G35 Timing of Blunt Force Injuries in Long Bones: The Effects of the Environment, PMI Length, and Human Surrogate Model

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After attending this presentation, attendees will understand how specific environmental conditions, the length of the Postmortem Interval (PMI), different bone types, and different animal models can influence bone fracture morphology and, consequently, the interpretation of blunt skeletal trauma as having occurred perimortemly or postmortemly.

This presentation will impact the forensic science community by increasing understanding of the timing of blunt force injuries in long bones with new data concerning the analysis of fractures in long bones under different postmortem conditions, using the Fracture Freshness Index (FFI). Moreover, new data concerning variations in fracture morphology between different animal models and bone types is presented, emphasizing the complexity of extrapolations to the human context.

The timing of blunt force trauma in human skeletal material is a critical issue in forensic pathology and anthropology. However, there is still limited knowledge as to how fracture morphology is influenced by specific environmental conditions, by the length of the postmortem interval (PMI), by different bone types and by different animal models. The goal of this study is to evaluate the influence of the type and duration of the postmortem environment in interpreting blunt skeletal trauma as perimortem or postmortem, based on comparisons of fracture morphology from long bones with different postmortem intervals and decomposition environments while simultaneously assessing variations in fracture characteristics between different bone types and species. Fresh limb segments from pigs and goats were used in this study and were sequentially left to decompose under three different environmental circumstances (ground surface, buried, and submerged) during a total period of 196 days, after which all sets of limb segments (each with different PMI) were fractured together with a fresh set. Fractured bones (total n=325; pig tibia=110; pig fibula=110; goat metatarsals=105) were assessed macroscopically and classified according to the FFI. Climatic data for the location of the experiment was collected. Statistical analysis included descriptive statistics, correlation analysis between FFI and PMI, Man-Whitney U tests for comparisons of FFI medians for different PMIs and linear regression analysis using PMI, mean pluviosity, and mean temperature as predictors for FFI. Surface samples presented increasing FFI values for each PMI increment, with positive correlation for all studied bone types, the same observed in submerged samples, except for pig tibia. Median FFI values for surface samples with PMI=0 could be statistically differentiated from PMI=56 days or above. Buried samples presented no significant correlation between FFI and PMI as well as no statistically significant linear regression models. Linear regression analysis of surface and submerged samples suggested differences in FFI variation with PMI between bone types, although it failed to show statistical significance. When adding climatic data to the surface regression models, PMI was no longer a predictor of FFI. When comparing different animal models, linear regressions seemed to suggest greater increases in FFI with increasing postmortem period in pig samples compared to goat samples in both surface and submerged environments, but they failed to reach statistical significance. No differences were found between environments except for buried versus submerged metatarsal goat samples and surface versus buried or submerged tibia pig samples. FFI seems to have a weak association with PMI, possibly due to the slow-rate fracture morphology changes with increasing PMI, and it seems to be affected by various factors, such as different bone types, decomposition environment, and climatic factors. Nonetheless, it does show some discriminating power in fracture morphology during the early postmortem period. The apparent variation between bone type cautions against current experimental studies, as extrapolations to the human species can be challenged. The present study demonstrates the potential of the FFI in reflecting fracture morphology changes over time; however, perimortem or postmortem fracture diagnosis based on the FFI seems to be extremely difficult.

Bone Fracture Morphology, Postmortem Interval, Postmortem Environment

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