MA Thesis – Human Skeletal Biology Track, Physical Anthropology – New York University (2013)

THE EFFECT OF ANGLE OF INCISION AND MAGNIFICATION LEVEL DURING ANALYSIS ON THE RECOGNITION OF STRIATION PATTERNS ON CUT COSTAL CARTILAGE

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Abstract

Although the analysis of toolmarks on bone and cartilage that result from sharp force trauma is a specialized area of analysis within the field of forensic anthropology, few studies verify the relationship between blade serration and striations made on cartilage. Previous research has focused on the identification of tool class characteristics, but there is an absence of published classification and error rates for the application of these class characteristics. This study: (I) establishes the probability of correctly classifying the blade type (serrated or non-serrated) based on the patterned or non-patterned striations observed on the cut surface; (II) examines how the striations on the cut surface vary based on angle of incision and magnification employed during analysis; and (III) quantifies the striation pattern on the cut surface in order to improve the scientific reliability of blade type classifications. These objectives address the demand for improved scientific validity in sharp force trauma analyses in response to the "*Daubert* standard" and the 2009 National Academy of Sciences report *Strengthening Forensic Science in the United States: A Path Forward*.

Six knives were utilized to create experimental cutmarks in porcine costal cartilage (*Sus scrofa*), including four serrated knives and two non-serrated knives. Two rounds of cuts were made with the goal of ascertaining a baseline accuracy level. Angle of incision was not specified and magnification level was not controlled during the examination for these rounds, and each cut surface was examined for the presence of patterned striations from which a determination of "serrated" or "non-serrated" was made. To examine how angle of incision influences the accuracy of blade determinations, a third round of cuts were made where each knife incised cartilage specimens at five different angles and the specimens were examined at five different and specific magnification levels, which resulted in a total of 150 observations (6 knives x 5 angles x 5 observations). In total, there were 210 observations included in this study (60 observations in rounds 1 and 2; 150 observations in round 3).

Serrated blades are distinguishable from non-serrated blades 100% of the time. Serrated blades produce distinct, patterned striations, whereas non-serrated blades produce fine, unpatterned striations or no visible striations at all as they cut through cartilage. Angle of incision does not affect the overall accuracy of blade type determinations. However, the distance between striations on the cut surface varies with angle of incision; cartilage specimens incised at 15° and 25° angles display more striations than cartilage specimens incised at 75° and 90° angles. As a result, measuring the distance between striations on the cut surface of cartilage specimens incised at 15° or 25° angles is more challenging, but the high number of striations allows for patterns to be more easily recognized, thus leading to more confident blade type determinations.

The accuracy of blade type determinations was also not influenced by magnification level used during examination. Lower magnification levels, such as 10x or 20x, are sufficient to distinguish serrated from non-serrated blades. Thus, sharp force trauma analysts may select magnification levels at their own discretion. The results of this study indicate that standard light microscopy techniques, which are readily available to the majority of forensic scientists, are sufficient to accurately determine blade type and measure striation patterns in cartilage.