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COLUMN:
TEACING AND LEARNING

Teaching Wound Care Management: A Model for the Budget Conscious Educator

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INTRODUCTION

For me, the concept of wound care has always been a challenging topic to demonstrate. How do you teach the concept without having a student in need of wound care or without having to spend money to buy another simulation manikin/model? I have recently created a simulation to demonstrate and practice the cleaning, closing, and dressing(Table 1) of external wounds in a very cost effective manner using equipment we already owned in our human performance laboratory. The purpose of this column is to provide athletic training educators (ATEs) with an innovative and cost efficient means to educate athletic training students as to how to clean, close, and dress external wounds.

MATERIALS

The materials needed for this lesson include:
1) muscular limb model (Fig. 1)
2) resistance band
3) 1" white adhesive tape
4) 35-mL syringe with a 19-gauge needle hub, plastic cannula, or angiocatheter to deliver a nontoxic cleaning solution (drinkable water or sterile 0.9% saline)
5) 3 x 3 or 4 x 4 gauze pads (sterile or non-sterile)
6) compound benzoin tincture (CBT)
7) skin tape/adhesive strips/skin closures (size is your choice)
8) forceps
9) adhesive dressing
10) nitrile gloves (or similar)

MODEL PREPARATION

One challenge of teaching the concepts of cleaning, closing, and dressing external wounds (ie, incisions, lacerations) is that most Institutional Review Boards are going to prohibit an ATE from inducing these types of wounds in the classroom on live students; thus some form of simulation model is required.

Begin creating your model by cutting a strip of blue elastic resistance band slightly smaller than the distance from the radiocarpal joint to the proximal humerus or acromioclavicular joint (ACJ). Adjust accordingly if using a lower extremity or another model. The blue resistance band worked well in my situation. I would not recommend the use of red or green elastic bands as they probably do not provide enough elastic resistance. The band needs to be shorter than the length between the two attachment points to provide some elastic tension; but not so short that the band either tears when incised or pulls away from the securing anchors. Using 1" white athletic tape, secure the resistance band at the radiocarpal joint and proximal humerus and/or ACJ and along the borders of the elastic band (Fig. 2).

When securing the band, be sure the band is taut horizontally and vertically, but again not so taut that the elastic band pulls away from the anchor points or leaves gapping holes when an incision in made. Using a scalpel,carefully make several incisions of varying length and directions in the elastic band. Be careful not to cut too deeply to avoid damaging the muscle model. Practice applying a set of skin closures before going to class to determine if the band has the correct amount of tension. If you find you have puckering of the band, it is probably too taut and needs to be loosened. The model is now ready to be used to teach the concepts of cleaning, closing, and dressing external wounds.

WOUND CLEANING, CLOSING AND DRESSING

Wound Cleansing

Begin cleansing the incised wound by placing the wound care model on a table and prepare the area with towels to catch excess irrigation drainage. To enhance the demonstration consider using moulage (ketchup) and small pebbles to simulate blood and debris in the wound (Fig. 3). Before beginning the procedure instruct students to assess the patient's condition and extent of the wound. Identify and document the wound's characteristics (ie, size, amount of

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Figure 1. Muscular arm model.

debris, drainage) and any allergies, specifically to cleaning and topical solutions (eg, CBT) or medications that may be used during patient care. This should be followed with a discussion related to the use of aseptic techniques to prevent contamination of the wound (by organisms) that can potentially cause infections. This means educating students on procedures such as hand hygiene before and after the patient care, the use of protective equipment (eg, gloves, eyewear), use of sterile equipment (when appropriate and available), maintaining a clean work area, and preventing cross contamination.

Wound cleansing can be defined as the "delivery of a solution or fluid to the wound surface by a mechanical force to remove foreign bodies/debris, excess exudate, and dressing residue as well as to reduce bacterial counts and rehydrate the wound."[1(p.286)] Wound irrigation using the piston syringe technique is a commonly used to cleanse external wounds. Begin by filling a 35-mL syringe with saline (sterile 0.9%)[1] or drinkable tap water. Drinkable tap water has been found to be strongly effective in reducing wound infections as compared with saline solutions.[2-4] Avoid the use of cleaning solutions such as povidone–iodine, acetic acid, hydrogen peroxide, and sodium hypochlorite (Dakin's solution) as these solutions are cytotoxic to human fibroblasts and macrophages and are not recommend for cleansing the wound.[5]

Hold the filled syringe just above the top edge of the wound bed at a distance of approximately 4 to 6 in. and gently depress the plunger, slowly and continuously until the syringe is empty.[1,6] The recommended irrigation pressure is between 4-15 pounds per square inch (psi); 8 psi is optimal.[6] Pressure greater than 15 psi can result in further wound damage and drive bacteria into the tissue.[7] An irrigation pressure below 4

Figure 2. Muscular arm model with covered with elastic resistance band.

Figure 3. Simulated wound debris.

psi is ineffective and only serves to moisten the wound and the surrounding area.[7] A syringe with an attached 19-gauge needle typically delivers an output pressure range of 11-31 psi; however, the end pressure reaching the wound can be as low as 8 psi.[6]

While depressing the syringe's plunger, move the syringe back and forth over the wound. When necessary concentrate the irrigation over large areas of debris, but do not force solution into the wound's pockets.[6] Be sure the solution flows from the clean to dirty area of the wound.[6] Remember, use enough force to flush out debris, but do not over-squirt or splash fluid. Place a cupped, glovedhand above the wound bed to lessen splash back from the irrigation stream when necessary. Repeat the procedure until all of the debris is removed from the wound. Cleanse the periwound tissues by irrigating or swabbing the area with sterile gauze;[1] this is a great opportunity to educate the students on the proper procedure for opening a sterile package. Gently pat dry the wound's edges, being careful to avoid touching the wound bedwith the contaminated gauze. Dispose of and clean supplies and equipment following Occupational Safety and Health Administration (OSHA) standards.

Wound Closure and Dressing

Once the wound bed has been thoroughly cleaned and the periwound tissue has dried; it is time to close the wound. Skin tape/adhesive strips/skin closures are commonly used with superficial, linear lacerations and incisions in areas of minimal static and dynamic tension, such as around the face and scalp.[1] The elastic resistance band used on the wound care model does a decent job simulating normal tissue and allows for linear incisions in a horizontal, vertical or diagonal direction. The CBT (a benzoin based resin in alcohol) normally used to increase adhesion of skin closures to the skinalso works well on the elastic resistance bands. Finally, the skin closures themselves adhere well to the elastic resistance band, in fact, four weeks after the lesson, the skin closures I used are still attached to the elastic band. Table 2 provides detailed directions for the application guidelines for skin closures using the wound care model.

Once the wound has been carefully closed the ATE can now instruct the students on appropriate wound dressing procedures using the medical director's and/or athletic training facility's standard of care procedures for wound management.

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Table 1. Acute Care of Injuries and Illnesses Competencies Focusing on Immediate Emergent Management - Wound Care.[8]

Number	Competency
AC-1	Explain aseptic or sterile techniques, approved sanitation methods, and universal precautions used in the cleaning, closure, and dressing of wounds.
AC-2	Select and use appropriate procedures for the cleaning, closure, and dressing of wounds, identifying when referral is necessary.

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EDUCATIONAL CONSIDERATIONS

Equipment

The wound care model discussed in this column was honestly the result of both panic and poor planning on my part—but it worked well and students thoroughly enjoyed the lesson. In fact, the remaining 4 sections of the athletic injury management class where wound care management skills are addressed (taught by 3 other instructors) utilized the same model and had similar positive experience for their students as well.

If money is no object, an internet search of simulation manikins/models will yield several companies (Table 3) who offer several different products to teach wound care. When performing an Internet search I would recommend using the search term "suture model" or something to this effect. This seems to work better than "wound care model." The term "wound care" appears to locate models that deal more with decubitus ulcers, rather than incisions and lacerations. Wound care/suture models can range in price from $160 to $1,700, depending on the model and model features. What I did note in my research is the suture practice arms/legs all seem to be produced by the same manufacture- just sold by different vendors under different names. They all appear to be made of soft vinyl skin over a core of stitchable foam. The skin texture is reported to be morerealistic, supposedly offering wrinkles, pores, and visible fingerprints as compared to the elastic resistance band used in my wound care model, which is smooth and flat. If an incision does wear out, more incisions can be made into the material.

The model I used cost approximately $1.00 to construct- but remember, I had a 3-D muscular arm available in the lab. The cost of this model can run upwards of $800.00. However, keep in the mind, the model can be used in variety of other athletic training courses that study the muscular system. Thus, this becomes a multi-purpose investment. One other advantage of my model is that I could get it wet and use the CBT and not worry extensively about water damage or staining. Once the elastic resistance band has been stained extensively or damaged, it can be changed relativity inexpensively. The model itself (as of this writing) has done well getting wet from the irrigation. However, the long-term consequences of getting the model wet are unknown.

Teaching the Skill

A tremendous benefit to utilizing this model was the cost and ease at which the students acquired the concepts. After reviewing the cognitive aspect of the lesson I have found that pairing the students together offers the opportunity for peer learning and corrective feedback as they perform the psychomotor skill. I have also found that given the length of the limb I can typically get two groups of two students working at a time on the model from different directions.This helps to eliminate the lag time between student participation.

Having a check sheet of critical skill steps with images can be extremely helpful. This way, the peer observing the skill can offer corrective feedback regarding any missed or inappropriate steps. Another suggestion is to integrate the skill just acquired into different scenarios, thereby allowing students to demonstrate decision-making and skill integration abilities.[8] Students may be able to competently perform the individual skills of wound cleaning, closing, and dressing in a controlled lab setting, but will they perform the steps correctly under less desirable circumstances when the patient presents with other medical concerns (eg, shock) not immediately identified during a secondary and/or ongoing assessment? What happens if the patient is allergic to the CBT or the forceps cannot be found in the athletic training kit/room? What if a complication arises while providing care? These are all real life events that will and do occur, which is why gaining practical experience with real life applications readies students to become competent professionals.

CONCLUSION

The concepts of wound cleaning, closing, and dressing are not difficult skills- rather they are skills that require yet more equipment, equipment that may only be used once or twice a year. This column offers the ATE with an alternative means of teaching two more educational competencies with minimal additional resources. This is by no means the best or only solution to teaching the two competencies in question, but it was convenient, feasible, and more importantly the students enjoyed the experience. By using one's creativity and the resources already available in an ATE's lab or athletic training facilities you would be amazed at the money that can be saved, while still accomplishing the program's and student's educational goals.

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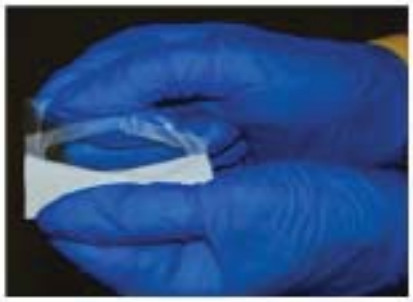
Table 2. Skin Closure Instructions.[1,9]

1. Ensure the skin is clean and dry at least two inches around wound.

2. Apply a thin layer of CBT on skin up to wound's edge. Be sure to avoid contacting wound with CBT as it may impair wound healing.

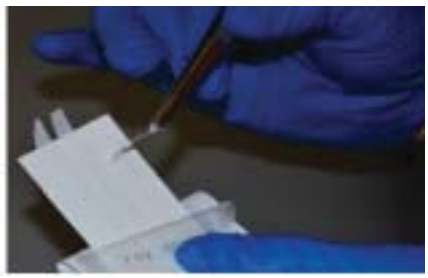
3. Open the package, peeling back package tabs to access the sterile skin closure.



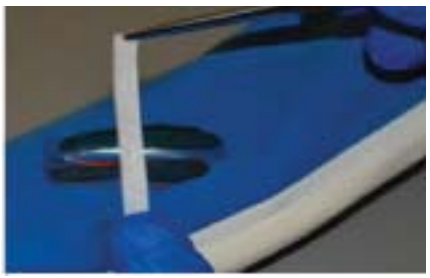
4. Remove card, using sterile precautions as necessary.

5. Bend the card at end perforation and gently remove the tab.

6. Grasp end of skin closure with forceps or gloved hand and lift straight upward (90°angle) to avoid the strips curling and complicating the process.



7. Place the first skin closure in the middle of the wound and anchor the closure below the wound on the periwound tissue.



8. Approximate the wound edges and pull the strip(s) with minimal tension across the wound. Do not stretch or "strap" the skin closure.

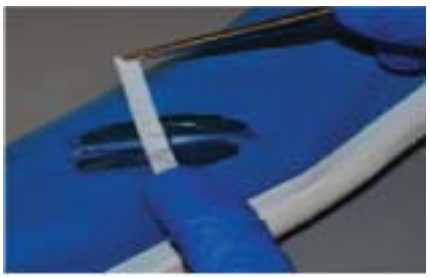


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Table 2 continued

9. Anchor the skin closure on the periwound tissues above the wound pressing down firmly.

10. Continue applying skin closures across the wound as described, approximately 3 mm apart, until approximation of the wound tissue is achieved.

11. Additional skin closures can be applied parallel to wound, approximately ½" in from ends to create a set of "railroad tracks." Railroad tracks can help reduce stress beneath the ends the ends of the skin closures limiting premature lifting of the closures.

12. Place a nonadherent sterile dressing over the skin closure.

13. Monitor daily for signs of infection and dehiscence.

14. Leave the strips in place for a minimum of 5 to 7 days or until the strips have separated from the skin.

Table 3. Wound/Suture Care Simulation Manikins/Models

Company	Web Address	Equipment	Retail Price
3B Scientific	http://www.a3bs.com/	Suture Practice Arm	$165.00
		Suture Practice Leg	$220.00
		Skin Suture Trainer	$190.00
Bound Tree Medical	https://www.boundtree.com/	Life/form® Suture Practice Arm	$164.95
eNasco	http://www.enasco.com	Life/form® Suture Practice Arm	$164.95
		Life/form® Suture Practice Leg	$220.00
		Life/form® Pediatric Suture Head Kit	$250.00
		Life/form® Suture and Stapling Practice Trainer Set	$365.00
Laerdal	http://www.laerdal.com/us/	Wound Care Assessment Set; Male	$1,653.00
		Wound Care Assessment Set; Female	$1,653.00

Note: Speak with a company representative to inquiry about educational pricing.

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