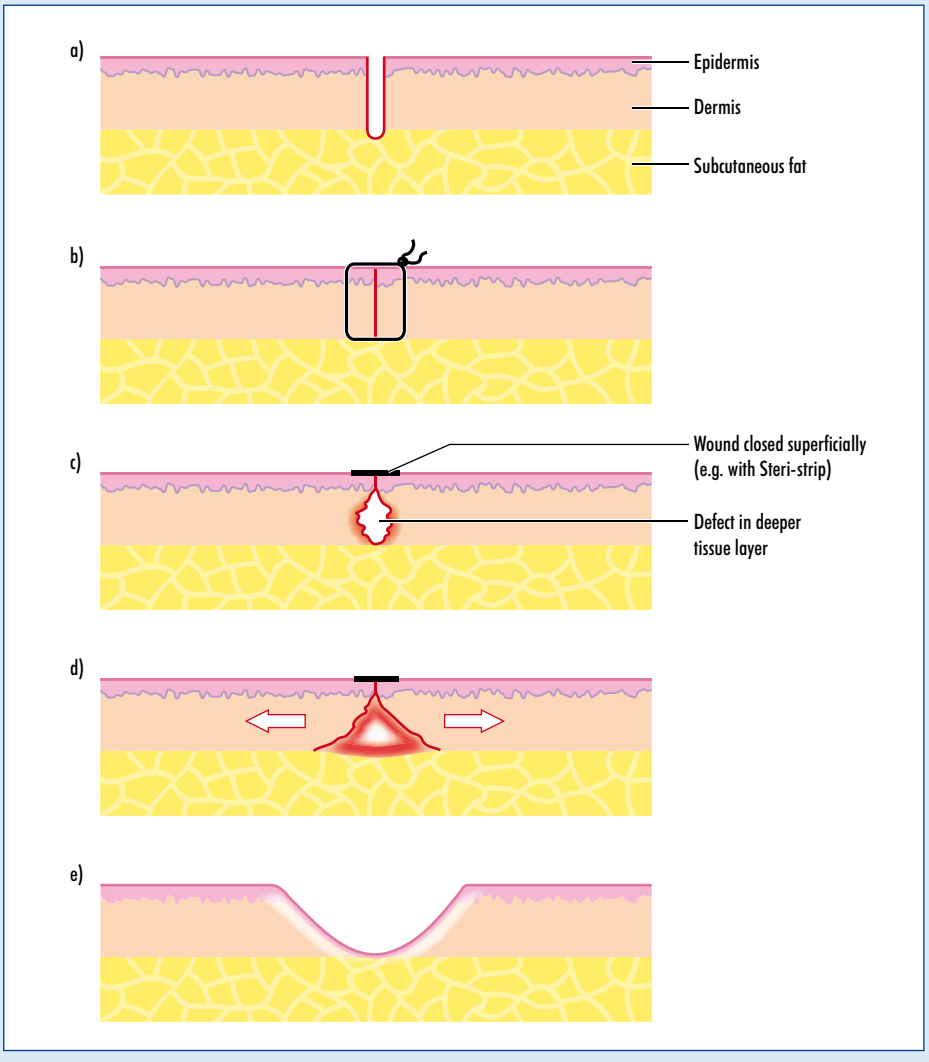
Different suturing methods should be selected according to the clinical situation. In acute wounds in the emergency setting, interrupted or mattress sutures are usually most suitable, as these minimize risk of subsequent infection. Mattress sutures are useful for areas where attaining eversion is difficult. Bow sutures are used in paediatric patients, where a fast, less stressful removal of suture following healing is preferable.

Postoperative care

How should the closed wounds be protected?

Closed wounds should be dressed. Application of Steri-strips further reduces tension and contributes to minimizing scarring. Dressings commonly used include adhesive dressings such as Cosmopore, Steri-strips, Micropore and Mepore, and for more complex areas such as across or close to the joints, non-adhesive Jelonet or Mepitel followed by gauze

Figure 1. a. Laceration extending through the full depth of epidermis and dermis down to subcutaneous fat. b. The suture must be inserted at right angle to the surface of the epithelium and through the full thickness of the dermis. This allows eversion of the wound edges and prevents the formation of gaps between the edges of dermis. c. If only the epidermis and superficial dermis are closed (for example with sutures placed too superficially or inappropriate use of Steri-strips or glue on deep wounds), there will be an underlying defect in the deep dermis. d. Over time the edges of such wounds will be stretched during the healing process. e. This can result in a stretched hypotrophic scar.



TOP TIPS

- Don't be afraid. There is no 'magic' to closing a simple wound. Better results are simply the result of greater understanding of the principles of closure, careful tissue handling, accurate wound closure and experience (which will develop).
- Enjoy it and take your time. While the time pressure of modern accident and emergency departments makes this difficult, it is important for the patient that you do not rush unduly. As you get more experienced, speed will come naturally.
- Glue is not used as if you were making self-assembly furniture. Be careful not to get it in the wound: while it may hold it together initially, it prevents healing across it, and as soon as the glue breaks down the wound will reopen. Although the epidermis is relatively resistant to the components of glue, it is actually toxic to the deeper tissues (Eaglstein and Sullivan, 2005).
- Hair-bearing areas are always challenging to close, because of hair getting in the way. Solutions depend on the length of the hair: short hair is usually not a problem, medium length hair is best shaved to prevent long-term scarring, alopecia or secondary infection. Long hair can be shaved or may be kept aside using tape, tying the hair out the way, or using aqueous gel to 'style' the hair out of the operating field.

and crepe bandage (Singer and Degum, 2008). For wounds where the application of dressings may be difficult (for example, the scalp), chloramphenicol ointment can be applied to keep the wound clean. If the wound lies over a mobile area such as the flexor aspects, splints or plasters can be applied to minimize movement and prevent dehiscence and wound tension. Patients must be advised to keep the wound dry for at least 48 hours, as this is the time it takes for the epithelial cells to migrate across the wound edges to form a waterproof layer.

Can we promote successful wound healing?

Other factors influencing wound healing should be optimized where possible. These may include nutritional status, diabetic control and prevention of infection. Where a wound has been contaminated, or has been open for several hours, it is advisable to prescribe a prophylactic broad-spectrum antibiotic such as co-amoxiclav (or a macrolide for penicillin-allergic patients) for 5 days. The decision should be taken in conjunction with local departmental policy. In order to prevent dehiscence and infection, advice must be given to avoid strenuous activities and sports such as swimming until the wound heals fully. Limbs should be elevated for 1 week in difficult cases. Smokers may also be advised to stop, as the associated tissue hypoxia impairs healing (Mills et al, 2011).

When should patients be reviewed?

Most treated wounds should be followed up in a review clinic or in primary care. Non-absorbable sutures must be removed early and dressings must be changed. Sutures on the face require removal in 5–7 days, limbs 14–21 days and other areas including trunk 7–10 days (Singer et al, 1997). These durations allow enough support at the wound edges to promote wound healing but are also short enough to minimize scarring.

Conclusions

Achieving an optimal mechanical and cosmetic result from acute wounds requires an understanding of the principles of tissue healing. The steps outlined above promote better outcomes, and minimize the risk of complications. BJHM

Conflict of interest: none.

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KEY POINTS

- Wounds should be thoroughly cleaned and assessed before embarking upon repair.
- In specialist areas such as the face you should have a low threshold for referring to a specialist – if the patient was your relative, how would you treat him/her?
- Beware finger tourniquets.
- Careful, patient suturing will give the best result.
- Arrange follow up and/or review to ensure that all has gone well and so that you can learn from your experience.