JWC International Consensus Document

Best practice for wound debridement

Contents

Consensus panel

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Foreword

It is my absolute honour to introduce this comprehensive resource that brings together the expertise and insights of a diverse group of wound-care professionals. Debridement plays a vital role in wound management, and this document serves as a valuable guide for health professionals seeking to optimise patient outcomes in this critical aspect of wound care.

Wound debridement is a multifaceted intervention that involves the removal of devitalised tissue (also known as non-viable, non-vital or dead tissue), including slough, necrotic tissue, debris, microorganisms and biofilm from the wound bed and edges. It is a fundamental step in creating an optimal wound-healing environment. However, the field of debridement is complex, with various methods, considerations and challenges that clinicians face in their daily practice. This consensus document aims to address these complexities and provide evidence-based recommendations to enhance the delivery of debridement care.

The development of this international consensus document was a collaborative effort, bringing together a panel of experts from diverse backgrounds and specialities. Their collective knowledge, clinical experience and research insights have shaped the content of this document, ensuring its relevance and applicability to real-world practice. The panel's dedication and commitment to advancing the practice of wound debridement is evident throughout this document.

This document begins by providing a clear definition of debridement and establishing the rationale for its importance in wound management. It explores the various methods of debridement, categorising them as either debridement methods needing an adjunct to be efficacious or as stand-alone options. It presents a new comprehensive framework for debridement methods that takes into account the invasiveness and efficacy of each method. The document explores the nuances of each method, highlighting its indications, benefits and considerations for safe and effective implementation.

Recognising the significance of wound assessment in guiding clinical decisions, the document offers valuable insights into evaluating wounds for debridement. It addresses key considerations such as the identification of non-microbial biomaterial, microbial bioburden, necrotic tissue and slough. By providing a systematic approach to wound assessment, this document empowers health professionals to make informed decisions regarding the most appropriate debridement method for each tissue type.

In addition to debridement techniques, the document also emphasises the importance of periwound and wound-bed cleansing, both as a preparatory step for debridement and during post-debridement. It highlights the role of cleansing in removing contaminants and creating an optimal environment for dressing placement and subsequent debridement. The document also provides an overview of various cleansing solutions that can be used, including surfactant-containing solutions, hypochlorous acid (HOCl) solutions and potable water, while acknowledging the regulatory variations between countries.

Safety is a paramount concern in wound debridement, and this document underscores the need for clinicians to prioritise patient wellbeing. It offers guidelines on how to debride wounds in a manner that strives to ensure viable structures such as nerves and blood vessels are not compromised. The document also addresses specific wound areas that require attention, including periwound hyperkeratosis. By providing clear recommendations and precautions, this document equips clinicians with the knowledge and skills necessary to perform debridement safely and effectively.

Integral debridement is a new concept that resonates throughout this document, emphasising the importance of tailoring debridement methods to individual patient needs, preferences and environments, as well as to local resources and available skill levels. The document recognises that different care settings may require different approaches, such as limitations to the scope of practice based on the provider's level of training, and it encourages clinicians to consider the clinical context and patient perspectives when selecting the appropriate debridement method(s). This patient-centred approach ensures that debridement care is not only effective but also aligned with the unique needs and goals of each patient.

This consensus document on wound debridement is a valuable resource for health professionals involved in wound management. It provides evidence-based recommendations, practical insights and expert perspectives to enhance the delivery of wound care. I extend my deepest gratitude to the panel members for their dedication, expertise and collaborative spirit in developing this document. It is my hope that this document will serve as a guiding light for clinicians, empowering them to optimise wound-healing outcomes and improve the quality of care for their patients.

Dieter Mayer, Panel Chair

Note on terminology:
For the purposes of this document, 'outpatient' refers to the management of ambulatory patients who have not been admitted to the hospital.

'Pressure injury' is used instead of 'pressure ulcer', reflecting the terminology in the 2019 guidelines from the European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and the Pan Pacific Pressure Injury Alliance.

Introduction

The purpose of this international consensus document is to outline the best practices and recommendations for effective debridement. Debridement is a crucial aspect of wound bed preparation, as it involves the removal of devitalised tissue (including slough), foreign material, microorganisms and biofilms, toxins, contaminants, pro-inflammatory cytokines and proteases from the wound bed to promote and optimise healing and prevent or treat infection. This document aims to consolidate the latest evidence including research and expert opinion to establish a consensus on the principles and techniques of debridement. The recommendations in this document apply to all patient populations.

Debridement is a crucial aspect of the management of various types of wounds, including surgical wounds, pressure injuries, venous leg ulcers (VLUs), diabetic foot ulcers (DFUs) and traumatic wounds. With ageing populations and an increase in surgical procedures, hard-to-heal wounds, such as complex surgical wounds, DFUs, VLUs, ischaemic ulcers and pressure injuries, continue to pose challenges in healthcare settings.[1] Meanwhile, at the earlier end of the spectrum of life, the fragility and immaturity of the dermoepidermal complex in childhood increases the risk of skin lesions and pressure injuries, especially in the intensive neonatal and paediatric settings (NICU-PICU).[2] Therefore, it is imperative to develop a standardised approach to debridement that can be applied across different populations.

In general, integral debridement serves multiple purposes:

- It facilitates the removal of necrotic tissue, slough and biofilm, along with their associated pro-inflammatory markers, which can impede the progression towards healing
- It helps accurately determine the wound's true dimensions
- It helps manage complications such as infection by facilitating the drainage of a previously hidden abscess
- It potentially reveals clinical signs of infection, enabling the collection of a deep culture swab or tissue sample, as appropriate, to identify the causative agent and guide antibiotic prescription
- It potentially prepares the wound bed to receive a cellular, acellular and matrix-like product (CAMP) when indicated.

How this document was developed

The development of this consensus document involved a panel of clinical experts, who played a crucial role in outlining and defining the recommendations and statements. The multidisciplinary panel, which met in a closed meeting in July 2023 in the UK, comprised individuals with extensive knowledge and experience in the relevant fields. In the meeting, they set out to make consensus recommendations and statements to inform best practices for debridement in a variety of patient settings. The recommendations were subjected to ongoing reflection and review during the development of this manuscript. They are supported by a hierarchy of evidence from level 1 (randomised controlled trials) to level 5 (expert opinion).

Summary

- This international consensus document aims to provide updated guidance on the principles and techniques of debridement.
- It describes a standardised approach to debridement that can be applied across different populations.
- The primary aim of debridement is to remove microbial and non-microbial wound components, including biofilm, devitalised tissue, cytokines and proteases, using the most effective method available with the fewest side-effects.
- It is vital that all wounds are regularly debrided, unless contraindicated, as this removes barriers that delay or stall healing.

What is debridement?

Consensus statement: The panel proposed a new, shorter definition of debridement: debridement is the removal of viable (living) and non-viable wound components, including necrotic tissue, slough, microorganisms, biofilm, extracellular polymeric substance (EPS) and foreign materials. Its primary goal is to reduce the presence of both microbial and non-microbial components using the most effective methods with the fewest side effects. These methods should be safely executable by a health professional with the knowledge and capability to do so at the site of service and within the boundaries of their sphere of practice.

It is vital that all wounds are debrided, as appropriate, unless contraindicated. This is particularly important for hard-to-heal wounds. These types of wounds often have more necrotic tissue and slough than others, which can impede the healing process. Debridement can help to promote the growth of new tissue, reduce inflammation in the wound bed and improve the effectiveness of topical treatments, thereby reducing the risk of infection and allowing for better wound healing.

There is evidence that regular debridement removes the barriers that stall or delay healing.[3–6] However, the literature suggests that approximately 60% of patients' wounds are not debrided frequently enough,[7] which means a key barrier to healing is not being addressed, causing much unnecessary wound-related morbidity and patient suffering. This is incurring a significant health economic burden.[4] Therefore, the panel recommends that, to be effective, debridement needs to be performed regularly when assessment identifies that devitalised tissue is present. The frequency of debridement often depends on local circumstances, so it can vary from twice weekly to weekly or once every 2 weeks.[8,9] Regardless of the specific interval, it is crucial to perform debridement on a regular basis, with due consideration of the wound characteristics and method of debridement, as this will help promote healing.

Healing will not take place unless the wound aetiology is assessed and treated, so debridement needs to be implemented as part of best practice that involves treating the primary aetiology and any other barriers to healing.

Consensus statement: Referral to a specialist for an alternative method of debridement may be necessary in complex cases or when the wound fails to respond to initial interventions.

Rationale for debridement

Debridement is a critical component of best practice in wound management due to its significant impact on the healing process. The rationale for debridement lies in the removal of devitalised tissue, microbial and non-microbial components (*Box 1*) and biofilm from wounds.

Devitalised tissue, such as necrotic tissue or slough, creates a barrier to wound healing and will reduce the antimicrobial efficacy of topical antiseptics. It hinders the migration of healthy cells and the formation of new blood vessels, impeding the wound's ability to progress through the phases of healing. By removing devitalised tissue, debridement can reduce inflammatory processes while promoting the growth of healthy granulation tissue, which facilitates wound closure.

Microbial and non-microbial components, including biofilm, can also play a significant role in impairing wound healing. Biofilm is a complex community of microorganisms embedded in a protective matrix called the extracellular polymeric substance (EPS), which is composed of polysaccharides, proteins, extracellular DNA and metal ions such as magnesium, calcium and iron. EPS is very immunogenic and, as such, should be removed from the wound. Biofilms can lead to chronic inflammation and delayed healing.[10,11] Debridement helps reduce the bioburden, including biofilm, within the wound bed, which creates a more favourable environment for healing and prevents recurring infection.[12]

Debridement also aids in the removal of foreign bodies or contaminants that may be present in the wound; examples include needles, wooden splinters, particles from clothing and dressing remnants (*Figure 1*). These foreign materials can also impede healing and increase the risk of infection.

Box 1. Non-microbial components

A non-microbial component refers to a complex mixture of materials found in a wound that are not directly related to the presence of microorganisms including bacteria. They include various components such as cytokines, proteases, and certain fibrin build-up. Excess levels of these substances are considered pro-inflammatory markers, that is they contribute to the inflammatory response in the wound. They can hinder the healing process, so are often associated with hard-to- heal wounds.

Why devitalised tissue is a source of microbial bioburden

Devitalised tissue refers to tissue that has lost its normal physiological function and is no longer viable. This tissue can become a source of microbial bioburden for several reasons. First, devitalised tissue provides a support for microbial adhesion: it lacks the ability to defend itself against invading microorganisms, making it more susceptible to colonisation.[13] Second, the compromised blood supply in devitalised tissue can create a hypoxic environment that is conducive to microbial growth, particularly of microaerophilic and anaerobic microbes.

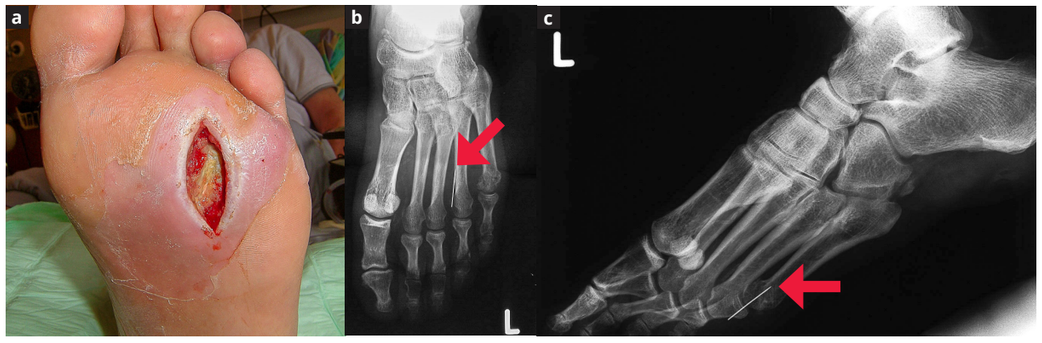
Additionally, a moist wound bed containing devitalised tissue provides a nutrient-rich environment in which bacteria and other microorganisms thrive. The presence of microbial bioburden in devitalised tissue can lead to infection and delayed wound healing. Therefore, provided holistic assessment identifies no contraindications, it is crucial to remove devitalised tissue to reduce the risk of microbial contamination and proliferation and to promote healing.

Devitalised tissue

Necrotic tissue

Necrosis refers to the localised death of tissue due to infection, ischaemia, trauma, burn injury and autoimmune conditions. The resulting necrotic tissue can be black, brown or grey in colour, and it can be dry (usually not infected) or wet (often infected). It is generally adherent to the wound bed.

Figure 1. Foreign body in wound: diabetic foot ulcer (a) containing a needle (b–c)



Dry necrosis refers to a type of tissue death characterised by the lack of moisture or fluid in the affected area. Dry necrotic tissue typically appears as a dry, blackened, or darkened tissue (*Figure 2*). Dry necrosis is commonly seen in conditions where blood supply to the tissue is compromised, such as arterial obstruction or prolonged exposure to pressure, leading to tissue death.

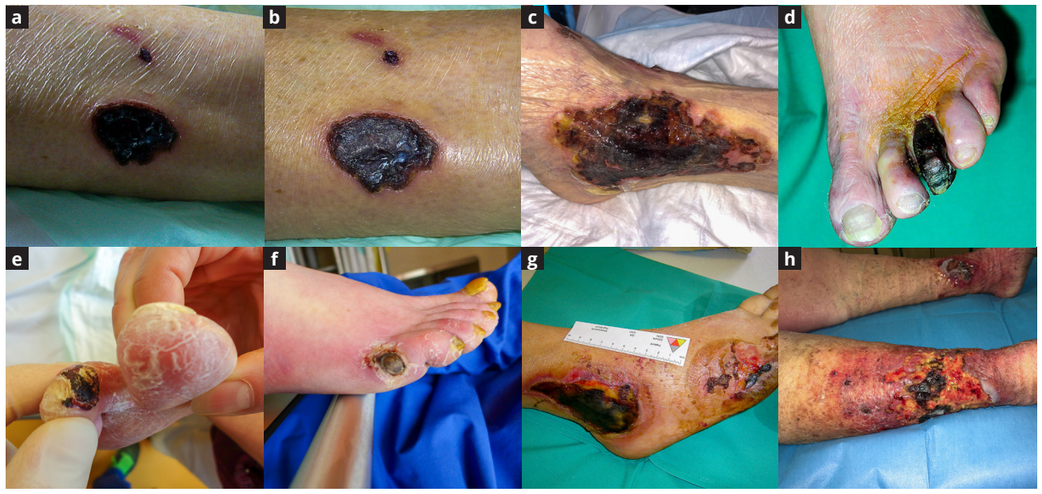
Wet necrosis is a type of tissue death that is associated with excessive moisture or fluid accumulation in the affected area. Wet necrotic tissue often appears as soft, swollen, and discoloured tissue. Wet necrosis is commonly seen in conditions such as severe infections or abscesses, where there is an influx of inflammatory cells and fluid.

Slough

Slough is a complex mixture of exudate proteins, degraded extracellular matrix proteins, white blood cells and multiple species of microorganisms in planktonic and biofilm phenotypes. Differences in the characteristics of slough in acute and hard-to-heal wounds are listed in *Box 2* and illustrated in *Figure 3*. It is a common occurrence in hard-to-heal wounds and may impair healing. Slough presents as a layer of devitalised tissue of varying colour (e.g., cream, yellow, greyish or tan) that may be loose or firmly attached to the wound bed, as well as slimy, stringy or fibrinous.[14]

Loose slough refers to a type of non-viable tissue that lightly adheres to the wound bed. It is often yellow or tan in colour

Figure 2. Examples of dry necrosis: on different wound locations (a–f); dry necrosis and adherent slough on the same wound (g); and dry necrosis and loose slough (h)



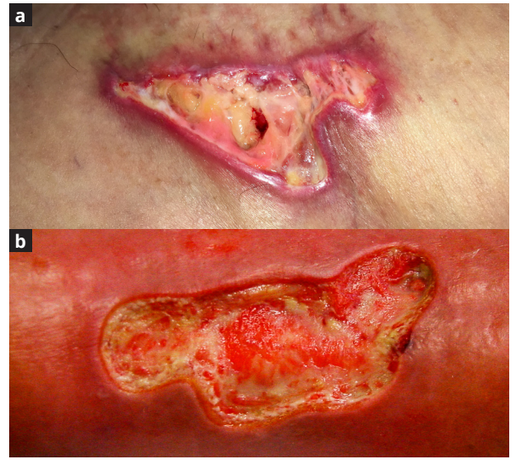
Box 2. Slough in acute vs hard-to-heal wounds

Slough is a common occurrence in both acute and hard-to-heal wounds, but there are some key differences between the two.

In acute wounds, slough is usually minimal and easily removed during the healing process, and is not pro-inflammatory. Often yellow or white, it consists of dead tissue and debris. Acute wounds tend to heal relatively quickly, and the presence of slough is usually a sign that the wound is progressing towards healing.

Hard-to-heal wounds often contain a significant amount of slough, which can be either moist or comprise a thick, dry adherent layer that is difficult to remove. An excessive volume of slough is typically associated with inflammation, infection, biofilm and other underlying factors, such as oedema or poor blood supply. Slough in hard-to-heal wounds can delay healing and increase the risk of infection. Many patients have issues with recurring slough and require ongoing debridement to promote healing.

Figure 3. Acute (a) and chronic (b) slough: the acute slough (a) is in a postoperative wound)



and can be easily removed from the wound surface. Loose slough is typically composed of dead cells, debris and fibrin (*Figure 4*).

Adherent slough refers to a layer of devitalised tissue that tightly adheres to the wound bed, making it challenging to remove. It is typically a complex mixture of fibres, degraded extracellular matrix proteins, exudate, white blood cells and bacteria that can impede the healing process (*Figure 5*).

Scientific evidence, including from polymerase chain reaction (PCR) and other laboratory tests, suggests that slough is polymicrobial,[14,15] meaning that it is composed of multiple types of microorganisms (e.g., different strains of bacteria and/or fungi). The presence of these microorganisms contributes to the wound bioburden, which refers to the total number of microorganisms present.

Slough is also known to contain a high concentration of pro-inflammatory regulatory proteins, such as C-reactive protein (CRP), tumour necrosis factor-alpha (TNF-α), interleukins (IL-1, IL-6, and IL-8), matrix metalloproteinases (MMP-2 and MMP-9) and prostaglandin E2 (PGE2), which cause excessive or prolonged inflammation, impeding the healing process.[14,16] Other components include proteins largely involved in skin structure and formation, blood-clot formation and immune processes.[14,17] As such, slough contains both microbial and non-microbial components, and so it requires removal.

Figure 4. Examples of loose slough (a–c)

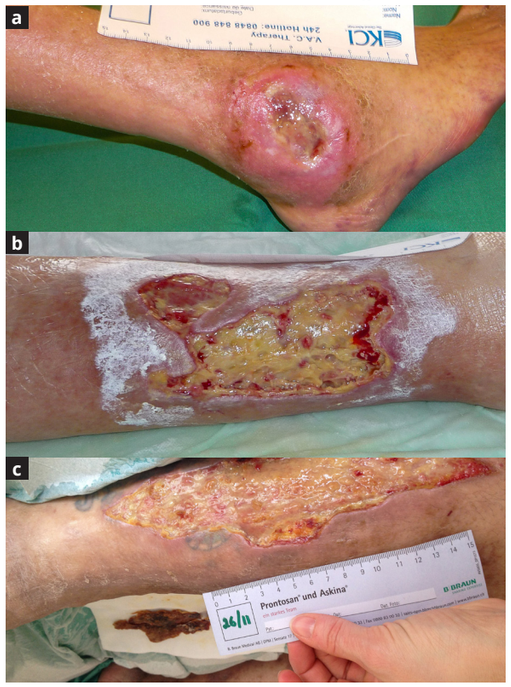


Figure 6 shows the different types of slough on the same wound, as well as coexistence of slough and necrotic tissue in the wound bed.

Biofilm

Biofilms are aggregates or co-aggregates of microorganisms that have unique characteristics and enhanced tolerance to treatment and the host's immune defences. Wound biofilm is not visible to the naked eye except via mapping, wound blotting and ultraviolet light.[18–20]

Figure 5. Examples of adherent slough (a–c)

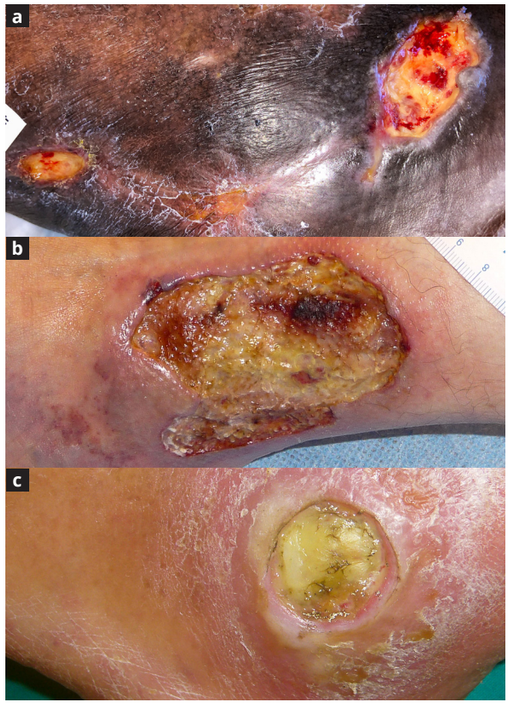
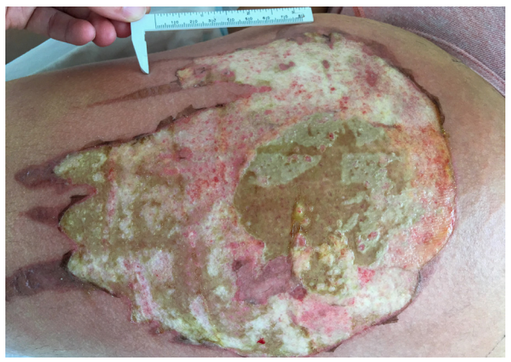


Figure 6. Loose and adherent slough on the same wound



Biofilm formation in a wound bed has been associated with the development of sustained unregulated inflammatory signalling or processes that contribute to impaired wound healing.[21,22] Biofilms typically form on the wound surface and can penetrate underneath the wound bed,[23] on the wound edges and even sometimes onto adjacent intact skin. They can also be found in wound exudate and slough, as well as attached to foreign bodies in the wound or wound dressings.[24]

Microbial bioburden

Microbial bioburden refers to the presence and quantity of microorganisms, such as bacteria, in a wound. It encompasses both free-floating planktonic microbes and biofilm. Planktonic microbes are more susceptible to antimicrobial interventions, while biofilm bacteria exhibit increased tolerance to antimicrobials.[25–27]

Planktonic microbes are easily dispersed and can colonise new areas, contributing to wound infection and delayed healing. On the other hand, sessile or biofilm microbes adhere to each other and onto (not necessarily solid) surfaces, including the wound bed, and form a complex structure that protects them from the immune system and antimicrobial agents. Biofilm microbes are known to exhibit enhanced virulence and can cause chronic inflammation and impaired wound healing.[15,28]

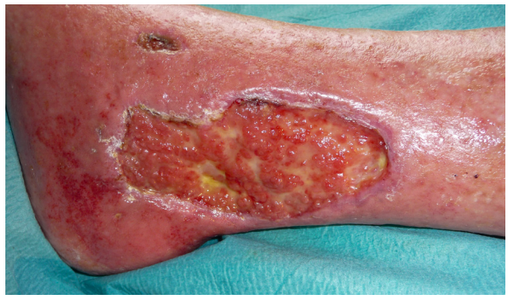
Understanding the distinction between planktonic and biofilm bacteria is crucial in wound management. Effective strategies for managing microbial bioburden should target both phenotypic states, considering the unique challenges posed by biofilm-associated infections.[15]

In patients with hard-to-heal wounds, biofilm plays a significant role in impeding the healing process. The host immune system struggles to remove both the microbial and non-microbial components associated with biofilm. This contributes to chronic inflammation, delayed wound closure and impaired tissue regeneration.[15,28]

Unhealthy granulation tissue

Unhealthy granulation tissue refers to granulation tissue in a wound with an abnormal appearance and characteristics.[29,30] Unhealthy granulation tissue is thought to be induced by biofilm.[31] Unlike viable healthy granulation tissue, which is pink or red, well-vascularised and composed of new blood vessels and

Figure 7. Unhealthy granulation tissue with loose slough



fibroblasts, viable unhealthy granulation tissue may exhibit signs of inflammation and/or excessive exudate. It may appear pale red to light yellow or even very dark red (*Figure 7*).[30]

Friable granulation tissue often bleeds spontaneously on gentle touch due to hyperaemia and inflammation and, sometimes, biofilm and low-grade infection. Treatment can comprise local steroids or cauterisation with topical silver nitrate. If there is concomitant hypergranulation, sharp excision with a scalpel or curette can be a viable option. When low-grade infection is present, povidone iodine (PVPI) or cadexomer iodine can be considered, but extended use of PVPI should be avoided due to the risk of cytotoxicity.

Accurate assessment and management of unhealthy granulation tissue are essential to promote wound healing and prevent further complications.

Rationale for the removal of microbial and non-microbial components

Removal of both microbial and non-microbial components is essential to facilitate healing in hard-to-heal wounds. Microbial components, particularly bacteria in biofilms, often lead to sustained infections that obstruct the healing process. Conversely, non-microbial elements, like cytokines and proteases, perpetuate chronic inflammation, impeding tissue regeneration.[32,33] By effectively removing these microbial components, debridement plays a pivotal role in fostering an environment conducive to healing.

Methods of debridement

Summary

- A new approach, integral debridement, is proposed. This is the combined use of different but complementary methods of debridement on the same wound, as required, to achieve an optimal outcome.
- The document also presents a new categorisation of debridement methods, which are listed in order of invasiveness and whether or not an adjunct debridement method is required.
- Although oxidative, autolytic, osmotic, enzymatic debridement are often referred to as debridement methods, they need to be used with an adjunct, such as mechanical or a more aggressive debridement technique, to promote healing and achieve closure.
- Stand-alone debridement methods comprise: biological, mechanical, technical (hydrosurgical, ultrasonic and negative pressure wound therapy with instillation and dwell-time), selective sharp debridement and surgical debridement.
- Hypochlorous acid and sodium hypochlorite can be used to assist (amplify) mechanical, selective sharp/surgical and technical debridement.

Among the various methods of debridement, selective sharp and surgical debridement have been widely recognised as the gold standard due to their effectiveness in removing biofilm and devitalised tissue, which are significant impediments to healing.[34] Both methods involve a blade, which can be a scalpel, curette or scissors. Surgical debridement typically involves incision into healthy viable tissue with associated bleeding, whereas selective sharp debridement usually refers to the careful and precise removal of devitalised tissue only. Surgical debridement is typically conducted with the patient under sedation in the operating theatre and is more invasive than selective sharp debridement, which is routinely performed at the bedside. In some countries, selective sharp debridement is regarded as a core skill of specialist wound practitioners.

However, access to and use of surgical blades remain limited, mostly due to a lack of resources and training. In addition, some patients' conditions contraindicate selective sharp/surgical debridement (*Box 3*). Other methods of debridement, such as autolytic or mechanical debridement, are less invasive and generally require less training, and so they are more widely used. However, a wide variety of debridement methods is available, and these vary in terms of their training requirements, modes of action, invasiveness and suitability for different settings.

It is over 10 years since the publication of the European Wound Management Association (EWMA) consensus on debridement, which outlined methods of debridement. However, the categorisation of debridement methods included in the document has not been updated or adhered to consistently since then.[24,35] The absence of a standardised classification system makes it difficult for health professionals to compare and select debridement products that they can safely use, based on their clinical competency and experience, for specific wound characteristics, to meet patient needs. As a result, there is a need for an updated and comprehensive categorisation system that reflects advances in debridement products and techniques.

The new categories of debridement products introduced since the publication of the EWMA consensus document have expanded the options available for health professionals. These categories offer innovative approaches to debridement, addressing specific challenges and providing alternative solutions for wound management. Therefore, it is essential to update and train health professionals on how to determine the effectiveness and potential benefits of these categories in promoting wound healing.

Integral debridement: a new concept

The choice of debridement method and frequency of application may vary, depending on the individual wound, patient characteristics, social factors (such as the patient's ability to monitor the wound and self-care) and resources available. Holistic assessment is crucial in determining the most appropriate approach to debridement for the individual patient, provided the resources and training needed are available.[36]

To achieve the objectives identified by holistic assessment, it may be necessary to use more than one method of debridement, depending on their mode of action and objectives, where the combination works effectively in tandem. For example, autolytic debridement can be used to soften devitalised tissue and prepare it for other methods of debridement, especially if the tissue is tender and painful to the touch.

Consensus statement: This consensus document proposes a new approach referred to as integral debridement, which the authors define as 'the combined use of different but complementary methods of debridement on the same wound'.

Here, the term 'integral' alludes to an approach that is holistic and complete. The type of approach and choice of products will depend on several factors (*Box 4*). By adopting the concept of integral debridement, health professionals can make more informed decisions regarding the selection and application of debridement methods. It also allows for a tailored and patient-centred approach to wound care that highlights the need to consider patient's comfort and preferences when selecting a debridement method.

Box 3. Cautions and contraindications for different types of debridement[35,36,118,119]

Methods needing an adjunct

Oxidative debridement
- Implanted electronic devices
- Malignancy
- Pregnancy
- Metal in or near the treatment area (caution)
- Patient Immunosuppression caution)
- Proximity to Sensitive Organs (caution)

Autolytic debridement
- Acute infection or sepsis
- Diabetic foot ulcers (caution)
- Ischaemic wounds (caution)
- Maintenance or end-of-life care[118]
- Peripheral vascular disease (caution)
- Product sensitivity

Osmotic debridement
- Sensitivity to honey, bee stings or bee products
- Dry wounds
- Lightly exuding wounds
- Diabetic foot ulcers (caution)

Enzymatic debridement
- Acute infection or sepsis
- Collagenase sensitivity (rare)
- Eschar (very necrotic tissue)
- Additional use of antiseptics or soaps that may impair enzymatic activity
- Acute wounds (in streptokinase)

Chemical debridement
- Ischaemic wounds
- Neoplastic wounds
- Burns
- Exposed tendon or bone
- Underlying abscess or fasciitis requiring incision or excision and drainage
- Unexplored tunnelling or undermining
- Underlying osteomyelitis
- Implants and vascular grafts
- Eschar (unless removed) (caution)
- Wounds near the facial region (mouth, nose and eyes) (caution)
- Wounds near the anus, vagina, penis or testicles (caution)
- Ongoing cancer treatment (caution)

Chemo-mechanical debridement
- Chemotherapy or ongoing pathologies in the wound area, such as cancer
- Do not use with chlorhexidine (caution)

Surfactant debridement
- Allergies or sensitivity to the product's components

Standalone methods

Biological debridement
- Allergy to eggs, soybeans, brewer's yeast or fly larvae
- Anticoagulant therapy
- Deep wounds, cavities or sinus tracts
- Wounds on the face and near the gastrointestinal tract or upper respiratory tract
- Proximity to major blood vessels or open blood vessels
- Wound location that affects survival of larvae
- Wounds with exposed blood vessels potentially connecting to deep vital organ
- Impaired perfusion (caution)
- Malignant (cancer) wounds
- Areas subject to pressure that could squash the larvae (caution)
- Heavy exudate that could drown the larvae (caution)

Mechanical debridement
- Anticoagulant therapy or bleeding disorders (caution)
- Diabetic foot ulcers (caution)
- Inadequately controlled wound pain (caution)
- Palliative or end-of-life care (caution)
- Peripheral arterial disease (caution)

Ultrasonic and hydrosurgical debridement
- Inadequately controlled wound pain (in high-powered waterjet device using Venturi's effect)
- Risk of aerosol contamination if not performed correctly (caution)

Negative pressure wound therapy with instillation and dwell time
- Necrotic tissue with eschar

Selective sharp/surgical debridement
- Anticoagulant therapy or bleeding disorder (caution)
- Exposed bone, ligaments, tendons (caution)
- Functionally and cosmetically important areas, such as the face, hands, perineum and feet (caution)
- Impaired perfusion (critical limb ischaemia without successful revascularisation)
- Inadequate tissue
- Inadequately controlled wound pain
- Poor general health, such as age-related frailty, immunocompromised status, multiple comorbidities or palliative care (caution)
- Pyoderma gangrenosum without adequate suppression of inflammatory component
- Risk of over-excision or wound enlargement in deeper layers (caution)
- Temporal areas, neck, axilla, groin and areas close to major blood vessels, nerves and tendons (caution)

Assisters of debridement

Hypochlorous acid
- None

Sodium hypochlorite
- Allergies or sensitivity to chlorine products

Use of integral debridement has the potential to enable implementation of holistic, patient-centred care, where it can be used as part of the 'step-up, step-down' approach advocated by Schultz et al.[37] It can also be an aspect of interdisciplinary collaboration.[37] This can help bridge limitations in an individual health professional's scope of practice and knowledge base, potentially enabling more effective outcomes.

Often, both adjunctive procedures and adjunctive methods of debridement are needed for optimal removal of devitalised tissue. Adjunctive procedures, such as revascularisation when there is a poor vascular supply, or the use of antiseptics or even systemic antibiotics in the case of infection, address specific underlying wound factors or complications while also supporting the debridement process. Adjunctive methods of debridement are discussed later in the document.

The consensus panel has proposed a framework (*Figure 8*) that orders the various categories of debridement by their level of invasiveness. Less invasive approaches may need an adjunct, as they are unlikely to achieve as effective an outcome if used in isolation. Often, a more invasive and advanced approach is also required. For example, if extensive, stubborn or hard-to-reach necrotic tissue is observed, a less invasive method might help prepare the tissue for use of selective sharp/surgical debridement. Similarly, some less invasive approaches need to be used in tandem with mechanical debridement to achieve the desired outcome.

Box 4. Factors that influence choice of debridement method

- Clinical need
- Clinician experience and competency
- How quickly devitalised tissue needs to be removed
- Level of inflammation
- Local access
- Patient age
- Patient perspective
- Presence of infection
- Risk of exposing non-tissue structures
- Treatment objectives
- Treatment setting
- Wound depth
- Wound type

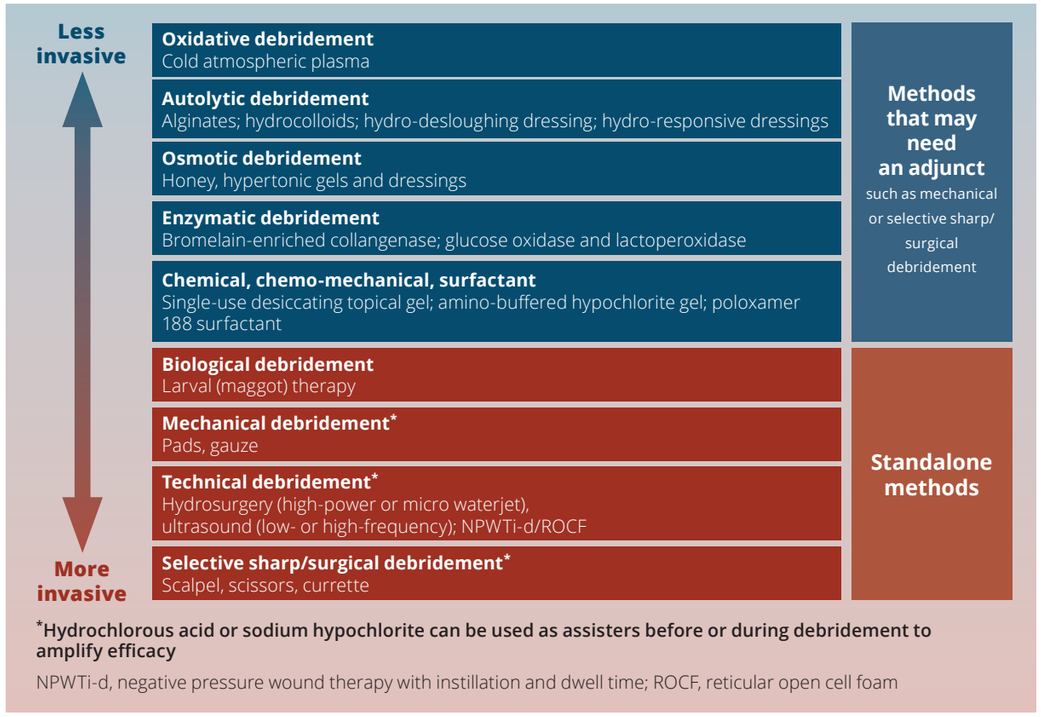
Debridement methods needing an adjunct procedure

Oxidative debridement

Oxidative debridement describes the topical application of chemical oxidising agents that enhance the breakdown and removal of necrotic tissues, slough and bioburden from a wound bed (*Table 1*). These agents oxidise key components in proteins, lipids, DNA and polysaccharides, which in turn fragment and destabilise their biological structures. Examples of oxidative debridement are processes that generate reactive oxygen species (ROS) or reactive nitrogen species (RNS).

Cold atmospheric plasma (CAP) debridement is another method of oxidative debridement. CAP works by generating ROS and nitric oxide, which have antimicrobial properties and promote tissue healing.[38] It may be necessary to prepare the wound by removing excess exudate and debris to optimise the efficacy of CAP debridement. Different devices using various technologies are available for CAP, each with varying intensities and effects, such as dielectric barrier discharge (DBD) devices, jet plasma devices or plasma needles. In addition, the specific indications for CAP debridement may vary depending on the device used. DBD devices create plasma through an electrical discharge between two electrodes separated by an insulating dielectric barrier.[39] This setup is beneficial for treating uneven surfaces such as wounds, as it can evenly distribute plasma over irregular shapes. Jet plasma devices emit a directed stream of plasma, allowing for precise application.[40] Jet plasma is particularly useful for targeting specific areas of a wound without affecting surrounding healthy tissue. Plasma needles are small, handheld devices that produce a low-temperature plasma output, ideal for minimally invasive treatment of chronic wounds.[41] Their design allows for deeper penetration of plasma into the tissue, potentially reaching otherwise inaccessible wound area.

Figure 8. Debridement methods by invasiveness and need for an adjunct



*Hydrochlorous acid or sodium hypochlorite can be used as assisters before or during debridement to amplify efficacy

NPWTi-d, negative pressure wound therapy with instillation and dwell time; ROCF, reticular open cell foam

Table 1. Summary of debridement methods needing an adjunct procedure

Method	Examples	Mechanism of action	Key indications	WBP	Referral
Oxidative	Cold atmospheric plasma	Oxidising agents that break down biological structures in bacteria, yeast and fungi, as well as non-microbial components including cytokines and proteases, or generate ROS and nitric oxide, to remove devitalised tissue and reduce bioburden	Infected wounds	Needed	See note*
Autolytic	Alginates; hydrocolloids; hydro-desloughing wound dressings; hydro-responsive wound dressings	Promotes moisture balance that facilitates the body's own breakdown of devitalised tissue	Most wound types. When more effective debridement methods are not available or acceptable to patient; to avoid maceration, do not use on highly exuding wounds; best used as an adjunct with mechanical debridement	Not needed	See note*
Osmotic	Honey; hypertonic gels and dressings	Induction of a hyperosmotic environment in the wound bed; The hypertonic (excess) fluid helps soften and liquefy devitalised tissue, making it easier to remove	Pressure ulcers/injuries; DFUs; venous leg ulcers; highly exuding wounds; infected wounds; wounds with high bacterial burden	Not needed	See note*
Enzymatic	Collagenase enriched in bromelain; glucose oxidase and lactoperoxidase	Specific enzymes breakdown devitalised tissue	Collagenase: neuroischaemic DFUs, hard-to-heal wounds; Bromelain: burns; Glucose oxidase and lactoperoxidase: hard-to-heal wounds	Not needed	See note*
Chemical	Single-use topical gel with desiccating properties	Desiccation of devitalised tissue and biofilm, which sloughs off in 1–5 days	Most wound types	Needed	See note*
Chemo-mechanical	Amino-buffered hypochlorite gel	Special sodium hypochlorite gel creates a highly alkaline and oxidative environment that kills pathogens and biofilm; application time is 2–5 minute and its primary function is not remove, not soften, tissue	DFUs and leg ulcers	Needed	See note*
Surfactant	Poloxamer 188 (pluronic F68), non-ionic, amphiphilic surfactant	Hydrophilic surface attracts and softens devitalised tissue and debris, which is then trapped by the hydrophobic core; it is washed away with water or saline	Most wound types	Not needed	See note*

Note: *Refer in extensive, deep wounds, exposed tendon or bone, chronic venous insufficiency, clinical signs of deep or systemic infection, worsening wound or no progress after 2–4 weeks of treatment; DFU, diabetic foot ulcer; WBP, wound bed preparation;

Autolytic debridement

Autolytic debridement is a natural process in which phagocytes, leucocytes and proteolytic enzymes in the body selectively target and degrade devitalised tissue. Autolysis will soften the devitalised tissue, leading to its eventual detachment from the wound bed. Autolytic debridement is typically indicated for non-infected wounds, but it can be used on in combination with antimicrobial therapy.[42] Autolytic debridement should also be used with other integral debridement techniques, such as mechanical or selective sharp/surgical debridement.

For autolysis to be effective, there needs to be a moisture balance in the wound that is conducive to the natural process of autolysis (in other words, the wound should be not too wet or too dry), and the immune system needs to be functional. A large wound size and the presence of a considerable amount of devitalised tissue present can limit its effectiveness, so another method (often selective sharp debridement) may need to be considered.

Moisture-retentive or donating products that can help promote autolytic debridement include, but are not limited to, hydrocolloid dressings, a variety of topical gels, and alginate dressings. For the purposes of this document, autolytic dressings are categorised based on their desired outcome, rather than described in detail. Clinicians should check the exudate volume before selecting an autolytic dressing to ensure the wound environment is conducive to autolysis,[43] as well as refer to the manufacturer's indications and instructions for use.

Autolytic with distinctive properties

Hydro-responsive wound dressings (HRWD) not only facilitate autolysis, but also sequester excess levels of proteases, such as matrix metalloproteinases (MMPs)[44]. These dressings contain superabsorbent polyacrylate (SAP) and continually release Ringer's solution into the wound, with the rinsing action

facilitating cleansing and enabling autolytic debridement.[45,46] As well as absorbing excess exudate, the SAP within the dressing can modulate MMPs and absorb bacteria, with an anti-inflammatory effect.[47,48] Combined with the moist wound environment promoted by the dressing, this can aid healing.[46,48,49] Indications include both acute and hard-to-heal wounds.

Hydro-desloughing dressings represent a distinct form of autolytic debridement. Negatively charged fibres in the dressing bond to positively charged regions in slough.[50] In this way, slough is bound and trapped in the dressing and then removed when it is changed.[51] This process is termed electrostatic charge physical attraction. Slough can be protonated (given a positive charge) with the application of a mildly acidic cleanser, such as HOCl. The dressing technology is designed to promote a moist environment conducive to healing, with its protective interface reducing pain at dressing changes and minimising the risk of damage to newly formed tissue.[52,53]

In general, autolytic debridement takes several days, but if significant autolysis is not observed in 1–2 weeks, another method of debridement should be considered. In such case, if more aggressive alternative debridement options are outside of the health professional's scope of practice, referral to an appropriately trained wound-care specialist should be considered.[54]

Osmotic debridement

Osmotic debridement uses osmotic agents to create a moist environment. A hyperosmotic gradient exerts an osmotic pull on tissue cells and wound fluids, which can improve the wound microcirculation and help soften and liquefy devitalised tissue. Osmolality measures the concentration of solutes in liquid relative to the number of particles by weight (kg) of liquid. It is important to differentiate between the osmolality of the various osmotic agents used for debridement. Which is considered light or heavy depending on how close or far it is from normal blood plasma level range (257–290 mmol/kg). Debridement products with an osmolality >350–400 mmol/kg are not suitable for the fragile skins of the very elderly, neonates and babies aged under 1 year.[55]

Hyperosmotic agents include medical-grade honey and hypertonic sodium chloride dressings and gels that create a hypertonic environment on contact with exudate. Again, when selecting a dressing to facilitate osmotic debridement, the wound characteristics must be considered to ensure the desired outcome can be achieved. For example, hypertonic sodium chloride-impregnated dressings should not be used on lightly exuding or dry wounds.[56] Always refer to manufacturer's indications and instructions for use before application.

Enzymatic debridement

Enzymatic debridement is another adjunctive method of debridement. This method uses specific enzymes, such as collagenase derived from Clostridium histolyticum and proteolytic enzymes, derived from pineapple stems and then enriched in bromelain, to break down devitalised tissue.[57]

Enzymatic debridement with proteolytic enzymes enriched in bromelain is primarily indicated for burns and in plastic surgery.[58] An adapted version of this formulation, indicated for hard-to-heal wounds, has been developed and is currently undergoing phase 3 trials.[59] This composition enables the product to promote a moist environment conducive to wound healing. The enzyme system produces reactive oxygen radicals that facilitates continuous debridement and offers antimicrobial protection.[60,61]

Consensus statement: Autolytic, osmotic, oxidative and enzymatic debridement are often referred to as methods of debridement. However, the panel considers that they need to be used in conjunction with mechanical debridement or other more aggressive debridement techniques to achieve the desired objective of wound closure.

Chemical, chemo-mechanical and surfactant debriding agents

Chemical debridement

Chemical debridement refers to the use of a single-use topical gel containing methanesulfonic acid, which has rapid desiccating properties,[62] with an application time of only 1 minute. Devitalised tissue and biofilm comprise up to 90% water.[35] When the gel comes into contact with water in the wound, a reaction occurs that produces sufficient energy to destroy almost all biochemical bonds in infected and devitalised tissue, including biofilm, which can result in swift desiccation and oxidation. According to the manufacturer, the desiccated, denatured tissue sloughs off the wound in the subsequent 5–7 days. Any adherent necrotic tissue must be removed with autolytic or selective sharp debridement before application. Chemical debridement is indicated for all infected non-surgical hard-to-heal wound types. Ischaemic wounds must be revascularised before use. The acidic action and desiccation effect can cause temporary pain during application, so topical analgesia should be administered beforehand, if required. Use of personal protective equipment (goggles, gloves and apron) is also required.

Chemo-mechanical debridement

Chemo-mechanical debridement involves an amino-acid buffered hypochlorite gel designed to soften and atraumatically remove devitalised tissue and biofilm.[63] Currently indicated for VLUs and DFUs, chemo-mechanical debridement has two components that are combined to form a gel. After application, the gel is left on the wound for 2–5 minutes, after which the softened tissue can be removed with a debridement pad. The gel can be applied up to twice weekly, for a maximum of 24 weeks, until there is no remaining devitalised tissue. Its active ingredient is sodium hypochlorite, which creates a highly alkaline and oxidative environment that dissolves and kills pathogens and biofilm.[63] According to the manufacturer, chemo-mechanical debridement is biocompatible for short application. Contraindications include diabetic macroangiopathy, chemotherapy or immunosuppression. Any adherent necrotic tissue will need to be removed with autolytic or selective sharp debridement before application. Sodium hypochlorite should not be confused with HOCl.

Surfactant chemical debridement

Surfactants reduce the surface tension between liquids and a surface, reducing the ability of molecules to attach to each other and aggregate. Poloxamer 188 (also known as a pluronic) is a non-ionic amphiphilic surfactant. Concentrated poloxamer 188 in a hydrogel formulation is an example of a surfactant debriding agent.[64,65] In aqueous solution, such as water or saline, surfactants form structures called micelles, which have a hydrophobic core and a hydrophilic surface.[66] On application onto a wound, the hydrophilic surface of its micelles can soften, loosen and trap debris and devitalised tissue, which is then trapped in their hydrophobic core.[67] As the gel is water-soluble, the debris and devitalised tissue can then be washed away with water or saline.[67] Its thermogel properties mean it thickens as it warms on contact with tissue and skin, but it becomes softer as it cools at dressing change, reducing the risk of trauma.[67] There is evidence the gel can break down biofilm[64,67–69] and enhance cellular migration and angiogenesis.[70] Moreover, concentrated non-ionic, amphiphilic poloxamer 188 gel and its micelle matrix can penetrate damaged membranes, substituting for lipids in the unstable portions of the bilayers, thereby stabilising the cell membrane. In this way, the cells can salvage their barrier function and survive.[66]

Standalone debridement methods

Stand-alone debridement methods refer to debridement techniques that can be used independently without the need for additional interventions to achieve the desired outcome (*Table 2*). They are biological, mechanical, technical and selective sharp/surgical debridement. They are often chosen based on the specific characteristics of the wound and the patient's condition, providing a comprehensive and self-sufficient approach to debridement.

Biological debridement

Biological debridement involves the application of medical-grade maggots (larvae) to the wound bed (*Figure 9*).[71] The

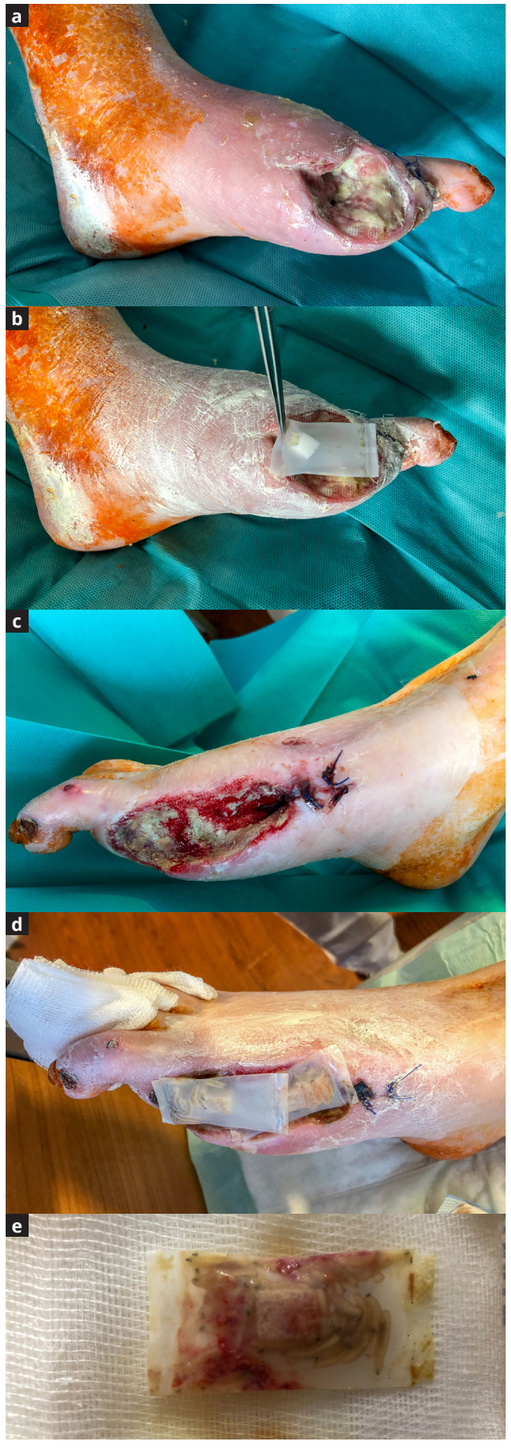
Table 2. Summary of standalone debridement methods

Method	Examples	Mechanism of action	Key indications	WBP	Referral
Biological	Contained larvae 'tea bag'; free-running larvae	Enzymes from medical-grade larvae (maggots) break down non-adherent devitalised tissue and biofilm; antimicrobial properties	Necrotic tissue, slough or biofilm; Do not use on adherent necrotic tissue, in body cavities and close to big vessels or nerves	Needed	See note**
Mechanical*	Debridement pads; gauze	Physical removal of devitalised tissue and debris from the wound bed	Most wound types, especially with loose slough tissue	Not needed	See note**
Technical: hydrosurgical*	High-power waterjet (Venturi effect); micro waterjet	Jet of water selectively cuts devitalised tissue	High-power waterjet: diabetic foot ulcers, pressure injuries and burn injuries; micro waterjet: most wound types, especially those in patients with very low tolerance to pain	Not needed	High-power waterjet: specialist procedure; micro waterjet: see note**
Technical: ultrasonic*	Low-frequency (20–40 kHz) or high-frequency (1–3 MHz) ultrasonic waves	Ultrasonic waves facilitate removal of devitalised tissue; most effective when used with an antimicrobial or antiseptic solution	Cavity wounds, neuroischaemic diabetic foot ulcers; low-frequency: exposed tendons and delicate structures; high-frequency: venous leg ulcers, pressure injuries	Needed for low frequency	Specialist procedures
Technical: NPWTi-d with ROCF*	NPWT combined with instillation of saline, hypochlorous acid or antiseptics and a debriding foam dressing	Mechanical action of the foam, supplemented by instillation and NPWT	Patients who cannot tolerate selective sharp/surgical debridement; Implant infections; multispecies, and multi-drug resistant infections as well as deep infections; neuroischaemic diabetic foot ulcers, especially located at risk sites for wound extension	Not needed	Specialist procedures
Selective sharp*	Scalpel, scissors or curette	Selective cutting away of devitalised tissue to promote wound healing and prevent infection while avoiding the excision of viable tissue	May be used for most wound types and combined with gentler debridement methods to accelerate debridement. Wounds with a solid layer of necrotic tissue, slough, biofilm or eschar, often when the devitalised tissue is starting to separate from healthy tissue	Not needed	See note**; wounds in challenging anatomical locations
Surgical*	Scalpel, scissors or curette	Complete removal of necrotic tissue, slough, or eschar, using precise incisions while excising into viable tissue where bleeding is observed	Extensive necrotic tissue, loose or adherent devitalised tissue, involvement of deep structures, biofilm or complications such as damage to blood vessels. When other methods of debridement have been ineffective or when immediate reconstruction is required. Wounds in functionally and cosmetically important areas, such as the face, hands, perineum, and feet. Often needed as an adjunct for gentler debridement methods	Not needed	Specialist procedures

Note: *Hydrochlorous acid or sodium hypochlorite can be used as assisters before or during debridement to amplify efficacy

**Refer in extensive, deep wounds, exposed tendon or bone, chronic venous insufficiency, clinical signs of deep or systemic infection, worsening wound or no progress after 2–4 weeks of treatment; DFU, diabetic foot ulcer; NPWTi-d with ROCF, negative pressure und therapy and instillation with dwell time with reticulated open-cell foam; WBP, wound bed preparation;

Figure 9. Biological debridement (a–e)



larvae secrete proteolytic enzymes that break down devitalised tissue while concurrently leaving healthy tissue intact and preserving deep structures such as tendon, ligaments and bone.[72] The larvae also have antimicrobial properties, helping to reduce the bacterial load in the wound.[73]

Key indications for biological debridement include wounds with necrotic tissue, slough or presence of biofilm. The digestive enzymes of larvae liquefy necrotic tissue, resulting in increased drainage. Larvae are obligate oxygen breathers, so to ensure their survival throughout the entire treatment episode, drainage management before and after application is critical to avoid suffocation. Biological debridement is generally well tolerated,[74] although sensate patients might be aware of the movement of larvae movement.

Referral to a specialist for larvae debridement may be required in complex cases or when the wound does not respond to initial interventions. Use of a skin barrier should be considered to avoid skin irritation due to larval secretion.

Mechanical debridement

Mechanical debridement involves the physical removal of devitalised tissue and debris from the wound bed.

Debridement pads (also available in in a wand shape or as a glove) are often preferred over traditional gauze for mechanical debridement. While there is no comparative evidence available, individual products within the debridement pad category have been extensively studied.[36–39] These pads are useful in the management of wounds at risk or with clinical signs of local infection, regardless of wound and patient characteristics.[40] There is also evidence that they remove biofilm.[36] Anecdotally, the pads are considered more effective when used with a surfactant solution. Debridement pads are less effective on thick, fibrous slough.[36]

Consensus statement: The use of saline-soaked gauze as a method of mechanical debridement should only be considered when no alternative method is accessible. The wet-to-dry method of debridement – the use of a saline-moistened dressing that is placed in the wound bed, left to dry and removed after a few hours – should never be used, as it is both painful and harmful to patients.

Technical debridement methods

Technical debridement refers to the use of advanced medical devices or techniques to mechanically remove devitalised tissue from the wound bed.

Hydrosurgical debridement

There are two options available for hydrosurgical debridement: high-power waterjet and micro waterjet.

Hydrosurgical debridement with a high-power waterjet uses a cutting action and the Venturi effect to disintegrate any devitalised tissues in its path.[75] It also generates a close-range suction, so that the fragments are cleared effectively.[76] A high-power waterjet requires a theatre setting and specialist training. The jet has a sharp, angled edge that makes it more selective than a straight-edged blade. Indications for use include DFUs and pressure injuries and burn injuries.

Hydrosurgical debridement with a micro waterjet is relatively selective, can be used in an outpatient setting and does not need specialist training.[77] A micro waterjet is particularly useful for patients who are sensitive to pain or for health professionals who may not feel confident using a blade for debridement. Nonetheless, this gentler option provides an effective alternative to the high-power waterjet, a blade and scissors.

Referral to a specialist for hydrosurgical debridement may be required in complex cases or when specialised training and expertise are necessary.

Ultrasonic debridement

There are two options available for ultrasonic debridement: low-frequency ultrasound and high-frequency ultrasound.

Low-frequency ultrasound involves the use of low-frequency (25–60 kHz) ultrasonic waves to facilitate the removal of devitalised tissue from the wound bed.[78] High-frequency (1–3 MHz) ultrasound debridement is another specialised technique that offers several advantages over a blade.[79] Here, high-frequency ultrasonic waves selectively break down and remove devitalised tissue from the wound bed.

Before initiating ultrasonic debridement, any excess exudate or debris must be removed by cleansing. Ultrasonic debridement is more effective when used in combination with an antimicrobial or antiseptic solution, as it has a synergistic effect in reducing bacterial load and promoting wound healing.[80] This method is particularly useful for areas that cannot be selectively sharp debrided, such as tendons or around delicate structures. Ultrasonic debridement is usually a specialist procedure, and referral may be required in complex cases or when the wound does not respond to initial interventions.[81]

There is evidence supporting the antibiofilm properties of ultrasonic debridement, including its ability to prevent biofilm re-formation.[80] Ultrasonic debridement can be used with either saline or hypochlorous solution.[82] Further research is needed to fully understand the optimal use of antiseptic solutions for this method of debridement. It is also important to consider the potential risks associated with the use of high-frequency ultrasonic devices. According to results of randomised controlled trials, the heat generated by these devices can cause hot spots, burns or endothelial injury.[83,84] Therefore, their use in medical practice may be limited.

Ultrasonic debridement is particularly useful in cavity wounds, where it is easier to use and more effective than a blade.

One key advantage of low-frequency or high-frequency ultrasonic debridement is its suitability for non-surgeons and non-trained specialists who may be uncomfortable using a blade. It provides a good alternative for those who want to debride aggressively but prefer a less invasive approach.

Negative pressure wound therapy

Negative pressure wound therapy and instillation with dwell time (NPWTi-d) using a reticulated open-cell foam (ROCF) is a specialised technique that combines the benefits of negative pressure wound therapy (NPWT), regular instillation of sterile normal selective saline, HOCl solution or other antiseptics with the mechanical action of regular changes of a specifically developed debriding foam.[85] When used with HOCl, the microabrasive processes associated with the ROCF produces an amplified mechanical effect, compared with topical use only. A separate consensus document on this topic has concluded that the combined use of HOCl with NPWTi-d is more efficient and effective than 'if used independent of one another'.[86] Use of NPWTi-d with HOCl (as opposed to saline) has been observed to reduce the number of operating theatre visits needed for patients with complex, infected wounds, reducing the length of hospital stay and resulting in cost savings. Before initiating NPWTi-d with HOCl, it is important to prepare the wound by removing any excess exudate or debris.[86–88]

NPWTi-d with ROCF is a valuable technique for patients who cannot tolerate the manipulation of the wound associated with selective sharp/surgical debridement. It offers a gentle approach to promote wound healing and manage complex wound environments including biofilms and microbial burden.[89] However, NPWTi-d is not recommended in wounds with exposed, unprotected organs and vessels, or undrained abscesses, over split-thickness skin grafts, over dermal substitutes and in acutely ischaemic wounds.[90]

Referral to an experienced specialist is highly recommended for the application and management of NPWTi-d.

Consensus statement: NPWT alone (without regular instillation of sterile normal saline, HOCl solution or other antiseptics, and without ROCF) should not be considered a debridement method.

Selective sharp debridement

Selective sharp debridement is commonly performed in the outpatient setting as part of routine wound care. Since selective sharp debridement (when properly performed) is confined to non-viable tissue, the risk of any significant blood loss is low. However, bleeding can occur during the procedure due to anticoagulant medication or other underlying pathology, so appropriate techniques and precautions should be taken to achieve haemostasis and prevent excessive blood loss during and after the procedure. For all patients, topical or, on rare occasions, injectable local anaesthesia may be required to avoid discomfort to the patient during the procedure. Selective sharp debridement must be undertaken by a health professional with the necessary competency. Examples of selective sharp debridement are given in *Figure 10*.

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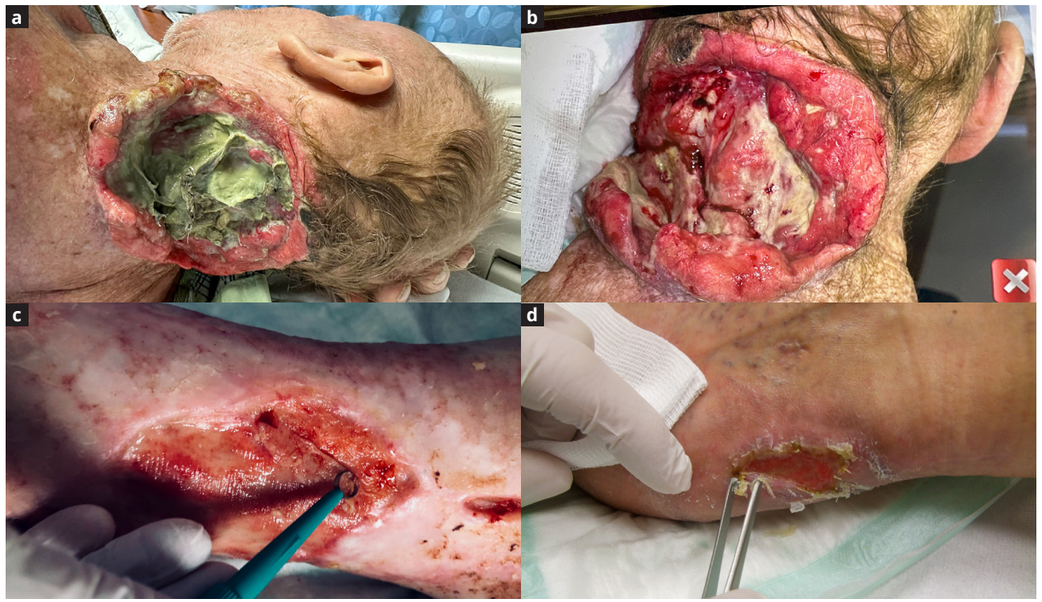
Figure 10. Selective sharp debridement: pre- and post in an inoperable fungating neck wound complicated with squamous cell carcinoma (a and b); with a curette (c) and with forceps (d)



Surgical debridement

Surgical debridement is performed by either a surgeon or a trained wound-care professional, depending on the country. When undertaken by a surgeon, in most countries this typically takes place in a dedicated facility, such as an operating theatre or procedure room, and usually requires topical, local, regional or general anaesthesia (*Figure 11*). In various countries including the US, surgical debridement not requiring the operating theatre is routinely performed in the acute-care outpatient clinic setting, as well as at the bedside in the post-acute setting, such as rehabilitation hospitals and in the patient's home. The procedure involves excision into viable tissue, so it requires expertise and must be undertaken by a health professional with the necessary competency.

Key indications for surgical debridement include full-thickness wounds with extensive necrotic tissue, involvement of deep structures or more complex complications requiring the skills of a trained surgeon, such as repair of damage to blood vessels.[87,88,91] Surgical debridement is particularly beneficial where other methods of debridement have been ineffective or immediate reconstruction is required. It is also indicated for wounds in functionally and cosmetically important areas, such as the face, hands, perineum and feet. However, patient psychosocial factors, such as nutritional status, that might affect healing may need to be addressed before surgical debridement can be performed. *Figure 12* shows a wound before and after surgical debridement.

In neonatal and paediatric wounds, great care must be paid when debriding this fragile tissue. Microsurgical debridement is sometimes necessary; this uses either 4.5x loops or the operating microscope from 6 to 12 magnifications.[92]

Assisters (amplifiers) of various debridement methods

The evidence base supporting the effectiveness of certain solutions in conjunction with mechanical properties has been growing since publication of the 2013 EWMA debridement document (*Table 3*).[35] Recent studies have demonstrated its efficacy in reducing the bacterial load, promoting wound healing and improving clinical outcomes.[93–95]

HOCl can also be used to assist (amplify) various standalone debridement methods, such as mechanical debridement, selective sharp/surgical debridement and technical methods including NPWTi-d with ROCF.[82] When applied to the wound bed, edges and periwound skin, stabilised HOCl will soften devitalised tissue, mechanically disturbing it during irrigation or mechanical debridement using either gauze or a debridement pad. In this way, it can assist mechanical debridement. It also has properties that enable it to remove germs and debris, in a way that differentiates it from saline, for which this has not yet been documented. HOCl as a preservative effectively eliminates bacteria, yeast and fungi both in planktonic and complexly colonised form.[21–23,96] As HOCl is a naturally occurring molecule with a high therapeutic index (safety margin), it will not harm healthy tissue or cause a stinging sensation, making it safe for frequent application. This means that HOCl-soaked gauze can be frequently applied to soften necrotic tissue (recommendation application time is 3–5 minutes), with this process being called wet-to-wet (mechanical) debridement. The gauze must not be allowed to dry out. Key indications for use of HOCl include wounds that are infected or have a high microbial burden or that contain complex polymicrobial colonies.[97]

Sodium hypochlorite (NaOCl), which has a comparable mode of action to HOCl, can also be used as an assister of various debridement methods including mechanical, technical and selective sharp or surgical debridement. It can remove necrotic tissue and reduce microbial load, thereby promoting a cleaner wound environment. NaOCl can react with biomolecules, such as fatty acids and proteins, on a molecular level, which weakens the structural bonds and so 'softens' necrotic tissue. NaOCl can also kill bacteria, viruses, fungi, and spores. It breaks down the microbial cell wall and cellular components, which results in cell lysis and death. This reduction in microbial contamination and removal of devitalised tissue help promote healthy granulation tissue formation. Depending on the concentration and formulation, NaOCl has a lower therapeutic index than stabilised HOCl.

Before initiating wound management with HOCl and sodium hypochlorite, it is important to prepare the wound by removing any excess exudate or debris. This ensures optimal contact between the HOCl or sodium hypochlorite solution and the wound bed. In addition, avoid soaking the wound bed with HOCl or sodium hypochlorite if a wound swab or biopsy is planned for culture post-debridement, as this could lead to a false negative result.

It appears that the concentration of the HOCl or sodium hypochlorite, usually expressed in ppm, is material to the ability of the cleanser to assist in the process of mechanical debridement.

Figure 11. Surgical debridement (a–i)

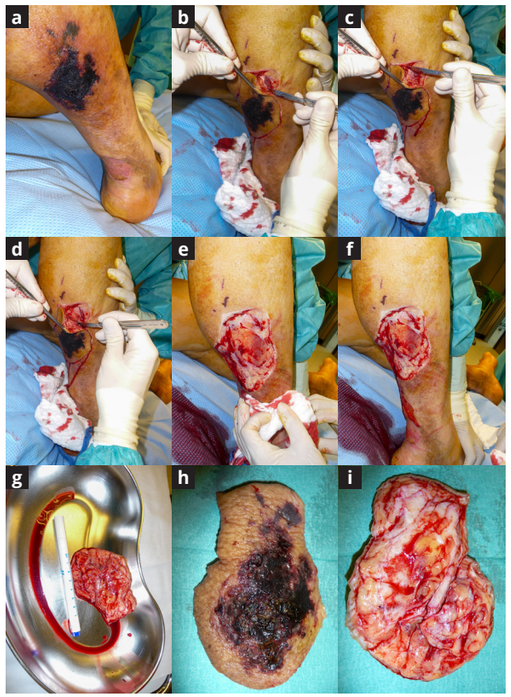


Figure 12. Surgical debridement: before (a) and after (b) procedure

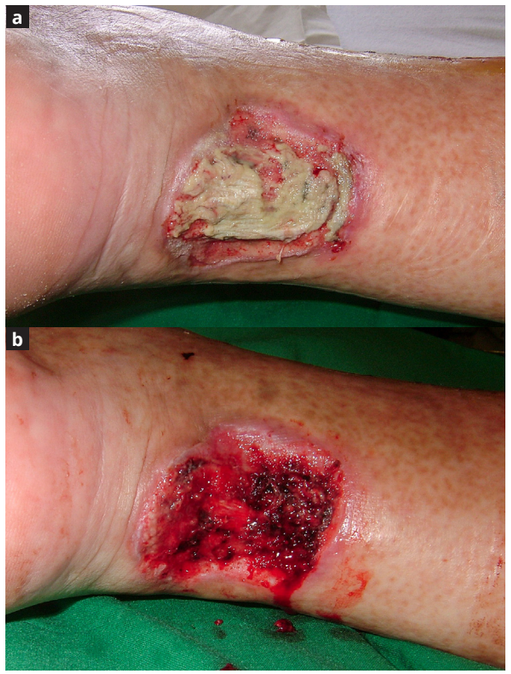


Table 3. Summary of assisters (amplifiers) of various debridement methods

Method	Examples	Mechanism of action	Key indications	WBP	Referral
Sodium hypochlorite	Stabilised solutions or gels	Mechanical disturbing of devitalised tissue and microbes during irrigation or in conjunction with mechanical debridement	Assists mechanical debridement in wounds with high bacterial burden	Needed	See note*
Hypochlorous acid	Stabilised solutions or gels	Mechanical disturbing of devitalised tissue and microbes during irrigation or in conjunction with mechanical debridement	Assists mechanical debridement in wounds with high bacterial burden	Needed	See note*

Note: *Refer in extensive, deep wounds, exposed tendon or bone, chronic venous insufficiency, clinical signs of deep or systemic infection, worsening wound or no progress after 2–4 weeks of treatment; DFU, ; WBP, wound bed preparation;

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Assessment

Summary

- A comprehensive holistic assessment must be undertaken before debridement. This should aim to address any potential barriers to participation in debridement, including patient anxiety and fear of pain during the procedure.
- Assessment of non-microbial components includes observation for any clinical signs of inflammation and identification of the tissue types present.
- Dry necrosis is typically characterised by non-infected, black and dry tissue. In many cases, particularly on the extremities, adherent dry necrotic tissue (eschar) can safely be left untreated.
- Wet necrotic tissue is often due to secondary infection or liquefactive processes. Prompt and effective management is required to prevent complications.
- Dry necrotic tissue in patients with severe peripheral arterial disease should only be debrided if infection is suspected underneath.
- The cause of slough formation must be identified and managed; simply wiping it away will not be sufficient.
- To avoid patient harm, it is important to be able to differentiate slough from other structures with a similar appearance, such as tendon, fascia and joint capsules.
- Always ensure care is patient-focused, and refer to a specialist if the wound is not responding to standard of care or presenting with complications, or when access to resources, expertise and specialist equipment is required.

A comprehensive holistic and wound assessment must be undertaken before debridement. This includes considering factors such as diagnosis of the wound type and identification of underlying comorbidities, social and environmental factors, patient and family concerns, and patient quality of life, wellbeing and psychosocial factors.[98]

Holistic assessment must consider individual patient needs and concerns. This includes addressing potential barriers to participation in debridement, such as patient anxiety and fear of pain during the procedure. By considering the patient's perspective, health professionals can provide individualised care that promotes patient satisfaction and cooperation.

The wound assessment must determine if it is safe to debride the wound, and, if so, what method(s) will be most effective, and whether integral or stand-alone debridement is required. Key objectives and aspects of holistic wound assessment prior to debridement are listed in *Box 5* and *Box 6*, respectively.

Diagnosis and comorbidities

Assessment plays a vital role in identifying the underlying cause of the wound and any comorbidities that may impact the healing process. An understanding of the specific factors contributing to the wound allows health professionals to deliver a standard of care that addresses the underlying aetiology or to consult the appropriate specialist when medical management is beyond their scope of practice.

For wounds on the lower limb, a thorough vascular assessment must be undertaken to evaluate the blood supply to the affected area, to determine if it is safe to proceed. Vascular assessment can include distal pulse palpation, the use of a hand-held Doppler ultrasound to calculate the ankle brachial pressure index (ABPI) and determination of toe brachial index

Box 5. Objectives of a holistic wound assessment prior to debridement

- Identify the wound's healing potential to determine if debridement is appropriate, as some wounds are unable to benefit from debridement due to factors such as advanced necrosis associated with peripheral arterial disease or vascular impairment or the patient being at end of life
- Diagnose the underlying aetiology of the wound to help select the most clinically appropriate debridement method
- Increases understanding of the specific needs of the wound to tailor a targeted treatment plan and guide decision-making
- Determine comorbidities so they can be managed to optimise wound healing
- Identify patient priorities and preferences to promote satisfaction and concordance

Box 6. Key aspects of holistic wound assessment prior to debridement

Wound
- Underlying aetiology
- Potential for healing
- Presence of biofilm
- Tissue types present (e.g., necrotic tissue, slough, granulation tissue)
- Overall wound characteristics

Patient factors
- Comorbidities that can impair wound healing (e.g., diabetes, poor perfusion and renal insufficiency)
- Advanced age or early years of life (premature, newborn and children aged under 5 years)
- Lifestyle factors (e.g., smoking, exercise, nutrition)
- Patient needs, priorities and preferences

Social factors
- Availability of support networks
- Access to adequate nutrition
- Caregiver capacity to perform debridement

Setting
- Availability of medical resources and equipment
- Clinician training and expertise in debridement

Box 7. Chronic venous insufficiency: characteristics and assessment

Chronic venous insufficiency (CVI) is characterised by dysfunction of the venous wall or valves in the leg veins, which impairs venous return to the heart. This venous malfunction results in increased venous pressure, which can cause fluid extravasation into the surrounding tissues, precipitating oedema, inflammation, and the formation of hard-to-heal wounds and skin necrosis. Accurate diagnosis of CVI typically involves a clinical evaluation supplemented by diagnostic imaging, such as duplex ultrasonography, which is used to evaluate the integrity of blood flow and valve operation within the veins.

and transcutaneous oxygen pressure (TcPO2).[98] With appropriate training, relevant peripheral arterial disease can quickly be excluded by determining the quality of the audible sound of the handheld continuous wave Doppler ultrasound.[99] A multiphasic waveform (biphasic or triphasic) is indicative of a normal ABPI (≥0.9).[100]

If hand-held Doppler is not available and foot pulses are not present, the patient must be referred to a vascular specialist for further assessment, which may include a colour duplex ultrasound, angiography or a CT scan. Depending on the severity of ischaemia, the wound should not be aggressively debrided before a vascular assessment has been undertaken. If waiting times are long and ischaemia is not critical, gentle debridement of slough and biofilm, to reduce the risk of infection, can be beneficial and is safe.[101] However, a study into patients with severe critical limb ischemia (Rutherford category 6) and gangrene (wound, ischaemia, and foot Infection classification stage 4) demonstrated that a strategy prioritising revascularisation before debridement led to improved outcomes. Implementing revascularisation as soon as possible, before any debridement procedures, provided a significant benefit in the management of these complex cases.[102]

Assessing the vascular status helps determine the underlying aetiology that needs to be addressed and guides the selection of the most suitable debridement method, whether for ulcers with arterial and venous aetiology. Principles of assessment for chronic venous insufficiency (CVI) are given in *Box 7*.

It is crucial to address and manage all comorbidities to create an optimal environment for wound healing.

Assessment of non-microbial components

Hard-to-heal wounds are often said to be stuck in a prolonged inflammatory response. To address this and promote healing, health professionals need to be able to recognise when non-microbial components are present. Visible indicators of non-microbial components include:

- Clinical signs of inflammation, including redness, swelling, heat and pain, which may trigger an immune response
- Necrotic tissue, slough, foreign objects or other non-viable substances present in the wound bed – an ultrasound scan, X-ray or even a CT/MRI may be requested to detect deeply penetrated foreign bodies, such as a needle in a DFU.

During the inflammatory response, pro-inflammatory markers, such as cytokines, chemokines and inflammatory enzymes, are released. These are associated with tissue damage or the presence of foreign materials. Common pro-inflammatory regulatory proteins include CRP, TNF-α, IL-1, IL-6, IL-8, MMP-2, MMP-9 and PGE2.

If devitalised tissue is present but there are no clinical signs of wound infection, elevated levels of these markers in wound exudate or blood samples can indicate the presence of non-microbial components and ongoing inflammation. Laboratory investigations, such as blood tests or wound exudate analysis, can help identify pro-inflammatory markers, but these are not yet widely available for clinical use.

Hard-to-heal wounds that are refractory to standard-of-care practices may require a biopsy to rule out atypical aetiologies, such as parasites, neoplasm or an autoimmune process.

Differential diagnosis

Dry vs wet necrosis

In the context of debridement, there are two main types of necrosis: wet and dry necrosis. It is vital to understand the differences between them and when it is safe to debride.

Figure 13. Eschar in fluctuant heel abscess: before (a) and after (b) surgical debridement and healed (c)

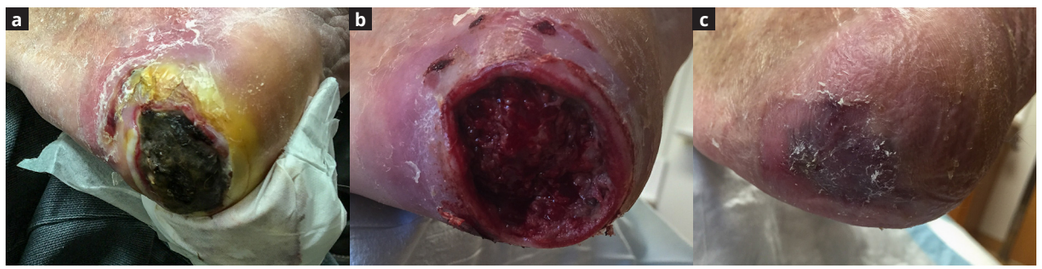
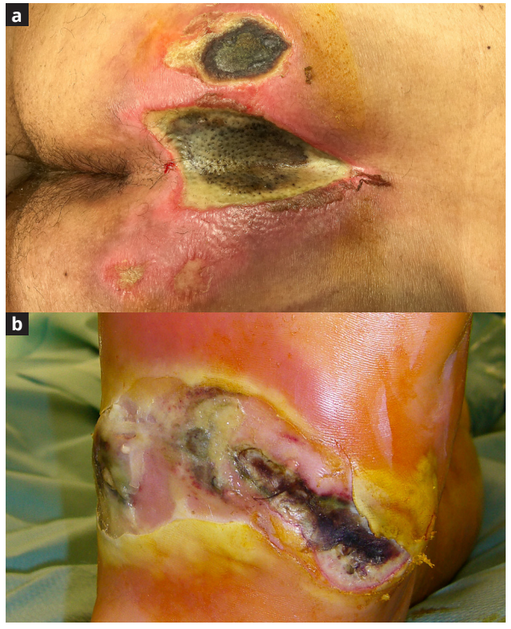


Figure 14 Transformation from dry to wet necrotic tissue



Dry necrosis is typically characterised by non-infected, black, dry tissue. Dry necrotic tissue that becomes black, dry and firm and adheres to the wound bed and edges is often referred to as eschar (*Figure 13*). In many cases, particularly in the extremities, such as fingers and toes, this type of dry necrotic tissue can be safely left untreated.[103] In patients with severe critical ischemia, removing dry necrotic tissue will result in its re-formation, necessitating further debridement, resulting in a vicious cycle that is harmful to the patient.

Consensus statement: Debridement should not be performed in necrotic tissue in patients with severe peripheral arterial disease (critical limb ischaemia) who are not candidates for revascularisation, as this could exacerbate the existing tissue damage, given that the blood flow is already compromised.

In some instances, it may be in the patient's best interest to prevent dry necrotic tissue from becoming moist, as this can increase the risk of infection. Black necrotic tissue with a soft and elastic surface that can be pressed with a subsequent rebound effect – or that detaches from the vital tissue on the wound edges – may be a sign of an impending deeper infection. This will require urgent investigation; if infection is suspected or identified, the black necrotic tissue should be removed. Examples of the transition from dry to wet necrotic tissue are given in *Figure 14*.

Wet necrosis is characterised by the presence of moist necrotic tissue, often due to secondary infection or the presence of liquefactive processes.[104] It typically occurs in environments where microbial infection or a robust inflammatory response introduces fluid into the necrotic area, leading to tissue breakdown and the production of pus or other liquid by-products processes. Wet necrosis is a complex condition that requires prompt and effective management to prevent complications. After performing complete selective sharp/surgical debridement, a specimen should be collected for microbiological analysis. Additionally, if there are clinical signs of a deeper or systemic infection, antibiotic therapy should be initiated and/or hospitalisation considered.

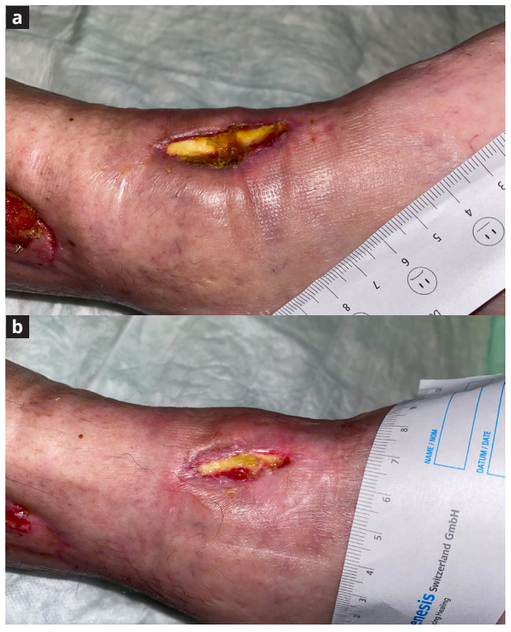
Slough vs other tissue types

It is essential to be able to understand the characteristics of slough and know when it is safe to remove it. Slough is located on the wound surface.[17] Simply wiping it away will not address its underlying cause and will be ineffective if the slough is adherent. The cause of slough formation must be identified and addressed to promote effective healing. Slough formation is associated with repetitive pressure over a wound, poor vascular status, prolonged inflammation or bioburden, biofilm and local infection.[17]

Box 8. Safety factors to consider before slough removal

- Location of the slough (deep structures like vessels, nerves, tendons, fascia, muscles)
- Underlying factors associated with poor vascular status
- Patient's general condition and medications
- Skill and expertise of the health professional

Figure 15. Exposed tendon that could be confused with slough



When considering the removal of slough, it is important to consider how to proceed without causing harm (*Box 8*). It is crucial to differentiate slough from other tissues or structures that may have a similar appearance, such as fat and other types of tissue, including fascia, tendon and joint capsules (*Figure 15*). Therefore, the location of the slough must be considered during assessment. If it is covering deep tissue structures, such as tendons,[105] its removal may risk injury, bleeding or other complications, such as damage to muscle, tendons or nerves. Accurate identification of slough will ensure that the method of debridement selected avoids harm to healthy tissue. In some instances, depending on the clinical setting and expertise available, it might be safer to undertake less-invasive methods of debridement, rather than use a blade.

Patient-centred concerns

Effective communication is vital. It is a legal requirement to obtain informed consent from the patient before proceeding with debridement. This requires that the patient understands the implications of debridement. In practice, this involves a discussion between a qualified health professional and the patient on the nature, indications, risks and benefits of the procedure, with information given on the different ways of removing devitalised tissue and the potential for pain or discomfort during the procedure. This will enable the patient to make informed decision about whether to proceed.

Patients should also be told to inform the health professional if they are experiencing any pain or discomfort experienced during the procedure. Following assessment, pain relief, usually topical, should be applied to avoid anticipated pain during the procedure. Prior experience of pain during a procedure such as debridement can have a psychological effect, with the potential for anticipatory pain and its associated anxiety the next time it needs to be performed.[106] Assessment should aim to identify if this is an issue and ensure appropriate pain relief and psychological support is provided when necessary.

To promote concordance, health professionals should encourage open communication, address any concerns or misconceptions, and ensure that the patient understands the importance of adhering to the recommended debridement regimen. Additionally, health professionals should prioritise patient comfort, manage pain effectively, and provide emotional support throughout the debridement process (*Box 9*).[20]

Box 9. Essential elements of concordance

- The patient has knowledge
- The patient participates as a partner in consultations
- The patient plays a proactive role in self-care

Finally, by conducting a comprehensive assessment, health professionals can develop a tailored treatment plan that promotes optimal wound healing outcomes while ensuring patient safety and satisfaction.

Ability of wound to heal

Awareness of the contraindications for debridement is essential to ensure patient safety and prevent complications.

Necrosis is often linked to peripheral arterial disease, where blood flow to the affected area is compromised. When necrotic tissue is identified, it is crucial to evaluate vascular insufficiency, as described above, and determine if revascularisation is required. Undertaking surgical debridement before proper revascularisation could lead to a further deterioration of the condition. Where acute infection is present alongside vascular insufficiency, immediate incision of an abscess or debulking and drainage of infected devitalised tissues before revascularisation may be limb- and/or life-saving.

There are other comorbidities that must also be considered. Specific comorbidities such as the untreated autoinflammatory component of pyoderma gangrenosum[107] or dry necrosis in a DFU[108] may be contraindicated for certain types of debridement due to the potential to exacerbate the condition. When managing patients on anticoagulants and antiplatelet medications, it is crucial to exercise caution due to an increased risk of bleeding, especially during procedures like selective sharp/surgical debridement. Health professionals should carefully evaluate the risk of bleeding associated with these medications and consider adjustments or temporary discontinuation, as necessary. If there is any uncertainty regarding the safety and management of anticoagulation in the context of surgical interventions, referral to a specialist institution should be considered for expert guidance.

Consensus statement: Referral to a specialist is often required when the wound is complex, not responding to standard of care, or presenting with complications such as deep tissue involvement or suspected malignancy. Referral may also be required when health professionals lack the necessary resources, expertise or access to specialist equipment needed to perform certain debridement procedures. Examples of complex cases often requiring referral are DFUs or wounds with black necrotic tissue on the heel. In such cases, assessment should identify if a referral, including for selective sharp/surgical debridement, is necessary.

Setting

Assessment should also consider local factors in the setting that may influence the choice of debridement methods and their application. Factors such as available resources, equipment, and expertise play a role in determining the sequence of debridement techniques. Adapting the approach to the specific setting ensures optimal outcomes and efficient wound healing.

Wound cleansing

Although both cleansing and debridement contribute to wound healing, they have different therapeutic properties and objectives.

Wound cleansing is the initial step in the debridement process. Its primary aim is to minimise bioburden and eliminate surface contaminants, debris and microorganisms from the wound, with a view to establishing a clean environment that reduces the risk of infection and promotes the formation of healthy granulation tissue.[109] Cleansing also ensures better visualisation of the wound bed and access to non-viable tissue.

Cleansing should not be confused with debridement: although it may facilitate the removal of some loose or non-viable tissue, its principal function is not the comprehensive extraction of devitalised tissue.

Consensus statement: The panel definition of cleansing is the reduction of bioburden through the removal of loose materials on the wound surface, wound edges and/or peri-wound skin by rinsing, irrigating and wiping with, for example, sterile wet gauze and an appropriate cleansing solution. Wound cleansing usually precedes and follows debridement. It does not replace debridement as it does not remove necrotic or devitalised tissue.

Debridement, in contrast, specifically aims to remove microbial and non-microbial wound components, including necrotic material, slough, biofilm, and foreign materials. It is a therapeutic intervention that promotes wound healing by eliminating barriers to tissue regeneration and reducing the risk of infection.

Why cleanse

Wounds should be cleansed before and after debridement.

Cleansing before debridement helps reduce the bioburden, including bacteria, debris, and contaminants.[109] The reduction in the microbial load creates a cleaner environment for the debridement process, which is also assisted by the greater visualisation of and access to non-viable tissue.

Cleansing after debridement aims to remove any remaining loose material, such as dried blood, and eliminate any remaining detached bacteria or biofilm. This step helps reduce the risk of biofilm re-formation and promotes a clean wound bed.[110]

It is important to cleanse the wound edges and periwound skin, as well as the wound bed. Cleansing the periwound skin helps remove contaminants and bacteria that may migrate into the wound, reducing the risk of infection and promoting wound healing. It can increase patient comfort.[30]

Summary

- Cleansing and debridement have different clinical aims. As such, cleansing should not be confused with debridement, and cannot replace it.
- The primary objective of wound cleansing is to minimise bioburden and eliminate surface contaminants, debris and bioburden from the wound via rinsing, irrigation and wiping.
- Cleansing normally precedes and follows debridement.
- Always refer to local guidelines for options for wound cleansing solutions.

Even when a wound is progressing well towards healing with no devitalised tissue present, small amounts of biofilm may be present in granulation tissue,[111] which can act as a barrier to healing if allowed to mature. Gentle cleansing is sufficient for granulation tissue. If the wound is not healing, the use of a debridement pad may be considered to remove the biofilm.

Following surgical debridement, soaking the wound with stabilised HOCl solution, if available, can further reduce the bacterial burden, including any remaining adherent colonies, in both the peri-wound and wound bed. This can help create an environment conducive to healing and reduce the risk of infection.

Cleansing solutions

Options for wound cleansing include potable water, normal saline, and solutions containing HOCls, NaOCls, iodine, surfactants and/or antiseptics, such as octenidine dihydrochloride or PHMB.

Surfactant-containing solutions are often used for wound cleansing before debridement. Surfactants are compounds that help reduce surface tension and facilitate the removal of debris, contaminants, and microorganisms from the wound surface. Always follow the manufacturer's instructions for the use and dilution of surfactant-containing solutions.

In some countries, water is used for routine wound cleansing, depending on national guidance or access to resources. A Cochrane Review stated that cleansing with tap water may make little or no difference to wound healing when compared with no cleansing.[112] Similarly, there was little or no difference in in the comparative results for the other parameters evaluated in the Cochrane Review.[112]

Guidance varies between countries on whether to use potable water or normal saline for cleansing. Health professionals should always refer to local guidelines.

Wound debridement

As critical as debridement is in wound management, there is some confusion among health professionals regarding its scope. While many consider debridement to be the removal of slough, it encompasses much more than that. One of its aims is to remove biofilm. Clinically, it is considered that most hard-to-heal wounds contain biofilm,[113] although the minimum level of biofilm that can be present in a wound is not yet known

New tools currently in development and advanced diagnostics have the potential to evaluate the effectiveness of debridement, including the removal of biofilm. For example, the acetate test, blotting test, and fluorescence bacterial imaging devices are emerging technologies that might aid assessment of the quality of debridement.[114–116]

Despite the importance of debridement, there is currently a lack of studies comparing the different methods and categories. Further research is needed to determine the most effective techniques for specific wound types and to establish evidence-based guidelines.

Consensus statement: When performing debridement, it is crucial to prioritise safety and to achieve the procedure's objectives. Care must be taken to avoid unintended exposure or even damage of viable structures, such as nerves and blood vessels. The health professional should have a thorough understanding of the human anatomy and, depending on their clinical competences and scope of practice, be able to distinguish between different tissue types in different anatomical locations to minimise the risk of damage.

Consensus statement: The more microbial and non-microbial components, such as exotoxins, endotoxins, enzymes and foreign materials, are removed with the least amount of damage to local healthy tissue, the more the barriers to healing will be diminished, and the more effective debridement will be in promoting healing without delaying or stalling healing.

Summary

- In contrast to cleansing, debridement aims to remove microbial and non-microbial wound components, including necrotic tissue, slough, biofilm and foreign materials. The more these are removed, the more the barriers to healing will be diminished.
- Care must be taken to avoid harm, particularly unintended exposure of or even damage.
- Wound edges harbour significant bioburden so must also be debrided; this will help remove barriers to cell migration and wound closure. Following debridement, the wound edges will quickly regrow and reform.
- Hyperkeratosis and callus pose a challenge to healing, so also need to be debrided.
- Both patients and health professionals should receive education on debridement.

Debriding the wound edges

The wound edges can harbour significant microbial burden, including biofilm, which must be removed to promote healing.[117] Biofilm is often present under rolled edges. Cleansing and debridement of the wound edges, therefore, involves the removal of barriers that hinder cell migration. This will not increase the wound size as viable tissue will quickly grow and reform, potentially accelerating healing time and rates. Before debriding, it is important to assess whether the wound edges are clean and flat, as these help facilitate epithelial migration, or whether there is the need for excision to achieve this.

Hyperkeratosis, a condition characterised by the thickening of the skin's outer layer, is a significant impediment to the healing of DFUs (*Figure 16*). It obstructs epithelial cell migration and wound closure, and needs to be removed to enhance cell migration and facilitate healing. Callus, a specific form of hyperkeratosis caused by prolonged pressure or friction, presents an additional challenge (*Figure 17*). It is crucial that callus is removed, as this will help facilitate effective wound hygiene and overcome healing barriers.

Figure 16. Hyperkeratosis

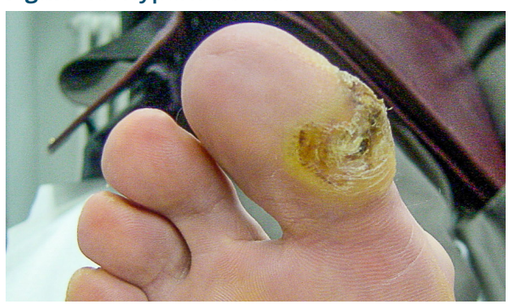
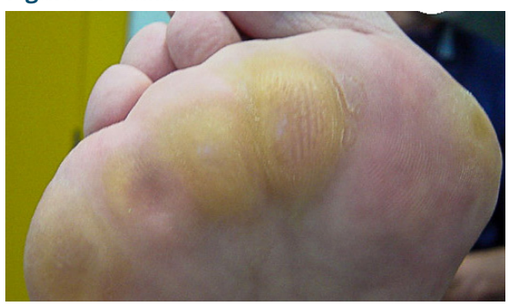


Figure 17. Callus



Education

Consensus statement: It is vital that all health professionals involved in the care of patients with wounds receive education on debridement.

Given the key role played by debridement in wound management, all health professionals involved in the care of patients with wounds must have access to education on this topic. This is crucial for many reasons including:

1 Improved healing outcomes: Non-viable tissue within a wound can harbour bacteria, increase the risk of infection, and impede the natural healing process. Educated health professionals can accurately assess, perform or recommend the appropriate debridement technique, promoting a better healing environment.

2 Infection control: Infection not only delays wound healing but can spread, causing systemic issues with potentially life-threatening consequences. Training on debridement helps professionals prevent infections by ensuring timely removal of non-viable tissue and pro-inflammatory (non-microbial) components.

3 Enhanced decision-making: There are many methods of debridement, each with its indications, benefits, and limitations. Training helps health professionals choose the most appropriate method based on the wound's characteristics, the patient's overall health and psychosocial status, and the wound-healing goals.

4 Multidisciplinary approach: Wound care often requires a multidisciplinary approach, involving nurses, physicians, surgeons, and, sometimes, physical therapists or other specialists. Providing education on debridement across these disciplines ensures a cohesive and integrated approach to wound management, allowing for shared knowledge, more appropriate referrals and standardised care strategies.

5 Patient education and engagement: Educated health professionals can effectively communicate the purpose, process, and benefits of debridement to patients and their families. This can enhance patient cooperation, reduce anxiety, and encourage adherence to treatment plans.

6 Prevention of complications: good debridement techniques can prevent complications such as pain, and delayed healing. Training ensures that professionals are adept at minimising risks associated with the procedure.

7 Cost-effectiveness: Efficient wound management, including effective debridement, can reduce the need for prolonged treatments, hospital stays, emergency department visits, readmissions and amputation rates in patients with diabetes, potentially decreasing healthcare costs.[7]

8 Implementation of new technologies and techniques: Wound care is continually evolving, with new debridement technologies and techniques being developed. Ongoing education will help keep health professionals remain up to date with the latest advancements, helping them to offer the best possible care to their patients.

9 Legal and ethical responsibilities: Health professionals have a legal and ethical responsibility to provide standard of care. Provision of education on debridement will increase their competence to perform this essential aspect of wound care, helping them fulfil their professional obligations and protecting them from litigation related to negligence or malpractice.

Telemedicine is a valuable forum for the provision of supervision and support on debridement, particularly for health professionals using a blade. It can enable immediate instructions and feedback from specialists, regardless of location and geography. It facilitates real-time visual assessment, which is particularly beneficial for precise procedures like debridement. It also enables continuous professional development through direct mentorship and learning opportunities, ensuring that health professionals remain up to date with the latest techniques and best practice. By offering a platform for immediate consultation and assistance, this method of supervision might not only improve the quality of patient care but also boost health professionals' confidence and competence.

In summary, education on debridement is essential for ensuring that all health professionals involved in wound care can provide effective, safe, and high-quality care, leading to better patient outcomes and more efficient use of healthcare resources.

The establishment and expansion of international educational initiatives on debridement are essential for the future advancements in wound care. By introducing a globally standardised curriculum, these programmes would aim to unify debridement methodologies, ensuring the consistent application of best practices across international borders. This educational strategy promises to improve the competency levels of health professionals worldwide, enabling them to adeptly manage wound care with the latest, evidence-based techniques. Furthermore, such a unified approach facilitates an international platform for the exchange of cutting-edge knowledge and innovative debridement techniques, enhancing the overall quality of wound care. The strategic development of these educational programmes is paramount, as they hold the potential to significantly reduce the prevalence of wound-related complications and improve patient outcomes.

Conclusion

Debridement is a crucial intervention in wound management aimed at removing non-viable tissue, debris, microorganisms and biofilm to promote wound healing. Furthermore, it aids to reduce and also prevent biofilm regrowth. This consensus document provides valuable insights into the various aspects of debridement, including methods, wound cleansing, and considerations for selecting the appropriate debridement method for different tissue types.

The document begins by introducing debridement as the process of removing slough, necrotic tissue, and biofilm from the wound bed and edges. The rationale for debridement lies in its ability to create a clean wound environment that facilitates healing. The consensus document was developed through the collaboration of a panel of experts who provided definitions and insights based on their clinical experience and research.

Methods of debridement are discussed, including adjunctive methods that combine mechanical debridement with other techniques (integral debridement), mechanical methods such as monofilament pads, stand-alone methods, chemical debridement, selective sharp debridement, and surgical debridement. The importance of assessing wounds for debridement is emphasised, with key considerations including the recognition and identification of non-microbial biomaterial, microbial bioburden, necrotic tissue, and slough. These factors guide clinicians in selecting the most appropriate debridement method for each tissue type.

Differentiating between wound cleansing and debridement is highlighted, with cleansing serving the purpose of removing contaminants and preparing the wound for debridement. Various cleansing solutions, including surfactant-containing solutions and potable water, are discussed as options for wound cleansing.

Safety is prioritised throughout the document, with guidelines on how to debride wounds while minimising the risk of damage to viable structures. The areas to consider for debridement include the wound bed, wound edges, and other barriers to healing such as hyperkeratosis and callus. The concept of integral debridement is emphasised, allowing for the use of different debridement methods based on the clinician's expertise, patient preferences, and clinical needs. The importance of wound assessment and considering the care setting is highlighted to ensure appropriate debridement techniques are employed.

In conclusion, this consensus document provides comprehensive insights into the practice of debridement in wound management. It covers various methods of debridement, considerations for wound cleansing, and recommendations for selecting the appropriate debridement method for different tissue types. By following these guidelines, health professionals can optimise wound healing outcomes and improve patient care in the field of wound management.

The consensus panel

Picture 1: Left to right: Dieter O Mayer, Astrid Probst, Heather Hodgson, Fiona Downie, Jane Hampton, Jose Luis Lazaro-Martinez, Greg Schultz, Ewa Klara Stürmer and Tracy Cowan **Picture 2:** William H Tettelbach **Picture 3:** Guido Ciprandi

Glossary

Biofilm Complex community of microorganisms that adheres to the wound surface and forms a protective matrix, presenting a significant barrier to wound healing and requiring removal during debridement

Callus Area of thickened skin that forms in response to pressure or friction. Callus needs to be removed during debridement to facilitate wound healing.

Cleansing solutions Solutions, such as surfactant-containing solutions or potable water, used to cleanse the wound, remove contaminants and prepare the wound for debridement.

Cleansing Process of removing contaminants and debris from the wound surface to create an optimal environment for debridement. Cleansing is a preparatory step before debridement.

Debridement Removal of viable and devitalised wound components, including necrotic material, slough, biofilm and foreign materials

Denatured Having a modified molecular structure

Devitalised tissue Dead tissue in a wound, including necrotic tissue and slough, that should be removed during debridement (also known as non-viable tissue)

Foreign material Any object or substance that is not naturally present in the wound or part of the normal wound healing process, such as debris, dirt or fragments of clothing or other objects, such as splinters, glass or metal, and should be removed during debridement

Hard-to-heal wound Wound that has failed to progress through the phases of healing in an orderly and timely fashion and has shown no significant progress toward healing in 30 days (also known as chronic wound or non-healing wound)

Hyperkeratosis Thickening of the outer layer of the skin, often associated with conditions like DFUs, that can impede wound healing and requires removal during debridement

Hypertonic Having a higher osmotic pressure than the surrounding fluid

Integral debridement New concept that emphasises the importance of using different methods of debridement on the same wound based on the health professional's experience, competency, clinical need and patient perspective; it considers the wound type, level of inflammation, presence of infection, the presence of biofilm, the type of tissue present (necrotic, slough, granulation), overall wound characteristics, wound aetiology, patient comorbidities, psychosocial issues and impacting social issues that are crucial in determining the most appropriate approach to debridement for the individual patient

Mechanical debridement Physical removal of devitalised tissue and debris using tools such as debridement pads or saline-soaked gauze

Microbial bioburden Presence of microorganisms, including fungi, bacteria and biofilm, in the wound, which needs to be eliminated during debridement to prevent infection and promote healing.

Necrosis Death of cells or tissues in the wound, often appearing as black or dark-coloured tissue that should be removed during debridement to facilitate healing

Non-microbial biomaterial Non-living materials, such as slough and necrotic tissue, present in the wound that impede healing and require removal during debridement

Osmosis Movement of a solvent through a semipermeable membrane, such as a living cell, into a solution with a higher solute concentration, resulting in equal concentrations of solutes on both sides of the membrane

Oxidative debridement The use of agents, such as cold atmospheric plasma, to promote the breakdown of devitalised tissue and biofilm during debridement.

Rolled edges Wound edges that are elevated or raised, which often contain biofilm and act as a barrier to wound healing and so require debridement to facilitate epithelial cell migration and wound closure

Selective sharp debridement Use of a scalpel or other sharp instrument to remove devitalised tissue and debris from the wound without excising into viable tissue; it is typically performed by trained health professionals

Slough Devitalised tissue that appears as a yellow or white fibrinous material in the wound and needs to be removed during debridement to create a clean wound bed

Stand-alone debridement Debridement methods that are used independently without the need for additional techniques or interventions

Surgical debridement Invasive form of debridement that involves the removal of devitalised tissue and debris through excision into healthy viable tissue, where necessary; it is usually performed in an operating-room setting

Viable structures Healthy and functioning tissues, such as nerves and blood vessels, that should be protected during debridement to prevent damage and promote healing

Wound assessment Systematic evaluation of a wound to determine its characteristics, including size, depth, presence of infection and tissue type, helping guide selection of the most appropriate debridement method

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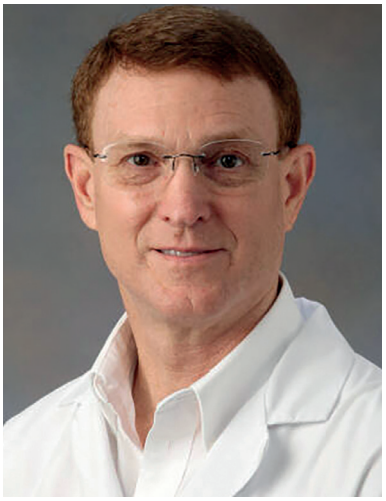

In loving memory of Greg Schultz,
a wonderful person and
true pioneer in wound care

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