G13 On the Effects of Preservation, Blade Angle, and Intra- and Inter-Individual Differences on the Identification of Tool Class Characteristics Retained on Human Costal Cartilage in Cut Marks Analysis

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After attending this presentation, attendees will understand how the preservation method, knife blade angle, and intra- and inter-individual differences in human cartilage samples affect the ability of costal cartilage to retain the original class characteristics of the knife, as measured by the distance between consecutive striations in cut mark analysis.

This presentation will impact the forensic science community by contributing to the identification of tool-class characteristics with new data concerning the analysis of cut marks on human costal cartilage which is a valuable source of data to forensic scientists. Human tissue has seldom been utilized in experimental studies, although its structure and biomechanical characteristics differ from that of non-humans, thus challenging the interpretation of the results acquired from animal models in order to extrapolate them to a human model.

Materials and Methods: The 160 cartilaginous samples used in this study originated from the ribcage of seven male cadavers that underwent autopsy at the North Branch of the National Institute of Legal Medicine in Portugal. Three different serrated knives were purchased from a large department store to be used in the study. Initially, 40 samples of dissected costal cartilage were manually cut using the same knife following a motion parallel to the long axis of the teeth in the serrated edge. Casts of the “fresh” cut surface were made using casting material for forensic use. The 40 samples of the dissected costal cartilage were then placed in a formalin 10% solution for seven days after which were all re-casted. Both “fresh” and “preserved” casts from each of the 40 samples were observed and photographed. The “fresh” casts images were then compared with the “preserved” casts images by direct image superimposition. In the second phase of the study, a total 120 samples of costal cartilage were used. Samples from two individuals were assigned to each knife. Each individual provided 20 cartilage samples. Cartilage samples were manually cut using each of the three knives following two motions, one parallel and one perpendicular to the blade’s teeth long axis. Casts of the samples were made with a casting material for forensic use. Image capture and processing were performed with a stereomicroscope and its software. Direct image superimposition was used to test how the preservation method used for the cartilage samples (formalin 10%) affects preservation of cut marks on the cartilage surface. The distance between striations in the acquired image was measured and data was statistically analyzed.

Results and Conclusions: Assessing the influence of formalin preservation on the striation pattern, direct and complete image superimposition, when comparing the two groups of casts (“fresh casts” vs. “preserved casts”) showed that no significant distortion or shrinkage of the striation pattern occurred by preservation of the cartilage samples in a 10% formalin solution for seven days. The blade’s penetration angle and the inter-individual differences were shown to affect the identification of the tool class characteristics from the striation pattern observed in a kerf wall, although this fact seems to be related only to the degree of calcification of the costal cartilage. Intra-individual differences do not seem to be relevant enough as to affect in a significant way the identification of the tool class characteristics from the striation pattern observed in a kerf wall for the same knife following the same motion. The degree of calcification of the cartilage is a source of great variation regarding the interpretation of striations pattern in cartilage.

Cut Marks, Tool Marks, Knives

