# Commonly Used Suturing Techniques in Skin Surgery

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Proper suturing technique is essential for obtaining good cosmetic results and avoiding infection, scarring and poor wound healing. Techniques that must be mastered include good eversion of skin edges, avoiding suture marks, maintaining uniform tensile strength along the skin edges and precise approximation of skin edges. Vertical mattress sutures have the advantage of good wound eversion and closure of dead space. Running continuous sutures can be quickly placed and divide tension equally along the skin edge. Interrupted sutures are more time-consuming but allow more precise wound edge approximation, while subcuticular sutures are useful for avoiding suture marks in conspicuous areas.

The primary function of a suture is to maintain wound closure and promote wound healing when the integrity of the wound is most vulnerable. The suture type and the amount used, the suturing technique and the degree of tension on the suture influence wound healing.

The process of wound healing has been divided into three phases: (1) the initial lag phase (days 0 to 5), in which there is no gain in wound strength, (2) the fibroplasia phase (days 5 to 14), when a rapid increase in wound strength occurs, and (3) the final maturation phase (day 14 until final healing), which is characterized by further connective tissue remodeling.

Wounds never gain more than 80 percent of the strength of intact skin. Only 7 percent of the final tensile strength of the repair is achieved after two weeks. Thus, nonabsorbable skin sutures, which are typically removed between days three and seven and, more importantly, buried absorbable sutures play a crucial role during the initial lag phase, when wound tensile strength is derived largely from epidermal cellular adhesion.

Table 1 summarizes the advantages and disadvantages of different suturing techniques. The ideal wound closure technique is one that produces maximal wound eversion, is technically simple to perform, maintains tensile strength throughout the healing process, allows for precise wound edge approximation and does not leave suture marks. Wound eversion, suturing time, careful approximation of wound edges and the potential for leaving suture marks are factors that should be considered before choosing a method for wound closure.

Eversion is important because the natural tendency of sutured wound edges is to become inverted after wound contraction has occurred. Thus, everted wounds heal as flat scars after wound contraction. Wounds that are sutured so that the skin surface is flat are likely to leave a more visibly indented scar after wound contraction has occurred. Sutures that are too tight or left in place too long can lead to permanent suture marks, or "railroad tracks". The greatest strength of the skin and, ultimately, of the repaired wound lies in the dermal layer. The epidermis is a superficial covering that gives a polished effect to the wound but does not contribute to the

strength of the repair.

## Buried Sutures

Buried sutures are important for obtaining wound eversion, providing prolonged wound tensile support and closing dead space. The width of a resultant scar may be estimated by the distance between the skin edges only after buried sutures are placed. The most common suture materials used in this technique are Vicryl (polyglactic acid), Dexon (polyglycolic acid), PDS (polydioxanone) and Maxon (polyglyconate).

The classic description of the buried suture technique emphasizes that the knot be buried downward. What is often not emphasized is that eversion can be obtained with the buried suture without leaving noticeable suture marks.

## Buried Vertical Mattress Suture

The buried vertical mattress suture everts the wound in a fashion similar to the nonburied vertical mattress suture. With this technique, the suture is buried with a slightly different path than the classic buried suture. The path of the needle is slightly wider and closer to the epidermal surface than the path in a common buried suture. The superficial placement of the suture and slightly wider needle path give more prolonged eversion. The superficial placement of the suture approaches the point of dimpling the skin surface. If the suture is placed too superficially, however, it can "spit". A vertical mattress suture allows the physician to remove superficial skin sutures earlier, since wound eversion is maintained longer. The everted wound flattens after wound contraction, providing a good result.

The ideally placed buried vertical mattress suture provides everted wound approximation itself, so only a loose final layer is necessary. If the wound is already well approximated with a buried suture, this final surface layer provides additional support during the first three to six days of wound healing. When approximation of wound edges is already completed with the buried suture, a running continuous suture is a good technique to approximate the skin surface.

## Running Continuous Suture

The running continuous suture can be performed quickly and distributes tension evenly along the length of the wound so that the suture is less likely to be too tight. Additional wound eversion is accomplished by pushing down on the wound edges as the needle enters the skin at a 90 degree angle to the skin surface and pushing up on the wound edges as the needle exits the skin. The skin can be effectively everted by pushing up or down on the wound edges with a finger or an instrument such as a skin hook or forceps. Alternatively, the wound edges can be everted with a skin hook as the needle enters and exits the skin.

A running stitch is used primarily for wounds that are well approximated and have little tension. These two conditions are usually present when buried sutures are well placed. Small

adjustments in the height of the wound edge can be made by exiting the needle superficially in the dermis on the higher wound edge and deeper in the dermis on the lower wound edge.

A running continuous suture is a disadvantage if subsequent removal of only a few sutures at a time is desired. In this situation, the end of the suture can be tied to a remaining loop, so that the suture will not unravel. Theoretic concerns about increased wound infection or decreased final tensile strength with this type of suture have not been proved in clinical situations or animal studies. A running continuous suture is useful in many situations because it is quick and shows good results.

## Interrupted Suture

The interrupted suture is more time-consuming and is apt to leave "railroad track" scars on the skin surface. However, it may allow more careful wound approximation when small adjustments must be made and buried sutures have not completely approximated the wound edges.

Interrupted sutures can also even out height differences between wound edges, although this can also be accomplished with the running continuous suture. The needle should exit or enter the skin on the high side superficially and exit or enter the skin deeply on the low side ("high on the high side, low on the low side"). Interrupted sutures allow the removal of every other suture (an uncommon need).

Wound eversion with interrupted sutures can be accomplished by pushing down on the skin as the needle enters and pushing up on the skin as the needle exits. Eversion can also be accomplished by everting the skin with a hook as the needle enters or exits the skin. Furthermore, eversion occurs if the path of the needle is wider at the deepest part of the wound so that the entire path of the needle is flask-shaped.

A common mistake encountered with the simple interrupted suture is that if it is tied too tightly, it causes suture marks after postoperative edema. Suture marks can be prevented by using a loop throw instead of the normal square knot. The first throw is the standard double-instrument tie; the second throw is tied looser, leaving a small loop, and the third and fourth knots are squared.

The loop stitch allows expansion of the stitch if edema occurs. Squaring the knots allows them to lie flat and ensures adequate holding power. Three throws may be minimally sufficient with a nylon suture, but Prolene (polypropylene) sutures usually require four throws because of the increased memory (the inherent tendency to return to original shape after manipulation) of Porlene. Furthermore, compared with nylon, Prolene and Novafil (polybutester) are more elastic (the intrinsic tension generated after stretching, which causes the suture to return to its original length). Thus, if edema occurs, these sutures stretch slightly.

## Vertical Mattress Suture

The main reason for using a vertical mattress suture is to produce greater wound eversion. Vertical mattress sutures also close dead space and provide increased strength across the wound, which is accomplished by taking a slightly wider bite than taken in a simple interrupted suture. The direction of the needle is reversed, starting closer to the wound edge on the same side that the suture just exited, and a narrower bite is used, entering the skin superficially closer to the wound edge, so that the suture is finally tied on the same side of the wound as the suture originally pierced the skin.

Disadvantages of the vertical mattress suture include difficulty in closely approximating wound edges and prominent suture marks if the sutures are not removed sooner than other techniques require. It is a somewhat time-consuming technique; it can take twice as long as a simple interrupted suture. Some physicians alternate between vertical mattress sutures and simple interrupted sutures along the length of the wound. The more accomplished the physician becomes in everting wound edges, the less often the vertical mattress suture is used.

## Shorthand Vertical Mattress Suture

The shorthand vertical mattress suture was recently described by Snow and colleagues. When properly performed, this technique accomplishes the same degree of tissue eversion as the classic vertical mattress suture, but in half the time. Using backhand rotation, the needle is inserted superficially close to the wound edge and removed at a point equidistant on the opposite wound edge. This step approximates the epidermal edges. The opposite skin margins are gently lifted upward by grasping the free end and proximal portion of the suture between the thumb and index finger. Then, using forehand rotation, the needle is reversed and deeply inserted far from the wound edge and passed through the deep dermis to an equidistant point on the opposite edge. A surgeon's knot is tied.

## Corner Suture

The corner suture, or half-buried mattress suture, has been considered necessary for suturing flap tips without compromising blood supply. This complication is highly unlikely, however, since a simple superficial interrupted suture through a flap tip has not been shown to cause flap tip necrosis in pigs or in clinical experience.

When a corner suture is used, it is started on the opposite wound edge from the flap tip. The nonabsorbable suture enters this wound edge across from the flap tip and then enters the flap tip at the same depth as it exited the opposite wound edge. The suture then goes through the dermis of the flap tip and enters the opposite wound edge. It exits the surface of the wound edge opposite to the flap tip and adjacent to the initial entry point. It is thus tied on the side opposite to the flap tip.

The main disadvantage of this suturing technique is that close approximation of the wound edges without trauma to the flap tip can be difficult.

## Subcuticular Suture

An elegant but difficult suturing technique is the subcuticular suture, or running intradermal suture, which was first described by Halsted. This technique is valuable when sutures should be in place for more than one week, but suture marks must be avoided. For example, subcuticular closure can be useful on the extremities, on the forehead of a patient with telangiectatic erythematous skin or on sebaceous skin, where prominent suture marks can occur.

Subcuticular sutures are placed totally within the dermis, so that the only possibility of suture marks is at the ends of the wound, where the suture enters and exits. The path of the needle crosses back and forth horizontally across the wound within the dermis. The needle holder can be held like a pencil, with the needle moving across the wound in a horizontal direction and the loops backtracking slightly. Usually, the more loops that are placed across the wound edges, the closer the approximation.

Securing the suture ends requires multiple knots at the end of the suture and the use of surgical tape. Buried sutures and simple interrupted sutures are often necessary to approximate the wound edges, since the subcuticular closure cannot always provide close wound approximation under tension. A running subcuticular closure is time-consuming and does not evert wound edges. However, a well-placed subcuticular suture can be the ideal technique in certain locations of the body.

## Horizontal Mattress Sutures

The horizontal mattress suture, a variation of the corner suture, is rarely used because of the risk of suture marks and skin necrosis. Even with the use of protective bolsters between sutures and skin surface, epidermal necrosis may result. The advantages of the horizontal mattress suture are that it closes dead space, facilitates wound eversion, minimizes wound tension and provides some hemostasis, although these goals can be accomplished with other techniques.

## Other Suturing Techniques

A number of other suturing techniques are less commonly used. Some of the them may be advocated occasionally, depending on the situation. The running locked suture, the running horizontal mattress suture, the running buried suture, the "baseball" stitch, the far-near/near-far suture and the figure-eight suture are described in the surgical literature but are rarely used, except under very specific conditions.

## Wound Closure Tapes

Wound closure tapes offer distinct advantages over both sutures and staples. They minimize iatrogenically induced trauma and apply less tension to the wound. Wounds closed with tape are more resistant to infection than suture wounds.

On the other hand, tape cannot provide adequate skin-edge eversion or deep-tissue approximation when used alone. Thus, tape is most commonly used as an adjunct to sutures or staples. For instance, tape helps reinforce wounds closed subcuticularly or with conventional suturing techniques; sutures or staples can be removed sooner if tapes are applied to the healing sutured wounds. In areas where contamination is suspected, foreign material within the wound may be reduced by alternating tape with sutures or staples to close the wound.

The performance of a tape is characterized by its tensile strength, porosity and adhesion. Tensile strength is required for maintenance of wound-edge apposition, and adequate porosity is necessary to prevent buildup of gas and water vapor, which can cause the tapes to separate from the skin. A good adhesive assures firm tape-to-skin attachment.

Adhesion is enhanced by the application of a tacky substance to the skin surface. Traditionally, tincture of benzoin has been used for this purpose, but a preparation containing gum mastic (Mastisol) has been shown to provide stronger adhesion. Although some tape manufacturers indicate that Mastisol is not required, in our experience all wound closure tapes have significantly enhanced adhesion when Mastisol is used.

Wound closure tape combined with the application of Mastisol is necessary after suture removal to prevent dehiscence. In addition, wound closure tape may be used at the time of surgery. We typically apply wound closure tapes, such as Steri-Strips, at the time of surgery and keep them in place for 10 days. When placed over the suture, wound closure tape can take tension off the wound edge, provide a semi-occlusive environment and prevent the patient from looking at or handling the wound until days after suture removal.

## Postoperative Wound care

Once the wound is properly closed, it should be cleaned with hydrogen peroxide to remove all debris and blood. Then a row of tape is applied directly over the wound. An adhesive agent is usually applied around the wound to obtain better adhesion, and paper tape is placed over the wound closure tape. Finally, a fluffed gauze formed into a pressure dressing is taped over the wound. Patients are instructed to keep the wound dry for at least 24 hours. After 24 hours, the patient can take a shower.

Patients begin self-care at home after 24 hours. They can remove the pressure dressing, but not the wound closure tape. Patients are told to apply antibiotic ointments such as Polysporin or Bacitracin (not Neosporin, because of the small risk of contact dermatitis) on top of the wound closure tape. The wound is then covered with a bandage. Wound closure tape is left in place until

the follow-up visit, typically five to seven days after surgery. In the follow-up visit, sutures should be removed and another layer of wound closure tape applied. The patient is then instructed to keep the tape in place for an additional three to five days.