Improving clinical outcomes and patient experience through the use of desloughing

Abstract

This article focuses on and aims to clarify the role of desloughing as a priority in modern-day wound care. Ambiguity around identification and slough removal has long been a clinical challenge. Effective removal of slough involves the elimination of dead and devitalised tissue as quickly and safely as possible, to enable the wound to return to a healthy state that supports healing. Desloughing is usually associated with typically conservative techniques compared with those used to debride necrotic tissue. More specific and timely targeted action to recognise and remove slough safely will significantly improve the clinical outcomes for patients as well as influence the effective use of scarce resources. The illustrative format of this article will facilitate how clinicians can become familiar with the different types of slough and the appropriate removal techniques.

slough ■ debridement ■ devitalised tissues ■ granulation tissue ■ biofilm

The removal of devitalised (or nonviable) tissue is an essential step in preparing a wound for healing (Falanga, 2004). This is of particular relevance in chronic wounds, where the normal healing trajectory has been disrupted or stalled. This article aims to help clinicians understand what devitalised tissue is and why it occurs, differentiate between slough and necrotic tissue, and develop effective strategies for managing such tissue within a wound.

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Causes of devitalised tissues

The wound healing process has four distinct phases: haemostasis, inflammation, proliferation (also known as granulation and contraction), and remodelling (also known as maturation) (Orsted et al, 2011). In chronic wounds, however, these phases are interlinked and may overlap, thus failing to follow the expected order.

During the inflammatory phase, neutrophils clean the wound of any debris by ingesting devitalised tissue and bacteria in a process known as phagocytosis (Martin, 2013). This process is supported by the release of free radicals and proteases that also destroy bacteria. Once they have completed this process, the neutrophils start to reduce in numbers and die off. At this point, they can be seen on the wound in the form of soft, stringy slough (Martin, 2013). In the normal healing process in a healthy individual, this slough is removed by macrophages that are attracted to damaged and devitalised tissue.

Failure to remove dead neutrophils results in the continual release of matrix metalloproteinases (MMPs) and inflammatory cytokines, thus prolonging the inflammatory phase (Gibson et al, 2009); this can cause the wound to become chronic. In normal wound healing, the concentration of MMPs is high in the initial inflammatory phase of healing. If the level remains high and the underlying cause is not corrected (e.g. relief of pressure), chronic degradation (breakdown) of any new tissue can occur, and this is considered devitalised tissue (Dowsett and Newton, 2005).

Devitalised tissue presents an ideal environment for bacterial colonisation, as it provides a food source for bacteria and acts as a medium for bacterial proliferation (Martin, 2013). Increased potential for biofilm formation can keep the wound in a state of prolonged inflammation and impair healing (Swanson et al, 2014). Biofilm is described as 'a complex microbial community of bacteria and fungi, which synthesise and secrete a protective matrix that attaches the biofilm firmly to the living or non-living surface' (Phillips et al, 2010). Consequently, biofilm can develop rapidly within days and become attached to the extracellular matrix causing persistent inflammation; it can be difficult to remove by using common cleansing methods or superficial debridement (Swanson et al, 2014), thus extending the healing time.

Devitalised tissue can either comprise slough or necrotic tissue. These are described in more detail below.

Slough

Slough consists of fibrin, proteins, and fibrinogen, and can be described as yellow fibrinous tissue (Gray et al, 2010). As stated previously it is a consequence of dead and dying neutrophils lying on the wound surface (Martin, 2013). The amount, consistency, and adherence of slough on the wound bed can vary considerably. When it first appears, it has a sticky, stringy consistency and may develop as superficial patches. This type of soft slough is usually not very adherent and can easily be removed using using wound care products that promote autolytic debridement.

Slough on chronic wounds can be more fibrous and cover the entire wound surface; it can also be more firmly attached to the wounds and thus problematic to remove (Flanagan, 1997). While slough is usually yellow or creamy white, it can be black if the wound is heavily colonised with anaerobic bacteria, although it will still have a slimy and stringy texture (Hoffman, 2007).

The exudate level can also affect the density of slough, which can be dry or moist (Bale and Jones, 1997). Slough can develop on the surface of a previously clean wound bed, possibly because of bacterial colonisation or a deterioration in the patient's underlying condition—for instance, owing to diminished vascular status, which may also affect density of the slough (Benbow, 2011).

Table 1. Key components of holistic assessment for debridement

Factor	Considerations
Patient's general health and condition	Is the patient able to tolerate or adhere to treatment?
Wound aetiology	Diabetic foot wounds may require alternative treatment, including glycaemic control and off-loading and referral for specialist advice
Vascular status and the potential for healing	Debridement may increase the risk of delayed healing in patients with poor perfusion, creating an environment that has poor oxygenation and that is unable to support healing
Wound size and location	This may determine the most appropriate method. For example, some dressings that promote autolysis will not be big enough for very large wounds or conformable enough for some anatomical locations
Presence of infection	Systemic infection should be treated with appropriate antibiotic therapy, and the devitalised tissue removed
Presence and level of exudate	This will influence the type of dressing chosen to promote autolytic debridement. A moisture-donating dressing might be suitable for a dehydrated wound, but inappropriate for a highly exuding wound

Source: Brown (2013)

It should be noted that tendons can look very similar to fibrous slough, so it is extremely important to consider the wound's anatomical location. If in doubt, further advise should be sought before deciding on any course of action.

Necrotic tissue

The development of necrotic tissue may be due to a disruption in the supply of blood that is rich in oxygen and nutrients, for example, a pressure injury resulting in acute occlusion of the blood supply to the tissues, as in category IV pressure damage (National Pressure Ulcer Advisory Panel et al, 2014). It could also be caused by an underlying disease process, such as atherosclerosis, which reduces the arterial blood flow and leads to ischaemia (Anderson, 2006).

Necrotic tissue can be black, brown, or grey in colour. Initially, it can have a soft consistency, but it becomes hard and leathery (eschar) as it becomes more dehydrated (Eagle, 2009). It should be noted that eschar is hard in comparison to black slough, which is slimy and stringy. Black necrotic tissue can appear as small patches in the wound or cover the entire surface.

Assessment

The factors that predispose individuals to chronic wounds and therefore devitalised tissue include (Benbow, 2011):

- Old age, which is associated with comorbidities and decreased collagen production
- A compromised immune response, which increases the risk of infection
- Circulatory and respiratory diseases, which affect the delivery of oxygen and nutrients to the tissues.

Ideally, devitalised tissue should be removed, but a thorough and holistic assessment will determine whether it is necessary and safe to remove it. *Table 1* outlines the factors to consider to guide decision making.

The range of tissue types present in the wound can include necrotic tissue and slough—considered devitalised or nonviable—and granulation or epithelial tissue—generally described as healthy tissue (Eagle, 2009). The different types or percentages of these tissues present in the wound should be identified and documented during the assessment (Flanagan, 2003). This will aid in the development of a care plan and provide a baseline measurement against which the wound's progression or deterioration can be monitored (Flanagan, 2003). Wound assessment tools and electronic records should be used to capture such information. A reduction in the percentage of devitalised tissue and an increase in healthy granulation or epithelial tissue usually indicates that the wound is healing. Wound tracings indicating the amount of slough or necrotic tissue and photographs are also useful in monitoring progress.

The removal of devitalised tissue should occur naturally by autolysis—the body's own process of destroying cells through the action of the cell enzymes that break down devitalised tissue and create a moist environment conducive to healing (Bale et al, 2000). A number of treatments can be employed to promote the natural process of autolysis to assist with

Clinical scenario 1. When to refer

The below picture shows eschar covering the whole surface of a pressure ulcer. This patient requires referral for specialist advice and holistic assessment, including vascular assessment, to determine the potential to heal following removal of the devitalised tissue. The fastest method of removing the necrotic tissue is sharp or surgical debridement, providing the patient has the potential to heal and a clear management strategy is in place to promote healing (Strohal et al, 2013). Sharp or surgical debridement must only be undertaken by a competent practitioner or surgeon in a controlled and safe clinical environment following assessment of the risks and benefits (Strohal et al, 2013). Methods other than sharp or surgical debridement may be considered, depending on individual patient factors.

All images supplied by author

Clinical scenario 2. Removing devitalised tissue in a mixed aetiology leg ulcer

This picture shows areas of devitalised necrotic tissue caused by infection and compromised vascular supply in a mixed aetiology leg ulcer. This was diagnosed using the results of a colour duplex scan and clinical signs and symptoms of infection (European Wound Management Association, 2005). This tissue can be removed with either sharp debridement or an antimicrobial dressing that promotes autolysis. A honey dressing is an example of the latter. Dressings that promote autolytic debridement can, if necessary, be applied under compression bandaging. Use of compression would be determined by assessment of vascular flow and consultation with vascular services. The clinician would also need to ensure that the surrounding skin is protected, and provide pain relief to the patient, if required. Once the devitalised tissue has been removed, an alternative dressing can be used to promote granulation tissue formation.

liquefaction and separation of devitalised tissue and achieve the removal of devitalised tissue.

Treatment of necrotic tissue

The following methods can be implemented to remove necrotic tissue:

- Autolytic: dressing products are used that support moisture balance and utilise the body's own enzymes to soften and liquefy dry slough or necrosis
- Mechanical: wet gauze is applied to the wound and allowed to dry. The devitalised tissue adheres to the gauze that is then removed. Alternatively, a more gentle approach would be to use a slough-trapping fibre dressing
- Biosurgical: green bottle fly larvae are used to remove soft slough and necrotic tissue
- Hydrosurgical: high-pressure saline is passed through an instrument that acts as a cutting tool to remove the devitalised tissue
- Surgical: devitalised tissue is excised down to a bleeding wound bed
- Sharp: devitalised tissue is removed using a scalpel or scissors just above the viable tissue. This method leaves a thin layer of devitalised tissue that will require a secondary method of debridement.

The fastest and most effective method of removing necrotic tissue, particularly eschar, is sharp or surgical debridement (Brown, 2013). It aims to remove both necrotic tissue and the cellular bioburden associated with it and to return the wound to a more acute state that stimulates healing (Falanga, 2004). Sharp debridement requires a high level of skill and competence, and will necessitate referral to a specialist (Wounds UK, 2013). Necrotic tissue and eschar may be safely removed by a generalist clinician using a dressing product that promotes autolysis; however, this method is generally slower and could take a considerable amount of time to be effective (Brown, 2013).

When not to remove necrotic tissue

Sharp debridement should not be undertaken in patients with poor perfusion because of their diminished ability to heal. These patients should be referred to a specialist team for investigations and/or intervention. Wounds in limbs with a known or suspected reduction in blood supply should be left dry, as the potential for infection is higher if the bacteria has a moist or wet environment in which to multiply. Since the supply of blood to the affected area has been impaired, the host (patient's) immune system is compromised because the white blood cells cannot get to the affected area. Systemic antibiotic delivery will also be diminished for the same reason (Vowden and Vowden, 2011). In some situations, as in mummification of a toe in patients with diabetes, it is safer to keep the wound dry and for necrotic material to autoamputate. In these instances, early referral to vascular services is recommended (Leaper, 2002).

Clinicians also need to consider the risks and benefits of leaving necrotic tissue in place when patients are at the end of life (Leaper, 2002). If the wound is completely covered with

Table 2. Commonly used products that support desloughing

Product	Advantages	Disadvantages
Alginate	Suitable for use on moderately exuding wounds	Dressing's ability to absorb exudate may vary (Timmons, 2009)
	Can be haemostatic for wounds that bleed easily	
	Suitable for shallow and cavity wounds	
Cadexomer iodine	Suitable for low levels of exudate	Use with caution with large wounds
	Has antimicrobial effect on high levels of bacteria	Do not use on patients with known allergy to iodine
	Suitable for shallow and cavity wounds	Total dose should not exceed 150 g/week; a single course of treatment should not exceed 3 months (Strohal et al, 2013)
Honey	Promotes a moist environment.	Can be painful for some patients
	Debrides sloughy wounds by osmotically drawing fluid from the tissues	Potential to cause maceration to peri-wound skin if incorrect dressing is chosen
	Reduces inflammation and bioburden	
	Reduces malodour	
Hydrocolloid	Useful for dehydrated wounds	Unsuitable for highly exuding wounds
	Softens and liquefies slough/necrosis	May not be suitable for some patients with fragile skin
		Some products may have an odour
		May not be suitable for diabetic foot wounds
Hydrofiber	Suitable for use on moderately to highly exuding wounds	Should be avoided in wounds with a tendency to bleed
	Suitable for shallow and cavity wounds.	
Hydrogel	Suitable for dehydrated wounds	Unsuitable for moderately to highly exuding wounds
	Softens slough and necrosis	May require frequent dressing changes
	Prepares wound for other methods such as larval therapy	May cause maceration to surrounding tissue if poorly monitored
	Amorphous gel can be used in cavities	Should not be used in fistulae or bleeding wounds
	Gel sheets are better suited to superficial wounds	
Slough-trapping fibre dressing	Slough-trapping fibres	Not indicated for use on dry necrotic eschar
	Technology Lipido-Colloid (TLC) healing matrix	
	Stimulation of fibroblasts	

eschar, no exudate and/or malodour is present, and the patient does not report any discomfort, it may be safer and more humane to leave the eschar *in situ* (Leaper, 2002). However, should the patient develop symptoms such as cellulitis or infection, then the care plan may need to be reconsidered, including the removal of devitalised tissue and antibiotic therapy. There are also cases in which relief of pressure and leaving an intact eschar untreated, thus allowing natural autolysis to occur underneath it, may be practiced. In such cases, the eschar acts as a dressing.

Removal of slough

The effective removal of slough involves the elimination of dead and devitalised tissue as quickly and safely as possible to enable the wound to return to a healthy state that supports healing (Dowsett and Ayello, 2004). Desloughing is usually associated with more conservative techniques than those used to debride necrotic tissue, such as using dressings that optimise the moisture balance in order to promote autolysis (Brown, 2013). Although slower than sharp or surgical debridement, desloughing is a safe and effective intervention (Wounds UK, 2013). Dressings that promote autolysis and support mechanical removal of the tissue are readily available on prescription and can be applied by generalist nurses with varying levels of expertise following accurate assessment. *Table 2* outlines the advantages and disadvantages of the various types of dressings used for this purpose. Some can also be used to remove necrotic tissue.

When selecting a dressing that promotes autolysis, it is important to consider its ability to absorb excess exudate, if appropriate, and therefore avoid the risk of maceration to the surrounding skin (Brown, 2013). *Table 3* lists some of the patient and clinician factors to consider. Other products, such

Table 3. Factors to consider before initiating treatment

Patient factors	Mental capacity and ability to consent
	Ability to adhere to treatment
	Underlying aetiology
	Condition of the wound bed
	Allergies
	Wound size and location
	Infection
	Exudate level
	Peri-wound skin
	Circulation
Clinician factors	Level of skill
	Access to resources
	Potential risks
	Mitigation of risks
Other considerations	Comorbidities
	Medication
	Nutritional status
	Psychosocial issues
	Socialeconomic factors

Source: Wounds UK (2013)

as monofilament pads, can be used for mechanically debriding wounds, although they differ from dressing products as they are used on the wound and then discarded, unlike dressings which are left *in situ* (Vowden and Vowden, 2011).

In chronic wounds, if the underlying aetiology of the wound is not treated, the slough will repeatedly recur following its removal (Wounds UK, 2013). This is because the wound will remain stuck in the inflammatory phase, which is associated with raised levels of MMPs and increased bacterial bioburden and exudate production, all of which prevent the formation of healthy tissue (Dowsett and Ayello, 2004).

Patient-centred care

Treatment of sloughy wounds should always be discussed with the patient, and a plan of care agreed with him/her. This will ensure that the patient understands the reason for the desloughing, the method chosen, and the consequences of the treatment. This is important as most wounds will appear larger and wetter following the removal of devitalised tissue (Brown, 2013). A patient-centred approach will also help to promote adherence to treatment and address any issues or concerns the patient may have.

When to refer

During the assessment, the percentage and consistency of slough and exudate level of the wound should be documented so that any improvement or deterioration in the condition of the wound can be monitored. The wound should be assessed at each dressing change. If it does not improve within the expected timeframe, within 4 weeks, or if there is rapid deterioration, consider referring the patient to a specialist tissue viability nurse or other appropriate health professional (Brown and Flanagan, 2013). Specialist referral should also be considered for the following patient groups (Vowden and Vowden, 2011):

- Children
- Patients with wounds on their hands, feet, and face (refer to a plastic surgeon and the wider multidisciplinary team, including podiatry)
- Patients with suspected or known arterial disease (refer to vascular service)
- Patients with pyoderma gangrenosum (refer to dermatology)
- Congenital abnormalities or suspected malignancy (refer to dermatology or plastic surgeon)
- Patient with prosthetic implants.

Desloughing in practice

The following case study describes how desloughing can help promote wound healing.

Case study

An 85-year-old woman was referred for specialist advice following admission to the community hospital because of a fall and cellulitis. She had a history of transient ischaemic attack, bilateral hip surgery, osteoporosis, and curvature of her spine, and had been treated at home by the community nursing team. She presented with an ulcer of 4 months' duration on her right lateral gaiter (*Figure 1*). It measured 8.3x5.6 cm, was producing moderate levels of exudate, and approximately 90% of the wound bed was covered with a thick layer of soft slough. Waveform Doppler was performed as she was unable to lie flat for a hand-held Doppler. The results of the test revealed triphasic and biphasic waveforms, which along with the other information gained during the assessment, suggested a mixed aetiology leg ulceration. Following discussion with the patient, she agreed to the use of a dressing (UrgoClean) to desloughher wound.

An absorbent and nonadherent dressing was required. Absorbency was important because, in this situation, slough liquefies, and the dressing would need to protect the surrounding skin. A nonadherent dressing was important because the limb was oedematous, and so the surrounding skin was fragile. The patient was reluctant to wear compression bandages as she did not feel confident with walking. Therefore, initially, a wool bandage and a retention bandage were applied toe to knee to create some light support for the limb, with a view to further discuss compression therapy with the patient at a later date.

The patient was cared for by the community nursing team, who visited twice weekly; the tissue viability team reviewed the care given. After a little over 2 weeks of treatment, the slough was superficial and reduced in extent (*Figure 2*). The peri-wound area was healthy and the patient reported that she was comfortable and was not experiencing any pain.

After 5 weeks of conservative treatment and continuous use of the UrgoClean, the wound measured 8.3x5.6 cm, and

Figure 1. The wound on presentation

Figure 2. After 2 weeks of treatment

Figure 3. After 5 weeks of treatment

Figure 4. After 12 weeks of treatment

soft superficial slough covered about 60% of the wound bed (*Figure 3*). The current regimen was continued, and when desloughing was almost complete and exudate could be easily managed, the team discussed the use of compression hosiery with the patient as an alternative to bandages.

After 12 weeks, the wound had significantly reduced in size and the slough was almost completely removed (*Figure 4*). The patient agreed to wear class 1 hosiery and a 10 mmHg liner over the top, which gave a level of compression between 24–27 mmHg in total. This helped to reduce the oedema and the patient stated that she was comfortable, could walk better, and felt more confident.

Conclusion

Nurses are governed by the Nursing and Midwifery Councils code of conduct and therefore clinicians must be confident and competent in ensuring the safe and effective removal of any devitalised tissue at the earliest opportunity to facilitate healing and to promote a positive patient experience. Timely evidence-based treatment for the removal of slough and necrosis in a wound can reduce treatment costs and maintain patient safety by preventing further complications and the potential risk of admission to hospital. **CWC**

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KEY POINTS

- The removal of devitalised tissue in a wound is an important consideration for wound progression and healing
- Devitalised tissue, including slough, provides an ideal environment for bacterial colonisation
- Clinicians should be able to differentiate between tissue types and develop an appropriate management plan
- Desloughing a wound tends to be done using conservative methods and can be carried out by clinicians with variable levels of skill