H40 Scanning Electron Microscopy of Saw Marks in Bone: Assessment of WearRelated Features of the Kerf Wall

Laurel Freas, MA, Department of Anthropology, CA Pound Human ID Laboratory, University of Florida, PO Box 112545, Gainesville, FL 32611*

After attending this presentation, attendees will learn the results of qualitative and quantitative analysis of wear-related patterns of change in cut mark morphology, as visualized in scanning electron microscope images of kerf walls from saw marks in bone.

This presentation will impact the forensic community and/or humanity by addressing the utility of scanning electron microscopy for the analysis of saw marks in bone, and will refine the understanding of the impact of increasing tool wear on cut mark morphology and the forensic interpretations thereof.

The use of scanning electron microscopy in the analysis of patterns of bone modification, including cut marks, is favored because of a number of features and capabilities of the scanning electron microscope, including greater image resolution and depth-of-field; a broad range of continuous magnification (sometimes up to 3000X); and improved visualization of surface contour profiles and bone microstructure, relative to normal light microscopy. In recent years, the SEM's enhanced image-capture capabilities have been used frequently and to great advantage by archaeologists and paleoanthropologists in their analyses of bone modification patterns from their respective contexts. Such studies have yielded important insights on many facets of cut mark analysis, including differentiation of true cut marks from "mimics" produced by scavenging animals, sedimentary abrasion, and other taphonomic processes; determination of the directionality and sequence of individual cut marks; and distinguishing among cut marks produced by different materials (e.g., stone versus metal tools). Yet in spite of the potential gains to be derived from the application of electron microscopy to the analysis of tool marks in bone from forensic contexts, only a few such studies exist. This limited use is owed to several factors, including the restrictions on sample size imposed by the dimensions of the SEM vacuum chamber; the need to cast and/or sputter-coat the sample to be imaged; the difficulties of imaging a material so structurally complex as bone; and the considerable cost of SEM imaging. It is easy to see why forensic anthropologists would be reluctant to submit irreplaceable forensic specimens to such analyses. However, recent advances in scanning electron microscope technology have gone a long way towards ameliorating many of these concerns, such that SEM imaging is drawing nearer to the realm of practicality for use in forensic anthropology, particularly with regards to cut mark analysis.

A poster by the author at the 56th Annual Meeting of the American Academy of Forensic Sciences presented the results of a preliminary study investigating the impact of increasing saw blade wear on the appearance of the kerf wall. Under light microscopy, it was observed that the patterns of coarse and fine striations visible on the kerf walls became progressively more shallow and indistinct with increasing saw blade wear. The purposes of the present study then, are two-fold: 1) to further consider these patterns of change—and their impact on the interpretation of saw marks in bone— by reexamining these sequences of cut marks under a scanning electron microscope; and, 2) to evaluate the utility of SEM imaging for the analysis of saw marks in bone.

Qualitative analysis of the SEM images of the kerf walls confirmed the prior observations of progressive loss of fine detail over the course of the cut mark sequences, and supports the interpretation that such changes are due to the blunting of sharp edges on the saw teeth. Nevertheless, other diagnostic features of the kerf wall persist in spite of these wear-related changes, indicating that even well-worn saw blades will still leave behind clues as to their class characteristics. In recognition of the growing drive within the forensic science community to develop quantitative analytical methods, it had also been hoped that the greater detail observable in the SEM images would permit accurate quantification of the features of the kerf walls, thereby facilitating statistical analysis of the observed patterns of wear-related changes. However, two separate approaches to quantification of these patterns were met with a number of difficulties, and ultimately proved to be unworkable, suggesting that such cut marks are perhaps not suited to a statistical analysis.

These results suggest that, although forensic investigators should consider wear-related features of the kerf wall during their analyses of saw marks, such features do not necessarily undermine the validity of the established methods for determining the class characteristics of the saw in question. Furthermore, the difficulties encountered in the analysis of the SEM images suggest that this imaging modality may not be of significant advantage to the forensic analysis of saw marks in bone.

Cut Mark Analysis, Scanning Electron Microscopy, Forensic Anthropology

 ** Presenting Author*