A17 Effects of Soil Environment on Bone Mass: A Human Prospective Taphonomic Study

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After attending this presentation, attendees will understand how decomposition can be affected by different soil environments, specifically human bone remains.

This presentation will impact the forensic science community by providing information on factors that influence bone alterations that are generated by burial. These alterations can be measured by the loss of bone mass to help pathologists in more accurately predicting the time-since-death on human remains in forensic settings.

A multitude of factors can affect each stage of the decomposition process by either accelerating the process or slowing it down. Variables in soil environments include moisture, temperature, pH, and scavenger activity.

An experiment was designed on four human ribs to document how moisture and temperature affect the bone weight related to the postmortem interval. Three of the ribs were buried and the fourth rib was placed in a controlled environment. Three human cadavers were used, and the R1, R2, R3, and R4 ribs were removed from each cadaver. All of the bones were manually defleshed, immediately weighed, and placed in their environments on the same day. The R1 and R4 ribs were buried outside in clay at a neutral pH, the R3 rib was buried in clay at a neutral pH under a hood at 20°C, and the R2 rib was placed under a hood at 20°C without clay as a control. Temperature and humidity were recorded daily. Ribs were weighed daily using a precision balance (Kern® ALT310-4, d=0.1mg). Daily weight loss of the three subjects (i.e., the percentage of remaining weight) were studied over 90 days and averaged depending on the burial environments.

Burial environments were compared by studying the distributions of bone weight loss using a Kruskal-Wallis test. Results showed there were significant differences between environments ($p<0.0001$) for inside vs. outside burials and burial vs. control: bone weight loss was significantly faster inside (*i.e.,* low moisture content and constant temperature) and without clay soil (i.e., without retaining moisture in the environment). Combined comparison tests were performed on a day-by-day, per environment basis using a Chi-squared test and Marascuilo's post-hoc procedure. The results showed there was a significant difference in bone weight loss ($p<0.0001$) between the indoor and outdoor environments from day one to day five of the postmortem interval. This difference was less significant from day six ($p<0.05$) and not significant from day ten. Bone weight loss continued and finally stabilized to approximately 50% of the initial mass at three months, regardless of the experimental conditions.

Bone tissue can be considered a composite material of an organic phase and mineral phase. An inorganic hydroxyapatite mineral is embedded in an organic matrix composed of type I collagen. Wet bone is composed of approximately 15% water, 20% organic, and 65% mineral portions by weight. The loss of bone mass can be explained primarily by the decrease in bone moisture content. The literature explained that the average ash percentage of bones increases dramatically but generally levels off. Moisture content decreases rapidly for nearly two months, after which the drying process continues at a slower rate. These observations are consistent with this study.

However, the loss of bone mass can also be explained by chemical and physical alterations of the tissue. The diagenesis of bone tissue is a multivariable process that affects mineral and organic phases. The mineral phase can undergo mineral precipitation, ion exchange, recrystallization, dissolution, and leaching. The organic phase is primarily associated with collagen loss due to chemical breakdown or microbial attack followed by leaching. The development of these phenomena should be better studied to understand the process of bone weight loss.

Postmortem Interval, Burial, Bone Moisture