Abstract
Due to the obvious constraints involved with working on human osseous material many advances in experimental aspects of biological anthropology have made use of research from the zooarchaeological analysis of faunal remains. Cut marks represent unequivocal evidence for human activity on animal bones, making the analysis of butchered remains an important part of zooarchaeological research. However, understanding the technical aspects of dismemberment is crucial to interpreting activity from assemblages where cannibalism has occurred. As faunal butchery has played an important part in developing an understanding of how humans may have used implements on other humans, it is equally important for those involved in human osteoarchaeology to also have an appreciation of how orientation, implement use and fundamental carcass dismemberment principles may affect how and why a particular process was carried out. This paper will highlight aspects of butchery and carcass dismemberment that may assist with interpretation and appraisal of cut marks on human remains, for example in distinguishing dismemberment for nutrition as opposed to cut marks made during ritual/sacrificial practices.

Keywords: butchery; zooarchaeology; osteoarchaeology; human remains; cut-marks

Cut mark research in context
The analysis of cut marks has become a vital means of achieving interpretive data from osseous remains. No other analytical tool indicates the unequivocal intent of humans to carry out a specific process, in this case, either as part of a procurement strategy or for ritual practice. This paper will explore some of the advances made through zooarchaeological research of processing marks, highlighting how these developments might find application as part of the identification and interpretation of cut marks noted on human remains within an archaeological context.

The use of zooarchaeology to assist with interpretations from human remains is not a novelty. The specific constraints placed on physical and forensic anthropologists have often led to a dependence on faunal research to assist where experimentation on human material would be prohibited. Thompson (2002, 2004), for example, studied the changes that occur to bone during various stages of burning. The research demonstrated that particular caution needed to be exercised when dealing with sexing of cremated material; throughout the experimental phase of the study there was a dependence on animal bone. While this example demonstrates the oft incurred reliance on animal bone as a raw material, other research has borrowed comprehensively from zooarchaeology. The taphonomic history of the human bone assemblage from Sima de los Huesos, Atapuerca, was analysed using terminology and models following Binford (1981) in order to distinguish between scavenging / carnivore activity and trampling damage (Andrews and Fernandez-Jalvo 1997). Studies of cannibalistic activities at Mancos Canyon, Colorado incorporated a broad appropriation of zooarchaeological theory and method (White 1992). In this study White undertook an appraisal of the human remains, incorporating perspectives from Lyman (1978, 1987) and Binford (1981), in an attempt to clarify what caused the particular pattern of cut marks and bone fragmentation.

The present article continues this trend by presenting aspects of ongoing zooarchaeological research into butchery and processing practices in order to outline how this might be used to better understand cannibalism. Of key importance is that an understanding of process during disarticulation is imperative and should be axiomatic; a fundamental criterion that merits concise and consistent appraisal.

The importance of cut mark research lies in its inherent dependence on an interdisciplinary approach. A true and accurate appraisal of butchery practice cannot be carried out without a lucid understanding of the tools that have created the mark, or knowledge of the soft tissues that surround the skeletal material. Focusing specifically on the relevance of cut mark analysis to human contexts, three main research areas are evident; the identification of subsistence strategies1, the clarification of ritual practice and exploring aspects of human conflict.

Integrating Zooarchaeology and Physical Anthropology/Forensic Archaeology
Within a zooarchaeological context cut mark analysis is invariably employed to explore economics, subsistence and/or procurement of meat, despite the fact that it can tell us a great deal about the perceptions and cultural contexts of animals (Seetah 2005). The work presented here has its naissance in research employing modern butchery as a means of understanding aspects of Romano-British meat processing. Thus, it is probably most accurately applied to looking at instances where humans may have been disarticulated as part of a procurement strategy. This caveat noted, developing an understanding of the process involved with regard to how the marks may have been inflicted on the skeleton, will certainly be of benefit in any instance where sharp

1 The use of the term ‘subsistence’ strategies is employed in the loosest sense as there is no intention to imply that humans would ever form the main or dedicated ‘meat source’.
implement trauma or ritual activity is suspected. This article is not a comprehensive evaluation of cut marks found on humans in relation to conflict, subsistence or ritual practice; rather it is an appraisal of factors that need to be addressed by the human osteoarchaeologist beyond the mere occurrence, level of fragmentation and location of where marks appear on the skeleton. It is aimed at providing a means of clarifying what cut marks on human bone signify and the types of interpretation they can lead to. This information can then be used to better understand aspects of culture, violence and the use of human flesh as a source of meat.

Conflict & Violence
Conflict between humans occurs in many forms. The inventiveness employed to create and utilize implements to inflict trauma on other humans seems to be limited only by the imagination of the mind, and the resources available to hand, as Gerssdorf (1517) so clearly illustrates (Figure 1).

![Figure 1. The Wounded Man, from Gerssdorf's Feldbuch der Wundartzney (1517)](image)

The majority of trauma evidenced from human skeletal assemblages can be placed into two main categories; those caused through warfare where violence has occurred on a scale of mass combat, and those caused through inter-personal violence between two or a relatively small number of individuals.

It may seem that cut mark analysis has little to contribute to this particular area, however, this is not the case. Generally there will be a lower occurrence of actual marks than for subsistence, as the intent is likely to be driven by a desire to cause as much injury and/or death as quickly as possible. However, the marks should lend themselves to clearer interpretation compared to a situation where there were multiple marks occurring in a complex matrix (as a result of a combination of procurement practices i.e. skinning, defleshing etc). Furthermore, two key areas do potentially benefit from a better understanding of the cut marks, namely accuracy of identification and recognition of subsequent activity.

Misidentification of marks is a significant problem and one that is particularly relevant where a single traumatic incident is evidenced (Boylston 2000: 359). Larsen (1997: 109) laments the problems of inaccurate identification leading to peculiar inferences relating to conflict and reconstructions of combat. To rectify this situation, taphonomic (and forensic) methodologies should be incorporated into the analysis of cut marks to improve rigour and reliability. Thus, it is clear that actual cut marks need to be clearly differentiated from post-depositional taphonomic processes, including damage created during excavation, in particular the ubiquitous and much maligned trowel marks.

Deciphering subsequent activity after a conflict situation also poses potential problems. It may be the case that after the relatively clear ‘trauma’ marks are identified, ensuing de-fleshing or disarticulation goes unobserved. In this way, intriguing cultural activity may be obfuscated because of a failure to recognise indicators of less prominent activity. Related to this is the identification of different types of activity that also results in the occurrence of mass traumatic incidences, for example, distinguishing warfare from massacre, genocide (Kennedy 1994) or forms of execution that involve dismemberment. These are likely to elicit marks that are evidently made from ‘weapons’, but it is essential to differentiate these from marks made in combat. This can be assisted, and indeed achieved, by improving our level of identification and by understanding the stages of activity that took place prior to and during the infliction of the mark.

Ritual & Perception
Interpreting the ritual treatment of human bodies, whether within a burial or sacrificial context, can provide important data for understanding past cultural activity. While it is the case that cut mark analysis of faunal remains invariably leads to conclusions relating to economics, when marks appear on humans there is a tendency to assume a ritual connotation. It must be appreciated that even when subsistence activity is evident, the potential for ritualistic involvement should not go un-noted.

While it is not the intention of this article to delve too deeply into ‘ritual activity’ per se, it is important to relate how aspects of cut mark analysis might be relevant to
understanding ritual behaviours, and the perceptions of humans and animals.

One way that cut marks might be linked to ritual activity (and indeed procurement strategies) is to look at whether there is a difference in the way humans have been treated compared to other animals. A key feature of carcass processing is that no matter what species is being dealt with, the overall morphology of the animal will, to a certain extent, dictate how the disarticulation process is carried out. This needs to be evaluated in light of the implements used; however, it is usually the case that sites of ‘natural disarticulation’ such as joint margins will be the obvious choice for dismembering. A similar disarticulation pattern is likely to be used for all fauna and any deviation from this with any particular species may be indicative of special treatment. Thus, it is possible to observe whether there is a pattern of human processing that mimics ‘faunal butchery’ and what the implications of this might be.

Generally, within a temperate climatic context, animals being hunted and subsequently processed will usually be cursorial. Within a tropical and subtropical environment the presence of arboreal primates may give clues as to whether, on a purely functional level, there are differences in methods of butchery based on morphology. Intriguing recent research from the Niah Caves, Malaysia, has shown that butchery of primates can follow an almost identical pattern as those employed on other fauna, such as pigs (Rabett & Piper nd.).

One might expect a different means of disarticulation of humans due to the unique morphology and mode of locomotion. If the same butchery techniques are used for animals, particularly primates, but a different range of cut marks are employed for humans, this might indicate a special perceptive view of humans, resulting in associated ritual practice.

How far this potentially extends is not always realised; methods of hunting and subsequent processing are often closely linked to the perceptions of the animal in question (Pluskowski 2005). This aspect of cut mark analysis is particularly important when humans form the ‘meat source’, as has been demonstrated by ethnographic studies. The Huaorani, an Amazonian hunter-gather group, view their implements either as ‘hunting’ or ‘killing’ tools. Blow pipes are used to hunt arboreal primates and birds; spears to kill the white lipped peccary and humans during conflict. Generally, groups that are not Huaorani are considered to be ‘others’ and are thought of as cannibalistic as opposed to the Huaorani who are ‘true humans’. Within Huaorani society, which is highly dependent on isolationism, the peccary is killed when it comes into the domain of the Huaorani, a situation repeated for people who are not Huaorani. Primates are actively hunted and a great deal is known about their social organisation. This distinction extends into the way tools are made and used as well as how the animals are processed (Rival 1996: 145-164). Although Rival does not discuss how animals or other humans are actually ‘butchered’, this study does illustrate how perceptions of species, environment, salubriousness and social organisation affect the way processing is carried out.

Crucial to the idea of humans being seen as meat is the image and perception of nature within the society in question (Howell 1996: 127-144). Not surprisingly, not all groups think of themselves as above and beyond nature, as is the case in western philosophical thought and morality (Ingold 1988).While there are numerous detailed accounts of the types of cut marks that might be observed as a result of mortuary practice and other more commonly observed ritual activities (and the relevance of economic factors such as meat quality and how these impact on methods of processing can be appreciated), there is often a failure to link the perceived attitudes of people towards that which they are processing.

**Anthropophagy & Subsistence**

No appraisal of cut marks on humans is complete without a discussion of cannibalism. Studies have focused on the modifications found on human bone as a result of this activity (Harkbut 2000) as well as the links with the perceptual and ritual attitudes of those eating their fellow human (Ogilvie & Hilton 2000). Cutting a human and eating the flesh has multiple implications; it can be seen as the ultimate act of humiliation where eating the flesh of an enemy implies an appropriation of their power and strength. Alternatively, within a mortuary context, eating the flesh of a deceased group member may imbue their knowledge and skills to those who participate in the ceremony. This is the area where zooarchaeological research, and in particular the specific research presented here, has the greatest contribution to make to human osteoarchaeology.

What is evident is that cannibalism has been almost universally practiced at one time or another in the majority of geographic regions, with the exception of Europe, within historic times. Despite its long history and wide spatial occurrence, clear identification of cannibalism is not easily accomplished (Wells 1964: 138-9).

Understandably, faunal butchery and disarticulation is easier to accept, particularly due to its considerably higher level of occurrence. However, one should not lose sight of the notion that under certain circumstances humans may be treated, through disarticulation, in the same manner as other animals. This extends to secondary processing through marrow extraction, cooking and processing of human bone for tools. While the potential for cut marks to indicate a perceptual difference between how humans and animals are viewed has been highlighted, the situation may also operate in reverse. Some societies may see other humans, particularly those defeated in battle, as a valuable meat resource that can be exploited. This situation may arise in environments where animal protein is already a scarce commodity and conflict is cyclical and self-perpetuating, resulting in a relatively stable supply of
meat. If these factors are coupled with the social sanctioning of necrophilia and anthropophagic activity (Spenneman 1990: 101) cannibalism may not be considered taboo.

Cultural connotations aside, the identification of cannibalism poses problems on a number of levels. As with recognition of conflict, it is imperative to distinguish cut marks arising from cannibalistic behaviour from other taphonomic agents. However, evidence for defleshing and subsequent consumption need not be restricted to cut mark analysis. Variation in the pattern of burnt human bone has been used to speculate that flesh had been removed prior to burning (Baxter 1996).

The preceding discussion has served as a brief prologue to three significant research areas that cut mark analysis can contribute to, giving an indication of the depth of interpretation that this unique tool can lead to. What must be remembered is that, in general, all three of these components potentially interlink and show interdependence when humans disarticulate other humans. Accordingly, they should form an important part of the interpretative process. The ensuing sections will look at some of the factors that are important in arriving at the stage where patterns of activity can be inferred, and what is needed in order to validate these conclusions.

**Chaîne opératoire of butchery – towards improved interpretation**

A fundamental difference exists between the analysis of cut marks from faunal assemblages and those where there is evidence of cannibalism. Within zooarchaeology it is rarely, if ever, the case that the species comprising the assemblage is also the one responsible for creating it; an obvious dynamic in anthropophage circumstances (White 1992: 102). This crucial aspects needs to be kept in mind as the already intricate task of determining how and why cut marks occur on bone is made considerably more complex with the addition of the conceptual attitudes of humans.

The two most salient aspects in determining anthropophage activity are the observed perimortem indications and the assemblage’s element representation (White 1992: 100). Closely linked to this is correctly distinguishing different categories of marks, for example slicing marks from chopping marks, and the accurate assessment of what implements have been used to make the marks.

A number of factors regarding more fundamental characteristics of cut mark analysis are worth mentioning before looking at issues of identification and implement usage. One of the most important issues when looking at butchery is that the marks are invariably incidental; the practitioner has not actively set out to leave a mark on the bone. There may be occasions where mutilation, ritual or mortuary activity involves deliberate incisions; however, these should be placed in a separate category as they are indicative of an entirely different pattern of activity. Cut marks following processing, be that part of a ritual, mortuary, or (as is being focussed on here) subsistence practice, are not intentionally created.2

A number of issues are involved; firstly whether discussing processing in an ethnographic or modern butchery context, the skill of the practitioner is consistently reported as being of a high standard. The working knowledge of both soft and hard skeletal morphology means that it rarely takes a trained butcher (modern context) or hunter-gatherer more then a matter of seconds to locate the exact joint position, or the best place to make an incision in order to disarticulate a joint (Spenneman 1990: 116; Rival 1996: 148-151; Food and Agriculture Organisation Pub. 91 1991). As mentioned previously, due to overall morphology, it is likely that disarticulation of humans will follow, at least in parts, the procedure by which all mammals are processed. Furthermore, it is essential to recognise the importance of tools; these are often highly specialised and can involve complex manufacturing techniques. Of paramount importance is the prevention of damage to the cutting edge of any implement; this allows for a longer period of use, reduces the need for sharpen the blade and facilitates cutting of the meat. To maintain a sharp cutting edge, a ‘butcher’ will actively avoid bone as this will invariably dull the edge.

What must be remembered is that the specialist morphological knowledge, coupled with the skills of the person carrying out the disarticulation and the desire not to damage the blade (by avoiding contact with bone) all work towards an under-representation of cut marks. Therefore, anyone interested in looking at cut marks, also needs to be prepared to look at overall patterns of fragmentation (Knüsel and Outram 2004) and processing activity that does not leave tangible evidence.

**Accurate Identification**

Identification is a crucial aspect of cut mark analysis and involves not only the initial recognition of butchery, often very much dependent on the skill of the osteoarchaeologist, but also the division into distinct categories of cut mark type.

Accuracy of initial identification forms the first stage of interpreting cut marks. A V-shaped cross-section, for example, has long been held as a reliable marker for identification of marks made with a metal knife (Stewart 1979: 33). While problems exist with regard to distinguishing cut marks from other taphonomic factors, research has shown a high level of accuracy in recognising ‘cut marks’ per se from carnivore activity and percussion marks (Blumenschine et al 1996). These findings show that, with a relatively small amount of practice, not only can the distinction be made from other taphonomic indicators, but different aspects of processing can also be differentiated.

2 Although mortuary rituals themselves may include aspects of cannibalism, the distinction being made here relates to the reasons behind the cut marks, and ultimately why the marks are present.
Other authors have outlined the main points for accurate identification of cut marks (White 1992: 100-163; Greenfield 1999; 2000; Lyman 2001: 294-352) in greater detail than space here permits. The following evaluation is restricted to aspects of identification that are important for understanding some of the broader perspectives that will aid with interpretation of the cut marks.

In order to make the most of cut mark analysis, one needs to think about the process of butchery from the initial stages of identification. This is especially relevant where humans are concerned as the factors involved are likely to be considerably augmented. What needs to be maintained is an appreciation for what the marks represent; potentially, a mark may be indicative of cause of death or is an appreciation for what the marks represent; this information needs to be used as a basis for understanding, for example, factors such as what orientation the body was in during the disarticulation process.

Achieving this level of information involves incorporating a more in depth look at the marks, as well as a more holistic approach to interpretation. The striation pattern left by the implement (Greenfield 1999) needs to be analysed in order to accurately assess the direction of the cut and the orientation of the practitioner, body and implement. All too often, the likelihood that the body (or parts of the body) are subject to movement and constantly re-orientated during the disarticulation process goes unrealised. Reports are presented that have clearly failed to recognise that the body or carcass is not in ‘normal anatomical position’ during processing.

This leads to the next point, namely the need on the part of the osteoarchaeologist to have a viable working knowledge of the soft skeletal morphology of humans (or animals). One cannot hope to make an accurate appraisal of how and why a cut was made without knowing what muscular parts of the body were being removed, cut into or disarticulated. Having a ‘viable’ knowledge does not imply necessarily having the depth or the same type of knowledge about skeletal morphology that a meat processor has. The experience of the ‘butcher’ is dedicated to one specific task, the most facile means of disarticulating and removing flesh from a carcass. This is a unique knowledge base and quite different to understanding the mechanisms of the body from an academic or even medical standpoint.

These two points are closely linked and should be used in tandem. Firstly, when butchery marks are noted on a bone, it should be orientate into correct anatomical position. The muscles, tendons and other soft tissues that would have been present need to be taken into account and effectively ‘overlaid’ onto the bone. Only then can the analyst begin the process of evaluating what the mark might represent. At this stage it is possible to start understanding some of the finer aspects of the dismemberment process, for example what position the carcass was in during disarticulation. By starting with the bone in [approximate] anatomical position it is possible to see what direction the mark came from and whether there would have been a deviation from ‘normal positioning’ i.e. with the person lying on the ground, placed on an elevated platform, or even suspended. To illustrate this, taking a zooarchaeological example, chop marks to the inferior surface in the region of the neck / tubercle of the ribs, for example of cattle, are likely to indicate that the animal was suspended. It would be difficult to deliver a ‘chopping cut’ (using a cleaver) into this region unless the carcass was in a suspended position. It is probable that the practitioner was facing the ventral aspect of the carcass (evisceration would likely take place in this position), chopping from the caudal vertebrae and pelvis to the cranium in order to split the carcass. This type of information can also be useful in estimating how many individuals were involved in the disarticulation process. In this case, once the animal has been suspended only one person is needed to split the carcass. In a situation where a human was being disarticulated at ground level, it would be more difficult to make this estimation. Subtle differences in the way the cutting implements were used, or if the ‘handedness’ of the practitioners could be established, might give clues to how many individuals were involved. However, this would be a subjective approximation at best.

It is imperative that, where possible, the osteoarchaeologist factors in the likely cutting implements found within the geographic region or chronological period. This will have a considerable impact on the probable cuts found and it cannot be stressed enough how important an accurate appraisal of implements is to understanding cut marks.

Improving Interpretation

All too often the outcome in zooarchaeology, when looking at cut mark analysis, has been to simply note where and how many marks are present from any given assemblage. Human osteology on the other hand has invariably been far more adept at looking for the broader interpretive frameworks that might lead to a better understanding of what was actually taking place during the disarticulation process and what was causal to it. This approach has its problems if factors such as correct identification or accuracy in assigning implements are not clarified and can result in incorrect interpretation. However, there is the acceptance that complex dynamics are involved and that interpretation of at least some of these factors is possible.

Caveat: this term is used loosely to describe a person versed in processing either human or animal bodies – it will invariably be the case that the skills associated with disarticulation will have been developed on animal carcasses, hence the use of the term butcher.

It is important that the marks are described in detail; the information thus gleaned should then be used to evaluate factors such as:
• How many different types of tools are evident?
• How many people might have been needed for the disarticulation process, and can this be estimated from the evidence?
• What does the grouping and location of the marks indicate about the type of activity being observed?
• Is it possible to detect whether the body was processed on the ground, on an elevated platform, or indeed suspended from the neck or feet?
• Can other taphonomic indicators, such as evidence for burning or levels of fragmentation contribute to our understanding of the overall sphere of activity?
• Can a link be established between the methods of disarticulation used for humans with those used other animals within the same context / region / period?

The issues and queries outlined above barely touch the surface of what cut mark analysis potentially offers. Analysts must be prepared to pose the right questions and evaluate each criterion using rigorous methods. The following ethnographic example offers a pertinent illustration of some of the information potentially available.

Spennerman (1990) recorded and analysed an assemblage of bones from Fiji, where both historical and ethnographic information have indicated that human flesh was consumed, particularly following conflict. The cut marks noted from the assemblage were very faint and would have gone unnoticed had it not been for the particular provenance of the assemblage. Due to the level of preservation, Spennerman was able to rule out pathological and other taphonomic factors as the cause for the modifications. All marks recorded were at, or near, joint articulations. This information was also viewed in light of the culinary practice of the indigenous peoples, who invariably cooked in earth ovens.

From this information Spennerman was able to decipher that the implements used were made from bamboo, an unusual material from a western perspective, but one that has been widely used in South East Asia and parts of Oceania. The blade is sharpened by removing a sliver of bamboo to leave a new cutting edge; however, due to the nature of the material it tends to leave very faint marks on the bone. The method of cooking did not require the meat to be processed beyond ‘gross disarticulation’ as large joints, and even whole pigs or humans, were known to be cooked in this way (Spennerman 1990: 108-134).

The above study demonstrates how a combination of accurate recognition coupled with aspects of tool manufacture and cooking practice, allowed for a convincing reconstruction of the overall process of disarticulation. The nature of the implements, along with the specific type of food preparation, formed the catalysts for the pattern of butchery seen. The implements could not cut bone in the same way that metal or flint tools do; nor was there any need for de-fleshing cuts as the cooking methods called for large joints of meat. Marks for meat removal, common in European contexts for example, were not evident in this type of assemblage as the meat, once cooked, was easily removed from the bone without the need for further cutting. What this project demonstrates is that factors such as provenence, implements and cooking practice are all essential criteria and need to be brought into the framework of interpretation. Only then will an accurate appraisal of the cut marks be established.

Conclusion
In conclusion, this article has provided an evaluation of the main areas where cut mark research can make a useful contribution to the investigation of human remains. Unfortunately, there are few specialists who focus specifically on the attributes of processing marks or on their potential for further interpretation; although it is fair to say that the majority of osteoarchaeologists do recognise the value of studying cut marks.

It should once again be reiterated that a good knowledge of skeletal soft tissue anatomy is essential when looking at butchery marks, as is an understanding of what implements were likely to be present and how they were used. Anyone interested in developing this line of research must gain a clearer understanding and appreciation for how important ‘process’ is to cut mark analysis. Furthermore, one must also be prepared to develop a knowledge of implements; specifically the implements likely to have been present and in use in the region/site/period under investigation.

It has been demonstrated that this line of research has broad application and is not restricted to evaluations of subsistence. It can certainly contribute to interpretations of injury and violence, which although rarely discussed in an anthropological context (Larsen 1997: 154), would gain a great deal by adopting a rigorous methodological approach to analysing the relevant cut marks.

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