Sim*Skin*Advanced

Training Guide

Suggested Exercises and Homework Assignments

Advanced surgical techniques including advancement flaps, Z-plasty, rhomboid flap, dog-ear repair, and complex wound closure

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Sim*Skin*Advanced

Suggested Exercises

Welcome to the Sim*Skin*Advanced training module! Sim*Vivo is excited to present this new suture training board which has many advantages over other skin models. The skin's unique flexibility not only allows for the practice of simple wound closure but also facilitates an understanding of complex wound management techniques. In addition, the needles and sutures don't pull through when tension is applied. This characteristic allows for the application of tension to the skin and opens a new dimension of surgical skill practice. With this learning system, you can learn and practice procedures that require the creation of flaps and local tissue transfer.

The exercises presented in this guidebook and mapped onto the skin board represent more advanced techniques for complex wound closure that might be required in the emergency department or operating room. Hopefully, this experience will "bring to life" the two-dimensional diagrams and pictures of these techniques for which you might have difficulty with spatial orientation (i.e., which flap goes into which slot). We have chosen several commonly used methods for tissue coverage that will add to your wound closure toolbox.

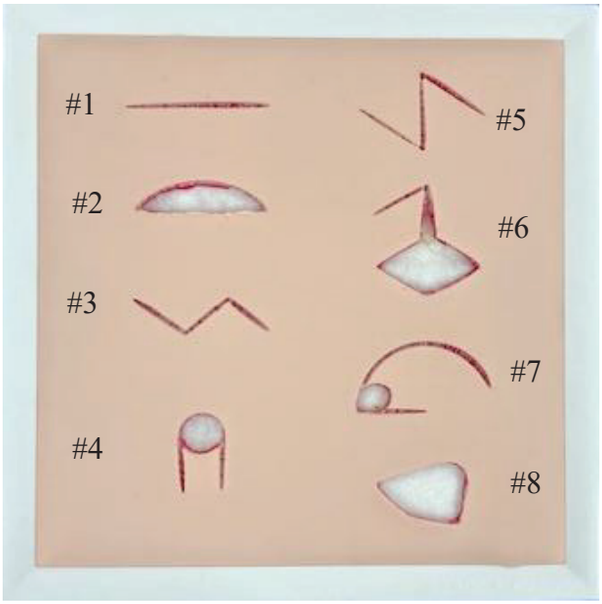
We will assume the dermis does not have to be separated from underlying tissues for these exercises since the model already provides for this. As such, wound closure techniques will focus on skin manipulation without including subcutaneous sutures. To facilitate practice, we suggest that all closures utilize a 4-0 nylon suture with a 19 mm 3/8 circle reverse cutting needle. However, in an actual clinical situation, 5-0 nylon sutures might also be considered. The provided suture is long (75 cm), so new packages do not have to be opened repeatedly. While nylon sutures usually require six locking throws to secure the knot, for more rapid training, two throws will be sufficient for these exercises. The provided equipment for this module includes a Hegar needle holder, a pair of Adson forceps, a scalpel, and Iris scissors. These instruments should be sufficient to practice all the proposed exercises.

This learning system will demonstrate several wound closure techniques that may be useful after large excisions or scar release. However, these examples do not represent an exhaustive list of available procedures. You might also consider sequentially using the same simulated wound to practice additional, more complicated potential closures to get more use out of the board. For instance, you might start with simple straight wound closure, remove the sutures, and then create a wound that will allow you to practice correcting "dog ears." Take out the sutures, and you might make a few more cuts to develop a Z-plasty or an advancement flap. The possibilities are nearly endless, and because the needle holes seem to heal themselves, you should be able to get plenty of uses from a single Sim*Skin*Advanced board. As with all Sim*Vivo learning systems, please pay particular attention to the disposal of needles and sharps, which should be placed in a

secure container after use. This portable module allows home use, so please keep the sharps away from children.

One last caveat: some non-toxic oils have been integrated into the simulated skin to create more realism. Some transfer and staining might occur if the board is left in contact with other absorbent materials (paper, cardboard, cloth, etc.). The original bag is reclosable and designed to keep the skin fresh. After use, the board should be returned to the bag until you are ready to practice again.

Since the skin's flexibility in this module is a critical element of its high fidelity, cutting it with a scalpel may be difficult unless substantial lateral tension is applied to the incised area. To alleviate any problems, "guidelines" have been made to facilitate the performance of procedures. In most cases, these do not entirely traverse the skin. To provide a full-thickness incision as directed in these exercises, a scalpel or Iris scissors can be used to cut the remaining layers before suturing or tissue transfer. A defect with a yellow base represents an open wound or excision site that needs to be covered. The following figure shows the guidelines for the exercises, and each is numbered as a reference to the presented procedure.



Training videos

For this learning system, instructional videos are available to demonstrate the techniques to be practiced. These short segments include animations of the procedure and a demonstration on the Sim*Skin*Advanced board. The individual chapters include:

1. Introduction and simple suture
2. Closing wounds with disparate length edges and repair of dog ears

3. Suturing an angled wound
4. Simple advancement flaps
5. Z-plasty
6. Rhomboid flap
7. Rotational advancement flap

Access to these instructional videos is available on the Sim*Vivo website (www.sim-vivo.com) using the "Instructional Video" icon. The QR code below will help you access the videos on your portable devices, and the corresponding video will be indicated for each exercise below.

Simple wound closure (#1) *Video#1 – Introduction and simple wound closure*

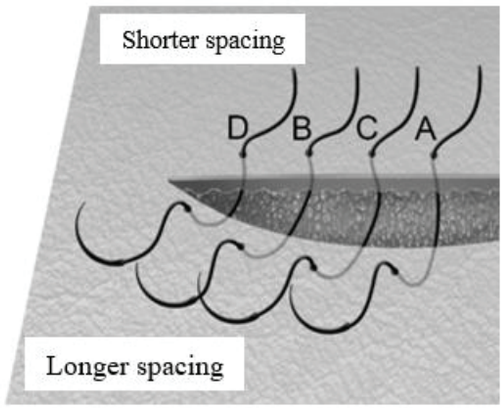
Let's get started! Even though you probably have a good grasp of suturing techniques, we should begin with something simple so that you can "get a feel for" Sim*Skin. A three-inch partial thickness, straight incision has been placed in the left upper corner of your Sim*Skin board. As noted, this can be converted to full thickness with the scalpel or Iris scissors. If you decide to incise the skin in another area, you will have to stretch the skin at the site of scalpel contact to facilitate cutting without skiving the edges. This can be facilitated by placing your thumb and index finger on either side of the proposed incision site and firmly retracting each laterally.

For this exercise, proceed with closure using simple interrupted sutures. Retract your knots away from the simulated wound to provide easier removal, which is done by grasping the knot with the Adson forceps and cutting the suture. Sim*Skin is also ideal for practicing the placement and removal of skin staples. Usually, two Adson forceps are required to elevate and approximate the skin edges for presentation to the skin stapler. Removal is completed with a standard staple removal device.

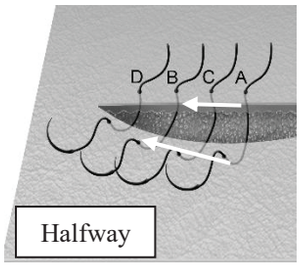
Curved wounds and dog ears (#2) *Video #2 – Curved wounds, repair dog-ears*

Closing wounds with edges of different lengths can pose a problem. An example of this is the #2 exercise on the board. The simulated yellow subcutaneous tissue indicates that there has been some tissue loss in this wound, leaving the straight edge of the wound shorter than the arc on the other side. Compensation for the disparity in edge length requires adjusting the distance between suture bites with broader spacing on the curved edge. The "rule of halves" will help provide this proportionate spacing on each side, as shown in Figure 1A. Start with suture A in the center of the wound. Then, estimate the halfway point of each wound edge and place a simple (or vertical mattress) suture B at these points (Figure 1B). The needle should enter and exit at right angles. You have now bisected the wound edges and divided the length inequality in half. Continue by finding the halfway point of the wound edges on both sides of suture B and place additional sutures at C and D. If necessary, continue bisecting the wound edges until closure is achieved.

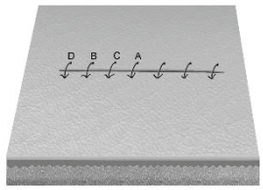
There may be an insignificant pleat in the longer edge, but a good wound approximation will facilitate wound healing, as shown in Figure 1C.



1A

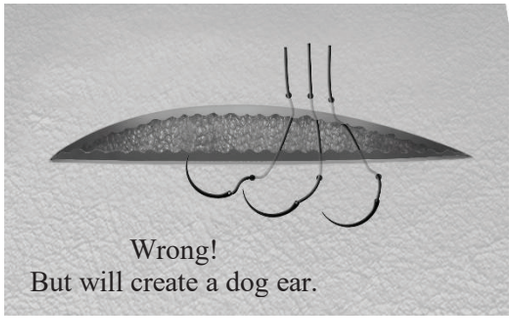


1B

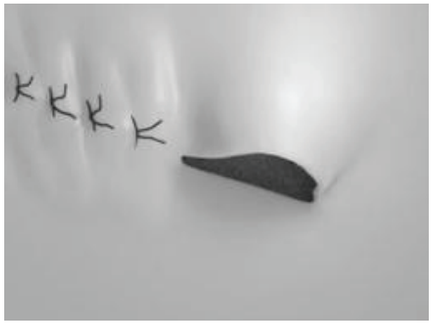


1C

Let's assume that you didn't close this wound correctly, and now you have a pesky little flap, a "dog ear," at one or both ends. How can we correct this? For this exercise, a dog ear can be created by exaggerating an error in closure in which the distance between sutures is longer on the straight side than on the curved side, which is opposite to the correct closure method (Figure 2A). After placing 3 or 4 sutures (in the wrong direction), you will have created a dog ear as illustrated in the Figure 2B

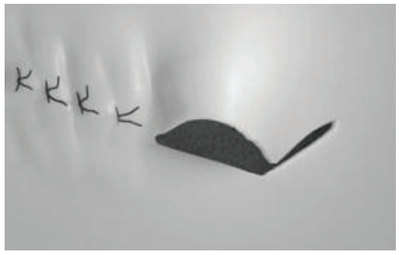


2A

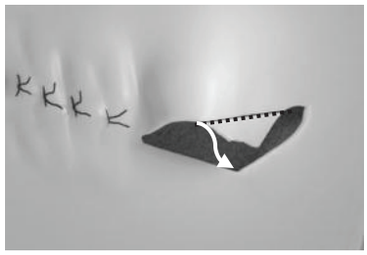


2B

A dog ear is a roll of excess skin on one side that overlaps the end of the wound. While it may be possible to tuck this excess skin into the wound, an unstable and unsightly scar will likely result. The optimal method for correcting this overlap is to extend the wound slightly with a short incision placed at a 90˚ angle into the side of the dog ear (Figure 3A). This will result in a flap overlapping the extended incision. The excess skin of the flap should be excised by making an incision from the beginning of the overlap to the apex (Figure 3B). A small triangle of skin will be removed. The wound is closed with two or three sutures placed perpendicular to the angled skin incision. The dog ear will be flattened, leaving a small "hockey stick" extension shown in Figure 3C.



3A

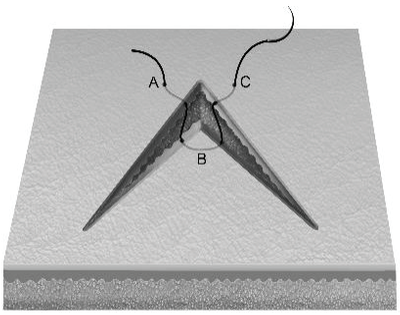


3B

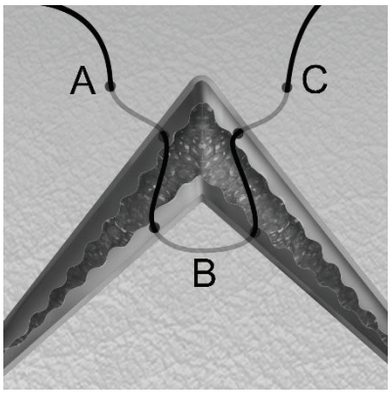
3C

Intersecting wound closure (#3) *Video #3 – Intersecting wound closure*

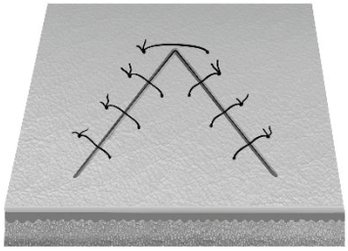
Accidental wounds are rarely as straight and clean as those created in the operating room. Often, they can be quite complex and frequently contain several intersecting lacerations. One of the challenges in this situation is the closure of these intersecting angled wounds. Exercise #3 on the board is an example of this situation. While a simple suture can approximate the defect's apex, a more elegant method utilizes a combination of simple and subcuticular sutures shown in Figure 4A.



4A



4B



4C

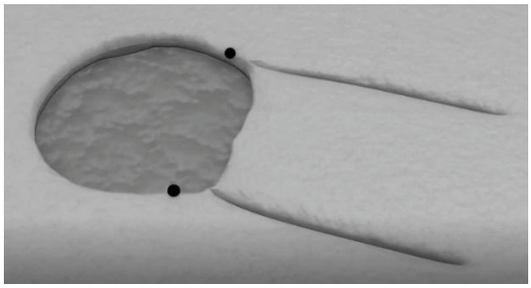
Begin with a simple suture placed at point A on the left side at the apex. The needle is then advanced as a subcuticular bite through the tip of the inner flap at point B. As illustrated in Figure 4B, careful attention is required to ensure that the depth of the bite of the first simple suture matches the depth of the subcuticular suture. After exiting the subcuticular bite, the needle is brought up as a simple suture through the other side at point C. Again, attention is directed to the depth of the skin entry and exit points to ensure that the skin edges align without overlap. Once the angle has been closed, simple sutures are used to close both arms of the wound (Figure 4C).

An alternative is to place a simple suture between the tip of one side and the "V" of the other. In many cases, the result will be satisfactory if attention is paid to the depth of needle entry and exit, which must match perfectly.

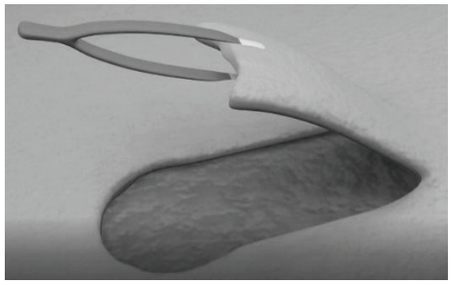
Simple advancement flap (#4) *Video #4 – Simple advancement flap*

There may be some situations where simple closure is impossible or will result in excessive tension on the suture line. A simple advancement flap (also known as a sliding flap) may be the answer. This is considered a "random flap," so specific attention to a defined or named blood supply is unnecessary, but several conditions are required to make this skin flap possible. First, there must be sufficient loose skin in proximity to the wound to be closed. In addition, there must be enough available distance to safely place the twin incisions that will create the pedicle. These should be two- to three times as long as the width of the wound to be closed. Advancement of skin from over a joint or on a tense surface usually won't work. Second, the skin for the flap needs to be healthy and able to survive through its subdermal collaterals. For instance, the advancement of scar tissue might lead to flap necrosis. And finally, the relationship between the base of the flap and the length requires consideration. Since the subdermal circulation is random, the base of the flap should be as broad as possible to ensure adequate collateral blood flow.

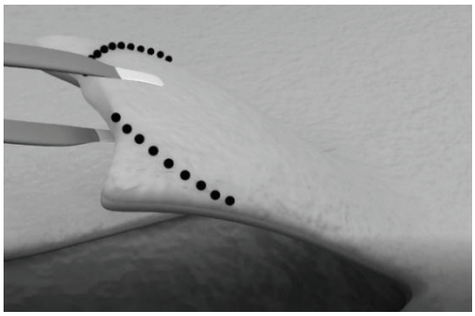
Example #4 on the board demonstrates principles of a simple linear advancement flap. The existing wound is circular, and while it might be approximated with simple sutures, the resultant tension on the skin edges would be substantial and associated with dog ears on both sides. In this case, two parallel incisions are indicated and will be used to create a linear pedicle flap. The base of the flap is relatively short but should suffice. Begin the exercise by completing the indicated incisions with the scalpel or Iris scissors (Figure 5A). We will assume that the flap has been previously separated from the underlying tissue leaving the subcuticular plexus attached (Figure 5B).



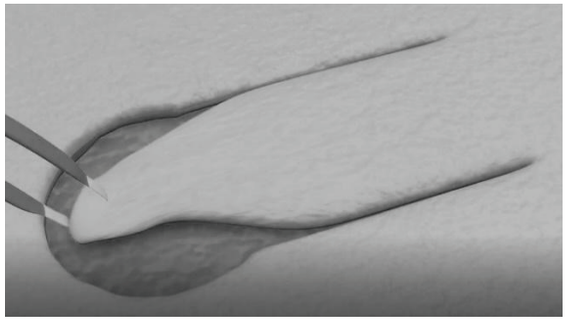
5A



5B



5C



5D

5E

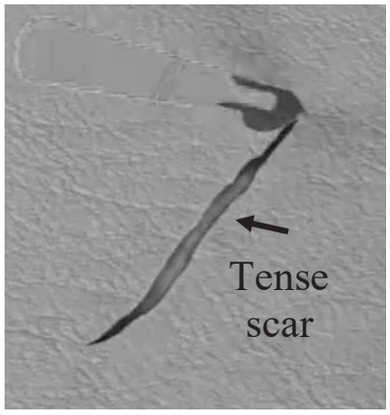
5F

Because the excision of the wound was performed in the shape of a circle, the corners of the flap need to be trimmed to better fit into the excised area (Figure 5C). To initially define the wound contours after the flap has been advanced, approximate the end of the flap into the far edge of the wound (Figure 5D) and place a single simple or vertical mattress suture to tack it in place. You will note that the outer edges of the incisions will be longer than the inner edge, and compensation will be required to avoid dog ears (remember the "rule of halves"). Repeated bisecting of the lateral incisions (Figure 5E) should result in a smooth closure on both sides (Figure 5F).

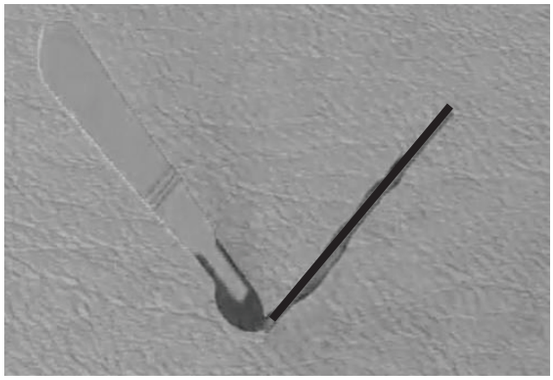
Z-plasty (#5) *Video #5 – Z-plasty*

The most common indication for a double transposition flap or Z-plasty is the presence of a tight scar or thickened tissue resulting in skin contracture or limited motion across a joint. The purpose of the Z-plasty is to lengthen the scar and rotate the axis of tension across the tight cutaneous surface or to transpose scars in a more favorable direction. This requires adequate loose skin on both sides of the contracted area to allow rotation without tension.

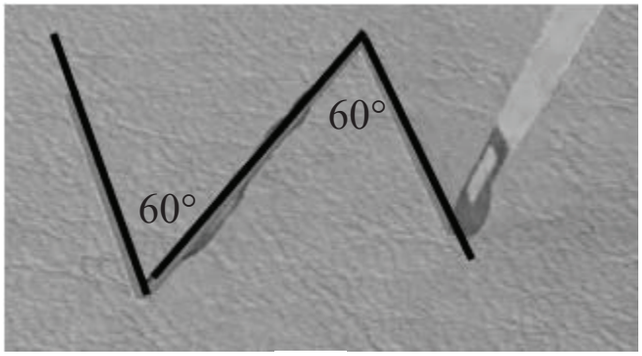
Figure 6A demonstrates a tense scar that is to be lengthened to reduce skin tightening. The procedure begins with an incision along the entire length of the scar (Figure 6B).



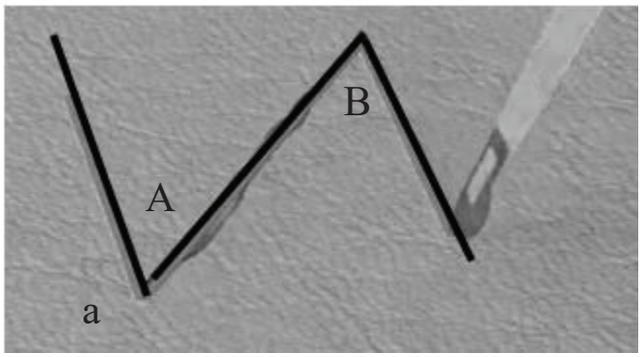
6A



6B



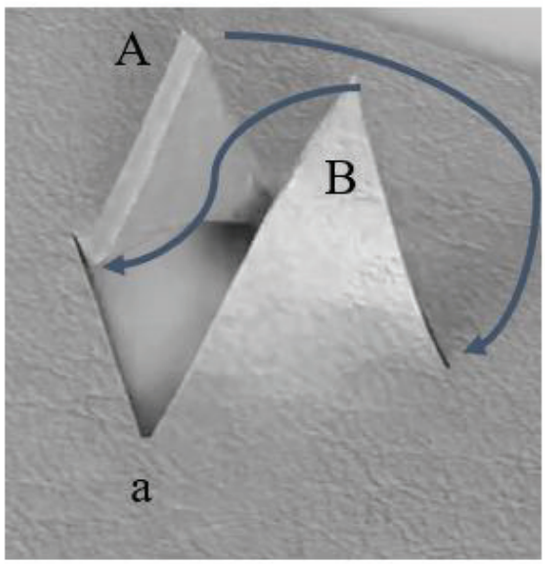
6C



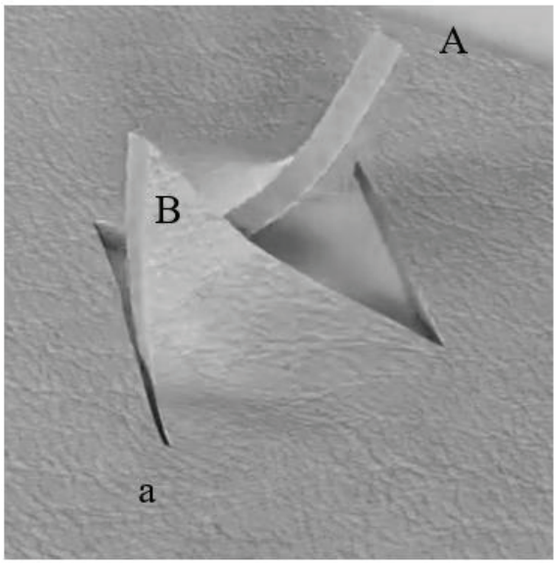
6D

From this point, the best way of illustrating the procedure is to break it down into steps that refer to the figures.

Step 1. At an angle of approximately 60 degrees, make two incisions outward from the ends of the primary cut. These extensions should equal the length of the initial incision over the scar. For this exercise, the partially cut lines can be made full thickness with the scalpel or Iris scissors. A 60-degree angle should result in a 75% increase in the length of the axis of the initial contracted region.
Step 2. Undermine both created flaps back to their base, which will be a line perpendicular to the end of the extensions (already completed with Sim*Skin). Figure 6D shows the flaps that have been annotated (Aa, Bb) for reference during the flap rotation.



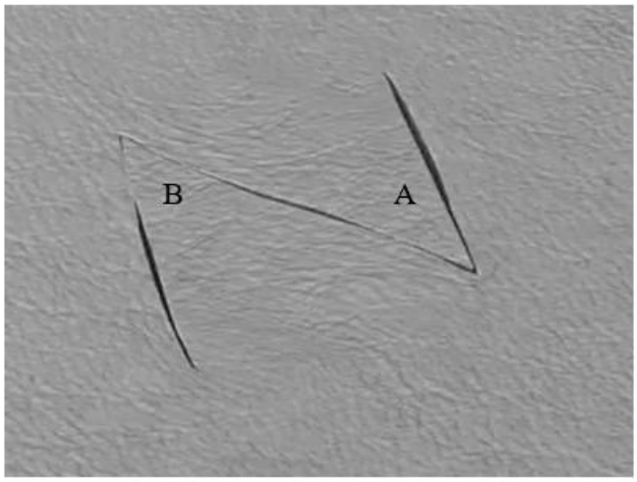
6E



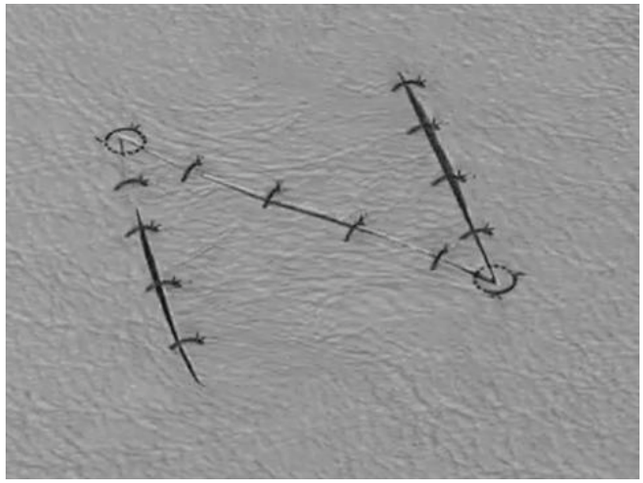
6F

Step 3. Rotate both flaps to insert them into the created slots (Figures 6E and 6F). The completed rotation is shown in Figure 6G.

Step 4. Secure the tips of the flaps with a subcuticular intersecting wound closure, as shown in Exercise #3. Alternatively, a simple suture can be used if attention is paid to the suture depth on both sides.
Step 5. Complete the closure with simple interrupted sutures. If all incision lengths are equal, dog ears should be avoided (Figure 6H).



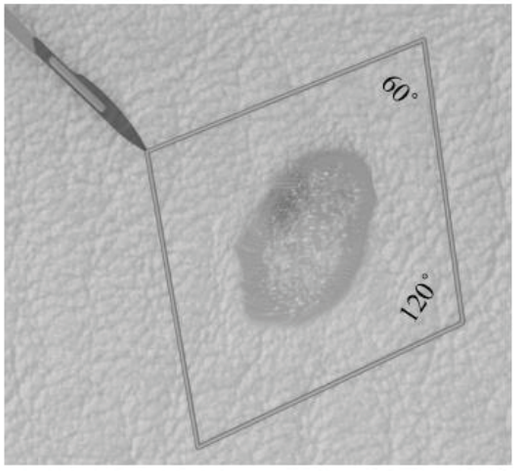
6G



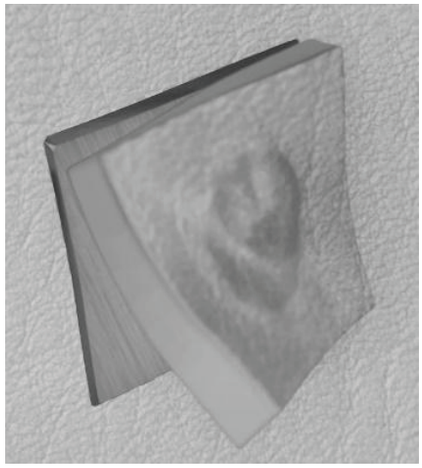
6H

Rhomboid Flap (#6) *Video #6 – Rhomboid flap*

With sufficient surrounding skin, a transposition or rhomboid flap (Limberg flap) may be considered for the closure of a large skin defect. This random flap is created to equal the size of the wound to be closed and has a large base and limited rotation to preserve circulation. A flap such as this might be considered when larger skin areas, such as on the torso or proximal limbs are available for flap creation. For this exercise, the procedure has been broken down into steps.

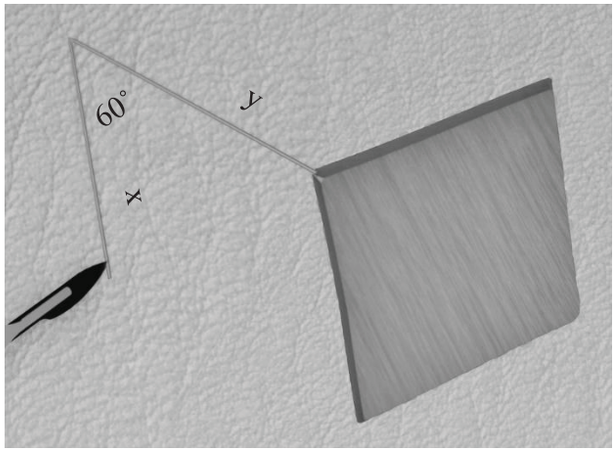


7A

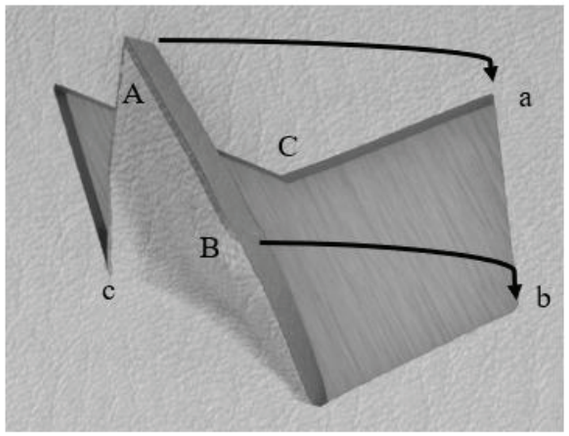


7B

Step 1: Incise a rhomboid wound around the area to be removed (Figure 7A). This has already been completed on the practice board. For this example, the angles of the rhomboid are 60˚ and 120˚. The length of each side will be equal and sufficient to include the entire affected area. The excised section is elevated for removal (Figure 7B)



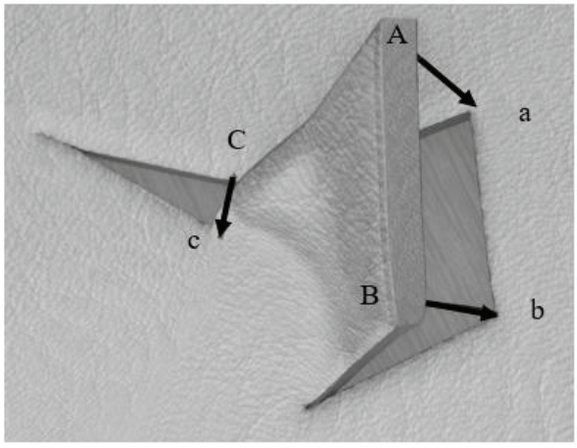
7C



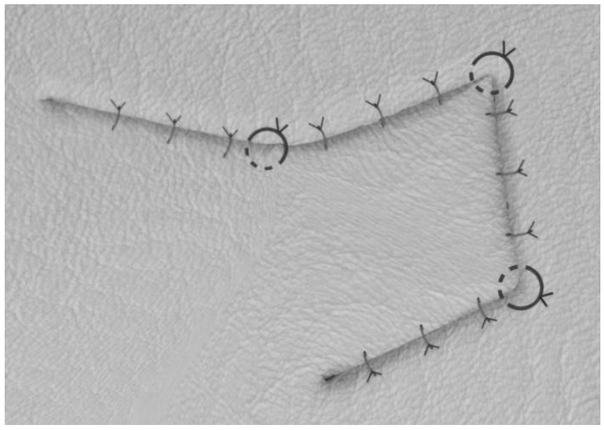
7D

Step 2. At the corner of the rhomboid with the 120˚ angle, incise the skin along a line that bisects and is perpendicular to the corner angle (Figure 7C, line y). The length should be identical to the side of the rhomboid. From the tip of this extension, create another incision parallel to the closest side of the initial rhomboid (Figure 7C, line x). This line will have the same acute angle (60˚) as on the rhomboid.

Step 3. Undermine the created flap preserving the subcuticular collateral blood supply. This has already been completed in this model. This flap should then be elevated and rotated (Figure 7D). With the rotation, corner A will be directed to slot a, and corner B will align with slot b.



7E



7F

Step 4. Continue to rotate the flap down onto the open rhomboid wound and attach the corners with simple sutures. With the rotation, a new corner (C) has been created that will slip into slot c

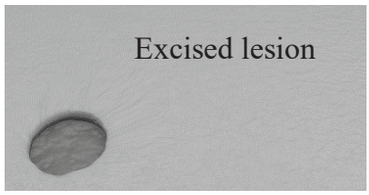
(Figure 7E.) The corners can be closed with angle sutures, as in Example #3, or with simple sutures.
Step 5. Approximate the remaining wounds with simple interrupted sutures (Figure 7F).

Simple rotational flap (#7) *Video #7 – Simple rotational flap*

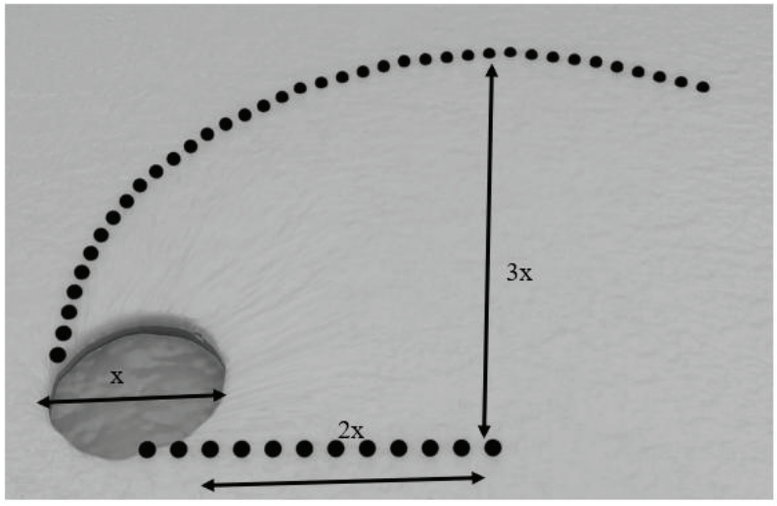
Depending on the size and location of the skin defect to be covered, a rotational flap may be most appropriate. This procedure involves skin movement in both a linear and a rotational direction and may be helpful if excessive transverse tension is expected. This will result in minimal tension on the axis of rotation with preservation of the blood supply.

For this example, we will assume that the lesion or tumor is excised, leaving a circular wound (Figure 8A). The procedure has been broken down into steps.

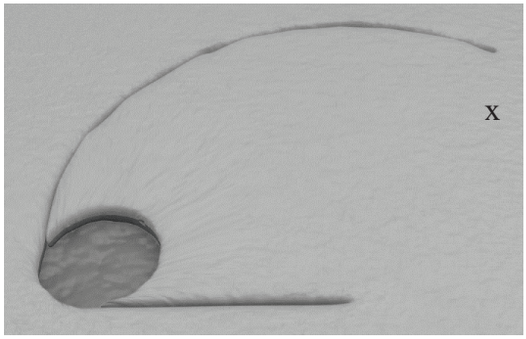
Step 1: From the inferior base of this wound, a straight line is incised laterally into an area of loose skin (Figure 8B). The length of this incision is about twice as long as the diameter of the initial excision.
Step 2: On the other side of the excised wound, an arc is incised, beginning with a right angle to the first incision. The radius of this arc is equal to the entire length of the initial base incision, including the excised wound (3x).



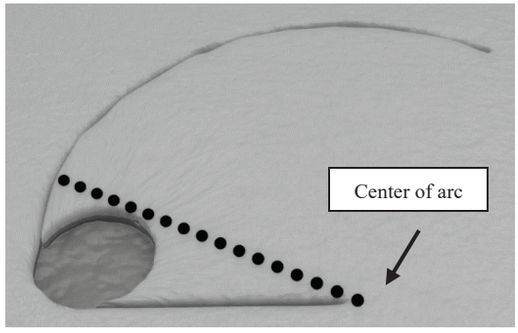
8A



8B

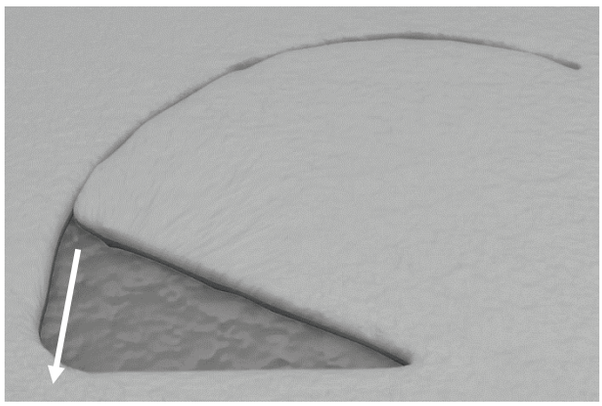


8C

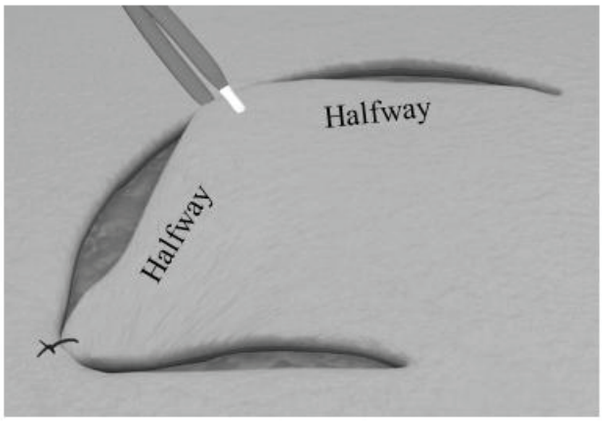


8D

Figure 8C shows the incisions that have been made.
Step 3: To provide an appropriately shaped bed into which the flap can be rotated, a triangle must be created. This is done by making an incision beginning at the arc's center point and extending outward to include the excised wound bed (Figure 8D). All flaps are undermined, which will allow for rotational movement.



8E



8F

Step 4: The tip of the flap is then rotated into the triangular defect, and a corner stitch will tack it into place (8E).
Step 5: Because of the disparity of the inner and outer edges for the rotational arc, bisecting sutures can first be placed to continue the closure (Figure 8F and 8G).
Step 6: Careful attention to suture distancing should yield a good closure, as shown in Figure 8H. A small dog ear might be present at the center of the rotation, but this can be removed, as shown in Exercise #2.

8G

8H

Complex wounds with tissue loss (8)

When confronted with a complex wound associated with tissue loss, you must remember that skin has substantial flexibility when detached from the underlying tissues. An additional thought is that the edges of the wound do not necessarily need to be returned to their initial position for healing to occur. These concepts allow for some degree of creativity with many options that can be used to bring the edges together.

On the surface of the skin board, you will see an example (#8) of a complex wound that you can address in various ways. This is your final exam, and let's see if you can close the wound with good skin approximation and no significant tension on the skin edges.

Remember, the following tools are available for you to accomplish this:

- Extending the incisions
- Creating new incisions
- Advancing flaps linearly
- Rotational flaps
- Transposition flaps

We hope that this learning experience has helped add to your surgical skills. Our goal at Sim*Vivo is to provide the learner with a satisfying and fun training option, and we hope that we have achieved this goal with Sim*Skin*Advanced. If you have any comments about this module or any of the Sim*Vivo Learning Systems, please send a note to John@sim-vivo.com. Best of luck with success in your surgical career!!

JBF, 2022

Notes:

Module Contents:

Sim*Skin*Advanced Practice Board
Hegar Needle Driver
Adson Forceps
Iris Scissors
Scalpel (#15)
Fenestrated Drape (2)
4-0 nylon on 19 mm reverse cutting needle, 75 cm (black)
Guidebook

Some materials are made in China and Pakistan. Board is modified and proudly assembled in in Naples, Florida, USA.
No materials in this module are sterile. All contents are to be used for educational or demonstration purposes only. Not approved for use on humans or animals. Please dispose of sharp materials in a safe manner

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