Abstract

Wounds present in several ways. There are 3 phases of wound healing, and the stage of wound healing at presentation may dictate wound treatment. Wounds should be clipped and cleaned thoroughly when they first present. Topical treatments and proper bandaging techniques are crucial in ensuring that wounds heal properly. This article discusses the modified Robert Jones and tie-over bandaging techniques.
Patients present to the veterinary clinic with many types of wounds, such as hit-by-car trauma, bite wounds, surgical site infections, and chronic draining tracts. Wounds can be challenging and frustrating to manage, especially in the face of multidrug-resistant organisms or other disease processes. The physiology of wounds can be complex, but most wounds can be managed in general practices. Wound type and location will determine treatment recommendations and what type of bandage will be needed, if any.

WOUND HEALING
There are 2 basic types of wound healing: first and second intention. First-intention wound healing involves primary closure of the wound, which is usually used when a wound has occurred less than 24 hours prior to presentation and there is no evidence of infection or contamination. Second-intention wound healing leaves the wound open to develop a healthy bed of granulation tissue. These wounds may be closed after some wound management or left to close on their own.

In both types of wound healing, there are thought to be 3 phases: the inflammatory phase, the proliferative phase, and the maturation phase. Multiple phases of wound healing can coexist.

Inflammatory Phase
The inflammatory phase is considered to be the first phase of wound healing and only lasts for 72 hours. The initial injury or trauma causes leakage of intravascular fluid and blood, leading to inflammation (FIGURE 1). Damaged cells release histamine, serotonin, and catecholamines, causing vasoconstriction followed by vasodilation. Platelets and other clotting factors form a platelet plug, and hemostasis is achieved too tight, so it should only be tightened in 1 direction.

Take-Home Points
- Modified Robert Jones (MRJ) bandages should be placed distal to proximal on a patient’s limb.
- When placing bandage layers, make sure that each layer overlaps the previous layer by 50%.
- When placing cast padding, ensure that it is free of wrinkles, which can lead to bandage sores.
- Cast padding cannot be put on too tight, as it will rip; however, conform gauze can be put on too tight, so it should only be tightened in 1 direction.
- MRJ bandages are better for wounds on the limbs, while tie-over bandages can be placed in most locations.

FIGURE 1. A wound in the inflammatory phase 24 hours after injury. Inflammation associated with this phase is evident from the redness and swelling.
with a fibrin clot. Neutrophils, followed by monocytes that transform into macrophages, enter the wound bed. Macrophages are responsible for phagocytosis of foreign material and bacteria. If the wound is not addressed in the inflammatory phase, or if it is contaminated, wound healing may be delayed.¹

Proliferative Phase
The second phase of wound healing is known as the repair or proliferative phase. This phase is marked by the presence of a granulation bed as well as epithelization of tissue and wound contracture. A granulation bed is characterized by a pink, fleshy appearance due to new capillary formation (FIGURE 2).¹ Oxygen and moisture in the granulation bed allow epithelial cells on the skin edge to cross the wound to create a new epidermis, which allows the skin edges to begin to contract and come together.¹,²

Maturation Phase
The final phase of wound healing is the maturation phase (FIGURE 3). Fibroblasts eventually become myofibroblasts that contract to encourage skin edges toward the middle of the wound.² Collagen is also present during the maturation phase and cross-links to strengthen the wound. Granulation tissue is much weaker than normal tissue during the healing process, and scar tissue has only 80% of the strength of normal tissue once fully healed.¹

WOUND CLEANING
Wounds should be clipped wide to check for additional wounds or allow the placement of stay sutures for a tie-over bandage. The periwound area should be cleaned with chlorhexidine gluconate 4% diluted with 25 to 50 mL of saline. Chlorhexidine can be cytotoxic to tissue; therefore, surgical lubricant can be placed into the wound in a sterile fashion to protect it from the chlorhexidine.

When appropriate, the wound should be lavaged with sterile saline using a high-pressure lavage system. Larger volumes of lavage should be used in contaminated wounds. Aerobic and anaerobic culture specimens of

FIGURE 2. Wound with a healthy bed of granulation tissue.

FIGURE 3. Wound in the maturation phase.
the wound should be taken to determine the appropriate antimicrobial therapy, but they should be taken after lavage has been performed. Debridement can be performed with Metzenbaum scissors or a surgical blade when indicated.

WOUND BANDAGING
Wounds can be covered with either a modified Robert Jones (MRJ) bandage (BOX 1) or a tie-over bandage (BOX 2). Tie-over bandages can be placed anywhere on the body (e.g., head, abdomen, hip), while MRJ bandages tend to be better for wounds on the limbs. FIGURE 4 shows a typical wound bandaging setup.

Modified Robert Jones Bandage
There are 3 layers to an MRJ bandage: primary, secondary, and tertiary. See VIDEO 1 for a step-by-step demonstration of applying an MRJ bandage.

Primary Layer
The first layer of the bandage is the primary or contact
layer. This layer should be placed steriley. For wounds in the initial phases of healing, wet-to-dry bandages can be used. Wet-to-dry bandages provide nonspecific mechanical debridement when they are removed; therefore, they should be avoided in wounds that have a healthy granulation bed. Wet-to-dry bandages consist of saline-soaked gauze, which is placed into a wound and then removed once it has dried. However, the current standard is moist wound healing. Moist wound healing allows excessive exudate to be removed with appropriate topical therapy and provides moisture to the wound. Regardless of bandage type used, the wound should not be excessively wet or dry.

For moist wound healing, a few options for topical therapies exist. Honey, triple antibiotic, and alginate can be used topically to provide antimicrobial protection. Honey, a hyperosmolar substance, draws fluid out of the wound bed and can be used in conjunction with a primary layer such as nonadherent gauze (e.g., Telfa) or abdominal pad. Alginate is a primary layer and comes in ropes or sheets. When calcium alginate is used, a topical therapy should be applied to the wound first. Silver alginate is a topical therapy that may be preferred to calcium alginate because silver provides antimicrobial protection.

**FIGURE 5.** Secondary layer of a modified Robert Jones bandage. (A) Cast padding properly applied, with 50% overlap of the previous layer. (B) Conform gauze being applied with appropriate tension and 50% overlap.
avoiding the need for a separate topical therapy. Algimates should be used for exudative wounds, as they turn to gel when they encounter exudate. This allows them to stay in a wound bed for multiple days, thereby decreasing the frequency of bandage changes.\(^3\)

### Secondary Layer

The secondary layer of an MRJ bandage consists of cast padding and conform gauze, which can absorb any exudate that escapes the primary layer. Cast padding should begin at the distal portion of the limb and work proximally. Cast padding cannot be put on too tight as it will rip, but it should be placed without wrinkles to avoid creating bandage sores. Each layer should overlap 50% with the previous layer (FIGURE 5A).\(^3\)

Kling or conform gauze is then applied over the cast padding. It can be applied too tightly; therefore, it is imperative to only tighten in 1 direction. Conform gauze can be used to gently apply some tension (FIGURE 5B).

### Tertiary Layer

The tertiary layer of an MRJ bandage is self-adherent bandaging tape (e.g., Vetrap, 3M), which provides compression and contains the bandage. Tape can also be placed too tightly; therefore, it is crucial to ensure that appropriate tension is applied.\(^3\) Depending on the location of the wound, it is important to leave toes exposed so that owners can monitor for bandage slippage or swelling of the toes. Elastic tape (e.g., Elasticon, Johnson & Johnson) can be placed to prevent scuffing of the bandage, but it is optional and should not be placed directly on the skin to avoid
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causing irritation (FIGURE 6). Bandages should be changed if strikethrough is noted or if they slip after placement.

Tie-Over Bandages
Tie-over bandages use the same principles as MRJ bandages with a topical therapy and contact layer. The secondary layer is usually gauze or lap sponges; lap sponges are usually covered with their wrapping to create an impervious barrier. Both the topical therapy and the lap sponges should be applied to the wound bed in a sterile fashion. Umbilical tape is placed through stay sutures to secure the bandage to the patient.

Stay sutures are placed surrounding the wound, but they should not be placed too close to the wound, as the tissue near the wound edges is weaker and may eventually necrose (FIGURE 7). A distance of 2 to 3 cm is appropriate. Once the lap sponges are covered, umbilical tape is placed through the stay sutures in a crisscross fashion to keep the tie-over bandage secure (FIGURE 8). See VIDEO 2 for a step-by-step demonstration of applying a tie-over bandage.

SUMMARY
While wounds can pose many challenges, they can be managed by team members in general practices. Appropriate bandage care and topical therapies can assist with and improve wound healing. Wounds can be managed many ways; therefore, it is crucial to determine the course of treatment based on the wound’s location and phase of healing. Although wounds can be frustrating, they can also be quite rewarding to watch progress from presentation to fully healed. TVN

References

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