H49 Examination of Saw Blade Teeth-per-Inch Measurements in Bone

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After attending this presentation, attendees will understand basic principles of saw mark analysis and several factors of bones and saws that may lead to variability of Teeth-per-Inch (TPI) measurements in bone.

This presentation will impact the forensic science community by demonstrating what needs to be considered in experimental research in saw mark analysis before attempting to provide error rates associated with quantifiable traits, such as measurements reflecting TPI of saw blades.

Tooth hop and tooth imprint are both measurable traits used in saw mark analysis to estimate the TPI of saw blade(s) in dismemberment cases. Tooth hop refers to striae across the kerf wall of a cut that show patterned waves. Tooth imprint refers to residual imprints from saw teeth in the kerf floor or the breakaway spur. For both traits, the distance from one wave's peak to another was measured as the Distance Between Teeth (DBT). Several hypotheses were considered in this research: tooth hop can accurately be measured to estimate TPI of a saw; tooth hop is more likely to occur where more cortical bone is present; tooth hop is less variable in denser bone; and a chisel-tooth blade is more variable than a crosscut blade.

This study utilized two saw blades of varying TPI and tooth type (a six TPI chisel-tooth and an eight TPI crosscut). Two species were also used (white-tailed deer long bones and human femora). Sample sizes of individual groups were as follows: 32 human crosscut; 32 human chisel-tooth; 62 deer crosscut; and, 55 deer chisel-tooth cuts. Only one side of each complete cut was analyzed. All cuts were assessed for tooth hop and imprint, which were then measured and photographed for DBT under a stereomicroscope. Thirty DBT measurements were also randomly taken between consecutive teeth down each blade to compare the variability of DBT from the actual blades to the variability of DBT taken from the bones. Overall images of each complete cut were used to quantify the amount of cortical bone and medullary space present. Trabecular bone was combined with medullary space because it was considered uninformative. Cortical thickness was also estimated. Welch Two Sample *t*-tests were performed to check for significant differences ($p<0.05$) between the DBT measurements of saws and species. Chi-squared tests compared observed and expected values for the presence/absence of tooth marks on the bones and the location of the marks on bone (wall or breakaway spur) between saws and species. Step-wise Discriminant Function Analysis (DFA) was used to compare groups with and without marks to estimate what variables were significantly different between the groups. Finally, multiple linear regressions were used to examine the correlations of the number of marks present to the cortical thickness, as well as other parameters, including the areas and perimeters of the cortical bone and medullary spaces.

Mean DBT measurements taken from the bones are not significantly different from mean DBT measurements taken directly from the saw blades. There are also no significant differences between species. However, the six and eight TPI blades are significantly different from each other. The chi-squared tests show that the two saw types left an equivalent amount of tooth marks on the two species. In terms of locations of tooth marks, marks are significantly present more on walls than on breakaway spurs ($p<0.05$). In DFA, the classification rate of marked bones versus unmarked bones is 63%. Stepwise selection suggests cortical thickness as the main discriminator between the two groups. However, when using multiple linear regressions, no significant correlation exists between the numbers of tooth marks in bone to the cortical thickness. These values become slightly more significant after the removal of dummy variables (bones that have no marks); nevertheless, their p-values do not fall below 0.05. Similarly, no correlations are found between the number of tooth marks and the other listed parameters.

In summary, all aforementioned hypotheses are confirmed. However, the variability found within the human bone measurements needs to be studied further in order to understand how DBT (and thus TPI) measurements are being affected. The more we understand about a material and what is cutting that material, the better we can estimate TPI measurements of saw blades used in dismemberment cases.

Dismemberment, Tooth Hop, Teeth Per Inch

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