Wound dressings

Skin wounds are seen across all subgroups of hospital patients and wound management is therefore an essential part of medical practice for all doctors. The key to wound dressing is accurate assessment of the wound properties and selection of the most appropriate dressing.

Wound dressings are technical products, which aim to create an ideal healing environment for wounds by allowing adequate moisture but removing excessive exudate and protecting from bacterial contamination. The broadest categories of dressings include occlusive films, which are ideal for versatile protection, and hydrocolloids, which can be used to gently debride chronic wounds. Negative pressure wound therapy is becoming increasingly more useful for complex wounds, and can be used effectively as both an inpatient and an outpatient. Complications of wound dressings are usually associated with hypersensitivity reactions, and are generally easy to treat. Some wounds cannot be managed with dressings alone. In cases where wounds are large or otherwise complicated, surgery may be indicated and referral to the plastic surgery team is the best route for this decision making.

Any skin wound causes a functional disruption to the integrity of the skin, exposing the patient to a risk of infection, blood loss, pain and scarring. Effective wound dressing provides a substitute barrier while the skin is ineffective, and promotes healing in the longer term. Wounds are exceedingly common. Hospitals report an incidence of pressure ulcers of 8.3–23% (Vélez-Díaz-Pallarés et al, 2015) and the costs of non-healing, chronic wounds have been estimated to exceed $3 million/year in the USA (Nwomeh et al, 1998), highlighting the importance of well-planned wound care.

Healing is classically described in four contiguous phases (Guo and Dipietro, 2010):

1. Haemostasis
2. Inflammation
3. Proliferation
4. Maturation.

It has been known since the 1960s that a moist environment is highly beneficial to healing wounds. Moisture increases the rate of epithelialisation two-fold (Winter, 1962), yet it can take decades for a change in practice to occur; many still advocate leaving a fresh wound 'open to the air'. Modern dressings aim to expedite healing by achieving a moist environment, remove excessive exudate, provide ongoing protection from (or treating) bacterial contamination, and reduce odour and pain. The properties of an ideal dressing are listed in *Table 1*. No particular dressing has all of these properties, which is why the dressing can only be selected after accurate assessment.

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Table 1. The properties of an ideal wound dressing

Prevents contamination
Removes odour
Maintains adequate moisture
Requires infrequent changes
Absorbent
Conformable
Antimicrobial
Painless
Promotes autolytic debridement
Cheap

Principles of wound assessment

Wound assessment is critical for dressing selection. The most fundamental properties of a wound are its aetiology, depth and any systemic patient factors. Perhaps the commonest wounds are traumatic lacerations and surgical incisions. These are often closed primarily and therefore usually require just simple dressings. In comparison, chronic ulcers caused by neuropathy or pressure, or vascular insufficiency, are more complex and demand careful care with appropriate dressings over a prolonged period of time. Burns are a separate subset of wounds with specific management strategies.

The depth of wound determines the structures involved, whether that is skin alone or extends through to muscle or bone. Patient-specific factors include allergies as well as comorbidities, such as diabetes mellitus, concurrent radiotherapy, smoking status or malnutrition, and medications, such as corticosteroids, all of which delay wound healing and exacerbate the risk of infection. The patient's global medical status must therefore be optimized – even the most carefully chosen dressing will not heal a wound in a patient with poorly-controlled diabetes. Patient compliance is vital for the use of some dressings; negative pressure wound therapy, for example, might not be appropriate in some patients with dementia who can become agitated by the attachment to a pump unit. Bearing all of this in mind, fundamentally similar wounds might be managed entirely differently in different patients.

Aside from assessing the three fundamental properties of aetiology, wound depth and patient factors, a popular framework for comprehensive assessment of key wound features is the TIME acronym (*Table 2*). This allows an in-depth review of the important wound factors to guide treatment. The tissue type might include necrosis or slough which needs removing. Infection may require antibiotics or at least an antimicrobial dressing. Assessment of moisture is critical: a moist environment

Table 2. TIME criteria for full assessment of a wound's characteristics

T	Tissue type	Is the wound granulating, sloughy, necrotic?
I	Infection	Suggested by heat, erythema, pain, oedema, odour, wound breakdown
M	Moisture	How wet is the wound? Dry, moist or wet. Why is it wet? Is exudate serous, serosanguinous or purulent?
E	Edges of wound	Are the edges rolled, thickened, undermined, callus?

must be achieved, but too moist and wound edges will macerate, predisposing to infection and wound breakdown. Finally, the wound edges can be thick and callused, which slows the wound's contraction and may need addressing. As a wound heals, its characteristics will change, necessitating ongoing reassessment and adaptation of the dressing strategy. Effective wound management is only possible after identifying and managing all of these wound- and patient-specific factors.

Dressing by type

Wound dressings are technical products that can be classified by type. Each type of dressing will have one or more specific functions, such as being absorptive, antimicrobial or moisture-retaining. This article discusses the range of dressings available and summarizes these in a quick reference table to provide wound care guidance (*Table 3*). Specific examples of the dressing that might be appropriate for common wound types are found in *Table 4*. The specific branded products available will vary according to any particular trust's formulary.

Polyurethane film dressings

These are transparent, semi-permeable films (e.g. OpSite, Tegaderm). They allow water vapour to escape from the dressing to some extent, but maintain a barrier of humidity and prevent bacterial contamination. The occlusive nature of the dressing does mean that any significant exudate will tend to collect underneath the dressing and potentially macerate the wound edges, making this dressing inappropriate for exudative wounds. Practically, however, polyurethane film dressings are easy to apply to difficult areas such as joint creases and, being transparent, allow monitoring of the skin around the wound for superficial infection. They are also cheap and versatile. This makes them a popular choice for covering simple surgical wounds, with evidence that they reduce the incidence of surgical site infection over a simple gauze dressing in this group (Arroyo et al, 2013). Polyurethane film dressings with a small absorbent pad incorporated have the additional advantage of being able to handle some exudate or minor bleeding.

Hydrocolloid dressings

Hydrocolloid dressings (e.g. Duoderm; *Figure 1*) are so called as the active area of dressing is structured from protein (such as pectin) and highly absorbent polysaccharides (such as sodium carboxymethylcellulose). The soft pad that these molecules form absorbs wound exudate in order to become gelatinous. This allows gentle adherence to

Table 3. Summary of wound dressings' properties by category

Dressing	Appearance	Uses	Advantages	Disadvantages	Absorbency	Examples
Gauze	Woven tissue	An absorbent secondary dressing for exudating or oozing wounds	Highly absorbent. Cheap	Desiccating and adherent	High	Gauze
Semi-permeable polyurethane film	Transparent film	For small, minimally exudative wounds as a primary dressing. As a secondary dressing for other wounds	Allows monitoring of skin. Conformable. Cheap	Fluid will become trapped and macerate. Allogenic	Minimal	Tegaderm OpSite
Moist gauze	Moist gauze. May contain antiseptic, e.g. iodine	To maintain a moist environment in dry wounds	Non-adherent. May be antiseptic	Non-occlusive. Require fixation dressing	Nil	Jelonet, Bactogras, Inadine
Hydrocolloid	Soft pad	Ulcers, leg ulcers, stoma sites	Promote autolytic debridement	Cannot be used on dry wounds	Moderate	Duoderm Aquacel
Foam	Soft pad	Ulcers or other chronic wounds	Promote autolytic debridement, conformable	Relatively expensive. Often cause localized erythematous reaction	Moderate	Biatain Ag, Mepilex Border
Fixation	Thin roll with a single adhesive side	Holding a non-adhesive dressing in place	Can be cut to any shape	Not a sole dressing	Nil	Mefix, Hypafix
Calcium alginate	Woven and fibrous	Exudating or mildly bleeding wounds	Highly absorbent. Haemostatic	Contraindicated in drier wounds	High	Kaltostat, Sorbisan
Negative pressure dressing	A sponge with a transparent film attached to a pump	Large, deep, contaminated wounds. Highly exudative wounds	Removes heavy exudate, oedema and infected material. Promotes angiogenesis	Expensive Disruptive to patient	High	VAC, PICO, Renasys Go

Table 4. Common wound types with example dressing suggestions. The actual dressing choice will depend on full assessment of the patient and the wound, and which products are locally available

Wound	Typical characteristics	Suggested dressing	Common brands
Clean surgical wound	Dry and clean	Film dressing	Tegaderm, Softpore, OpSite
Pretibial laceration	Relatively dry with minor contamination	Antiseptic gauze with woven gauze and a crepe bandage	Inadine gauze, Bactigras gauze
Large, dehisced laparotomy wound	Very large, heavily exudative and contaminated	Negative pressure wound therapy	VAC, PICO
Diabetic foot ulcer	Shallow, mild-to-moderately exudating	Hydrocolloid	Duoderm, Comfeel, Acticoat Flex
Grade 3 pressure ulcer	Deep, often contaminated, moderately exudating, malodourous	Antimicrobial foam or antimicrobial paste with a foam	Aquacel Ag, Biatain Ag, Acticoat Flex, Iodoflex paste
Grade 3 pressure ulcer (highly exudating)	Deep, highly exudative	Alginate dressing, with or without antimicrobial	Sorbisan, Kaltostat
Skin abscess cavity	Open, deep, contaminated and moderately-to-highly exudative	Alginate dressing, with or without antimicrobial	Sorbisan, Kaltostat

the wound but, more importantly, provides a moist environment for healing and autolytic debridement (Cuschieri et al, 2013) – that is, the body's own breakdown of necrotic tissue and eschar until it can be lifted away.

The properties of hydrocolloids make them suitable for dressing ulcers and chronic wounds (*Figure 2*). Indeed, manufacturers produce dressings shaped specifically for commonly affected anatomical sites such as the sacrum and heel. A Cochrane review suggests no benefit of hydrocolloids over other modern dressings, although equally no evidence of harm (Dumville et al, 2013). There is little doubt, however, that hydrocolloids offer good healing advantages over gauze dressing (Health Quality Ontario, 2009) and as such are useful as a relatively inexpensive, simple dressing option in many cases, in keeping with current National Institute for Health and Care Excellence recommendations (Stansby et al, 2014).

Foam dressings

Foam dressings (e.g. Allevyn Gentle Border, Biatain Silicone; *Figure 3*) are polyurethane sheets of spongy foam that have hydrophilic properties, absorbing moisture quite readily. They generally have an external film which allows some humidity to escape, but prevents significant strikethrough and protects from wound contamination. These dressings are useful but do come at a higher cost than many other dressing types. They are also associated with mild skin irritation underneath the dressing itself, although this does not appear to have any clinical consequences (Cowan, 2015).

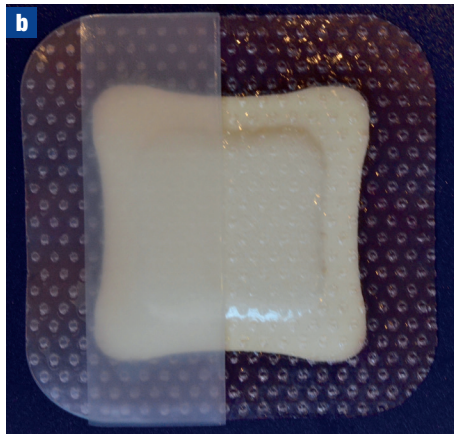
Fixation dressings

These are not designed to be used as a primary dressing (e.g. Hypafix, Mefix). They are typically a long roll of thin, slightly elastic dressing with one adhesive side (*Figure 4*). They adhere well to healthy skin, and therefore can hold a non-adherent dressing in place over a wound. The dressing can be stretched to apply gentle structural support over a wound and can be cut to fit difficult shapes. They can also easily be applied over very large areas, which is why they are often used in dressing skin grafts and skin graft donor sites.

Figure 1. Duoderm (ConvaTec, UK). A common hydocolloid dressing.

Figure 2. A non-infected chronic leg wound.

Figure 3. **a.** Biatain Silicone (Coloplast, Denmark). **b.** Allevyn Gentle Border (Smith & Nephew, UK).



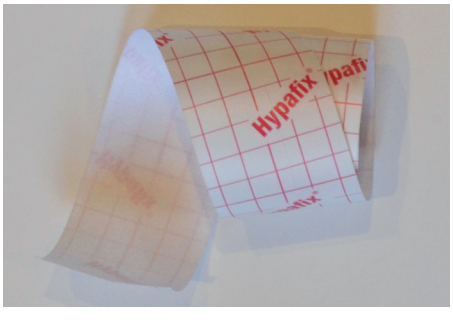
Low-adherence dressings

These are a gauze or mesh impregnated with chemicals such as iodine (Inadine), paraffin (Jelonet) (*Figure 5*) or chlorhexidine (Bactigras). These help moisturise wounds and may be antibacterial. The combination of moisture and antisepsis makes these dressings good to cover shallow open wounds (such as pre-tibial lacerations), as they reduce the risk of contamination, do not stick painfully to the wound and do not allow it to dry out. Acticoat Flex 3 and 7 are examples of silver-coated gauze dressings designed to provide antimicrobial activity for 3 and 7 days respectively, which can be used alone or in conjunction with negative pressure wound therapy. These are particularly suitable for chronic wounds with superimposed superficial infection. Many of these meshes do not have adhesive components so need to be held in place by a bandage or fixation dressing.

Calcium alginate dressings

These dressings are similar to hydrocolloid dressings, in that their properties are dependent on contact with wound exudate (e.g. Kaltostat, Sorbsan). The dressings are made of spun fibres extracted from seaweed; the active components are calcium chloride and sodium alginate. When in contact with fluid, the dressing absorbs it and becomes gelatinous. Calcium alginate dressings are therefore an excellent choice for moderate to highly-exudative wounds. Usefully, the dressing is also effective at bringing about superficial haemostasis in bleeding wounds such as grazes or split skin graft donor sites. Long ribbon-type calcium alginate dressings can be useful to pack deeper wounds and sinuses, allowing effective exudate absorption. Calcium alginate dressings do not usually have an adhesive component, so require a fixation dressing to hold them in place.

Figure 4. A roll of Hypafix (BSN Medical, UK), which is cut to the desired length.



If the calcium alginate dressing fully dries out a wound, the persisting fibres can remain non-gelatinous and become incorporated into the granulating tissue – this makes it adherent and difficult to remove. As such, prolonged application to drier wounds is not recommended.

Honey

There is growing interest in the use of honey, and it can be applied in prefabricated sheets of honey-impregnated gauze. Randomized trials provide some evidence that honey is superior to conventional dressings in some contexts (Jull et al, 2013) and can aid eradication of meticillin-resistant *Staphylococcus aureus* in ulcers (Gethin and Cowman, 2008), but good quality evidence is, in general, currently lacking.

Creams and pastes

These are usually added underneath occlusive dressings to contribute certain properties to the wound environment, usually moisture and antimicrobial activity. Flamazine contains antimicrobial silver and is commonly used in burns. Iodoflex paste is also antimicrobial, and is effective at chemical debridement, making it suitable for sloughy wounds such as chronic ulcers (Floyer and Wilkinson, 1988). As an added benefit, this will also reduce the odour associated with these wounds.

Negative pressure wound therapy

This is a relatively modern concept whereby wound healing is enhanced by a constant negative pressure being applied through foam or gauze overlying a wound (e.g. VAC, PICO). This has four main advantages:

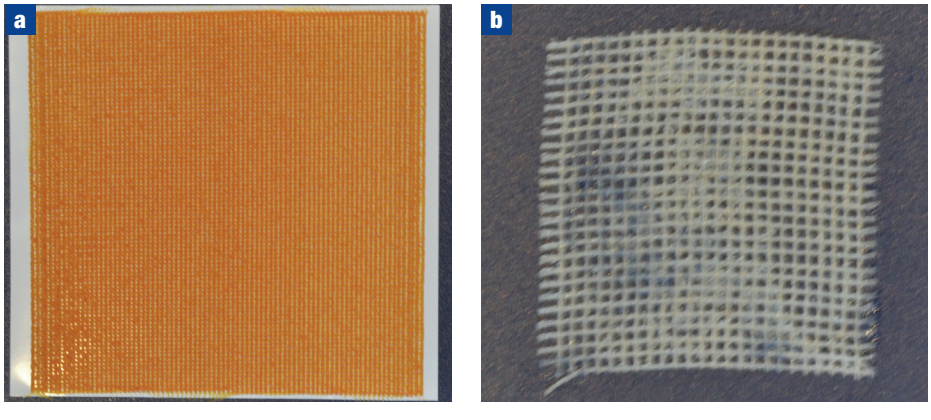
1. Macrodeformation – wound edges are brought closer together, often enough to allow delayed primary closure
2. Microdeformation – the wound bed becomes reorganized into healthy granulation tissue
3. Fluid removal
4. Environmental control. The wound is kept clean by constant fluid removal and non-permeable dressing cover.

Negative pressure wound therapy is a well-accepted treatment for delayed primary closure after emergency laparotomy (Kaplan et al, 2005) and for patients with large soft tissue defects. Work is ongoing to develop an international consensus on exactly how negative pressure wound therapy should be used (Birke-Sorensen et al, 2011). Negative pressure wound therapy is undoubtedly very useful for both achieving wound closure in itself, or for preparing a wound bed for skin grafting.

The constant negative pressure applied by the dressing means that this should not be applied over exposed blood vessels, nerves or unexplored fistulae. This is also usually not used in wounds where malignancy is or has recently been present because of the theoretical risk of seeding into new planes.

On a practical level, the use of negative pressure wound therapy is restricted to patients who can tolerate the presence of a drain, and outpatient use requires a patient capable of managing the mechanical unit. However, the availability of relatively new, small and highly portable vacuum units (e.g. PICO, Smith & Nephew, UK) reduces this demand on patients and has extended the applicability of negative pressure wound therapy in the outpatient setting (*Figure 6*).

Figure 5. **a.** Inadine (Systagenix, UK), iodine impregnated gauze. **b.** Jelonet (Smith & Nephew, UK), paraffin impregnated gauze.



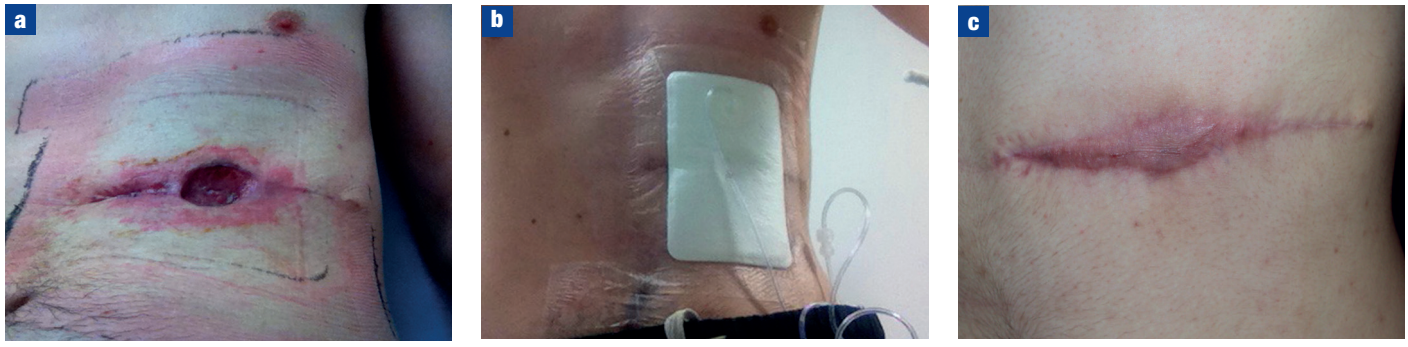


Figure 6. **a.** A dehisced surgical wound. **b.** PICO negative pressure wound dressing in place. **c.** The healed wound.

Wound dressing complications

Localized reaction to dressing material (or more specifically, dressing adhesive) is a commonly encountered problem (Jones et al, 2006), typically characterized by erythema. Alternatively, a poorly applied dressing can cause shearing and blistering. For either of these problems, usually all that is required is removal of the dressing. Allergy to iodine or silver is not uncommon, and a history of sensitivity to these products must be checked.

Wound maceration is caused when the wound has been allowed to become excessively moist. This is usually caused by ineffective exudate removal, or an occlusive dressing remaining in place for too long. Maceration creates a breeding ground for bacterial infection and can cause subsequent wound breakdown.

Some dressings, such as foams or alginates, are impregnated with silver which manufacturers suggest contraindicates magnetic resonance scanning. However, reports of pain, burns, or degradation of image quality with these dressings have not been substantiated (Chaudhry et al, 2009).

Non-organic dressings that are not completely removed can become retained within the healing wound. This could be the underlying cause of a non-healing wound (Ahmed et al, 2010).

Referral for surgery

Surgical intervention may be beneficial where wound healing is very slow to progress, complicated by recurrent infection or associated with unacceptable cosmesis. This step will also require appropriate nursing care, rehabilitation, nutrition and social set-up.

The main reason for surgical intervention is to allow debridement of necrotic tissue including assessment of deeper structures, perhaps also using a negative pressure dressing (*Figure 7*). Pressure ulcers are a particularly complex wound subset. Certain ulcers may benefit from sharp debridement; this is often best performed on the ward as the ulcer itself is usually insensate, and the patient may have multiple comorbidities, contributing to the anaesthetic risk. Tissue viability nurses may be specifically trained for sharp debridement, and so they are a great first point of call for any patient with a pressure ulcer. Tissue viability nurses establish dressing routines, arrange follow up and recommend timely involvement of other specialists, such as plastic surgeons. The aphorism 'prevention is better than cure' is especially true for pressure ulcers, which can be entirely prevented in hospital by patient position protocols and using pressure-relieving mattresses in at-risk patients.

Other surgical options for complex wounds are skin grafts or skin substitutes which can enhance recovery of large, clean defects. Occasionally, a faecal diversion tube (such as Flexiseal, Convatec, USA) or even a (hopefully temporary) diverting colostomy might be required in treating sacral wounds such as pressure ulcers, to allow effective dressing without persistent faecal contamination.

Conclusions

Wound dressing choice can seem complicated. Detailed review of the patient and the properties of the wound is critical in decision making. Meticulous debridement is often the key to treating more complex wounds, but good care can prevent many wounds getting to this point. Most hospitals have a dedicated tissue viability team, and larger centres will usually have specialist plastic surgery or burns nurses. Spending time with these true experts is an investment for anyone who wants to learn how to dress wounds, as the value of their experience cannot be underestimated. **BJHM**

Conflict of interest: none.

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Figure 7. An infected, necrotic arm wound. This wound benefited from surgical debridement and negative pressure wound therapy, followed by skin grafting.

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KEY POINTS

- Wound dressings are technical products and must be used appropriately.
- Assess wounds according to aetiology, depth and patient factors.
- Choose dressings based on these factors and the TIME classification.
- Tissue viability and plastic surgery nurses are true experts and a great first port-of-call for wound concerns.

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