H69 Validation Study of Microscopic Analysis of Saw Marks in Bone

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The goals of this presentation are to review the current method of microscopic analysis of saw marks in bone, showcase the variables utilized in the analysis, and present the results of an independent validation study of the method.

This presentation will impact the forensic science community by increasing the general knowledge of the method of microscopic analysis of saw marks in bone and providing specific information regarding interobserver error and the potential error rate associated with the method.

Microscopic analysis of saw marks in bone is a well published, generally accepted, and commonly used method. The strength of the method is that it is based on the use of standard laboratory equipment, a stereomicroscope, to analyze easily recognized qualitative and quantitative characteristics of a saw mark. Despite the method's attractiveness, it has not been independently validated, nor has the potential error rate been defined.

In 1975, Bronte published a seminal article on microscopic analysis of saw marks. He expanded the then current method of measuring the width of a saw mark to the analysis of the shape and pattern of striations observed in the walls of the saw mark.[1] He disproved the hypothesis that saw marks on bone destroy themselves with each consecutive stroke of the saw and showed that several class characteristics of the saw are recorded in the mark. In 1978, Andahl expanded on Bronte's work. He divided a saw mark into two components: the floor and the wall.[2] Andahl found features recorded in the floor of the mark, both in partial cuts and on the breakaway spur of complete cuts, that reflected the number of teeth per unit length, tooth set, degree of wear, direction of cut and condition of the blade. Symes contributed to previous works in his doctoral dissertation.[3] He evaluated experimental saw/cut marks made using 26 types of saw blades and serrated knives. Through microscope analysis, Symes observed and described numerous features of the marks that reflected the class characteristics of the tool.

Harris County Institute of Forensic Sciences Anthropology Division designed a validation study of microscopic analysis of saw marks in bone. Experimental saw marks were examined by three analysts following the current method as described by Symes.[3,4] Experimental saw marks were made using three hand saws and one power saw. The hand saw blade types were an 18 teeth per inch (TPI) wavy set, an 18 TPI raker set, and an 8 TPI raker set. The power saw was a reciprocating saw with a 10 TPI raker set blade. The four saws were used to create 58 samples in four human femora. Each sample consisted of a false start and both surfaces of a complete cut. The samples were separated using a Stryker saw and each Stryker saw cut was scored to differentiate it from the experimental cut surfaces. Each sample was analyzed using a Keyence digital microscope and indirect fiber optic light. Fourteen variables were evaluated on each sample. Eight variables were quantitative: minimum kerf width, tooth width, trough width, floor dip length, pull out striae interstriation distance, number of directional changes of striae, inter-tooth hop distance and inter-harmonic distance. Six variables were categorical: breakaway spur, kerf wall shape, kerf flare, trough morphology, entrance shaving and exit chipping.

Initially, a pilot study was conducted with 10 randomly chosen samples. Consistency among the three analysts for each feature was measured. The analysts agreed on the kerf wall shape and exit chipping six out of 10 times, consistency of cut seven out of 10 times, presence of pull out striae eight out of 10 times, kerf flare, trough morphology and entrance shaving nine out of 10 times, and harmonics 10 out of 10 times. The difference in minimal kerf width measurements ranged from 0.01 – 0.67mm and the difference in inter-tooth hop distance ranged from 0.14 - 2.54mm.

Not all variables showed equal sensitivity. Harmonics were found to be absent in all of the samples. The floor morphology of the false start was found to be flat in all but one of the samples. Also, entrance shaving was found to be absent in all but one of the samples.

Following the pilot study a review of the variable definitions and results of the study was conducted. The complete study was initiated and is ongoing. The statistical analysis of the complete data set will show the discriminative value of each variable, the associated interobserver error, and the potential error rate of the analysis.

References:

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