

# SECONDARY CLOSURE OF WOUNDS

LT. GEORGE CRILE, M.C., U.S.N.R.

In the Naval Hospital at Auckland, New Zealand, the most common operation was the secondary closure of wounds. The majority of the wounded evacuated through this hospital from the Guadalcanal and New Georgia campaigns had open wounds when they arrived. Convalescence was often materially shortened and disability minimized by closing these wounds. I believe that the same principles can well be applied to wounds and injuries seen in civilian practice.

## INDICATIONS FOR SECONDARY CLOSURE

The rate of healing of wounds varies greatly and does not appear to be related either to gross infection or to vitamin C deficiency. Moreover, the factors which influence the rapidity with which a wound closes of its own accord have not been determined.

Wounds close by contraction and by epithelization. These processes proceed at different speeds in different persons and in wounds of the same size in different locations. Wounds of the leg, particularly over the tibia, and wounds about the hip usually close slowly. An underlying bone, such as the tibia, seemingly interferes with contraction and with the blood supply necessary for growth of epithelium. Difficulty in immobilizing the hip without using a body cast may be responsible for failure of wounds about the hip to heal.

The size of a wound does not necessarily determine the advisability of closing it. In general, a wound over 2 inches in diameter should be closed, although occasionally it contracts and epithelizes so fast that spontaneous healing is nearly as rapid as the development of solid union after closure. However, a wound only 0.5 inch in diameter may reach complete equilibrium in which no further contraction or epithelization takes place. This phenomenon is usually encountered in wounds over the tibia, but may occur in any wound of long duration when a base of dense scar tissue limits the blood supply and ability to contract.

Since at first glance it is impossible to tell from the rapidity of healing whether closure is desirable, the wound should be observed for a week before advising closure. During this time any residual infection can be

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cleared up so that operation can be done in as clean a field as possible. Many fresh wounds which at first seem to require closure heal so fast during the period of preparation that operation is no longer necessary.

On the other hand, if a small wound, even 0.5 inch or less in diameter, reaches a stage when the edges appear totally inactive, when it is no longer closing by contraction and has remained the same size for a week or more, much time will be saved if a secondary closure is done without delay. Only by observing the wound and noting lack of progress under adequate conservative treatment can the time for closure be determined. Similarly, a wound which has been totally inactive may suddenly start to close and heal with miraculous celerity.

In general, the maximum healing tendency is not indicated until two weeks after the wound has been sustained. By this time the infection usually has subsided, and the wound is granulating cleanly and beginning to contract and epithelize. However, a wound which is two or more months old will exhibit no dramatic healing tendency and often develops the chronicity of an ulcer. It is a good rule, therefore, to close an old wound promptly and to delay in closing a small wound of recent origin. Large fresh wounds heal in accordance with the law of diminishing return: the wound may heal rapidly at first, and then, as scar tissue forms at the base and impedes circulation and contraction, the wound heals more slowly or may never heal. Thus it is unwise to expect the rapid spontaneous closure of a large wound, no matter how fast at first it may appear to be closing.

#### SECONDARY CLOSURE VS. SKIN GRAFTS OR SPONTANEOUS EPITHELIZATION

Whenever possible, closure of a defect by suture is preferable to the grafting of skin. After a closure the surface is composed of normal skin and subcutaneous tissue and is much more resistant to trauma than even a thick skin graft. Scarring is minimal, and unless there is injury to deeper tissues, the patient is fit to return to duty as soon as the wound is solidly healed.

A skin graft, however, must be protected from trauma for weeks or even months and, in areas subjected to weight-bearing or trauma, may never afford an entirely satisfactory surface.

In a large wound extensive scarring from spontaneous epithelization is similarly undesirable. The epithelium is thin and lacks the supportive

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structures of normal skin. This type of epithelium may break down repeatedly from the slightest trauma, and if the scar is at the site of a joint, contracture may limit motion. Secondary closure, therefore, is the treatment of choice of all wounds which might heal with a broad scar that might be the site of future trouble.

It is difficult to determine when to graft skin and when to close a wound by suture. Usually, the skin defect is more apparent than real. The same elasticity of the skin which causes wide separation of the wound edges, especially after radical debridement of the wound, allows the wound to be closed again by suture.

However, when large amounts of skin are actually missing, as in a wound of exit when skin has been avulsed by shell fragments, or when primary closures have broken down with loss of skin edges, the defect may be too large to close without grafting. When this is true, grafting should be deferred until the wound is clean and until all sinuses have filled. After suitable preparation of the surface, a split skin graft should be applied.

The success of secondary closure depends largely upon the ability of the surgeon to immobilize the part and to apply an effective pressure dressing to the wound. When a snug pressure dressing can be applied by a circular elastic bandage, wounds of the arms or legs can be closed even under considerable tension. Wounds about the hip, however, are subject to motion with every movement of the trunk or legs unless a spica cast is used. If there is much tension in an area subjected to motion, the sutures tend to cut through and the wound edges tend to separate, resulting in a failure of the closure. Moreover, pressure is difficult to apply to wounds about the hip. Consequently, although wounds of the legs or arms may be closed under extreme tension, wounds of the hip should be grafted unless they can be brought together with ease.

Wounds of the muscular portions of the legs or arms can be undercut widely so that the edges can be approximated and firm pressure dressing can be applied without danger of interference with the circulation of the skin flaps. Wounds over the tibia, however, must be treated more carefully, for if flaps are widely undermined, the pressure of the dressing against the tibia may cut off the circulation and cause necrosis of the skin edges.

Similarly, when a flap is to be swung from the side of the leg over the tibia, it should first be elevated and then replaced in its bed for a week before effecting final transfer. The circulation of the skin is not so good in the leg as elsewhere, and when flaps are longer than the width of the bases, it is safer to transfer them in stages.

TECHNIC OF SECONDARY CLOSURE

If a defect is to be covered with a skin graft, the surface should be as clean and the granulations as healthy as possible. However, it is not so important that the granulations be flat and red if the wound is to be closed as it is if a graft is to be applied. Although a closure usually can be accomplished successfully even in the presence of considerable discharge, there should be no unclosed sinus tract leading to a pocket from which infection can spread to the entire wound.

Preparation for secondary closure of a clean granulating wound usually consists of sprinkling sulfanilamide powder on the wound twice daily for two days and of applying a pressure dressing saturated with azochloramide solution.

The operation is performed either under local anesthesia or under pentothal and consists of the following steps.

1. Granulation and scar tissues are excised down to normal muscle or fat. When nerves, vessels, tendons, or other important structures are in the vicinity, only the granulations are shaved away. Although it is my impression that the results are better when scar tissue is completely excised, there are not enough failures to warrant the risk of damaging important structures.

2. The skin is undercut sufficiently to accomplish a satisfactory closure.

3. Hemostasis is obtained chiefly by a pressure dressing, no attention being paid to venous or capillary oozing. Spurting arteries are ligated with No. 50 or No. 60 cotton. No catgut is used because of its tendency to cause reaction in the tissues with the resultant development of infection. Few or no ligatures are used. In my experience cotton is not discharged from these wounds.

4. The entire wound is dusted with sulfanilamide powder.

5. The skin edges are approximated with vertical mattress sutures of No. 32 stainless steel wire taking large bites. No rubber gauze nor other material is placed between the loops of the sutures and the skin to prevent the wires from cutting through. The wire with the aid of a pressure dressing holds the skin together long enough to insure adherence of the edges, and then, if the wire does cut through, only small vertical slits are left instead of large areas of necrosis from pressure of the material designed to keep the wire from cutting. Moreover, the circulation of the skin edges is not jeopardized by pressure from broad pieces of rubber under the wire loops. In short, it seems preferable in wounds closed under extreme tension to accept the cutting through of a small loop of the suture rather than to jeopardize the circu-

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lation of the entire edge of the wound by pressure from various devices designed to prevent the sutures from cutting.

6. In the presence of considerable oozing or gross contamination, a small rubber drain is inserted through the skin edges at the dependent part of the wound.

7. A gauze dressing is applied to the wound, and over this, sterile mechanic's waste (cotton) is placed to assure an even distribution of pressure. Pressure is then applied with a woven elastic bandage.

8. If the wound involves a joint, the joint is splinted to insure absolute immobility.

9. The wound is inspected for infection after five days, and if it is healing well, the pressure dressings and splint are reapplied. The sutures are not removed for two or three weeks, even if they tend to cut partially through the tissues. The incidence of infection in these cases is low, and the results are good when pressure and immobilization can be attained, even when the wounds are closed under great tension.

### SUMMARY

The effective secondary closure of wounds shortens the duration of convalescence and minimizes deformity from contracture of wounds. Whenever possible, closure of a defect by suture is preferable to the grafting of skin.

## CHRONIC LARYNGEAL STENOSIS

### *Report of a Case Treated by Skin Grafting*

PAUL M. MOORE, M.D.

Chronic laryngeal stenosis is a diminution in the size of the airway through the larynx, due to formation of scar tissue and adhesions in the larynx as a result of trauma or disease. The same condition may occur immediately below the larynx in the upper end of the trachea. According to Chevalier Jackson<sup>1</sup> 75 to 85 per cent of his cases are the result of high tracheotomy. For years he and his many followers have emphasized the importance of placing the tracheotomy tube as low in the neck, and consequently as far from the laryngeal structures, as possible. If circumstances should demand a fairly high emergency tracheotomy, this should be changed to a low tracheotomy as soon as the patient can reach a properly equipped operating room. Even in a dire emergency, however, one can make the opening in the trachea well below the danger level