H29 Controlled Fracture of Bones Before and After Degradation Under Different Environmental Conditions

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The goal of this presentation is to provide research results pertaining to the examination and comparison of perimortem trauma with subsequent weathering to postmortem trauma induced at increasing time intervals.

This presentation will impact the forensic community and/or humanity by providing additional information regarding the determination of ante-, peri-, or post-mortem bone trauma.

Mechanical strength of the bone and the appearance of the fracture site as a function of environmental conditions and exposure time will be presented. The authors hypothesized that the application of different treatment conditions would have differing effects on the mechanical properties, fracture mechanics, and appearance of bone. The objective of the study was to compare the fracture behavior and mechanical properties of bone under three degradation conditions during a four-month period of time. A mechanical test method was designed to simulate blunt force trauma from a pipe or crowbar.

The humerus (H) and fused radius/ulna (R/U) from the forelimbs of 18 sheep (*Ovis aries*), Rambouillet and Columbia crossbreds, were used. A custom-designed three-point bend test jig on an MTS 858 Mini Bionix II was used to break the bones. A one-inch diameter indenter modeled a standard crowbar and was used to inflict blunt force trauma to the midshaft of the bone in a cranial-caudal (i.e., anterior-posterior in the human) direction at a speed of 6 in/s. Three sets of bones served as controls and were broken after removal of soft tissues. One set of controls (H & R/U) and five additional sets were each set outside under the following conditions: 1) full sun, 2) shade, and 3) submerged in water. One set of bones (H & R/U) for each of the environmental conditions was broken at 1, 2, 4, 8, and 16 weeks. The experiment took place during the summer in central Texas (May to August 2006). Peak load (lbs) was measured for each bone. The fracture surface of each bone was photographed and analyzed using Scion Image to determine inner and outer diameter at mid- shaft in the medial-lateral and cranial-caudal directions. Total area of the bone was also calculated. These measurements were used to calculate stress in order to normalize the measurements to control of size differences between animals. A standard formula used to calculate the bending stress is $s = -Mc/I$. A simplifying assumption was made that the shape of the midshaft of the bone was elliptical.

Data from this study were compared to a preliminary study conducted in central Texas during the winter (November 2004 to February 2005). During the current test period, the average high temperature was 93.1°F, the average low temperature was 69.4°F, and the average daily rainfall was 0.054 in., and during the preliminary study the average high temperature was 63.0°F, the average low temperature was 42.7°F, and the average daily rainfall was 0.089 in. The mechanical properties of bone were significantly affected by environment in both studies and distinct differences were noted between the appearances of ante-mortem vs. post- mortem trauma. The biggest differences in mechanical properties for the current study were seen at 2 weeks. The changes in mechanical behavior of the bones that were stored submerged in water appeared to be similar in both studies. However, for the specimens stored in the shade, the difference in temperature made a difference in the degradation of mechanical properties. The specimens that were tested in winter took longer to show a drop in peak load. Specimens that were exposed to the sun in the summer also showed a decrease in peak load much earlier in the study than those tested in the winter.

Bone, Blunt Force Trauma, Fracture Mechanics

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