Management of burns in the community

Burn injuries pose a significant burden to the NHS with 250,000 patients presenting annually to primary care teams and a further 175,000 presenting to A&E (National Burn Care Review, 2001). The large majority of these patients are managed in the community by healthcare professionals who may have limited experience or lack formal training in burn management. The purpose of this article is to highlight key principles in managing burns in the community from the provision of first aid to rehabilitation, as well as guidelines for referral to a specialist burns unit.

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Wounds

Burn injuries range from the most severe, requiring high levels of intensive care and multiple surgeries, to the most trivial, for which self-treatment may suffice. Almost all of us will experience a burn injury in our lifetime, even if only in a minor form such as from fleeting contact with a hot surface or a minor scald from a hot drink. Burn injuries pose a considerable burden to the NHS with 250,000 patients presenting to primary care teams, and a further 175,000 patients presenting to A&E annually in the UK. Fortunately, only 10% of those presenting to A&E need admission (National Burn Care Review, 2001). A significant number of minor burns are managed in the community by a diverse group of healthcare professionals with varying degrees of experience or formal training in burns management. This disparate group includes not only GPs but more frequently practice and district nurses. The purpose of this article is to outline some of the key principles in burns management in the community including initial assessment and first aid, classification of mechanisms of burn injury, assessment of burn depth, estimation of total body surface area (TBSA) burnt, and the types of dressings that may be used. It also aims to highlight the criteria for referral to specialist burns units as set out by the National Burn Care Review, thus providing a plan for the management of burns in the community.

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Initial assessment

The immediate steps taken during an initial encounter with a burn victim can be life-saving. After initial first aid, the assessment of all burn patients should be followed by a primary survey according to advanced trauma life support guidelines (British Burn Association, 2008). This includes:

- **A** Airway maintenance with cervical spine control
- **B** Breathing and ventilation
- **C** Circulation and haemorrhage control
- **D** Disability — neurological status
- **E** Exposure and environmental control
- **F** Fluid resuscitation proportional to burn size which is recommended for burns >10% in children and >15% total body surface area (TBSA) in adults (although burns of this nature are not suitable for management in the community).

The importance of this common approach lies in the detection of associated non-burn injuries that may pose a more immediate threat to life and require urgent medical attention. The aim of first aid should be to stop the burning process, cool the burn, provide pain relief and cover the burn (Hudspith and Rayatt, 2004). Key steps include:

- Removing the victim from the source of the burn without endangering the rescuers. This may involve turning off electricity in the case of electrical burns
- Assisting the victim to 'drop and roll' if their clothing is alight
- Removing all clothing as soon as possible — unless adherent to underlying skin (which may be the case with nylon clothes)
- Cool the burn with cool/tepid running water for at least 20 minutes (Yuan et al, 2007). It has been observed in animal studies that the heat transferred during a thermal injury will continue to dissipate and deepen the burn wound unless cooled. Ideally this water should be at about 15°C. Very cold or icy water can cause vasoconstriction and worsen tissue ischaemia and thus paradoxically deepen the burn wound (Sawadal et al, 1997). In the case of chemical burns, copious

amounts of water should be used to wash away the agent
- Cover the burn preferably with polyvinyl chloride film (cling-film) or a sterile cotton sheet. Covering the burn in this way provides pain relief by covering the exposed nerve endings and prevents external noxious agents contaminating the wound. Cling-film has the added advantage of being non-adherent and transparent, thus enabling subsequent assessment of the burn. Do not use constrictive circumferential dressings that may compromise circulation
- Do not use topical creams or agents such as silver sulfadiazine as these may affect subsequent assessment of burn depth in the specialist unit.

Figure 1. A full-thickness contact burn from a radiator. This type of burn may require excision and skin grafting if it fails to heal with conservative treatment.

Figure 2. Bitumen burn in the cheek from a road surfacing accident. Bitumen is a mixture of organic liquids that are highly viscous, sticky and entirely soluble in carbon disulphide. This type of burn may occur in individuals working in road surfacing, roofing and waterproofing industry. Immediate removal of the bitumen is essential.

Table 1

Aetiological factors for burn injuries and their specific features

Burn type	Key points and features
	Thermal injury
Flame burn	• Common from various causes including house fire • Accelerants such as lighter fluid and petrol are contributing factors often found among teenagers • Can be of any depth and is usually a mix of different depths
Scald	• About 60% of 'burns' in children are scalds • Important aetiological factors include hot water from bath, kettle or hot drink
Contact burn	• Often present in children as small percentage burns over the hands, face or extremities • Sources include radiator (*Figure 1*), glass front of gas fires and irons • Can cause full-thickness burns in those unable to extricate themselves, such as the elderly, post-convulsion or individuals incapacitated by drugs and alcohol
Flash burn	• Usually caused from ignition of a volatile substance or from an unexpected ball of fire (such as when pouring petrol over a barbeque fire) • Commonly results in superficial flame burn usually to the face, neck and upper limbs
	Electrical injury
Low voltage	• From domestic electrical supplies <240volts • Inspect for entry and exit wounds • Usually small area burns in the extremities • ECG to rule out arrhythmias and hospital admission may be required so that the patient can be monitored for the first 24 hours
High voltage	• From power cables (>1,000 volts), industrial accidents or lightening strikes • Can lead to significant systemic injuries • Will need hospital admission to rule out cardiac, renal and skeletal muscle damage
	Chemical injury
Acids	• Usually painful • Hydrofluoric, sulphuric and hydrochloric acid are the common agents • Testing for pH is useful • Copious lavage with or without a specific antidote is essential
Alkali	• Onset of pain may be delayed • Examples include household cleaning agents, bleaches and cement • Testing for pH is useful • Mostly lead to deeper burns • Copious lavage (for up to 24 hours) with or without a specific antidote is essential
Organic compounds	• Bitumen (or tarmac) burns (*Figure 2*) • Treatment involves early cooling with water and removal of bitumen (agents such as citrus and petroleum distillate, sunflower oil or butter may be used) • Chemical debridement using kerosene, gasoline, acetone or alcohol may cause local irritation or toxicity and should be avoided

Taking a history

The importance of taking a thorough history from the burn victim cannot be overemphasised. Elucidation of the exact mechanism of injury, the duration of exposure to the injurious agent, details of any first aid delivered and an understanding of any other salient points of the burn history will facilitate referral to specialist secondary or tertiary services, enable risk assessment and thereby help to assess whether the patient can be managed in the community. Young children and the elderly are at a higher risk of sustaining burn injuries since factors such as physical impairment, poor mobility and inability to extricate themselves from danger act as contributing factors. When assessing burns in children and the elderly, it is imperative to consider the possibility of non-accidental injury even if the extent of burns may appear trivial. Delays in presentation, inconsistent history, incongruity between history and clinical findings, an unusual pattern of injury, and a history of previous similar incidents are all possible indicators (Andronicus et al, 1998) and should alert the examining healthcare professional to initiate appropriate action according to local policy.

Mechanism of burn injuries

Identifying the exact mechanism of burn injury in the history is useful as particular patterns of injury and burn depths can be predicted from this aspect of the history alone. *Table 1* summarises some common and important aetiological factors for burn injuries. Thermal injury is the most common form.

Assessment of burn depth

Assessment of burn depth is important not just because it affects the choice of dressing, but also because burn depth can determine whether a wound will heal without surgical intervention. It is also a determinant of the severity of residual scarring. Burns are broadly classified as epidermal (superficial), dermal or full-thickness, corresponding to the level of involvement of the skin and underlying tissues. This classification takes into account the amount of skin and skin appendages affected, and thereby the ability of the wound to heal and the resulting scarring (superficial burns that heal with conservative treatment will cause considerably less scarring than a full-thickness burn that requires surgical excision with or without a skin graft). Dermal burns can be further classified as superficial dermal (also called superficial partial thickness) and deep dermal (also called deep partial thickness). The various burn depths are illustrated in *Figure 3*. *Table 2* highlights some of the essential clinical characteristics of burns of different depths (Enoch et al, 2009) and some clinical examples of burns of different aetiologies and depths are represented in *Figures 4, 5* and *6*.

It can indeed be challenging during the first consultation to accurately assess burn depth on inspection and by clinical examination. In fact, a comparison of experienced surgeons showed concurrence rates as low as 60% (La Hei et al, 2006). Therefore, modalities such as laser Doppler imaging, transcutaneous videomicroscopy and infrared thermography have been developed, although none are in routine clinical use. Furthermore, burn depth in a given area may often be mixed and the depth of a burn wound can progress over 24–48 hours. Progression may be hastened if the initial management was inadequate (British Burn Association, 2008), or in the presence of infection. Reassessment of the wound should be undertaken at 24–48 hours if the initial assessment was considered to be unsatisfactory or the depth deemed uncertain. In the

Table 2
Features of different burn depths

Burn type	Appearance	Blisters	Capillary refill	Sensation	Treatment
Epidermal (epithelial)	Red and glistening	None	Brisk	Painful	Heals with conservative treatment
Superficial dermal (superficial partial thickness)	Pale pink	Yes	Brisk	Usually painful	Usually heals with conservative treatment
Deep dermal (deep partial thickness)	Dry, blotchy and cherry red	May be present	Absent	Dull absent	Although can heal spontaneously may require surgical intervention in certain instances
Full thickness	Dry, white or black. Eschar may be present	None	Absent	Absent	Seldom heals with conservative treatment. Usually requires surgical intervention

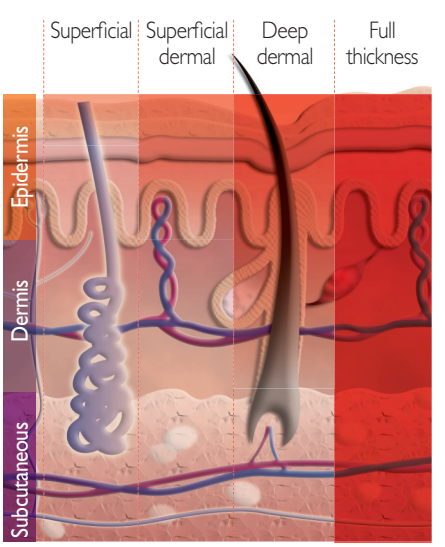


Figure 3. Illustration of depth of burns in relation to layers of the skin.

Figure 4. Hot water scald to the back of a child demonstrating some erythema, superficial areas (epidermal) and superficial/deep dermal areas (with blisters). These blisters need to be 'de-roofed' to accurately assess the burn depth before it can be decided if the areas can be treated conservatively.

Figure 5. A scald to the knee mostly involving the superficial dermis, thus demonstrating a pale pink surface. This type of scald will usually heal with appropriate conservative treatment.

Figure 6. A flame burn over the anterior aspect of the knee demonstrating different depths. The middle of the burn is full thickness (dry, pale white and no blisters), the superomedial aspect is mid/deep dermal (dry and blotchy), and the periphery may be superficial or deep dermal (note the blisters). The depth of the burn at the periphery can be assessed accurately only after the blisters have been de-roofed.

case of mixed depth wounds, the choice of dressing should be guided by the predominant burn depth in a given area.

Estimation of a burn surface area

Areas with only erythema should not be included in the calculation of TBSA

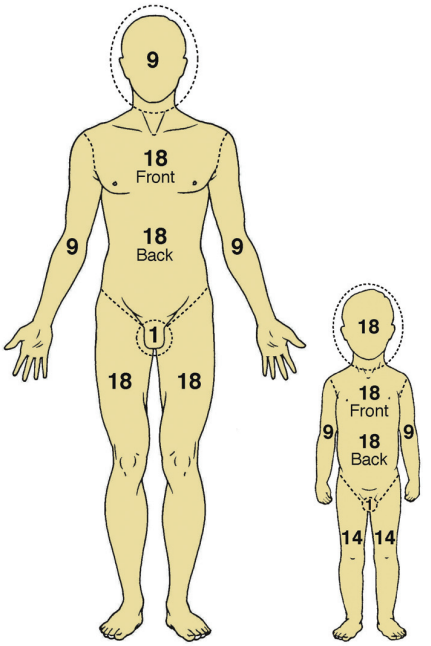


Figure 7. Wallace's 'Rule of Nines'. In adults, this is a useful tool — 18% each for chest, back and legs apiece, 9% each for head and arms apiece and 1% for the perineum. It is quick to apply and easily remembered, although there may be a tendency to overestimate the area by about 3%.

burnt. This is a common error when estimating TBSA burns in referrals made to the specialist burns units. Including erythema results in overestimation of the area burnt leading to patients being inappropriately referred for unnecessary investigations, given excessive fluid resuscitation (with its own associated risks) and being unnecessarily referred to burns units. Only the de-epithelialised areas should be included in the TBSA burn calculations. There are three commonly used methods to estimate the TBSA burnt:

- Wallace's 'Rule of Nines' (*Figure 7*) (Wallace, 1951) is easy to remember and can be used to make a quick estimate but tends to overestimate the area of the burn by about 3% (Watchel et al, 2000). It is more useful for adults.
- The Lund Browder Chart (*Figure 8*) (Lund and Browder, 1944) is more accurate than 'Rule of Nines' since it takes the patient's age and body proportions into consideration. It is thus useful across all age groups (Watchel et al, 2000), particularly children. However, the specific chart is required to make the calculations.
- Palm as one percent: the patient's palm and fingers make up about 1% of TBSA which is a useful tool in obtaining a quick estimate. Although this is a relatively crude method, it is useful in estimating small or large burns (<15% or >85% TBSA). In large burns, the burnt area can be quickly calculated by estimating the area of uninjured skin and subtracting it from 100.

Who should be referred to a specialist unit?

Having made the initial assessments, administered first aid, taken a good history and assessed severity of the burn in terms of depth and TBSA burnt, a decision should be made as to whether referral or transfer to a specialist burns unit is needed. The National Burn Care Review (2001) has issued referral guidelines to help in this decision-making process (*Table 3*). Put simply, burns can be classified into complex and non-complex. Burns <5% TBSA that are superficial or superficial dermal in depth are non-complex and can be managed in the community (provided there are no associated injuries or comorbidities). The other situation in which a burn patient might be managed in the community is when they are recovering from a complex burn and are discharged from hospital. The management of such patients will not be discussed in this article.

Although the guidelines highlight the types of burn injury that can lead to a complex clinical course, they are not intended to be rigidly prescriptive. If in doubt it is always best to seek guidance from the specialist burns unit. In addition to the types of burns listed in *Table 3,* the following patients should also be considered for referral to a burns unit or burns clinic:

- Any burn wound that remains unhealed 14 days post-injury
- Infected burn wound with surrounding cellulitis or systemic spread
- Patients (usually children) manifesting evidence of toxic shock syndrome (pyrexia, rashes, vomiting and/or diarrhoea), or toxic shock-like illness (pyrexia, rash or general malaise)
- Patients who develop problematic scarring that causes pain, discomfort,

Table 3

National Burn Injury guidelines for referral to a burns unit

All complex injuries should be referred. A complex burn injury comprises and is likely to be associated with:

- Extremes of age (<5 or >60 years)
- Site of injury — face, hands, or perineum. Any flexural surface such as neck, axilla, front of elbow or back of the knee. Circumferential dermal burns, or full-thickness burn of the limb, torso or neck
- Inhalation injury*
- Mechanism of injury

Chemical burns >5% TBSA

Hydrofluoric acid burns >1% TBSA

Exposure to ionising radiation

High pressure steam injury

High tension electrical injury

Suspected non-accidental injury**

- Large size

Paediatric (<16 years old) >5% TBSA

Adult (≥16 years) >10% TBSA

- Co-existing conditions
- Serious medical conditions (e.g. immunosuppression)
- Pregnancy
- Associated injuries (fractures, head injury or crush injuries)

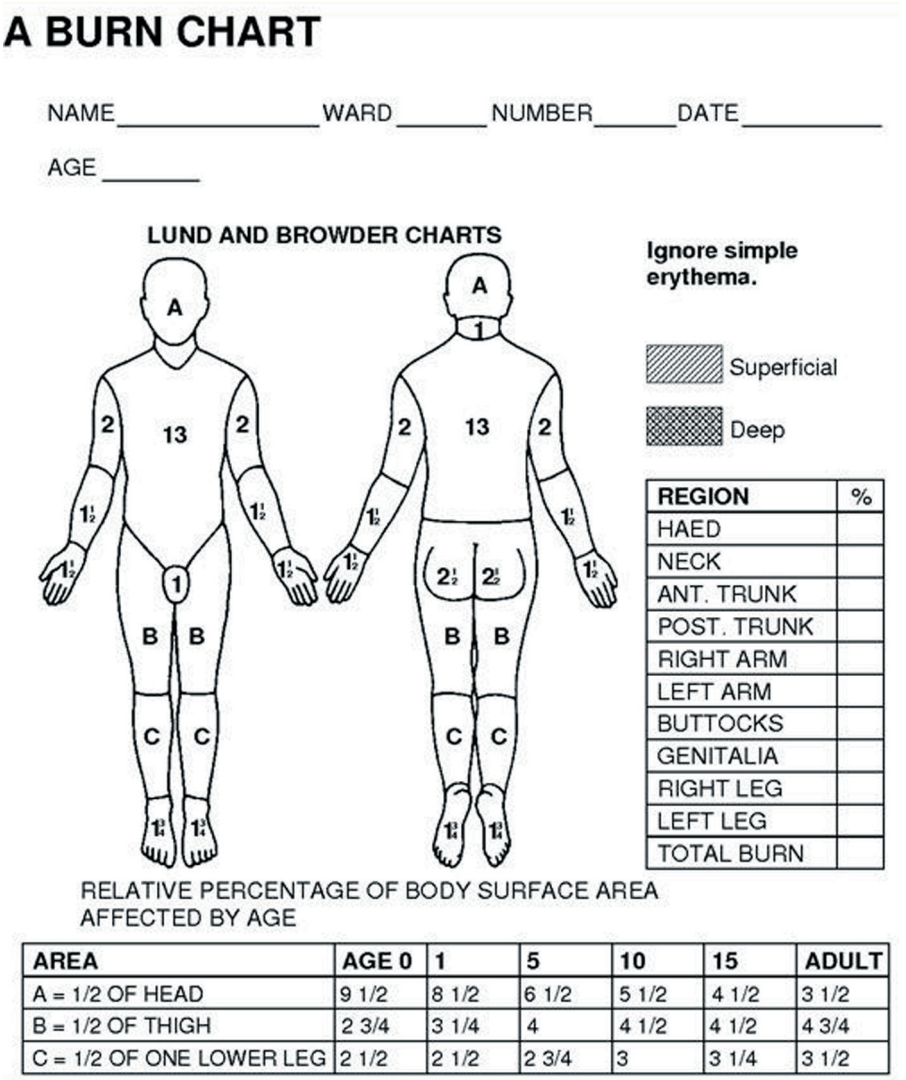
* Suspect inhalation injury if:

- Burns occurred in enclosed space (e.g. a house fire)
- Smoke during incident
- Blast, explosion and detonation
- Patient is unconscious
- Facial burns or singed hairs
- Soot in airway
- Hoarseness of voice or stridor
- Tachypnoea
- Decreased Glasgow Coma Scale rating

** Suspect non-accidental injury in a vulnerable individual such as a child or older person if the presentation is delayed, the pattern of injury is unusual, the history is inconsistent, there is discrepancy between history and clinical findings, there are multiple injuries, and/or old scars are noted in unusual anatomical locations

functional impairment or cosmetic dissatisfaction.

All facial and neck burns should be referred to a specialist unit and reviewed by an anaesthetist as early as possible, since the rapid development of post-burn oedema can lead to serious life-threatening airway obstruction. It is also essential to recognise the signs of inhalation injury as these patients may require management in an intensive care setting even in the absence of significant cutaneous burns. Inhalation injury must be suspected whenever burn injuries take place in an enclosed space or explosions, or if the patient manifests any of the features listed in *Table 3*.



AREA	AGE 0	1	5	10	15	ADULT
A = 1/2 OF HEAD	9 1/2	8 1/2	6 1/2	5 1/2	4 1/2	3 1/2
B = 1/2 OF THIGH	2 3/4	3 1/4	4	4 1/2	4 1/2	4 3/4
C = 1/2 OF ONE LOWER LEG	2 1/2	2 1/2	2 3/4	3	3 1/4	3 1/2

Figure 8: Lund and Browder Chart. This method takes into account the vicissitudes of body surface area with age (and growth) and thus has the advantage of being useful for all ages and being particularly useful for children. The chart also divides the limb areas into smaller components and is thus more accurate than the Wallace 'Rule of Nines'.

Management of minor burns

Cleaning the burn and debridement of burn debris with soap and water

A new burn is essentially sterile and management is directed at keeping it that way. The European Working Party of Burns Specialists has issued guidelines stating that the burn should be washed thoroughly with soap and water or mild antibacterial wash such as diluted chlorhexidine before applying dressings (Alsbjörn et al, 2007). Although there is some controversy regarding the management of blisters (Uchinuma et al, 1998), it is widely accepted that all blisters apart from those <1 cm should be de-roofed (Hudspith et al, 2004). In addition to enabling more accurate assessment of burn depth, de-roofing the blister removes dead tissue that can subsequently act as a medium for bacteria. There is no role for the routine use of antibiotics.

Dressings

There is a huge assortment of dressings

Figure 9. Biobrane®, a biological dressing, has been applied over areas of superficial dermal burn and the edges of the dressing stapled. Note the translucency of Biobrane.

available for the management of burn wounds and as result the task of choosing an appropriate dressing for a particular clinical problem can, at first sight, appear daunting. There is, however, little evidence to suggest that one dressing is superior to another. Therefore, an understanding of the few key aspects (*Table 4*) is more important than in-depth knowledge about individual dressings. Although traditionally wet to dry gauze was used to dress wounds, in the past two decades it has been widely accepted that it is the maintenance of a moist environment that is key for optimal wound healing. For this reason, plain gauze is not widely used (Hudspith et al, 2004). Simple non-adhesive dressing such as a soft silicone (such as Mepitel® [Mölnlycke, Goteburg]) padded by gauze is effective in most superficial and superficial dermal burns. Other non-adhesive dressings such as Jelonet® (Smith & Nephew, Hull), which consists of dressing gauze impregnated with paraffin, can also be considered.

Secondary dressings can be placed over this first layer and might include a gauze pad, wool and crepe. In the limbs, applying the wool and crepe in a 'figure-of-eight' fashion and securing with tape will prevent any unwarranted movement of the dressings and resultant shear forces being applied to the burn wound. The dressing should be examined at 48 hours in order to re-assess the depth of the burn and should be changed if there is considerable soakage. After this first change, the dressings can be left intact for 3–5 days at a time, as long as there is:

- No prior soakage of dressings
- No significant malodour
- No pain
- No evidence of infection.

Table 4

Examples of different dressings that can be used in a burn

Dressing type	Examples	Use
Low adherent dressings	Jelonet® (Smith and Nephew), Paratulle, Tulle Gras, Atrauman® (Hartmann), Mepilex®, Mepitel® NA dressing (Mölnlycke)	Superficial or superficial dermal burns with minimum exudate
Semi-permeable films	Opsite® Flexigrid, Opsite® Plus (Smith and Nephew), Tegaderm® (3M)	Superficial or superficial dermal burns with minimum exudate Allows visual checks and may be left in place for 2–3 days Should not be used in infected or heavily exuding burns
Hydrocolloids	Comfeel®, Comfeel® Plus (Coloplast), DuoDERM® Extra Thin (ConvaTec), Granuflex® (ConvaTec)	Superficial dermal or small area deep dermal burns in 'difficult areas' such as digits, heel, elbow, sacrum Absorbent and conformable
Hydrofibers	Aquacel® (ConvaTec), Versiva® (ConvaTec)	Superficial dermal burns Can be used in moderately exuding wounds
Hydrogels	Aquaform® (Unomedical), Intrasite® Gel (Smith and Nephew)	Useful in small area deep dermal burns with slough
Alginate	Kaltostat® (ConvaTec)	Used to dress skin graft donor sites
Foam/ Hydrocellular	Allevyn® Adhesive, Allevyn® Lite Island, Allevyn® Thin, Allevyn® Plus Adhesive (Smith and Nephew), Biatain® Adhesive (Coloplast)	Superficial or superficial dermal burns with minimum exudate Provides a degree of cushioning and may be left in place 2–3 days
Antimicrobials	Acticoat, Actisorb® Silver 200 (Johnson and Johnson), Aquacel® Ag (ConvaTec), Inadine® (Johnson and Johnson)	Superficial dermal or small area deep dermal burns with moderate exudate and/or evidence of local infection

All of these factors necessitate earlier dressing changes and re-examination of the wound.

In the hospital setting and in children in particular, biological dressings such as Biobrane® (Smith & Nephew, Hull), which consists of porcine collagen, are being increasingly used for superficial dermal burns as they have been shown to control pain well and allow wound inspection without disturbance of the dressing due to its translucency (Whittaker et al, 2008) (*Figure 9*). Small areas of superficial dermal burns can also be managed with hydrocolloid dressings such as Granuflex® and the thinner DuoDERM® (both ConvaTec, Ickenham) that trap moisture in the wound. Any overlying exudate on the wound after removal of the dressing should be wiped away before reassessment of burn depth. Flamazine® (Smith & Nephew, Hull), a hydrophilic cream containing silver sulfadiazine, is the most widely used topical cream in burn wounds and should be reserved for deep dermal burns. The silver ions act as a broad spectrum antimicrobial agent and are particularly useful in the treatment and prevention of colonisation with Gram negative organisms such as pseudomonas. It is also excellent at keeping the wound well hydrated and is soothing and painless on application. It should, however, be reserved in the

first instance for deep dermal burns, as early use in superficial burns can make subsequent assessment of depth difficult due to staining of the wound which can make it appear deeper. When Flamazine is used, it should be changed on alternate days until any eschar has lifted and epithelialisation has commenced.

Emerging therapies in burn management include the use of artificial skin substitutes produced through tissue engineering techniques and the use of various growth factors to modulate different phases of the healing process. Some of the tissue engineered skin substitutes (AlloDerm® [Biohorizons, Alabama] and Integra® [Integra, NJ]) are particularly useful in large area burns where the availability of donor skin might be limited. However, the cost, patient selection and the meticulous skill/technique required in the application of these products precludes their use outside specialist burn units. There is insufficient evidence at present for the routine use of growth factors, or for the role of gene therapy or stem cell therapy in burn wounds.

After the wounds have healed

Once healed, burn wounds often leave an area that is dry, sensitive, pruritic (itchy) and prone to pigmentation changes (hypo or hyper) after sun exposure. Therefore, it is important to advise applying moisturising cream to the areas regularly and protect them from direct sunlight; a high factor sun block for up to 12 months may be indicated. Physiotherapy is required in burns involving anatomical areas such as neck, axilla, elbow, wrist, ankle and digits since these areas are prone to excessive scarring and contractures that may cause functional limitation. Patients with these injuries should be referred to the physiotherapists as soon as possible. Problematic scarring can also be minimised with the use of pressure garments and silicone therapy, and therefore referral to the occupational therapist should be made if necessary.

Management of a patient with burns goes beyond the management of the wound. A burn injury that might seem trivial to the healthcare professional can have a devastating impact on the psychological well-being of the patient. Psychological and social factors play an important role in the patient pathway from initial injury to the process of recovery and rehabilitation. It is therefore vital that the expertise of a psychologist is sought when needed. Likewise, an assessment of home circumstances and activities of daily living will not only aid return to normal life but may, in some cases, prevent further injury. As with all complex health problems a multidisciplinary team approach is needed in the management of patients with burns. WUK

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Key points

- When managing burns, appropriate first aid and initial management according to ATLS principles is essential and it is also important to be aware of associated injuries.
- A good history and accurate estimation of the total body surface area is vital to the immediate and onward management in the community as well as for an appropriate and safe referral to a specialist unit.
- Early cleaning and debridement of burn debris aids healing and is essential for estimation of burn depth.
- Aim for a well-hydrated wound when choosing dressings.
- Always solicit advice from the specialist burns unit if there is any doubt.
- Burn injuries may represent a highly complex clinical problem and are best managed with a multidisciplinary approach.