

HOW TO ASSESS ACCURATE BURN DEPTH

Burn depth is a key determinant of a patient's long-term health, function and appearance and accurate assessment of burn depth is crucial to determine the most appropriate treatment. This article examines how the nurse can ascertain the depth of a burn by using clinical evaluation.

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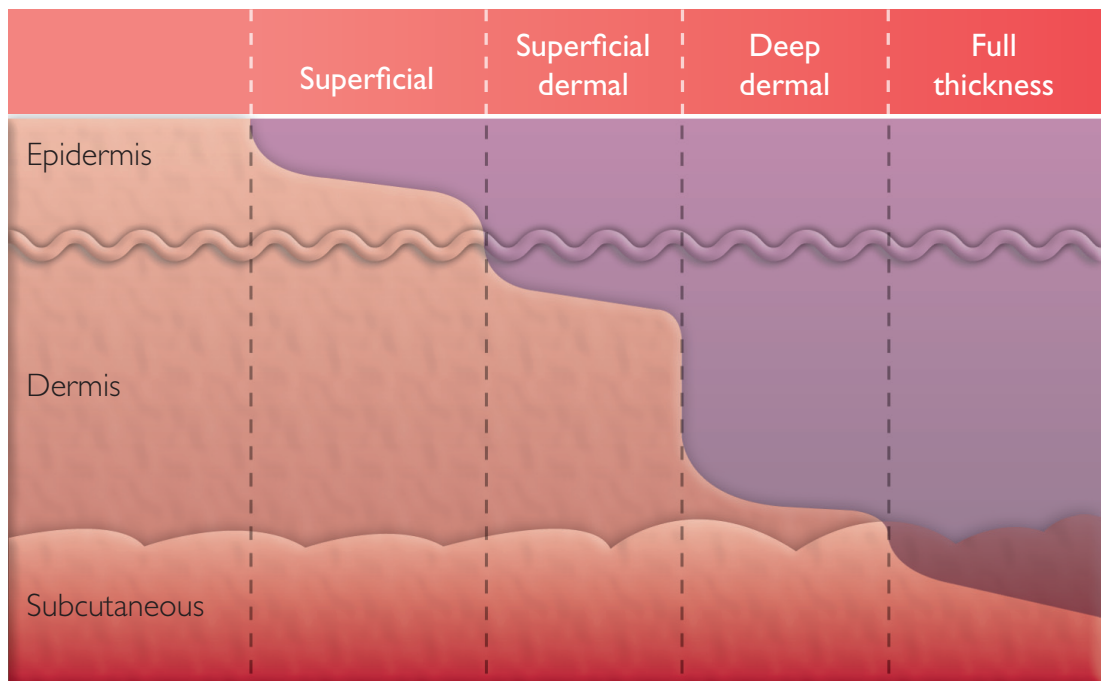


Figure 1. Diagram illustrating different burn depths.

Burn injuries are a common cause of death or ill-health globally (Enoch et al, 2009). Indeed, work undertaken by the National Burn Care Review (NBCR, 2001) found that in the UK alone approximately 250,000 people sustain burn injuries each year.

It is understood that appropriate management of such injuries is a crucial component in facilitating optimum recovery and preventing or limiting complications for these individuals. Consensus within the burn care literature suggests that timely, accurate and holistic assessment of burn wound depth

is one of the keys to meeting this aim (Monstrey et al, 2008; Emergency Management of Severe Burns [EMSB], 2008). Chipp et al (2008) found in their study that the majority of burns were partial thickness or had some component of that depth in them. Partial-thickness burns include:

- » Superficial burns
- » Superficial dermal burns
- » Deep dermal burns.

Thus superficial burns fall into the category of partial-thickness burns (Hettiaratchy and Papini, 2004).

This article will review best practice literature on how to assess burn depth, with particular reference to the superficial and superficial dermal burn.

Why is assessment important?

A good starting point is to consider why depth assessment is important. Depth assessment is important because burn depth is one of the primary determinants of a patient's long-term health, appearance and function, (Monstrey et al, 2008). Indeed, accurate and timely assessment is needed to promote optimum healing potential and thus reduce

complications such as infection, wound contracture and scarring (Monstrey et al, 2008).

The accuracy of assessment is crucial in order to start treatment that will facilitate optimum functional, cosmetic and psychological well being. This is especially significant when considering that treatment will differ according to the classification of depth (Devgan et al, 2006; Monstrey et al, 2008; Enoch et al, 2009).

Superficial burns generally heal with the help of appropriate measures that promote re-epithelialisation. These measures include treatment with appropriate dressings along with fluid and nutritional support (Papini, 2004). Such burns are then more likely to follow the path of normal wound healing. This in turn will reduce the complications associated with prolonged wound healing such as the increased potential for infection, wound contracture and hypertrophic (thick, raised) scarring.

Full-thickness burns generally need surgical intervention to assist with healing and to minimise the incidence of contracture and hypertrophic scarring that often occur as a consequence of deeper burns (Devgan et al, 2006). Inaccurate and/or delayed assessment can result in suboptimal outcomes and may even contribute to a superficial burn becoming deeper. Burn wound progression (Monstrey et al, 2008) is a phenomenon particular to burn injuries, whereby superficial burns can convert into deeper injuries. Although the mechanism

Table 1.

Glossary of terms (Brooker, 2008)

Basal metabolic rate	The rate at which energy is consumed at complete rest for essential physiological functions
Blister	Separation of the epidermis from the dermis with tissue fluid accumulation inbetween
Capillary refill time	Technique used to assess skin perfusion
Catabolism	The breakdown of complex substances into simpler ones
Dermis	Layer of dense connective tissue lying below the epidermis
Dessication	To dry out
Epidermis	The outer avascular layer of the skin. Comprises of several layers of cells that renew themselves
Erythema	Reddening of the skin
Hypertrophic	Increase in size of tissues or structures, independent of natural growth
Nociceptors	Receptors that respond to harmful stimuli that cause pain, such as trauma and inflammation
Macrovascular	Pertaining to or containing many large blood vessels
Metabolism	Biological processes that sustain life
Microvascular	Pertaining to or containing many small blood vessels
Patency	Not closed or occluded
Perfusion	The flow of blood through tissues and organs such as the skin
Scar	Dense, avascular fibrous tissue formed as the end result of healing, especially in the skin
Superficial	Near the surface
Subcutaneous	Beneath the surface

by which this process occurs is complex and not fully understood (Singh et al, 2007), a consensus within the literature suggests that appropriate and timely intervention may limit or even halt the process (Kao and Garner, 2000; Papini, 2004; Singh et al, 2007), thus the need for accurate assessment is crucial.

Classification of burn depth

Assessment of burn depth leads to classification into one of four categories:

- ▶▶ Superficial
- ▶▶ Superficial/dermal
- ▶▶ Deep dermal
- ▶▶ Full thickness.

However to understand these

classifications, it is first necessary to have an understanding of the skin's structure.

Skin consists of two parts; the outer, thinner part is called the epidermis. This consists of several layers of cells which help to protect the underlying skin, tissues and structures. The epidermis is attached to an inner, thicker layer consisting of connective tissue — this is called the dermis and contains an extensive network of blood vessels, nerve fibres, hair follicles and glands. Beneath the dermis is the subcutaneous layer. Although this is not part of the skin, it is a layer of fatty

tissue that is attached to the skin and also attaches to deeper underlying structures (Tortora and Grabowski, 1993).

Burn depth is categorised by the extent to which the layers of the skin are damaged (Hettiaratchy and Papini, 2004; EMSB, 2008):

- ▶ Superficial (epidermal burn): tissue damage to the epidermis only. Commonly seen in sunburn (Papini, 2004)
- ▶ Superficial/dermal: tissue damage extends through the epidermis into the upper layers of the dermis
- ▶ Deep dermal: tissue damage extends into the deeper layers of the dermis (normal healing associated with contraction and scarring)
- ▶ Full thickness: tissue damage that extends all the way through the dermis (sometimes down to fat (subcutaneous layer), or the underlying structures of muscle or bone. Healing occurs from edges of wound with considerable contraction and scarring).

Figure 1 demonstrates the different burn depths (Hettiaratchy and Papini, 2004). *Figure 1*, as well as the above descriptions of burn depth, neatly compartmentalises burns into different depths of tissue damage. Unfortunately, burn depth assessment is rarely that simple. This is because few burns are of a uniform depth. Indeed, it is universally recognised that the depth of most burns tends to be mixed (Hettiaratchy and Papini, 2004; Monstrey et al, 2008; Enoch et al, 2009). A number of methods exist to help facilitate the accuracy of assessment.

Assessment of burn depth

Biopsy and histology

Biopsy (medical test involving the removal of cells or tissues for examination) of burn wound tissue and then histological analysis (microscopic analysis of tissue) is used to find changes at a cellular and vascular level that would indicate a change in the nature of the tissues (Monstrey et al, 2008). This assessment is performed by a pathologist on thin sections of tissue using staining techniques.

Thermography

Thermography measures burn wound temperatures and works upon the principle that deeper wounds have a less viable blood supply and thus are cooler than superficial burns (Devgan et al, 2006).

Laser Doppler

Laser Doppler techniques again target blood supply as a means to measure burn wound depth. The Doppler principle states that when light waves are reflected off moving objects a change in frequency occurs (Devgan et al, 2006). Laser light is thus directed at burn-damaged tissues to demonstrate a frequency change that is proportional to the amount of perfusion (blood flow) in the tissues (Devgan et al, 2006).

These methods, although reliable, are not always available from a cost, practitioner experience and/or practical perspective. Nevertheless, an awareness of these techniques is a useful adjunct to a knowledge of burn management.

Clinical evaluation

Clinical evaluation is by far the

most widely used method of burn depth assessment. This involves a subjective assessment of the characteristics of the burn to diagnose its depth.

Key indicators of depth include (Hettiaratchy and Papini, 2004):

- ▶▶ The appearance of the burn
- ▶▶ The patency of the blood vessels within it
- ▶▶ The level of pain/sensation the patient may experience at the burn site.

When attempting to judge the appearance of the wound, nurses should look for the presence or absence of blisters and look at the colour of the wound bed.

Burns that blister are generally superficial/dermal in nature (Papini, 2004; EMSB, 2008). While deeper dermal burns can also produce blisters (EMSB, 2008), the colour of the exposed tissue when the blister has been deroofed can help to distinguish between these two depths. This highlights the importance of deroofing blisters and debriding dead skin in order to be able to assess the wound bed. A superficial/dermal burn commonly has a pale pink appearance, while a deep dermal burn may show a blotchy 'cherry red' base (Enoch et al, 2009). The significance of this colour difference is that the deeper, fixed red colour can indicate destruction of the larger blood vessels that lie at the bottom of the dermis and thus greater depth of tissue damage (EMSB, 2008).

This example highlights the relationship between burn depth and the patency of the blood vessels within the skin. Full-

thickness burns may appear white, brown, black or charred in appearance and often show evidence of destroyed vessels at the surface of the injury.

Superficial (epidermal) burns, like deep dermal burns, are red in colour (Enoch et al, 2009). This colour similarity may cause some confusion, however the fluidity of colour in superficial burns contrasts against the fixed colour of deep dermal burns and helps to distinguish differences in depth. This phenomenon again equates to blood vessel patency, which can be established by testing the amount of blood flow through the injury by means of testing capillary refill time.

Capillary refill

Testing capillary refill time can indicate the efficiency of blood flow (perfusion) through the skin. This can be done by applying pressure to the injured tissue with a gloved fingertip. If the tissue still has a blood supply, it will blanch on pressure. Its ability to refill with blood when the pressure is released will give clues as to its depth. This is indicated by colour returning to the skin.

A burn that rapidly refills with blood indicates that it still has a good blood supply and is thus more likely to be superficial (Hettiaratchy and Papini, 2004). A burn that regains its colour more slowly shows a restricted blood supply with more extensive vascular damage and thus a deeper injury. A full thickness burn will neither blanch nor refill to indicate a non-existent blood supply (Hettiaratchy and Papini, 2004).

This technique may be particularly useful in mixed depth burns when

it can be difficult to distinguish between sometimes subtle differences in wound appearance.

Sensitivity to touch

Testing what the patient can feel at the injury site is also an important adjunct to depth assessment. This is because the level of pain and sensation experienced at the burn site can also be a key indicator of burn depth (EMSB, 2008). The burn-injured individual may feel anything from a range of extreme pain and full sensation to no sensation/pain at all. To understand the significance of this phenomenon, it is necessary to have some knowledge of the mechanism of pain.

Immediate pain following burn injury is due to stimulation of nociceptors (Richardson and Mustard, 2009). Nociceptors are nerve receptors that detect pain. They reside in the epidermal and dermal layers of the skin and are stimulated in response to tissue damage. Generally, the deeper the burn the more damage there is to the nociceptors. Complete tissue destruction, like that seen in full-thickness burns, can entirely destroy nociceptors rendering the injury insensate (lacking in sensation) (Junger et al, 2002). This is why superficial burns can be extremely painful, yet a person with deep burns may feel no pain at all.

However, mixed depth burns can again complicate this assessment. This is because the patient may be unable to distinguish between insensate and painful areas. In this instance it is useful to test the presence or absence of pain and sensation

using a pin prick. This is done by testing various areas of burn with a sterile hypodermic needle (Hettiaratchy and Papini, 2004). Pain equates with a superficial or superficial/dermal burn — non-painful sensation equates with a deep dermal burn. While full-thickness injuries are insensate.

The nurse should ask patients to look away while testing sensation with a needle as they will then be unaware of the moment the needle touches the skin and, thus, are more likely to give an accurate indication of the presence or absence of pain and sensation

Although clinical evaluation of burn depth is the most widely used method of assessing burn wound depth, it is not 100% reliable (Monstrey et al, 2008). More accurate results are likely if clinical assessment modalities are not seen in isolation. Burn assessment literature highlights the interrelating nature of burn wound characteristics and the need to see these as combined entities in order to give a clearer picture of depth (*Table 2*) (Papini, 2004; EMSB, 2008; Enoch et al, 2009).

Emphasis on the importance of a holistic approach to assessment cannot be undervalued. That is why depth should not be established without also taking a full medical and social history from the patient.

Importance of history-taking

All of the relevant literature highlights the importance of establishing a history surrounding the patient's injury (Hettiaratchy and Papini, 2004; Enoch et al, 2009). This includes:

Table 2.

Burn wound characteristics

PARTIAL THICKNESS	Burn type	Appearance	Blisters	Capillary refill	Pain
	Superficial (epidermal)	Red/glistening	Possible	Brisk	Painful
	Superficial (dermal)	Pale pink	Possible	Brisk but with slower return	Painful
	Deep dermal	Dry, blotchy and cherry red	Possible but unlikely	Absent	Dull or absent
	Full thickness	Dry, leathery, white or charred	None	Absent	Absent

- ▶▶ How the injury was sustained
- ▶▶ The nutritional status of the patient pre-injury
- ▶▶ Medical history
- ▶▶ Whether any first aid measures were undertaken.

This is because all of these factors can have an effect on burn depth (Hettiaratchy and Papini, 2004).

Mechanism of injury

Whatever the cause of burns (thermal, chemical or electrical), the amount and depth of tissue damage is related to the temperature or strength of the injuring agent and the length of time it has been in contact with the skin (EMSB, 2008).

Temperature

Temperatures above 50 degrees Celsius will produce tissue necrosis, especially when the skin is thin, as in children and the elderly (EMSB, 2008). The following measures can help to establish the temperature of the burn:

- ▶▶ Scald injury: the nurse should ask the patient whether the liquid was boiling
- ▶▶ Scalded by a hot drink:

the nurse should establish whether any milk was added as this would affect temperature and therefore depth

- ▶▶ The injury resulted from contact with a radiator: the nurse should ask what setting it was on.

Composition of injuring agent

This is especially significant when dealing with chemical burns, as the extent of tissue damage from chemical burns is dependent on a number of factors, including the strength or concentration of the chemical, the duration of contact with the skin and the chemical's mechanism of action (EMSB, 2008).

People often sustain chemical burns from household and work-related products, and the nurse should ask the patient if they have any information with them about the chemical involved. The nurse should also seek advice from his or her nearest burns centre and may want to obtain specific antidote information from a regional or national toxicology unit (Enoch et al, 2009).

Duration of contact

There is a proportional relationship between burn depth and duration of contact. Limited contact with an injuring agent will tend towards a more superficial burn. Likewise, prolonged contact indicates the possibility of deeper tissue damage. For instance, prolonged contact from a chemical agent will mean that its corrosive effects continue to cause tissue damage until the agent is removed (Hettiaratchy and Dziewulski, 2004). Similarly, the depth of a burn resulting from direct contact with a hot object, such as an iron, depends not only on the temperature of the contacting agent, but also the length of time the object has been in contact with the skin (EMSB, 2008).

Nutrition

The nutritional status of a burn patient may give an indication as to the potential burn depth because the nutrients that the body needs to sustain biological processes may be lacking. Indeed, metabolic processes require nutrients to provide the energy needed for tissue function (Casey, 2003). A patient with a burn injury not only needs energy

to replace destroyed tissues, but also does so in a catabolic environment because the body's response to burn injury is to breakdown proteins, cells and tissues (Demling and Seigne, 2000). The basal metabolic rate is known to increase up to three times its original rate in order to cope with the demands of a burn injury (Hettiarachy and Dziejulski, 2004). If nutritional stores are depleted, the body will not have enough energy to meet these demands (Casey, 2003).

Malnourished patients are therefore at risk of increased complications (Herndon, 2007), including infection and possible further tissue breakdown, (Demling and Seige, 2000). Nutritional status is also an indicator of how a burn will heal, Casey (2003). Specific nutrients are needed for tissue repair include:

- ▶ Proteins: needed for cellular activity at the wound bed
- ▶ Vitamin A: essential for the replacement of epithelial tissue
- ▶ Vitamin B (thiamine; riboflavin): necessary for division of cells to accomplish repair
- ▶ Vitamin C: needed for collagen synthesis (Casey, 2003).

Patients lacking in these nutrients again have a higher risk of delayed wound healing and its associated complications (Herndon, 2007).

Medical history

Taking a full medical history will provide an insight into factors that may affect burn depth, (Hettiarachy and Papini 2004). For instance, people with

diabetes mellitus are prone to macrovascular and microvascular complications that alter blood flow and can lead to impaired oxygen and nutrient delivery (Herndon, 2007), which can adversely affect burn depth and tissue repair

Immediate first aid and treatment measures

Attention to detail regarding first aid measures will also provide clues to expected burn depth. The consensus of opinion suggests that if measures have been taken to stop the burning process and to cool the wound this will benefit the subsequent viability of the tissues (Hudspith and Ryatt, 2004; Yuan et al, 2007; EMSB, 2008). This is because halting the burning process will reduce tissue damage (EMSB, 2008). Furthermore, cooling the surface of the burn will help to reduce the production of inflammatory mediators and promote tissue viability, thus helping to prevent tissue damage progression (Hudspith and Rayatt, 2004; EMSB, 2008).

Nurses should ask the patient what first aid measures were undertaken if any at all. In general, cooling the wound with cold running water for 20 minutes has been found to provide sufficient cooling for initial first aid purposes (Yuan et al, 2007).

However, if the patient has used ice or extremely cold water this may have a counterproductive effect because the resulting vasoconstriction could cause further tissue damage (EMSB, 2008).

Nurses should also be aware that children may be at risk of hypothermia if subjected to prolonged cooling (EMSB, 2008).

Taking note of how the burn has been managed from time of injury to time of assessment is also an important precursor to gauging burn depth. This is because burns that have been left exposed are more susceptible to desiccation, which produces deepening of the wound (EMSB, 2008). Contrary to popular belief, exposure treatment of burns, except for the very superficial, is not appropriate (Papini, 2004; EMSB, 2008).

Conclusion

This review highlights that assessment of burn depth is not easy. Assessment often relies upon a nurse's subjective assessment of the burn wound. This carries a great responsibility. It is therefore necessary to have an informed knowledge of the important components needed to facilitate accurate assessment.

These are an awareness of the structure of the skin, knowledge of burn wound classification, a grasp of the different modalities available for burn wound depth assessment, knowledge of the key factors involved in a subjective clinical assessment, and an awareness of the clues that can be extracted from taking the patient's history.

Above all, the literature emphasises the need to take a holistic and integrated approach. By adhering to the principles of holism and adopting this integrated approach, it is possible to make an accurate assessment, which can in turn help to facilitate the best possible outcome for the individual with a burn injury. **WE**

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Key points

- ▶ Burn depth is a key determinant of a patient's long-term health, function and appearance.
- ▶ Accurate assessment of burn depth is crucial to determine the most appropriate treatment.
- ▶ Burn depth can be difficult to assess as burns are often a combination of different depths.
- ▶ There are a number of techniques used to assess burn depth but clinical evaluation of the burn is the method most frequently used.
- ▶ It is usually possible to assess the depth of a burn by inspection.
- ▶ Superficial burns may extend from the epidermis into the upper part of the dermis.
- ▶ They are usually characterised by a red/pink appearance and are often blistered.
- ▶ Superficial burns are often very painful.
- ▶ Superficial burns usually still have a good blood supply and so have a brisk capillary refill on pressure.
- ▶ Always reassess burn depth up to 48 hours post injury to take account of burn wound progression.
- ▶ Remember that it is important to take a holistic and integrated approach to clinical evaluation.
- ▶ This should include inspection of wound appearance along with a full medical and social history and mechanism of injury and any first aid measures taken – these will all provide clues as to burn depth.