A21 A Methodology in Differentiating Between Knives From Cut Marks on Bone

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The goal of this presentation is to propose a flowchart as an additional tool to enhance the assessment of cut marks on bones.

This presentation will impact the forensic science community by offering a new implement to recognize characteristics of cut marks and provide an effective method to correctly identify the type of knife used.

Many studies in sharp force trauma discuss knife cut mark analysis in the context of dismemberment in murder cases; however, blunt force trauma and sharp force wounds are the most common injuries in crime, especially in homicides.[1] Furthermore, sharp force trauma has been debated as being the leading cause of murder in the United Kingdom.[2] The research in lesion identification on bones has been successful, particularly in determining the type of blade used (serrated or non-serrated); however, there has been no uniformity in the characteristics used to identify the weapon's type.[3,4]

This study was conducted with the goal of creating a standard method for knife identification based on specific characteristics detectable in the marks left on bone tissues. This study chose, as a starting model, the characteristics used for sword and saw cut marks analysis, adapting them to the study of knife injuries and specific characteristics (e.g., grooves).[5,6]

In this study, a total of 150 cut marks were made on domestic pig (*Sus scrofa*) rib bones. These bones were macerated to ensure complete removal of tissue before beginning the experiment. Three different categories of blade were used to inflict cuts on the surface of the bones: non-serrated; micro-serrated (eight Teeth Per Inch with, average distance between teeth: 3mm); and, macro-serrated (five Teeth Per Inch with, average distance between teeth: 4.9mm). During the experiment, the knife was moved one time forward and backward to simulate a stabbing action.

After microscopic analysis (10x7-10x45), χ^2 tests of independence were performed for all characteristics to determine the relation between trait and type of knife. According to the probability of correct identification of knife type by each characteristic, a flowchart was developed. The features were structured from the distinction between serrated and non-serrated, and then between micro- and macro-serrated blades. Four characteristics were chosen for the differentiation between serrated and non-serrated knifes: grooves along the kerf wall; flaking; kerf shape; and general aspect. An additional feature, the presence of shards, is used for the separation between micro- and macro-serrated blades.

A blind test on an additional 100 cut marks was performed. The accuracy of the identification with the support of the flowchart is very high (95%) in the diagnosis between non-serrated and serrated knifes; however, there is a difference when the kind of serration is analyzed as well (0.7%). This suggests that the flowchart needs further improvement in this area, with additional features for the distinction between micro- and macro-serrated blades.

To test how intuitive the use of the proposed flowchart is and the characteristics used, two groups of forensic anthropology students (five undergraduates and five postgraduates) were tested. None of them had received training on cut marks, but they had different degrees of experience in human anatomy and osteology. All undergraduates had significant differences when compared to more experienced individuals, while the results of the postgraduate students closer to the expected values. This result demonstrates that, even if an in-depth knowledge and training in osteology is a prerequisite, the proposed flowchart is a useful tool that has the potential to increase the reliability of knife cut mark analysis. In addition, its use appears to be intuitive and supports the possibility of introducing this method as a teaching tool in graduate programs.

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