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SHORT COMMUNICATION

Reconstruction of devastating head injuries: a useful method in forensic pathology

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Abstract Crushing head injuries usually do not allow direct visual identification of individuals, and above all, it constitutes an obstacle to comprehensive evaluation of discrete traumatic changes of the skin and soft tissues. We present our experience with the plastic adaptation of devastating head injuries in the two exemplary cases. The principal of the reconstruction is manual repositioning of bone fragments of the cranial and facial parts of the skull and careful approximation of the wound edges and their gradual suture using suture material. The reconstruction method can be recommended as an auxiliary technique in the identification of unknown victims with crushing head injuries and in the evaluation of devastating gunshot wound of the head.

Keywords Crushing head injury · Shots to the head · Krönlein shot · Skull · Comminuted fracture · Reconstruction · Identification

Crushing head injuries are characterized by extensive soft tissue laceration, closed and open comminuted fractures of cranial and facial parts of the skull, often in conjunction with laceration of the brain or its partial or total prolapse (e.g., Krönlein shot; [1, 2]). This type of injury usually does not allow direct visual identification of individuals, and above all, it constitutes an obstacle to comprehensive evaluation of discrete traumatic changes of the skin and soft tissues. Typical examples of the mechanisms that often lead to large, mutilating, and devastating head injuries include: gunshot injuries (i.e. shotgun injury, shotgun slug injury, high velocity missile injury), explosions, high-energy injuries on railways and roads, falls from height (head-first impacts), injuries caused by solid objects, burial under the soil, stones, machine, etc. In the following note, we present our experience with the reconstruction method: plastic adaptation of devastating head injuries.

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Technique

The first step of the reconstruction is manual repositioning of bone fragments of the cranial and facial parts of the skull. Primary repositioning does not require any special instrumentation (e.g., metallic osteosynthetic material, bone glue, etc.). In the event of major defects in the cranial part of the skull, the relevant part of the bone may be substituted, e.g., with a cast of plaster or resin. In case the cranial vault fragments cannot be returned into their original position, the cranial vault may be remodeled, e.g., using a modeling clay, or in extreme cases, it is possible to fill the cranial cavity with operating masks or paper pulp to create the basic shape for the subsequent soft tissue reconstruction.

The principal of soft tissue adaptation, especially in the facial region, is a careful approximation of the wound edges and their gradual suture using suture material. To facilitate the adaptation, we can apply so-called patch stitches or single anchor stitches which are in the second period replaced with a careful suture using silk or other suitable

suture material. In our experience, an optimal procedure is adapting the wound edges with different stitches; however, a continuous suture can also be used. The total time required for the overall reconstruction is individual and can take up to several hours depending on the degree and extent of the devastation. In the following, we present two illustrative cases.

Case 1

A 64-year-old man committed suicide in a forest stand using a repeating hunting rifle (model CZ 550; ammunition caliber 308 W, projectile SPCE-soft point cutting edge, 150 gr). As a result, a devastating head injury with a complete exenteration of both brain hemispheres occurred (called Krönlein shot; Fig. 1). The autopsy could not clearly determine the appearance of the primary gunshot wound, and the entrance and exit wounds were not identified with certainty (Fig. 1).

After reconstructing the skull bone and adapting the soft tissue with sutures (Figs. 2, 3), it was possible to identify precisely the entrance wound in the right temporal region, including the muzzle imprint and the fouling (Fig. 3), as well as the exit wound at the crossing of the left temporal and parietal regions. After the reconstruction, the secondary tears of the facial skin and soft tissue were also easily identifiable, even when found at a greater distance from the primary injury.

Fig. 1 Destruction of the cranium by a contact shot with hunting rifle (CZ 550, caliber 308 W, projectile SPCE-soft point cutting edge, 150 g) to the right temple. Bursting of the skullcap with complete exenteration of the brain (Krönlein shot)

Fig. 2 Reconstruction of the face by bringing the wound margins into apposition

Case 2

A 23-year-old man was buried under slate and soil during excavation work. The result was a crushing head injury

Fig. 3 Reconstruction of the face by bringing the wound margins into apposition. The secondary tears of the facial skin are easily identifiable

Fig. 4 Catastrophic disruption of the head after an earth slide. Bursting of the skullcap with complete exenteration of the brain

with laceration and a complete exenteration of the brain (Fig. 4). Within the injury, a traumatic luxation of teeth was also found which, to some extent, made it more difficult to identify the victim based on dental records. Therefore, in addition to other customary autopsy and laboratory identification procedures, we carried out skull reconstruction and soft tissue adaptation with suture (Fig. 5).

The head reconstruction enabled us to compare the victim's face with the available photographic documentation acquired before the accident.

Discussion

In the medicolegal literature, reconstruction of devastating head injury is only occasionally mentioned as a method of choice [1, 3, 4]. The reason is that this method is time-consuming and requires a certain degree of manual skill and anatomical knowledge. In our experience, a reconstruction produces the best results when conducted by a doctor with the assistance of another doctor or autopsy technician. However, the reconstruction method does have limitations when applied to severe injuries with loss of bone and soft tissues, since these types of injuries do not allow for optimal adaptation [5].

The essential use of this method lies within the assessment of devastating gunshot head wounds caused by a high-velocity projectile [1, 3, 4, 6], a shotgun slug [2, 7], or shotgun projectiles [8]. The reconstruction often enables investigators to identify unambiguously the entrance and the exit wounds as well as, in certain cases, to assess the distance or the firing angle and possible secondary injuries (caused by the subcutaneous or intraoral expansion of the muzzle gases and/or the radial forces of the bullet resulting in ballooning and overextension of the facial soft tissues). The reconstruction method can also be recommended as an auxiliary and supporting technique in the identification of unknown persons with crushing head injuries. Careful reconstruction of the skull bones, including adaptation of the soft tissue wound edges, directly facilitates a primary visual identification, and/or an indirect visual identification of individuals when evidence is compared with the photographic documentation available in the second period. Moreover, the reconstruction may lead to determination of other identification minutiae which were hidden or not estimable before the reconstruction itself (e.g., hairline, birthmarks, scars, tattoos, etc.).

The reconstruction techniques applied in devastating head injuries can also be useful in the identification process as one of the recommended procedures, not individually, but as a complementary procedure. The results of reapproximation, however, are by no means a substitute for identification based on dental evidence, DNA profile determination, etc. The actual reconstruction technique is simple, financially affordable, and its final outcomes are worth the effort required.

Fig. 5 Reconstruction of the head by bringing the wound margins into apposition revealed basic facial landmarks useful for visual identification

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