

INTERNATIONAL BEST PRACTICE

BEST PRACTICE GUIDELINES: EFFECTIVE SKIN AND WOUND MANAGEMENT OF NON-COMPLEX BURNS



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This document is a practical guide to the management of burn injuries for healthcare professionals everywhere who are non-burns specialists.

With an emphasis on presenting hands-on and relevant clinical information, it focuses on the evaluation and management of non-complex burn injuries that are appropriate for treatment outside of specialist burns units. However, it also guides readers through the immediate emergency management of all burns and highlights the importance of correctly and expediently identifying complex wounds that must be transferred rapidly for specialist care. Finally, it looks at the ongoing management of newly healed burn wounds and post-discharge rehabilitation.

The document acknowledges the importance of continuous and integrated input from all members of the multidisciplinary team, where such a team exists, while recognising the role and resources of singlehanded and outreach generalists providing a complete care service.

Although strategies vary within and between regions, this document seeks to present the essential key best practice principles that can be applied universally and adapted according to local knowledge and resources.

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Introduction

Burn injuries present many challenges to the diverse range of healthcare professionals who encounter them worldwide. The European Burns Association describes a burn injury as a complex trauma needing multidisciplinary and continuous therapy¹.

Most non-complex burn injuries (see Box 1 for definitions) will heal spontaneously with conservative treatment. However, the quality of initial care will affect the pain and distress a patient may experience, and will greatly influence the aesthetic and functional outcome. Studies show that burn injuries that take more than 2-3 weeks to heal are much more likely to result in hypertrophic scarring².

Complex burns must be promptly and appropriately identified and referred. Practitioners called on scene must also be well versed in emergency management, including optimal fluid resuscitation and wound care, prior to transfer.

BOX 1: DEFINITIONS

This document uses the following definitions

Non-complex burn: (previously described as minor burns) any partial thickness thermal burn covering $\leq 15\%$ total body surface area (TBSA) in adults or $\leq 10\%$ in children ($\leq 5\%$ in children younger than 1 year) that does not affect a critical area*. Includes deep dermal burns covering $\leq 1\%$ of the body.

Complex burn: (previously described as major burns) any thermal burn injury affecting a critical area* or covering $>15\%$ TBSA in adults or $>10\%$ in children ($>5\%$ in children younger than 1 year). All chemical and electrical burns are considered complex.

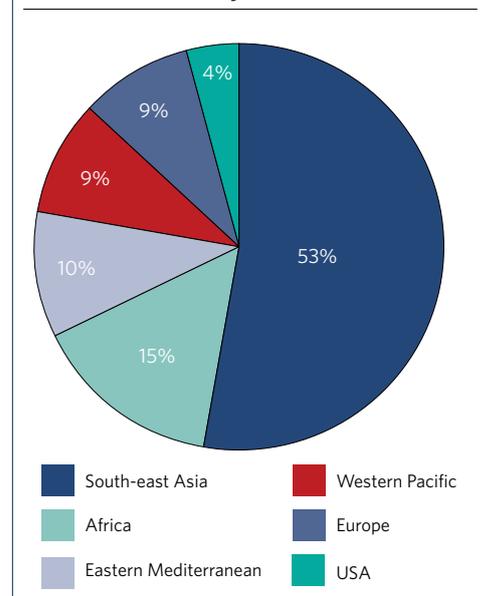
*Burns to hands, feet, face, perineum or genitalia, burns crossing joints and circumferential burns

SIZE OF THE PROBLEM

Worldwide, an estimated 6 million people seek medical treatment for burns annually, but most are treated in outpatient clinics (World Burn Foundation www.burnfoundation.com). However, the lack of national and international registration of burns injuries makes it difficult to estimate the true cost of burns.

In developing low- and middle-income countries (LMICs), burn injuries are an in-dominant problem, and much more common than in the USA and Europe or other high-income developed countries³. However, the exact number of burns in LMICs is difficult to determine. A conservative estimate puts the number of people admitted to hospital with burns in India (population over 1 billion) at some 700,000 to 800,000 each year⁴. WHO reports that the majority of burn-related deaths occur in LMICs, in particular South-east Asia (Figure 1) (Box 2⁵).

FIGURE 1: Regional distribution of fire-related mortality⁶



Illiteracy, poverty and urban overcrowding, along with social, infrastructural, economic and cultural issues complicate further the universal challenges of prevention and management^{3,4}. A discussion of the strategies needed to address these issues is beyond the scope of this document, but the main points for consideration are listed in Box 3 (see p2).

Survival outcomes in developed countries have improved dramatically over the decades, so the emphasis today is on restoring post-burn function, appearance and confidence by taking a considered multidisciplinary approach at all stages of management^{9,10}.

BOX 2: REGIONAL DIFFERENCES IN BURN RATES⁵

- Infants in the WHO African Region have three times the incidence of burn deaths of infants worldwide
- Boys under 5 years living in LMICs of the WHO Eastern Mediterranean Region are almost twice as likely to die from burns as boys living in LMICs of the WHO European Region
- The incidence of burn injuries requiring medical care is nearly 20 times higher in the WHO Western Pacific Region than in the WHO Region of the Americas

BOX 3: STRATEGIES FOR BURN MANAGEMENT IN LMICs. ADAPTED FROM^{4,6,7,8}

- Include burns as part of the national health agenda
- Drive effective prevention programmes, including burn educational campaigns in schools
- Create a central registry of burns to document extent of burns
- Improve pre-hospital care with promotion of better referral systems based on triage
- Develop regional centres of excellence with basic burn care undertaken at district and base hospitals
- Define health needs based on priorities defined locally with optimisation of existing facilities to achieve minimally acceptable standards of care
- Implement cost-effective treatment approaches (re-use/recycle/adapt available resources)
- Develop a national body of burn professionals to educate healthcare staff involved in burn care

Using the UK (population about 60 million) to illustrate the size of the problem in developed countries, each year around^{10,11}:

- 250,000 people receive burn injuries
- 175,000 of people with burns attend emergency departments
- 16,000 of these are admitted to hospital for specialist care
- 1,000 people have burns severe enough for formal fluid resuscitation
- 300 people die as a result of their burn injury.

In the USA (population about 314 million), each year around^{12,13}:

- 1.25 million people receive burn injuries
- 450,000 of these receive medical treatment
- 40,000 people require in-hospital care, including 30,000 at hospital burn centres
- 5,500 people die as a result of their burn injury.

A European-wide systematic review found that, across Europe, mortality rates vary from 1.4% to 18%¹⁴. There was a clear correlation between prognosis and the extent and depth of the burn injury. Therefore, it

must be made clear to first-aid physicians who work at the scene of burn accidents and to those involved in after-treatment in hospitals how extremely important it is to possess adequate basic knowledge¹⁵.

Inappropriate or poor treatment may result in complications, such as infection and scarring, unnecessary pain and anxiety for the patient and family and increased societal costs (e.g. temporary loss of school or work activities).

TRAINING AND EXPERIENCE

Most burn injuries (around 90% in the UK and the USA) are non-complex wounds that can be safely and effectively managed outside of specialist burns units^{10,12,13,16}.

Non-complex burns are commonly assessed by a range of healthcare professionals, and there is a need to have agreement about what types of injury need referral to a specialist burn facility. However, distinguishing between complex and non-complex burns is not straightforward, and many non-specialist doctors and nurses lack experience or formal training in burn management.

In a survey carried out in the minor burn facility of the Royal Perth Hospital in Australia, only 39% of patients had received appropriate first aid from their primary healthcare provider¹⁷. In a review of minor burns care in hospital emergency departments in Ontario, Canada, 70% of clinicians surveyed said they would not measure burn area when assessing a patient and 45% did not discuss analgesic requirements¹⁸. Both are key components of burn care. These are serious issues as poor initial management can cause a superficial burn wound to progress to a deeper, more complex wound¹⁹.

In some parts of the world, uncertainty and misconceptions about management are complicated by limited resources and lack of support personnel.

Causes of burns

Burns are caused by exposure to thermal (heat), electrical, chemical or radiation sources. Children under 5 years and the elderly are at increased risk of burn injury

CAUSES OF BURN BY AGE

Children account for almost half of the population with severe burn injury and children below five years of age account for 50–80% of all childhood burns²⁰. Burns are the eleventh most common cause of death in children aged 1–9 years and the fifth most common cause of non-fatal childhood injuries. Globally, the majority of children with burns are boys with a ratio of 2:1 to girls, and there is a higher mortality rate from burns among boys²⁰.

Most childhood burns occur in the home; scalds are the most common burn type (accounting for 60–70% of all hospitalised burn patients), followed by flame and contact burns^{21,22} (Box 4).

The vast majority of adult burns occur in the home, outdoors or in the workplace. These result from thermal (scalds, flame, contact), electrical or chemical sources. Other important causes include radiation and extreme cold (frostbite).

Who is at increased risk?

Those most vulnerable to burn injury include:

- Children
- Elderly people
- Those with reduced mental capacity, e.g. those with dementia or learning difficulties and those who may not recognise or react to a dangerous situation
- Those with reduced mobility and anyone with sensory impairment, which may prevent a quick response to injury.

MECHANISM OF INJURY

It is important to consider the mechanism by which a burn was caused, as this influences the pathophysiology of the injury and, therefore, how it should be managed.

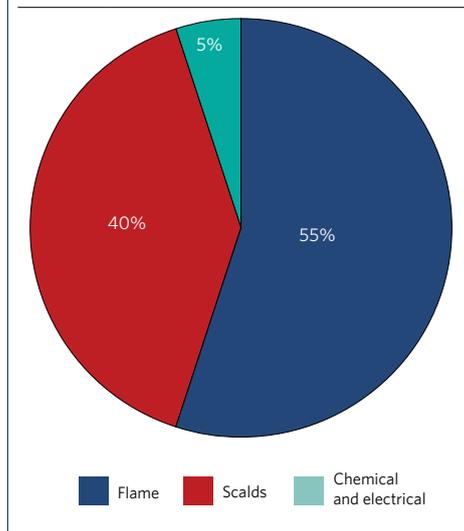
THERMAL BURNS

Most burns are thermal injuries and these predominantly comprise scalds and flame injuries (Figure 2)²³.

Flame injuries

In developed countries, flame injuries are most commonly seen in men and women of working age (15–64 years). The incidence in children

FIGURE 2: Causes of burns by incidence in the UK . Adapted from²³



decreased after legislation restricting the design and material of night clothing. In developing countries, flame injuries are the most common form of burn, occurring mainly in women aged 16–35 years^{21,22}. This group spends long periods cooking at floor level in loose-fitting clothing, using equipment that may be unsafe^{4,6} (Figure 3).



Figure 3: Flame burn wound.
Photo courtesy Professor Franck Duteille

BOX 4: CAUSES OF BURNS BY AGE IN THE UK. ADAPTED FROM²³

Young children (1–4 years)

- 20% of all patients with burns
- 70% due to scalds
- Boys more likely to be burnt than girls (due to behavioural differences)

Older children and adolescents (5–14 years)

- 10% of all patients with burns
- Teenagers often injured from illicit activities involving accelerants or electrocution

Working age (15–64 years)

- 60% of all patients with burns
- Predominantly flame burns
- Around 33% work-related incidents

Elderly people (>65 years)

- 10% of all patients with burns
- At higher risk of scalds, contact burns and flame burns (due to effects of aging, such as immobility and slowed reactions)



Figure 4: Scald burn wound.
Photo courtesy Professor Franck Duteille



Figure 5: Scald burn wound showing typical map of Africa topography.
Photo courtesy André Magnette



Figure 6: Contact burn wound. Photo courtesy Professor Franck Duteille



Figure 7: Deep dermal contact burn wound. Photo courtesy André Magnette



Figure 8: Electrical burn. Photo courtesy Professor Franck Duteille



Figure 9: Electrical burn. Photo courtesy Professor Franck Duteille

Flame injuries tend to be of any depth (partial or full thickness — see Definitions of burn depths, p10) and often a mixture of depths.

Scalds

Scalds are frequently due to spilling of hot drinks and liquids, and immersion in a hot bath or shower (Figure 4, p3). They account for around 70% of burns in children, although they are also common in elderly people.

Scalds tend to cause superficial or superficial dermal burns, and may involve a large area of skin. In children who have pulled a hot liquid onto themselves from a height, a typical 'map of Africa' distribution may be seen with a large area of burn at the top and a smaller area underneath (Figure 5, p3).

Contact burns

Contact burns occur either when the skin touches an extremely hot object (often seen in industrial accidents) or when it touches a less hot object for a very long time. The latter may be seen in people who have lost consciousness, such as those with epilepsy or who misuse alcohol or drugs, or in elderly people after a fall or blackout.

Common sources of contact burns include irons, oven doors, vitro-ceramic cooking stations, radiators and the glass fronts of gas fires (Figure 6).

Contact burns tend to cause deep dermal or full thickness burns (Figure 7).

ELECTRICAL BURNS

Electrical burns occur when electricity flows through the body from an entry point to an exit point. The burn is caused by the heat energy of the electric current damaging tissue along its path of flow (Figures 8 and 9).

The extent of tissue damage is determined by the voltage of the current:

- Low-voltage (domestic current) burns
 - Small, deep contact burns are seen at the entry and exit points
- High-voltage burns
 - Currents of more than 1,000 volts cause extensive deep tissue damage and even limb loss. Currents of more than 70,000 volts are usually fatal.

Flash burns (high voltage) occur when a person is exposed to an arc of high-voltage current, but the current does not actually enter the body. The associated heat energy causes superficial burns to exposed body parts (such as face, neck, hands and upper limbs). Ignited clothing may cause deeper burns.

Electrical burns may interfere with the cardiac cycle and cause arrhythmias. Cardiac monitoring should be considered on admission.

CHEMICAL BURNS

Burn injuries from corrosive agents occur mainly in industrial accidents, but they can also result from products found in the home.

Chemical burns are caused by:

- Acids (e.g. sulphuric, nitric, hydrofluoric, hydrochloric and phosphoric)
- Alkalis/bases (e.g. sodium or potassium hydroxide, sodium or calcium hypochlorite, ammonia or phosphates, and chemicals in household cleaning agents, bleaches and cement). These tend to cause deeper burns than acids
- Organic products (e.g. bitumen).

Chemical burns tend to cause deep dermal or full thickness burns because the tissues continue to be damaged until the chemical is completely removed (e.g. by copious irrigation) (Figures 10–12, p5).

Be aware of the serious effects of absorption of chemical products from the skin. For example mercury can cause renal failure even from a small area of local skin damage.

PATHOPHYSIOLOGY

The pathophysiology of burn wounds is a slowly evolving process, unlike many other forms of trauma²⁴. Whatever the mechanism, burn injuries cause a local response and, in complex burns, a systemic response.

Local response

The local response to a burn injury consists of inflammation, regeneration and repair. A burn may be divided into three zones (Figure 13, p5):

- Zone of coagulation/necrosis
 - At the centre of the wound
 - No tissue perfusion
 - Irreversible tissue damage due to coagulation of proteins
- Zone of stasis
 - Surrounds the central zone of coagulation
 - Decreased tissue perfusion
 - Some chance of tissue recovery with optimal management
- Zone of hyperaemia
 - At the periphery of the wound
 - Good tissue perfusion
 - Tissue recovery likely.

These zones are dynamic environments. In the superficial areas and around the edges, the usual process of repair occurs (ingrowth of capillaries and fibroblasts followed by formation of granulation tissue and scar). After 3–4 days, loss of tissue viability in the zone of stasis (for example, due to delayed or suboptimal management) will cause the burn wound to become deeper and wider.

Systemic response

In complex burns of more than 20–30% TBSA, there is also a systemic response due to the extensive release of inflammatory mediators at the injury site. The effects are far reaching and include systemic hypotension, bronchoconstriction, a threefold increase in basal metabolic rate and a reduced immune response²⁵.



Figure 10: Dry necrotic eschar covered chemical burn. Photo courtesy Professor Franck Duteille

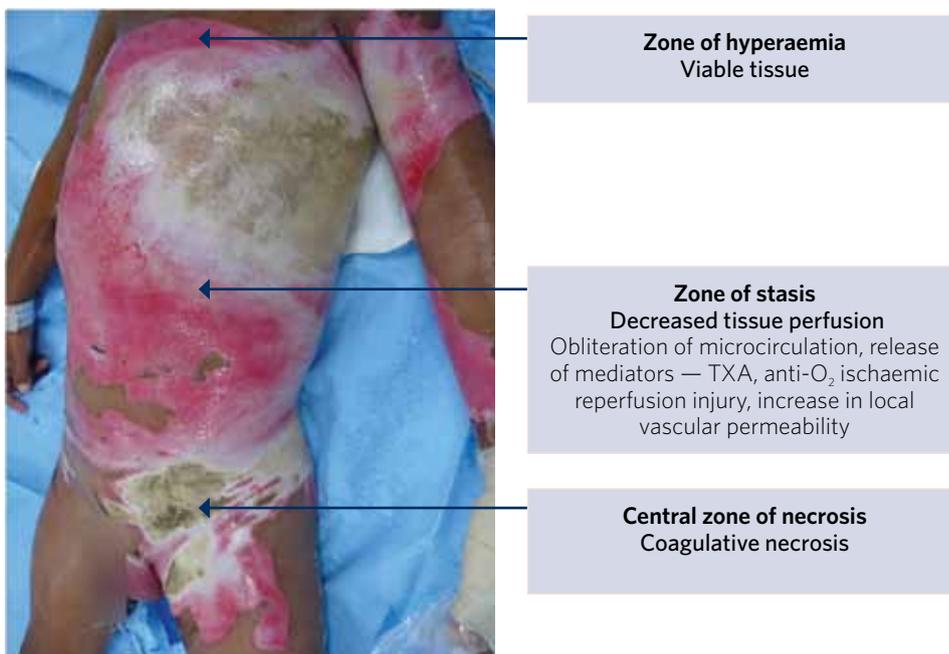


Figure 11: Chemical burn with acid. Such wounds tend to be superficial and self-limiting. Photo courtesy Professor Franck Duteille



Figure 12: Chemical burn due to sodium hydroxide (caustic soda) a strong alkali. Photo courtesy André Magnette

FIGURE 13: Zones of a burn injury (photo courtesy Professor Heinz Rode)



Emergency management of non-complex burns

Clinicians working in the emergency department or community must be confident in assessing and managing burn injury to ensure optimal outcomes

GENERAL FIRST AID

First aid and initial management of the burn site can limit tissue damage and subsequent mortality²⁶. Emergency management continues to be effective for up to 3 hours after the initial burn injury.

If you are the first on scene responder, the priorities are to:

- Check that it is safe to approach the patient, call for help and, if appropriate, wear appropriate personal protective equipment
- Stop the burning process (extinguish any flames using 'drop and roll' or turn off the electricity supply, as appropriate) and remove the patient to a safe place with fresh air. Remove non-adherent clothing and any potentially restricting jewellery
- Apply general first aid to cool the burn wound.

Cool the burn wound

Cooling thermal burns with tepid, running water (12–18 °C) removes heat and prevents progression of a thermal burn injury and limits tissue damage²⁷. It can also reduce pain, cleanse the wound and minimise swelling. This is effective if performed within 20 minutes of the injury occurring¹⁶ and should be continued for up to 30 minutes^{28,29,30}.

If water is not available then wet towels/compresses or hydrogels (in adults only) are a second-line alternative^{31,32}, although they may be prohibitively expensive in some regions.

Ice or very cold water should be avoided because it causes vasoconstriction and may, paradoxically, deepen the wound²⁷.

Chemical burns require longer periods of copious irrigation — until the injury no longer causes pain or the pH has been normalised (e.g. by testing with urine pH sticks). Corrosive agents continue to cause tissue damage until they are completely removed. Eye injuries should be irrigated copiously with sterile saline. Diphoterine® solution, if available, is a very effective washing agent for chemical burns^{33,34}.

In some situations an antidote can combat the effects of the chemical irritant (e.g. calcium gluconate gel will inactivate hydrofluoric acid). Some regions therefore recommend seeking advice from a regional or national toxicology unit.

Irrigation of electrical burns is not appropriate because the heat damage occurs deep under the surface of the skin. Water irrigation definitely must not be performed before turning off the electric power source.

Remember: cool the burn, not the patient. Cooling large areas can cause hypothermia, especially in children²⁹. For this reason, do not apply wet soaks or ice packs, or use these during transit. Patients should be covered with coats, sheets or blankets to keep them warm.

Cover the burn

In most instances, burns should be covered immediately after cooling. Covering the burn helps to:

- Prevent bacterial colonisation^{29,35}
- Prevent desiccation³⁶
- Relieve pain from exposed nerve endings³⁷.

Layers of polyvinylchloride (PVC) film (i.e. cling film, Glad wrap, Saran wrap) forms an excellent emergency dressing for an acute burn injury (Figure 14). The layers of film must be laid over the burn rather than wrapped circumferentially, to avoid the possibility of constriction. If PVC film or a cost-effective alternative is not available, then a clean, cotton sheet or similar is appropriate.

Cellophane transparent film (made from regenerated cellulose) can worsen chemical burns so dressings soaked with water/saline or hydrogels should be used instead, taking care to avoid hypothermia¹⁰.

In hot, humid, subtropical climates, burn dressings become rapidly saturated and infected. Burn wounds should therefore be left exposed, or loosely covered with a clean towel or moisture-retentive ointment.



Figure 14: Cling film for dressing burn wounds. Lay on wound to prevent external contamination. Allows inspection of wound, is non-adherent, conformable and essentially sterile. Photo courtesy Professor Heinz Rode

Do NOT apply topical antimicrobial creams at this stage, as they will hinder later assessment of the wound.

RELIEVE PAIN

Pain management in patients with burn injuries is often inadequate. While cooling and covering the burn gives some relief, opioids may be needed initially for pain control.

Superficial epidermal burns can be extremely painful (more so than deep wounds) because the nerve endings remain intact but exposed. Medicate with a combination of paracetamol with a low to moderate potency opioid at the correct dose. Subsequently, a non-steroidal anti-inflammatory drug is sufficient.

Patients with partial thickness dermal burns should be given intravenous opioids at a dose appropriate to body weight^{10,16,38} or intranasal diamorphine¹⁰.

Cooling gels (e.g. Burnshield) may be used to cool the burn and relieve pain in the initial stages¹⁶. A full discussion of pain relief as part of ongoing management is given in Management of non-complex burn wounds (p17).

The tetanus status of the patient should be determined and immunisation given if indicated³⁹.

ASSESSMENT — PRIMARY SURVEY

All burn victims should be evaluated first as trauma patients, using advanced trauma life-support guidelines^{1,29,39}. This is often known as the primary survey, and it aims to identify and stabilise any life-threatening injuries. The mnemonic ABCDEF indicates the order of priority for addressing problems (Box 5).

For burn victims, there should be a particular emphasis on the airway and breathing. These may be compromised by³⁸:

- Mechanical restriction of breathing (e.g. due to a circumferential deep dermal burn limiting chest expansion or a burn to the lower part of the face)
- Blast injury (e.g. causing penetration of the lung)
- Smoke inhalation (e.g. combustion products causing lung irritation and the effects of carboxyhaemoglobin).

In patients who are clearly well other than an obviously non-complex burn injury, it is acceptable to move straight to the secondary survey.

Fluid resuscitation

Effective fluid resuscitation is the cornerstone of management in major burns. If the burn area is over 15% in adults or 10% in children, intravenous fluids should be started as soon as possible on scene (e.g. using the rule of 10, see Box 6), although transfer should not be delayed by more than two cannulation attempts^{16,29,37,40}. For physiological reasons the threshold is closer to 10% in the elderly (>60 years)¹¹.

BOX 6: THE RULE OF 10

1. Estimate burn size to the nearest 10
2. %TBSA x 10 = Initial fluid rate in ml/h (for adults weighing 40-80kg)
3. For every 10kg above 80kg, increase the rate by 100ml/h

Various resuscitation fluids are available and there is no ideal regimen to follow. Healthcare professionals should refer to local protocols. However, a commonly used regimen using crystalloid Hartmann's solution and the Parkland formula to calculate the volume required is given in Box 7.

BURN-SPECIFIC EVALUATION — SECONDARY SURVEY

A patient history and physical examination (sometimes known as the secondary survey) should identify issues that impact on the immediate management of the patient and/or have implications for transfer decisions. The evaluation should determine¹³:

- Approximate wound size (see Evaluating burn injury: assessing area and depth, p9)
- Approximate wound depth (see Evaluating burn injury: assessing area and depth, p9)
- Location of burn injury (including any involvement of the face, eyes, ears, hands, genitals or feet)
- Presence of an inhalation injury
- Presence of a circumferential deep dermal burn injury
- The cause of the burn injury (thermal, electrical or chemical)
- Suspicion of abusive injury.

BOX 5: PRIMARY SURVEY FOR PATIENTS WITH BURN INJURIES

- A Airway maintenance with cervical spine control
- B Breathing and ventilation
- C Circulation with haemorrhage control
- D Disability — neurological assessment
- E Exposure — preventing hypothermia
- F Fluid resuscitation

BOX 7: SUGGESTED REGIMEN FOR FLUID RESUSCITATION. ADAPTED FROM³¹

Adults

Resuscitation fluid alone (first 24 hours)

- Give 3–4ml (3ml in superficial and partial thickness burns/4ml in full thickness burns or those with associated inhalation injury) Hartmann's solution/kg body weight/%TBSA. Half of this calculated volume is given in the first 8 hours after injury and the remaining half in the second 16-hour period

Children

Resuscitation fluid as above plus maintenance (0.45% saline with 5% dextrose, the volume should be titrated against nasogastric feeds or oral intake):

- Give 100ml/kg for the first 10kg body weight plus 50ml/kg for the next 10kg body weight plus 20ml/kg for each extra kg

BOX 8: WHERE THERE IS A DELAY IN TRANSFER TO A BURNS SERVICE

If the time from burn to arrival at a burns service is <6 hours and the burn is clean:

- Wash burn wound, cover with plastic cling wrap for transfer (do not wrap circumferentially), allowing for easy assessment at the burns service without undue discomfort from removal of dressings

If transfer is likely to be >6 hours or the burn is dirty:

- Dirty or charred burns should be washed with sterile water/tap water (depending on local protocol) and dressed with a silver product (impregnated silver dressing or topically applied silver sulfadiazine cream)
- Clean burns should be dressed with a low-adherent silicone dressing

In addition, the following situations may warrant special consideration or referral even if the burn is non-complex:

- Any co-existing medical conditions (e.g. cardiac disease, diabetes, pregnancy or immune-compromised state)
- Any predisposing factors that may require further investigation or treatment (e.g. a burn resulting from a fit or faint)
- The possibility of non-accidental injury
- The person's social circumstances (e.g. an older person living alone).

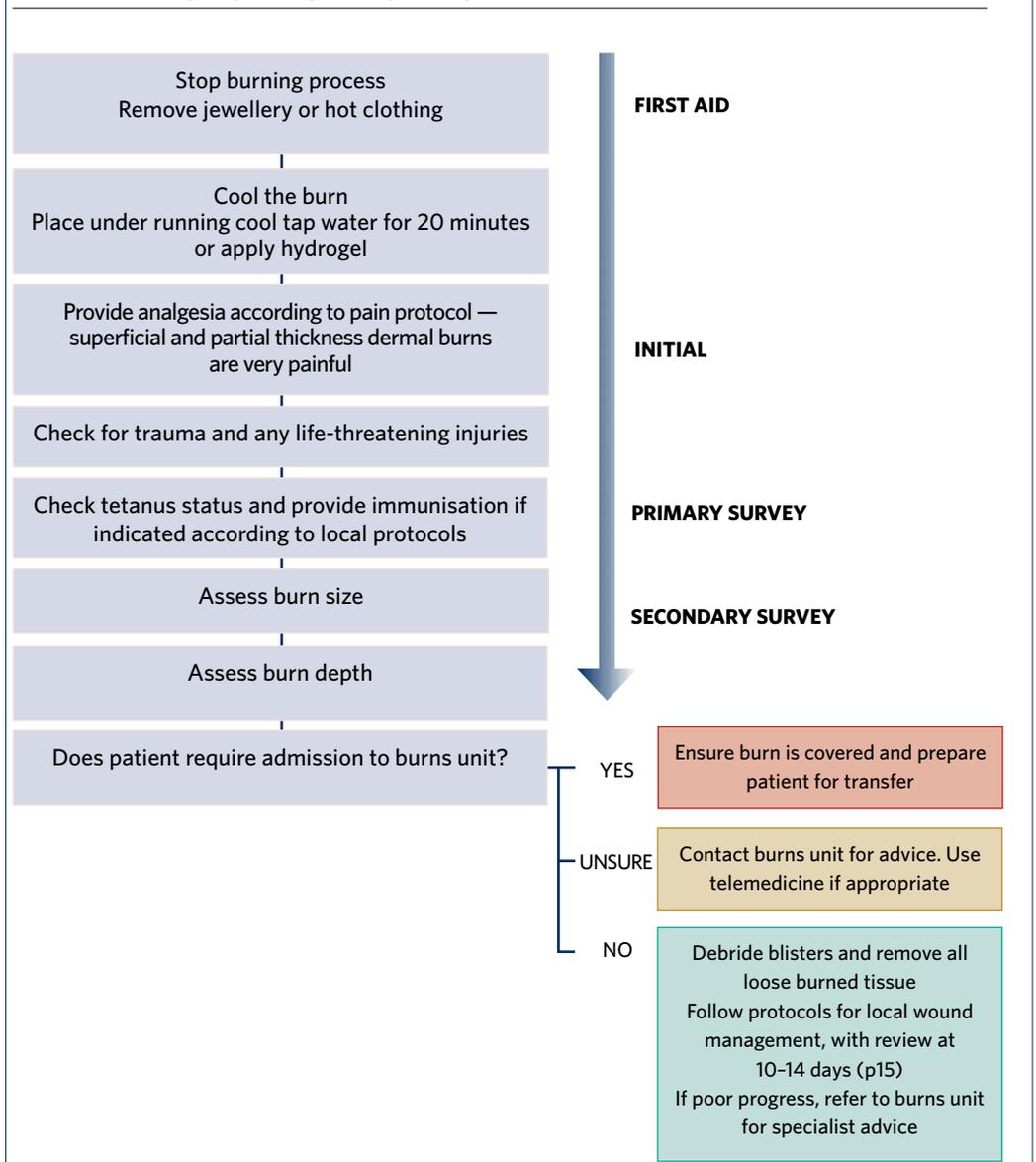
Therefore admissions criteria to specialist care (burns unit or plastic surgery) are not

based purely on the size and depth of the burn, and careful assessment of the patient is required⁴¹. If there is uncertainty whether referral is appropriate, seek specialist advice (Figure 15).

When transfer is delayed, ensure the burn is suitably dressed (Box 8) to avoid contamination.

Telemedicine and transmission of photographs to the burn unit may help make a more accurate estimate of the burn extent.

FIGURE 15: Emergency management pathway for burns



Evaluating a burn injury: Assessing area and depth

The total area of the burn is significant as the skin acts as a barrier to the environment

The cause of injury, depth and extent of a non-complex burn should be assessed in the same way as for more complex burns.

Timely and accurate estimation of the surface area and depth of a burn injury is essential for determining appropriate management, ensuring rapid healing and preventing complications.

It is important to expose and assess all of the burn. With large burns, parts of the body can be uncovered in turn to help keep the patient warm.

ASSESSING BURN AREA

Total burn area is expressed as the percentage of the TBSA. It is vital for establishing fluid resuscitation needs and for monitoring healing progress.

Three methods are commonly used:

- Lund and Browder chart
- Wallace's 'rule of nines'
- Palmar surface.

Lund and Browder chart

The Lund and Browder chart is one of the most commonly used methods for assessing burn area⁴². It takes into account the variation of body surface area with growth and can be used for both adults and children (Figure 16).

Wallace's rule of nines

This is a useful tool for estimating burn area in adults⁴³. The body is divided into regions divisible by 9 and the total burn area can be calculated by estimation from a standard diagram (Figure 17).

FIGURE 16: Lund and Browder chart

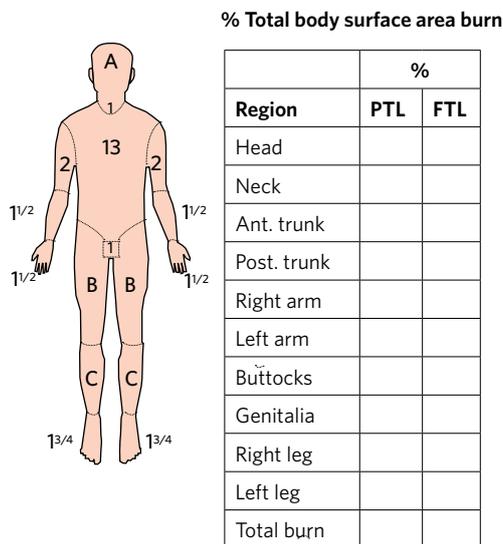
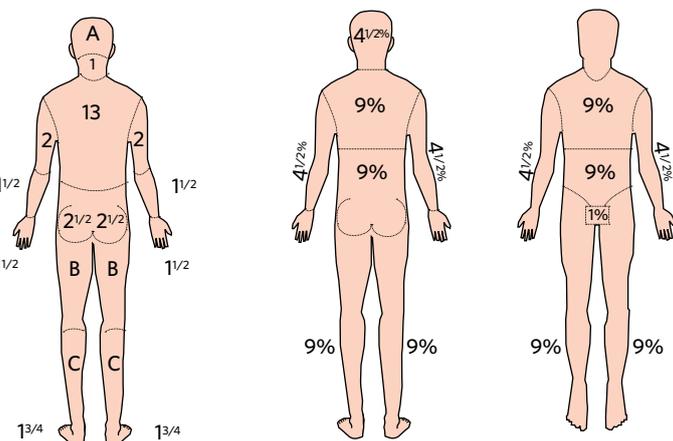
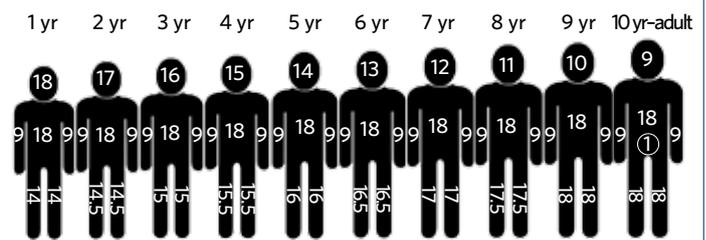


FIGURE 17: Rule of nines (adults)

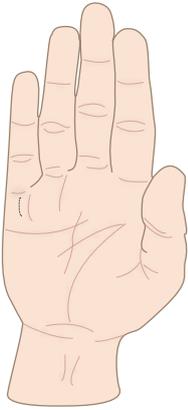


Paediatric assessment ruler



Body surface area percentiles for each age group. Select patient's age to determine body surface area ratio for each body area to calculate burn size. Adapted from Victoria Burns Service www.vicburns.org.au

FIGURE 18: Palmar surface



The hand area (palm and digits) approximates to 1% of the total body surface area⁴⁴

Palmar surface

A simple method to estimate burn area is to consider the palm of the patient’s hand with closed fingers as representing approximately 1% of the body surface area. It is effective for estimating the area of small burns (<15%) or large burns (>85%). In large burns, the burnt area can be quickly calculated by estimating the area of uninjured skin and subtracting it from 100 (Figure 18).

When estimating TBSA, do not include simple erythema (reddening of the surrounding skin) in your calculation⁴¹.

In practice, burn size is estimated correctly only one third of the time. A single-centre study comparing the initial assessment of TBSA in the emergency room with the final evaluation made in the burn centre showed that the TBSA was overestimated by over 100% in 24 out of 134 patients⁴⁵. Nichter et al described an error rate of 29% using the rule of nines and Lund and Browder charts⁴⁶.

A summary of the advantages and disadvantages of the three main assessment tools is given in Table 1.

ASSESSING BURN DEPTH

The depth of a burn is determined by the amount of energy delivered to the skin and the thickness of the skin. It is a key measure of long-term prognosis, and the assessment will directly inform the management plan.

Burn depth may increase with time, so re-assessment after 24-72 hours is essential.

Before looking at techniques for estimating burn depth, it is important to understand the terminology used.

Definitions of burn depth

Burn injuries are classified into two groups according to the amount of tissue damage.

1. Superficial partial thickness burns (also known as first and second degree)

Most burns are partial thickness burns or have an element of this depth⁴⁷. These injuries do not extend through all the layers of skin. They may be further classified into:

- *Superficial/epidermal (also known as superficial first degree)*
 - Only the epidermis is damaged (Figure 19, p11)
 - Typified by sunburn
 - No blistering
- *Superficial dermal (also known as superficial partial thickness)*
 - Burn extends into the upper layers of the dermis
 - Painful (due to exposed superficial nerves)
 - Blistering present (Figure 20, p11)
- *Deep dermal (also known as deep partial thickness)*
 - Burn extends into the deeper layers of the dermis, but not into the underlying subcutaneous tissues (Figure 21, p11)
 - Seen with burns from hot fat or oil
 - Healing associated with some contraction and scarring.

2. Full thickness burns (also known as third degree)

- Burn extends through all layers of the skin and into the subcutaneous tissues
- Underlying tissue may appear pale or blackened
- Remaining skin may be dry and white, brown or black with no blisters (Figure 22, p11)
- Healing associated with considerable contraction and scarring.

Severe full thickness burns (fourth degree) extend into muscle and bone.

TABLE 1: Burn area assessment tools: pros and cons

Method	Pros	Cons
Palmar surface	Quick and easy for small or large burns	Not accurate for medium burns
Rule of nines	Quick and easy in adults	Tends to overestimate area; not accurate for children
Lund and Browder	Most accurate method; suitable for adults and children	Takes time to record and calculate values

TABLE 2: Characteristics of burn types according to depth

Burn type	Appearance	Blisters	Capillary refill/ blanching on pressure	Sensation	Treatment
Superficial epidermal (superficial/first degree)	Red and glistening (moist)	Not present	Brisk	Painful	Usually heals within 7 days with conservative treatment No scarring
Superficial dermal (superficial partial thickness)	Red/pale pink	Large blisters	Brisk, but with slower return	Painful	Usually heals within 14 days with conservative treatment No scarring
Deep dermal (deep partial thickness)	Dry, blotchy/ mottled and cherry red/ stained appearance	May be present	Absent	Variable	Although can heal with conservative treatment, complex burns may require surgical intervention Possible scarring
Full thickness (third degree)	Dry, leathery, white or black (charred). Eschar may be present	Not present	Absent	Absent	Complex full thickness wounds seldom heal with conservative treatment. Usually requires surgical intervention

Assessment of burn depth

Burn depth is determined by making a subjective assessment of the characteristics of the injury (Table 2). This is not easy; in one comparison of assessments by experienced surgeons, there was only a 60–80% concurrence⁴⁸. Other objective methods are available (e.g. biopsy and histology, thermography and laser doppler), but these are expensive tools requiring expert operators and are not practical outside of specialist burn units⁴⁹.

Burn depth may be heterogeneous, ranging from superficial in some parts to deep dermal or full thickness in other areas.

It may be necessary to derroof any blisters and/ or debride dead skin to be able to visualise the wound bed (see Management of non-complex burn wounds p15).



Figure 19: Superficial epidermal burn. Photo courtesy André Magnette



Figure 20: Superficial dermal burn. Photo courtesy Professor Franck Duteille



Figure 21: Deep dermal burn. Photo courtesy Professor Franck Duteille



Figure 22: Full thickness burn. Photo courtesy Professor Franck Duteille

Evaluating a burn injury: Taking a full history

A detailed history informs the decision to refer the patient and guides subsequent management²⁶

BOX 9: NUTRITIONAL ASSESSMENT

A patient's nutritional status can affect how well the burn wound heals. A full nutritional assessment should be taken to identify any nutritional deficiencies that might affect wound healing or shed light on the underlying cause of the burn (e.g. history of falls). One such assessment tool is the Malnutrition Universal Screening (MUST) Tool⁵⁰

A detailed history should include⁴⁹:

- Exactly how the injury was sustained
- Medical and social history
- Nutritional status (Box 9)
- Details of any emergency management/first aid performed
- Family contact details.

MECHANISM OF INJURY

Detailed information should be sought about the cause (thermal, chemical, electrical) of the burn injury.

The size and depth of tissue damage is determined by the temperature or strength of the injuring agent and the amount of time it was in contact with the skin. You should therefore ask^{29,49}:

- What was the exact cause of the injury?
- When did the injury occur?
- How did the injuring agent (e.g. flame, chemical, electrical current) come into contact with the patient?
- For how long was the patient exposed to the injuring agent?

Specific questions for different causes are as follows.

Scald injuries

- What was the liquid?
- Was it boiling or recently boiled?
- For hot drinks, was milk added (this will lower the temperature)?
- Was a solute, such as food to be cooked, added to the boiling water (this will raise the boiling temperature)?

Contact burn injuries

- What setting was the heat source on?

Flame burn injuries

- Was the patient exposed to a flash or did they have direct contact with the flame?
- Did it occur in an open/closed space?
- What was the source of the fire (i.e. what materials were ignited? Were flammable liquids involved, which may intoxicate by absorption)?

Electrical burn injuries

- What was the voltage (domestic/industrial)?

- Was there a flash or arcing?

Chemical burn injuries

- What was the chemical?
- What was the strength/concentration?
- Does the patient have any information with them about the agent involved?

MEDICAL HISTORY

A full medical history may reveal factors that can affect the depth of the wound, for example, patients with diabetes can be prone to micro- and macrovascular complications⁵¹. Comorbidities may also be relevant to potential interventions (e.g. chronic obstructive pulmonary disease and ischaemic heart disease). The history may determine why the patient suffered the burn. Many patients receive burn injuries because they are vulnerable; for example, they may have had an epileptic seizure or a stroke or have been intoxicated. Elderly patients may have lost consciousness or have fallen, and there may be an underlying cause for this²⁴. You should ask about:

- Previous and current medical problems
- Medicines they are taking/vaccinations
- Allergies
- Smoking habits (may affect blood gas analysis)
- Possible pregnancy (the unborn child needs special consideration)⁵².

EMERGENCY MANAGEMENT UNDERTAKEN

The extent and quality of any first aid undertaken will give clues to the expected burn depth.

You should ask:

- What first aid was performed?
- How long was cooling applied?
- Was fluid resuscitation started and when?
- What treatment has been started?

NON-ACCIDENTAL INJURY

It is important to be vigilant for signs and symptoms of non-accidental injury when evaluating a burn, particularly in a vulnerable patient. Some 3-10% of burns in children are due to non-accidental injury²⁵. Any suspicion should prompt an immediate hospital admission (regardless of the complexity of the burn) and notification of social services.

Evaluating a burn injury: When to refer

Keep in mind the expected evolution of the burn injury; if healing does not progress as predicted, then the patient should be referred to a burn unit

Once the burn injury has been evaluated the team must decide whether the patient should be transferred to a specialist burns unit or is suitable for outpatient management. In general, all complex burn injuries should be hospitalised (Box 10)^{1,11,29,39,53}.

The decision should be based on:

- Size of the burn injury (TBSA)
- Depth of the burn injury
- Mechanism of the burn
- Site of the burn wound
- Pain not adequately controlled with oral analgesia
- Other (e.g. living alone, inadequate support at home or inability to cope with dressing care, or problems in attending appointments due to transport difficulties).

If there is any doubt about whether to refer a patient, discuss the injury with a consultant in your local specialist burns unit.

There is a shortage of specialist burns beds

worldwide, and many burns can be managed effectively in general hospitals. Only the most complex cases should be referred to a specialist burn facility. Non-complex burns heal spontaneously, and only those requiring surgical consultation will require referral.

Be aware of toxic shock syndrome — a rare but fatal complication of small burns in children (Box 11).

In developing countries, referral is complicated by the fact that specialist burn units tend to be located in large cities, which are often difficult to reach. Many units have limited resources, lack operating time and may not be able to cope with the high volume of referrals. They may be staffed by general surgeons without formal training in burn injuries and so complex surgical interventions are not available to the vast majority of patients who need them^{3,4}. Telemedicine can be an invaluable tool here, especially if access to a burns specialist is remote.

BOX 11: TOXIC SHOCK SYNDROME

- Usually occurs in small burns (>10% TBSA)
- May present with:
 - Fever
 - Rash of any type
 - Diarrhoea/vomiting
 - Irritability
 - Drowsiness
 - Poor feeding
 - Capillary refill >3 seconds
 - Tachycardia
 - Tachypnoea
 - Mucosal hyperaemia
- Usually manifests 2–4 days post injury
- Burn wound often appears 'clean'
- Patient often deteriorates rapidly
- Children <2 years are particularly susceptible
- Once shock develops, mortality may be as high as 50%

Adapted from *Guidelines for the Management of Paediatric Burns*. Available from www.wch.sa.gov.au

BOX 10: CRITERIA FOR REFERRING BURN INJURIES TO A SPECIALISED BURN UNIT

A complex burn injury comprises and is likely to be associated with:

- Large size:
 - >10% TBSA in children (>5% in children younger than 1 year)
 - >15% TBSA in adults
- All full thickness burns in any age group and any extent
- Deep dermal burns >5% TBSA in adults and all deep dermal burns in children
- Mechanism of injury:
 - All chemical and electrical burns
 - Exposure to ionising radiation
 - High-pressure steam injury
 - Suspected non-accidental injury
- Age (<10 or >49 years)
- Site of injury (there are no absolute criteria, but the following should be considered):
 - Face, hands, genitals or perineum
 - Any flexural surface such as neck, axilla, front of elbows OR back of the knee
- Circumferential deep burns in any age group
- Burns with a suspicion of inhalation injury
- Co-existing conditions that could complicate burn management, prolong recovery or affect mortality
- Associated injuries (fractures, head injury or crush injuries)
- Septic burn wounds
- Burn patients who require special social, emotional or long-term rehabilitation support

Late referrals (e.g. wounds not healed with conservative treatment within 10 days) are discussed in Management of non-complex burn wounds (p14)

Management of non-complex burn wounds

Patients with non-complex burns can be managed as outpatients in emergency departments, minor injuries clinics, walk-in centres and GP surgeries rather than specialist centres

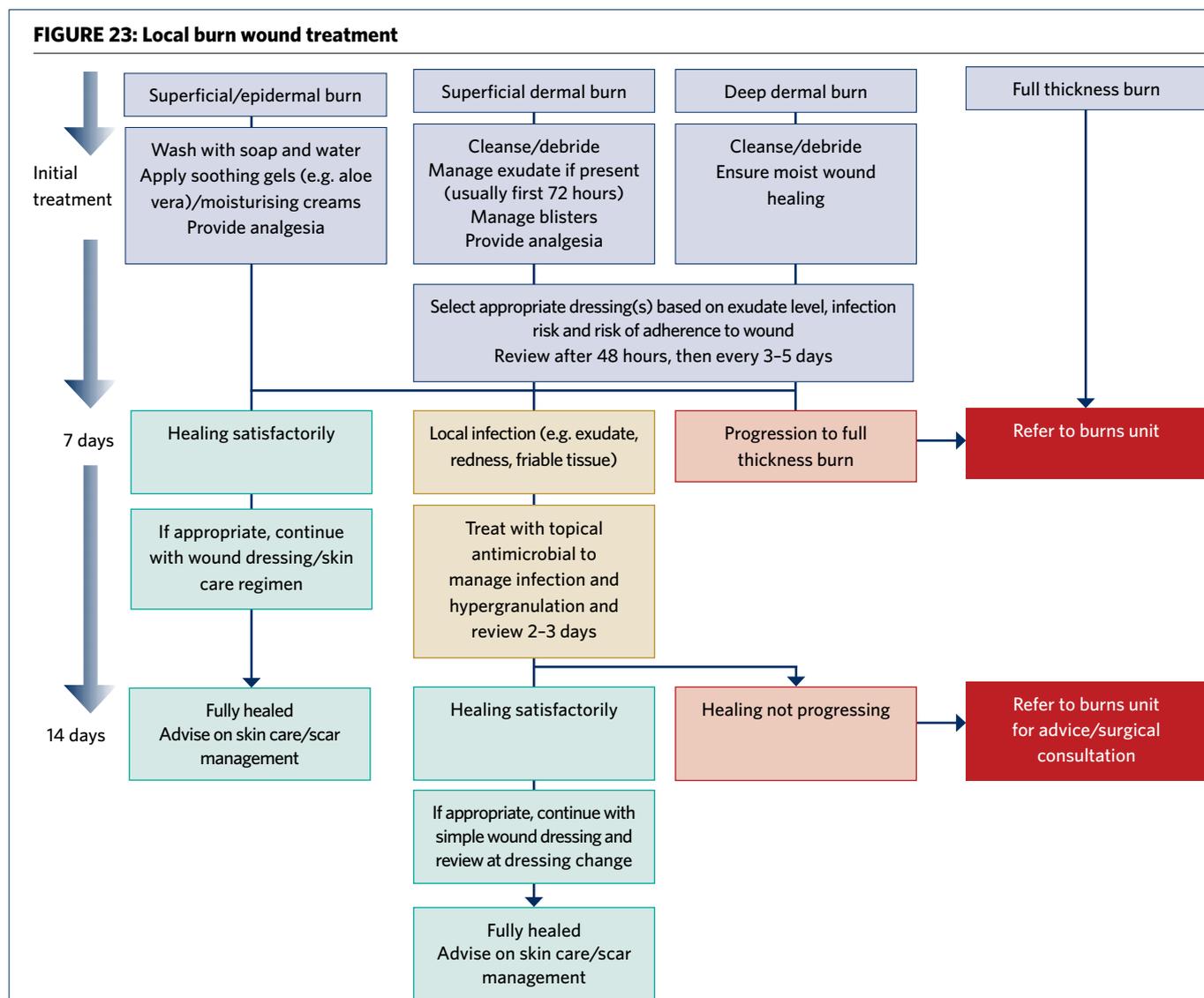
The care of patients with non-complex burn injuries is usually nurse-led, and services should be aimed at:

- Preventing or reducing the risk of wound infection
- Applying moist wound care
- Optimising pain relief
- Providing patient education.

Local burn wound management is one of the most important aspects of burn therapy after the emergency treatment phase and can have considerable influence on time to healing⁵⁴. The goals of local wound management are the prevention of dessication of viable tissue

and control of bacteria through moist wound healing (Figure 23). Superficial and superficial dermal burns generally heal rapidly (within one week) with the support of simple measures (e.g. soothing gels, such as aloe vera), while dermal burns will require a secondary dressing and may take up to 2 weeks to heal. Factors that delay healing or lead to wound progression include wound infection, presence of hypergranulation tissue, wound dessication and systemic issues such as hypotension. Deep dermal wounds are more difficult to treat, but some will heal without surgical intervention if a moist wound environment that is free from infection is encouraged.

FIGURE 23: Local burn wound treatment



CLEANSING AND DEBRIDEMENT

A new burn is essentially sterile and it is important to keep it clean and moist to promote the development of healthy granulation tissue. To minimise the risk of microbial contamination, all wounds should undergo some form of cleansing to remove foreign bodies, soluble debris, necrotic tissue or slough, all of which can become a focus for infection^{1,39,53}. Irrigation is the preferred method for cleansing wounds, and various solutions can be used, including normal saline or warm tap water. Mild soap may also be used. Topical wound irrigation solutions containing topical antiseptics (e.g. polyhexamethylene biguanide [PHMB]) can be considered to maintain a low bacterial load, reducing the risk of infection^{55, 56} and improving time to healing⁵⁵.

Wound cleansing is an integral part of burn management. To optimise burn wound healing, further evidence-based studies to confirm the positive effects of topical antimicrobial agents are needed to form a unified approach⁵⁷.

Debridement of the wound and wound edges to remove necrotic tissue can reduce the risk of infection and encourage epithelialisation³⁰. This may be a one-off debridement or ongoing for maintenance. It is important to use a debridement method that is appropriate to the location of the wound, amount of tissue to be removed and the needs of the patient as well as the skill of the healthcare professional⁵⁸. Appropriate analgesia should be given before dressing change — it should not be painful for the patient. If surgical debridement is indicated, the patient should be sedated and given a general anaesthetic.

Managing blisters

The general consensus is that blisters greater than 1cm² should be deroofed, while smaller blisters should be left intact¹⁶. Blisters on the palm of the hand should be left intact (as deroofing is painful here) unless they restrict movement²⁵ (Figures 24 and 25). After deroofing, any remaining dead skin should be removed with sterile scissors.

At this point, you should also take swabs for microbiology if infection is suspected, although giving routine prophylactic antibiotics is not recommended^{1,13,53,59}.

Taking photos of the wound will help monitor healing progress and may be useful if specialist advice about assessment and treatment needs to be sought.

BURN WOUND DRESSINGS

Selecting a dressing

A wide variety of dressings is available for the treatment of partial thickness burn wounds, but none has strong evidence to support their use⁶⁰. Understanding the key principles of dressing selection will help to simplify the process.

Traditional dressings include a combination of paraffin-impregnated gauze and an absorbent cotton wool layer⁶¹. However, these simple dressings tend to adhere to the wound surface⁵³.

Advances in dressing technology has led to a wider range of dressing options, some of which may offer advantages over traditional products in terms of time to healing, pain experienced and frequency of dressing changes⁶⁰. The characteristics of a good burn wound dressing have been described as⁵³:

- Maintains a moist wound environment
- Contours easily
- Non-adherent to protect delicate skin
- Retains close contact with the wound bed
- Easy to apply and remove
- Painless on application and removal
- Protects against infection
- Cost-effective.

A simple non-adhesive wound contact layer with a secondary absorbent layer is effective for most non-complex superficial dermal burns (Table 3). Pain is also an important consideration and, where possible, non-adherent products (e.g. incorporating soft silicone) should be considered. These can remain in place for a few days, allowing the wound bed remain undisturbed. The secondary absorbent layer can be changed more often to manage exudate⁶².

Where a burn injury is a mixture of depths, your choice of dressing should be based on the predominant depth²⁶.

In some LMICs the use of expensive commercially produced dressing products may not be viable. The development of cheaper,



Figure 24: Blisters are common features of superficial dermal burns. The skin covering the blister is dead and is separated from the base by inflammatory oedema fluid (blister fluid). Photo courtesy Professor Heinz Rode



Figure 25: When the blister ruptures (or is deroofed), the underlying dermis is exposed. Dessication of the exposed dermis may affect the depth of tissue loss. Photo courtesy Professor Heinz Rode

FIGURE 26: Dressing selection based on extent of burn injury

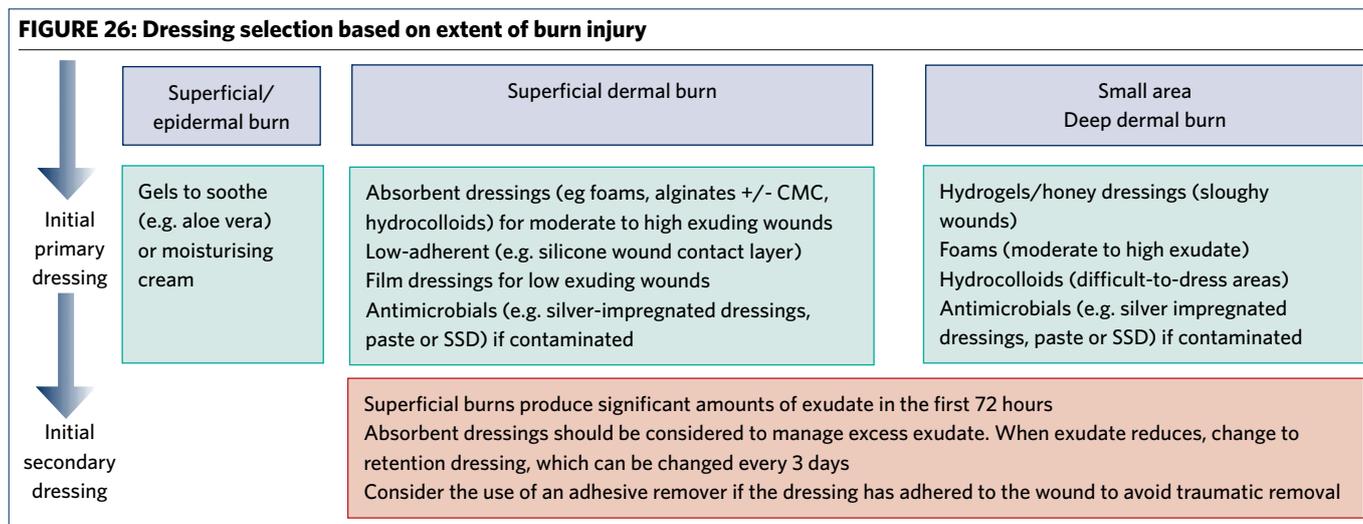


TABLE 3: Common dressing types for non-complex burns

Type	Description	Actions	Indications/use	Precautions/contra-indications
Alginate/carboxymethyl cellulose (CMC)	Alginates are a natural wound dressing derived from algae and seaweed These may be combined with CMC gelling fibres Dressings made from CMC alone are known as Hydrofiber	Absorbs fluid Promotes autolytic debridement Moisture control Conforms to wound bed	Moderate to high exudate	Do not use on dry wounds Use with caution on friable tissue (may cause bleeding)
Foam	Generally made from a hydrophilic polyurethane foam	Absorbs fluid Moisture control Conforms to wound bed	Moderate to high exudate May be left in place for 2-3 days	Do not use on burn wounds with minimal exudate
Honey	Wound dressing incorporating medical-grade honey	Antimicrobial	Sloughy, low to moderate exudate wounds and/or evidence of local infection	May cause 'drawing' pain (osmotic effect) Known sensitivity
Hydrocolloid	Opaque dressing made of gel-forming components. Dressings are biodegradable, non-breathable (occlusive) and adhere to the skin	Absorbs fluid Promotes autolytic debridement	'Difficult-to-dress areas', such as digits, heel, elbow, sacrum	Do not use on highly exuding burns May cause maceration May cause hypergranulation
Hydrogels	Hydrophilic polymer dressing	Moisture control Promotes autolytic debridement Cooling	Sloughy wounds	Do not use on highly exuding wounds or where anaerobic infection is suspected May cause maceration
Low-adherent	Wound contact layer or dressing with silicone or lipo-colloid matrix	Protects new tissue growth Atraumatic to periwound skin Conformable to body contours	Low or minimal exudate	Known sensitivity to silicone
Polyhexanide (PHMB)	Antiseptic impregnated dressing	Antimicrobial	Low to high exuding wounds Clinical signs of local infection	Known sensitivity to PHMB
Polyurethane film	Semi-permeable dressing	Moisture control Breathable bacterial barrier Transparent (allows visualisation of wound)	Low exudate May be left in place for 2-3 days	Should not be used in infected or heavily exuding burns
Silver	Topical preparations including SSD cream, impregnated dressings and paste Combined presentation with foam and alginates/CMC for increased absorbency	Antimicrobial	Clinical signs of local infection Low to high exudate	Some may cause discolouration Known sensitivity Discontinue after 2 weeks if no improvement and re-evaluate

alternative dressings using locally sourced materials, including banana leaf dressings, honey, papaya, and boiled potato peel bandages have been shown to be effective in the management of burn injuries³⁰.

Role of antimicrobials in preventing and treating infection

Wound infections are one of the most serious problems that occur in the acute phase after a burn injury⁶³. Topical antimicrobials can be used for prevention of infection in extended burns and are indicated in the presence of signs and symptoms of local infection (e.g. slough, hypergranulation tissue, dark/friable granulation tissue). Topical antimicrobials should be efficacious without increasing the risk of resistance or allergic reactions⁶⁴. They should also allow visual inspection, and balance dehydration with risk of maceration⁶⁴.

The most commonly used topical antimicrobial in burn wounds is silver sulfadiazine (SSD) cream (Flamazine[®]). This is a broad-spectrum agent, which is effective against Gram-negative bacteria (e.g. *Pseudomonas*). It can be applied as a 1cm thick layer and needs to be washed off and redressed daily. However, SSD cream may itself delay healing due to a toxic effect⁶⁰. Impregnated dressings or pastes, using other forms of silver, most notably elemental silver or in the ionic state (Ag^+), have been demonstrated to have a broad antimicrobial effect⁶⁵⁻⁶⁷ and may have some benefit over SSD dressings in terms of time to healing⁶⁰.

Prophylactic use of systemic antibiotics is not recommended. However, systemic antibiotics may be given in patients with suspected toxic epidermal necrolysis or beta haemolytic streptococcus infection.

Applying a dressing

When applying dressings it is important to use an aseptic or non-touch technique⁶⁸ to reduce the risk of cross-infection.

Ensure dressings do not impede patient mobility and are secured to prevent slippage¹⁶. To avoid damaging fragile or newly healed skin, adhesive tape should not be applied and non-adhesive dressings or retention bandages selected. Patients should be advised to keep the dressing clean and dry and

to have the dressing changed if it is wet or dirty, loose or smelling offensive⁶⁹.

Dressing changes

The first dressing change should be 48 hours after injury and then every 3-5 days thereafter, depending on how healing is progressing.

Where possible, dressings that have a tendency to adhere to the skin — such as alginate and paraffin gauze (Jelonet[®]) dressings — should be avoided and modern alternatives such as a soft silicone wound contact layer and foam dressing should be used to ensure atraumatic and pain-free removal.

Dressings should be changed immediately if they become painful, foul smelling or saturated (strikethrough). It is important to remind patients to look out for these signs and to monitor for signs of infection.

Any non-complex burn wound that has not healed within 2 weeks should be referred to a burn surgeon for possible excision and grafting^{11,53}.

Where the patient refuses referral or hospital or surgical intervention, a conservative approach may be adopted using Flammacerium[®] (cerium nitrate-silver sulfadiazine)⁷⁰. This may also be used in patients not suitable for surgery because of comorbidity, general age or frailty. The product is thought reduce the inflammatory response to burn injury, decrease bacterial colonisation and provide a firm eschar for improved wound management⁷⁰.

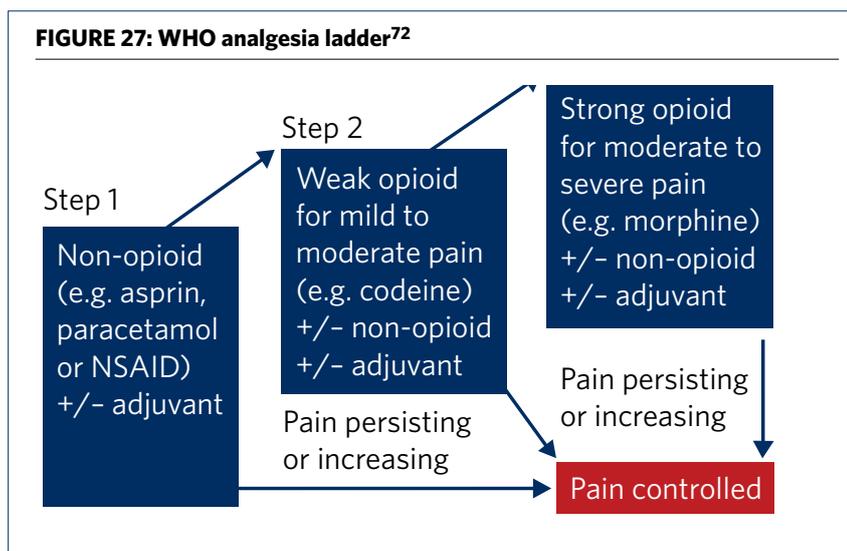
PAIN MANAGEMENT

Pain management in patients with burn injuries is often inadequate; pain is commonly underestimated and under-treated, even in specialist burn units⁷¹.

Ideally, all patients should have a pain management plan based on individualised pain scores¹. A structured approach to pain management should be used, for example based on the WHO analgesic ladder (Figure 27)^{1,72}.

Superficial burn injuries can be extremely painful. The pain can be exacerbated by

FIGURE 27: WHO analgesia ladder⁷²



procedures such as cleansing and debridement, dressing changes, application of gels or creams and physiotherapy. If not already given, analgesia should be provided well before of any interventions are performed. If necessary, procedures should be delayed to allow pain relief to reach its full effect⁷³.

It is important to ask about pain at dressing changes. Pain ratings can be recorded throughout the day using a simple 4- or 10-point pain scale to inform the dosing regimen for managing background pain. Inadequate control of pain (score of 4 or greater on a scale of 0-10) can increase patients' anxiety, which may lead to negative associations with wound care interventions^{73,74}.

Non-pharmacological measures (e.g. hypnosis, cognitive behavioural therapy and relaxation techniques) can also be considered if they are available locally¹. The value of friendly conversation and distraction techniques should not be underestimated, and children can be encouraged to take part in dressing changes to put them at ease⁷⁴.

Patients often describe pain when they are actually experiencing itching. It is important to help the patient distinguish between these sensations to avoid unnecessary use of opioids. The benefits of pain relief should be clearly explained (especially in relation to night pain, which can cause sleep disturbance) to improve concordance with treatment and reduce risk of anxiety and depression.

Pain that becomes more frequent or intense should trigger a review of the pain management plan, and it may be necessary to change the patient's regular analgesia⁷⁴.

PATIENT EDUCATION

Patients may forget instructions when they are in pain or upset by their burn injury⁴¹. Written information should be provided at the key stages of management to help patients and their families or carers make informed decisions about their care. It should be clear, understandable, evidence based and culturally sensitive⁷⁵.

The UK National Burn Care Network recommends that all patients should be given information on⁷⁵:

- Pain and itch management
- Resuming activities of daily living
- Preventing burns in the future
- Recognition of complications associated with a burn injury
- Aftercare of the burn wound (scar management and protection)
- Psychosocial care, information and support available
- Key contact details (including 24-hour access to the clinical team)
- Patient support groups
- Follow-up appointment details and location.

Continuing care of patients with a burn injury

Follow-up care after burn injury with support from the multidisciplinary team is necessary to ensure all aspects of care are coordinated and patient needs are met

The effects of burn injuries — both physical and psychological — are long lasting. Providing continuous, holistic and, preferably, multidisciplinary care with long-term follow-up will help to prevent the acute wound becoming a chronic disability.

GENERAL HEALTH

To improve burn wound healing and general health, encourage patients to:

- Eat a high-calorie/high-protein diet with fresh fruit and vegetables and avoid refined foods and commercially-baked products
- Maintain hydration — drink 6–8 glasses of water a day and avoid caffeine and alcohol
- Take a multivitamin or daily nutritional supplement (especially in those who are immunocompromised)
- Stop smoking
- Attend to basic principles of cleanliness and good personal hygiene.

SKIN CARE

Healed burns can be sensitive, develop dry, scaly skin and have irregular pigmentation. The skin is delicate and vulnerable to injury. The area should be moisturised daily with a non-perfumed emollient (e.g. mineral oil/baby oil, petroleum jelly or almond or coconut oil) and massaged using a downwards, circular motion to reduce dryness and to keep the healed area supple. This should be continued until the burn area is no longer dry or itchy (usually around 3–6 months, but emollients may need to be applied for up to 12 months).

The skin should be cleaned every day due to build up of moisturiser, which can cause irritation. Once dressings are no longer required, patients may take a bath or shower. Using non-perfumed products will help to prevent skin reactions⁶⁹.

Newly healed skin may be sensitive to temperature and can be numb in places. Patients should test the temperature of bath/shower water before immersion⁶⁹.

Patients should be advised to use a sun cream with a high sun protection factor

(30–50) for 12–24 months to prevent further thermal damage and pigmentation changes. This is important even in temperate European countries from March/April. In all regions, when the sun is strong patients should also wear a hat, long-sleeved tops and trousers if going outside and should avoid sun exposure between noon and 4pm. If the new skin is allowed to tan, it may appear permanently blotchy⁶⁹.

BURN ITCH

Burn wound itching usually begins at the time of wound closure and peaks at 2–6 months after injury⁷⁶. It can be worsened by heat, stress and physical activity¹⁶. There are no preventative measures, with the exception of skin moisturisers, to maintain moisture and hydration. These may be combined with a suitable aromatherapy product (consult local aromatherapy specialist) or topical antihistamine to ease itching⁷⁶.

Oral medication, including antihistamines (such as chlorphenamine) and analgesics may also help¹⁶. Custom-made pressure garments can also be considered to reduce itching. Keeping the area cool (e.g. by using a fan, keeping towels or moisturiser in the fridge and wearing loose clothing made of natural materials) and relaxation, distraction and desensitisation techniques can provide relief⁷⁷.

Patients should be encouraged to keep fingernails short and to 'pat not scratch'. For those affected by night-time itching, patients should take an antihistamine before bedtime to reduce the risk of scratching at night.

HYPERTROPHIC SCARRING

The overlying skin on a healed burn injury should be soft, flat, pale in colour and barely visible⁷⁷. In deep burns and where healing has been delayed, however, abnormal hypertrophic scarring may occur 4–6 weeks following injury to the deep dermis (Figure 28). Factors that increase the risk of hypertrophic scarring are given in Box 12.

BOX 12: RISK FACTORS FOR HYPERTROPHIC SCARRING

- Inadequate first aid and fluid resuscitation
- Suboptimal wound and dressing management
- Burn wound infection
- Position in hospital
- Concomitant medical conditions
- Deeper burn depth



Figure 28: Hypertrophic scarring. Photo courtesy Professor Franck Duteille



Figure 29: Scar with retraction. Photo courtesy Professor Franck Duteille

In a retrospective follow-up study of children with burn injuries, hypertrophic scarring had occurred in less than 20% of superficial scalds that healed within 21 days, but it occurred in up to 90% of injuries that took 30 days or more to heal².

Hypertrophic scarring results from the build-up of a dense, thick, non-uniform layer of collagen fibres during wound healing⁷⁷. The classic signs of a hypertrophic scar are described in terms of the 3Rs — raised, rigid and red⁷⁸. Other features include⁷⁸:

- Altered pigmentation
- Contractures (shortening of the scar and underlying tissues after the wound has closed) (Figure 29, p19)
- Altered sensation
- Pain
- Itch.

The scar becomes smaller and less visible with time, although it can take up to 2 years for the scarring to fully settle⁶⁹. Lack of elastin means the scar is less pliable than normal skin and, when combined with contractures, this may limit mobility (for example, reduced ability to straighten the leg when scarring occurs behind the knee)⁷⁸.

Managing hypertrophic scarring

Massage and moisturising

Some scars may respond to simple measures, such as massage and moisturising. A non-perfumed emollient should be massaged into the skin two to three times a day, using a circular motion that is firm enough to cause the skin to blanch. This action helps to realign the collagen fibres into a more normal, uniform pattern⁷⁸.

Pressure garments

Pressure is thought to encourage reorientation of the collagen fibres and quicken the maturation of the scar^{77,79}. Wearing a pressure garment appears to reduce redness and soften and flatten the scar⁷⁸. Classic pressure garments may also be combined with a silicone silastic sheet, gelsheet or pad⁷⁹.

Pressure garments must be worn for up to 23 hours a day for one to two years, depending on the extent of scarring. Patients need to be referred to a specialist burns service to be individually measured and they may need to be remeasured every 3

months as the size and shape of the scar changes^{77,80}.

Contact media

Silicone gel sheets and elastomer moulds can be used to soften and flatten the scar, reduce redness and increase pliability^{78,79}. Silicone sheets are worn for up to 23 hours a day, but should be removed once or twice a day to clean the scar and avoid maceration of the skin. Elastomer moulds are useful for areas where it is difficult to mould the silicone, such as toes and the web spaces between them^{65,77,79}.

Physiotherapy

Patients with hypertrophic scars should be referred to a physiotherapist for support with maintaining movement and function. If contractures develop, the physiotherapist can fit an individually tailored thermoplastic splint, which will apply a stretch to the scar tissue⁷⁸. Usually patients are advised to wear the splint overnight and then exercise the area, or use the area as normally as possible, during the day.

Camouflage

Camouflaging cosmetics are a useful adjunct and can increase confidence and self-esteem. Patients should be referred to specialist scar services, where available, where a consultant will help select the most appropriate shade and advise on application. Products may also be available in high-street make-up counters and via some charities. Not all scars will benefit from camouflaging cosmetics (e.g. some scars with varying texture or contours) and it is important to manage patients' expectations⁷⁸.

MULTIDISCIPLINARY SUPPORT

Once the burn wound itself has healed, patients must come to terms with the emotional and physical after-effects of the injury. Multidisciplinary support from the community team is vital at this time of transition.

Psychosocial support

Burn injuries — even minor ones — can have a devastating impact on the psychological health of a patient. For example, coping with flashbacks, changes in body image, and the stress of returning to work can continue for months or years after the initial event, with a subsequent deterioration in quality of life.

All patients — even those who appear on the surface to be coping — should receive planned follow-up appointments and be screened for symptoms of distress. Psychotherapy must be offered if needed.

Depression has a significant prevalence in burns patients as a consequence of their injury and the impacts on their lives¹.

It is important to identify signs and symptoms of anxiety and depression and provide specialist management to maximise quality of life and prevent future problems. Guidelines (many produced by associations/societies) and local protocols should be followed^{1,81,82} (Box 13).

Support groups, peer counselling and burn camps can be important. Major burn centres should have a network of burns survivors who are willing to talk to patients⁸³ (Box 13).

Physiotherapy/occupational therapy

All healed scars should be reviewed at two months to identify patients with physical limitations. Where necessary, patients should be referred for physiotherapy and/or occupational therapy for help with exercise, general day-to-day activities and scar management.

Continuous and consistent support and advice is essential to help motivate patients. Patients should be encouraged to take responsibility for their treatment⁷⁷.

Returning to work

Most patients will want to return to their previous quality/standard of life as quickly as possible and this should be encouraged. However, some patients will need to take long periods off work and may be under pressure by insurance companies to return to work quickly. Also, on returning they may need to negotiate changes to their hours, days or job status. Ideally, all working-age patients should be offered an individualised vocational rehabilitation plan and a professional counsellor who can guide them through the return-to-work process¹. However, this is not likely to be a realistic goal in developing countries where, for example, a 90% drop-out from rehabilitation occurs after 1 year.

Healthcare professionals should acknowledge patients' return to work as an important factor in wellbeing, self-perceived health and quality of life¹.

Children and their families

Families of children who have been burnt may suffer profound psychological, emotional, social and financial consequences^{1,84}. The European Burns Association states that healthcare professionals should¹:

- Offer continuous psychosocial support at all stages of a child's recovery
- Promote cohesion, reduce conflict and increase the stability of families
- Adapt to individual needs and pay special attention to cultural aspects.

Involving the family in the general care of the child's wound can help promote positive feelings¹.

Preparation for returning to school should begin early and should take into consideration the developmental level of the child, the style and needs of the child and of their family, and support for teachers¹.

BURN PREVENTION

Greater application of educational programmes in schools and public health campaigns can help to lower the burden of burn injury globally. These have been successful, especially in LMICs⁸⁵. This is especially important due to lack of resources and specialist burn facilities in these regions^{21,86}.

Simple safety measures can reduce the risk of burn injury:

- Install smoke alarms in strategic locations
- Make a fire-escape plan
- Set water temperature at 50 °C and install thermostatic mixer taps
- Put cold water in the bath first and test water
- Follow safety measures in the kitchen, bathroom and outside area
- Store cleaning solutions and paints in containers in well-ventilated areas and keep out of reach of children
- Store matches safely
- Take care with any flammable substances used to start fires, such as lighter fluid
- Check electrical appliances regularly.

BOX 13: USEFUL LINKS

- American Burn Association www.ameriburn.org
- Australian New Zealand Burn Association www.anzba.org.au
- British Burn Association www.britishburnassociation.org/
- European Burns Association euroburn.org
- Euro-Mediterranean Council for Burns www.medbc.com
- International Society for Burn Injuries www.worldburn.org

Journals:

- Annals of Burns and Fire Disasters www.medbc.com/annals/
- Burns www.sciencedirect.com/science/journal/03054179
- Burn & Trauma www.burnstrauma.com
- Journal of Burn Care & Research www.burncareresearch.com
- International Journal of Burns and Trauma www.ijbt.org

Patient support:

- Changing Faces www.changingfaces.org.uk
- Katie Piper Foundation www.katiepiperfoundation.org.uk
- WAFS Burn camp wafs.org/summer_camp.asp

- European Burn Association. European practice guidelines for burn care. Minimum level of burn care provision in Europe. Vienna, Austria: EBA, 2013 <http://euroburn.org/142/guidelines.html>
- Cubison TCS, Pape SA, Parkhouse N. Evidence for the link between healing time and the development of hypertrophic scars (HTS) in paediatric burns due to scald. *Burns* 2006;32:992-9
- Atiyeh B, Masellis A, Conte C. Optimizing burn treatment in developing low- and middle-income countries with limited healthcare resources (Part 1). *Ann Burns Fire Disasters* 2009;22:121-5
- Ahuja RB, Bhattacharya S. ABC of burns. Burns in the developing world and burn disasters. *BMJ* 2004;329:447-9
- World Health Organization. Burns. Fact sheet No 365. WHO, 2012. Available at: <http://www.who.int/mediacentre/factsheets/fs365/en/>
- Atiyeh BS, Costagliola M, Hayek SN, Dibo SA. Effect of silver on burn wound infection control and healing: review of the literature. *Burns* 2007;33:139-48
- Atiyeh B, Masellis A, Conte C. Optimizing burn treatment in developing low- and middle-income countries with limited healthcare resources (Part 3). *Ann Burns Fire Disasters* 2010;23:13-8
- Albertyn R, Bickler SW, Rode H. Pediatric burn injuries in Sub-Saharan Africa: an overview. *Burns* 2006; 32:605-2
- Bloemsma GC, Dokter J, Boxma H, Oen IM. Mortality and causes of death in a burn centre. *Burns* 2008;34:1103-7
- Enoch S, Roshan A, Shah M. Emergency and early management of burns and scalds. *BMJ* 2009;338:b1037
- National Burn Care Review. National burn injury referral guidelines. In: Standards and strategy for burn care. London: NBCR, 2001:68-9
- Brigham PA, McLoughlin E. Burn incidence and medical care in the United States: estimates, trends, and data sources. *J Burn Care Rehabil* 1996;17:95-107
- American Burn Association. Burn incidence and treatment in the United States: 2013 fact sheet. ABA, 2013. http://www.ameriburn.org/resources_factsheet.php
- Brusselsaers N, Monstrey S, Vogelaers D, et al. Severe burn injury in Europe: a systematic review of the incidence, etiology, morbidity, and mortality. *Critical Care* 2010;14:R188
- Becker D. On burn disease. *Ann Burns Fire Disasters* 2001;14:163-7
- Hudspith J, Rayatt S. ABC of burns. First aid and treatment of minor burns. *BMJ* 2004;328:1487-9
- Rea S, Kuthubutheen J, Fowler B, Wood F. Burn first aid in Western Australia—do healthcare workers have the knowledge? *Burns* 2005;31:1029-34
- Bezuhly M, Gomez M, Fish JS. Emergency department management of minor burns injuries in Ontario, Canada. *Burns* 2004;30:160-4
- Monstrey S, Hoeksema H, Verblenen J, Pirayesh A, Blondeel P. Assessment of burn depth and burn wound healing potential. *Burns* 2008;34:761-9
- Agbenorku P, Agbenorku M, Fiifi-Yankson KP. Pediatric burns mortality risk factors in a developing country's tertiary burns intensive care unit. *Int J Burns Trauma* 2013;3:151-8
- Forjuoh SN. Burns in low- and middle-income countries: a review of available literature on descriptive epidemiology, risk factors, treatment, and prevention. *Burns* 2006;32:529-37
- Van Niekerk H, Rode H, Laflamme L. Incidence and patterns of childhood injuries in the Western Cape, South Africa. *Burns* 2004;30:341-7
- Hettiaratchy S, Dziewulski P. ABC of burns. Introduction. *BMJ* 2004;328:1366-8
- Clarke J. Burns. *Br Med Bull* 1999;55:885-94
- Hettiaratchy S, Dziewulski P. ABC of burns. Pathophysiology and types of burns. *BMJ* 2004;328:1427-9
- Senarath-Yapa K, Enoch S. Management of burns in the community. *Wounds UK* 2009;5:38-48
- Venter TH, Karpelowsky JS, Rode H. Cooling of the burn wound: the ideal temperature of the coolant. *Burns* 2007; 33:917-22
- Yuan J, Wu C, Holland AJA, et al. Assessment of cooling on an acute scald burn injury in a porcine model. *J Burn Care* 2007;28:514-20
- British Burn Association. Emergency management of severe burns course manual, UK version. Wythenshawe Hospital, Manchester, 2008
- Atiyeh B, Masellis A, Conte C. Optimizing burn treatment in developing low- and middle-income countries with limited healthcare resources (Part 2). *Ann Burns Fire Disasters* 2009;22:189-95
- Australian and New Zealand Burns Association. Initial management of severe burns 2013. <http://anzba.org.au/care/severe-burns/>
- Jandera V, Hudson DA, de Wet PM, et al. Cooling the burn. Evaluation of different modalities. *Burns* 2000;26:265-70
- Donoghue AM. Diphoteryne for alkali chemical splashes to the skin at alumina refineries. *Int J Dermatol* 2010;49:894-900
- Palao R, Monge I, Ruiz M, Barret JP. Chemical burns: pathophysiology and treatment. *Burns* 2010;36:295-304
- Van de Velde S, Broos P, van Bouwelena M et al. European first-aid guidelines. *Resuscitation* 2007;72:240-51
- Papini R. Management of burn injuries of various depths. *BMJ* 2004;329:158-60
- Allison K, Porter K. Consensus on the pre-hospital approach to burns patient management. *Emerg Med J* 2004;21:112-4
- Hettiaratchy S, Papini R. ABC of burns. Initial management of a major burn: I — overview. *BMJ* 2004;328:1555-7
- American Burn Association. Practice guidelines for burn care, 2001 www.Ameriburn.org
- Jennes S, Casaer M, Colpaert K, Magnette A. Les recommandations de la BABI sur le Management Pré Hospitalier et Intra Hospitalier des Grands Brûlés au cours des 72 premières heures post brûlure. www.brulures.be/index.php/management-pre-hospitalier-et-intra-hospitalier/fr/
- Fowler A. The management of non-complex burns within the community. *Nursing Times* 2003;99:49-55
- Minimus DA. A critical evaluation of the Lund and Browder chart. *Wounds UK* 2007;3:58-68
- Wallace AB. The exposure treatment of burns. *Lancet* 1951;1: 501-4
- Nagel TR1, Schunk JE. Using the hand to estimate the surface area of a burn in children. *Pediatr Emerg Care* 1997;13(4):254-5
- Hammond JS, Ward CG. Transfers from emergency room to burn center: errors in burn size estimate. *J Trauma* 1987;27:1161-5
- Nichter LS, Bryant CA, Edlich RF. Efficacy of burned surface area estimates calculated from charts—the need for a computer-based model. *J Trauma* 1985;25:477-81
- Chipp E, Walton J, Garman DF, Moiemens NS. A 1-year study of burn injuries in a British emergency department. *Burns* 2008;34:516-20
- La Hei ER, Holland A, Martin H. Laser Doppler imaging of paediatric burns: burn wound outcome can be predicted independent of clinical examination. *Burns* 2006;32:550-3
- Souter D. How to assess accurate burn depth. *Wound Essentials* 2010;5:94-101
- British Association for Parenteral and Enteral Nutrition. The MUST Report; Nutritional Screening of Adults a Multi-disciplinary Responsibility. BAPN, 2003. Available at: http://www.bapen.org.uk/pdfs/must/must_exec_sum.pdf
- Herndon DN. Total burn care (third edn). Saunders Elsevier, Galveston, 2007
- Rode H, Millar AJ, Cywes S, et al. Thermal injury in pregnancy - the neglected tragedy. *S Afr Med J* 1990;77:346-8
- Alsbjörn B, Gilbert P, Hartmann B, Kazmierski M, Monstrey S, Palao R, et al. Guidelines for the management of partial-thickness burns in a general hospital or community setting - recommendations of a European Working Party. *Burns* 2007;33:155-60
- Atiyeh BS, Ibrahim A, Hayek SN. Burn wound cleansing: an efficient evidence-based treatment modality or a ritualistic practice. *J Wound Technol* 2010;7:6-10
- Wardhana A, Nindita E. The use of PHMB (polyhexamethylene biguanide) and Betaine Surfactant irrigation solution and gel in burn injuries. Presentation at 15th European Burns Association Congress, Vienna, Austria, August 2013
- Coetzee EE, Whitelow A, Khan D, Rode H. The use of topical, un-

- buffered sodium hypochlorite for 20 minutes to the burn wound. *Burns* 2012;38(4):529-33
57. Atiyeh BS, Dibo SA, Hayek SN. Wound cleansing, topical antiseptics and wound healing. *Int Wound J* 2009;6:420-30
 58. Wounds UK. Effective debridement in a changing NHS: A consensus document. Wounds UK, 2013. Available from: www.wounds-uk.com
 59. Ugburo AO, Atoyebi OA, Oyenyin JO, Sowemino GO. An evaluation of the role of systemic antibiotic prophylaxis in the control of burn wound infection. *Burns* 2004;30:43-8
 60. Wasiak J, Cleland H, Campbell F, Spinks A. Dressings for superficial and partial thickness burns. Cochrane Database of Systematic Reviews 2013, Issue 3. Art. No.: CD002106. DOI: 10.1002/14651858.CD002106.pub4
 61. Hudspith J. First aid and treatment of minor burns. *BMJ* 2004; 328(7454):1487-9.
 62. Atiyeh BS, Hayek SN, Gunn SW. New technologies for burn wound closure and healing - review of the literature. *Burns* 2005;31:944-56
 63. Edwards J. Use of Silvercel Non-Adherent on burn wounds: a case series. *Wounds UK* 2013;9:81-4
 64. Magnette A. Sharing expertise: skin and wound management — Burns. B Braun, 2012.
 65. Atiyeh BS. Non-surgical management of hypertrophic scars (Hss): evidence-based therapies, standard practices and emerging modalities. *Aesthetic Plast Surg* 2007;31:468-92
 66. Cutting K, White R, Edmonds M. The safety and efficacy of dressings with silver - addressing clinical concerns. *Int Wound J* 2007;4:177-84
 67. Wounds International. International Consensus: Appropriate use of silver dressings for wounds. London: Wounds International, 2012. Available from: www.woundsinternational.com
 68. Rowley S, Clare S. ANTT: a standard approach to aseptic technique. *Nurs Times* 2011; 107(36):12-4
 69. North Bristol NHS Trust. Caring for your child following a burn or scald injury. 2012. www.nbt.nhs.uk/webfm_send/1153
 70. Garner JP, Heppell PS. Cerium nitrate in the management of burns. *Burns* 2005;31:539-47.
 71. Patterson DR, Hofland HW, Espey K, Sharar S. Nursing Committee of the International Society for Burn Injuries. Pain management. *Burns* 2004;30:A10-15
 72. World Health Organization. WHO's pain relief ladder. WHO, 2014. Available at: www.who.int/cancer/palliative/painladder/en/
 73. World Union of Wound Healing Societies. Principles of Best Practice: minimising pain at wound dressing related procedures. A consensus document. London: MEP Ltd, 2004
 74. Judkins K, Clark L. Managing the pain of burn wounds. *Wounds UK* 2010;6:110-8
 75. National Network for Burn Care. National burn care standards. NNBC, 2013
 76. Demling RH, DeSanti L. Scar management strategies in wound care. *Rehab Manag* 2001;14(6):26-30
 77. Edgar D, Brereton M. ABC of burns. Rehabilitation after burn injury. *BMJ* 2004;239:343-5
 78. McGrory C. Reducing the impact of hypertrophic scarring. *Wounds UK* 2013;9:18-22
 79. Van den Kerckhove E, Stappaerts K, Boeckx W, et al. Silicones in the rehabilitation of burns: a review and overview. *Burns* 2001; 27:205-14
 80. Atiyeh BS, El-Khatib AM, Dibo SA. Pressure garment therapy (PGT) of burn scars: evidence-based efficacy. *Ann Burns Fire Disasters* 2013; 26:205-12
 81. National Institute for Health and Care Excellence. Depression: the treatment and management of depression in adults (update). Clinical guideline 90. London: NICE, 2009
 82. National Institute for Health and Care Excellence. Generalised anxiety disorder and panic disorder (with or without agoraphobia) in adults. Management in primary, secondary and community care. Clinical guideline 113. London: NICE, 2011
 83. Wiechman SA, Patterson DR. ABC of burns. Psychosocial aspects of burn injuries. *BMJ* 2004;329:391-3
 84. Phillips C, Fussell A, Rumsey N. Considerations for psychosocial support following burn injury - a family perspective. *Burns* 2007;33:986-94
 85. Atiyeh BS, Costagliola M, Hayek SN. Burn prevention mechanisms and outcomes: pitfalls, failures and successes. *Burns* 2009;35:181-93
 86. World Health Organization. Facts about injuries: burns. http://www.who.int/violence_injury_prevention/publications/other_injury/en/burns_factsheet.pdf



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