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Journal of Archaeological Science 35 (2008) 1216–1223

Journal of Archaeological SCIENCE

http://www.elsevier.com/locate/jas

An experimental investigation of cut mark production and stone tool attrition

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Received 25 May 2007; received in revised form 20 August 2007; accepted 22 August 2007

Abstract

In discussions of Paleolithic hominin behavior it is often assumed that cut marks are an unwanted byproduct of butchery activities, and that their production causes the dulling of stone tool edges. It is also presumed that Paleolithic butchers would have refrained from making cut marks to extend the use life of their tools. We conducted a series of butchery experiments designed to test the hypothesis that cut marks affect the use life of tools. Results suggest cut marks are not associated with edge attrition of simple flake tools, and therefore it is unlikely that Paleolithic butchers would have avoided contact between bone surfaces and tool edges. Edge attrition is, however, significantly greater during skinning and disarticulation than during defleshing. This suggests that skinning and disarticulation activities would require more tool edges relative to butchery events focused purely on defleshing. Differences between the number of cut-marked bones relative to the number of stone artifacts deposited at taphonomically comparable archaeological localities may be explicable in terms of different types of butchery activities conducted there, rather than strictly the timing of carcass access by hominins. Archaeological localities with higher artifact discard rates relative to raw material availability may represent an emphasis on activities associated with higher edge attrition (e.g. skinning or disarticulation).

Keywords: Cut marks; Use life; Butchery; Stone tools; Actualistic study

1. Introduction

In many Paleolithic butchery studies there is an implicit assumption that prehistoric butchers would have avoided creating cut marks with their stone tools. This assumption is based on the notion that the production of cut marks causes edge attrition, or dulling, of the sharp edges of these tools. Identifying such links between butchery activities and stone tool use life is potentially invaluable for understanding stone artifact discard decisions by Paleolithic tool users, the role of these decisions in formation processes at Stone Age archaeological sites, and the relationship between the abundances of stone tools and hominin-modified fossil bone. However, this particular assumption has never been explicitly tested and the relationship between cut mark production and stone tool edge attrition has never been quantified.

Despite this assumption remaining untested, it has influenced a variety of other types of analyses in Paleolithic studies including analyses of cut mark frequency, and raw material procurement, use, and conservation. Bunn (2001) is perhaps most explicit, stating that "…butchers with any interest in preserving the sharpness of their knife blades are not going to repeatedly hack into the visible bone surfaces when the adhering meat can be shaved free without hitting the bone directly enough to produce cut marks. Cutmarks are mistakes; they are accidental miscalculations of the precise location of the

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doi:10.1016/j.jas.2007.08.015

bone surface when muscle masses obscure it. As soon as the butcher can see the bone surface, few if any cut marks will be inflicted thereafter in that area'' (Bunn, 2001: 207).

Bunn (2001: 208) further asserts that ''[E]ven partial defleshing by carnivores reveals where the surface of the bone is, which enables the butcher to avoid hitting it with the knife (which would only be dulled by contacting the bone and producing a cutmark).'' Bunn has therefore used the assumption that stone tools are dulled by the creation of cut marks to build a scenario in which Paleolithic butchers are unlikely to make marks on bones that have been previously defleshed by carnivores. From this he has made the behavioral inference that at archaeological sites with cut-marked fossils, the bones must have been accessed by hominins while they retained substantial muscle masses.

The assumed relationship between cut mark production and tool edge attrition (dulling) also has obvious implications for the use life of tools found in archaeological assemblages (Shott and Sillitoe, 2005). Understanding the factors that influence use life of simple flake tools during butchery activities is important for understanding the functional significance of stone artifacts at Early Stone Age sites (Tactikos, 2005; Toth, 1982, 1987). Although new studies suggest that many Early Stone Age sites may represent the use of stone artifacts to procure non-mammal tissue resources (Mora and de la Torre, 2005), there remains extensive evidence that sharp edge flakes were associated with extracting resources from large mammal carcasses during this time period (Bunn et al., 1980; Bunn, 1981, 1986; de Heinzelin et al., 1999; Dominguez-Rodrigo and Pickering, 2003; Dominguez-Rodrigo et al., 2005; Potts and Shipman, 1981). Therefore, exploration of the association between stone artifact use life and various butchery activities will assist in the development of hypotheses about tool discard behaviors in the past (Schick, 1987).

Two things are required before such analyses may proceed. First, the assumption that cut mark production dulls stone tools must be tested and quantified. Second, the relationship between various butchery activities and stone tool edge attrition must be more precisely investigated. This study reports a series of butchery experiments designed to address these requirements. We first quantify the degree of association between cut mark number and three different measurements of edge attrition, thereby examining the basis of Bunn's (2001) inference that hominins took measures to reduce the likelihood of tool-bone contact. We then evaluate the relationship between stone tool edge attrition and three specific butchery tasks, not all of which would consistently leave archaeological traces that would be preserved in the form of cut-marked fossils: skinning, disarticulation, and defleshing.

2. Methods

This study is based on two separate types of butchery experiments designed to test specific hypotheses. The first set of experiments is aimed at determining the association between cut mark number and edge attrition. This set of experiments included the systematic butchery of 18 individual hindlimbs of various sized animals (6 sheep; 6 juvenile cows; 6 zebras) acquired from a local commercial butcher. In these 18 experiments (Cut Mark Experiment 1–18, henceforth CME 1–18) skinning was carefully conducted with a metal knife in a manner that precluded contact between the knife edge and any bone surfaces. Subsequent defleshing was done with a single whole flake (detached piece with a complete platform and completely intact distal edge: *sensu* Isaac, 1981) so that all cut marks could be associated with edge attrition of a single flake. These limbs were not disarticulated. The second set of experiments was conducted to measure edge attrition in three separate butchery tasks (defleshing, disarticulation and skinning). This set of experiments included the systematic butchery of two sheep (Cut Mark Experiment A and Cut Mark Experiment B, henceforth CME A and CME B). All of the stone tools used for the butcheries were made from fine-grained tholeitic basalts from the Gombe Group of basalts in the Turkana Basin in northern Kenya. This raw material was used by the majority of hominins that produced the archaeological record in the Koobi Fora Formation (Braun, 2006).

2.1. Butchery

The butcheries were conducted by two Turkana men who were skilled butchers (Dominguez-Rodrigo, 1999). These men were aware that the butcheries were being conducted for research purposes. For CME 1–18 butchers were presented with the skinned hindlimbs and told to completely deflesh each limb. A total of 18 flakes were used for these experiments. The CME A and B experiments were conducted following the pattern described by Jones (1980). An initial vertical incision was made with a metal knife from throat to tail to remove the viscera. The head was then removed with a metal knife. No cut marks were made on the limbs during these two operations. The carcass was then hung upside down from a tree, by a rope tied around one leg, to facilitate butchery.

In CME A and B, a single whole flake was used for each butchery task (skinning, disarticulation, defleshing) on each limb (4 forelimbs, 4 hindlimbs). A total of 24 flakes were used for these two experiments (8 skinning flakes, 8 disarticulation flakes, and 8 defleshing flakes). Periosteum was not removed. The sequence of butchery on each limb was as follows:

1) skinning, which began at the carpals or tarsals and removed enough skin to disarticulate the limb from the axial skeleton;
2) initial disarticulation, or removing the limb from the axial skeleton;
3) defleshing, which involved the scapula/humerus/radio-ulna in the forelimbs and femur/tibia in the hindlimbs (metapodials were not processed, as they have very little flesh and the butchers said they would not normally process them for flesh);
4) secondary disarticulation, or removing each of the aforementioned limb bones from each other.

Only one whole flake was used for each of these butchery activities during CME A and B, regardless of the difficulty