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Machete Cut Marks on Bone: our Current Knowledge Base

Abstract

Forensic anthropological research examining sharp force, or hacking trauma, on bone have primarily focused on saw, and knife tool marks on bone. The use of different weapons of opportunity in war crimes, genocide and contemporary crime has led to the need to identify cut marks on bone made by specific weapons and develop standard investigation processes that may identify a specific weapon used in such crimes, especially in the absence of eyewitness accounts. This paper provides a summary of research undertaken to identify cut marks on bone made by machetes and identifies gaps in the knowledge base to assist in further research. The limited numbers of studies to date have not investigated the affects of different weapon sharpening methods, different weapon materials, excluded the effects of weapons becoming blunt through use and made assumptions that some bone types will not exhibit specific weapon traits The lack of research highlights the need for further research in this field.

Keywords: Forensic anthropology; Machete; Cut marks; Bone; Crime; War crimes

Perspective

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Penny McCardle[1]* and Timothy Lyons[2]

[1]*Newcastle Department of Forensic Medicine, John Hunter Hospital Campus, Australia*

[2]*Department Forensic Medicine Newcastle, University of Newcastle, Australia*

***Corresponding author:** Penny McCardle, Forensic Anthropologist, Newcastle Department of Forensic Medicine, Rosella Close, John Hunter Hospital Campus, Po Box 664J, Newcastle, NSW 2300, Australia, Tel: 9198800666; Email: pschad@arrogengroup.com

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Perspective

Forensic anthropology has traditionally dealt with identifying a biological profile of the deceased, including the estimated age at death, sex, height, and ethnicity. Over the past few decades the remit of forensic anthropology has expanded to include the identification of the weapons responsible for blunt and sharp force trauma and gunshot wounds. The majority of forensic research on hacking trauma on bone was first derived from archaeological studies [1-4], followed by experiments that have mainly focused on knife [5-8], and saw tool marks [9-10]. The use of weapons of opportunity (eg. shovels, saws, shears, machetes) in war crimes, genocide and contemporary crime and the absence of eye witness accounts, has led to the need to identify the specific marks different weapons leave on bone. While multiple types of weapons are used in physical assaults, the machete has seen a significant rise in its use and media attention [11].

Burd and Gilmore reported that no two implements will produce the same tool mark and nor will the same tool produce an identical mark [12]. When used with sufficient force, sharp weapons leave marks that potentially provide individual and class characteristics on bone. Additionally, sharp force hacking trauma is essentially a blunt force trauma inflicted by a sharp object, and thus the analysis of the complete bone is necessary. One of the most important factors identified by Maples [13] was that when the sharp edge of a machete is used on live flesh or fresh bone, the cortex is compressed to the sides and when it is withdrawn, the elasticity of the bone will tend to close the cortical wound. This results in a wound width that is smaller than the blade that caused it, thus rendering wound thickness as an identifying weapon trait unreliable, a fact that has largely been ignored in tool mark identification.

The first attempt at distinguishing sword from axe cut marks on bone, independent of weapon/blade type, was undertaken by Wenhem [14]. Using six archaeological specimens with a total of 38 cut marks, Wenham established three criteria for distinguishing between the weapons. However, the type of swords used is unknown and no details regarding the experiments are provided.

Recent forensic experiments have focused on hacking trauma by large bladed weapons used for dismemberment, including the machete. Humphrey and Hutchinson [15], defined hacking trauma made by a machete, a cleaver and an axe on partially fleshed porcine limb sections. Twenty eight bones with a total of 58 cut marks were analysed. The results summarised in Table 1 & 2 indicate three defined classes of hacking trauma. They argue that hacking trauma could be differentiated based on size, shape and breakage associated with the different classes' cut marks and that these wound pattern characteristics were sufficiently different to make a reasonable judgment as to what weapon was used. However, the possible cortical wound closing, or possible partial closing was not considered, nor was the depth of a cut mark which would vary according to an individuals' strength. Additionally, no information regarding wound fracturing (i.e. blunt force trauma associated with sharp force hacking trauma) was discussed. Finally, the sharpness and blunting of the weapons and associated cut marks were not discussed and it is possible this may alter the cut marks.

Subsequent analysis on the same cut marks using SEM was undertaken by Tucket et al. [16] showed that the weapons used can be identified to class and possible individual weapons. For example, one of the machetes' topography was similar to that of a cleaver, and this was reflected in the cut mark. On closer examination, the striations were similar to machete striations, and is was suggested that those striations may reflect the weapon's use as an agricultural tool as evidenced through the presence of 'polishing' on the blade as the striations are comparable to archaeological micro wear analysis on stone tools [17,18]. Axe cut marks were excluded due to bone shattering.

The accurate identification of trauma, including sharp, blunt, thermal or poly (multiple) trauma, is dependent on pattern recognition as well as intrinsic and extrinsic factors that determine the way bone fractures [19]. Additionally, the patterns weapons leave on long and short bones may not be evident in other types of bones (such as flat and irregular bones). To date research into hacking injuries on bone is limited. Examination of the different materials weapons are made from and the different characteristics they may produce is needed. Likewise, more information is needed to determine whether sharp and blunt blades produce significant differences in tool mark morphology and whether different sharpening techniques (grinding machine, file, sharpening stones) produce different microscopic patterns on the weapon and hence the cut mark. Experiments of hacking trauma on different bone type sis also necessary as experiments to date have focused on long bones only.

Table 1: Summary of Entry and Exit Characteristics of Three Weapon Types: Cleaver, Machete and Axe [15].

Characteristic	Cleaver	Machete	Axe
Entry Site Recognition	Clearly recognisable	Less clearly recognisable	Sometimes clearly recognizable
Entry Site Appearance	Clean	Clean, chattering	Clean, chattering, crushing, fractures
Width of Entry Site	Narrow; approx. 1.5mm	Medium; approx. 3.5mm	Medium to large; approx. 4-5mm
Fractures at Entry Site	Never	Most commonly originate past entry site at kerf floor on obtuse-angled side; several fragments	Originate at entry site; extend outward; large pieces of bone pushed into entry
Depth of Penetration Due to Cut	Perpendicular cuts never penetrated through entire bone	Rarely penetrated entire bone; mean penetration was 31.5% of bone diameter	Rarely penetrated entire bone; mean penetration was 14.2% of bone diameter
Exit Site Recognition	No exit sites	Clearly recognizable	Clearly recognizable
Exit Site Appearance and Fractures	No exit sites	Fractures with several small to medium bone fragments	Fractures with large triangular bone Fragments (often only one)

Table 2: Summary of SEM Characteristics of Injuries Inflicted on Bone by a Clever and Machete [16].

Characteristic	Cleaver	Machete
Striations on Bone	All but one cleaver produced parallel striations perpendicular to the kerf floor on the smooth obtuse-angled side of the cut; Striations were thin, fine, distinctive and relatively close spaced; Overall surface of the striations were smooth	Parallel striations perpendicular to kerf floor on the obtuse side of the kerf wall; Striations were course, more pronounced, had a smoother 'Rolling hill' appearance, and were more widely spaced and rugged in morphology than the cleaver
Striations on Weapon	Displayed a uniform and consistent striation pattern that included numerous thin, fine parallel striations clear at 40X magnification	Parallel striations with a 450 angle and striations that intersect one another on the used machete; rolling topography present and striations had a course rugged surface
Cut Surface and Weapon Comparison	Clear similarities in the morphology of striations on bone and topography of the blades The higher resolution image weapon edge displays more numerous striations than the cut sample due to the malleable properties of metal and the cellular structure of bone.	

Conclusion

In the absence of eyewitness accounts, class and individual characteristics of tool marks may play a major role in weapon identification. Such identification has the potential to add another level of scientific inquiry when examining evidence in a trial. Forensic anthropology will continue to develop as offenders continue to use different weapons of opportunity. This variety of weapon usage necessitates further research to enable the identification of the marks that the each of the weapons leaves on their victims. Further experimentation is currently being undertaken by the author as part of a PhD.

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