

Fundamental Techniques
in
**Veterinary
Surgery**

THIRD EDITION

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Instrument Square Knot

Figure 2-30. The needle holder is placed between the left and right strands, and a loop is formed with the left hand.

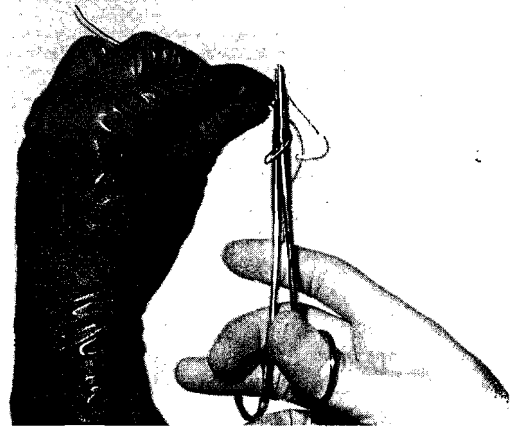


Figure 2-31. The right (short) end is grasped in the needle holder.

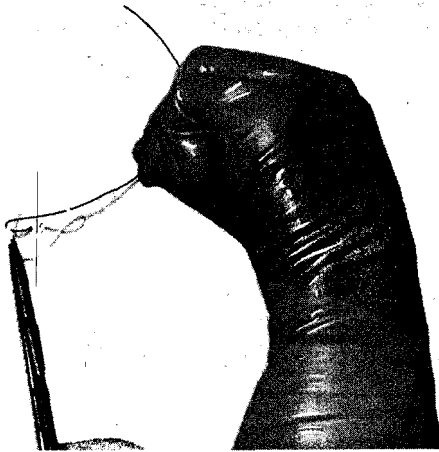


Figure 2-32. The left and right hands are reversed in position, and even tension is applied.

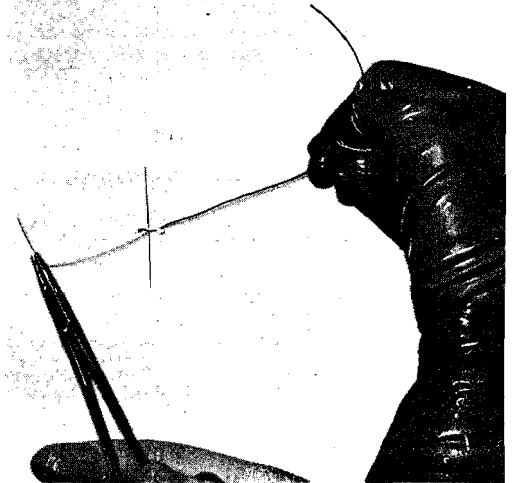


Figure 2-33. The knot is tightened.

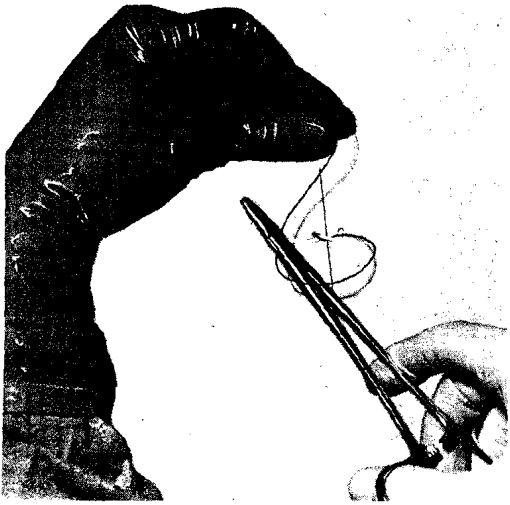


Figure 2-34. A second loop is made by placing the needle holder between the two strands and forming a loop with the long strand.

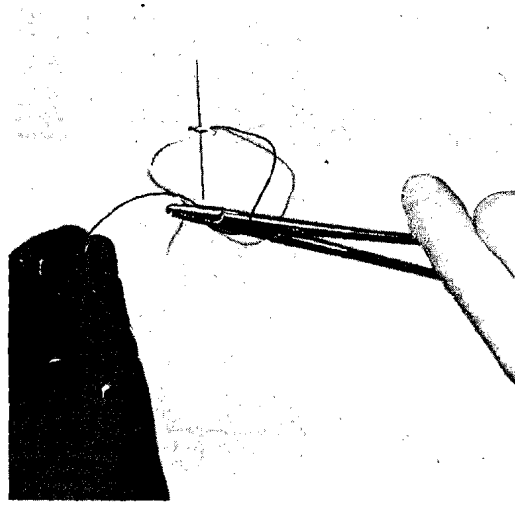


Figure 2-35. The end of the short strand is grasped with the needle holder.

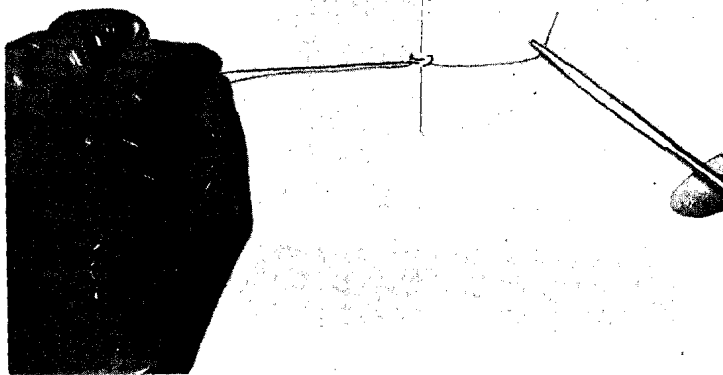


Figure 2-36. The strands are tightened under even tension as they are held close to the incision. The instrument square knot may also be tied by placing the needle holder on the outside of the two strands for each throw. However, placement of the needle holder between the two strands for one throw and exterior to them for the second throw will result in a granny knot.

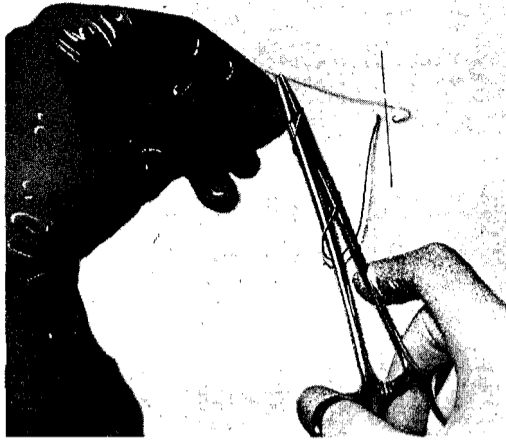
Instrument Surgeons' Knot

Figure 2-37. The instrument surgeons' knot is tied in much the same fashion as the instrument square knot, but a double loop is placed around the needle holder.

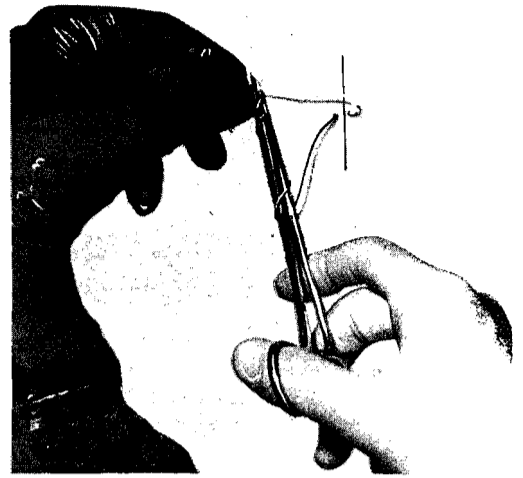


Figure 2-38. The short end is grasped in the needle holder.

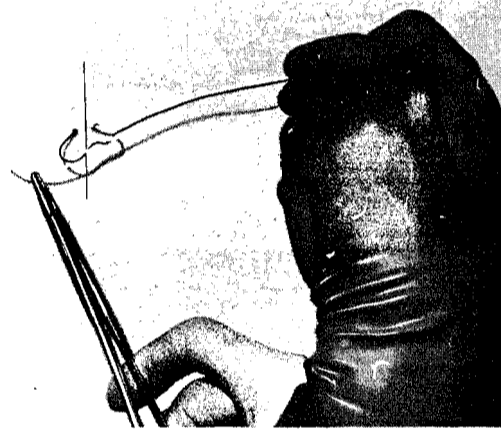


Figure 2-39. The hands are crossed and even tension is applied.

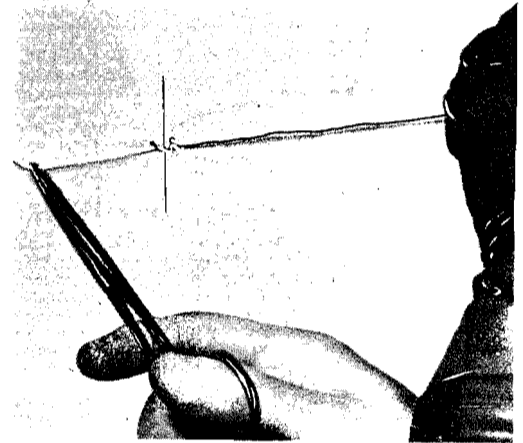


Figure 2-40. The first loop, when tightened, will not slip as readily as it does in the square knot.

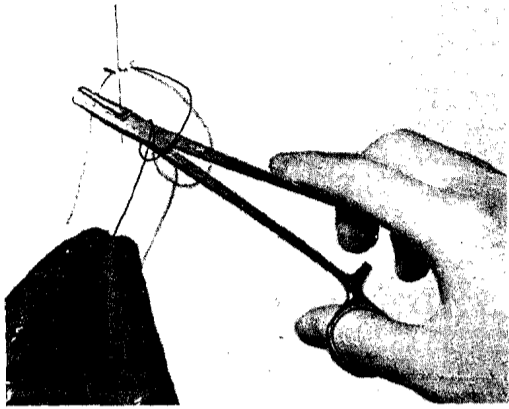


Figure 2-41. The second loop is tied as a single throw around the needle holder, which is placed between the two strands.

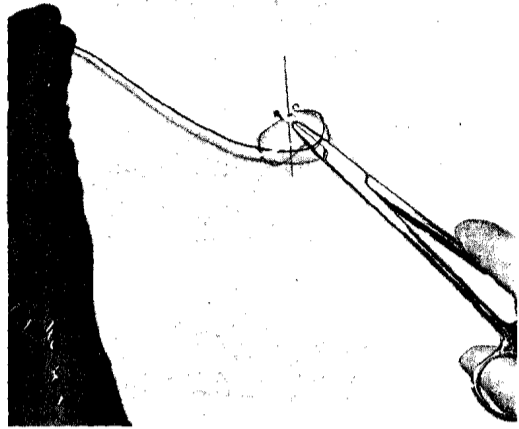


Figure 2-42. The short end is grasped and pulled through the loop.

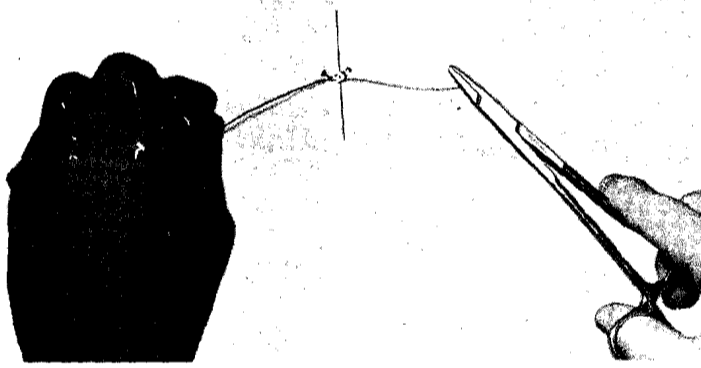


Figure 2-43. Even tension is applied to tighten the knot.

3

SUTURE PATTERNS

INTRODUCTION

A number of surgical suture patterns are used in human beings and animals. For purposes of categorization, the suture patterns are described as *continuous* or *interrupted*. Continuous sutures are not cut short or quickly severed; they run from the point of origin to some relatively distant end point. They incorporate numerous bites in the tissue. Interrupted sutures are tied and cut after one or two passages through the tissue. Lembert and Cushing sutures are examples of the continuous suture; horizontal and vertical mattress sutures are two types of interrupted sutures. There are simple continuous and simple interrupted sutures as well. Suture patterns need not be described exclusively as continuous or interrupted. Indeed, they may be divided into the *simple* and *mattress* categories. The simple type of suture is one that directly apposes adjacent tissues by a single passage through the tissue on each side of the incision. Mattress sutures are designed to withstand added tensions. Mattress sutures incorporate a small mass of tissue on each side of the incision.

Suture patterns may additionally be classified as everting, inverting, and apposing. The latter suture is designed to bring the tissues in direct apposition. Everting sutures tend to turn the tissue edges outward (away from the patient and toward the surgeon). Inverting sutures turn the tissue inward toward the patient or toward the lumen of a viscus. The advantages and uses of the various suture patterns will be discussed individually.

INTERRUPTED SUTURES

Simple Interrupted Suture

The primary advantage of the interrupted suture is its ability to maintain strength

and tissue position if part of the suture line fails. Each suture in the interrupted pattern is individually tied and severed distal to the knot; each suture is therefore a unit and not entirely subject to the strength of the adjacent sutures. The technique for the individual sutures is easy and rapid. The disadvantages of interrupted sutures are the greater amount of suture material used, the overall time involved in tying and cutting additional knots, and the presence of additional amounts of suture material in the tissues in the form of knots. Frequently, these knots may be palpable for some time after surgery. In addition, the pattern has minimal holding power against stress.

The simple interrupted suture is made by directing the needle through the tissue approximately 2 to 3 mm ($\frac{1}{8}$ ") lateral to the incision line. The suture is inserted through the tissue on one side, passed through that on the opposite side, taking the same amount of tissue in a single bite, and tied. The knot should be offset, so as not to rest on the incision, and the ends should be cut. The next simple interrupted suture is placed approximately 0.5 cm from the first (Fig. 3-1). The surgeon should take advantage of



Figure 3-1. Simple interrupted suture pattern.

the field of incision and his own dexterity by placing sutures from right to left in a horizontal incision if he is right-handed, and from left to right if he is left-handed. Whatever hand they favor, surgeons should suture a vertical incision from the end most distal toward the end most proximal. The simple interrupted suture is an apposing suture if properly applied, but excessive tension will generally cause inversion. Inversion of the skin should never be allowed; eversion would be preferable. Inverting simple interrupted skin sutures should be converted to everting sutures or replaced by sutures with less tension before a bandage is applied.

Horizontal Mattress Suture

The horizontal mattress suture is a tension suture. It is used where relative speed is desired but the need for a larger tissue mass within the suture is apparent. It is particularly useful in suturing the skin of the dog, the horse, and the cow. In making the horizontal mattress suture, the surgeon introduces the needle 2 to 3 mm to the right of the incision (if he is right-handed). The needle is passed angularly through the tissue below the edge of the tissue plane, crosses the incision line, and exits in an angular pattern on the opposite side. The suture is advanced approximately 8 mm and is introduced from the left side, crossing the incision line to the right side. The suture is tied on the right side (Fig. 3-2). The advantages of the horizontal mattress suture are twofold: It involves a small amount of suture



Figure 3-2. Horizontal mattress pattern.

material, and it can be rapidly applied. In addition, a tension type of suture is obtained. The primary disadvantage of the horizontal mattress suture is the relative difficulty of applying it in skin without causing excessive eversion. The fact that the pattern is so difficult for the novice to apply properly makes it an excellent teaching tool requiring total concentration on technique. If the mattress suture is applied so that it angles through the skin and passes just below the dermis—and if the incision is just tight enough for the skin edges to meet—eversion is less likely (Fig. 3-3). Depending on the subject and the tissues to be sutured, the horizontal mattress sutures are usually separated by a 4-mm space.

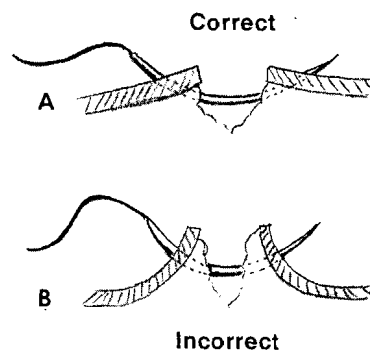


Figure 3-3. Positioning of the horizontal mattress suture.

Vertical Mattress Suture

The vertical mattress suture is also a tension suture. It is stronger in tissues under tension than is the horizontal mattress suture. The disadvantages of the vertical mattress suture are that it requires an increased amount of suture material and is time-consuming to apply. The vertical mattress suture is introduced approximately 8 mm from the incision on one side, passed across the incision line, and made to exit at an equal distance on the opposite side of the incision. The needle is then reversed and returned to the original side by passing 4 mm or less from the incision on each side. The knot is tied on the side of origin (Fig. 3-4). The sutures should be placed approximately 5 mm apart. There is little eversion, because the returning suture is placed close to the incision line.

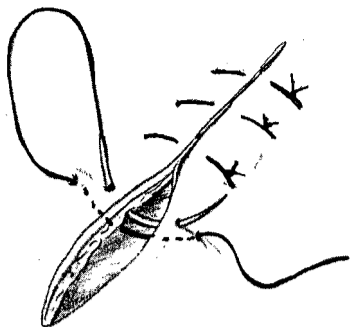


Figure 3-4. Vertical mattress suture.

The Cross Mattress Suture (The X-Mattress Suture)

A modification of the mattress suture is the cross mattress suture (the X-mattress suture). The suture is applied as though it were two simple interrupted sutures joined together. The needle is introduced on one side 3 to 4 mm from the incision and is passed to a corresponding point on the opposite side. The needle is then advanced approximately 5 mm and is passed across the incision line without entering the tissues. A second passage is made through the tissues parallel to the first passage. The suture origin on one side is tied to the contralateral end on the tissue surface. A figure X is obtained (Fig. 3-5). The cross

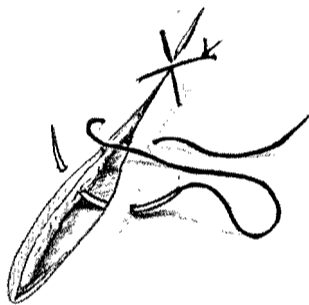


Figure 3-5. Cross mattress suture (or X-mattress suture).

mattress is a tension suture that has the advantage of bringing tissues into apposition, which is particularly useful in suturing stumps. Amputations of the tail and digits of dogs tend to result in flaps of skin that open rather than join. The vertical mattress pattern may be used to close such stumps

effectively but requires twice as many sutures as the cross mattress pattern. Cross mattress sutures provide strength and prevent eversion.

Crushing or Gambee Suture

Crushing sutures are useful in intestinal anastomoses, in which a single-layer interrupted closure is desired. Experimental studies in the dog and cat indicate that crushing sutures produce minimal leakage and good apposition of viscera with large lumen size. Crushing sutures may be applied in simple interrupted or Gambee pattern. In the former, the simple interrupted sutures are placed and tightened firmly so that they are indented through the mucosa and serosa. The Gambee suture is introduced much like a simple interrupted suture, passing from serosa through muscularis and mucosa to the lumen. The suture is returned from the lumen through the mucosa to the muscularis before it crosses the incision or the site of anastomosis. The needle is introduced in the muscularis on the opposite side and is continued through the mucosa to the lumen. It is then reintroduced through mucosa, muscularis, and serosa to exit at the external surface. The beginning and end are tied tightly so that the suture impresses itself on the bowel tissue (Fig. 3-6). The pattern tends to re-

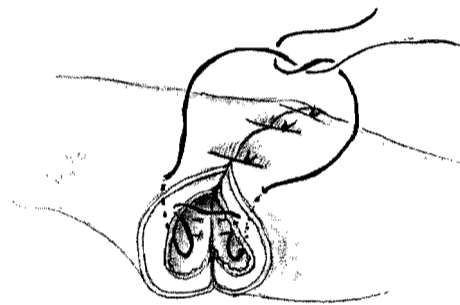


Figure 3-6. Gambee suture.

duce the passage of fluid from the lumen to the serosa along the suture, which occurs in most through-and-through sutures (this characteristic is known as the wick tendency). In the dog and the cat, crushing sutures have caused minimal stenosis, adhesions, and infection.

BURYING THE KNOT

In certain suture patterns, the knot should be buried beneath the tissue surface to prevent excessive irritation. Catgut sutures of subcutaneous and subcuticular tissues should be buried; if they are not, the presence of a large knot below the skin may cause excessive pressure and local necrosis of the skin. The knot may be buried by introducing the needle deep in the subcutaneous tissues and passing the suture toward the dermis. The exit point of the suture is the incision line ventral to the dermis (Fig. 3-7). The suture is then passed across the

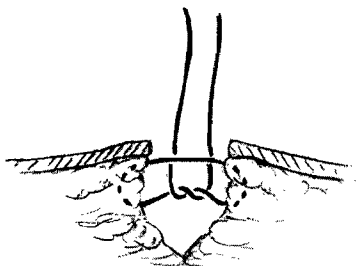


Figure 3-7. Burying the knot.

incision line, introduced in the subcutaneous tissue close to the dermis, incorporating subcutaneous tissues, and recovered deep in the incision line. The beginning and end are knotted deep in the tissues.

CONTINUOUS SUTURES

Continuous sutures are those that are neither knotted nor cut after each introduction or pair of introductions through the tissue. The advantages of the continuous suture line are ease of application, minimal use of suture material, minimal amount of knots, and ease of removal. In addition, there is more complete tissue apposition. Where simple interrupted sutures may cause a curtaining effect between sutures, a continuous pattern will firmly appose the adjacent tissues and will prevent fluid or tissue leakage through the incision line. The primary disadvantage of the continuous suture pattern is the dependence of the whole pattern on each of its parts. Slippage of either the beginning or end knot is likely to cause failure of the entire suture line. Particular attention must be paid to the integ-

rity of the suture material and the knots when continuous sutures are used. The surgeon suturing in a continuous line should grasp catgut sutures with forceps *only when tying a knot*. Any other compression with forceps causes a loss of strength, which may result in the loss of the suture pattern.

Simple Continuous Suture

The simple continuous suture consists of a series of simple interrupted sutures that are tied at the beginning and end but are continuous between these two points. A simple interrupted suture is placed and knotted, but only the short, or non-needle, end is cut. The end with the needle is advanced and introduced through the tissue perpendicular to the incision line. No tying is done as the suture is again advanced and reintroduced in the same direction as the previous sutures. The suture pattern that results has a suture perpendicular to the incision line below the tissue and advancing forward above it (Fig. 3-8). The procedures can be



Figure 3-8. Simple continuous suture.

reversed so that the external suture is perpendicular to and the deep passes are angled across the incision. The small improvement in appearance does not appear to justify the minimal increased difficulty of application. At the end of the incision line, or a distance usually not exceeding 13 cm (5"), the suture is tied with three single throws. The suture is ended with one of several techniques. When a swaged-on needle is used, the needle end of the suture may be tied to the last available external loop of suture (Fig. 3-9A). If the remaining end is short and a

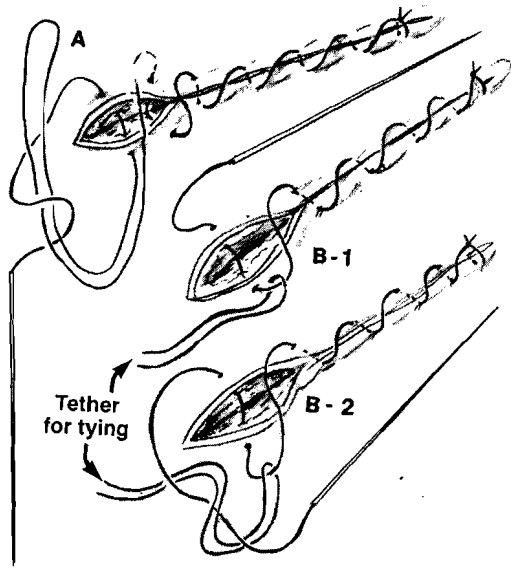


Figure 3-9. Ending a continuous suture with a swaged-on needle. A, Tie for a long end. B, Tie for a short end.

hand tie is preferred, an additional piece of suture may be passed through the loop and used as a tether to tie a flat knot (Fig. 3-9B). A better knot results by placing an added suture close to and in reverse direction from the normally last passage, tying the needle end to the narrow loop produced (Fig. 3-10A). If a needle with an eye is used,

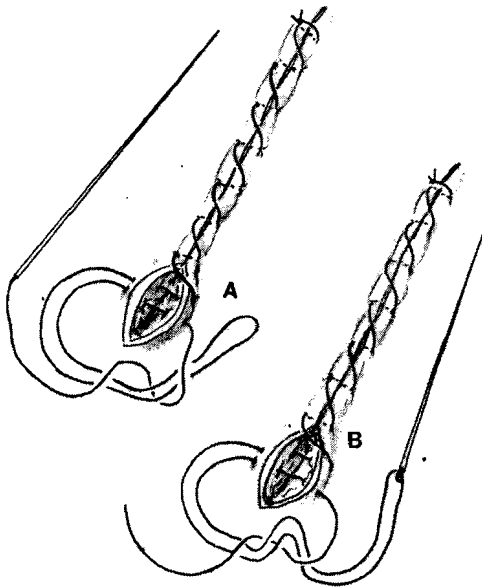


Figure 3-10. Alternative ending patterns to produce a smaller knot with a continuous suture pattern and swaged-on (A) or open-eyed (B) needle.

the needle is advanced through the tissues, and the short end of the suture is held on the proximal end of the needle passage (Fig. 3-10B). A loop of suture is pulled through with the needle, and this loop is tied to the single end on the contralateral side. The knot is tied, and the suture material is cut beyond the knot. A modification of the simple continuous suture is the *running suture* (Fig. 3-11). The running suture is a simple

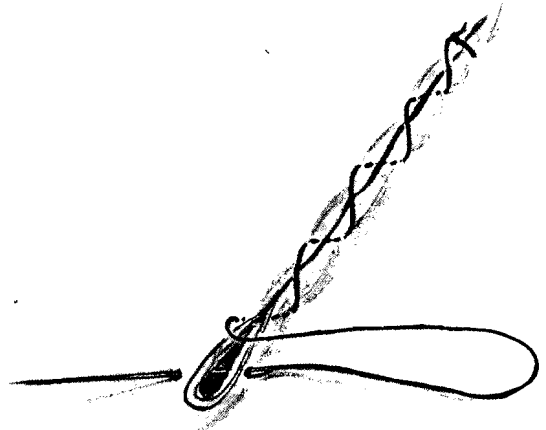


Figure 3-11. Running suture.

continuous suture in which both the deep and superficial portions advance rather than the deep portion passing perpendicular to the incision line. The result is a basting stitch. The running stitch allows the surgeon to advance the suture somewhat faster than does the simple continuous suture; nevertheless, regularity in stitching (i.e., a symmetrical pattern) is more elusive.

Simple continuous sutures are generally used in tissues that require minimal holding but maximal tissue apposition. The suture tends to create an air- and liquid-tight seal that prevents passage of even minimal quantities of fat through the incision line.

The simple continuous suture is also quite useful in the closure of subcutaneous tissues and fascia in nontension planes. The knot may be buried with simple continuous and running sutures. The first pass is begun deep in the tissues and is directed toward the surface. The needle is reinserted from the surface and is directed to the deep tissues on the opposite side. The end of the suture should be held toward the open portion of the incision line rather than toward the starting point of the sutures. The needle