H77 Healing Following Cranial Trauma

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After attending this presentation, attendees will understand the macroscopically observable osseous changes related to cranial healing for an historic skeletal sample with known time since injury.

The analysis of fractures in dry bone is of considerable medicolegal importance and can contribute significant information on cause and timing of death. Perhaps the most difficult task faced by the forensic anthropologist is in regard to fracture timing and distinguishing between perimortem and antemortem fractures. This study supports that many factors, both internal and external, promote or retard the fracture healing process. Even with numerous interacting components, some generalizations regarding fracture healing can be made. In calculating time elapsed since trauma, one can provide a minimal response time only, knowing that it takes at least a certain number of days for a response to occur. Some individuals will respond more slowly, but due to the physiology and pathophysiology of bone remodeling, individuals cannot respond more quickly.

The analysis of fractures in dry bone is of considerable medicolegal importance and can contribute significant information on cause and timing of death. Perhaps the most difficult task faced by the forensic anthropologist is in regard to fracture timing and distinguishing between perimortem and antemortem fractures. With the right sample, it is possible to be more definitive in estimating the time elapsed since injury in the cranium. This paper reports on the gross appearance of the initial osseous response following perforating and penetrating gunshot wounds and the course of this bony response over time.

The Civil War skeletal collection at the National Museum of Health and Medicine, Armed Forces Institute of Pathology, contains nearly 2,000 skeletal specimens showing disease and trauma. Detailed reports by physicians exist with significant case history information regarding the nature of the injury, time elapsed from insult to recovery or death, and the methods of medical treatment. From this collection, a total of 134 crania, calvariae, and cranial sections were analyzed for evidence of bony response following fracture. Each specimen was examined and scored for the presence or absence of four types of bone response: osteoblastic response, osteoclastic response, line of demarcation, and sequestration around the site of fracture. Osteoblastic response was defined as the deposition of subperiosteal new bone typically seen in a periosteal reaction. Osteoclastic response was defined as areas of pitting affecting the existing cortical bone and occasionally exposing the diploë. A line of demarcation was seen as an “etched” line running adjacent to the fracture margin, appearing as a shallow depression or canal with sharp margins. Sequestration was noted when a segment of the bone was becoming necrosed and detached.

The patterns of osteoclastic and osteoblastic response to cranial fracture are similar. In general during the first week post-fracture, no blastic or clastic response was noted. Following this latent period, there is increasing incidence of expression, and by the sixth week postfracture both osteoclastic and osteoblastic activity were scored for 100% of the sample. While this pattern appears to be straightforward, interpretation of the expression of the line of demarcation and sequestration are more difficult. The observations suggest that the line of demarcation establishes the boundary between the living bone and bone which will not survive the fracture due to a disruption in its blood supply. The resorption or exfoliation of the sequestrum appears to be a long-term event as sequestration is scored as present in the sample well past the eighthweek of healing.

In the specimens used in this study, the role of infection must be considered. During the U.S. Civil War nearly 100% of soldiers who survived gunshot injuries suffered from infection, and there is evidence that two of the osseous responses scored are most likely due to infection. In a 1946 study of cranial in adult rats, Pritchard observed that infection will cause widespread new bone formation under the periosteum of the skull. Similar response was observed in the Civil War sample with the formation of subperiosteal new bone formation at distances greater than 5 cm from the fracture margin. In addition, sequestration is rare when pyogenic infection is not present. Yet, sequestration was scored as present in over eight percent of all observations and in nearly twenty percent of the observations occurring after the third week post-fracture.

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Cranial Fracture, Trauma Healing, Time Since Injury

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