A23 The Forensic Application of Skeletal Stress Indicators: A Correlation Study of Linear Enamel Hypoplasia (LEH), Harris Lines, Cortical Bone Loss (CBL), and Stature

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After attending this presentation, attendees will understand how the analysis of multiple skeletal stress indicators can be simultaneously incorporated into forensic biological profiles.

This presentation will impact the forensic science community by expanding upon current studies of skeletal stress by addressing unresolved questions concerning the differences between manifestations of skeletal stress in recent, forensic populations versus in more traditional studies of prehistoric populations. Understanding the relationship between LEH and other postcranial stress pathologies in recent populations would help forensic anthropologists gain a more comprehensive foundation for incorporating skeletal stress into biological profiles. This research uses data obtained from the Hamann-Todd skeletal collection, which can be used as a proxy for recent, forensically relevant populations.

Skeletal stress indicators have provided important bioarchaeological insights into prehistoric populations, but are rarely used in forensic contexts. Incorporating LEH — a readily visible, non-specific indicator of stress — into current forensic biological profiles has proved a promising method for identifying and repatriating the remains of undocumented migrants in Southern Arizona; however, the relationship between LEH and other postcranial stress markers is unknown.[1] Harris lines, a postcranial indicator of stress associated with LEH in prehistoric remains, may be equally useful in this effort since both LEH and Harris lines can be linked to nutritional stress events during life; however, current studies focusing on correlations between Harris lines and LEH have been conducted on prehistoric populations rather than contemporary populations and yield mixed results.[2-7] Work on prehistoric samples also associates Harris lines with CBL and stunted stature within stressed populations.[4] In Neolithic contexts, these stress indicators have been associated with periods of agricultural transition, but analogous lifestyle changes are not seen in forensically relevant populations today.[8]

This study, therefore, considers the relationships between LEH, Harris lines, CBL, and stunted stature in the Hamann-Todd collection, a recent (1900s) skeletal population. One hundred twenty-five individuals (74 males and 51 females) ranging in age from 1-72 years were scored for LEH. Known statures provided by the Hamann-Todd collection were recorded, and tibiae from all individuals were radiographed and assessed for the presence of Harris lines. Cortical bone thickness was measured as a percentage of total bone width at the midshaft of each tibia using the same radiographs. All measurements were then recoded into binary to denote the presence ("1") and absence ("0") of skeletal stress. LEH and Harris lines were recoded based on the visual assessments. Stature and CBL were respectively recoded by plotting residuals for each age group and identifying outliers more than two standard deviations away from each group's mean. Multiple regression models and correlation analyses were run on the entire dataset as well as on each defined age group. Unlike previous studies on these indicators in prehistoric contexts, sex differences in trait correlations were also considered.

Results suggest that future studies should consider the interaction between these measures histologically at higher resolutions. Based on the intertrait correlations produced between Harris lines and cortical bone thinning (ranging across current age groups from -0.289 to -0.559), this study tentatively supports the hypothesis that Harris lines may be more indicative of periods of increased growth velocities rather than periods of malnourishment and arrested growth. Future forensic work on skeletal stress should incorporate histological measures of cortical bone. No significant differences in trait expression were found based on sex (p=0.260). Additional results from the same data condensed into new age groups (0-18 years, 19-34 years, 35-49 years, and 50+ years) are pending.

In conclusion, this study finds that incorporating non-specific stress indicators into forensic analyses requires the independent consideration of traits coupled with an in-depth analysis of life history events. While not practical for all forensic case work, this approach may aid the identification and repatriation of individuals with sparse antemortem data, such as undocumented migrants or long-unidentified individuals.

Reference(s):

1. Beatrice J.S., Soler A. Skeletal indicators of stress: A component of the biocultural profile of undocumented migrants in Southern Arizona. *J Forensic Sci.* 2016:61(5):1164-1172.
2. Buikstra J., Cook D. Paleopathology: An American Account. *Annu Rev Anthropol.* 1980: 9:433-470.
3. Gambhir P. Application of radiology in skeletal biology. *Bulletin of the Deccan College.* 1998-1999:58/59:77-83.
4. Cook D.C. Subsistence base and health in prehistoric Illinois Valley: Evidence from the human skeleton. *Med Anthropol.* 1979:3: 109-124.
5. McHenry H., Schulz P. The association between Harris lines and enamel hypoplasias in prehistoric California Indians. *Am J Phys Anthropol.* 1976:44: 507-512.
6. Clarke S.K. Childhood morbidity trends in prehistoric populations. *Hum Biol.* 1980:52(1): 79-85.
7. Papageorgopoulou C., Suter S.K., Rühli F.J., Siegmund F. Harris lines revisited: Prevalence, comorbidities, and possible etiologies. *Am J Hum Biol.* 2011:23(3):381-391.
8. Larsen C. Bioarchaeological interpretations of subsistence economy and behavior from human skeletal remains. In: Schiffer MB, editor. *Advances in Archaeological Method and Theory*. vol. 10. New York: Academic Press, 1987:339-445.

Linear Enamel Hypoplasia, Skeletal Stress, Cortical Bone

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