A120 A Histomorphological Analysis on the Variability of the Entire Human Skeleton: Implications for Differentiating Human From Non-Human

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After attending this presentation, attendees will be better informed regarding bone histology of the entire human skeleton, not only the compact bones widely presented in literature. In addition, attendees will also understand the useful role bone histology may cover in forensics in general, specifically regarding species diagnosis.

This presentation will impact the forensic science community by informing attendees of the importance of continuing to investigate this particular field, which has become increasingly more important in anthropology for a variety of purposes.

Bone histology has always proven to be of great importance in anthropology, especially when dealing with age estimation, postmortem alterations, trauma analysis, and species identification. The latter (differentiating human from non-human) has acquired an essential value in forensics, and anthropologists often have to undertake species diagnosis conducted with very small bone fragments. Although bone histology has been deeply explored, there is not yet a full consensus regarding classifications and terminologies of bone microscopic structures. In addition, even if the literature provides numerous studies reporting the histological bone characterization within different species, it primarily regards the compact bones; thus, there is still a need for in-depth investigation of the variability of the bone tissue appearance within the entire skeleton and/or on the same bone.

This study seeks to histologically map the entire human skeleton in order to clarify the histomorphological variability by determining and comparing the diverse tissue typologies that can possibly belong to the human skeleton and to different portions of a same bone.

The histomorphological analysis conducted on 50 cross-sections from a human adult skeleton (comprising long, flat, and short bones) revealed the prevalence of secondary bone characterized by secondary osteons immersed in a lamellar matrix.

As per the literature, no histological sections exhibited fibrous bone, which is instead typical of initial growth (fetus and infant), bone healing, and response to pathological conditions. Regarding the Haversian tissue, the most frequent pattern was characterized by scattered secondary osteons with no organization.

Generally, excluding the trabecular bone (characterized by avascular or poorly vascularized lamellar tissue), long bones displayed a higher variability (alternation of tightly packed secondary osteons and scattered Haversian systems immersed in a lamellar matrix). On the contrary, flat and short bones seemed characterized by a greater uniformity, namely scattered osteons with no organization. In general, flat bones are formed by scattered secondary osteons and smaller Haversian systems with abundant interstitial lamellae; the occipital, rib, sternum, the superior border of scapula, and ileo-pubic ramus also exhibit a greater osteon density. The only exceptions regarding short bones are the middle portion of the metatarsal, in which the osteons are tightly packed without organization, and the middle portion and the distal end of the metacarpal, in which Haversian systems are organized in circular rows.

The difference in the Haversian system density between long bones confirms what has been reported in previous research regarding the relationship between the physical properties of bone and its histological structure. The femur and tibia displayed a higher osteon density when compared to the fibula, in which the Haversian systems are smaller with higher amounts of interstitial lamellae. A large number of small osteons and fragments make the tensile strength of a given amount of bone smaller if compared to areas with few large osteons and fragments. On one hand, Haversian systems reduce the tensile strength and increase the tensile strain of cortical bone; on the other hand, interstitial lamellae reduce the tensile strain while increasing the tensile strength. This results in a greater tensile strength and elasticity of the fibula as compared to the femur and tibia.

The observation of the histological sections by polarized light allowed identification of the presence of several drifting osteons in the diaphysis of the ulna, clavicles, and rib's heads.

The finding of drifting osteons in the study sample is in accordance with literature since, although they are typical of young individuals, their presence in adult individuals is also verified.

Further research on the histomorphometric variability of human and non-human bones is paramount in order to have a complete understanding of bone histology and to improve all its application fields, such as the differentiation between human and non-human species.

Bone Histology, Human vs. Non-Human, Forensic Anthropology