The goal of skin substitutes is to achieve rapid wound closure and restore normal skin function. These products generally consist of bilayered systems that approximate the structure and function of human epidermis and dermis. Table 2 describes several skin substitutes currently on the market. Because biosynthetic dressings and skin substitutes are generally reserved for use in highly specialized areas of wound care, such as burn clinics, a complete account of these products is beyond the scope of this text. The reader should refer to other sources for detailed information regarding these promising new products.

<table>
<thead>
<tr>
<th>Skin Substitute</th>
<th>Description</th>
</tr>
</thead>
</table>
| Alloderm        | • Acellular dermis  
                 | • Used for permanent coverage of partial-thickness burns and soft tissue replacement |
| Apligraf        | • Also known as Graftskin, bilayered matrix containing cultured neonatal keratinocytes and fibroblasts on Type I bovine collagen, contains granulocyte/macrophage colony-stimulating factor  
                 | • Used for permanent coverage of nonhealing neuropathic, pressure, or venous insufficiency ulcers, chronic wounds, and full-thickness burns |
| Biobrane        | • Synthetic dermis, temporary skin substitute comprised of an inner nylon layer and outer silicone layer with added bovine collagen  
                 | • Most commonly used for temporary coverage of partial- and full-thickness burns |
| Dermagraft      | • Cultured neonatal fibroblasts in a polyglycan mesh  
                 | • Used as a skin substitute for burns and neuropathic ulcers |
| Epicel          | • Epidermal substitute consisting of cultured autogenous keratinocytes  
                 | • Used for permanent coverage of large deep partial-thickness or full-thickness wounds |
| GRAFTJACKET     | • Human acellular dermal tissue matrix |
| Integra         | • Collagen glycoaminoglycan dermal matrix covered with an outer silicone layer; requires thin skin graft over it for definitive closure  
                 | • Used for permanent coverage of full-thickness burns |
| Transcyte       | • Inner nylon layer containing neonatal fibroblasts covered with an outer silicone mesh layer  
                 | • Used for temporary coverage of partial- and full-thickness burns |

**Checkpoint Question #3**

Your 55-year-old patient sustained a partial-thickness volar forearm wound 3 days ago in a boating accident. She has a history of osteoarthritis. The wound is uninfected and measures 3.4 × 4.0 cm. Which of the following dressings is not appropriate at this time for this patient? Why?

a. Amorphous hydrogel with a gauze dressing  
   b. Semipermeable film  
   c. Semipermeable foam  
   d. Growth factor with a gauze dressing
Dressing Selection and Bandaging

CLINICAL DECISION MAKING

After becoming familiar with the basic properties of the main categories of wound dressings, the clinician must select an appropriate wound dressing based on the information obtained during the wound examination. In most cases, the desired outcome of wound management is wound healing: the wound bed is completely resurfaced with epithelium, and the tissue is remodeled so that its strength approaches normal. An interim step in this process is to obtain a clean, warm, moist granular wound bed while protecting the peri-wound and intact skin. There are two key questions the clinician must answer to determine the most appropriate local wound care:

1. Is the wound draining or nondraining?
2. Is the wound granular or necrotic?

After these two key questions are answered, the clinician must consider other factors affecting local wound management to fine-tune the choice of the most appropriate wound dressing.

Draining or Nondraining

Because a moist wound environment enhances wound healing, the dressing selected must assist with obtaining and maintaining this type of environment. The key clinical decision point, therefore, is determining whether the wound is draining or nondraining. A draining wound requires a dressing with the ability to absorb moisture and protect the surrounding tissue from maceration. A nondraining wound requires a dressing that provides moisture or prevents evaporative fluid loss. Since moisture will be added to the wound bed, as with a hydrogel, a skin sealant is also required to protect the surrounding tissues of nondraining wounds. Prior to removing a wound dressing, the clinician should always check to see when the dressing was applied. This can help determine the amount of wound drainage and the ability of the current dressing to handle this moisture content.

Granular or Necrotic

A granular wound requires a dressing that will protect the wound bed from trauma. In contrast, a necrotic wound requires debridement. The clinician must determine the most appropriate method(s) to accomplish the removal of necrotic tissue.

Wound Dressing Decision Grid

By considering the first two key decision points and the characteristics of the main categories of wound dressings, the clinician can develop a wound dressing decision grid (see Table 3). Wounds can be grouped into four categories: (1) granular and nondraining, (2) granular and draining, (3) necrotic and nondraining, and (4) necrotic and draining.

Granular and Nondraining

A granular and nondraining wound is healing as expected. The granulation tissue and periwound should be protected. To attain a moist wound environment, moisture may need to be added, as with an amorphous hydrogel, or a more occlusive dressing may be needed to better retain the wound's moisture content.

Granular and Draining

If a wound is granular and draining, the granulation tissue and periwound should be protected. To obtain a moist, but not wet, wound environment, a more absorptive dressing should be applied. Since there is no necrotic tissue to be solubilized, the most common reason for a granular wound to be heavily draining is the presence of an infection. Excessive drainage from a granular wound or friable granulation tissue may be the only sign of a silent infection in patients who are immunocompromised or patients with chronic wounds. If the wound is not infected, the drainage indicates that the dressing may need to be changed more frequently or be slightly more absorptive.

Necrotic and Nondraining

The necrotic, nondraining wound requires debridement and softening of eschar. To attain a moist wound environment, moisture may need to be added,
TABLE 3 Wound Dressing Decision Grid

<table>
<thead>
<tr>
<th>Wound Description</th>
<th>Short-Term Goals</th>
<th>Debridement Options</th>
<th>Dressing Options *</th>
</tr>
</thead>
</table>
| Granular, nondraining   | 1. Obtain/maintain moist environment  
                        | 2. Protect surrounding tissue                       | NA                 | Gauze†            |
|                         |                                                      |                     | Impregnated gauze†|
|                         |                                                      |                     | Transparent film  |
|                         |                                                      |                     | Hydrogel          |
| Granular, draining      | 1. Observe for infection  
                        | 2. Absorb exudate                                       | NA                 | Gauze             |
|                         | 3. Protect surrounding tissue                                       |                     | Alginate          |
|                         |                                                      |                     | Semipermeable foam|
|                         |                                                      |                     | Hydrocolloid†      |
| Necrotic, nondraining   | 1. Soften eschar  
                        | 2. Remove eschar                                         | 1. Surgical        | Gauze†            |
|                         | 3. Obtain/maintain moist environment  
                        | 4. Protect surrounding tissue                           | 2. Sharp           | Impregnated gauze†|
|                         |                                                      | 3. Enzymatic       | Transparent film  |
|                         |                                                      | 4. Autolytic‡      | Hydrogel          |
|                         |                                                      |                     | Hydrocolloid      |
| Necrotic, draining      | 1. Observe for infection  
                        | 2. Absorb exudate                                       | 1. Surgical        | Gauze             |
|                         | 3. Remove eschar                                       | 2. Sharp           | Alginate          |
|                         | 4. Protect surrounding tissue                          | 3. Enzymatic       | Semipermeable foam|
|                         |                                                      | 4. Autolytic‡      | Hydrocolloid‡     |

*Skin sealant should be applied to intact periwound as needed.
†With topical agent, such as an amorphous hydrogel.
‡If not infected.

as with an amorphous hydrogel, or a more occlusive dressing may be needed to better retain the wound's moisture content. Enzymatic debridement of a necrotic, nondraining wound may accomplish two goals: (1) the active enzyme can assist with debridement, and (2) the enzyme preparation may assist with attaining and maintaining a moist wound environment. The surrounding tissue should be protected with a skin sealant.

**Necrotic and Draining**
A necrotic, draining wound requires debridement, absorption, and protection of the surrounding tissue. The clinician should observe the wound for signs of infection both because a necrotic wound has a higher bioburden than a granular wound and because the wet wound bed provides an ideal environment for these microbes to proliferate.

**Other Considerations**
After using the two key decision point questions as a guide for determining dressing options, the clinician should consider a few other factors before making a definitive dressing selection.136, 137

**Wound Infection**
A clean or colonized wound can be safely bandaged with any type of wound dressing, though moisture-retentive dressings are generally more conducive to wound healing than gauze dressings. Infected wounds should not be occluded and should be rebandaged at least daily. Therefore, infected wounds may be best covered with gauze dressings. Infected wounds that are draining heavily may require additional gauze layers, an alginate, or semipermeable foam for increased absorption.
Dressing Selection and Bandaging

Wound and Skin Characteristics

Small wounds can be managed successfully with either gauze dressings or moisture-retentive dressings. However, large wounds are more conducive to gauze dressings. Deep wounds require light filling to prevent abscess formation (refer to Figure 9). This may be accomplished with gauze packing strips, gauze, alginates, or hydrocolloid particles along with a secondary dressing. Tunneling wounds are generally best managed with gauze dressings and more frequent dressing changes. Adhesives and adherent dressings should be avoided in patients with poor skin integrity.

If a wound is draining more than the current dressing can absorb, periwound maceration may be evident. Therefore, the clinician should choose a more absorbent dressing, perform more frequent dressing changes, and/or use a skin sealant.

Frequency of Dressing Changes

If the patient or caregiver is unable or unwilling to perform dressing changes, a moisture-retentive dressing may be more appropriate than gauze because it is designed to stay in place for several days. Gauze dressings are best for frequent dressing changes. Generally speaking, the optimal dressing for an uninfected wound may be the one that requires the least frequent dressing change.12,22,25,26 Because periwound skin can be damaged if an adhesive moisture-retentive dressing is changed too frequently,35 these dressings should be used only if the dressing is intended to stay in place for at least 3 days.

Availability of Dressings

The choice of wound dressings is dictated, in part, by the availability of wound care products. If a certain category of dressings is not available, the clinician must choose the next best alternative. In general, there are only minimal differences between various wound dressings within each of the nine main categories presented earlier. Therefore, it is usually acceptable for one type of semipermeable film dressing to be substituted for another semipermeable film dressing.

Cost

Clinicians must consider the economic impact of their choice of wound management. For example, it would not be fiscally responsible or clinically applicable to use a hydrocolloid for a wound that requires daily dressing changes. For one-time dressing changes, gauze dressings are less expensive. However, if an occlusive dressing can be used and left in place for several days, the overall cost of wound management (product cost plus the cost of skilled personnel to perform the dressing change) is reduced.32

Wound Location

Wounds in highly mobile areas, such as the palm, may be best managed with adherent moisture-retentive dressings. Similarly, wounds in areas that are not conducive to wrapping, such as sacral wounds, also are more easily bandaged with adherent moisture retentive dressings. Digital wounds may be more easily wrapped with gauze. Refer to the next section for location-specific bandaging tips.
Your patient presents with a wound on the lateral fifth metatarsal measuring 1.2 × 1.3 cm and 0.5 cm deep. The wound has copious drainage that is milky white. The periwound is warm to the touch and there is erythema noted up to 3 cm away from the wound. Which of the following dressings is not appropriate at this time? Why?

a. Amorphous hydrogel with a gauze dressing
b. An alginate with a gauze dressing
c. A hydrocolloid
d. A bulky gauze dressing

Comprehensive Wound Management

Although the focus of this chapter has been the philosophy of moist wound healing, wound dressings comprise only a portion of comprehensive wound management. The importance of examining and treating the patient as a whole cannot be overstated. The clinician must look beyond the wound and periwound characteristics. To achieve lasting wound closure, the health care team must identify and control wound etiology, contributing factors, and infection. The basic tenets of wound management are recapped in Table 4.

Bandaging Procedure

Box 13 provides a step-by-step guide for general wound bandaging. As with all other types of interventions, the clinician must follow accepted standard precautions at all times. Wound bandaging occurs after debridement, modality, and irrigation procedures have been completed. Some wound dressings, such as hydrocolloids and gauze, may leave a residue within the wound bed that must be removed with each dressing change. Because alginate residue is biocompatible, it need not be meticulously removed with each dressing change. In most cases, it is sufficient to use clean technique. However, sterile technique is indicated for patients with extensive burns, immunosuppression, or wounds requiring filling. If gloves become contaminated during wound care procedures such as debridement or measuring, they should be discarded and clean gloves should be donned prior to bandaging to ensure that the outer bandage is free of contaminants.

Adherent Occlusive Dressings

Adherent occlusive dressings (semi-permeable films, adherent semi-permeable foams, hydrocolloids, and composite dressings) are commonly used on small- or medium-sized uninfected wounds provided that the patient’s skin integrity can tolerate the dressing’s adhesive properties. Because these dressings are conformable and have some elasticity, they will move along with the patient without traumatizing the wound bed, making adherent occlusive dressings ideal for hands, arms, legs, and trunk wounds. As discussed previously, butterfly-shaped adherent occlusive dressings are ideal for uninfected sacral and coccygeal pressure ulcers. After preparing the wound site, the clinician places the occlusive dressing over the wound bed, ensuring there is about a 1- to 2-cm border of intact skin to provide an adequate edge seal. The clinician should ensure there are no wrinkles or creases in the dressing as these may provide a channel for microbes to enter the wound bed. To enhance dressing adhesion, it is recommended that the clinician apply gentle pressure to the dressing perimeter. The warmth of the clinician’s hands molding the dressing to the patient’s skin may also increase the dressing’s adherence. The clinician should remove and discard his or her gloves and provide the patient/caregiver with any necessary posttreatment instructions. Writing on the wound dressing provides an important means of determining how much the wound has drained as well as how well the dressing has stayed in place. This process is particularly important when more than one person is participating in dressing