H65 Defining Perimortem: Blunt Force Trauma

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After attending this presentation, attendees will understand the quantiative and qualitative changes to bone when blunt force trauma is induced at 30-day intervals over six months.

This presentation will impact the forensic community and/or humanity by demonstrating that if the morphological changes in fracture characteristics of bone throughout the decomposition process can be quantified and statistically validated, such findings would facilitate skeletal trauma analysis and subsequently the testimony of forensic anthropologists.

Determining whether a traumatic lesion occurred perimortem or postmortem is one of the most important concerns in the analysis of skeletal remains. Distinguishing between perimortem trauma and damage that occurs after deposition, however, can be difficult. While the different fracture characteristics of fresh and dried bone are known and easily identifiable, the varying fracture characteristics of bone throughout the decomposition period are unknown. As bone decomposes, moisture, grease, collagen fibers, and other organic materials that give elasticity to the bone degrade, resulting in bone that is more friable and fragile with time. The rate at which these materials are lost is dependant on postmortem environmental and climatic factors. In fact, the fracture characteristics of fresh bone may remain for several weeks after death, making it difficult to determine when a fracture occurred during the decomposition process. If these morphological changes could be quantified and statistically validated, such findings would facilitate skeletal trauma analysis and subsequently, the testimony of the forensic anthropologist.

To examine the differing fracture characteristics of bone throughout the perimortem to postmortem interval, a trauma study using sheep humeri was conducted. A constant blunt force was used to induce trauma on sheep humeri at 30-day time intervals for six months. The study bones were obtained from ewes of the same age, when they were sacrificed as part of a biomedical femoral-tibial joint replacement study. At the time of sacrifice, the right and left forelimb of twelve animals was dissected, the wool and skin removed, and the humeri disarticulated at proximal and distal joints. The muscle tissue was kept on the humeri to allow for more realistic trauma induction and decomposition of the remains. Two hours after sacrifice, trauma was induced on two right humeri—these specimens served as time “0” or the perimortem baseline.

The remaining specimens were placed in a wire mesh cage in the western desert of Utah between May and October 2003, allowing the humeri to decompose naturally. Temperature and humidity at the location was monitored with an Oakton RH/TempLog at fifteen-minute intervals for the entire length of the study. Every 30 days, two of the humeri were retrieved, measured, photographed, and subjected to blunt force trauma.

Blunt force trauma was induced with a metal femoral head component attached to a guillotine apparatus, which allowed for a consistent reproduction of known force (designed by Dr. Kent Bachus, director of the biomechanics Laboratory at the University of Utah School of Medicine). The right humeri were clamped to the base of the apparatus at the proximal and distal joint surfaces to allow for trauma induction on the anterior-lateral midshaft. The guillotine was dropped from a height of 67 cm, resulting in trauma induced at 25.3 joules.

Following trauma induction, anterior-posterior and medial-lateral contact-radiographs and photographs were taken. All adherent soft tissue was carefully removed, making sure not to alter the fractured surface. The skeletal trauma was photographed, reconstructed, illustrated, and described in detail. The following variables were measured for each specimen:

- Thickness of cortical bone at impact site
- Fracture type
- Number of fragments
- Minimum and maximum length of each fragment
- Angle of fracture margin bevel (internal, external, flush)
- Number and length of radiating fractures
- Color of host bone and color of bone at fracture margins

These variables will be coded for the two specimens in each of the six time periods. Multivariate statistical analysis will be conducted to assess any temporal trends in the data. At the time of abstract submission, our analysis of the first three time periods has identified distinct differences in fracture morphology, especially in the size and number of fragments. Specifically, there is a 1200% increase in micro-fragments (<1mm), an 80% decrease in small fragments (1mm - 10 mm), and a 400% increase in the number of radiating fractures. Change was also observed in the angle of the fracture bevel. Internal beveling decreased by 42%, external beveling decreased by 2%, and flush margins increased by 66%.

Perimortem Trauma, Blunt Force Trauma, Postmortem Damage

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