H11 Microscopic Characteristics of Hacking Trauma on Bone: The Potential for Interpretation and Identification

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After attending this presentation, attendees will gain a better understanding of the utility of microscopic characteristics of hacking trauma in correct weapon identification as well as the results of qualitative analysis of microscopic (and macroscopic) characteristics of cut marks inflicted by hacking trauma, using various common sharp instruments, as observed in Stereo zoom and 3D incident light microscope images of striations present on kerf walls.

This presentation will impact the forensic community and/or humanity by addressing the utility of microscopic characteristics of hacking trauma in weapon identification, their potential in creating reliable sets of class characteristics in future tool mark analysis, and the usefulness of different kinds of light microscopy in interpretation of cut marks.

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While the field of tool mark analysis continues to grow and while much attention has been given to characteristics of saw and slice marks on bone, little research has been conducted in order to determine if similar patterns and class characteristics can be extracted from cut marks caused by hacking trauma. The few studies that have been published focused only on the microscopic characteristics of specific sharp instruments, namely cleavers, axes, and machetes. In addition, these studies have all employed scanning electron microscopy to gain images of striations on cut mark kerf walls. While SEM is becoming a more and more popular method for viewing tool marks, it has several disadvantages for practical use including: time intensive preparation of samples, sample size necessary, and high cost. In addition, it must be recognized that not all institutions have access to SEM and it should be determined if there is an alternative imaging system that can adequately capture these images. Light microscopy has several practical advantages. Images can be taken from simple casts without altering the cast or specimen and light microscopes are less complicated to use and are more common.

In the current study, various types and sizes of knives (plus a machete and axe) were used to create hack marks in large sections of femora previously cut and cleaned for other research. Each tool was assigned one femur consisting of a fragment cut from approximately mid-shaft and a longer section including distal shaft, metaphysis, and epiphysis. Multiple cut marks (hack marks) were made using each tool and were then casted using low viscosity injection –type impression material. Casts were viewed under both stereo zoom (Leica MZ-APO) and real-time 3D incident light (Edge Scientific H160) microscopes. Images captured were then analyzed for striation patterns and the ability to match images of specific cut marks to each other and to their respective weapon. In addition, images and patterns were compared to determine if larger tool- type characteristics could be determined.

While striation patterns were successfully captured and these images could generally be associated with cut marks from the same bone (and therefore, weapon) and respectively to the tool used, overall tool class characteristics were much more difficult to define and may prove unreliable. Light microscopy was adequate in visualizing striation patterns on kerf walls. However, more research comparing the images captured to some taken using SEM must be done to show whether one method is better than the other for studying hacking trauma characteristics.

These results show that although kerf striations on cut marks caused by hacking trauma can potentially be used for identification of specific weapons used, more research is required in order to create reliable class characteristics that could be used to determine tool-type when no suspected weapon is available.

Forensic Anthropology, Cut Mark Analysis, Microscopy