Tangential Wounds of the Head

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A tangential head wound is that specific type of injury caused by a missile grazing the head. It is unique in that forces generated at the point of impact cause more damage than the course of the missile per se. Forms of tangential head wounds have been described by Cushing,4-6 Ascroft,1,2 Dodge,9,10 Lewin and Gibson,13 Descuns, et al.,5 Davidoff and Feiring,7 Purvis,14 and Jacobs.12

This paper describes the authors’ experience with 18 such cases. All patients received their definitive treatment at the United States Army Neurosurgical Treatment Center of the Third Field Hospital, Saigon, Republic of Viet Nam, from November, 1965, through June, 1966.

Mechanism of Injury

Dodge and Meirowsky9,10 described the mechanism of tangential head wounds based on their material from the Korean War. The missile, which may be of either moderate or high velocity, strikes the skull at an angle too acute for penetration. The projectile bounces off the skull, but may remain in the scalp. The impact, however, may cause injury to the scalp, calvarium, dura, and underlying brain.

Since the transmission of energy at the point of impact is proportional to the square of the velocity of the missile, high velocity missiles cause much greater damage than moderate velocity fragments.

Brain injury is due to several factors in a tangential head wound, namely, the contusion from the shock of the missile impact, penetration of bone for long or short distances into the brain, and, less commonly, pressure effects of expanding blood clots.

Minor degrees of injury occur when only the scalp is involved. The skin need not even be penetrated, leaving only a local bruise. If the fragment penetrates deeper, any or all of the scalp layers can be involved, but intracranial injury need not occur.

When the missile hits the skull, however, a series of forces comes into play. These have been described by Gurdjian and his associates.11 There is a local indentation of the bone, which, depending on the elasticity of the bone and degree of penetration, may or may not spring back. A linear fracture may occur at the point of impact. More often, however, there is a comminuted depressed fracture at the impact site (Figs. 1–4). A peculiar pattern in some tangential skull wounds is the ability of the outer table of the bone to spring back into normal position while the inner table of the bone remains fragmented and depressed. Thus, inspection of the wound shows deceptively little, whereas in reality a depressed fracture of the inner table of the skull may be present, with the fragments either resting in the epidural space (Fig. 2) or penetrating dura and brain for short and long distances (Fig. 4).

In the most severe type of tangential skull injury, both outer and inner tables are depressed. Fragments of bone may penetrate deeply, even crossing to the opposite hemisphere.

Gross Evidence of Intracranial Damage

Gross Pathology. Where there is a depressed fracture of the inner table of the skull, there may be laceration of the dura. Extradural vascular channels may be ruptured by the bony fragments. According to Dodge,10 however, large epidural collections are rare in tangential wounds. This was confirmed in our series of 18 cases. However, subdural hematomas of both major and minor proportions may occur.

Following impact of the missile, there may be a transient or prolonged loss of consciousness; 16 of our 18 patients lost consciousness after their injury. When the period of unconsciousness is prolonged, or when neurological sequelae occur, brain...
contusions or brain lacerations are likely. A localized area of cerebral contusion is often found beneath the site of impact. The severity of the contusion, as well as its location, dictates the subsequent neurological impairment. Brain lacerations by bony projectiles are common. These may be associated with intracerebral hematomas of clinically significant proportions. Penetration of bone fragments into the opposite hemisphere or into the brain stem may occur.

**X-Ray Findings.** All our patients had plain x-ray films of the skull. The usual finding in a tangential skull injury was a comminuted depressed skull fracture. The depression may be slight (Fig. 1 right) or badly comminuted with bone driven in a wedge-shaped pattern deeply into the brain (Figs. 3 and 4). Metallic fragments were not found in the cranial cavity but were often seen in the scalp (Figs. 1 right, 4).

**Clinical Data**

Our 18 cases with tangential head wounds had injuries produced by high velocity missiles in 10 cases, moderate velocity fragments in six, and unknown in two. The location of the head wounds were: six frontal, six parietal, three frontoparietal, one tempoparietal, one frontotemporal, and one occipital (Table 1).

The clinical state of the patients on admission is summarized in Table 2. Certain clinical features were consistent with the location of the injury. Focal paralysis was common and was present in 11 of our patients; one of these had a paraparesis and a bilateral cortical sensory deficit secondary to a midsagittal parietal tangential head wound (Fig. 1).