A34 A Comparative Analysis of Macroscopic, Microscopic, and Chemical Alterations in Modern and Ancient Bones: A Preliminary Study

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After attending this presentation, attendees will understand that the taphonomical evaluation of skeletal remains cannot be limited to the macroscopic aspect but must take into account microscopic and chemical alterations since these may react differently.

This presentation will impact the forensic science community by showing how information related to site of deposition, time-since-death, etc., should be searched not only macroscopically but also microscopically and chemically since different levels of tissue structure may tell different stories.

Bone conservation may be different according to the level at which one examines it: macroscopic, microscopic, chemical, or biochemical. Degradation can be used in relation to Postmortem Interval (PMI), environment of deposition of human remains, or applicability of biological tests. For this reason, it is fundamental to verify how, when, and in which components bone degrades. For example, is a well-preserved bone surface a predictor of the survival of the histological component? Or does a negative luminol test necessarily mean that the collagen in the bone is completely gone? Very few comparative studies exist in the literature. This study, therefore, has a dual goal: (1) investigating the preservation of the organic and inorganic bone components; and, (2) testing the accuracy and precision of the methods already employed.

The right tibia or femur of 40 human skeletons was collected from four known populations of the following historical periods: (1) ten Roman (3rd-5th century A.D.); (2) ten 16th century A.D.; (3) ten 17th century A.D.; and (4) ten contemporary (1990-1992 A.D.). Macroscopic, microscopic, and luminol testing were performed on all.

For the macroscopic analysis, this study evaluated the general appearance of the remains and their state of preservation, in accordance with Behrensmeyer's classification, through the observation of specific parameters and morphological characteristics.

Histological analysis was performed both on undecalcified and decalcified sections. The histological analysis conducted on the thin undecalcified sections was performed by scoring preservation according to the Oxford Histological Index (OHI). In parallel, the decalcified stained sections were scored as either well or badly preserved according to the percentage of collagen (>60%=well preserved).

To evaluate the survival of the heme molecule in bone, this study performed a luminol test, a quick, inexpensive method developed to detect blood traces.[1] As expected, results showed a divide in conservation between contemporary and archaeological bone. However, interesting results were seen when comparing different levels of preservation. The macroscopic evaluation showed that 62.5% of both contemporary and archaeological samples were well preserved (stage 0-1). Undecalcified histological microscopy in general showed a good osteonic conservation in contemporary (80%) bone, with high OHI (4-5), whereas archaeological bone showed a high OHI in only 20% of the samples. Therefore, a large difference was noticed in macroscopic and microscopic degradation, particularly among older bone.

When evaluating survival of the collagen component of bone via Hematoxylin-Eosin (H&E) microscopy of the decalcified bone, a slight amelioration in conservation was noticed, which may indicate that if the structure of the calcified matrix is degraded, the respective connective tissue component may be better preserved.

The luminol test was negative in 70% of the ancient samples and in 20% of the contemporary samples, as could be expected; however, when comparing the luminol vs. histological response among older samples, in 27% of cases where luminol was negative, microscopic preservation was very good, and in 25% of cases where histology was negative, luminol was positive.

In conclusion, results show that macroscopic, microscopic, and chemical preservation may not depend upon each other. This means that, according to the type of environment and to other unknown variables, the evaluation of taphonomical degradation must be performed at different levels.

Reference:

1. Ramsthaler F, Ebach SC, Birngruber CG, Verhoff MA. Postmortem interval of skeletal remains through the detection of intraosseal hemin traces. A comparison of UV-fluorescence, luminal, Hexagon-OBTI®, and Combur® tests. *Forensic Sci Int* 2011:209:59-63.

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