EARLY COMPLICATIONS FOLLOWING PENETRATING WOUNDS OF THE SKULL

MAJOR JOHN MARTIN, M.C., A.U.S.,* AND COLONEL ELDRIDGE H. CAMPBELL, JR., M.C., A.U.S.
12th General Hospital and 33rd General Hospital, U.S. Army

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A n analysis of 14,000 battle wounds treated in 5th Army hospitals in the year 1944 disclosed that 6.17 per cent involved the head (exclusive of maxillo-facial injuries). One third of these were classified as intracranial† while the remainder were scalp wounds. At the same time 24.4 per cent of all deaths in these institutions were attributed to brain injuries. The vast majority of these patients were hopelessly injured and died within a short time after reaching a forward hospital. Of those patients with penetrating skull wounds who survived to reach a general hospital in the Zone of Communications, another 3.7 per cent succumbed. For the most part these deaths were ascribable to complications of wound healing. These disorders occurred not infrequently and even though not fatal in the majority of cases, entailed further damage to neural tissue and prolongation of convalescence. It is to describe our experiences in dealing with the problems that arose during the early postoperative course of 426 cases of penetrating skull wounds that this paper is written.

Since morbidity and mortality in military surgery vary according to the echelon, and to the tactical situation, and since weather, topography and evacuation are factors that must always be considered, the following facts are pertinent. The patients whose cases form the basis of this report were wounded in the Tunisian, Sicilian and Italian campaigns. The majority were operated upon in evacuation hospitals, situated 5 to 30 miles behind the front lines. After 3 to 10 days they reached general hospitals, consecutively located in Oran, Bizerte, Rome and Leghorn, where they came under the care of the authors. Evacuation was by ambulance, air, rail or hospital ship. In general the trip appeared to have upset them very little, save those individuals with elevated intracranial pressures. During the period in which this study was made, the skill and experience of forward neurosurgeons greatly increased, with the result that debridements were carried out more thoroughly. Penicillin was used routinely (25,000 units intramuscularly every 3 hours) beginning in the Spring of 1944.

* On terminal leave; now at 700 North Michigan Avenue, Chicago 11, Illinois.
† Major W. R. Pitts reported 108 (1.03 per cent) penetrating brain wounds which came to operation among 10,455 battle casualties admitted to the 38th Evacuation Hospital. Shearburn operated upon 189 (1.6 per cent) patients with similar lesions among 8,660 battle casualties at the 8th Evacuation Hospital; an additional 28 patients were desperately ill on admission and died without operation.
SUPERFICIAL INFECTION

Superficial infection occurred in approximately 19 per cent of the cases in 1943; the incidence was approximately 16 per cent or significantly unchanged in 1945. In this category we have included infections that extended no deeper than the dura, wound dehiscence, and necrosis of even mild degree (in other words any condition less than *per primum* healing). For the most part they were mild, localized processes, usually associated with too much tension or too heavy silk. Removal of sutures and sometimes the application of hot wet dressings sufficed to clear them up within a few days. Rapid healing was not always the case, however, and if the dura had been left open grave complications sometimes ensued. If the wound were large, and particularly if the debridement had not been thorough, it often filled with dirty, purulent granulation tissue and required weeks to heal.

The types of incision employed and the tensions under which they were closed were factors of considerable importance. Even mild wound necrosis or local dehiscence usually led to superficial infection. Where practical the simple vertical or curvilinear incision was most satisfactory from the standpoint of healing. Quite often so much scalp was destroyed that direct closure, particularly after debridement, could not be carried out. To effect approximation under these circumstances was not easy. Methods commonly employed were the “tripod” incision or its Isle of Man modification, one or more relaxation incisions or a large flap. The latter sometimes included the scalp defect in one limb or, if small, in its center.

Tripod incisions, while affording a convenient and rapid exposure, have, in our experience, not healed well. In one series of 26 cases, necrosis of the apex of one or more flaps, wound separation or infection occurred in 18. Sometimes a multangular wound made such an incision unavoidable. When employed, great care must be exercised in handling the flaps to avoid bruising their apices. The flaps should be sufficiently long for the limited elasticity of the scalp to permit stretching over the defect without undue tension. The narrowest angled flap should be on the side of the best blood supply, while constricting sutures at the apices should be avoided.

If relaxation incisions or pedicle flaps are used, it is well to leave the pericranium intact and to cover the defect with a split thickness graft immediately. Grafting requires but a few additional minutes’ work and goes far to insure primary healing. Failure to do so led to local infection in several instances, thus endangering the primary wound.

*S*-shaped incisions, in which the wound was included in the central limb, proved very satisfactory. Here again it is well to point out that they should be generously long, for the scalp has but limited elasticity, and it is desirable to distribute the tension over a wide area.

DEEP INFECTION

Deep infection occurred in 72 or 16 per cent of our 426 cases. Local purulent cerebritis progressed to abscess formation in 58 cases, and resulted