H90 Defining the Peri-Mortem to Postmortem Transition: Macroscopic and Microscopic Changes in Subadult Bone Undergoing Trauma

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The goal of this presentation is to more clearly and accurately define the peri-mortem period in forensic anthropology by documenting changes in traumatized subadult bone across the peri-mortem to postmortem transition.

This presentation will impact the forensic science community by providing a better understanding of the peri-mortem /postmortem transition and enable practitioners to more clearly distinguish between peri-mortem versus postmortem pediatric trauma.

Scientific Working Group for Forensic Anthropology (SWGANTH) guidelines for trauma analysis[1] have called attention to the need for great caution when using the term “peri-mortem” due not only to different definitions of the term across soft and hard tissue, but to a paucity of understanding of the timing and process involved in fresh bone becoming “dry.”[1] One approach has been to define this transition in terms of characteristic signatures related to biomechanical properties of “fresh” versus “dry” bone breakage. Using this approach, retention of classic macroscopic peri-mortem Blunt Force Trauma (BFT) signatures has been observed well into the postmortem period (five months); however, a discrete, standardized definition and timing of this transition has been elusive.[2]

The current study documents microscopic and macroscopic changes in subadult bone undergoing BFT across the peri-mortem to early postmortem transition (approximately seven weeks) (peri-mortem is defined in this study as at or very near the approximate time of death). Twenty (unprocessed) stillborn pigs (*Sus scrofa*), frozen at death, were used in the study. After thawing, two pigs underwent immediate trauma induction delivered by means of a standardized drop-force mechanism. Pigs were placed on a hard substrate and impacted by a 1,109g concrete cylinder on both their left and right sides. Right side impacts (three per pig—focused on the lateral cranium, lateral shoulder, and ribs) used the same standardized drop mechanism through a stabilized 50cm-long PVC pipe. Similarly, three impacts on the same areas (cranium, shoulder, ribs) on the left side were dropped through a 108cm-long PVC pipe. Pigs were radiographed after trauma induction, then underwent maceration. The remaining 18 pigs, immediately upon thawing 24 hours, were placed in outdoor and indoor surface environments in the summer season to decay. All were placed in cages lined with ¼ in, fine wire mesh to allow access to insects, but limit larger scavenging and allow natural decomposition to occur. At regular intervals over the seven-week period (Days 5, 10, 20, 35, and 50), three pigs from each environment (two outdoor, one indoor) underwent identical trauma induction, radiography, and processing. The final two pigs (one outdoor, one indoor) remained in their environment for the entire 50 days, undergoing no trauma.

Macroscopic and microscopic (using a Keyence VHX-1000 Digital Light Microscope with 5 – 50x and 20 – 200x lenses) comparisons were made across the Day 0 through Day 50 bone samples. Standardized variables examined included:

- Fracture (Fx) type (linear, hinge, diastatic, depressed, comminuted, stellate), frequency, completeness;
- Fx morphology (including fx outline, fx edge shape);
- Fx metrics (e.g., distance between incomplete fx edges; length of radiating fx lines);
- Presence/absence of hinging, radiating and/or concentric fx lines, inbending/outbending, displacement, curling/uplifting; degree of refit of fx edges.

Results indicate a change from many classic peri-mortem fracture signatures to postmortem ones early in the postmortem period (by Day 5). This includes an increase in overall fragmentation as indicated by fracture frequency (particularly those of ribs) between 0 and 5 days postmortem, a pattern continuing until Day 50. Color differentiation between fractured and non-fractured surface edges is visible by Day 5. Decreases in sharp-edged denticulate fx edges and increases in jagged, irregular, and frayed fx edges are observed by Day 10. There is a concomitant decrease in the number of possible refits across this period. An illustrated timeline for microscopic and macroscopic bony changes across this peri-mortem/postmortem transition is provided. It is recommended that a standardized fracture terminology in the description of peri-mortem trauma and postmortem breakage be adopted, through quantifiable microscopic and macroscopic comparisons. These results will aid in the differentiation of peri-mortem versus postmortem pediatric fractures and further clarify both the nature and the timing of the peri-mortem period.

References:

1. www.swganth.org
2. Weiberg DAM, Wescott D. Estimating the timing of long bone fractures: correlation between the postmortem interval, bone moisture content, and blunt force trauma fracture characteristics. *J Forensic Sci* 2008;53(5):1028-34.

Peri-Mortem, Postmortem, Pediatric Trauma