H112 Antemortem Versus Postmortem Bone Fractures: The Usefulness of Morphological Observation Using Scanning Electron Microscope

Silvia D. Visona, MD, University of Pavia, Via Forlanini 12, Pavia 27100, ITALY; Chiara Rossetti, MD, Forensic Medicine, University of Brescia, Piazzale Spedali Civili, 1, 25123 Brescia (BS), ITALY; Yao Chen, MD, University of Pavia, Via Forlanini 12, Pavia 27100, ITALY; Matteo Moretti, MD, University of Pavia, Via Forlanini 12, Pavia 27100, ITALY; Luisa Andrello, MD, Henri Guisan Street, 3, Bellinzona, Canton Ticino 6500, SWITZERLAND; Gulnaz T. Javan, PhD, Alabama State University, Forensic Science Program, 915 S Jackson Street, Montgomery, AL 36104; Andrea Verzeletti, MD, University of Brescia, Piazzale Spedali Civili, 1, Brescia 25123, ITALY; and Antonio M.M. Osculati, MD, University of Pavia, Via Forlanini 12, Pavia 27100, ITALY*

The goal of this presentation is to observe the morphology of bone fractures using a scanning electron microscope to ascertain a number of specific characteristics that can be used for distinguishing between peri-mortem and postmortem fractures.

This presentation will impact the forensic science community by providing new tools to distinguish vital fractures from postmortem fractures.

One of the most important evaluations in the forensic assessment of a trauma is the timing of the injuries in respect to the time of death, which is more difficult in bone fractures than skin lesions; however, in many cases, it is crucially important to determine if the person was alive when the fracture occurred.

The evidence of bone remodeling is crucial for determining that a skeletal injury was produced antemortem. When the cortical surface of bone is disrupted by a fracture, a well-known series of events normally ensues. Initially, vascular damage causes a hematoma that forms in the area of injury. Within hours, the clot is invaded by inflammatory cells; after several days, fibrous matrix begins to replace the clot. Later, the callus is remodeled and converted to lamellar bone.

The length of time required for the production of new bone or other signs of healing is very variable and depends on the location of the injury, the health status of the individual, genetic variations, and other factors. The evidence of remodeling associated with the fracture indicates that the injury occurred at least a week before death.

For forensic purposes, it is often necessary to establish the vitality of fractures supposedly produced very shortly before death, when the healing process has no time to progress enough to be observable using the common methods (macroscopic evaluation and light microscopy). Therefore, it was hypothesized that the new morphologic markers, using a scanning electron microscope, are able to distinguish vital fractures from postmortem fractures.

The fracture lines and their relation to bone microstructure were studied on 15 fragments of fractures collected from the skulls of individuals who died from head trauma (i.e., traffic accidents, falls from heights, gunshot injuries). For each case, a forensic autopsy was performed. Each sample was compared to another bone fragment collected from the same subject during the autopsy and then experimentally fractured using a hammer. All samples were fixed in glutaraldehyde solution for 48 hours, then dehydrated and dried. These were coated with gold using a metal ion spattering instrument. The samples were examined with a Zeiss EVO® 40 scanning electron microscope.

The results demonstrated that a relevant, different pattern can be observed in vital fractures compared to postmortem fractures. High-power views indicate that the vital fracture is characterized by a pull-out of elastic and collagen fibers, as well as "bridges" formed by fibers, not seen in postmortem fractures, that have flatter surfaces with characteristic "micro-cracks."

The present study, therefore, suggests the usefulness of the scanning electron microscope in the evaluation of bone fractures, especially in regard to the timing of the injury.

Scanning Electron Microscope, Bone Fractures, Vitality Evaluation

*Presenting Author