Continuing Medical Education

Tools to Create the Ideal Environment for Wounds to Heal

Here are some practical ways to improve healing times and patient satisfaction.

Objectives

The objectives of this article are as follows:

- Discuss the fundamental concepts of wound bed preparation.
- Discuss critical roadblocks to wound healing that can be addressed through simple tools.
- Identify several simple-to-use wound care products that can create the ideal wound healing environment.
- Discuss how to use ancillary services and products to maximize wound healing.
- Discuss how to maximize the effectiveness of biological alternative tissues through the use of an inexpensive product readily available in the office.

Welcome to Podiatry Management*'s CME Instructional program. Our journal has been approved as a sponsor of Continuing Medical Education by the Council on Podiatric Medical Education.*

You may enroll: 1) on a per issue basis (at $20.00 per topic) or 2) per year, for the special introductory rate of $139 (you save $61). You may submit the answer sheet, along with the other information requested, via mail, fax, or phone. In the near future, you may be able to submit via the Internet.

If you correctly answer seventy (70%) of the questions correctly, you will receive a certificate attesting to your earned credits. You will also receive a record of any incorrectly answered questions. If you score less than 70%, you can retake the test at no additional cost. A list of states currently honoring CPME approved credits is listed on pg. 186. Other than those entities currently accepting CPME-approved credit, Podiatry Management *cannot guarantee that these CME credits will be acceptable by any state licensing agency, hospital, managed care organization or other entity. PM will, however, use its best efforts to ensure the widest acceptance of this program possible.*

This instructional CME program is designed to supplement, NOT replace, existing CME seminars. *The goal of this program is to advance the knowledge of practicing podiatrists. We will endeavor to publish high quality manuscripts by noted authors and researchers. If you have any questions or comments about this program, you can write or call us at:* ***Podiatry Management, P.O. Box 490, East Islip, NY 11730, (631) 563-1604 or e-mail us at bblock@podiatrym.com.***

*Following this article, an answer sheet and full set of instructions are provided (p. 186).—**Editor***

By Jonathan Moore DPM, MS

Disclosure Statement: *I have no direct financial ties to any wound care companies. I have provided academic lectures on behalf of AmerX in the past, and occasionally am asked to lecture for AmerX, yet I am not in any way tied to them financially.*

Wound care and practice management are not often mentioned together in the same sentence; however, the two go hand in hand quite naturally. Contrary to what some think, practice management is much more than simply improving your bottom line. It is much more about enhancing outcomes through effective patient management while concurrently providing tools and services that enhance patient satisfaction and convenience. Improving the bottom line is a natural by-product of doing this well.

Treating diabetic patients with (or without) wounds can be incredibly satisfying and can present

Continued on page 178

Tools...

unique challenges and opportunities. This is especially true in consideration of the clear link between diabetic foot ulcers and leg amputations because diabetes is the cause of almost 50% of all nontraumatic lower extremity amputations worldwide.[1] These opportunities and tools that are available to us can have an amazing impact on our patients' lives.

Treating a patient with a lower extremity ulcer requires a comprehensive approach that not only includes a knowledge of the wound healing cascade, but more importantly the ability to provide these patients with what they need right away.

Delay in treatment and in providing our patients the right tools can be detrimental. Legal cases across the country demonstrate the vital importance of acting quickly and diligently. One recent case that resulted in settlement for over a million dollars simply constituted not ordering vascular studies in a timely fashion, resulting in limb loss two months after the patient had left the practice and started treatment at a wound care center.

Treating wounds in patients with diabetes has become more complex than simply choosing what dressing to use. Emerging technologies over the past decade have not only helped improve our understanding of how wounds heal, but more importantly why wounds don't heal. Understanding and addressing the physiological alterations of the wound healing cycle in the diabetic patient is fundamental.

Treating wounds in patients with diabetes has become more complex than simply choosing what dressing to use.

As chronic diabetic wounds become stalled in the inflammatory phase of wound repair, chronic wound fluid with elevated levels of matrix metalloproteinases (MMPs) increases proteolytic activity in the wound, which in turn inactivates growth factors. In addition, with decreased collagen synthesis and impaired cellular activity due to hyperglycemia, nitric oxide is available and less endothelial cell proliferation.[2]

Acute Wounds

Acute wounds demonstrate a different cellular mechanism as compared to chronic wounds during wound repair.[3-5] The inflammatory, proliferative (granulation phase), and remodeling phases can be categorized according to the activity of their cellular components, including cytokines, chemical mediators, and cellular components.[6] Intrinsic medical conditions or extrinsic environmental factors rarely affect the repair process in the healthy individual.

Acute wounds demonstrate a different cellular mechanism as compared to chronic wounds during wound repair.

Chronic wounds must be addressed comprehensively in order to achieve success. Intrinsic, extrinsic, and wound environment factors must be simultaneously treated for optimal outcomes. Intrinsic factors include the patient's medical status, prescribed medications, and concomitant disease processes. Extrinsic factors include repetitive trauma, off-loading, and pressure reduction.

As we approach these patients with chronic wounds, the wound bed status (amount of necrotic tissue, type and amount of exudate, fibrotic tissue, per cent granulation, re-epithelialization), and the cellular activity in the wound, must be identified in order to choose the right dressings for treatment. Not only must there be control of the diabetes disease process, comprehensive podiatric care requires us to evaluate carefully the selection of appropriate shoes and devices to reduce or eliminate pressure, pursue aggressive wound debridement as needed, and finally, provide the ideal wound dressing that addresses the needs of that wound at that time. Neglecting or failing to promptly supply these products and services may delay or prevent wound closure.

This is where podiatric physicians and surgeons must be practice managers. By not offering and supplying the right off-loading device, shoes, vascular tests, surgical debridement or wound care product, we are failing our patients and sending potential revenue out the door.

With impaired wound healing physiology, it becomes vital for the wound care specialist to provide the wound what it lacks (e.g., growth factors, BATs, etc.) and decrease what it produces in excess (chronic wound fluid). Consequently, providing the wound with what it needs at the right time is imperative.

Wound Bed Preparation

Over the last several decades, three distinct phases or revolutions in our therapeutic strategies have been identified in our approach toward wound healing. The first revolution began years ago with the realization that moist wound healing principles were applicable to the treatment of chronic wounds. Since then, a variety of dressings capable of providing optimal coverage for wounds in different situations and actually stimulating wound repair have been developed.

The second revolution, still ongoing, began with topically applied growth factors and bio-engineered skin. The third revolution began with the introduction of the concept of wound bed preparation, which allows us to break down into individual components the critical steps involved in optimizing the clinical aspects and the micro-environment of chronic wounds.

Continued on page 179

Tools...

Wound bed preparation can be defined as the global management of the wound to accelerate endogenous healing or to facilitate the effectiveness of other therapeutic measures.

One common error is to view wound bed preparation as the same as wound debridement. In acute wounds, debridement is a good way to remove necrotic tissue and bacteria. After that is done, one should have a clean wound that can heal with relative ease. This is not the case for chronic wounds, where much more than debridement needs to be addressed. Assessment of the type of necrotic material in chronic wounds is important, along with the presence of exudate, which has been shown to inhibit the proliferation and function of key resident cells and to contain proteases that break down extracellular matrix proteins.[7-9]

Chronic Wounds

Chronic wounds can be intensely inflammatory (e.g., venous ulcers), and thus produce substantial amounts of exudate that interfere with healing or with the effectiveness of therapeutic products such as growth factors and bioengineered skin. So, in the context of wound bed preparation, not only do we need to concern ourselves with removal of actual eschars and frankly nonviable tissue, but also with the exudative component.[10] Moreover, there is increasing realization that the resident cells in chronic wounds, e.g., fibroblasts and keratinocytes, may be phenotypically altered and no longer responsive to certain signals, including growth factors.

Phillips et al.[11] described the presence of senescent cells at the margins of chronic venous ulcers. Senescent cells are characterized by cells which are viable, but have lost their proliferative capacity. These senescent cells would not be expected to respond well to the presence of endogenous or exogenous growth factors in the wound. Debridement of senescent cells, nonviable tissue, fibrotic tissue, wound debris, and other unwanted wound components may significantly expedite wound closure while increasing the availability of viable cells able to produce and respond to growth factors and other cytokines. Debridement and its correlation to the significant increase in wound closure, particularly when followed by the application of platelet-derived growth factor (rhPDGF-BB) is supported by a large randomized double-blinded and controlled trial.[12]

The literature has well described the process of preparing the wound bed for application of a BAT. The TIME acronym (T = Tissue management; I = Inflammation and Infection control; M = Moisture balance; E = Epithelial advancement), as proposed by the International Wound Bed Preparation Advisory Board, lays an exceptional framework for the physician to improve the opportunity for wounds to heal (Table 1).[13]

TABLE 1
International Wound Bed Preparation Advisory Board—TIME Principles

T	**Tissue management**
I	**Inflammation and Infection control**
M	**Moisture balance**
E	**Epithelial advancement**

Wound Dressings

Stocking and carrying a variety of wound dressing products has long been the topic of many lectures. As the wound evolves, so should our ability to provide the wound what it needs. There are many good reasons we should be dispensing these products out of our office (a certificate of durable medical equipment is needed to dispense). Here are some considerations:

- Improves continuity of care.
- Allows you to provide the products you like.
- Provides direct patient supply.
- Provides immediate care.
- Creates less patient confusion.
- Improves healing times.

Although there are hundreds of wound care products on the market, a small variety of several categories should be supplied based upon your patient population and your preference. The following are four categories of dressings you could supply to patients:

- Alginate (with or without silver): An excellent tool to use for highly exudative wounds with or without contamination A6196.
- Collagens: Indicated for mild to moderate drainage to promote granulation tissue A6021.
- Foams: Indicated for mild to moderate drainage A6212.
- Hydrogel: Indicated for dry/dessicated ulcerations A6248.

Obviously there are many more very good dressings that are available to dispense out of your office. Whatever you use, identify what the wound needs and choose the dressing most appropriate.

Dressings

Although there is no one right answer, we do know that creating the perfect "microcosm" around the wound will not only actively modify the physiology of the wound environment, but it will also stimulate cellular activity and growth factor release. While no perfect wound dressing exists for every wound, the properties necessary to create the ideal microcosm include the following:

- Promotes a moist wound environment.
- Provides mechanical protection.

Continued on page 180

Tools...

- Allows for removal without pain or trauma (non-adherence).
- Is capable of absorbing excess exudates.
- Allows for gaseous exchange.
- Is non-cytotoxic to healthy tissue.
- Is antimicrobial/antifungal.

Antimicrobial Hydrogel-Impregnated Gauze

In consideration of these properties, one wound care product that meets most of the above criteria is the antimicrobial hydrogel-impregnated gauze. Implied in the name and within the design are the ability to provide an antimicrobial barrier (MRSA), a moist environment, the ability to absorb some exudates, and the ability to provide mechanical non-adherence. In addition, based on two studies by the author, the antimicrobial hydrogel-impregnated gauze product is an ideal covering following the application of biological alternative tissue, demonstrating an average healing time of 17.8 days with a 95% confidence interval of 15.6 days to 20.2 days. (Moore)

The product utilizes a polyethylene glycol base (polyethylene glycol 400 and polyethylene glycol 3350) that has the ability to remain moist without causing maceration. Because the product is still technically a gauze, it will also absorb excess wound fluid into its fibers while keeping the wound moist for up to five to seven days.

Having wound care supplies can be a great tool to provide outstanding care, enhance outcomes, and build your practice.

Although there are other hydrogel-impregnated gauze products on the market, only one possesses antimicrobial and antifungal properties.[14] This dressing effectively reduces the bio-burden through not only its intrinsic antimicrobial/antifungal properties, but also through its absorptive capabilities that trap debris and bacteria in its fibers.

The antimicrobial agent in the product is Oakin®, an oak extract containing tannins. Its mode of antimicrobial action is through its ability to inactivate microbial adhesins, enzymes, and cell envelope transport proteins.[15,16] Tannins are astringent compounds that act locally by precipitating proteins to the wound, decreasing cell membrane permeability, and exerting anti-inflammatory and bactericidal properties.

Recombinant human platelet-derived growth factor-BB (rhPDGF-BB) (becaplermin) is the only growth factor to date approved by the US Food and Drug Administration for the treatment of diabetic foot ulcers.

The use of an antimicrobial hydrogel impregnated gauze over the BAT application site will facilitate a closer adherence of the living or acellular tissue to the wound bed, and will almost have an "anchoring" effect by its adherence to the surrounding tissues, thus also serving to evacuate any hematoma or seroma upon application.

Having wound care supplies can be a great tool to provide outstanding care, enhance outcomes, and build your practice. Here are some guidelines when billing and dispensing wound care products out of your office:

- The patient is not eligible for wound care products dispensed by your office if under the care of a hospice or a home health care plan.
- The wound must be full thickness, Wagner Grade 1 or higher and must be debrided at some point prior to, but not necessarily on, the day of dispensing.
- You must have a separate prescription on file with the name or type of product, frequency of change, duration of need, amount and size of the dressing. A new order is needed if either the quantity or frequency of the dressing is increased, each time a new dressing is started, or after three months, whichever comes first.
- A DME dispensing form with warranty and complaint resolution information, signed by the patient, must be dispensed. The name of the dressing, size, the number given, and frequency of change must be on this form.
- Your progress note must document medical necessity with size, depth, amount and type of drainage, debridement method, and depth of tissue removed, frequency of dressing change. Wound measurements must be documented at least monthly.
- The patient must be given the 21 Supplier standards form and written instructions on the use of product.
- The place of service for billing is always "home."

Enzymatic Debridement Agents

Currently, two enzymatic preparations are rather prominent in terms of their use in chronic wounds: papain-urea based combinations and collagenase. The advantage of the papain-urea combination may be non-specific bulk debridement within a broad pH range (3.0–12.0); however, a prominent inflammatory response is associated with its use in chronic wounds. This inflammatory response, together with breakdown of still viable components of the wound bed, is perhaps the reason for considerable pain in some cases.

Continued on page 181

Tools...

To remedy this situation, chlorophyllin was added to use as an anti-agglutinin to increase thrombus formation and fibrin deposition and plugging of capillaries and lymphatic vessels, thus decreasing pain.

In experimental wounds in animals, the papain-urea combination has been shown to be quite effective for debridement.[17] However, in both experimental and human burns, these preparations may behave too aggressively, both in terms of affecting viable tissue and in causing pain.

Collagenase is another well-known and established enzyme preparation used for debridement. Derived from bacteria (Clostridium histolyticum), Collagenase is a water-soluble proteinase that specifically attacks and breaks down collagen,[18,19] thus facilitating rapid debridement and healing of chronic wounds. The mechanism of action of collagenase is to degrade collagen and convert it to gelatin, upon which fewer specific enzymes can then act; however, until collagenase cleaves collagen, no other enzyme is capable of breaking it down. Collagenase has been found to be remarkably gentle on viable cells. In fact, Collagenase has shown to enhance keratinocyte proliferation and migration up to 10-fold.[20] Other potentially underestimated effects of collagenase include enhanced angiogenesis and epithelialization.

Biological alternative tissues or living skin equivalents that can be applied in the office setting must have both a Q code for product reimbursement and an application code.

Recently, both older and more novel means of wound debridement have been reported. The use of maggot therapy for debridement of necrotic tissue, decreasing bacterial load and stimulation of wound healing regained popularity for use on non-healing wounds. Several recent clinical trials have shown maggot therapy to be effective in the treatment of diabetic foot ulcers and pressure ulcers that were unresponsive to conventional therapy,[21,22]

In addition, the use of low energy ultrasound mist has been advocated for the debridement of diabetic foot ulcers.[23] This method of wound debridement continues to undergo both clinical and scientific research.

Negative Pressure Wound Therapy

The use of negative pressure wound therapy (NPWT) devices may be useful in treatment of non-healing wounds as they may reduce edema, remove bacterial products, and draw the edges of wounds together to promote closure. These products, though not reimbursable through the podiatric office, provide an invaluable tool to help fill in deeper wounds and promote closure.[24]

Any BAT must stay hydrated in order to achieve wound incorporation.

Advanced Wound Care Products

With an improved understanding of the impaired wound-healing integral to the diabetic foot ulcer, the development of products that address these wound bed deficiencies has provided addition tools to improve outcomes.

Recombinant human platelet-derived growth factor-BB (rh-PDGF-BB) (becaplermin) is the only growth factor to date approved by the US Food and Drug Administration for the treatment of diabetic foot ulcers. Levels of PDGF have been shown to be lower in chronic wounds.[25] Administered in a gel formulation along with a thorough regimen of good wound care, becaplermin gel has demonstrated shorter times to complete wound closure and complete wound healing.[26]

Biological alternative tissue (BAT's) or living skin equivalents (LSE) are FDA-approved biological alternative tissues for use in diabetic foot ulcers. While the precise mechanism of action of LSE is not completely understood, it is believed that improved wound healing is because LSEs fill the wound with extracellular matrix proteins and subsequently induce and express growth factors and cytokines that are necessary for wound healing. Additionally, the matrix components may further facilitate the recruitment of cells to the wound, improving wound repair.[27]

Thorough wound bed preparation should be performed to stimulate granulation as minimal to no fibrotic or necrotic tissue should be present. A moist, non-adherent dressing (like the antimicrobial hydrogel-impregnated gauze mentioned above) is then applied and left on for three to five days. At the first dressing change, the presence of the LSE may be evident in the wound bed.[28]

Biological alternative tissues or living skin equivalents that are applied in the office setting must have both a Q code for product reimbursement and an application code. The three products used most in our office are as follows:

- Apligraf® (Organogenesis, Inc., Canton, MA) Q4101, CPT 15320
- Dermagraft® (Advanced Biohealing, La Jolla, CA) Q4106, CPT 15365
- GammaGraft® (Promethean LifeSciences, Inc., Pittsburgh, PA) Q4111, CPT 15320

Of note, GammaGraft® is a human skin allograft with both dermal and epidermal layers. It has a shelf life of greater than two years, along with a price tag significantly less than any BAT on the market.

Continued on page 182

Tools...

GammaGraft™ is the first irradiated human skin allograft storable at room temperature, and is indicated for partial and full thickness wounds, including chronic wounds, burns, and traumatic injuries. When the product is removed from the sterile package, it is folded over on itself, dermis side to dermis side. The tissue is opened gently and the dermis side is applied onto the wound.

When applying GammaGraft® or any other BAT, the concepts shown in Table 2 should be employed to maximize the incorporation of the BAT.[29]

1) B = Bioburden

Despite proper preparation of the wound bed before application of the bioengineered tissue through debridement, among other modalities (Table 2), maintenance of the bioburden after BAT application remains important. Thus, after application of the bio-engineered tissue, use of non-cytotoxic antimicrobials should be considered to prevent colonization.

2) R = Reduction of pressure and shear force

In order for incorporation of the BAT to take place in the chronic wound, excess pressure, motion, and shearing must be eliminated. Unless the bio-engineered tissue maintains excellent adherence to the wound bed with proper pressure redistribution, BAT incorporation will fail.

3) A = Adapting to the moisture needs of the wound and the bioengineered tissue

Any BAT must stay hydrated in order to achieve wound incorporation. Early desiccation of the wound bed and the surrounding tissues will ultimately lead to BAT failure and subsequent slower healing times.

4) I = Incorporation and Identification

Successful incorporation of the BAT hinges upon the molecular environment of the wound. Incorporation of the acellular BAT into the wound bed, through a collagen matrix allowing for the recruitment of cells into the wound, facilitates the induction and expression of growth factors and cytokines necessary for wound healing. Acellular BAT's work by effectively providing a cover for the wound that prohibits desiccation and fluid loss within the wound, thus decreasing the bacterial burden and promoting angiogenesis, allowing vascular ingrowth into the dermal layer of the allograft.

5) N = Non-adherence

It has been said that the choice of the wound dressing at one stage of the wound may well influence subsequent events in the later phases of healing.[30] In reviewing the protocols set forth by most BAT manufacturers, the one common denominator among all of them was the recommendation of a "non-adherent dressing" as the primary dressing to be used over the bio-engineered tissue.

According to recent studies regarding evidence-based protocols for diabetic foot ulcer treatment, advanced wound care products should be considered in cases where traditional care does not succeed in 50% wound reduction after a three-week treatment period.[31]

Tools for Effective Off-loading

Total contact casting has been considered as one of the most effective methods for off-loading diabetic foot ulcers as measured by wound healing rates; however, due to the significant disadvantages associated with the total contact cast, few clinicians use this technique.[32] Most now prefer to use a removable temporary device to remove plantar pressure. Among the most popular are the Bledsoe® Walker (Bledsoe Brace Systems, Grand Prairie, TX L2280, L4386), and the Ossur Active Off Loading Walker (Ossur Medical, Aliso Viejo, CA). Remember that the above off-loading options are not covered by Medicare for the ulceration itself. The products must be dispensed in connection with the underlying musculoskeletal deformity.

Taking into consideration all of the biomechanical factors (shear,

Continued on page 183

TABLE 2
BRAIN Principles to Maximize BAT Incorporation and Wound Healing

B	Bioburden
R	Reduction of pressure and shear force
A	Adapting to the moisture needs of the wound and the bioengineered tissue
I	Incorporation and Identification
N	Nonadherence

Tools...

deformity, pressure, poor balance) associated with the diabetic neuropathic foot, more custom off-loading tools should be considered.

One of the most effective off-loading tools ideal for diabetic patients with plantar (or other anatomical) deformities is the gauntlet ankle foot orthosis with custom foot plate extension.

• One of the advantages of the gauntlet ankle foot orthosis is the ability to accomplish several goals with one device.

• The higher the AFO is above the ankle, the more off-loading can be achieved. In most cases, the height of the AFO can be determined by your prescription, depending on the amount of off-loading needed and the extent of the deformity (Charcot).

• The plantar plate of the AFO (extending to the toes) can be fabricated to accommodate any plantar deformity. The foot plate should be covered with a custom multi-laminar Plastizote orthosis to further off-load the foot.

• The AFO can be posted as needed (intrinsically or extrinsically) depending on the deformity and specific stabilization needs of the patient. Posting can play an important role in achieving plantar pressure relief along with ankle stability.

• Dorsiflexion-assist and other accommodations are available.

One of the most effective off-loading tools ideal for diabetic patients with plantar (or other anatomical) deformities is the gauntlet ankle foot orthosis with custom foot plate extension.

Ancillary Services to Maximize Wound Healing

Without question, the central component of any diabetes center of excellence should be the ability to perform accurate and reproducible vascular studies that should include ankle brachial indexes, pulse volume recordings, and toe brachial indexes. Several guidelines have been published regarding indications for ABI. The American Diabetes Association (ADA) recommends ABI measurement for the following (ADA):

• Any diabetic patient over 50 years old;

• Any diabetic patient less than 50 years old with risk factors such as smoking, hypertension, hyperlipidemia, or a duration of diabetes of more than 10 years;

• Any patients with symptoms of peripheral arterial disease.

ABI testing for PAD in patients with diabetes is enormously productive.

The American Heart Association-American College of Cardiology recommends ABI measurement for:

• All patients with PAD symptoms;

• All patients more than 70 years old;

• All patients more than 50 years old but less than 69 years old who smoke or have diabetes (AHA).[33]

There are many testing devices on the market for the podiatric physician to use in the office. An excellent choice is the Biomedix PADnet for the following reasons:

1) Easy to Administer (CPT Code 93923);

2) Excellent Reporting Capability (Connectivity with Vascular Surgeon Online);

3) Ability to evaluate PVR's, TBI's along with ABI's;

4) Portable;

5) Excellent Support;

6) Compliance/Documentation Assistance;

7) NOT technician dependant/excellent reproducibility.

ABI testing for PAD in patients with diabetes is enormously productive. Routine screening of individuals with diabetes > 50 years of age can be expected to identify PAD in nearly a third. To put that yield rate in perspective, a recent evaluation of sigmoidoscopy by the National Cancer Institute (Prostate, Lung, Colorectal and Ovarian Cancer Screening Trial [PLCO]) (ref) found pre-cancerous and cancerous lesions in 3.1% (292/9317). Furthermore, identifying PAD before it has progressed to its more severe stages in this population allows effective treatment to be offered. Therapies may arrest PAD development and, perhaps, as seen with regression of atherosclerosis in other vascular beds through aggressive blood pressure and lipid control, reverse its advance, while at the same time undoubtedly reducing cardiovascular risk.[34]

In a recent article in the Journal of the American Medical Association (JAMA), the authors relate the following: "ABI is rarely applied in routine clinical practice, as most clinicians are not aware that a low ABI is a marker of cardiovascular risk and would not know how to perform the test. Results showed that a low ABI (0.90 or less) predicted vastly increased risks of 10-year cardiovascular mortality in both men and women."[35]

Clearly, identifying vascular disease can have broad ramifications for patients with diabetes who may be at risk for severe cardiovascular disease.

Conclusion

Podiatric physicians have an incredible opportunity to impact lives through the use of simple tools that are available in our offices. Diabetic patients have unique needs, and we are in position (if we take up the mantle) to provide

Continued on page 184

Tools...

those services. It is up to us to educate and invest in ourselves to assure that we are the best in our communities to offer these services. Through educational programs and workshops offered by the American Academy of Podiatric Practice Management, many opportunities now exist for the podiatric community to learn how to implement these ancillary services and products in a way that maximizes patient outcomes and ensures compliance. ■

References

[1] Schultz GS, Sibbald RG, Falanga V, et al., Wound bed preparation: systematic approach to wound management. Wound Repair Regen:11(Suppl 1):S1–S28., 2003.

[2] Loots MA, Lamme EN, Zeegelaar J, et al., Differences in cellular infiltrate and extracellular matrix of chronic diabetic and venous ulcers versus acute wounds. J Invest Dermatol;111:850–7, 1998.

[3] Kerstein MD. The scientific basis of healing. Adv Wound Care1997; 10: 30–36.

[4] Witte MB, Barbul A, General principles of wound healing. Surg Clin North Am; 77: 509–28, 1997.

[5] Kane DP, Krasner D, Wound healing and wound management. In: Krasner D, Kane D, eds. Chronic Wound Care: A Clinical Source Book for Healthcare Professionals. 2nd edn. Wayne, PA: Health Management Publications, Inc, 1997.

[6] Hunt TK, Hopf H, Hussain Z, Physiology of wound healing. Adv Skin Wound Care; 13 [Suppl]: 6–11, 2000.

[7] Bucalo B, Eaglstein WH, Falanga V, Inhibition of cell proliferation by chronic wound fluid. Wound Rep Regen;1:181–6., 1993.

[8] Trengove NJ, Stacey MC, MacAuley S, et al., Analysis of the acute and chronic wound environments: The role of proteases and their inhibitors. Wound Rep Regen;7:442–52., 1999.

[9] Raffetto JD, Mendez MV, Marien BJ, et al., Changes in cellular motility and cytoskeletal actin in fibroblasts from patients with chronic venous insufficiency and in neonatal fibroblasts in the presence of chronic wound fluid. J Vasc Surg;33:233–41, 2001.

[10] Falanga V, The chronic wound: Failure to heal. In: Falanga V (ed). Cutaneous Wound Healing. London: Martin Dunitz Publishers,:155–64., 2001.

[11] Phillips TJ, Al-Amoudi HO, Leverkus M, Park HY, Effect of chronic wound fluid on fibroblasts. J Wound Care; 7: 527–532, 1998.

[12] Steed DL, Donohoe D, Webster MW, Lindsley L, Effect of extensive debridement and treatment on the healing of diabetic foot ulcers. J Am Coll Surg; 183: 61–64 1996.

[13] Dinh T, Pham H, Veves A, Emerging Treatments in Diabetic Wound Care. Wounds 14(1) 2-10, 2002.

[14] Eisenbud D, Hunter H, Kessler L, et al., Hydrogel Wound Dressings: Where Do We Stand in 2003. Ostomy/Wound Management 49(10) 52-57, 2003.

[15] Akiyama H, Kazuyasu F, Yamasaki O, Oono T, Iwatsuki K, Antibacterial action of several tannins against Staphylococcus aureus, Journal of Antimicrobial Chemotherapy 48, 487-491, 2001.

[16] Cowan, MM, Plant Products as Antimicrobial Agents; Clinical Microbiology Reviews, 12(4) 564-582, 1999.

[17] Hebda PA, Flynn KJ, Dohar JE, Evaluation of efficacy of enzymatic debriding agents for removal of necrotic tissue and promotion of healing in porcine skin wounds. Wounds;10:83–96. 1998.

[18] Herman I, Stimulation of human keratinocyte migration and proliferation in vitro: Insights into the cellular responses to injury and wound healing. Wounds;8:33–41.,1996.

[19] Rao DB, Sane PG, Georgiev EL, Collagenase in the treatment of dermal and decubitus ulcers. J Am Geriatr Soc;XXIII:22–30., 1975.

[20] Field FK, Kerstein MD, Overview of wound healing in a moist environment. Am J Surg.;167(1A):2S–6S. 1994.

[21] Mumcuoglu KY, Ingber A, Gilead L, et al., Maggot therapy for the treatment of intractable wounds. Int J Dermatol.; 38(8):623–627., 1999.

[22] Sherman RA, Wyle F, Vulpe M, Maggot therapy for treating pressure ulcers in spinal cord injury patients. J Spinal Cord Med.;18(2):71–74., 1995.

[23] Ennis WJ, Valdes W, Gainer M, Meneses P., Evaluation of clinical effectiveness of MIST ultrasound therapy for the healing of chronic wounds. Adv Skin Wound Care.;19(8):437–446., 2006.

[24] Steed DL, Attinger C, Colaizzi T, et al., Guidelines for the treatment of diabetic ulcers. Wound Repair Regen.;14(6):680–692., 2006.

[25] Chaby G, Senet P, Vaneau M, et al., Dressings for acute and chronic wounds: a systematic review. Arch Dermatol.;143(10):1297–1304, 2007.

[26] Wieman TJ, Smiell JM, Su Y, Efficacy and safety of a topical gel formulation of recombinant human platelet-derived growth factor-BB (becaplermin) in patients with chronic neuropathic diabetic ulcers. A phase III randomized placebo-controlled double-blind study. Diabetes Care.;21(5):822–827., 1998.

[27] Muhart M, McFalls S, Kirsner RS, et al., Behavior of tissue-engineered skin: a comparison of a living skin equivalent, autograft, and occlusive dressing in human donor sites. Arch Dermatol.;135(8):913–918., 1999.

[28] Muhart M, McFalls S, Kirsner RS, et al., Behavior of tissue-engineered skin: a comparison of a living skin equivalent, autograft, and occlusive dressing in human donor sites. Arch Dermatol.;135(8):913–918., 1999.

[29] Moore J, The BRAIN Principle: Managing Wounds After Application of Bioengineered Alternative Tissues to Maximize Incorporation and Wound Healing, doi: 10.3827/faoj.2008.0105.0003, The Foot & Ankle Journal, 1(5):3, 2008.

[30] Kerstein MD, The scientific basis of healing. Adv Wound Care: 10:30-6, 1997.

[31] Brem H, Sheehan P, Rosenberg HJ, Schneider JS, Boulton AJ, Evidence-based protocol for diabetic foot ulcers. Plast Reconstr Surg.; 117(7 Suppl):193S–209S; discussion 210S–211S., 2006.

[32] Armstrong DG, Nguyen HC, Lavery LA, et al., Offloading the diabetic foot wound: a randomized clinical trial. Diabetes Care.;24(6): 1019–1022, 2001.

[33] Hirsch AT, et al. JAMA.;286:1317-1324., 2001.

[34] National Cancer Institute, Prostate, Lung, Colorectal & Ovarian Cancer Screening Trial (PLCO). Available at: http://www3.cancer.gov/prevention/plco/.

[35] F. G. R. Fowkes et al, Ankle Brachial Index Combined With Framingham Risk Score to Predict Cardiovascular Events and Mortality, A Meta-Analysis, JAMA;300 (2):197-208, 2008.

Dr. Moore is board certified with the American Board of Podiatric Orthopedics and Primary Podiatric Medicine and Fellowship-trained in diabetic foot salvage at the University of Texas Health Science Center. He serves on the Board of Trustees of the American Academy of Podiatric Practice Management and is Editor of *AAPPM News*. Dr. Moore is a lecturer and author on diabetes and practice management topics and is in private practice in Somerset, KY.

EXAMINATION

Continuing Medical Education

See answer sheet on page 187.

1) The following are characteristics of a chronic wound EXCEPT:
- A) stalled inflammatory phase
- B) decreased levels of matrix metalloproteinases
- C) increased proteolytic activity
- D) inactivated growth factors

2) Which of the following is NOT part of the wound bed preparation process as described above?
- A) Tissue management
- B) Moisture management
- C) Infection control
- D) Plantar pressure control

3) Senescent cells are characterized by the following, EXCEPT:
- A) increased proliferative capacity
- B) do not respond well to exogenous growth factors
- C) common in venous wounds
- D) respond well to debridement

4) Which is NOT a characteristic of the ideal wound dressing?
- A) Promotes a moist wound environment
- B) Does not allow for gaseous exchange
- C) Is non-cytotoxic to healthy tissue
- D) Has non-adherence

5) Which of the following product/indication combinations is NOT correct?
- A) Alginate/highly exudative
- B) Collagens/No drainage
- C) Foams/Highly exudative
- D) Hydrogel/dry wounds

6) Which of the following is NOT true about off-loading the diabetic ulceration?
- A) Ankle foot orthoses are an excellent choice for long-term off-loading.
- B) Over-the-counter, off-loading boots are NOT covered by Medicare for diabetic ulcerations.
- C) Ankle foot orthoses offer few options for accommodation to plantar deformity.
- D) Off-loading the diabetic ulceration is vital in order to achieve wound healing.

7) Which of the following is NOT true regarding compliance when dispensing DME?
- A) A prescription for the DME is not needed, as the pickup form in the chart is adequate.
- B) The patient must be given the 21 Supplier standards form, and written instructions on the use of product.
- C) The wound must be full thickness, Wagner Grade 1 or higher, and must be debrided at some point prior to, but not necessarily on, the day of dispensing.
- D) The patient is not eligible for wound care products dispensed by your office if they are under the care of Hospice or a home healthcare plan.

8) The following must be given to the patient upon dispensing DME with the EXCEPTION of:
- A) Warranty information
- B) Complaint resolution form
- C) 21 Medicare DME Standards
- D) ABN

9) Which of the following is NOT true regarding enzymatic debridement agents?
- A) Papain-urea combinations provide a broad pH range.
- B) Papain-urea combinations produce a weak inflammatory response.
- C) Collagenase is derived from bacteria.
- D) Collagenase specifically attacks and breaks down collagen.

10) All of the following statements are true about living skin equivalents or biological alternative tissues EXCEPT they:
- A) fill the wound with extracellular matrix proteins.
- B) induce and express growth factors.
- C) induce and express growth factors.
- D) facilitate the recruitment of proteolytic enzymes for wound repair.

11) The following statements are true about vascular testing:
- A) The American Diabetes Association recommends that only patients with claudication symptoms be tested.
- B) The American Heart Association recommends testing for all patients with claudication symptoms and all those over 50 who smoke.
- C) Ankle brachial index is one of the most sensitive and specific tests as compared to other testing.
- D) A low ABI (0.90 or less) predicts increased risk of 10-year cardiovascular mortality in both men and women.

12) Which of the following is NOT a good reason to dispense wound care products from your office?
- A) They improve continuity of care.
- B) Care begins immediately.
- C) There is no paper work involved.
- D) They allow you to provide the product that you like.

13) Which of the following would NOT be a good choice for off-loading a diabetic ulceration?
- A) Post-op shoe
- B) Bledsoe conformer boot
- C) DH walker or active off-loader
- D) Total contact cast

14) Which of the following has the longest shelf life?
- A) Apligraf®
- B) Dermagraft®
- C) GammaGraft®
- D) GraftJacket®

Continued on page 186

Continuing Medical Education

EXAMINATION

(cont'd)

15) Which of the following is NOT one of the principles to maximize BAT incorporation and wound healing?
- A) Bioburden
- B) Reduction of pressure
- C) Adaptation to the moisture needs of the wound
- D) Shelf-life of the BAT

16) Which of the following would NOT be a valid way of treating a diabetic ulceration?
- A) whirlpool therapy
- B) low energy ultrasound mist
- C) Maggot therapy
- D) Wound VAC

17) Which of the following statements is NOT true regarding Oakin®?
- A) contains tannins
- B) an oak extract
- C) activates microbial adhesins, enzymes, and cell proteins.
- D) exerts anti-inflammatory and bactericidal properties.

18) Which of these general principles is NOT true regarding treatment of the diabetic patient?
- A) Practicing comprehensively is critical
- B) There are many services and products that we can carry that can provide immediate care for patients with diabetes.
- C) Generating revenue should be the number one principle behind your care of the diabetic patient.
- D) Ancillary services in your office provide convenience and improved outcomes.

19) Which is NOT true regarding becaplermin or rhPDGF-BB?
- A) It's the only growth factor approved by the FDA for diabetic foot ulcers.
- B) Levels are low in chronic wounds.
- C) does not require any additional wound care.
- D) comes in a gel formulation that has demonstrated shorter times to wound closure.

20) Which of the following statements is FALSE regarding ABI?
- A) According to a 2008 JAMA article, ABI is frequently used in routine medical practices.
- B) Routine screening of individuals with diabetes > 50 years of age can be expected to identify PAD in nearly a third of individuals.
- C) low ABI is a marker of cardiovascular risk.
- D) a "low" ABI is 0.90 or less.

See answer sheet on page 187.

PM's CPME Program

Welcome to the innovative Continuing Education Program brought to you by *Podiatry Management Magazine*. Our journal has been approved as a sponsor of Continuing Medical Education by the Council on Podiatric Medical Education.

Now it's even easier and more convenient to enroll in PM's CE program!

You can now enroll at any time during the year and submit eligible exams at any time during your enrollment period.

PM enrollees are entitled to submit ten exams published during their consecutive, twelve–month enrollment period. Your enrollment period begins with the month payment is received. For example, if your payment is received on September 1, 2006, your enrollment is valid through August 31, 2007.

If you're not enrolled, you may also submit any exam(s) published in PM magazine within the past twelve months. **CME articles and examination questions from past issues of *Podiatry Management* can be found on the Internet at http://www.podiatrym.com/cme.** Each lesson is approved for 1.5 hours continuing education contact hours. Please read the testing, grading and payment instructions to decide which method of participation is best for you.

Please call (631) 563-1604 if you have any questions. A personal operator will be happy to assist you.

Each of the 10 lessons will count as 1.5 credits; thus a maximum of 15 CME credits may be earned during any 12-month period. You may select any 10 in a 24-month period.

The* Podiatry Management Magazine *CME program is approved by the Council on Podiatric Education in all states where credits in instructional media are accepted. This article is approved for 1.5 Continuing Education Contact Hours (or 0.15 CEU's) for each examination successfully completed.

Home Study CME credits now accepted in Pennsylvania

Enrollment/Testing Information and Answer Sheet

Continuing Medical Education

Note: If you are mailing your answer sheet, you must complete all info. on the front and back of this page and mail with your credit card information to: ***Podiatry Management*, P.O. Box 490, East Islip, NY 11730.**

TESTING, GRADING AND PAYMENT INSTRUCTIONS

(1) Each participant achieving a passing grade of 70% or higher on any examination will receive an official computer form stating the number of CE credits earned. This form should be safeguarded and may be used as documentation of credits earned.

(2) Participants receiving a failing grade on any exam will be notified and permitted to take one re-examination at no extra cost.

(3) All answers should be recorded on the answer form below. For each question, decide which choice is the best answer, and circle the letter representing your choice.

(4) Complete all other information on the front and back of this page.

(5) Choose one out of the 3 options for testgrading: mail-in, fax, or phone. To select the type of service that best suits your needs, please read the following section, "Test Grading Options".

TEST GRADING OPTIONS

Mail-In Grading

To receive your CME certificate, complete all information and mail with your credit card information to:

Podiatry Management
P.O. Box 490, East Islip, NY 11730

There is **no charge** for the mail-in service if you have already enrolled in the annual exam CPME program, and we receive this exam during your current enrollment period. If you are not enrolled, please send $20.00 per exam, or $139 to cover all 10 exams (thus saving $61* over the cost of 10 individual exam fees).

Facsimile Grading

To receive your CPME certificate, complete all information and fax 24 hours a day to 1-631-563-1907. Your CPME certificate will be dated and mailed within 48 hours. This service is available for $2.50 per exam if you are currently enrolled in the annual 10-exam CPME program (and this exam falls within your enrollment period), and can be charged to your Visa, MasterCard, or American Express.

If you are *not* enrolled in the annual 10-exam CPME program, the fee is $20 per exam.

Phone-In Grading

You may also complete your exam by using the toll-free service. Call 1-800-232-4422 from 10 a.m. to 5 p.m. EST, Monday through Friday. Your CPME certificate will be dated the same day you call and mailed within 48 hours. There is a $2.50 charge for this service if you are currently enrolled in the annual 10-exam CPME program (and this exam falls within your enrollment period), and this fee can be charged to your Visa, Mastercard, American Express, or Discover. If you are not currently enrolled, the fee is $20 per exam. When you call, please have ready:

1. Program number (Month and Year)
2. The answers to the test
3. Your social security number
4. Credit card information

In the event you require additional CPME information, please contact PMS, Inc., at **1-631-563-1604**.

ENROLLMENT FORM & ANSWER SHEET

Please print clearly...Certificate will be issued from information below.

Name _____ Soc. Sec. #_____
Please Print: FIRST MI LAST

Address_____

City_____State_____Zip_____

Charge to: _____Visa _____ MasterCard _____ American Express

Card #_____Exp. Date_____

Note: Credit card is the only method of payment. Checks are no longer accepted.

Signature_____Soc. Sec.#_____Daytime Phone_____

State License(s)_____Is this a new address? Yes_____ No_____

Check one: _____ I am currently enrolled. (If faxing or phoning in your answer form please note that $2.50 will be charged to your credit card.)

_____ I am not enrolled. Enclosed is my credit card information. Please charge my credit card $20.00 for each exam submitted. (plus $2.50 for each exam if submitting by fax or phone).

_____ I am not enrolled and I wish to enroll for 10 courses at $139.00 (thus saving me $61 over the cost of 10 individual exam fees). I understand there will be an additional fee of $2.50 for any exam I wish to submit via fax or phone.

Over, please

ENROLLMENT FORM & ANSWER SHEET (cont'd)

EXAM #2/10
Tools to Create the Ideal Environment for Wounds to Heal
(Moore)

Circle:

1.	A	B	C	D	11.	A	B	C	D
2.	A	B	C	D	12.	A	B	C	D
3.	A	B	C	D	13.	A	B	C	D
4.	A	B	C	D	14.	A	B	C	D
5.	A	B	C	D	15.	A	B	C	D
6.	A	B	C	D	16.	A	B	C	D
7.	A	B	C	D	17.	A	B	C	D
8.	A	B	C	D	18.	A	B	C	D
9.	A	B	C	D	19.	A	B	C	D
10.	A	B	C	D	20.	A	B	C	D

LESSON EVALUATION

Please indicate the date you completed this exam

_____

How much time did it take you to complete the lesson?

_____ hours _____minutes

How well did this lesson achieve its educational objectives?

_____Very well _____Well

_____Somewhat _____Not at all

What overall grade would you assign this lesson?

A B C D

Degree_____

Additional comments and suggestions for future exams:

_____

_____

_____

_____

_____

_____