New tool for CSI? Geographic software maps distinctive features inside bones

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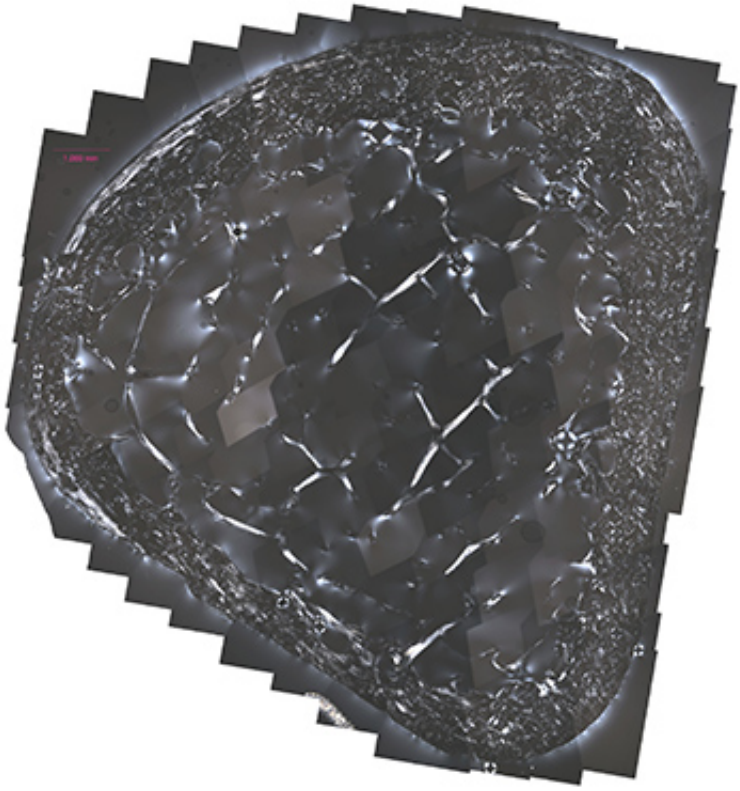

This polarized microscope image shows a cross-section of a metatarsal, or long foot bone. White spots on the periphery of the bone are osteons -- structures that fix small cracks in bone and maintain mineral levels in our blood. Image by David Rose.

(Medical Xpress)—A common type of geographic mapping software offers a new way to study human remains.

In a recent issue of the American Journal of Physical Anthropology, researchers describe how they used commercially available mapping software to identify features inside a human foot bone – a new way to study human skeletal variation.

David Rose, a Captain in the Ohio State University Police Division and doctoral student in anthropology, began the project to determine whether the patterns of change inside the bones of human remains could reveal how the bones were used during life.

"Our bones adapt to the load that's placed on them. Patterns of tension and compression show up in our internal bone structure, and this software lets us look at those patterns in a new way," Rose said.

Julie Field, study co-author and assistant professor of anthropology at Ohio State, explained that archaeologists frequently use geographic information system (GIS) software to map the location of objects uncovered at an excavation site.

"We try to identify important clusters of objects such as household tools or agricultural tools that would indicate patterns of human activity," Field explained. "Based on certain scientific criteria that you give it, the software gives you a statistical measure of whether the objects you're looking at actually constitute a cluster."

In this case, the researchers used a program called ArcGIS. But similar types of mapping software can analyze any kind of spatial data, such as crime statistics or flood models, Rose added. He usesthe same program to map line-of-site views to develop security plans for events on campus.

This is the first time anyone has used GIS software to map bone microstructure.

Co-author Sam Stout, professor of anthropology at Ohio State and Rose's advisor, explained why the study of internal bone structure is important.

"Dave's work allows us to visualize, analyze, and compare the distribution of microscopic features that reflect the development and maintenance of bones, which we can relate to skeletal health and disease – for example, bone fragility in osteoporosis," Stout said.

Advances that relate to the study of foot bones in particular would be useful in forensics, Rose explained, because of one grisly fact: when unidentified human remains are discovered today, the foot bones are sometimes intact, having been protected by the deceased person's shoes. Any information about the person, such as age, sex, or body size could ultimately aid law enforcement in identifying a body.

For this study, the researchers studied the cross-section of a metatarsal – a long bone in the foot – from a deceased woman who generously gave her body to the Division of Anatomy's Body Donation Program. Using this bone cross-section, they demonstrated how the software could be used to show the loads experienced in the foot during gait.

Rose recorded an extremely high-resolution image of the bone cross-section under a microscope, and used the software to map the location of key structures called osteons.

Osteons are microscopic structures created throughout life to fix small cracks or to maintain mineral levels in our blood. The size and shape of osteons, along with the direction of the collagen fibers from which they are made inside bone, are influenced by the loads we place on our bones during life.

In this case, the donor's metatarsal bone showed the predicted pattern of

normal bone remodeling, with concentrations of particular types of osteons along the top and bottom of the bone which could have been formed by forces experienced as she walked – just where researchers would expect to see telltale signs of foot flexure and compression.

This study provides a proof of concept, Rose cautioned, and many more bones would have to be studied before GIS software could provide meaningful insight into bone biology.

"Really, we're just combining very basic principles in GIS and skeletal biology," he said. "But I believe that there is a tremendous opportunity for advancements at the intersection of both disciplines. The real advantage to this method is that it offers a new scale for the study of human variation offering to shed light on how we adapt to our surroundings."

Co-author Amanda Agnew, assistant professor of anatomy, agreed and added that the work "combines bone biology, biomechanics, and biomedical informatics to explore new methods to evaluate old questions."

Provided by Ohio State University

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