A5 Revisiting Serrated vs. Non-Serrated Kerf Marks in Sharp Force Trauma (SFT) Analyses

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Learning Overview: The aim of this presentation is to inform attendees of the questionable utility of the qualitative method of analyzing morphological characteristics of kerfs as well as the quantitative method of measuring length and width of kerf to positively infer the causative implement.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by discussing the need to develop more robust methodologies to identify blade types to ensure reproducibility.

Sharp Force Trauma (SFT) is one of the leading types of injury in the United Kingdom. As of March 2020, injuries caused by knives or other sharp implements have been implicated in 39% of all homicide cases. However, much of SFT research has focused on saw and hacking marks related to dismemberments. These events are arguably much less common than stab injuries, which have received little attention in research. Therefore, this study was designed to investigate stab injuries through a combination of quantitative and qualitative methods. This study adopted previously established methods for distinguishing morphological characteristics of "serrated" and "non-serrated" knife blades. It sought to examine whether: (1) the kerf (marks left by implements) characteristics and striation patterns can infer the causative implement in stab injuries, and whether (2) the metric analysis provides meaningful insights in differentiating the blade types.

To address these questions, knives with serrated and non-serrated blades were utilized. These were mounted onto a partially mechanized guillotine fashioned from a paper-cutter machine mimicking a cantilever system. The purpose of this mechanistic effect was to mitigate possible variations of the penetrative angle of the knife while maintaining reasonably consistent human force when delivering the stab marks. *Sus scrofa* (pig) specimens (n=30) chosen in this study were macerated and fully skeletonized to avoid possible inter-variations in soft-tissue depth between each sample. These stab marks were then visually observed to record kerf characteristics resulting from each blade type. Two-dimensional images were also obtained using a Scanning Electron Microscope (SEM) to examine the microscopic striations, and these images were later processed through the program ImageJ to obtain metric measurements of the lengths and widths of the kerfs. A pilot study with intra- and inter-error tests was conducted by enlisting three individuals outside of the anthropology field to measure the lengths and widths of the kerfs. This was to ensure that the measurement protocols established in this study were consistent with minimal vagaries and were reliable.

The qualitative analysis in this study found that macroscopic and microscopic characteristics previously associated with serrated and non-serrated blades were not reproducible. The morphological features resulting from each blade type were either not produced or occurred at a much lower rate than expected to infer the type of causative implement. Further, the high-resolution imaging technique provided by SEM could not observe the characteristic striation patterns associated with either blade type on most of the sample specimens. In terms of quantitative analysis, the one-way Analysis of Variance (ANOVA) (p-value<0.05) showed that there was a statistically significant difference between lengths and widths between serrated and non-serrated blades. However, this does not provide a meaningful context in identification without reliable qualitative features to corroborate the metric analysis. This indicates that there is a crucial need to develop more robust methodologies in identifying blade types that would be in line with current efforts in the discipline of forensic science to ensure reproducibility and scientific rigor. This concerted effort could help avoid the potential for misclassification of knife blades in forensic investigations.

Forensic Anthropology, Sharp Force Trauma, Stab Injuries