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Surgical pearl

Understanding the logic of common suturing techniques in dermatologic surgery

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Abstract

Although most trainees in dermatology learn that different suturing techniques are designated for a specific purpose (i.e., certain functional and cosmetic outcomes), students often have a difficult time visualizing how a given suture functions in its designated capacity. In this article, we address the logic behind the most common suturing techniques in dermatologic surgery, including the direction and magnitude of their pulling force with respect to the wound edges and the ensuing displacement of dermal and epidermal structures. To aid better understanding, we diagram the vectors of suture force with each of the techniques discussed.

Introduction

Suturing techniques help to achieve specific functional and cosmetic outcomes for patients and dermatologic surgeons prefer specific subcutaneous and epidermal closure techniques at different anatomical sites [1]. However, students often have a difficult time visualizing how a given suture functions in its designated capacity to yield desired outcomes. Factors to consider when deciding on the appropriate suturing technique for wound closure are that the sutures should produce wound edge approximation and eversion, properly redistribute tension while maintaining the necessary tensile strength to avoid dehiscence, eliminate any dead space, provide adequate hemostasis, and at the same time obey natural anatomic contours without leaving permanent marks on the skin surface. Variables such as anatomic location, depth and tension of wounds, as well as thickness of the wound edges and degree of bleeding can all influence the surgeon's decision [2]. Understanding the logic behind suturing techniques, including the direction and magnitude of their pulling force with respect to the wound edges and the ensuing displacement of dermal and epidermal structures, is helpful in determining the best approach to specific types of wounds. In this article, we address these basic logical principles and diagram the vectors of suture force with the most frequently used suturing techniques in dermatological surgery.

Bi-layered closure and the buried sutures

The majority of dermatologic surgeons prefer "bi-layered" wound closures at all anatomical sites [1]. A bi-layered closure refers to the use of two separate sutures, one placed in the deep dermis or subcutis and another suture placed superficially. The deeper

suture is especially important in deep gaping wounds and is referred to as a buried suture because it underlies the skin surface. *Buried sutures* take equal bites from both wound edges at the same depth to appose the deep dermis and subcutis. The primary closure forces of this suture are directed towards the wound margin from both sides at the same depth (Figure 1). The buried suture helps eliminate dead space, decrease tension on the wound edges, and lend significant structural support to the wound during healing [2]. Buried sutures are also integral to achieving wound edge eversion, with subsequent fine-tuning with epidermal sutures; everted wound edges allow for subsequently flat scars, whereas initially flat scars may lead to depressed scars as wounds contract during the healing process [3].

Moreover, the buried suture can help correct uneven alignment of wound edges. There are multiple potential approaches to correcting height discrepancies with the buried suture which depend on the relative depth and size of the suture loop in both wound edges. One can vary relative heights of the top aspect of the loops or relative heights of the bottom aspect of the loops. We favor an approach focusing on the relative height of the top aspect of two equal-sized loops to address the problem (Figure 2).

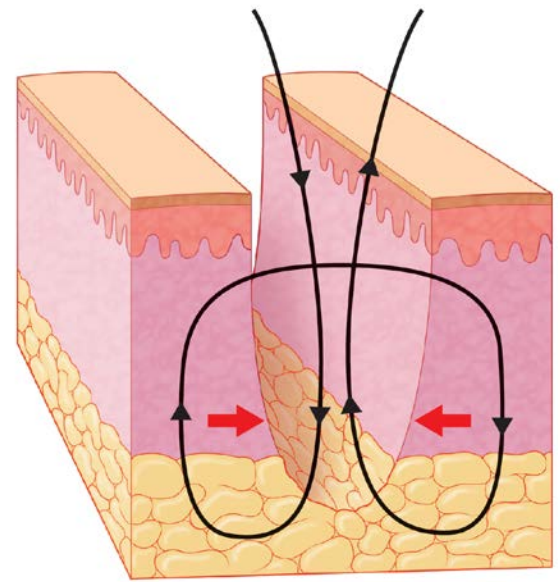
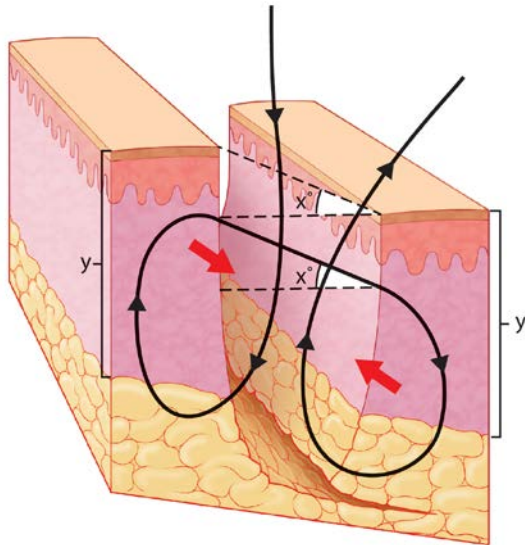
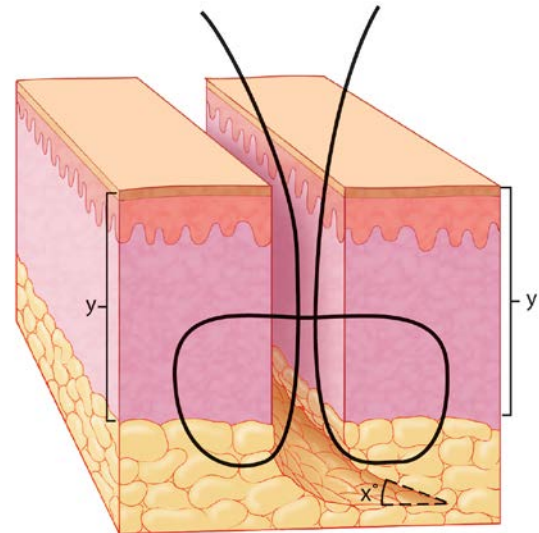


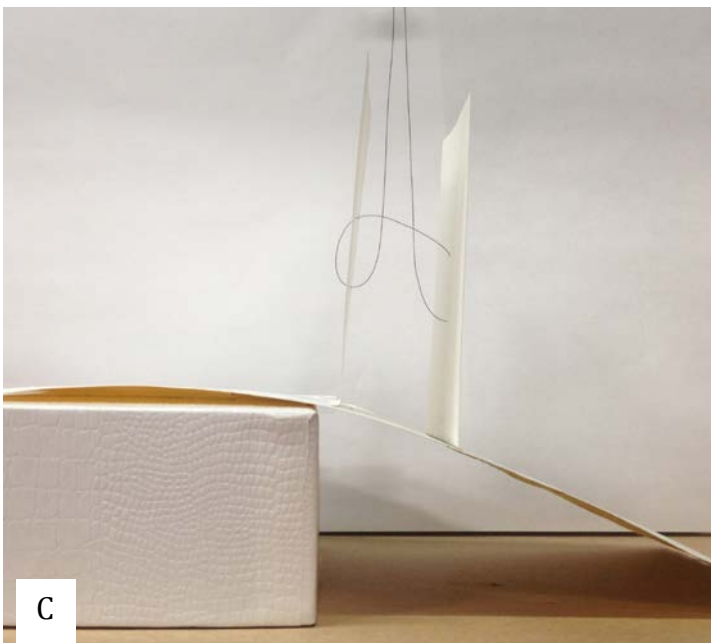
Figure 1. Buried suture: By taking equal bites from both wound edges at the same depth, this suture helps appose the deep dermis and subcutis.



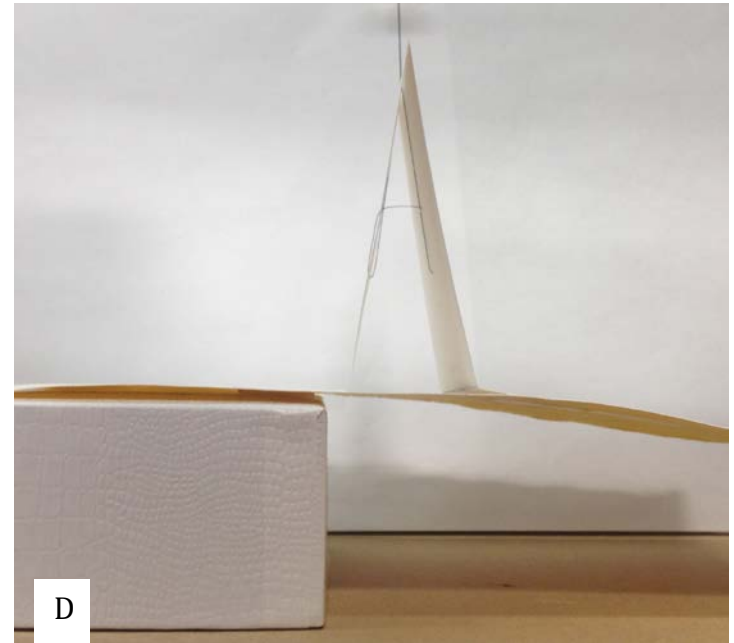
A



B



C



D

Figure 2. The buried suture can re-align uneven wound edges. Note that the cause of the height differential is an imbalance or slanting in the subcutis, and the height of the epidermis + dermis (y) is equal on both sides. As such, any attempt to make both wound edges flush with the horizontal will necessarily sacrifice non-flushness in the subcutis (i.e., create dead space) – this can be facilitated with undermining in the subcutis on the depressed edge. The relative heights of the top aspect of the two suture loops should mirror the difference in the relative heights of the two wound edges, such that an imaginary line connecting the discrepant wound edges is parallel to the suture line connecting the two loops (A). Upon cinching the knot, the subcutis is pulled up to create dead space, the wound edges are both even with the horizon, and the suture line connecting the loops is also parallel to the horizon (B). The same concept can be visualized using two equal-sized pieces of paper on an uneven base (C and D).

Epidermal closure and the simple sutures

Simple interrupted sutures are excellent for wound edge approximation and provide greater tensile strength than a simple running suture, though they are more time consuming to place. The simple interrupted is preferred in areas of high tension or where wound healing may be impaired, whereas the simple running suture can be used to close wounds more quickly when there is little tension, equal thickness of wound edges, and no dead space [2].

The *simple interrupted suture* takes equal bites from each wound edge to produce two closure forces of the same magnitude pulling the edges of the wound together from both directions (Figure 3). These forces appose the epidermis and superficial dermis to produce a small scar. There is a risk of wound edge inversion in susceptible anatomical regions (i.e., posterior neck, cheeks, nose, forehead) [4]. The *pulley stitch*, commonly used to reduce wound tension while placing other sutures, allows for amplifying of closure force on the wound without changing tension on the suture. The closure force produced equals that of two simple sutures (Figure 4).

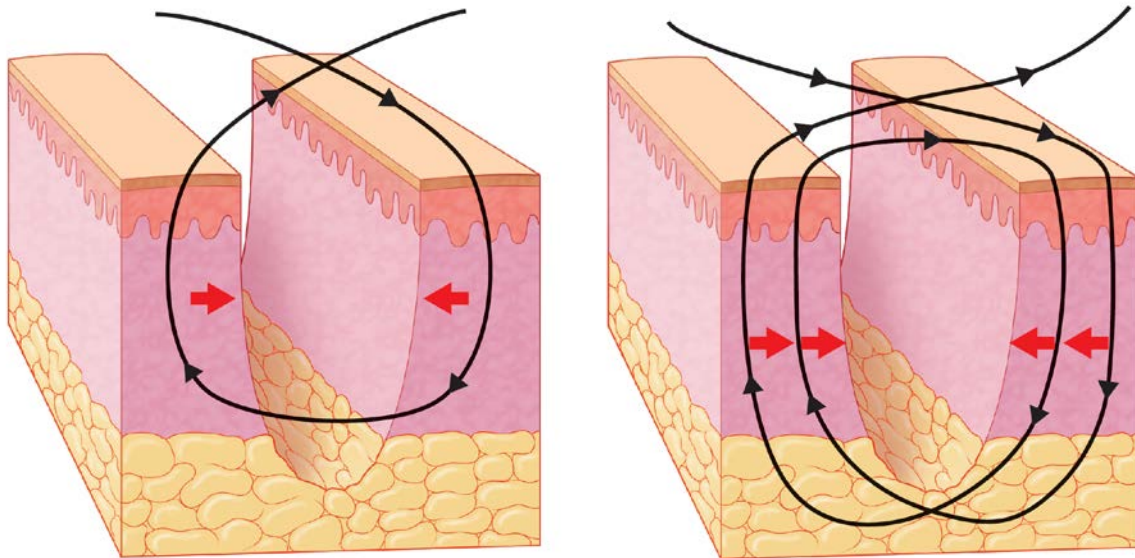


Figure 3. Simple interrupted suture: By taking equal bites from each wound edge, this suture produces two closure forces of the same magnitude pulling the edges of the wound together to appose the epidermis and superficial dermis. **Figure 4.** Pulley stitch: By piercing the skin in a far-near-near-far arrangement all in the same plane (perpendicular to the wound), this suture takes two equal bites from each wound edge and produces closure forces that are similar in direction to the simple interrupted suture, with twice the pulling force.

The mattress sutures: eversion and hemostasis

The vertical and horizontal mattress sutures both take a deep and a superficial bite across the wound and thus provide a bi-layered closure in one suture [2]. Although time consuming to place, they can reduce tension on the wound edges, produce eversion, and eliminate dead space [4, 5].

The *vertical mattress* is regarded as one of the best techniques for producing wound edge eversion, while offering moderate hemostasis. The vertical mattress employs a far-far deep bite across the wound and then a more superficial near-near bite all on the same vertical plane. This suture thus produces symmetrical forces pulling downwards at points away from each wound edge, and towards the wound margin from both sides. The vector sum of these forces points diagonally towards the wound bed, bending both wound edges to the sky (i.e., eversion), and allowing for better dermis-dermis wound edge approximation (Figure 5). Greater eversion can be achieved for cosmetically sensitive regions like the head and neck by taking bites farther from the wound edges

(i.e., 10-12 mm vs. 6-8 mm) to encompass more tissue between the suture loops to produce a greater upward force at the proximal wound edges [5].

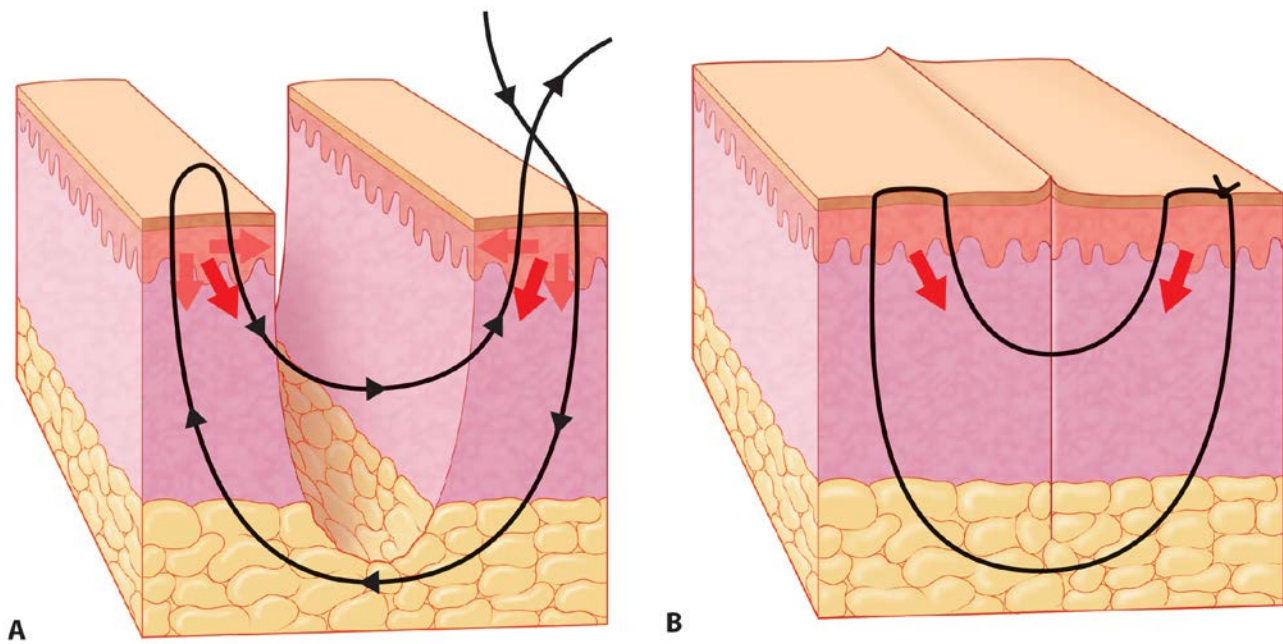


Figure 5. Vertical mattress suture: (A) The vector sum of forces from this suture points diagonally towards the wound bed, (B) allowing for better dermis-dermis approximation and final wound edge eversion.

The *horizontal mattress* is also comprised of two bites across the wound margin, but unlike the vertical mattress, these bites are spaced apart along the horizontal plane, are at the same distance from the wound margin, and reach the same depth. This arrangement not only produces good eversion but achieves much greater hemostasis [4]. Whereas a simple suture provides a force of closure immediately under the line of the suture (and only shuts off vessels under the suture knot), the force of closure between the limbs of the horizontal mattress approaches that of an infinite number of simple sutures between the limbs. This can provide much greater hemostasis to the extreme of threatening wound edge necrosis (Figure 6) [2, 4]. The horizontal mattress can be used to reduce tension and offer hemostasis temporarily while other sutures are placed to avoid this potential pitfall [2]. In fact, placement of a preliminary horizontal mattress suture prior to punch biopsies of the scalp has been proposed as one method of achieving quick hemostasis [6].

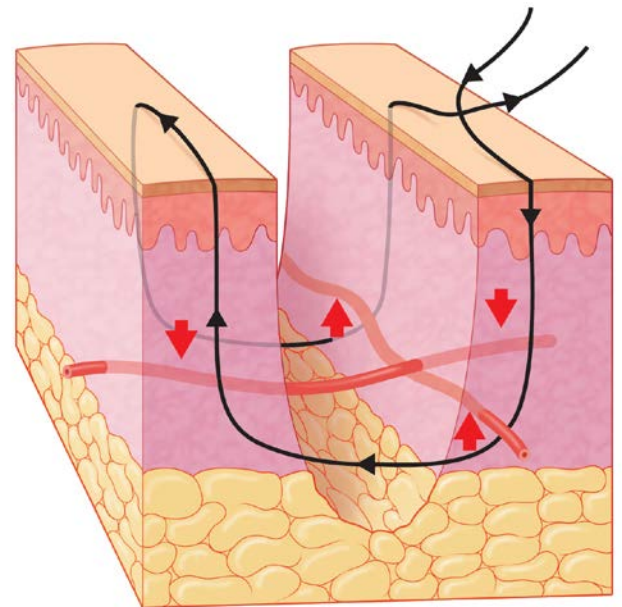


Figure 6. Horizontal mattress suture: after the knot is cinched, this suture creates downward strangulating vectors parallel to the wound and upward strangulating vectors orthogonal to the wound. The net result is strangulation of the tissue (i.e., dermal vascular plexus) encompassed within the entire suture.

Conclusions

Understanding the mechanism of wound closure with different suturing techniques helps in deciding on the best potential approach for each patient and each wound. Although randomized controlled trials to compare functional and cosmetic outcomes with different suturing techniques in clinical scenarios warrants further study, thinking about these techniques in a logical sense is the first step towards optimizing their use.

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