

ADVANCED SUTURE TECHNIQUES: Clinically Illustrated

Craig A. Camasta, D.P.M.

Soft tissue manipulation and approximation are integral parts of a variety of lower extremity surgical procedures. The ability to control tendon, joint capsule, and the integument directly influences the long-term outcome of procedures which require an advanced technique. The description of many surgical procedures often alludes to performing some form of soft tissue suture manipulation; however, the assumption is too often made that the surgeon is adept at performing such a maneuver. Likewise, few descriptions have been presented to direct the surgeon to the proper technique. Even if the diagnosis is accurate and the surgical procedure is appropriate for the deformity, the outcome may be compromised if one of the critical components are inadequately performed. This may account for differing reports on the success of a procedure, based on name alone, if the technical details of one of the components are compromised. The success of soft tissue manipulation of a flatfoot correction, muscle-tendon balance of a hallux valgus repair, or effectiveness of a tendon transfer, directly correlates to the manner in which the soft tissues are approximated.

Three techniques of soft tissue manipulation will be presented in detail. These include the adductor tendon transfer, a tendon-capsule advancement pulley suture, and a method of skin closure which sequentially reduces tension on a gaping wound. Although simple in the effect that is desired, the actual maneuvers require attention to detail which will facilitate ease of performance and effectiveness of correction.

Central to understanding how each suture technique works is the observation that if a suture crosses itself, it will become entangled, restricting the glide of the suture through the tissue. This requires the surgeon to place undue force on the suture, which compromises adequate manipulation of the tissue, and further traumatizes or shreds the tissue that is being handled. Since the tissues that are to be approximated are often not in direct

apposition, one must visualize where each tissue layer will eventually be positioned, and plan the passing of the suture through the tissue, with the end result in mind.

ADDUCTOR TENDON TRANSFER

The adductor tendon transfer in hallux valgus surgery is an essential element of soft tissue contracture rebalancing of the first metatarsophalangeal joint. The procedure requires the transfer of a tendon into a distant region of joint capsule. Since the tendon is under tension, both structures will not be directly opposed until the suture is knotted at the end of the maneuver. One must visually predict where the tendon needs to end up, and over-compensate for flexibility of the soft tissues that are being apposed. A simple interrupted technique is inadequate for such a repair, since too much tension is required to bring these two distant tissues together, and the soft tissues fail to support the pull of the suture. In addition, the tendon has longitudinally running fibers which a suture easily pulls through if too much tension is placed on one point of stress. Use of an over-and-over technique allows for four points of tension distribution. However, crossing of the suture impedes smooth tension-free gliding of the suture through the tissues, and results in shredding of the tendon and failure of the suture. Performing such a technique requires that the deepest layer of tissue is addressed first, followed by closure of the more superficial layer (one should not close the superficial layer before addressing the deeper layer). A suture which is placed in the following manner will effectively distribute tension over four points of stress, and prevent pull-out of the suture through the tendon without crossover (Figs. 1A-1K).

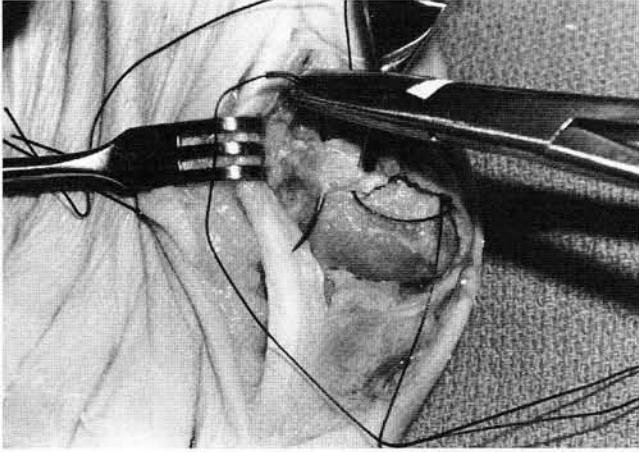


Figure 1G.

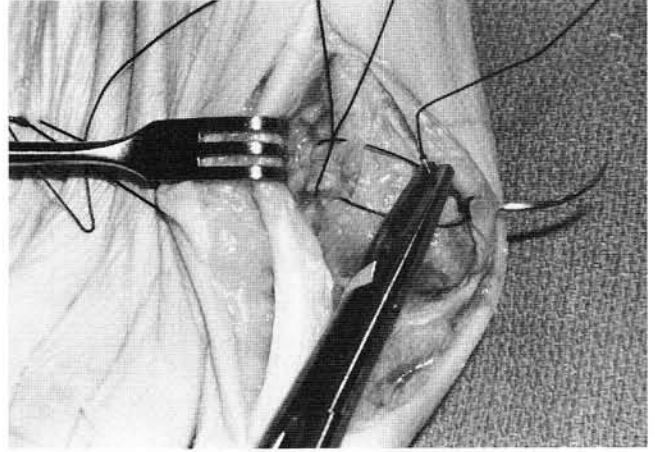


Figure 1H.

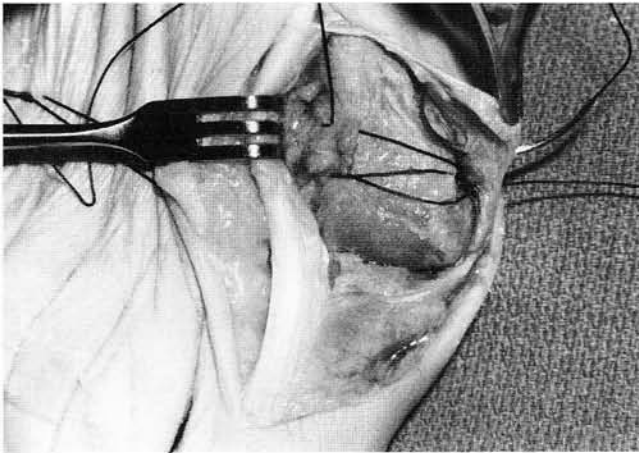


Figure 1I.

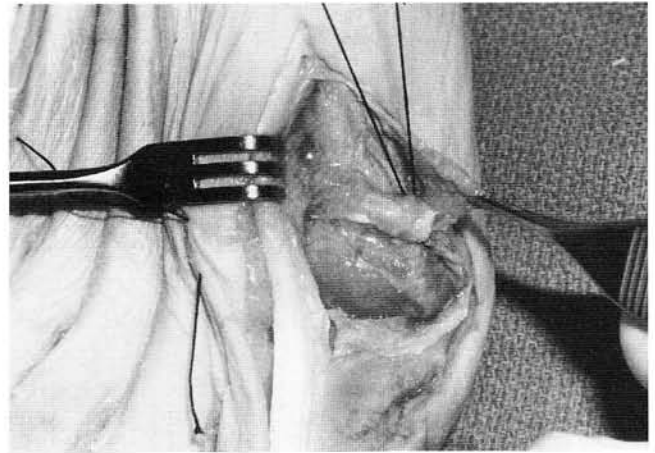


Figure 1J.



Figure 1K.

TENDON-CAPSULE ADVANCEMENT BOX SUTURE

Manipulation of tendon or joint capsule is an integral part of the soft tissue correction of the medial arch in repair of a flexible flatfoot deformity. Other anatomic uses of this technique include tendon transfers (TATT, TPIT, PLTT), or tendon transfer augmentation in the repair of tibialis posterior dysfunction or lateral ankle stabilization procedures. Effective transfer or shortening of a tendon or joint capsule requires a strong suture which can withstand the tension required to obtain correction, and hold the corrected position until healing has occurred. Similar to the adductor tendon transfer technique, the deepest layer of closure needs to be addressed first, followed by the more superficial layer. Since the two layers to be shortened upon one another are usually not in direct apposition, the surgeon will need to visualize which layer will end up superficial to the other, and plan the sequence of passing the suture so that the knot will lie on the surface which faces the surgeon. One must remember that the knot will end up on the side of the tendon or capsule that the suture is first passed through. By visualizing a box orientation to the way in which the suture will pass through the tissues, one can prevent crossing of the suture which will impede smooth gliding of the suture through the tissue. Tendon to tendon, tendon to capsule, and capsule to capsule repairs can be performed utilizing the following techniques.

Technique I

This technique is recommended for situations where the deeper layer of tissue is a tendon, since the orientation of the suture through the tendon is perpendicular to the longitudinal fibers of the tendon, which encircles the fibers and prevents pull-out of the suture. This technique can also be used to advance capsule on capsule, since neither layer contains fibers which will be affected by the orientation of the suture. Notice that the first pass of the suture is on the bottom (deep) side of the superficial layer, and that the free end of the superficial layer is addressed last. This will insure that the resultant knot will face the surgeon, and that the free end of the superficial layer will remain accessible to completing the final passes of the suture (Figs. 2A-2I).

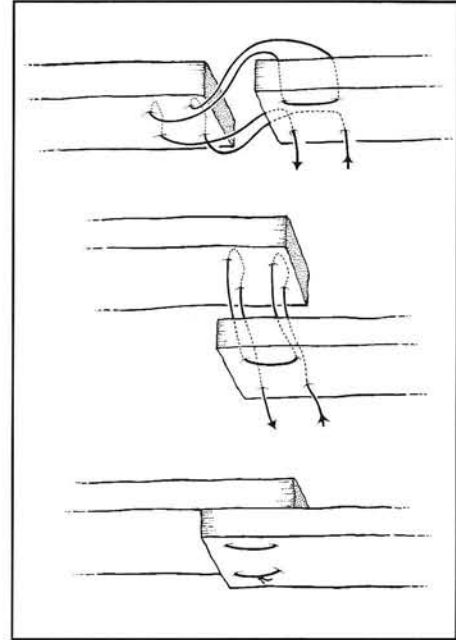


Figure 2A.

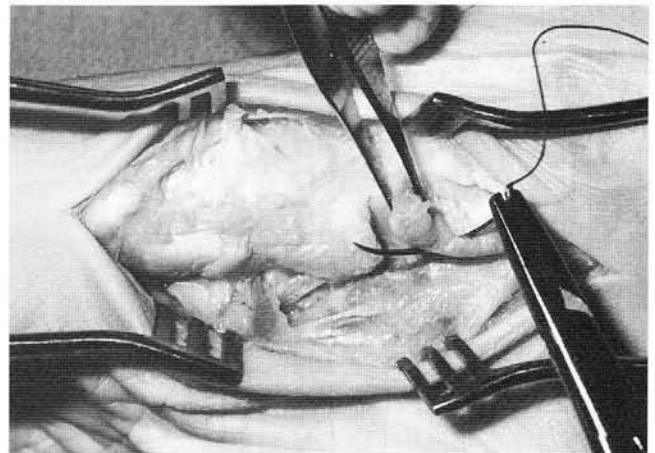


Figure 2B.

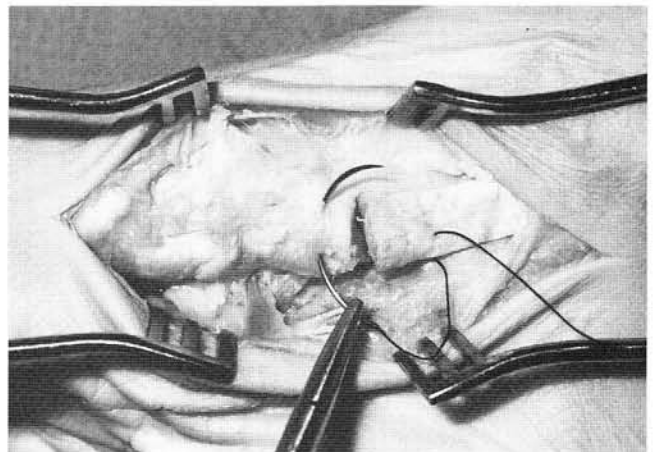


Figure 2C.

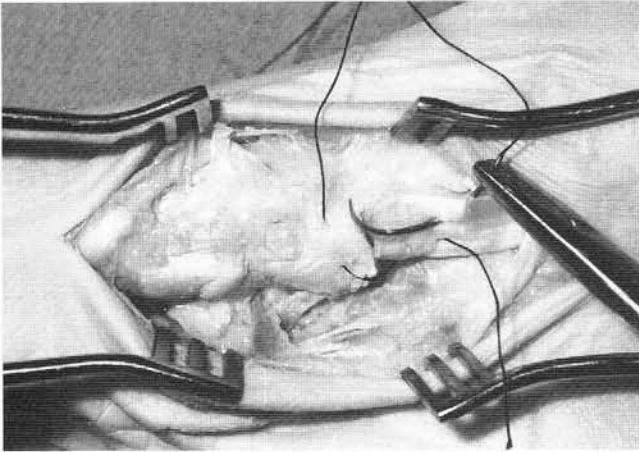


Figure 2D.

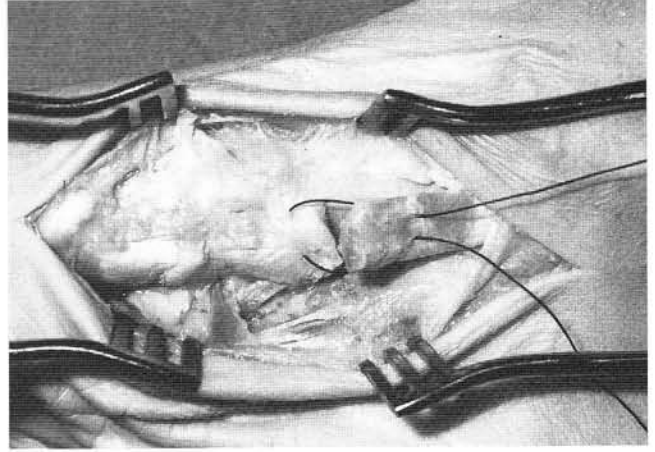


Figure 2E.

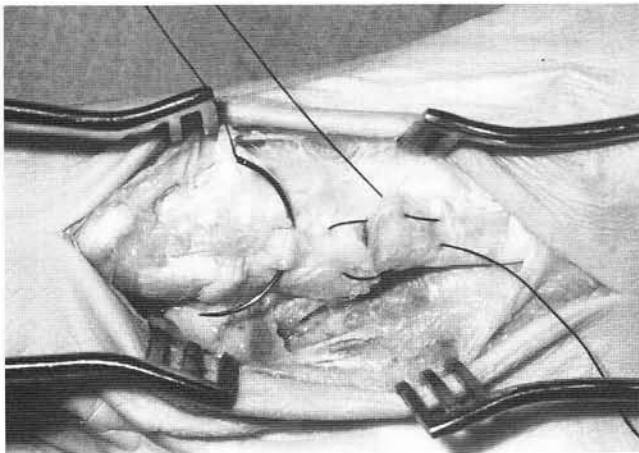


Figure 2F.

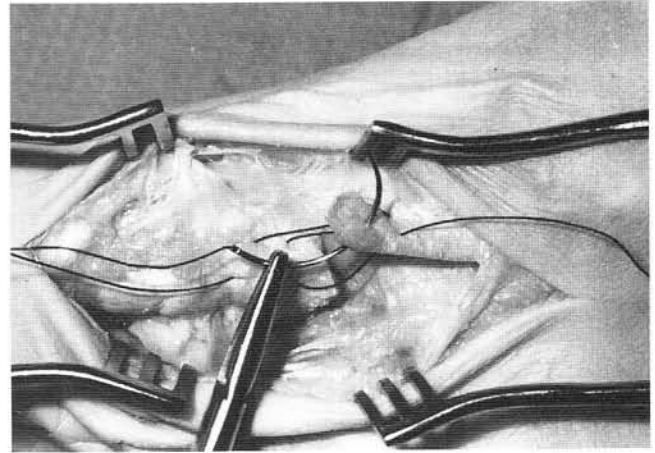


Figure 2G.

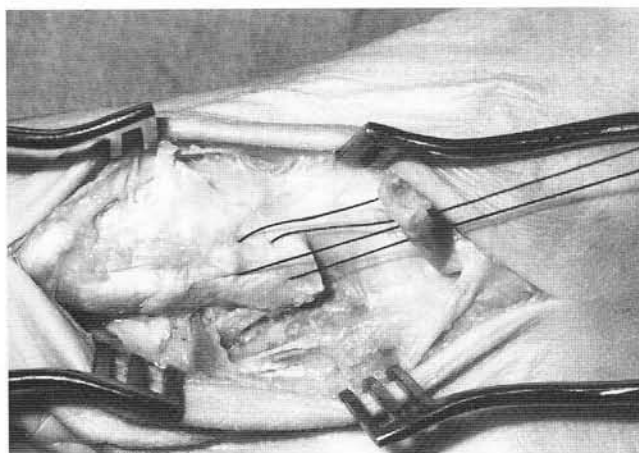


Figure 2H.

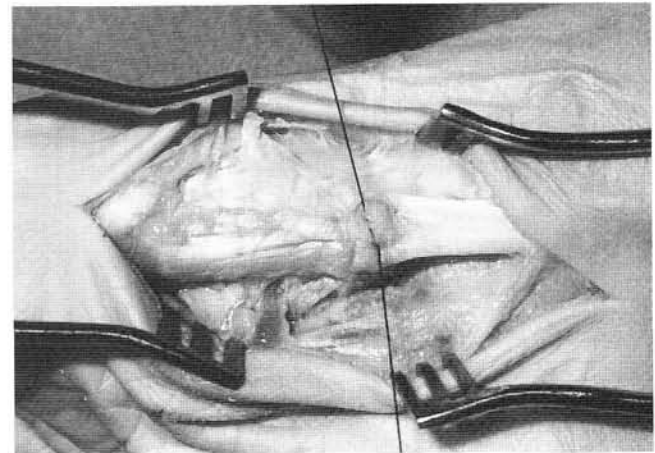


Figure 2I.

Technique II

This technique is the mirror image of the previous technique. This method of passing the suture is recommended when the superficial layer of tissue is a tendon, since it will encircle the longitudinal fibers of the tendon, and prevent pull-out of the suture. Again, the first suture pass starts at the bottom (deep) side of the superficial layer, and the free end of the superficial layer is addressed last to allow access to pass the suture without crossing the previous passes (working from deep toward superficial) (Figs. 3A-3D).

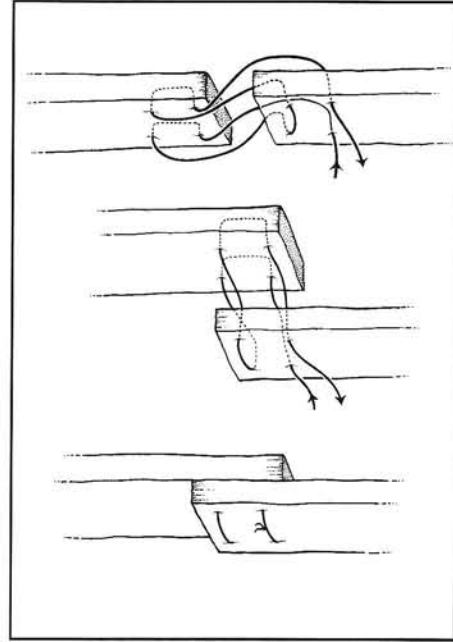


Figure 3A.

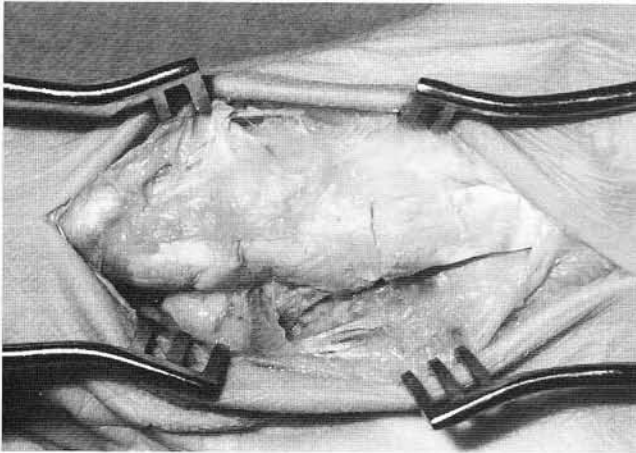


Figure 3B.

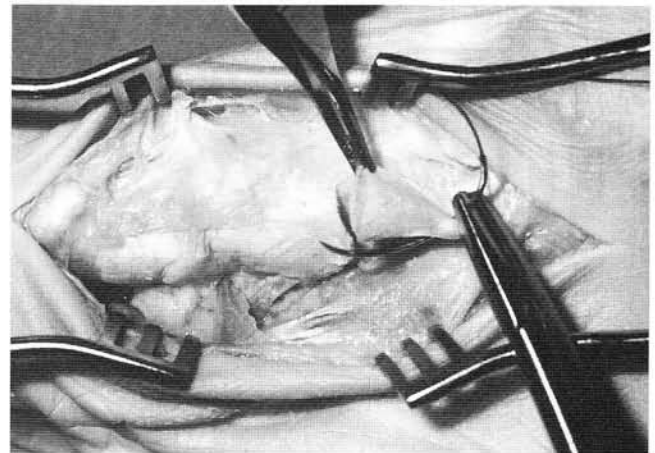


Figure 3C.

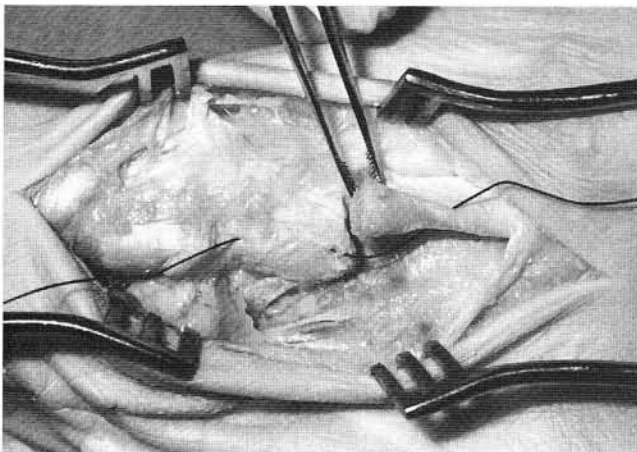


Figure 3D.

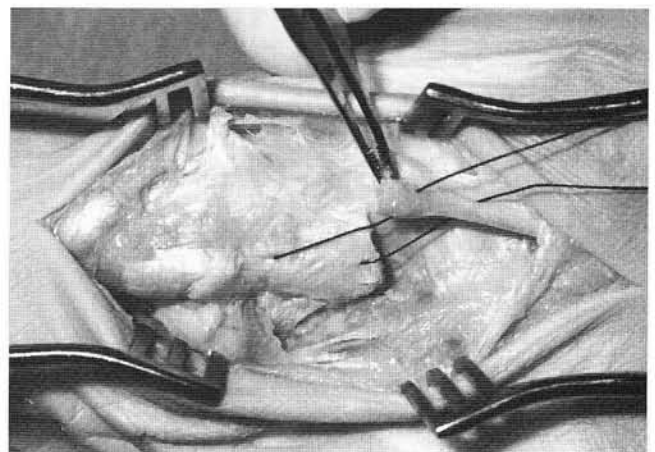


Figure 3E.

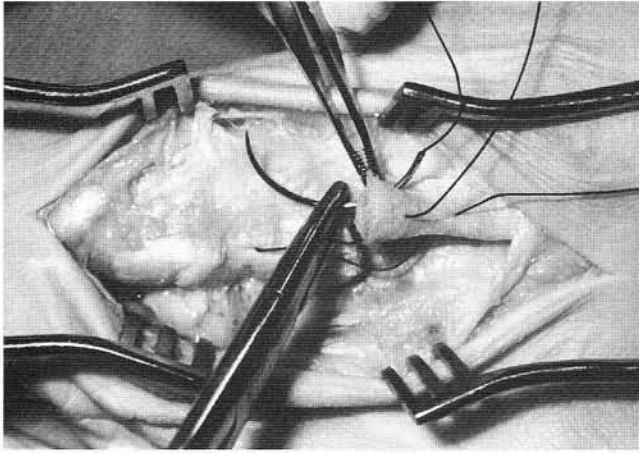


Figure 3F.

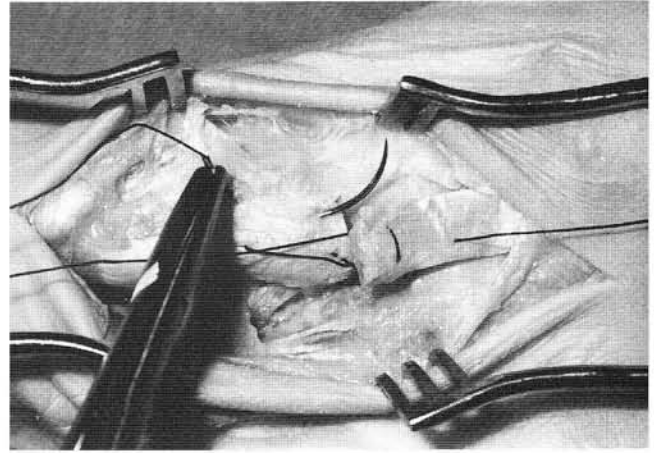


Figure 3G.

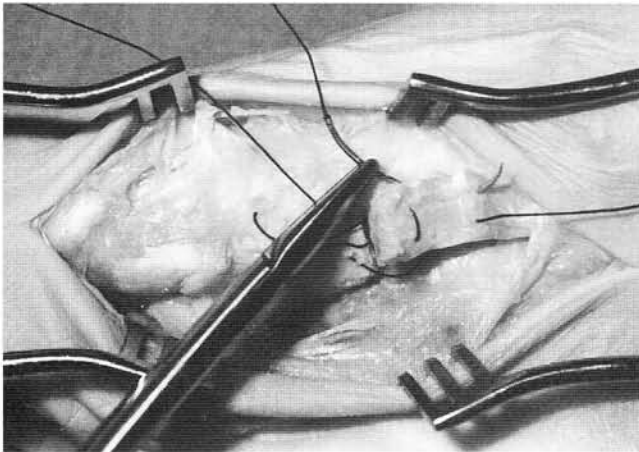


Figure 3H.

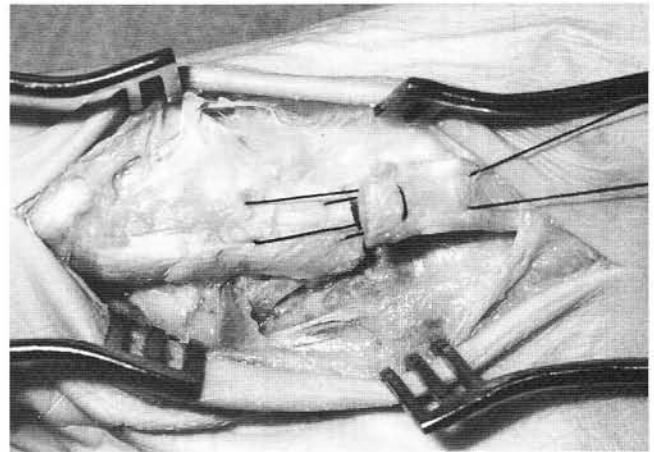


Figure 3I.

OBLIQUE MATTRESS SKIN SUTURE

Surgery often requires gaining skin closure in the face of a gaping wound which is under a great degree of tension. Clinical situations in which this is encountered include soft tissue loss from trauma, incision for drainage of an infection or a wound dehiscence, scar revision, or following a wide resection biopsy or excision of an ulcer. This method combines the benefits of both the horizontal and vertical mattress suture techniques. This technique relies on each successive suture to reduce the tension on the skin for the next suture pass. The first pass of the suture is near the skin edges, while the second pass of the suture both advances in the manner of a horizontal mattress suture, and also encompasses a wider margin of skin similar to the vertical mattress technique. The advancing wide pass of the suture reduces the tension on the skin margins, thereby setting-up for the next suture, which begins with a skin margin apposing throw followed by another wide margin retention pass. A series of these sutures results in gradual reduction of skin margin tension, and enables the surgeon to close a gaping wound that would otherwise require a skin flap or graft for closure. The resultant suture line resembles a herring-bone pattern (Figs. 4A-4G)

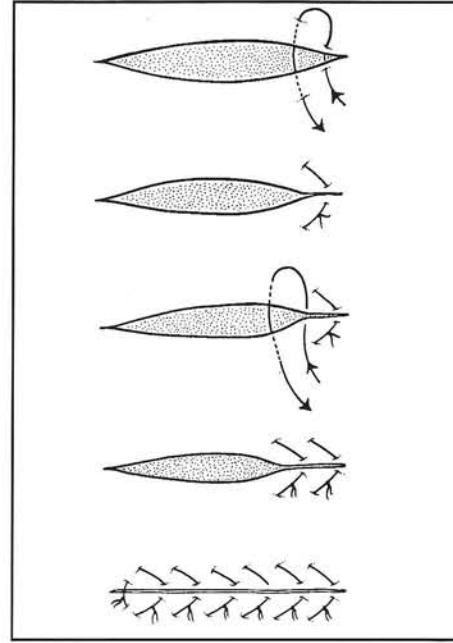


Figure 4A.

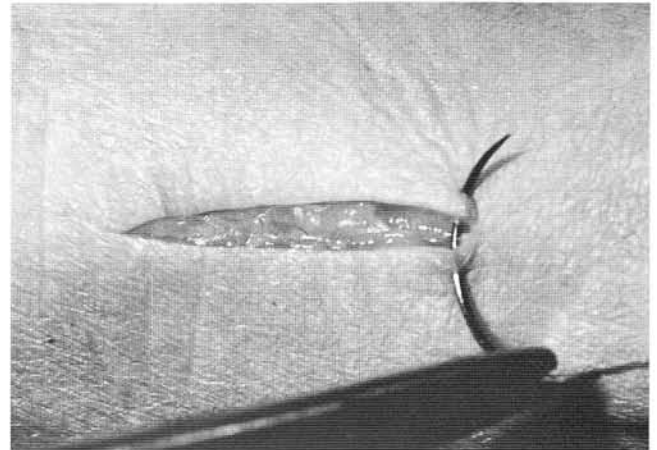


Figure 4B.

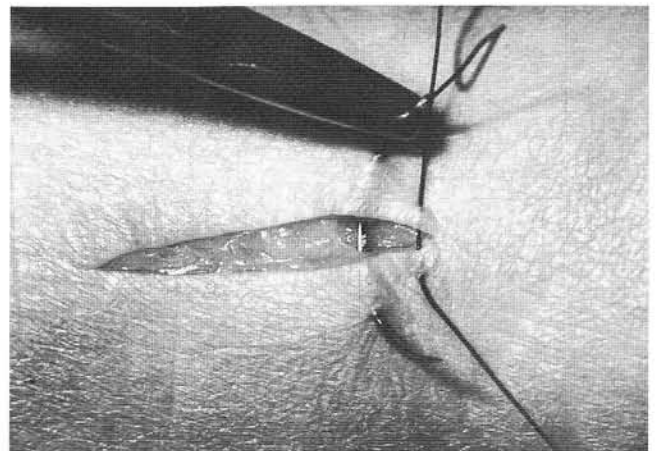


Figure 4C.

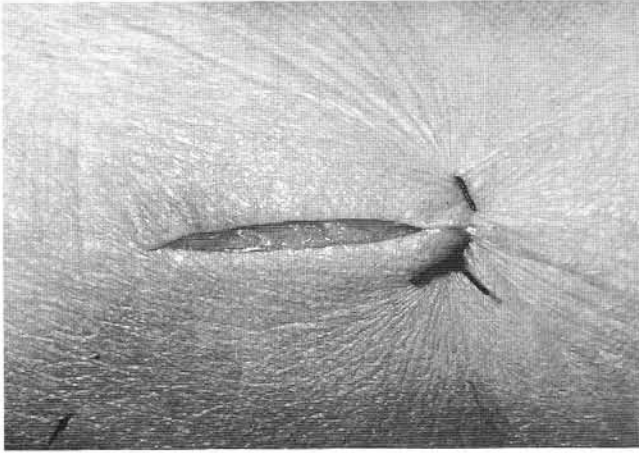


Figure 4D.

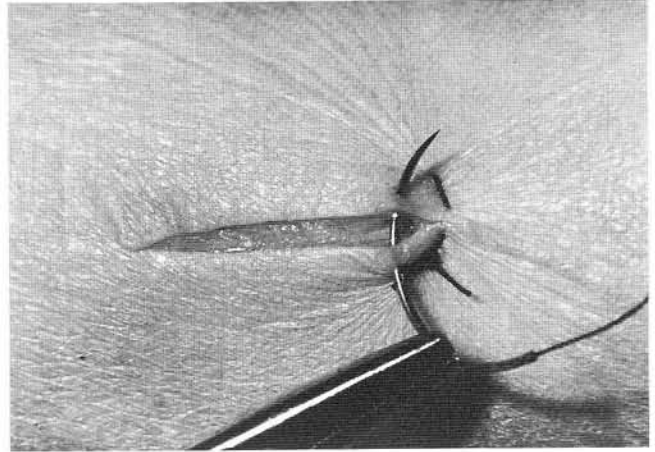


Figure 4E.

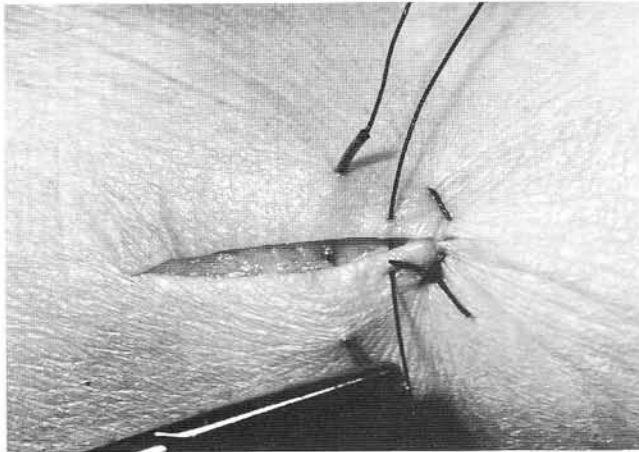


Figure 4F.

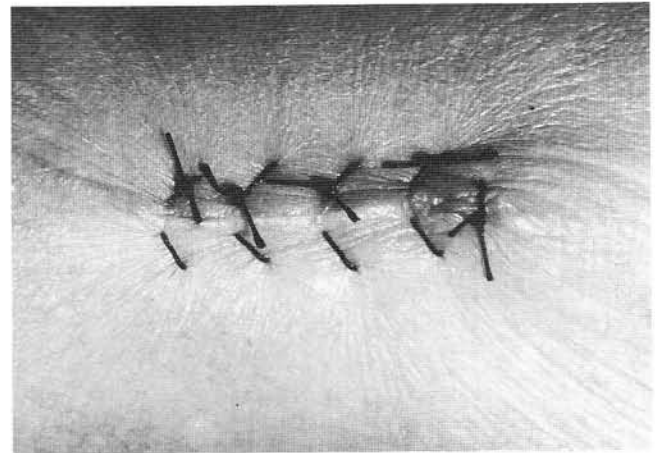


Figure 4G.