

wound healing perspectives®

A CLINICAL PATHWAY TO SUCCESS

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➔ WOUND HEALING BASICS

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The best dressed wound

Has much changed in several thousand years in wound care? A cynic might say no—we clean a wound and then cover it with the most appropriate dressing. The choice of the most appropriate dressing is still based on the ‘humors’ of the wound, today’s ‘humors’ being exudate, wound bed color, and pain.

However, we need not be cynics. We have scientific evidence that covering a wound improves speed of healing, quality of the resultant wound and patients’ quality of life. The choice of dressings is based, more and more, on the evolving knowledge of what is happening within the wound bed and uses rationale-developed products to address molecular, cellular, microbiologic and enzymatic changes in the wound bed.

This issue of *Wound Healing Perspectives* provides insight into modern wound dressings and their various categories. Increasingly, wound dressings are used to manage the bioburden existent within the wound bed and special attention is given to the antimicrobial dressings currently available.

With the best evidence currently available, this issue helps you to understand, and choose wound dressings to benefit your patients.

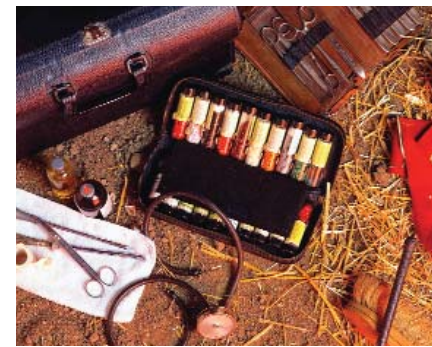
Sincerely,



Robert Kirsner, MD, PhD
Chairman, Medical Advisory Board

The history of wound management

Wound management dates back centuries. According to a 2002 article by Ovington, the earliest written evidence of man’s interest in wound healing can be traced to the Sumerians prior to 2000 B.C. Egyptian writings later revealed a basic “recipe” for an Egyptian wound dressing, consisting of lint, grease, and honey. The Greeks acknowledged that wounds were either “fresh” or “non-healing” in what may be the first recognition of the difference between acute versus chronic wounds. Galen of Pergamum (120-201 AD) recognized empirically that wounds healed best in a continuously moist environment. Nineteen centuries later, Gilje (1948) and Winter (1962) would scientifically prove the healing benefit of a moist environment, sparking an evolution in the types of materials for wound dressings. By the 19th century, the discovery of antiseptics reduced mortality rates from wounds caused by surgery or trauma. In the mid-20th century, Winter, in a landmark study in swine, described an almost 50% increase in the epithelialization rate for partial thickness wounds occluded with polyethylene



film when compared to wounds left exposed to air [Ovington, 2002]. Such studies eventually led to the commercial development of polymeric dressings for wound management during the 1970s and 1980s, which continue to be used today. ■

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Wound assessment and dressing selection

Critical colonization

For years, clinicians have accepted that colonization of most chronic wounds is common, possibly even unavoidable. As a result, attention was focused on avoiding or managing wound infection. More recently, focus has shifted to a bacterial condition known as “critical colonization,” which occurs before invasive infection of the wound tissues occurs. This indistinct condition represents a transition state between surface colonization by bacteria that does not impair the healing process and invasion of those bacteria into viable tissues. A relatively new concept, critical colonization is not yet validated and is still based on clinical observations. ■

SOURCE: OVINGTON, 2003

The goal of treating any wound is to create an environment that is conducive to normal, timely healing [Attinger, Janis, Steinberg, Schwartz, Al-Attar, and Couch, 2006]. According to Baranoski [2005], research over the last 40 years has proven that a moist wound dressing provides the optimal setting for accelerated wound healing with less scarring. According to Fleck [2006], to adopt the best course of action, clinicians should ask themselves six simple questions relating to wound assessment, management, and dressing selection. Is the wound healing? Is the tissue viable or necrotic? Is the wound wet or dry? Is there dead or open space in the wound? Does the wound or surrounding area have edema? What is the condition of the peri-wound skin or the skin surrounding the wound [Fleck, 2006]?

The first step is to develop a detailed wound assessment that includes the wound’s location, size, color, type of wound tissue, amount and type of exudate/drainage, presence of odor, peri-wound skin condition, wound margins, the presence of pain, dressing management, adjunctive therapies, and overall



THE USE OF APPROPRIATE SYSTEMIC ANTIBIOTICS, ADMINISTERED ORALLY OR INTRAVENOUSLY, CAN BE USED WITH CERTAIN TOPICAL THERAPIES TO TREAT THE BACTERIAL INFECTION, CONTAIN EXUDATE, AND IMPROVE THE QUALITIES OF THERAPIES [HESS, KIRSNER, 2003].

patient knowledge of the level of disease process and wound management [Hess and Kirsner, 2003].

After both the patient and the wound have been assessed, a plan of care should focus on preparing the wound bed for healing. According to Fleck [2006], an optimal level of moisture is recommended for the best healing outcome. If the wound is wet, for instance, a product that manages exudate and maintains moisture should be applied. If the wound is dry, a product that maintains optimal moisture or adds moisture should be used.

Hess and Kirsner [2003] cites that managing the amount of wound exudate may speed healing by improving the migration

of key cells, such as keratinocytes, fibroblasts, and endothelial cells, as well as MMPs and other proteases. Which exudate management device to use will depend on the etiology of the wound and may include compression therapy which improves the rate of venous ulcer healing, mechanical devices/products such as negative pressure wound therapy, or the use of absorptive wound products which may absorb excess wound exudate and maintain a moist wound environment.

Assessing the bacterial levels within the wound also is imperative. The clinician must recognize when the bacterial load has increased through

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Wound assessment and dressing selection

(continued from page 2)

changes in granulation tissue appearance and exudate amount. The bacterial load of a wound has reached the critical colonization level when there is foul or excessive odor, absent or abnormal granulation tissue, change in color of the wound bed, delayed healing, friable granulation tissue, severe or increased pain at the wound site, excessive or increased serous exudates, serous exudates with concurrent redness of the surrounding periwound edges, and tunneling or pocketing of the wound [Hess and Kirsner, 2003].

What's more, a critically colonized wound can appear healthy with no sign of nonviable tissue. The granulation tissue may have a characteristic

the only sign of critical colonization of the wound surface may be a plateau in healing progress [Ovington, 2003].

The debridement of healable wounds to remove nonviable, contaminated, or infected tissue is also imperative. As the devitalized tissue is removed from the wound, the release of available growth factor in the wound may begin to occur [Hess and Kirsner, 2003]. When appropriate, a moist wound environment will promote autolytic debridement of the wound. According to Okan, Woo, Ayello, and Sibbald [2007], autolytic debridement is the promotion of liquefaction of wound slough and granulation through dressing-facilitated endogenous enzymes. A

niques (the use of sterilized bottle fly maggots), enzymatic (which harnesses enzymes to break down necrotic tissue without affecting viable tissue), mechanical (which consists of applying a wet-to-dry dressing, using a whirlpool bath, and surgical/sharp debridement [the removal of dead or devitalized tissue with a sharp instrument or laser] [Hess and Kirsner, 2003].

The use of appropriate systemic antibiotics, administered orally or intravenously, can be used with certain topical therapies to treat the bacterial infection, contain exudate, and improve the quality of therapy [Hess and Kirsner, 2003]. ■

ACCORDING TO BARANOSKI [2005], RESEARCH OVER THE LAST 40 YEARS HAS PROVEN THAT A MOIST WOUND DRESSING PROVIDES THE OPTIMAL SETTING FOR ACCELERATED WOUND HEALING WITH LESS SCARRING.

color and texture and may appear bright red in color, foamy in appearance, and may bleed quite easily. Critically colonized wounds also may exhibit new areas of tissue breakdown, bridging of epithelium, sudden odor, and increased exudate production. In many cases, however,

moist wound environment accelerates autolytic debridement of the wound bed because the proteolytic and fibrinolytic enzymes involved in autolytic debridement function solely in an aqueous milieu, states Okan et al [2007]. Other debriding methods include biosurgical tech-

Incompatible products



Although commonly used, the products listed below are unsuitable for use under hyperbaric conditions:

- Enzymatic debriding agents containing prohibited substances (e.g. glycol, mineral oil, alcohol, etc)
- Products containing castor oil
- Cadexomer Iodine products containing glycol
- Hydrogels containing prohibited substances (e.g. glycerin, petrolatum, alcohol, etc.)
- Topical antibiotics containing prohibited substances (e.g. petrolatum, glycol)
- Paste bandages containing prohibited substances (e.g. petrolatum, glycerin)
- Petrolatum impregnated bandages ■

Effects of proper dressing selection

Selecting the proper dressing for a wound is imperative for a wound to heal properly. What's more, consideration should be taken in choosing a wound care product that will address the needs of both the wound and the patient [Miscavige, 2005]. Product choice should be based on the amount of drainage, location of the wound, wound bed condition, wound size, as well as the underlying cause of the wound. Okan et al suggest matching the

dressing absorbency characteristics and wear time to the wound surface moisture to create a moisture-balanced environment that promotes healing.

On the other hand, inappropriate dressing selection can compromise periwound integrity. There could be delayed wound healing, increased risk of infection, and added cost of care to the patient.

There are many positive

benefits to using proper wound dressings. They manage moisture levels by keeping ulcers moist and peri-ulcers dry, they create a protective barrier from environmental contaminants and provide a balance between cost and benefit. Appropriate wound dressing selection also creates the optimal ulcer environment, increasing healing rates, reducing pain, decreasing infection rates, and providing cost-effective care. ■

Activated charcoal and silver

Actisorb Silver 220 Antimicrobial Binding Dressing combines broad-spectrum antimicrobial action, bacterial toxin management, and odor control. It has been proven effective in vitro against more than 150 clinically relevant wound pathogens, including antibiotic-resistant strains such as *Staphylococcus aureus* and Vanomycin-resistant *Enterococcus*. They are very beneficial in the treatment of infected wounds, especially those colonized by Gram-negative bacteria. ■

SOURCE: OVINGTON, 2003 AND JOHNSON & JOHNSON WOUND MANAGEMENT

Foam dressings offer pain relief and wound healing

Approximately 2.5 million people in the United States suffer from ulcerations on the lower extremities. These ulcerations may be caused by venous insufficiency, peripheral arterial disease, connective tissue disorders, diabetes, microthrombotic disease, and vasculitis [Miscavige, 2005].

Since pain is a factor, certain considerations must be taken into account when choosing a dressing for patients suffering from ulcerations, especially those found on the foot or heel. Such dressings should be easy

to apply due to patient's physical limitations from aging and/or disease processes, and provide the patient a high level of comfort.

According to Miscavige, soft silicone border foam dressings often provide patients with ulcerations the added comfort they need while promoting wound healing.

In one case study reported by Miscavige, a Mepilex Border Self-Adherent Soft Silicone Foam Dressing—a water-proof dressing that can stay in place for several days—was used with

much success. According to the case study, the patient reported an immediate decrease in pain once the foam dressing was applied, reporting the pain to be a six out of a scale of ten. The foam dressing also provided the patient with additional padding to her diabetic shoe while not affecting the overall fit.

On her next visit, the patient reported even less pain, stating she now experienced only occasional discomfort rather than continual pain. What's more, her peri-wound skin was intact and wound size was stable. ■

Classes of wound care dressings

A number of wound care dressings are now available depending on the characteristics of the wound and the practical needs of the patient. Below is a list of dressings and their characteristics.

SOURCE: ATTINGER, 2006 AND OKAN ET AL, 2007

TYPE OF DRESSING	CHARACTERISTICS
Calcium alginates	Non-adherent calcium alginate available in fiber or non-woven form. Requires tape or secondary dressing to adhere. Foul odor and appearance of gel may be confused with infection. For use in moderate to heavily exuding wounds. Ideal as a dead space filler.
Hydrofibers	Non-adhesive dressing available in sheets or ropes. Has a high degree of absorption and provides moisture-balance milieu, promoting slow autolysis. Good fiber strength allows for loose packing into wounds.
Hydrogels	Cross-linked polymer gels or sheets. Available with adhesive borders as well as silver ion-impregnated formulations. Generally waterproof. Change daily to every seven days.
Foams	Hydrophilic polyurethane/polymer or gel-coated dressings that are non-adherent. Support autolytic debridement. Minimum to moderate absorption capability. Maintain a moist wound environment. Not to be used over dry eschars. These foams do not prevent periwound maceration in heavily exuding wounds.
Transparent films	Adhesive, semi-permeable, polyurethane membrane dressings that vary in thickness and size. Waterproof and impermeable to bacteria and contaminants. Allow for observation of the wound bed. Should not be used on fragile skin or on wounds with moderate to heavy exudates.
Hydrocolloids	Occlusive or semi-occlusive dressings. Autolytically debrides necrotic tissue. Impermeable to bacteria. Not to be used in heavily exudative wounds. Come in various shapes, sizes, and adhesive properties and forms.
Non-adhesive film	Permeable and transparent, allowing for continuous inspection of wound. Conforms to wound shape. Not self-adhesive so requires tape or secondary dressing to adhere. Direct absorption of antimicrobial agents. Leakage channels may lead to fluid accumulation and subsequent critical colonization.
Activated charcoal	Non-adhesive and absorbent. Absorbs both odor and bacteria. Used with infected, purulent wounds. Protective layer prevents leakage of exudate, keeping charcoal dry and active.

Treating odoriferous wounds



Odoriferous and fungating wounds, caused by neoplasm or infection, present a special challenge in dressing selection. Clinicians should determine whether the odor is related to the dressing interacting with exudates. Odor may be an indication to change the dressing more frequently. If *Pseudomonas* is present, topical anti-infective dressings can help with the smell. In addition, activated charcoals can bind toxins and odor-causing molecules. ■

Anti-infectives

A variety of anti-infective products are available to treat an infected wound, ranging from silver-release products to classic antiseptics such as iodine. Below is a list of these products and their descriptions.

Silver-release products

Silver has been used for centuries to prevent and treat a variety of diseases and infections. The pure silver present in today's silver dressings has been shown to have potent antimicrobial activity as well as pro-healing and anti-inflammatory properties. What's more, sustained release of silver is important in reducing bacterial burden. Silver nitrate must be applied every two hours to be effective, and the cream base in silver sulfadiazine must be applied once to twice daily and reacts with serous exudates to form a pseudoeschar that must be removed before the cream can be re-applied. Current silver dressings can be left in place for up to seven days. A thin moisture layer beneath the silver dressing also maintains a moist healing environment. Hyperosmolar creams, which have a short period of silver activity, can also cause surface desiccation.

Cadexomer iodine

The polymers in cadexomer iodine based

products absorb fluids, removing exudates as well as debris. As they swell, iodine is slowly released killing microorganisms and forming a protective gel over the wound surface. Their sustained release of cadexomer iodine does not cause cytotoxic effects.

Prisma

Promogran Prisma Matrix by Johnson & Johnson Wound Management is a unique combination of collagen, oxidized regenerated cellulose (ORC), and silver and delivers a balanced combination of protection and growth for a variety of wound types and conditions at any exudate level. It removes destructive elements and components in wound fluid, kills clinically relevant bacteria in the dressing to help maintain bacterial balance and reduces bacterial growth. It also promotes healthy tissue growth while delivering silver to the wound.

Antiseptics

Considered both a drying agent and an antimicrobial, antiseptics include iodine, peroxide, hypochlorite, chlorhexidine, boric acid, alcohol, hexachlorophene, Merthiolate, gentian violet, and permanganate. According to Attinger, antiseptics should be avoided in clean wounds since they are unselective in their effect and destroy

both bacteria and local tissue. Their usefulness has only been demonstrated in dirty, open wounds. They may be considered for use in acute ulcers, grossly infected ulcers for a limited time of approximately two days, when bacterial load is a greater concern than healing.

Topical antibiotics

A variety of topical antibiotic ointments and creams can be used in wound care. For example, Mupirocin has good coverage against Staphylococcus, although patients can develop resistance. Over-the-counter antimicrobials such as Bacitracin and Neosporin, are also used frequently. Their use is discouraged in those with long-term wounds since they may contribute to contact dermatitis and could promote Pseudomonas overgrowth. ■

Signs and symptoms of infection



An infected wound will show many classic signs and symptoms including:

- periwound and soft tissue edema
- periwound and soft tissue erythema
- fever
- foul odor
- severe or increasing pain at the wound site
- tenderness at the wound
- excessive odor and/or purulent drainage
- warmth of the surrounding soft tissue
- elevated white blood cell count with an increase in newly developed cells ■

SOURCE: HESS AND KIRSNER [2003]

Enzymatic debridement – Collagenase preparations

According to Falanga (2002), collagenase is a well known and established enzyme preparation used for debridement. Its development as a debriding agent as well as for other applications came to a peak in the early 1970s. Collagenase is a water-soluble proteinase that specifically attacks and breaks down collagen. It has been shown that collagenase can hydrolyze native collagen and thereby facilitate rapid debridement and healing of chronic wounds. The mechanism of action of collagenase is to degrade collagen and convert it to gelatin, upon which less specific enzymes can then act. An interesting observation is that the collagenase preparation may be selective for nonviable collagen. This effect needs to be studied further, but it is thought that viable collagen is

surrounded and protected by mucopolysaccharide sheaths. One hypothesis for how collagenase enters the necrotic tissue and aids in debridement is that collagenase may cleave the collagen molecules at the boundary of the necrotic tissue, thus freeing up the necrotic tissue from the wound. Thus, it has been shown that necrotic tissue is anchored to the wound by strands of undenatured collagen. Until these fibers are severed, debridement cannot take place. This explanation may be applicable to other debriding agents, for it is difficult to understand how these topically applied agents can effectively penetrate thick eschars and other necrotic areas.

Collagenase has been found to be remarkably gentle on viable cells. For example, cell suspensions prepared with

collagenase, then stored at low temperature, were found equal to trypsinized cells in their viability and growth. Similarly, collagenase can be used as a permanent ingredient of culture media without loss of cell viability. In more recent work, the addition of collagenase derived from *Clostridium histolyticum* to keratinocyte cultures enhanced their proliferation and migration up to 10-fold. It has been suggested that some potentially underestimated effects of collagenase, such as angiogenesis and epithelialization, occur at the same time wound debridement is being accomplished by this enzyme. As is the case with the papain-based debriding systems, there is considerable published information detailing the effectiveness of collagenase for wound debridement for all types of wounds. ■

Enzyme products



Enzyme-containing products, previously regarded mainly as debriding agents, have acquired new significance within the context of wound bed preparation. While debridement will certainly remain one of the debriding agents' critical roles, their other properties and our understanding of what is needed for optimizing wound care preparation has the potential to greatly expand therapeutic benefits. ■

SOURCE: FALANGA [2002]

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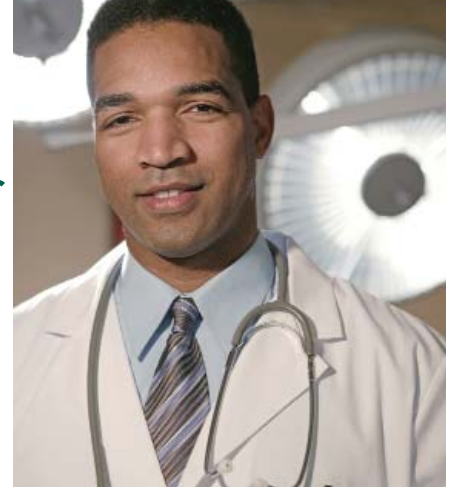
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Working with a Wound Healing Center specializing in chronic wounds

Wound Healing Centers have dedicated, skilled physicians specifically trained in the identification, diagnosis, and treatment of atypical wounds, including those that are hard to heal. Not only are the centers uniquely equipped to administer therapies for these unusual conditions, they also offer follow-up education for primary care physicians and their patients to endure optimal healing without recurrence. The knowledge gained by consis-

tently tracking outcomes is applied to each treatment plan to speed healing and improve the patient's quality of life. When it comes to wound dressings, the Wound Healing Center is able to offer a wide variety of dressings that normally would not be provided at a physician's office. Additionally, the nurses can arrange for dressing supplies to be provided in the home environment or arrange home care as needed.

Dressing selection is made with consideration of patient resources and cost effectiveness of overall care. ■



BENEFITS OF PARTNERING WITH A WOUND HEALING CENTER

- Avoid upfront costs for advanced products (such as dressing supplies and advanced modalities)
- Alleviate storage constraints
- Provide access to clinicians, nurses, and case managers with expertise dealing with extensive wound population
- Ensure follow-up patient education
- Arrange home care as needed
- Stay informed of healing progress with regular reports



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