Multifunctional and patient-focused

Mepilex Border Flex: an exploration of its holistic clinical benefits

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Mepilex Border Flex is marketed as Mepilex Border Comfort in the UK

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Foreword

Intelligent design, a term coined by early theologians as a proof of God, asserted that something with a complex design must have had a designer. Subsequently, early twentieth century creationists relied on intelligent design to counter Darwin's theory of evolution. In this publication, I dare to usurp and repurpose the phrase for application to the evolution of dressings designed for the care of complex hard-to-heal wounds.

In the beginning, wound care and surgical dressings consisted of dry or moistened plain gauze. The wet-to-dry dressing flourished on the surgical ward and, unfortunately, has yet to become extinct. Far from the ideal dressing, gauze provided little or no barrier protection, but rather served as a Petri dish promoting bacterial growth on the wound surface. Gauze dressings required frequent changes and, although inexpensive to purchase, the nursing effort required to provide daily or twice daily dressing changes offset any savings. Finally, the removal of gauze dressing traumatised the wound and frequently resulted in increased pain.

Dressings on the next step of the evolutionary ladder targeted exudate management. They consisted of foams, gels and hydrocolloids that provided a moist environment favourable for wound healing. Alginates and hydrofibers emerged to control the large amount of exudate from draining wounds. A vast improvement over gauze, these moisture-balancing dressings allowed the practitioner to choose a wound covering that matched the needs of the wound.

Atraumatic dressings with a silicone-ulcer interface reduced the pain associated with removal and decreased trauma to the healing wound and periwound skin at dressing change.

The new generation of dressings exemplify the principle of intelligent design as it applies to treating wounds. The goal is to optimise wear time, control exudate, prevent bacterial proliferation in both the wound and dressing, and provide an atraumatic ulcer interface that minimises patient discomfort. This supplement highlights the features and clinical effectiveness of an intelligently designed dressing, Mepilex Border Flex. The wound contact layer of soft silicone minimises trauma and pain. The second foam layer absorbs exudate. The third, spreading layer, distributes the fluid throughout the dressing to promote total fluid handling. On top of this, a retention layer traps exudate containing bacteria and proteases, preventing them from re-entering the wound. Finally, a fifth backing layer protects the wound from external contamination while allowing water to evaporate from the dressing. This multifunctional five-layered dressing extends wear time and promotes healing.

This supplement reviews the challenges associated with exuding wounds and how dressings with intelligent design can address these challenges. A review of the Mepilex Border Flex technology is followed by case examples.

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Wound exudate: the pros and cons

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Most non-healing wounds produce excessive levels of harmful exudate that promotes the formation of devitalised tissue and increases the local bioburden. To encourage healing, it is essential that exudate is absorbed and retained within a dressing, leaving only enough fluid to create the moist environment that is, in most cases, conducive to healing

Many intrinsic and extrinsic factors can result in delayed or stalled wound healing. For example, advanced age, patient comorbidities or an impaired immune system might all be contributing factors. In the local wound environment, raised levels of cytokines and proteinases, and increased bacterial activity will all play a part in producing the prolonged inflammatory response that is associated with delayed healing. In such cases, the wound will start to produce a high volume of often corrosive exudate, which will promote bacterial proliferation and tissue degradation, leading to the vicious circle of an ongoing inflammatory response. Exudate management therefore plays a key role in the provision of holistic wound care. Central to this is the use of dressings that can absorb and retain excess exudate, creating a moisture balance that is conducive to healing. In this way, the wound is able to resume its progress through the various stages of the wound healing process. This article describes how these issues occur and can best be addressed in practice.

The properties and function of wound exudate

Wound exudate first appears during the inflammatory phase of healing, when blood vessel dilation and increased permeability occurs in response to injury.[1,2] Under normal circumstances, serous fluid leaks from capillaries, across the capillary walls, into the body tissues; the amount of fluid is determined by the permeability of the capillaries, and hydrostatic and osmotic pressures.[3] Approximately 90% of the fluid is reabsorbed into the capillaries and the remaining 10% returns to the central circulation via the lymphatic system.[3] In this way, leakage from the capillaries is balanced by the reabsorption and drainage of fluid.[4] However, when the skin is wounded (and thus its integrity is breached), the inflammatory response is initiated and the capillaries become more permeable. Additional fluid therefore enters the wound, which forms the basis of wound exudate.[3,4]

Wound exudate is mainly composed of water, but also contains many vital factors that facilitate healing. These include electrolytes, nutrients, proteins, inflammatory mediators, protein-digesting enzymes, growth factors and different cell types, such as neutrophils, macrophages and platelets.[5]

As a wound progresses towards healing, the amount of exudate tends to decrease. Generally, wounds produce larger volumes of exudate in the early to mid stages of healing than in the later stage of epithelialisation.[6] However, the volume and composition of exudate will vary in terms of its endogenous and exogenous (e.g. bacterial) content, depending on the wound aetiology and type, the nature and severity of tissue damage, the coexistent pathological processes and the local wound environment.[1,2,5,7,8]

For instance, an unexpected increase in the volume of exudate may be seen if the wound becomes infected.[9] Conversely, a wound with a low exudate level may be at risk of dehydration. A decrease in exudate volume can be associated with dry eschar or localised ischaemia,[10] as well as a possible systemic problem.[5,10,11] When there is too little exudate, cells are unable to migrate across the wound bed, which may delay healing.[11] It may also lead to delayed autolysis and slow or stalled healing.[5] In addition, low exudate levels can increase the risk of dressing adherence to the wound bed, which can cause further trauma and pain during removal.[5,11] However, a dry wound bed may be the preferred environment for some ischaemic wounds.[5,10]

"Exudate in non-healing wounds contains elevated levels of inflammatory proteases"

Acute wound exudate promotes a moist environment, which aids the healing process.[3,5] It provides the wound with essential proteins and cytokines that facilitate autolytic debridement, angiogenesis, granulation tissue formation and keratinocyte migration.[12] This fluid is usually clear and straw or amber-coloured.[3] It is generally rich in leucocytes that move to the injury site in response to local inflammation, proteases that help clear wound debris, and growth factors that promote tissue regeneration and facilitate cell migration.

The composition of wound exudate, including proteases, protease inhibitors and cytokines, can vary from wound to wound, even among similar wound types.[13] Variations in the colour, consistency, odour and volume can be indicative of a disruption to the normal healing process.[14] As a result, there are several types of wound exudate, each with different characteristics. In some circumstances, the type of wound exudate produced may signify underlying issues.[10,15]

Wound exudate in chronic, non-healing wounds

Many chronic wounds produce excessive levels of exudate. When the wound becomes trapped in a heightened inflammatory response, the level and nature of exudate production can become a problem, creating a local environment that is detrimental to healing.[16] Examples of wounds where excess exudate may pose a clinical challenge are fungating wounds, burns, non-healing venous leg ulcers/pressure ulcers, dehisced surgical wounds and infected wounds.[3]

Exudate produced by non-healing chronic wounds contains elevated levels of inflammatory mediators and proteases, which create a hostile environment that must be managed in order to allow the wound to progress towards healing.[4,17,18] In wounds that are healing normally, proteases and their inhibitors play a fundamental role in maintaining an equilibrium between extracellular matrix synthesis and degradation. This is essential for the timely and coordinated healing of cutaneous wounds.[19] Compared with acute wound fluid, chronic wound exudate typically contains elevated levels of proteases, including activated matrix metalloproteinases (MMPs), and diminished levels of their inhibitors.[19,20] This tip in the balance between degradative substances and their inhibitors results in the breakdown of essential proteins and has an inhibitory effect on growth factor activity, which ultimately prevents the wound from progressing to the proliferative phase of healing.[17,21]

Factors affecting exudate volume and nature

Several factors can increase the exudate volume. Local factors can include increased inflammation, infection and trauma (e.g.

surgical debridement), and the presence of foreign bodies. Systemic factors include congestive cardiac, renal or hepatic failure, infection, inflammation, endocrine disease, certain medications and obesity/malnutrition.[4] However, any factor that influences the extent of capillary leakage or development of tissue oedema can increase the amount of exudate produced.[4,5] Practical factors that may affect exudate production include the wound location, the local temperature, the wound management regimen and a reduced willingness or ability from the patient to adhere to it.[4] While the choice of dressing or other intervention can affect the exudate level, this might not be a true reflection of what is actually happening in the wound.[10]

Impact on the patient

Exuding wounds can cause patients distress and have a significant impact on their quality of life (QoL). For example, malodour and leakage/strikethrough onto clothing can adversely affect a patient's psychological state.[9,22,23] Feelings of disgust, self-loathing, low self-esteem, embarrassment and subsequent restrictions in ability to undertake day-to-day activities and interact socially, with associated social isolation, have been identified as negative consequences of having an excessively exuding wound.[22,23] Living with such a wound may also lead to anxiety and depression.[22,24] A high volume and viscous consistency of exudate can be linked to painful periwound maceration and an increased risk of infection.[23]

Practitioners, therefore, should carefully consider the impact of factors such as malodour and leakage not only on wound healing, but also on a patient's mental and physical health.[22] Wound management should seek to address these issues with consideration of the patient's preferences. Understanding the needs of the patient, as an individual, is fundamental to choosing the most appropriate wound management strategy. Practitioners should consider all aspects of a patient's life, ability or willingness of the patient to adhere to treatment, and the likelihood of treatment success. However, it should be borne in mind that, even when best practice is implemented, some treatment options are not feasible and do not always serve the patient's best interests.[23]

Assessment of wound exudate

As the wound moves through the phases of healing, the exudate will often change not only in volume but also in consistency, colour and odour, depending on the underlying factors. While it is difficult to accurately measure the exudate volume, an assessment of its nature can help the practitioner to better understand how the wound is healing and gauge whether certain components and contaminants, including bacteria, are present, and/or the underlying factors and disease processes.[4,15] Although exudate assessment is primarily subjective, it is an important part of the overall wound assessment process.[25,26] Valuable information can be gained from examining the wound bed, periwound area and soiled dressing during dressing changes.[4,15] For example, it can help identify barriers to healing, while evaluating the interaction between the exudate and dressing can influence local management.[4] It is important that the nature of the exudate is consistently assessed, so that relevant comparisons can be made at subsequent assessments.[25]

The effectiveness of current wound products and the need for alternative treatment options should be evaluated at each dressing change.[4] Ongoing holistic assessment of the exudate, wound and patient allows for a thorough treatment pathway. It is important to explore the underlying causes of high exudate levels and manage them appropriately. Furthermore, treatment options should not be considered in isolation.[3]

Managing wound exudate through patient-centred care

Patient wellbeing should be a focal point of wound care. Compared with health-related QoL, wellbeing is a more subjective measure of the relationship between positive emotions and contentment in the absence of 'persistent negative emotions'.[27] Poor patient wellbeing can lead to feelings of loss of self-worth, limitations in the ability to perform daily activities and social isolation.[27] Patient-centred and personalised care planning requires optimal patient-practitioner communication and trust. It also values the patient's wishes, beliefs, priorities and concerns, and allows for patient engagement.[23,27]

"The characteristics and properties of absorbent dressings can vary significantly"

Providing individualised care that combines a personal and empathetic approach may require the involvement of a multidisciplinary team including, for example, physiotherapists, nutritionists and psychologists.[28] Involving the patient in their wound care pathway, initially through the consultation process, allows them to voice any concerns about their wound and its treatment, such as leakage, malodour, discomfort, pain, emotional distress, sleep disturbance, social and financial issues, and fears of being a burden. This helps the practitioner gather information to aid diagnosis and ensures that the patient's wishes and beliefs are taken into account.[3,4,27] Indeed, effective wound management should involve a holistic approach to ensure that the whole person—not just the wound—is considered. This approach may help mitigate both the physical and mental consequences of suboptimal wound management.[25]

There is a greater chance of a successful outcome if the practitioner has listened to the patient's preferences and concerns, and chooses an effective treatment option that suits his or her lifestyle.[28] Maintaining a good relationship with the patient can also promote adherence to treatment. Education is a key part of the patient-practitioner relationship, and not taking the patient's experience into account when developing education strategies may lead to poor adherence.[27] The clinical relationship may also be extended to the patient's family and/or carer(s).[3]

Exudate management: treatment options

As levels and the nature (colour, odour, viscosity and concentration/activity of exudate constituents) of exudate vary during the different phases of wound healing, it is important that the correct management strategy is chosen throughout each stage.[29]

The challenge for practitioners is to overcome barriers to healing. Important factors to consider are infection, device-associated complications, including the impact of frequent dressing changes and poor dressing performance, and patient pain and discomfort.[16,29,30] Inappropriately controlled wound exudate may lead to further complications. For instance, a poorly managed wound environment can create an ideal milieu for bacterial growth, increasing the risk of wound infection and associated malodour.[11] Effective exudate management may reduce healing times, minimise its physical and psychological impact, and optimise healthcare efficiency. Dry wounds may need to be rehydrated and the use of semipermeable films or hydrogels considered.[10] Figure 1 and Table 1 indicate how to create an optimal moisture balance.

Before selecting an appropriate treatment option to manage the exudate, the wound bed should be optimised.[3] This may involve debridement and addressing any underlying

infection and inflammation.[3] In terms of local wound management, dressings are the main option, although other therapies, such as negative pressure wound therapy, can also be considered.[4] The main wound dressing categories for exuding wounds are foams, gel-forming fibrous dressings, alginates and superabsorbents.[23] Dressings can be formulated to combine physically distinct layers of different materials. As such, their characteristics and properties can vary significantly.[4] Some dressing materials are available in different forms—for example, as flat sheets, pastes, gels and ropes.[4]

The ideal dressing for exudate management would have several characteristics to optimise the healing environment. It would possess high absorption and retention properties to cope with varying volumes and viscosity of fluid, and to prevent leakage and strikethrough. It would also protect against excoriation and maceration, minimise trauma and pain during removal, and stay intact and in place during wear. Managing high viscosity exudate can be challenging; it is important to assess the factors that may be altering the volume and consistency of the exudate so that appropriate action can be taken.[15] Wound dressings vary in their absorption and retention properties. Not all absorbent dressings can manage high viscosity exudate: for instance, the passage of thick exudate through the wound contact layer may be hampered if the perforations are too small.[15] From the patient's perspective, the dressing must also be comfortable and conformable.[3] Selecting an absorbent dressing that is discreet and not bulky will increase patient satisfaction and QoL.[23]

There are many wound and patient-related factors to consider when choosing a dressing. For example, it must be able to maintain its absorption and retention properties if compression is required and when the patient is sitting or lying on it; the wound location must also be considered.[25] The presence of undermining or raised wound edges may also need investigation.[3] Frequency of dressing changes should be considered to minimise trauma and skin stripping. Some wounds may also require a dressing (or other treatment modality) that can manage infection.[25]

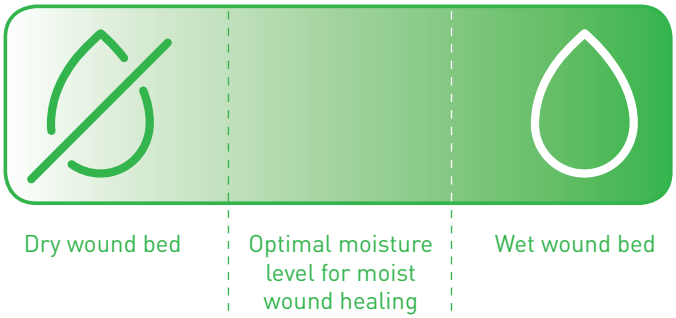

Figure 1. Wound bed moisture level (adapted from WUWHS[10])

Table 1. How to achieve the optimal moisture balance (adapted from WUWHS[10])

The wound is too dry: • Reduce the dressing change frequency • Use a dressing that donates moisture • Use a less absorbent dressing
The wound is too wet: • Use a more absorbent dressing • Assess the current dressing's fluid-handling capacity and, if necessary, replace it with one that performs better in this regard • Use an absorbent secondary dressing. If necessary, replace the existing one with a more absorbent alternative • Increase the dressing change frequency • Consider using a concomitant therapy, such as negative pressure wound therapy or a drainage bag

Conclusion

The nature and volume of wound exudate vary, and depend on many factors. Although exudate plays a fundamental role in wound healing by creating a moist local environment, its over- or underproduction can be detrimental to healing.

Wound management is affected by a range of factors, and it is important to involve the patient throughout the process to facilitate an effective outcome. The impact that a wound can have on a patient's QoL and wellbeing should not be underestimated. Patient factors should, therefore, be carefully considered during the wound management process.

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Fluid-handling and conformability of Mepilex Border Flex

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Wounds that produce a high volume of exudate and those in difficult-to-dress areas of the body can be problematic. This article summarises the evidence on Mepilex Border Flex, a dressing designed to cope with these wound characteristics and offer improved conformability and comfort, as well as atraumatic, painless removal

The search for the ideal wound dressing has been going on for millennia. The first wound dressings—made from mud or clay, with the addition of various plants, herbs and oils—protected wounds and absorbed exudate. The oils probably reduced the risk of infection and helped prevent adherence.[1] The core attributes of an ideal wound dressing remain much the same today. The dressing should protect the wound from further trauma, excoriation and maceration. It should remain intact while in place for long periods to minimise changes. Therefore, the dressing needs to be comfortable and conformable.[2]

To minimise trauma and pain on removal, ideally, a dressing should not adhere to the wound bed.[2] It should adhere securely to the intact periwound area, but not damage the surrounding skin during removal. Silicone-bordered foam dressings do not adhere to the wound bed or damage the periwound area. Furthermore, they tend to be less adhesive than dressings incorporating other adhesives.

An ideal wound dressing should remove excessive exudate, prevent leakage between changes and not allow strikethrough,[2] which is visually unpleasant and may allow exudate to leak onto clothing, bedding and furniture.[3] Exudate is a complex biological fluid comprising, among other components, water, nutrients, electrolytes, enzymes and inflammatory mediators.[3,4] It facilitates movement of white blood cells into the wound and creates a moist environment that promotes healing.[4]

Dressings need to be able to cope with the considerable volumes and varied consistencies of exudate produced by some wounds. Burns may create more than 0.5 g/cm^2 exudate a day, for example. Venous leg ulcers may produce between 0.4 and 12 g/cm^2 a day.[4] In addition to the issues mentioned above, exudate strikethrough can contribute to malodour.[2]

Malodour, which can arise in wounds where healing is uncomplicated—for example, when autolytic debridement generates liquefying necrotic tissue—as well as in those that are infected, can cause patients considerable distress and embarrassment, and may contribute to social isolation, disturbed sleep, anxiety,

Box 1. Properties of Mepilex Border Flex

- A bordered foam dressing that can be used for multiple wound types and locations, including highly mobile areas and anatomical locations where previous bordered foam dressings would not have been appropriate
- An all-in-one soft silicone-coated foam dressing. The five-layer foam structure is designed to retain excess exudate, while keeping the wound environment moist
- Designed to adapt to body contours, Mölnlycke proprietary Flex Technology evenly distributes forces to the dressing's borders, which helps optimise adherence and conformability
- Offers 'Smart Exudate Management': exudate moves from the foam into the spreading layer and remains away from the wound bed. Mepilex Border Flex shows higher fluid-handling capacity than six other dressings.[8,9] Once the exudate is absorbed, the dressing traps bacteria within it, keeping potential pathogens away from the wound bed
- The wound contact layer incorporates a proprietary technology, called Safetac, that minimises painful dressing changes and the risk of maceration[5,6]

depression and low self-esteem.[2,3] Therefore, advanced wound dressings should effectively manage excess exudate.

This article reviews the evidence on whether the design features of Mepilex Border Flex (Box 1), an all-in-one soft silicone-coated foam dressing, meet the following requirements for an ideal absorbent dressing: it can be applied to a wide range of acute and chronic wounds (including those in highly mobile areas), it can prevent damage to the wound and periwound region, and is atraumatic on removal.

Design features

Mepilex Border Flex (Figure 1) has a five-layer structure that retains excess exudate, while keeping the wound environment moist and adapting to body contours.

Backing film layer

The outermost layer includes an 'exudate progress monitor,' which is a pattern of dots that allows the practitioner to track and record the spread of fluid without disturbing the wound. This helps avoid unnecessary dressing changes.

Retention layer

Located under the backing film layer, the retention layer contains superabsorbent fibres

Figure 1. The five-layer design of Mepilex Border Flex

and Mölnlycke proprietary Flex Technology, where Y-shaped cuts allow 360° stretch. The Flex technology evenly distributes forces to the dressing's borders. This helps optimise adherence and conformability, while allowing the dressing to stretch, which is especially beneficial when applied to joints and other highly mobile areas.

Spreading layer and foam layers

Mepilex Border Flex offers 'Smart Exudate Management.' The spreading layer, which is underneath the retention layer, also uses Flex Technology and sits above the foam layer, which absorbs exudate. The exudate moves from the foam into the spreading layer, which distributes the fluid across the full surface area of the dressing. This maximises the movement of fluid to the retention layer and backing film, and helps ensure that excess exudate is kept away from the wound bed.

Safetac wound contact layer

The wound contact layer incorporates a proprietary technology called Safetac, a silicone-based adhesive that helps minimise painful dressing changes and the risk of maceration.[5,6] Dressings with Safetac are designed to conform to the skin without sticking to the moist wound, allowing easy removal. As well as reducing pain on removal,[5] dressings with Safetac protect new tissue and intact skin, thereby supporting faster healing. Despite adhering gently to the skin, dressings with Safetac are designed to seal the wound margins to avoid leaks and maceration.[6]

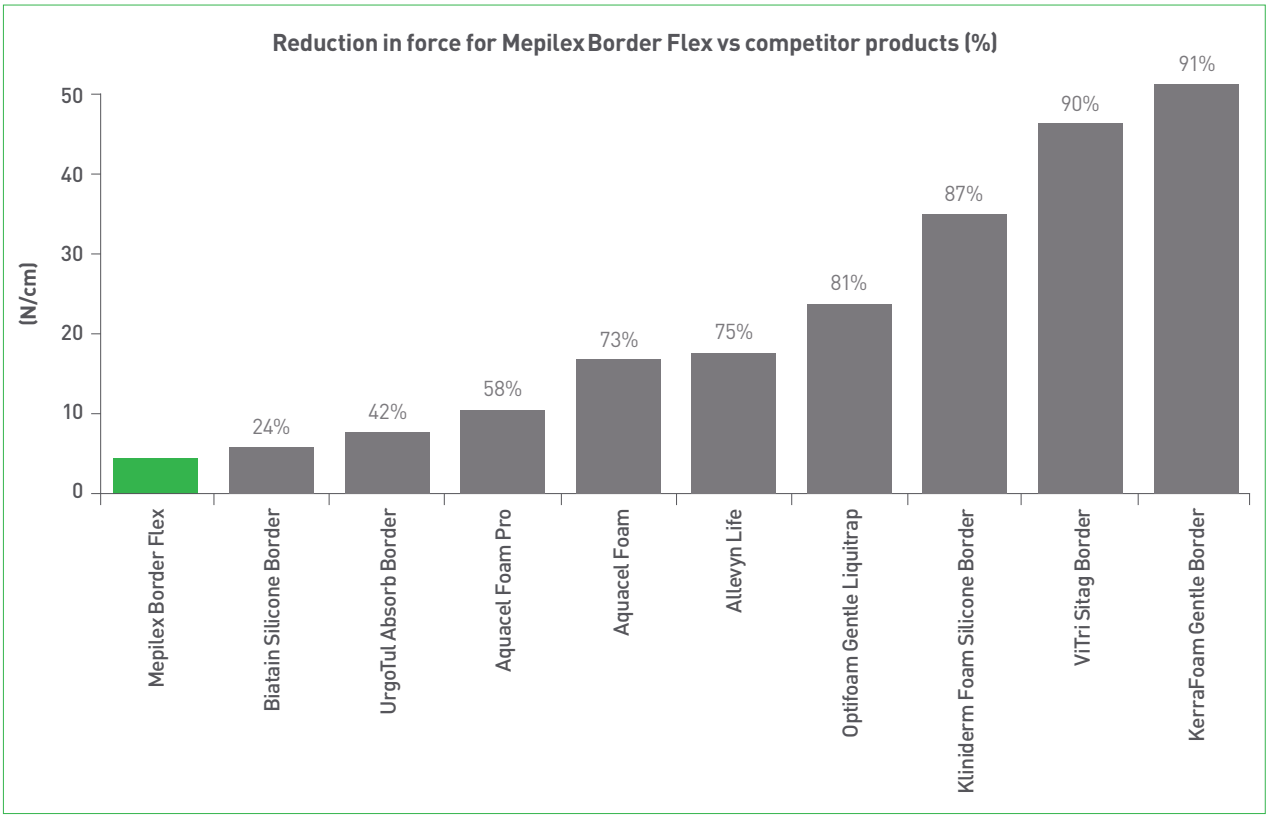

Figure 2. The graph bars show the force needed to stretch a test strip in both directions. Less force needed equates to greater conformability[7]

Conformability and fluid-handling capacity

A dressing's comfort depends, in part, on its flexibility and conformability. No area of the body is completely flat or does not experience some kind of movement. The less force needed to stretch a dressing, the more flexible and conformable it will be in practice. One way to test stretch (technically called extensibility) in the laboratory is to attach one end of a dressing to a fixed point and clamp the other end to a movable head that gradually increases the force exerted (which is measured in Newton (N) per cm), thereby pulling and stretching it.

Extensibility depends on two elements:

- Ability to stretch in the same direction as the machine is pulling: this is the machine direction (MD)
- Ability to stretch at 90° to the MD: this is the cross-direction (CD).

Extensibility in both directions is important for comfort and conformability.

Mepilex Border Flex is flexible in 360° and its extensibility is the same in all directions. Clinically, this means that comfort and conformability does not depend on the direction in which the dressing is applied.

A comparative test performed by Mölnlycke set out to assess the conformability of Mepilex Border Flex by calculating the force needed to extend strips of 11 dressings by 20% for 60 seconds (Standard test method SS EN 13726–4:2003 (E)). The less force needed to extend a dressing, the more flexible and conformable it will be in clinical practice. As Figure 2 shows, the force needed to stretch Mepilex Border Flex in the MD, CD, and overall, were all lower than for the other dressings tested.[7]

A dressing's fluid-handling capacity depends on, first, the amount of exudate it absorbs and, second, the efficiency with which moisture vapour is transported through the backing film. Mölnlycke used an *in vitro* system to compare the fluid-handling capacity of seven waterproof

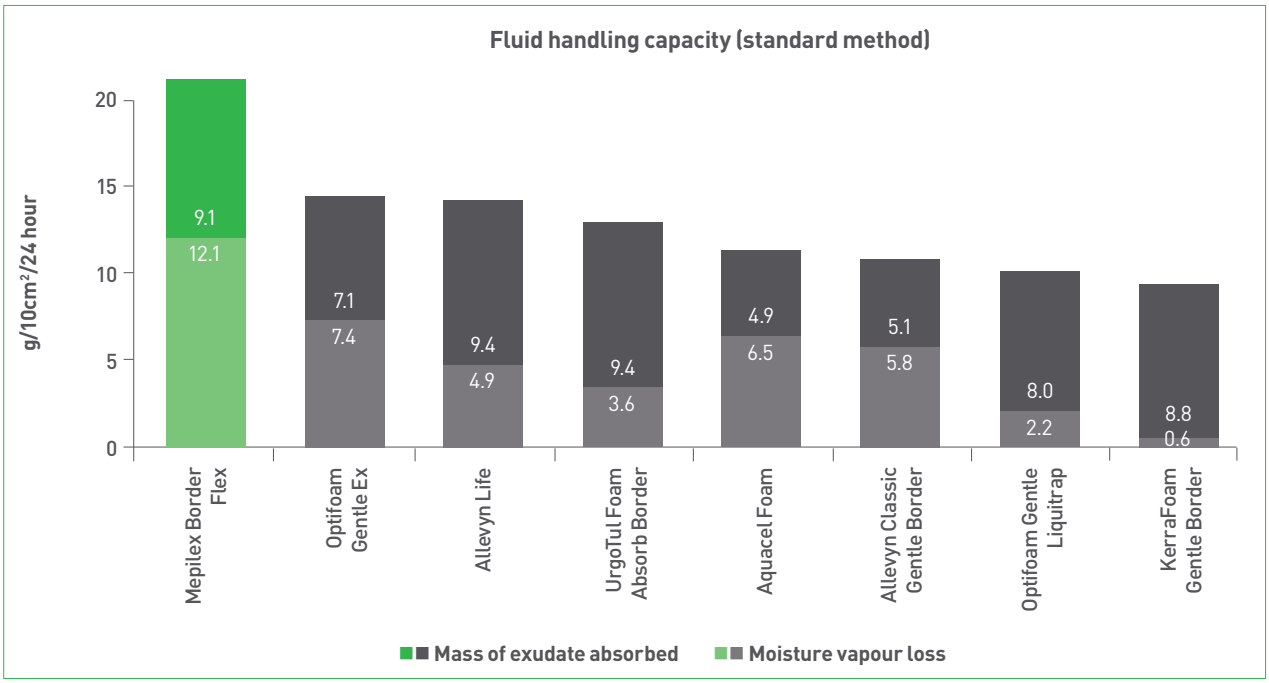

Figure 3. Fluid-handling capacity based on the standard method of Mepilex Border Flex compared with other dressings[8]

dressings that are typically left *in situ* on wounds for more than 24 hours and used when absorption of exudate and management of the micro-environment are important.[8] The study employed a standardised method widely used to assess dressings and an adapted version that more accurately mimics wound exudate.

The test used a cylinder sealed at one end with a dressing to investigate its capacity to handle the following fluids:

- The standard method (Standard test method, SS-EN 13726–1:2002 (E) 3.3): a solution of sodium chloride and calcium chloride with an ionic composition that is comparable (in terms of its ionic strength) to human serum or wound exudate
- The adapted method: a 1:1 mixture of this solution and horse serum, which mimics the content of larger molecules, such as proteins, in wound exudate.

The test fluid (30 ml) was introduced in one end of the cylinder and left for 24 hours at a controlled humidity and temperature. Absorbency and moisture vapour loss were calculated on the basis of weight loss. Mepilex Border Flex showed higher handling capacity for both test fluids than the other dressings tested (Figure 3 for the standard method).[8,9]

Bacterial trapping properties

Recent studies suggest that the range of bacterial and fungal species in wounds is greater than previously recognised.[10] Wounds harbour a large number of aerobic and anaerobic bacteria, which differ in their clinical importance.[10] For example, the dominant species of bacteria present in wounds are constantly changing[10] and may be influenced by dressing selection, especially those that contain antimicrobials.[11]

Bacteria travel with the exudate into the wound dressing. Once in the dressing, the patient's immune system has a limited effect on bacterial growth. The only factors that limit bacterial growth there are the amount of nutrients available and the interactions between the organisms. As a result, there is potential for uncontrolled growth of bacteria within the dressing. Unpublished data produced by the

A
Mepilex Border Flex after 1 hour of contact, number of bacterial colonies: between 0 and the low single digits

B
Sorbact Foam Gentle Border after 1 hour of contact, number of bacterial colonies: about 70 bacterial colonies

Figure 4. Bacterial trapping under pressure

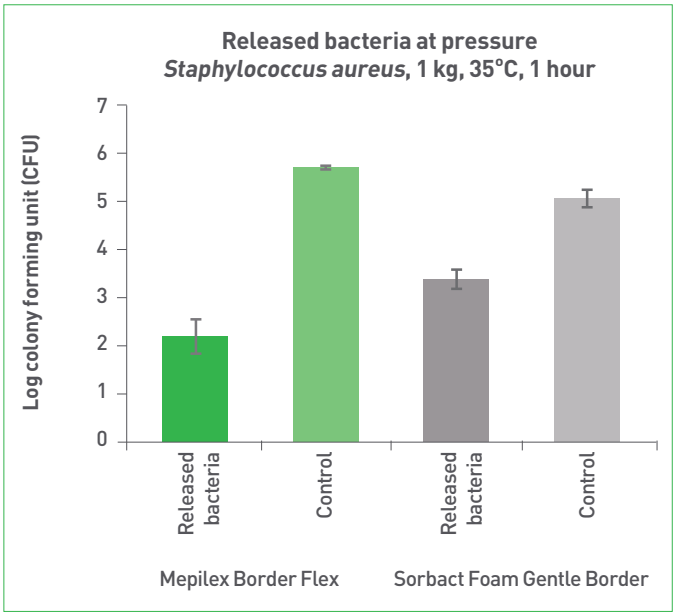

Figure 5. Number of bacteria released under pressure after inoculation of bacteria suspension in simulated wound fluid to Mepilex Border Flex foam and Sorbact Foam Gentle Border

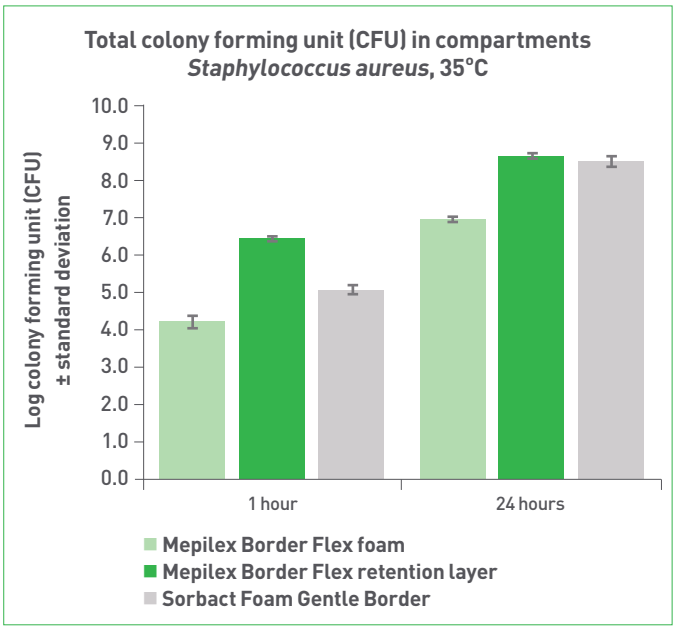

Figure 6. Number of bacteria in Sorbact Foam Gentle Border and Mepilex Border Flex

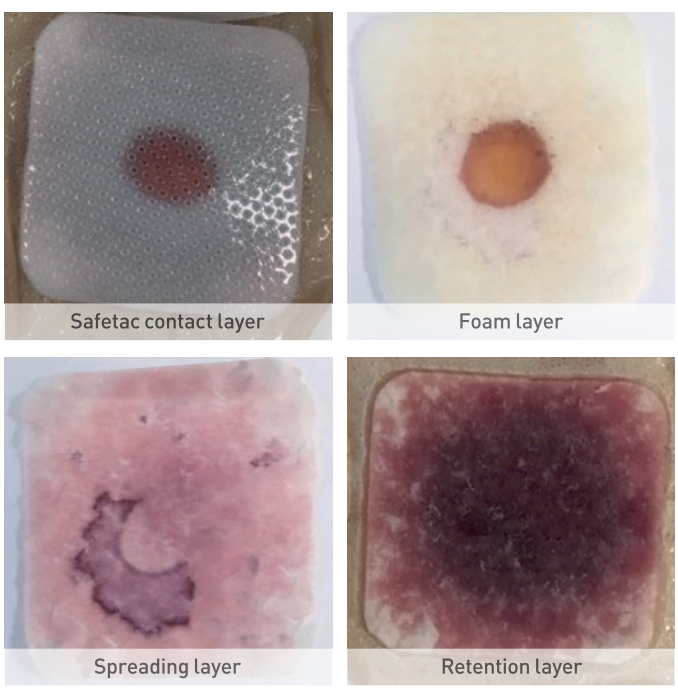

Figure 7. Iodonitrotetrazolium chloride staining of bacteria in Mepilex Border Flex after 24 hours, showing bacteria in the foam layer and even distribution in the retention layer[14]

manufacturer indicate that colony forming unit (CFU) counts inside the dressing far exceed those inside the wound. Clearly, therefore, bacteria in exudate need to be trapped within the dressing rather than allowed to re-enter (infect) the wound, which would increase the bioburden and potentially overburden the patient's local immune defences.

Once the exudate is absorbed within it, Mepilex Border Flex is designed to trap bacteria, keeping potential pathogens away from the wound bed. As mentioned above, the retention layer is adjacent to the spreading layer and the backing film. In contrast, in Sorbact Foam Gentle Border, the foam layer is attached to the green dialkylcarbamoyl chloride (DACC)-coated wound contact layer. Against this background, *in vitro* studies from Mölnlycke confirm that Mepilex Border Flex absorbs, channels and traps exudate that contains bacteria.[12,13,14]

In the first study, the two dressings were placed on filters, subjected to a challenge of extra pressure in the form a 1000 g weight, and left for one hour in contact with an agar plate (Figure 4).[13] Mepilex Border Flex showed low single digit or no CFUs. Sorbact Foam Gentle Border showed about 70 CFUs.[13]

In a further experiment, researchers inoculated the same two dressings (through their wound contact layers) with bacteria suspended in simulated wound fluid (SWF) containing 50% fetal calf serum and 50% maximum recovery diluent. The volume applied was one third of the dressings' maximum absorption. As a result, 1.9 times more bacteria were added to Mepilex Border Flex than to Sorbact Foam Gentle Border. The dressings were placed on filters, subjected to a 1000 g weight and left for one hour.[14] After one hour, Sorbact Foam Gentle Border showed about 10 fold higher release of bacteria compared with Mepilex Border Flex (Figure 5). Most of the bacteria in Mepilex Border Flex resided in the retention layer.

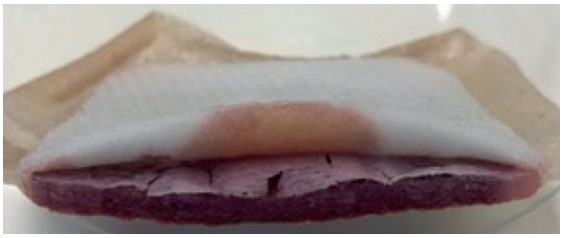

Figure 8. Cross-section of Mepilex Border Flex showing iodonitrotetrazolium chloride staining of bacteria in the foam layer[14]

Some 130 times more bacteria were found in the retention layer than in the foam layer of Mepilex Border Flex. Seven times more bacteria were found in the foam of Sorbact Foam Gentle Border than in that of Mepilex Border Flex (Figure 6). The results indicate that bacteria follow exudate as they are absorbed and channelled through the dressing.[14] Studies using the dye iodonitrotetrazolium chloride, which changes from almost colourless to purple in the presence of bacteria, confirmed that bacteria move from the foam to the retention layer, where they are evenly distributed (Figures 7 and 8).[14]

Conclusion

Dressings should protect the wound, remain intact and in place for long periods to avoid unnecessary changes, be comfortable and conformable, and minimise trauma and pain during removal.[2] They should also distribute excessive exudate away from the wound, prevent leakage between dressing changes and avoid strikethrough.[2]

Mepilex Border Flex, a versatile all-in-one soft silicone-coated foam dressing, is designed to optimise healing of multiple wound types, including those in difficult-to-dress anatomical locations. The Flex Technology enables it to conform and remain in place even in areas where previous bordered foam dressings would not have been considered appropriate, while still being atraumatic on removal. Mepilex Border Flex has also showed higher fluid-handling capacity when compared with six other dressings.[8,9] The five-layer dressing absorbs, channels and traps exudate, tracks exudate progress, and traps bacteria.[12,14] These characteristics indicate that Mepilex Border Flex is a versatile all-in-one dressing, which can support healing in a wide range of chronic and acute wounds.

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Note: In all the centres that contributed case studies to this supplement, local clinical practice recommends that dressings should be changed at each scheduled clinic visit, or sooner, if they become saturated

CASE STUDY 1: neuropathic foot ulcer

José Luis Lázaro-Martínez, Head of Diabetic Foot Unit, Complutense University of Madrid, Spain

A 62-year-old man presented at the podiatry clinic with a neuropathic foot ulcer. He had a five-year history of type 2 diabetes mellitus, which was controlled with medication (his HbA1c was 6.9%). He had two amputations on the lower limb: one below the knee on the right leg due to gangrene and another of the fifth metatarsal head of the left foot. The patient previously had an ulcer on the left foot. The patient was employed and his job involved moderate physical activity. He was not a cigarette-smoker.

The neuropathic ulcer, which was located on the lateral aspect of the fifth metatarsal head of the left foot, measured 143 mm^2 and had been present for 12 weeks (Figure 1). The wound bed was covered with granulation tissue and was producing a moderate volume of serosanguinous exudate. There were no clinical signs of wound infection. The periwound skin was macerated.

The patient's recorded ankle brachial pressure index (APBI) was 0.96 and his toe brachial index was 0.47; pedal and tibial pulses were palpable. As such, it was concluded that peripheral vascular disease was not present.

Previous treatment comprised Promogran (Acelity), Mepilex (Mölnlycke Health Care) and Actisorb Plus (Acelity). He wore orthopaedic postoperative shoes that contained a total contact insole and walked with crutches.

The podiatrist changed the treatment to Mepilex

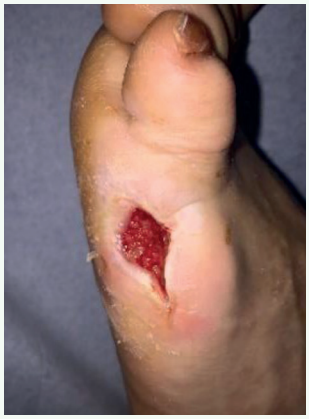

Figure 1. The wound at presentation

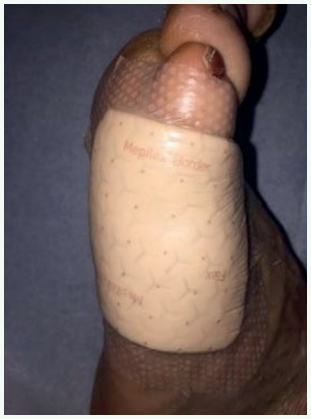

Figure 2. The wound following the first application of the dressing, which conformed well

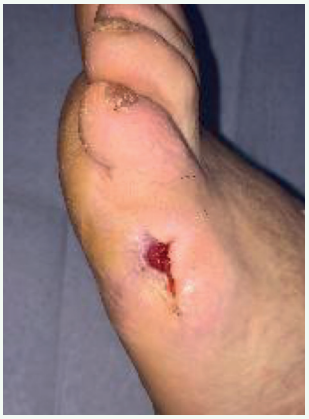

Figure 3. The wound at day 14

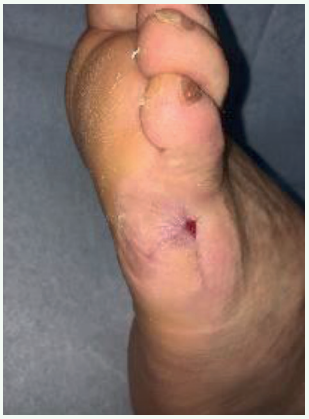

Figure 4. The wound at the end of the evaluation (day 28)

Border Flex (Figure 2). The patient continued to wear the postoperative shoes and use crutches. Treatment with this dressing was monitored for 28 days, during which time the patient attended four follow-up visits at the clinic, when the dressing was changed (median dressing change frequency was seven days, range 4–10 days).

There was no change in wound size during the first week of treatment, but the wound was producing a low volume of clear/serous exudate.

At the second follow-up visit (week 2, day 14), the wound area had reduced to 70 mm^2 (51% reduction) (Figure 3). The wound was still producing a low volume of exudate.

At the third follow-up visit (week 3, day 21), the wound had reduced to 28 mm^2 (80.4% reduction) and the periwound was now healthy and intact. There was no change in the wound size for the rest of the follow-up period. By day 28, the exudate level was almost imperceptible (Figure 4).

Throughout the follow-up, 100% granulation tissue was observed in the wound bed, and there were no clinical signs of infection. The patient never experienced any pain at dressing change.

CASE STUDY 2: diabetic foot ulcer

José Luis Lázaro-Martínez, Head of Diabetic Foot Unit, Complutense University of Madrid, Spain

A 75-year-old woman presented at the podiatry clinic with a neuroischaemic ulcer caused by ill-fitting footwear. She had a 48-year history of type 1 diabetes mellitus, which was poorly controlled (her HbA1c was 11.2%). Her medical history included hypertension, hyperthyroidism, hypercholesterolemia and breast cancer. She was prescribed medication for each comorbidity. She had previously experienced an ulcer on the left hallux and had undergone revascularisation of the left leg.

The patient was mobile and led an active lifestyle. She was an ex-cigarette smoker.

The neuroischaemic ulcer, which was located on the hallux of the left foot, measured 156 mm^2 and had been present for two weeks (Figure 1). The wound bed was covered with 70% slough and 30% granulation tissue. It was producing a low volume

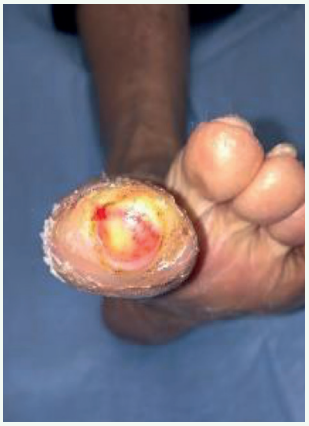

Figure 1. The wound at presentation)

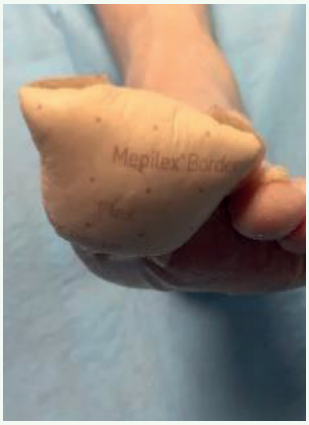

Figure 2. The wound following the first application of the dressing, which conformed well

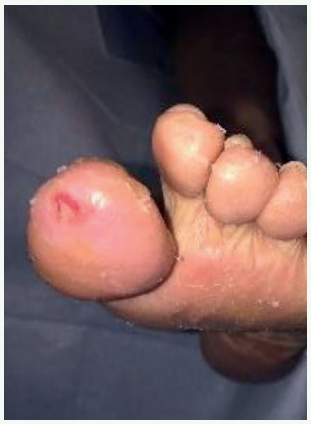

Figure 3. The wound at day 21

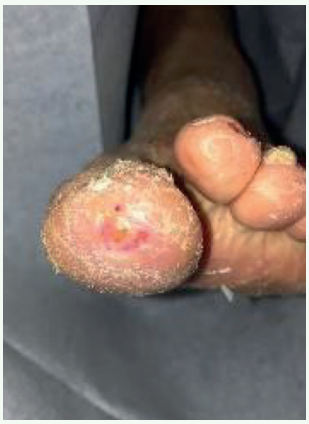

Figure 4. The wound at the end of the evaluation (day 28)

of serous exudate. There were no clinical signs of wound infection. There was hyperkeratosis on the periwound skin.

The patient's ankle brachial pressure index (ABPI) was 0.82; pedal and tibial pulses were not palpable.

The wound had previously been treated with Mepilex Ag (Mölnlycke Health Care), Mepilex (Mölnlycke Health Care) and Urgotul (Urgo Medical). The podiatrist switched to Mepilex Border Flex (Figure 2); the patient continued to wear orthopaedic postoperative shoes with a total contact insole.

Treatment with this dressing was monitored for 28 days, during which time the patient attended four follow-up visits at the podiatry clinic, when the dressing was changed (median dressing change frequency was seven days, range 6–8 days). Any existing slough was sharp debrided at these dressing changes.

After one week of treatment, the wound area had reduced to 49 mm^2 (68.6% reduction). The amount of granulation tissue had increased to 80% and there was no hyperkeratosis.

After 2 weeks, the wound had increased slightly (70 mm^2), but then continued to decrease. The wound bed was now fully covered with granulation tissue. At the next follow-up visit on week 3, the wound area was 10 mm^2 (77.6% reduction) (Figure 3). The wound continued to produce a low volume of exudate up to this point.

At the final assessment (week 4), the wound had almost healed (Figure 4). The patient never experienced any pain at dressing change.

CASE STUDY 3: neuropathic foot ulcer

José Luis Lázaro-Martínez, Head of Diabetic Foot Unit, Complutense University of Madrid, Spain

A 44-year-old man with neuropathy caused by radiculopathy associated with a lumbar vertebral disk presented at the podiatry clinic with a pressure ulcer on the hallux of his right foot. The first, second and fourth toes of his right foot had been amputated. He had previously experienced another ulcer on the right hallux. He had no other relevant comorbidities.

The patient was self-employed and worked in a restaurant.

The neuropathic ulcer measured 72 mm^2 and had been present for four weeks (Figure 1). The wound bed was completely covered with granulation tissue and was producing a moderate volume of serosanguinous exudate. There were no clinical signs of wound infection. Hyperkeratosis was present on the periwound skin. The only previous treatment it had received was wound cleansing followed by application of an antiseptic solution.

The patient's recorded ankle brachial pressure index (ABPI) was 1.0; his pedal and tibial pulses were palpable. The patient wore a removable cast walker to offload the wound. As such, it was concluded that peripheral vascular disease was not present.

The podiatrist applied Mepilex Border Flex to the wound (Figure 2) and the patient continued to wear the cast walker. Treatment with this dressing was monitored for 29 days, during which time the patient attended four follow-up clinic visits, when the dressing was changed (median dressing change frequency was seven days, range 7–8 days).

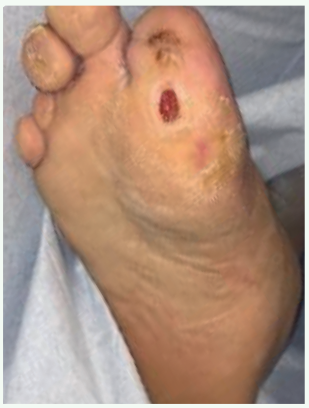

Figure 1. The wound at presentation

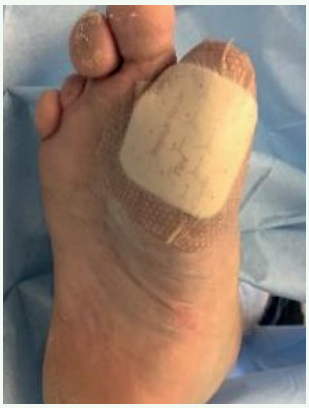

Figure 2. The wound following the first application of the dressing, which conformed well

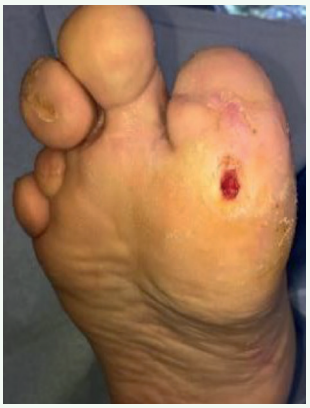

Figure 3. The wound at day 21

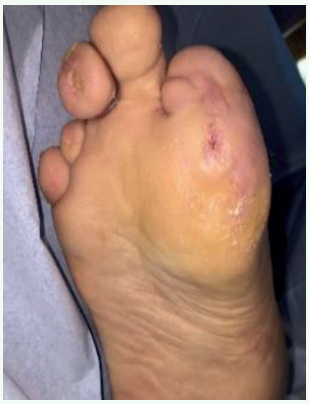

Figure 4. The wound at the end of the evaluation (day 29)

After one week of treatment, the wound area had reduced slightly to 70 mm^2 (2.7% reduction). At week 2, it had reduced to 36 mm^2 but was still producing a moderate volume of serosanguinous exudate, and the hyperkeratosis remained unchanged. At week 3, the wound had almost healed. The hyperkeratosis had also resolved, and the surrounding skin was healthy and intact (Figure 3). Figure 4 shows the wound at week 4.

The patient never experienced any pain at dressing change.

CASE STUDY 4: neuropathic foot ulcer

José Luis Lázaro-Martínez, Head of Diabetic Foot Unit, Complutense University of Madrid, Spain

A 59-year-old obese woman presented at the podiatry clinic with a neuropathic ulcer. She had a history of type 2 diabetes mellitus (her HbA1c was 12.4%), hypertension and cataracts. She had previously experienced a styloid process ulcer on the right foot.

The ulcer, which was located on the hallux of the left foot, measured 225 mm^2 and had been present for 12 months. The wound bed was completely covered with granulation tissue, which was spongy at the centre and producing a moderate volume of serous exudate (Figure 1). There were no clinical signs of wound infection and osteomyelitis was ruled out. There was hyperkeratosis and maceration on the periwound skin.

The patient's ankle brachial pressure index (ABPI) was 0.93; all pedal pulses were palpable. The previous dressing regimen comprised a foam dressing. The offloading regimen comprised an orthopaedic postoperative shoe with a total contact insole.

The patient was retired, and his activity level was moderate. He was an ex-cigarette smoker.

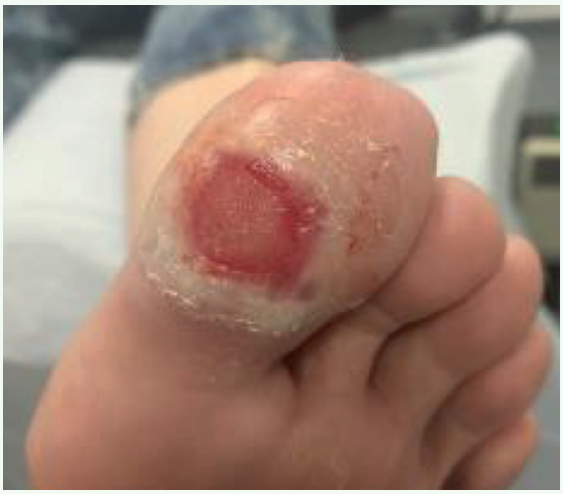

Figure 1. The wound at presentation

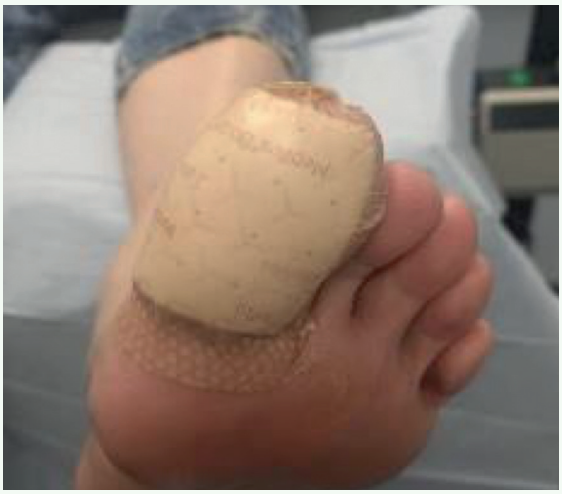

Figure 2. The wound following the first application of the dressing, which conformed well

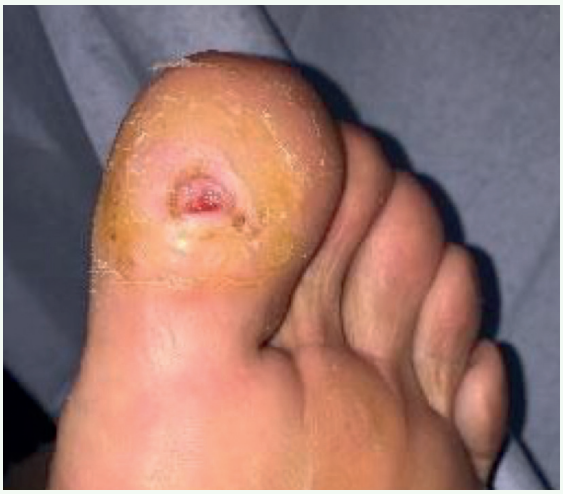

Figure 3. The wound at day 14

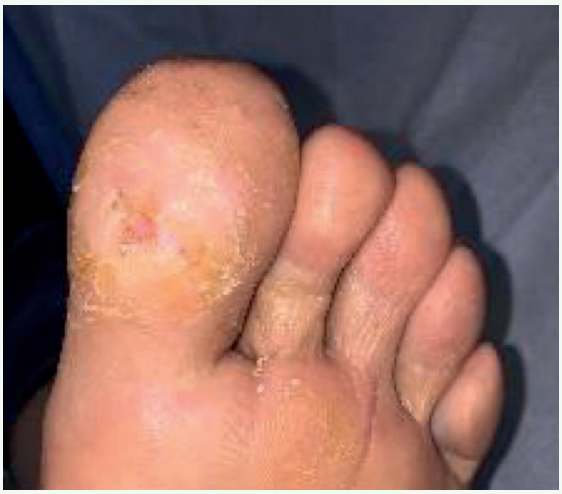

Figure 4. The wound at the end of the evaluation (day 21)

The wound was treated with Mepilex Border Flex (Figure 2). The patient continued with the offloading regimen. Treatment with this dressing was monitored for 21 days, during which time the patient attended three follow-up visits at the clinic, when the dressing was changed (median dressing change frequency was seven days, range seven days). The spongy granulation tissue was sharp debrided at each visit, when required.

At the first follow-up visit at week 1, the wound area had reduced to 156 mm^2 (30.7% reduction). It was still producing a moderate volume of serous exudate, and hyperkeratosis and maceration were still present on the periwound skin.

At week 2, it had decreased significantly in size to 16 mm^2 (92.9% reduction). It was still covered with granulation tissue and producing a low volume of serous exudate (Figure 3). The periwound skin was intact and healthy.

At the final follow-up assessment at week 3, the wound had healed (Figure 4).

The patient never experienced any pain at dressing change.

CASE STUDY 5: open surgical wound

Elena Conde Montero, MD, PhD, Specialist in Dermatology. Hospital Universitario Infanta Leonor, Madrid, Spain

An 88-year-old man presented with an open surgical wound on the vertex region of the scalp following the excision of a squamous cell carcinoma. After surgery, the edges were sutured, with a view to achieving healing by secondary intention. The patient had no other comorbidities. He was retired and led an active life.

The wound surface area was 1200 mm^2 and its depth was 2 mm. The wound duration was 58 days. Previous treatment comprised an alginate dressing covered with gauze and a bandage. The bulky bandages applied to the wound after surgery had a negative impact on the patient's wellbeing and limited his ability to perform daily activities.

The wound bed was covered with 100% red granulation tissue, through which the punch graft was visible. The punch grafting had been performed to enhance epithelialisation. The wound was producing a low volume of serosanguinous exudate. There were no clinical signs of wound infection. The periwound skin was healthy and intact (Figure 1).

Mepilex Border Flex was applied to the wound (Figure 2). Treatment with this dressing was monitored for 14 days, during which the patient attended two follow-up visits when the dressing was changed (median dressing change frequency was seven days, range 4–10 days).

At the first dressing change, this superficial wound was covered with 75% of epithelial tissue and 25% granulation tissue, and was producing a low volume of serosanguinous exudate. Some drainage is always expected after punch grafting.

After 14 days, 95% of the wound bed was covered with epithelial tissue (Figure 3). The wound was still producing a low level of brown/blood exudate, but the periwound skin had remained healthy and intact. The patient did not experience any pain during the dressing changes.

Scalps are difficult areas to dress. This self-adherent dressing contoured well to the grafted wound, avoiding the need for bulky bandages, which increased patient satisfaction.

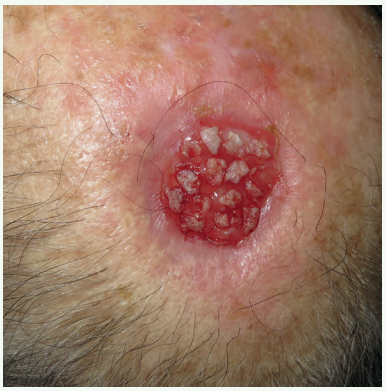

Figure 1. The wound at presentation

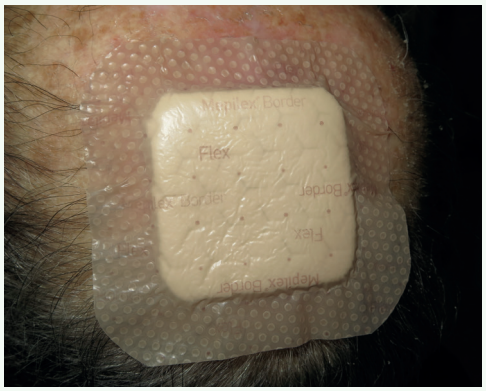

Figure 2. The wound following the first application of the dressing, which conformed well

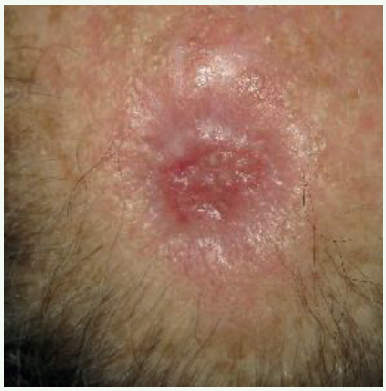

Figure 3. The wound at the end of the evaluation (day 14)

CASE STUDY 6: post-traumatic ulcer

Elena Conde Montero, MD, PhD, Specialist in Dermatology. Hospital Universitario Infanta Leonor, Madrid, Spain

An 86-year old woman presented with a post-traumatic ulcer one week following a punch skin graft. Her comorbidities included type 2 diabetes mellitus and hypertension. She was not a cigarette smoker.

The ulcer was located on the pretibial region of the right leg. Its surface area was 4500 mm^2 and it was 2 mm deep; the wound duration was six weeks. The wound bed was covered with 75% slough and 25% adherent punch grafts (Figure 1). It was producing a moderate volume of serosanguinous exudate. There were no clinical signs of wound infection. The periwound skin had signs of eczema.

The patient was anxious that the wound would stop her from performing her activities of daily living. She was retired but had an active social life.

Previous treatment had comprised an alginate dressing secured with a fixation bandage.

Mepilex Border Flex was applied to the wound (Figure 2). Treatment with this dressing was monitored for 28 days, during which time the patient attended four follow-up visits, when the dressing was changed (all dressings were changed every seven days). The slough was removed with autolytic debridement, which was aided by the presence of the punch grafts.

After one week of treatment, approximately 30% of the wound bed was covered with epithelial tissue. The remainder was a mixture of granulation tissue and slough. At weeks 2 and 3, the proportion of epithelial tissue increased to 60% and 75%, respectively. When grafting is performed on a less than perfect wound bed, epithelialisation can occur even if there is slough tissue between the grafts. The exudate volume also decreased during this period, but was still serosanguinous.

At day 28, the wound had almost completely re-epithelialised and only small areas of superficial erosions, covered with a 'crust' and bits of post-inflammatory skin desquamation, remained (Figure 3). The exudate was still serosanguinous but was very low in volume. The patient did not experience any pain at dressing change.

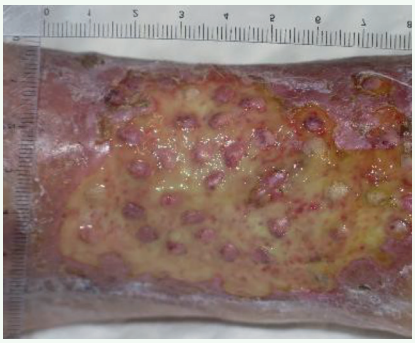

Figure 1. The wound at presentation. Note: the whitish colour on the wound margins is secondary to the use of zinc oxide as a skin barrier

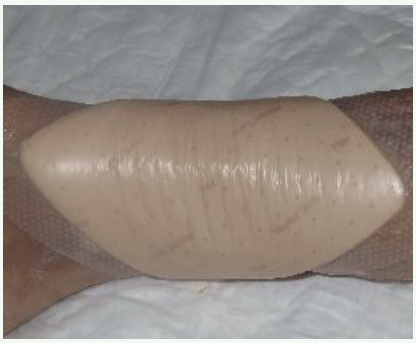

Figure 2. The wound following the first application of the dressing, which conformed well

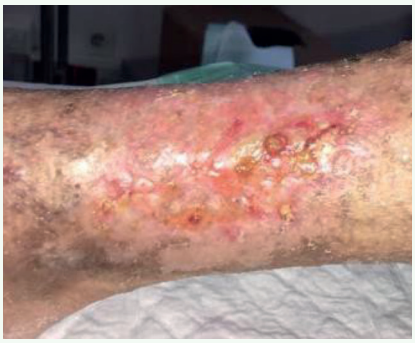

Figure 3. The wound at the end of the evaluation (day 28)

CASE STUDY 7: mixed-aetiology leg ulcer

Juan José Suárez Sánchez, Doctor of Clinical Research (PhD), Primary Care Team Nurse and Professor at University of La Laguna, Las Palmas College of Nursing, Ingenio, Gran Canaria, Spain

This case study is about an 82-year-old severely obese woman (body mass index: 37.3) with a long-standing arterial leg ulcer on the left lateral medial leg. The patient had a history of chronic venous insufficiency, with a CEAP score of C2 (varicose veins). Her Fontaine classification score was IIb (intermittent claudication after walking less than 200 meters).

The patient experienced a sudden arterial occlusion, caused by a thrombus, at the ileo-femoral artery of the left lower limb. She was admitted to hospital, where the region was revascularised and oral anticoagulants (acenocoumarol (Sintrom 4mg)) were prescribed to maintain an international normalised ratio (INR) of between 2.0 and 3.0. She was discharged when she was considered to have reached INR stabilisation. She was followed up by the angiology and vascular surgery service on an outpatient basis, while the primary health centre provided her with home care. Her other comorbidities were hypertension and congestive heart failure.

This mixed-aetiology wound measured approximately 170x80 mm. It was producing a high volume of exudate and was mostly covered with devitalised tissue (60% slough and 10% necrotic tissue), plus 30% granulation tissue. Treatment, which focused on the arterial component, comprised Mepilex Ag (Mölnlycke Health Care) and a non-compressive bandage.

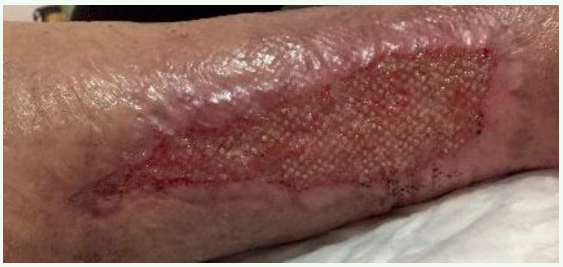

Figure 1. The wound at presentation

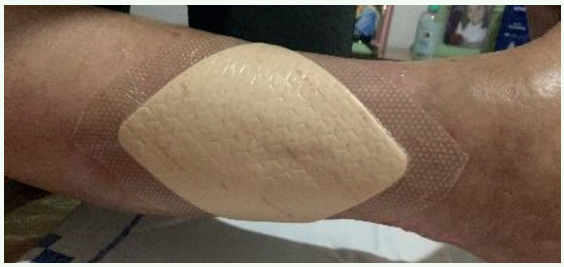

Figure 2. The wound following the first application of the dressing, which conformed well

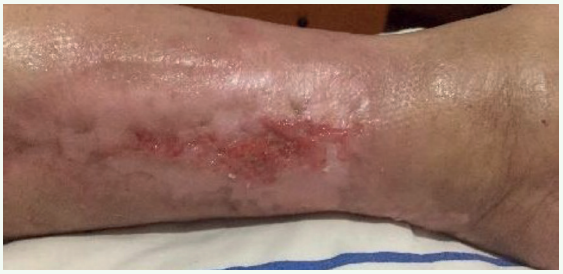

Figure 3. The wound at the seventh follow-up visit (day 27)

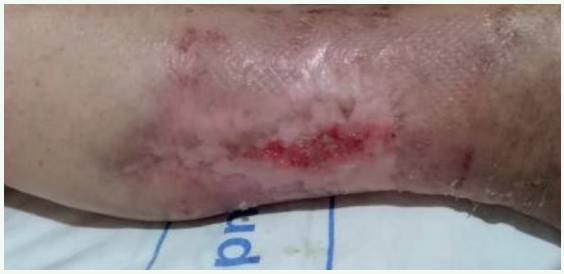

Figure 4. The wound at the end of evaluation (day 51)

After five months, more attention was paid to the venous component of the wound, as the chronic venous insufficiency was causing oedema in both legs. The wound size was largely unchanged, but the wound bed now comprised 70% slough and 30% granulation tissue (Figure 1). Clinical signs of infection included high levels of yellow/green exudate, pain, erythema and oedema. The periwound skin was macerated and eczematous.

The treatment regimen was changed to Mepilex Border Flex (Figure 2) and, following a vascular assessment, reduced compression bandaging (15–20 mmHg). The patient was also prescribed a 10-day course of oral levofloxacin (500 mg/day). Treatment with Mepilex Border Flex was evaluated for 51 days, when the patient attended 13 follow-up visits at the clinic for dressing changes (median dressing change frequency was four days, range 2–7 days). The same semi-compressive bandage as above was used throughout the follow-up period.

The dressing was changed three times in the first nine days (on days 1, 4 and 9). By day 4, 50% of the wound was covered with granulation tissue, although it was still producing a high volume of purulent exudate and the periwound skin was red. After this, the percentage of devitalised tissue reduced from 40% on day 9 to 30% on day 14, when there was 70% granulation tissue.

By day 14, epithelial buds were evident on the wound edges. However, the wound was still producing a high volume of purulent exudate, and there was an increase in erythema on the periwound skin, which was attributed to friction between the dressing and the bandaging. A cotton or cellulose layer was applied to prevent this. At the next follow-up assessment five days later (day 15), the exudate volume had reduced to medium and most of the wound surface (80%) was covered with granulation tissue.

By day 23, oedema was the only remaining clinical sign of localised infection, and was attributed to the patient's arterial ischaemia and anticoagulant medication. The wound was now producing a moderate volume of serous exudate. Varicose eczema was still visible on the periwound skin. Ninety percent of the wound bed was covered with granulation tissue.

At the next assessment, on day 27, the wound measured 2700 mm^2 and was 10 mm deep (Figure 3). The wound bed now comprised 80% granulation tissue and 15% epithelial tissue. The wound was still producing a moderate volume of serous exudate and varicose eczema was present. By day 39 there was no longer any devitalised tissue, with the wound bed comprising 70% granulation tissue and 30% epithelial tissue. By day 51, the wound had reduced to 525 mm^2 (73.5% reduction) and was 5 mm deep, with 70% epithelial tissue (Figure 4). The varicose eczema had disappeared.

Dressing-change related pain remained low throughout the follow-up period, reducing from 3/10 at its start to 1/10 at visit 13.

CASE STUDY 8: chemical burn

Juan José Suárez Sánchez, Doctor of Clinical Research (PhD), Primary Care Team Nurse and Professor at University of La Laguna, Las Palmas College of Nursing, Ingenio, Gran Canaria, Spain

A 42-year-old man presented at a primary care clinic with a 5-day-old partial-thickness, deep-dermal (alkaline) chemical burn on the anterior region of the metatarsal of the right foot. The patient was a cleaner, and the burn occurred when he dropped an alkaline cleaner on his foot at work. He had no relevant comorbidities. He was unable to walk, and thus work, because of the burn. As he was self-employed, this had financial repercussions for him.

The patient had initially presented at the emergency department with wound inflammation, paraesthesia (pins and needles) and severe pain, where he was prescribed a five-day course of topical mupirocin and a 10-day course of amoxicillin 875 mg and 125 mg clavulanic acid. As there was no marked improvement and only a slight decrease in pain after five days, he self-presented at the primary care clinic.

At this point, the burn had a surface area of 72 mm^2. The epidermis and both layers of dermis were involved. The wound bed was covered with 60% slough, 20% necrotic plaques and 20% granulation tissue (Figure 1). Clinical signs of infection included increased levels of wound exudate (high volume, yellow/green and purulent), severe ongoing pain (visual analogue scale (VAS) score of 9/10), spreading erythema and oedema. The periwound skin was dry, excoriated and very painful. It had both white and brown patches, and a waxy texture. There were no blisters. The biggest clinical challenges were erythema and pain.

Mepilex Border Flex was applied and secured with therapeutic tape (Figure 2).

Treatment with this dressing was evaluated for 43 days, during which time the dressing was changed nine times in the clinic (median dressing change frequency was five days, range 2–7 days).

Due to the high exudate volume, three dressing changes were required in the first week (days 1, 3 and 8), when any necrotic tissue was removed with sharp debridement. At the second dressing change, there was a slight improvement in the clinical signs of infection, but at day 8 the only remaining signs were a high volume of purulent, yellow/green exudate and spreading erythema on the periwound skin, which was still macerated. The wound bed characteristics remained unchanged. The patient's VAS score for pain at dressing change was now 3/10. The patient was able to go back to work, where he was very active with little rest.

After two weeks' treatment, there was still only a slight improvement in the remaining clinical signs of infection, but more granulation tissue (30%) was present. The dressing was managing the exudate well and, despite only a slight reduction in the exudate volume, the erythema on the surrounding skin was subsiding.

The wound continued to progress and, at approximately week 3 (day 19), the burn surface area had reduced by 75% to 875 mm^2 and was very shallow, with a depth of only 1 mm (Figure 3). It was producing a moderate level of serous exudate and there was no maceration. The only remaining clinical sign of infection was erythema. His VAS score for pain at dressing change was now 2/10.

By day 25, the wound was covered with 50% slough and 50% granulation tissue. All clinical signs of infection had disappeared, the exudate was serous and the periwound area healthy and intact.

At the final follow-up on day 43, the wound had reduced to 100 mm^2 (97.1% reduction) (Figure 4). It was now producing a low volume of serous exudate. The VAS score for pain at dressing change was 1/10.

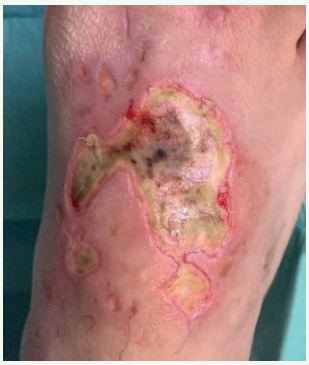

Figure 1. The wound at presentation

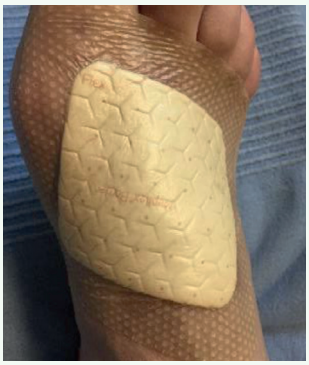

Figure 2. The third dressing application (day 5): the dressing conformed well to the wound

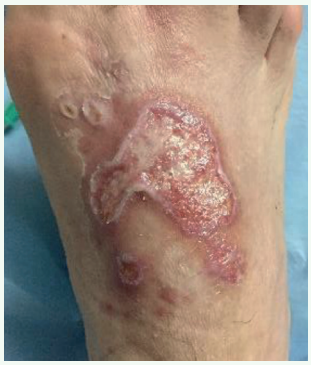

Figure 3. The wound at the fifth follow-up visit (day 19)

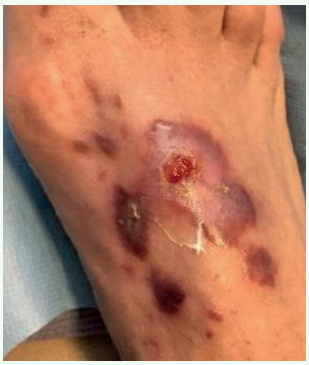

Figure 4. The wound at the end of the evaluation (day 43)

CASE STUDY 9: non-healing venous leg ulcer

Juan José Suárez Sánchez, Doctor of Clinical Research (PhD), Primary Care Team Nurse and Professor at University of La Laguna, Las Palmas College of Nursing, Ingenio, Gran Canaria, Spain

A 72-year old man was referred by his general practitioner to a primary care clinic with a non-healing venous wound of traumatic origin. He had hypertension and chronic obstructive pulmonary disease, for which he was prescribed angiotensin II receptor blockers and tiotropium bromide. He was retired and was the main carer of his wife. He was a non-smoker.

The venous leg ulcer, which was located on the anterior region of the right ankle, measured 40x30 mm (1200 mm^2). It had been present for 41 days and he was unable to walk long distances because of it. The main clinical challenges were hypergranulation tissue and a moderate volume of serous exudate. There was also a small amount of non-viable tissue on the wound bed (10%) (Figure 1). Excoriation and spreading erythema were visible on the periwound skin, which was becoming increasingly warm to touch. The limb was oedematous.

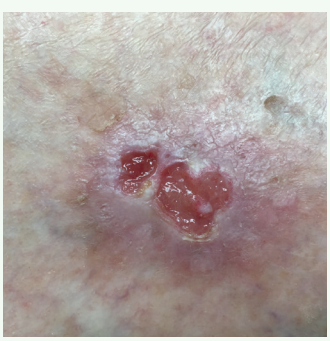

Figure 1. The wound at presentation

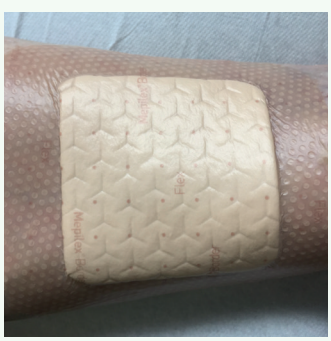

Figure 2. The wound following the first application of the dressing, which conformed well

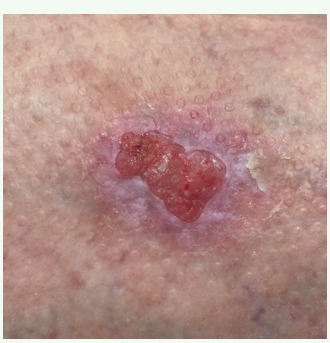

Figure 3. The wound at the fourth follow-up visit (day 28)

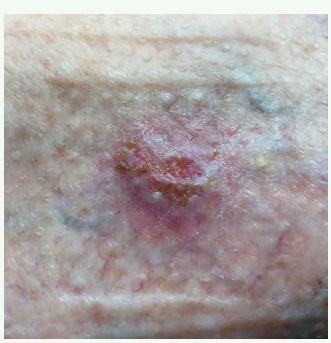

Figure 4. The wound at the end of the follow-up period (day 42)

Previous treatment had comprised a foam dressing and mupirocin ointment. The patient self-reported mild pain at dressing change (2/10 on a visual analogue scale (VAS)). No compression therapy had been used.

The clinician at the clinic prescribed a new treatment regimen of Mepilex Border Flex (Figure 2) and compression bandaging, which had not been used previously. Treatment with the dressing was evaluated for 42 days, during which time the patient attended six follow-up visits, when the dressing was changed (dressing frequency was always 7 days).

After one week of treatment, there was no change in wound size, but the devitalised tissue had disappeared and there were buds of epithelial tissue on the wound margins. Hypergranulation tissue was still present and the exudate volume remained unchanged. However, the periwound skin was no longer warm to touch, although erythema and excoriation were still present.

At the next assessment one week later, the wound had reduced to 35x30 mm (1050 mm^2), but hypergranulation tissue was still present, which was slowing the movement of epithelial tissue from the wound margins. The wound was still

producing a moderate volume of exudate, but the dressing was controlling it well. The periwound skin was hydrated with slight signs of erythema.

There was a further reduction in wound size at at week 3, when it measured 30x25 mm (750 mm^2) and the wound bed comprised 70% granulation tissue and 30% epithelial tissue. The volume and nature of the exudate remained unchanged.

At week 4, the wound measured 25x20 mm (500 mm^2) and there was now 40% epithelial tissue (Figure 3). The periwound skin was now hydrated and intact.

The wound continued to reduce in size, measuring 20x15 mm (300 mm^2) at week 5, by which time the exudate volume was low and the wound bed was covered with 65% epithelial tissue. The periwound skin was hydrated, and there were no signs of erythema or oedema.

At the end of the follow-up period (week 6), the wound measured 10x5 mm (50 mm^2) (87.5% reduction) and was producing a low volume of serous exudate (Figure 4).

The patient found the dressing and compression bandages comfortable, and was able to perform his daily activities independently.

Pain at dressing change remained low throughout the follow-up period, never rising above a VAS score of 2/10.

CASE STUDY 10: hypergranulating venous leg ulcer

Juan José Suárez Sánchez, Doctor of Clinical Research (PhD), Primary Care Team Nurse and Professor at University of La Laguna, Las Palmas College of Nursing, Ingenio, Gran Canaria, Spain

An 86-year-old man presented at the primary care clinic with a venous leg ulcer, of three months' duration, on the posterior region of the left leg. He was frail and had limited mobility, and so required some help to complete his activities of daily living, such as getting dressed. He had no cognitive impairments. The patient had a history of atrial fibrillation and heart failure, and was taking medication for arterial hypertension as well as oral anti-coagulants. His international normalised ratio (INR) was monitored regularly.

Previous treatment had comprised an alginate primary dressing and a foam secondary dressing, as well as a topical corticosteroid cream. No compression therapy had been used.

At the initial assessment, the wound measured 130x50 mm (6500 mm^2) and the wound bed comprised 30% hypergranulation tissue, 50% healthy granulation tissue and 10% devitalised tissue (Figure 1). The following clinical signs of localised infection were present: a high volume of yellow/green exudate, spreading erythema (to 3.5 cm beyond the wound edges) and eczema on the periwound skin, which was also oedematous. The patient self-reported moderate pain at dressing change (visual analogue scale (VAS) score of 4/10).

The treatment regimen was changed to Mepilex Border Flex (Figure 2) and compression therapy. No antibiotics were prescribed. Treatment with the dressing was evaluated for 46 days, during which time the patient attended six follow-up visits at the clinic, when the dressing was changed (dressing change frequency was seven days, range 3–5 days).

Due to the high exudate volume, the dressing was changed three times in the first week (days

1, 4 and 7), but it was considered to manage the excess fluid well.

After 2 weeks of treatment, the wound had reduced to 110x4 5mm (4950 mm^2) and the exudate level was moderate. The wound bed comprised 30% hypergranulation tissue, 60% granulation tissue and 10% epithelial tissue. The wound continued to reduce in size during the next two weeks. However, it still produced yellow-green exudate and the condition of the periwound skin remained unchanged throughout the first four weeks of treatment.

After 4 weeks, the wound measured 95x35 mm (3325 mm^2) and the exudate was now serous, although still moderate in volume. The wound bed now comprised 20% hypergranulation tissue (Figure 3), 50% granulation tissue and 30% epithelial tissue.

By day 35 (week 5), the only remaining clinical sign of infection was erythema, which now extended 1.5 cm beyond the wound edges and was less intense in colour. The wound measured 70x25 mm (1750 mm^2) and comprised 10% hypergranulation tissue, 30% granulation tissue and 60% epithelial tissue.

The wound continued to contract and at the final follow-up on day 46 measured 45x10 mm (450 mm^2), representing a 93.1% reduction over the 6.5 weeks of treatment. At day 46, the wound was producing a moderate to low volume of serous exudate. There was still some periwound erythema but its colour was fading (Figure 4).

Pain at dressing change reduced during the follow-up period, falling from a VAS score of 4/10 at its start to 2/10 at the last two assessments.

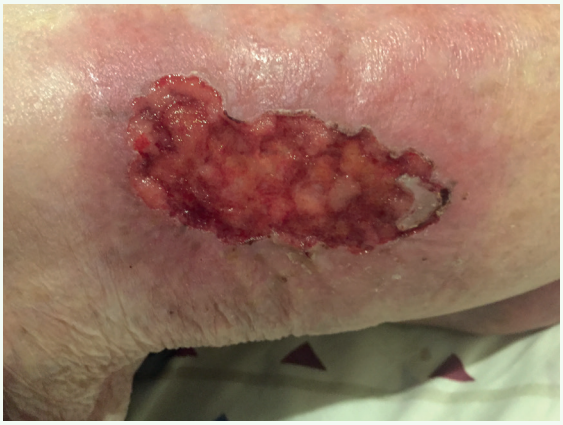

Figure 1. The wound at presentation

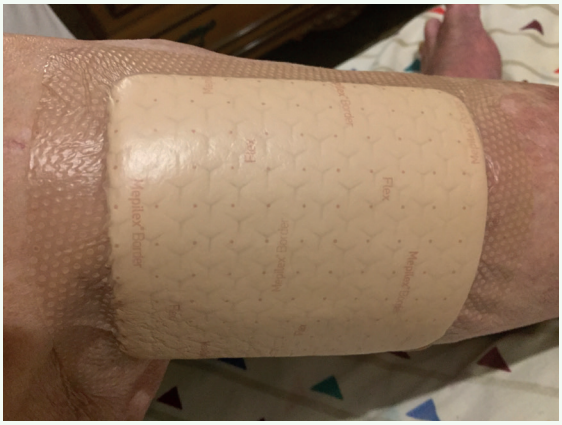

Figure 2. The wound following the first application of the dressing, which conformed well

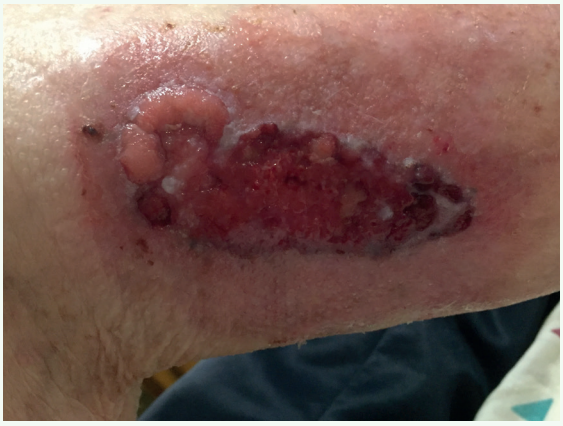

Figure 3. The wound at the fourth follow-up visit (day 28)

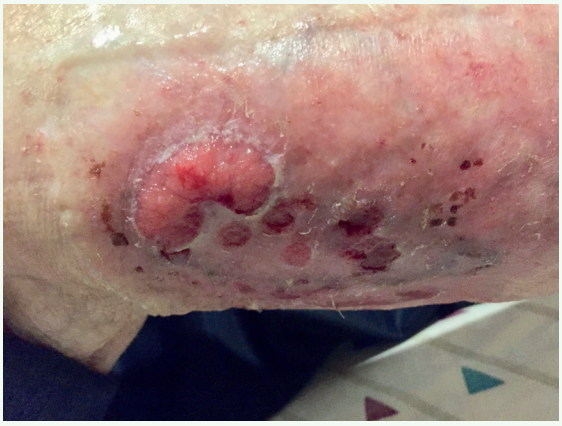

Figure 4. The wound at the end of the follow-up period (day 46)

Concluding remarks

José Luis Lázaro-Martínez, Head of Diabetic Foot Unit, Complutense University of Madrid, Spain

When a company launches a new wound-care device, the question I always have in my mind is what is its added value. Practitioners are used to receiving marketing information about the benefits of new products, always supported by good results from pre-marketing studies undertaken by the manufacturer. But what are the real needs in wound care today? What are the unresolved issues that wound-care devices are not currently addressing?

A newly launched dressing is expected to conform to the wound, stay in place during longer wearing times, maintain a good moisture balance and keep pathogenic bacteria away from the wound bed. This will help promote healing and avoid trauma, re-infection and tissue damage.

The dressing will also need to inspire confidence. Companies often ask practitioners why or how often they change a dressing. Sometimes, we do not have a response to this, mainly because we often change the dressing simply to inspect the wound and check it is healing, and thus gain confidence in the product. We could perhaps reduce the frequency of dressing changes if a dressing were able to give us this information without the need for removal. This would reduce nursing time and costs, as well as increase patient wellbeing.

Important properties required of foam dressings are exudate absorption and retention. Some chronic wounds, such as a diabetic foot ulcers (DFUs), receive thousands of microtraumas every day when patients walk, even when they are wearing offloading shoes. Microtrauma often reduces the capacity of saturated foam dressings to retain exudate. An important added value for a foam dressing, therefore, is the ability to retain exudate even when subjected to shear forces and/or pressure.

Another important requirement is the ability to manage the bacterial load. It has been demonstrated that 40% of initially uninfected DFUs go on to develop an infection.[1] This means that a significant number of DFUs are becoming infected due to poor control of the bacterial bioburden. Dressings that are unable to retain exudate within their layers might be exposing the wound bed to an increasing number of (proliferating) bacteria, potentially resulting in infection.

Conformability and adherence are other important features. The body is not a flat plane but, rather, mostly convex surfaces, some of which are mobile and/or subjected to shear. Both will reduce a dressing's capacity to stay in place. I am sure all practitioners reading this will have had some experience of a dressing moving under a bandage during wear and finding it some centimetres away from the ulcer location. This is especially common when an ulcer is exposed to shear, such as a DFU on the plantar surface of the foot.

It seems that Mölnlycke Health Care set out to meet all of these requirements when it developed an innovative dressing, Mepilex Border Flex. Its conformability and adhesion enable longer wear times. Exudate, and thus the bacteria within it, is quickly absorbed and retained within its central layers away from the wound bed. Furthermore, the incorporation of Safetac into the wound contact layer ensures atraumatic removal and thus minimal pain at dressing change.

Reference

1 Jia L, Parker CN, Parker TJ et al. Incidence and risk factors for developing infection in patients presenting with uninfected diabeticfoot ulcers. PLoS One. 2017 17;12(5):e0177916. doi: 10.1371/journal.pone.0177916.

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