It’s important to understand these five basic methods.

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 $17.50 per topic) or 2) per year, for the special introductory rate of $109 (you save $66). 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. 210. 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@prodigy.net. An answer sheet and full set of instructions are provided on pages 210-212.—Editor

The diabetic foot is constantly at risk of daily breakdown, sometimes preventable and sometimes not. When it breaks down and ulcerates, the foot may develop an acute wound, and acute wounds heal through the normal healing process. The main concern with diabetic foot wounds is that most of the time they behave not as acute wounds, but rather as chronic ones. These types of wounds pose the ultimate challenge for the physician treating the lower extremity. The problem arises because a chronic wound does not follow the usual healing phases. To properly treat this type of wound, the physician needs to correctly debride and off-load the wound. In terms of importance, debriding the wound may be as critical or even more critical in healing the wound, than off-loading[1]. There are five main methods to debride a chronic wound: 1. Debridement with scalpel and tissue forceps, nippers, or scissors, 2. Biosurgical (maggot) therapy, 3. Newer methods, such as ultrasonic surgical debridement, 4. Mechanical Debridement (by removing dry gauze from a wound) and 5. Autolytic debridement (from macerating tissue until it is able to be removed). Again this is dressing-related. These five methods of wound debridement are not stand alone methods but are often used in combination to correctly treat the wound. The purpose of this paper is to provide a practical basis for performing the first three of the above-mentioned methods.

Continued on page 122

bleeding tissue should be removed. All callus, necrotic tissue, and eschar prohibit healing of the wound. If the border between the viable and nonviable tissue is clearly demarcated, then skin should be excised along the border. If the border is not clearly defined, then one should start in the center of the wound and remove concentric circles of the skin until viable tissue is reached. Tissue should be removed circumferentially about the wound until the periphery of the wound exhibits a firm connection between epidermis and dermis. Upon reaching the edge of the wound, normal bleeding should occur. When there are clotted venules at the skin edge, further dissection should be carried out until normal bleeding is encountered. Any non-viable tissue should be removed centrally from the wound, as required, through sharp excision or curetage. Digital pressure may then be applied to the wound to achieve hemostasis. The wound may then be probed to assess the involvement of underlying tissue and for the presence of occult infection. The wound will then be dressed with a standard wound dressing and properly off-loaded. The hallmark of an appropriately off-loaded wound is the noticeable lack of undermining at the wound’s edge at follow up. Off-loading will help to decrease the unwanted tissue at further visits for surgical debridement.

The key disadvantage of aggressive surgical debridement is that it requires a modicum of experience on the part of the clinician and a modicum of healing potential (ie. arterial outflow) on the part of the patient. These two issues are somewhat less important when chronic

---

**Surgical Debridement**

Surgically debriding the wound with the use of the scalpel and tissue forceps or nail nippers may be the most efficient method of treatment to achieve a complete removal of nonhealing tissue. One drawback of this method is that it can cause excessive pain and bleeding (in the sensate or coagulopathic patient, respectively) and needs to be performed carefully. For larger wounds, the tissue may be handled with sterile tissue forceps and scalpel or for smaller wounds with a tissue nipper or scissors. The skin may be incised (Figure 1-Figure 5) or the nipper may be introduced to the fullest extent of the undermining between the epidermis and dermis (Figure 6-Figure 9). When debriding the skin, all nonviable, non-
Debride…

wounds are instead treated with maggot debridement therapy and ultrasonic surgical debridement⁹.

Biosurgical (Maggot) Therapy

Maggot therapy has been used for centuries and was well understood by the military physicians who found that battle wounds infected by maggots had healed quickly without infection⁹. Maggot therapy was first introduced in the United States in the 1930s by Bier and, and became quite popular until the invention of the antibiotic and aggressive surgical debridement⁹. Maggot therapy reintroduced itself in the U.S. in the late 1980s, and the use of medical larvae or maggot debridement therapy has steadily increased in usage in the past 10 years, particularly in many progressive, high-volume wound care centers in Europe and Asia. One factor in this increase is over the past decade inpatient care of wounds has declined, and outpatient wound management has increased⁹. Our center uses this modality frequently in care of patients who are not candidates for aggressive frequent surgical debridement, as described above.

Maggot therapy has been used for many years and is securing a place in wound care. The object is to apply the maggots to the wound and keep them from escaping from the wound, while allowing them to breathe and grow. The maggot therapy application process is consistent throughout the literature.

First, the wound needs to be surgically debrided as much as is appropriate and have any eschar removed. As famished as they may be, the maggots do not eat through the eschar formation as quickly and efficiently as other necrotic tissue.

Second, a cage-like dressing has to be made around the wound. This is performed by preparing the peri-wound area with a skin adhesive. This allows the peri-wound barrier to firmly attach to the skin and not leak.

Third, the peri-wound barrier is constructed. This peri-wound barrier is either made of hydrocolloid dressing or waterproof tape. This dressing can be formed by cutting strips and applying them to the periphery of the wound connecting at the corners.

Fourth, a nylon or Dacron chiffon dressing is constructed to accept and contain the larvae on the tissue. The chiffon can be laid on

Continued on page 124
Debride...

two pieces of moist gauze and set on the Mayo stand close to wound for easy application.

Fifth, the larvae are now applied to the dressing (Figure 10-Figure 12). Depending on the size and depth of the wound, anywhere from 50-1,000 maggots, 24-48 hours old, are applied to the wound[9]. The chiffon/4x4 dressing with maggots is transferred to the wound and adhesive foam tape is used to secure the dressing to the hydrocolloid dressing.

Sixth, an air permeable dressing is applied to the wound, usually done by a gauze layer dressing allowing air into the wound, not causing a necrotic liquification that is harmful to the maggots. The gauze layer absorbs the exudate produced by the maggots.

If the wound is located on a weight-bearing surface then care must be taken to off-load the area so the maggots are not disturbed. It has been suggested that 10 maggots/cm² of necrotic tissue be applied[9]. It is easier to leave smaller maggots on for 2-3 days, but it has been reported that larger maggots changed every 24 hours debride the wound more efficiently and faster[9]. When the dressing is changed, the maggots are flushed from the wound or picked out of the wound using tissue forceps. The larvae are significantly larger, up to four times the size of when they were applied, about 1 cm in length[10]. If the necrotic and fibrotic tissue has been adequately removed from the wound, then a standard wound dressing may be applied. If the wound base is not completely granular, then another application of maggot therapy can be applied. The goal behind maggot therapy is to rid the wound of unwanted tissue and stimulate the formation of granulation tissue. Maggot therapy is an effective method to debride the wound (Figure 13-Figure 17).

Ultrasonic Surgical Debridement

Ultrasonic wound debridement technology has been used for many years in neurosurgery and general surgery in Europe and Asia. In the United States, it has only been used in the treatment of diabetic foot wound. Research suggests that ultrasound is the gentlest option for cleaning injured skin, as well as decreasing the blood loss or pain associated with the treatment[11].

The principles behind ultrasonic debridement are the concepts of thermal, cavitation, and “direct” effects. “Thermal” refers...
Debride...

to the heat generated by the ultrasound bath that can be easily controlled and dissipated in the water to prevent tissue damage. This application is used when the wound is completely immersed in the water bath, but it is not used in foot debridement. “Cavitation” refers to the shearing action of stable microtubes in alternating high and low pressure waves that are generated by the ultrasonic transducers. The “direct” effect refers to any result after the ultrasonication that cannot be described by the first two effects(12).

Ultrasonic debridement for foot wounds is performed as if a surgical instrument were being directly applied to the wound along with constant purging. The extremity is not immersed in an ultrasonic water bath but is put under a stream of pressure delivered from the machine. One of the systems used in ultrasonic debridement is the Sonoca Soring system. The system has the portable ultrasonic unit and the sonotrode (Figure 18). The three different modes on the machine are 1. superficial mode bubbling, that has no tissue contact, 2. superficial mode touching, that has full skin contact, and 3. immersion mode. The superficial mode bubbling is used on soft coatings; the superficial mode touching is used on necrotic tissue; and the immersion mode is used for deep wounds and wound pockets. The sonotrode can be in the form of a spatula, hoof, or ball.

In one study, the treatment was applied three times per week for a duration of thirty seconds per square centimeter of wound at the maximum available output of 25kHz. The sonotrode was set to superficial mode touching and 5 ml of Ringer’s solution was applied per minute for continued purging(13). It is recommended that for smaller wounds the application should be applied from 30-60 secs/cm2, and for bigger wounds the time should be limited. Different wounds have been treated with all three types of the sonotrode, all three modes, and times ranging from seconds to 30 minutes. When applying the treatment the patient should be situated so that the water does not pool but flows off the patient. It has been recommended that when first applying the application, the power should be set at 60% and then moved to 100%(14). The process can be painful and some topical antibiotics may be needed.

Continued on page 126
therapy), and ultrasonic debridement, all three have a part in wound healing. The application of these three methods has been discussed. As stated earlier these methods can and will be used in combination throughout the length of the wound treatment. Surgical debridement has been around for many years and will continue to be used. Maggot therapy is making a strong comeback in wound management. Ultrasonic debridement is newer and is slowly working its way into wound management in the U.S.

Debriding the wound is essential for the wound to heal, and so learning how to effectively debride a wound is critical for the

Summary

The diabetic chronic wound is difficult to treat, but proper treatment is essential. The wound needs to be properly off-loaded and debrided for healing to take place. There are three effective methods for debridement: surgical debridement, biosurgical (maggot therapy), and ultrasonic debridement.
Debride...

podiatric surgeon. Understanding these three methods and their application will contribute greatly to wound management.

References

13. Cshulze, CH, Huls Kamp, T, Schikorski, M, Thies, E: Effective, gentle low-pain wound debridement with low frequency ultrasound applied using mobile equipment. Section for general, accident and visceral surgery phlebology. 1

1) What is a complication of surgical debridement in wound management?
   A) Excessive bleeding and pain
   B) Good granular wound base
   C) Eschar formation
   D) Excessive fibrotic tissue

2) A good time to use maggot therapy in wound management is when
   A) Patients are not good candidates for aggressive surgical debridement
   B) As a last resort
   C) Before using surgical debridement
   D) There is a disvascular wound

3) Application of maggot therapy is first done
   A) Before surgical debridement
   B) By debriding necrotic tissue and eschar formation
   C) By applying Coban above the wound
   D) By making a peri-wound barrier

4) After having applied one round of maggot therapy, when is it appropriate to apply another round of maggot therapy?
   A) When the wound is completely granular
   B) When the wound is bleeding and very painful
   C) When the wound does not have a complete granular base
   D) When the wound edges are macerated

5) Maggots in the wound will help to stimulate which of the following?
   A) Fibrotic tissue
   B) Eschar formation
   C) Ligament tissue
   D) Granulation tissue

6) Which of the following is a mode setting on the ultrasound machine?
   A) Superficial mode bubbling
   B) Superficial mode touching
   C) Immersion mode
   D) All of the above

(Left to right): Joshua Johnson is a second year surgical resident at the Southern Arizona VA Medical Center. Brent Nixon is the Chief of Podiatry in the Department of Surgery at the Southern Arizona VA Medical Center. David Armstrong is the Director of Research in the Department of Surgery at the Southern Arizona VA Medical Center

See instructions and answer sheet on pages 210-212.

Continued on page 128
7) In smaller wounds what is the recommended time to apply the ultrasound therapy?
   A) 30-60secs/cm2
   B) 20-70secs/cm2
   C) 1 minute only
   D) 3 minutes/cm2

8) Which of the following is an effective method of wound debridement?
   A) Surgical debridement
   B) Biosurgical/maggot therapy
   C) Ultrasound therapy
   D) All of the above

9) Why are chronic wounds more difficult to heal than acute wounds?
   A) Chronic wounds don’t follow the normal healing pattern
   B) Acute wounds don’t bleed as much
   C) Chronic wounds bleed more
   D) Acute wounds have more fibrotic tissue present

10) What are the 2 key factors in treating a wound?
    A) Debridement and dressing
    B) Off-loading and dressing
    C) Debridement and off-loading
    D) None of the above

11) Of the debridement methods available, which is the most efficient?
    A) Biosurgical/maggot therapy
    B) Surgical debridement
    C) Ultrasound therapy
    D) Autolytic debridement

12) What is the method of applying maggots to the wound?
    A) Directly applying them to the wound
    B) Applying them after applying the chiffon dressing
    C) Applying them before surgical debridement
    D) Applying them through a hole in the peri-wound barrier

13) What determines the number of maggots used on the wound?
    A) Amount of fibrotic tissue present
    B) How long the wound has been present
    C) Size and depth of the wound
    D) Where the wound is located on the foot

14) What detrimental effect in the wound can cause the maggots to die off?
    A) Necrotic liquification
    B) Fibrotic tissue
    C) Bleeding
    D) Exposed bone

15) When would the setting of superficial mode bubbling be used in ultrasound therapy?
    A) On soft coatings
    B) Necrotic tissue
    C) Deep wounds
    D) Wound pockets

16) When applying ultrasound therapy to the wound, the most pain can be felt in the
    A) Center
    B) Edges
    C) Center and edges
    D) It is not painful

17) If the probe is moved too quickly over the wound, what can be the possible outcome?
    A) Too little exposure to bacteria
    B) Increase in bacteria count
    C) Increase in fibrotic tissue
    D) Not enough heat exposure

18) Why did maggot therapy fall out of favor in the US years ago?
    A) Invention of the antibiotic and aggressive surgical debridement
    B) Ultrasound therapy was introduced
    C) It did not work
    D) It is too expensive

19) When the wound is properly off-loaded what will be noticed at the next visit?
    A) Fibrotic tissue
    B) Increase in wound size
    C) Lack of undermining at the wound’s edge
    D) Hyperkeratotic tissue around the wound edge’s

20) In surgical debridement, if the border of the wound is not clearly defined debridement should begin
    A) In the center
    B) At the wound edges
    C) Where the wound looks the worst
    D) Where the wound looks the best

SEE INSTRUCTIONS AND ANSWER SHEET ON PAGES 210-212