

# FUNDAMENTAL PRINCIPLES AND CURRENT TECHNIQUES FOR SKIN CLOSURE

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## INTRODUCTION

The majority of lower extremity surgery primarily corrects a functional or structural deformity, and the goal of any procedure should be maximal correction with minimal morbidity. Surgical exposure, however, necessitates dissection through specific anatomic structures, the most superficial and visible layer being the integument. Although cosmesis is a secondary or tertiary goal of surgery, the surgeon's expertise is often measured by the patient based on the resultant scar. The technique to be described will focus on closure of the most visible surgical layer, the skin.

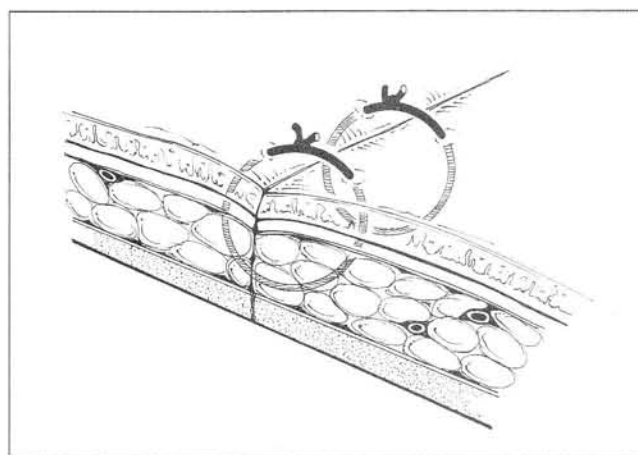
## PRINCIPLES OF WOUND CLOSURE

The principles of wound closure are universal, and can be applied to any anatomic region of the body. There are four distinct tissue planes that are commonly encountered in surgical dissection, including the periosteum, deep fascia, superficial fascia, and skin. Careful identification and preservation of these layers will facilitate intraoperative closure, allow for uncomplicated healing, and lead to early restoration of function.<sup>1</sup>

Successful wound closure requires an understanding of the principles of wound healing, and the contribution of each anatomic layer to the support of the repair.<sup>2</sup> The skin's greatest strength is within the dermal layer, and the most favorable repair results when the entire depth of the dermis is accurately reapproximated.<sup>2,3</sup> Although a precise coaptation of the epidermis gives a polished effect to the repair, it does not contribute strength.

Furthermore, adipose and muscle add little support to the repair as they have a limited ability to withstand the tension placed on sutures.<sup>3</sup> Although the dermal layer provides the majority of support to the skin, excessive tension on this layer during healing will result in increased scar formation and prolonged healing.

The indiscriminate closure of multiple planes of tissue, often in one or two layers, places the tension of the wound directly on the skin. (Figure 1) By employing a multi-layered approach to closure, each tissue plane is individually addressed, thereby distributing the tension across each of the layers. In addition to providing a tension-free skin closure, this will also help to eliminate dead space, reduce hemorrhage, and add physical strength to the wound.<sup>4,5</sup>



**Figure 1.** Inappropriate closure of multiple tissue planes without reapproximation of individual layers. This places too much tension on the skin, leading to unacceptable scar formation.

## SURGICAL TECHNIQUE

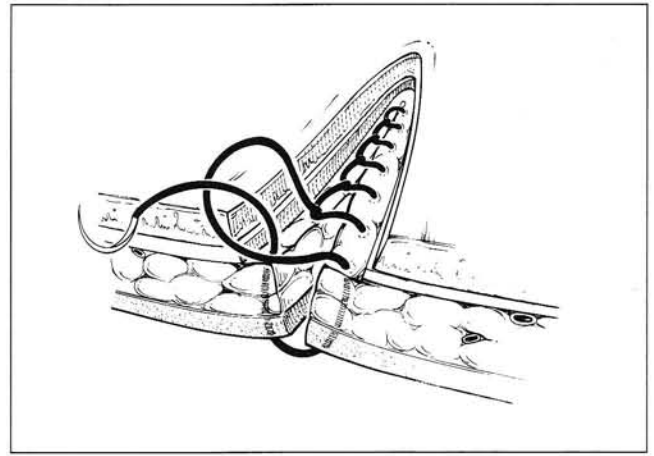
### Principles of Dissection

A discussion of the surgical technique of skin closure begins with the initial skin incision, as a properly dissected surgical plane will facilitate anatomic closure. The proposed incision line is routinely drawn with a skin marker prior to surgery. The skin incision is then made with a No. 10 blade, making sure that the blade maintains a perpendicular relationship to the skin surface, especially around contoured surfaces. Special care is taken to penetrate the entire layer of skin with one pass of the blade, thus preventing multiple skived cuts within the dermis. Conversely, one must not penetrate too deeply into the superficial facial layer, as this layer of tissue houses superficial cutaneous nerves and blood vessels. Subsequently, as dissection progresses through the deep layers of tissue, care is taken to avoid traumatizing the skin edges, especially when retracting.

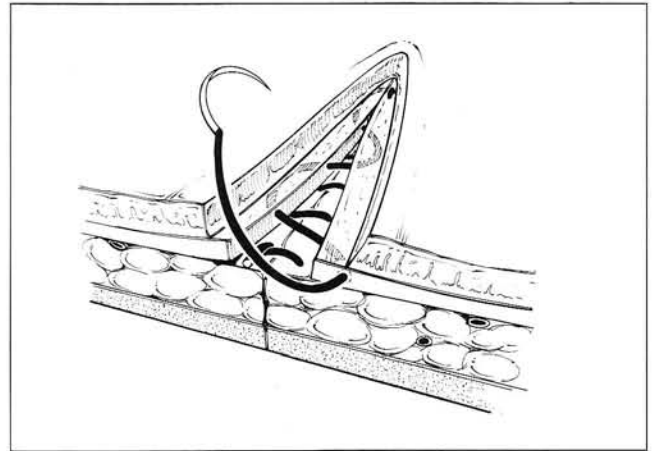
### Skin Closure

Properly selection of suture material and needle configuration are of equal importance in minimizing scar formation as the technique used in closure.<sup>3,4</sup> The appropriate choice of needles will facilitate the mechanical execution of atraumatic suture passage. Similarly, the suture material chosen for skin closure must be able to support the wound throughout the healing process, with a minimal degree of tissue reactivity.

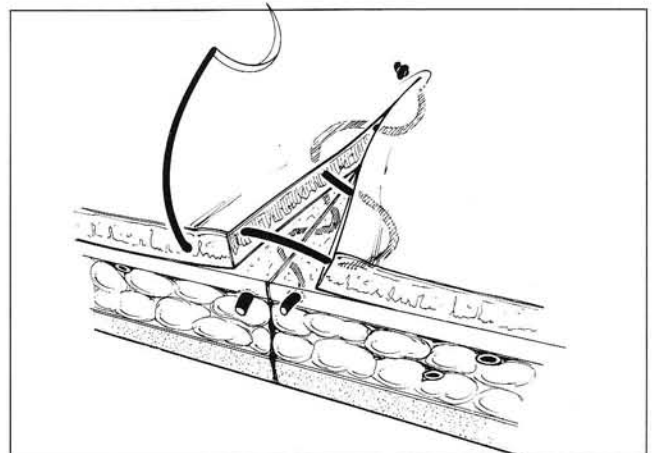
Closure of the wound should be performed in a layered fashion, starting with the deep structures, and progressing in a more superficial manner. In the majority of foot surgery (especially in the forefoot), the periosteal and deep fascial layers are inseparable and continuous with one another. When dissected as a combined layer, they are also closed as a combined layer. A running interlocking stitch is commonly employed in closure of this layer. (Figure 2) The relative avascularity of this layer, as compared to the superficial fascia, allows for vertical passage of the needle without compromise to neurovascular structures. A 3-0 absorbable suture is most commonly used in the forefoot, however 2-0 is preferable in rearfoot and ankle surgery. A cutting needle is preferred for closure, as this layer is dense in texture and requires sharp penetration of the needle.



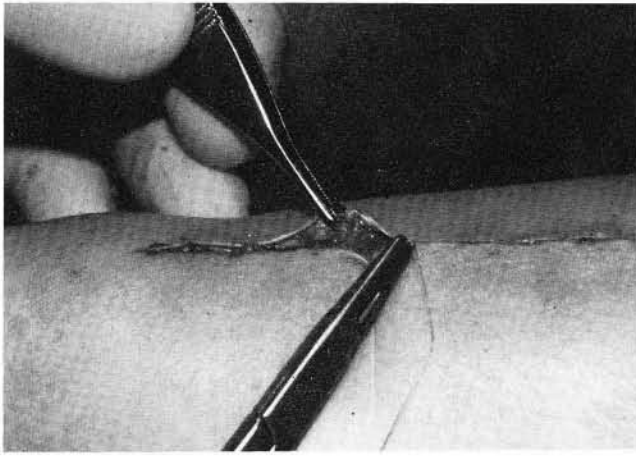
**Figure 2.** Reapproximation of the deep fascia and periosteal layer with a running interlocking stitch.



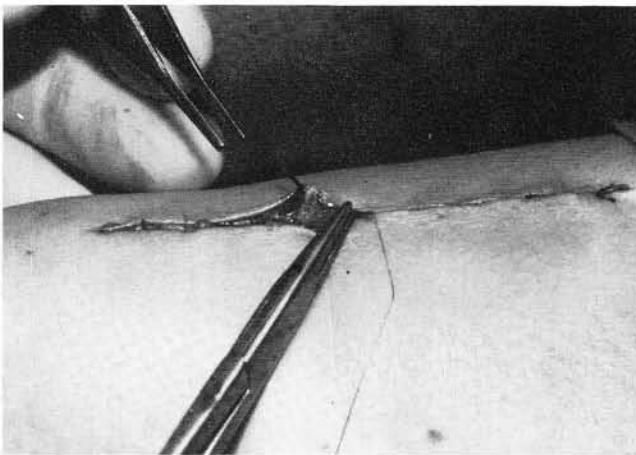
**Figure 3.** Superficial fascia (subcutaneous) closure with a continuous running stitch.



**Figure 4.** Skin closure with a running subcuticular stitch.



**Figure 5A.** Subcuticular skin closure demonstrating retraction and elevation of the skin edge with an atraumatic forceps.



**Figure 5B.** Subcuticular skin closure demonstrating retraction and elevation of the skin edge while the needle is "curved" through the skin. Note that prior to skin closure, there is no gapping of the skin margins, indicating a tension-free closure.



**Figure 5C.** The final skin closure.

The next layer encountered is the superficial fascia. This layer, which houses the majority of neurovascular structures, also has a limited ability to support suture closure since there is relatively little fibrous tissue (collagen). This is, however, the most crucial layer of closure in that any tension taken up by this layer will prevent tension on the skin. To avoid strangulation of neurovascular structures, the suture needle is passed through this layer in a running continuous, horizontal manner, paralleling the overlying skin. Deep passage of the needle at the subdermal level will facilitate tension-free reapproximation of the skin margins. (Figure 3) The typical suture for closure of this layer is a 4-0 absorbable material, either on a tapered or cutting needle. When using a cutting needle to close this layer, care must be taken to avoid penetration into the dermis, as this will cause "puckering" of the skin surface and an uneven reapproximation.

Skin closure is then performed in a running intradermal (subcuticular, sub-epidermal) manner using either an absorbable or non-absorbable material, typically size 5-0. (Figure 4) A plastic surgical needle is preferred, as this is a very thin layer of tissue, especially on the dorsum of the foot. Fine instrumentation is necessary for delicate handling of the needle, as the needle is made of a thin gauge wire which is prone to bending or breaking. A fine, atraumatic, tissue forceps is also required, as excessive grasping of the skin leads to the crushing of tissue and skin necrosis.

This process of skin closure entails the use of a curved needle to close a flat surface, therefore the skin must be manipulated in such a manner as to allow passage of the needle into and out of the skin. By lightly retracting and elevating the skin surface at the proposed exit point of the needle, the needle can be passed in an arcing fashion through the skin. The motion is created by a rotation of the wrist, with care taken not to "push" the needle through the skin. (Figures 5A, 5B)

Assistance in skin closure is provided by the application of slight proximal tension on the skin, parallel to the incision line. This helps to stabilize the skin surface, and provides resistance to the passage of the needle. In addition, the assistant should "work" the suture from side to side after each passage of the needle. This helps the surgeon to identify the starting point for the next throw of the needle, as each subsequent throw of

the needle should begin directly perpendicular to the previous exit point.

Upon completion of the skin closure (Figure 5C), the incision line is cleansed with saline or Betadine solution. A skin adherent can then be used to prepare the skin for the application of 1/4" or 1/8" adhesive tape strips (Steri-strip). Dried Betadine solution serves as a satisfactory adherent, however, one could also use Tincture of Benzoin solution. Finally, a sterile dressing is applied with mild compression to control postoperative edema.

### SUMMARY

The principles of skin closure are universal throughout the body, despite a variety of specific anatomic locations. The precise apposition of sequential tissue layers will prevent tension on the skin margins and minimize scar formation. Delicate handling of tissues with the appropriate instrumentation will prevent complications and further enhance the surgical outcome.

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