

EXTENSILE EXPOSURE IN THE FOOT AND LEG

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There are many factors involved in the planning and execution of elective surgical exposure in the foot and leg. General considerations include patient age, the condition of the skin to be incised, the overall health of the patient, as well as regional anatomic and functional influences. A working understanding of the concept of relaxed skin tension lines (RSTL), as well as specific technical factors are also of much significance. The chief goals behind careful planning and execution of elective surgical incisions are adequate extensile exposure, and the formation of a satisfactory postsurgical scar.

General Considerations

It is important to realize that the skin of younger patients is more elastic and is supported by more subcutaneous fat than is the skin of elderly individuals. Therefore the younger individual's relaxed skin is, in general, under a greater amount of distention. An incision placed in the skin of a young patient will tend to gape and lead to scar hypertrophy unless it is properly oriented and managed.

The condition of the skin to be incised greatly influences the resultant scar. Obviously, elective surgical procedures should be delayed until the resolution of any local infection, sinus tract, erosion or ulceration, as well as trauma blisters or any other vesicular or bullous eruption. Any local defect that further disrupts the dermal architecture or enhances the risk of infection will aggravate wound healing and scar formation. Hyperkeratotic lesions should be debrided prior to vertical knife penetration. Moreover, systemic conditions such as poor nutritional status, constitutional illness (RA, DM, collagen-vascular disease) and/or corticosteroid usage can adversely influence the postoperative scar.

Regional anatomic and functional considerations influencing surgical approaches to the foot and leg are reviewed in great detail by Miller (1). Of key importance is the avoidance of injury to regional neurovascular and tendinous structures. An appreciation of the fact that plantar weight-bearing skin heals equally as well as nonweightbearing and dorsal skin when properly incised and managed, is also important.

Concept of Skin Tension Lines

The concept of relaxed skin tension lines (RSTL) is described by Borges and Alexander (2). The RSTL, or lines of skin tension, vary with body configuration. They are conceptual, or imaginary, and their importance lies in an understanding of the significance of their direction.

Skin tension lines exist because of the visco-elastic nature of primarily dermal, and to a lesser degree subcutaneous, collagen and elastic fibers. Over a period of time the fibers in relaxed skin will align their long axes in the direction of stretch or tension, produced *within* the skin by underlying structures such as muscles, tendons, and bone. The collagen and elastic fibers in relaxed skin are, therefore, oriented perpendicular to the long axis of the underlying muscle and/or tendon (2-7). The microscopic fiber orientation within relaxed skin is also perpendicular to the gross functional direction of pull of the muscle acting on the entire extremity.

Understanding the direction of the RSTL makes clear the fact that an incision oriented perpendicular to the skin tension lines will gape apart as it is subjected to the tension within the skin. This tendency for the wound edges to separate leads to hypertrophy of dermal collagen and an unsatisfactory scar. On the other hand an incision oriented parallel to the RSTL will not tend to gape, thereby enhancing fine scar formation.

Another point to consider is that the collagen fibers in a healing incision will align parallel to the long axis of the scar. This occurs regardless of the orientation of the incision to the lines of skin tension. Ideally, the collagen fibers within a scar should align with the fibers in the surrounding relaxed skin, otherwise hypertrophic scar formation is enhanced.

Taking into consideration the concept of RSTL, we see that the best elective surgical incision is oriented parallel to these lines. Incisions oriented oblique to the RSTL will gape to a lesser degree than those that are perpendicular, and the oblique incisions will gape in an "S" shape (Fig. 1). Moreover, it is also clear that extensile exposures of the foot and ankle that require long incisions are more likely to have fine scar formation if a zigzag technique

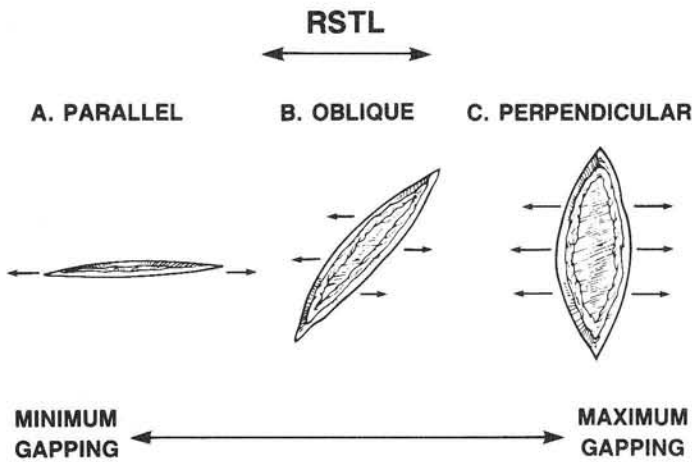


Fig. 1. Incisions oblique to the relaxed skin tension lines (RSTL) tend to gape in an "S".

is used, rather than a long curved design that violates the RSTL over a large portion of its length (Fig. 2).

The imaginary RSTL can be visualized in the skin of the lower extremity by:

1. Noting existent creases and wrinkles in relaxed skin
2. Actively contracting skeletal muscles
3. Gently applying manual compression to the relaxed skin in the direction of skeletal muscle function.

The majority of these lines in the foot run transversely.

Technical Factors

The use of a skin scribe is recommended as an aid in the visualization of the proposed incision with respect to surface landmarks and deeper structures. Cross-hatching the incision at the start of the case may also be useful during closure of a long curvilinear exposure.

The choice of blade size and the type of grip used to hold the scalpel are based upon the individual surgeon's preference. Generally, a # 10 blade is used for initial skin penetration on the glabrous surfaces, followed by deeper dissection using a # 15 blade. A # 15 blade may enhance control when making fine zigzag incisions or when working on the digits.

Anatomic dissection techniques are utilized at all times. Hemostasis is generally achieved using a dilute epinephrine solution infiltrated throughout the subcutaneous layer deep to the proposed incision. Anatomic dissection allows systematic tissue separation, visualization of all gross anatomic structures, and provides the

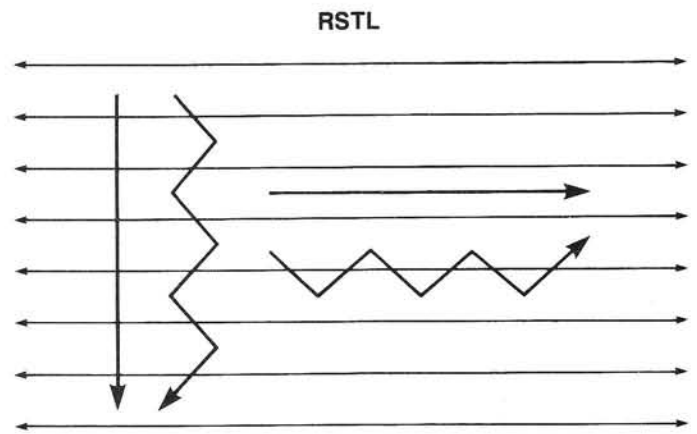


Fig. 2. Zig Zag incisions tend to accommodate to skin tension lines, thus leading to a finer scar.

foundation for systematic wound closure and fine scar formation.

The initial incision is performed in a controlled-depth fashion and is termed the intradermal incision. Crucial to the execution of this and to all incisions is a perpendicular relationship of the knife blade to the surface being incised. Scar formation is primarily based on dermal collagenation, therefore dermal injury must be minimized (4). A beveled incision will increase the degree of dermal disruption, as well as adversely affect surface epithelization, thereby enhancing poor scar development.

The next step in the dissection of skin is the transdermal incision. This incision completes the separation of the dermis and exposes the vessels and nerves within the subcutaneous fat. Bleeders are ligated or electrocoagulated as necessary. Deeper dissection continues following the same principles, until the critical level of the deep fascia is reached.

A final technical factor involves wound margin mobility and incision design. A long curved incision will produce a concave and a convex wound margin. It is important to remember that the concave margin will be less mobile and more difficult to retract when compared to the convex side of the incision. This relationship should be used as a guide to the exact placement of a long curved or curvilinear incision.

Summary

The following guidelines should be taken into consideration every time an elective skin incision is made for extensile exposure of the foot, ankle, or leg.

1. Know the location and direction of neurovascular and tendinous structures in the region to be dissected.
2. Avoid making a beveled (scived) skin incision.
3. When possible always attempt to orient the skin incision parallel to the RSTL.
4. Avoid a straight line incision perpendicular to the RSTL by using curvilinear and/or zigzag techniques.
5. If more exposure is necessary after the dissection has started, simply lengthen the skin incision in the direction parallel to the RSTL.

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