

The Osteology of Social Complexity

Searching for Osteological Indicators of Social Status Independent of Archaeological Context

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Introduction

-the king is dead..... where is his crown?

Social stratification has always been a contentious issue in the study of complex societies. It is problematic since the exact characterization of what indicates true social stratification is something that exhibits extreme diversity, both between the cultures themselves and the anthropologists that study them. Debates on the origins of social complexity are perhaps the most divisive of all arguments in the study of past cultures and many an anthropologist have 'gone to war', so to speak, over their beliefs.

One might think that perhaps mortuary evidence would help to clarify this issue, yet it often throws the discussion further into disarray and conflict. In the study of the pre-contact Maya this problem is exemplified by the significance placed on death from the ritualistic offerings of human sacrifice and other like rituals to the elaborate funerary offerings that often accompanied Mayan elite burials. The debate between whether elaborate mortuary remains should be considered a true burial or a sacrificial offering can become confusing and lead archaeologists astray in their interpretations. The best known of these circumstances in Mesoamerica come from the central Mexican highland site of Teotihuacán. In this instance, sacrificial victims were initially miss-identified as elites in what would otherwise have been interpreted as a royal tomb dug into the heart of the Pyramid of the Sun. This interpretation did not fit previous notions of early-classic Mexican cultures as these groups, unlike the Maya,

tended not to bury elites within their public monuments (Sugiyama 1989). The remains were later reinterpreted as sacrifices and the 'tomb' actually, a sacred cave.

These sorts of misunderstandings have a profound effect upon our understanding of the cultures we study. Often it is the mortuary settings that provide us the best glimpses into the actual lives of past people and thus we need to better understand what this evidence says about the cultures and time periods we study. Though from another culture, the Teotihuacán example depicts the importance of understanding the social status of Mayan osteological remains in Mayan archaeology.

Social Status in Death

To better understand the presence/absence of complexity in a mortuary setting we need to be able to identify the status of the individual buried. We need to be able to identify the elite and royal burials from offerings and ritualistic sacrifices found in caches of human remains. To do this, we need to be able to establish the social status of an individual through their physical remains.

Archaeological evidence can often be misinterpreted or misplaced and thus requires independent verification through other means to be sure of and archaeologically based status interpretations. If we can make connections between the skeletal evidence provided by the osteological analysis of Mayan remains found in archaeological contexts to what has been established through archaeological analyses, we may be able to better understand the role of social

differentiation among the Maya. To do this we need to begin by creating a set of criterion by which an individual's social status can be inferred independently of the associated archaeological evidence that may accompany these remains and bias their interpretations.

This paper will strive to piece together various aspects of Mayan culture, as known archaeologically, as it is depicted osteologically. Through macro-physical, developmental and osteo-chemical analyses I will show how Mayan elites can be differentiated from their non-elite contemporaries. I will also depict how osteological evidence is capable of providing Mayan archaeologists with new information on the nature of Maya social complexity.

Status and Diet

-Socially Complex Carbohydrates

Differences in diet are often some of the best indicators of social status in any population. Basic logic suggests that individuals in positions of higher status will use that power and wealth to eat better quality foods in higher quantities than non-elites. Among the Precontact Maya this idea of elites eating better than commoners relates to the heart of the whole idea of complexity. Social complexity among the Maya was linked to the idea of power being illustrated and manifested through the use of elite symbols, including the consumption of elite foodstuffs (Freidel and Schele 1988). While some of these foodstuffs held little more than economic significance (cacao consumption was

akin to lighting cigars with hundred dollar bills) there existed a definite differentiation between the nutrition of elites and commoners (LeCount 2001). In the end, elites took what they needed and commoners got what was left.

As a result of this apparent disparity between foodstuff consumption the question is, how can we see evidence of this differential consumption in osteological remains? To answer this question I will explore two independent osteological indicators of diet in an effort to better understand this issue, stable isotopic analysis and gross dental analysis.

Isotopic Indicators of Diet

Carbon Isotopic Analysis

Stable isotopic analysis, though relatively recent in osteological work, is perhaps the best osteological indicator of diet in past populations. Stable isotopes of carbon are differentially preserved in living tissue naturally, including bone collagen, through normal biological processes. Differential photosynthetic pathways between what are known as C₃ (leafy plants normally found in forested environments) and C₄ plants (among others maize) result in differing ratios of ¹³C (δ¹³C) being absorbed into the plant material (Ubelaker et al 1995). Upon digestion, these carbon isotopes are absorbed into human tissues in relatively similar ratios as they existed in the plants, eating animal protein will also pass along these isotopes in the ratios of the plants eaten by the animals themselves. By looking at the δ¹³C present in bone protein (collagen) and

comparing those ratios to those of plants and animals consumed by humans, chemists are able to make estimations of overall diet including whether dietary animal protein is marine or terrestrial in origin (for a comprehensive review of this technique see Katzenberg 1992). The biggest advantage of this analysis is that due to maize being a C₄ plant this method provides a good indicator of the proportion of maize that existed in the Maya diet.

Nitrogen Isotopic Analysis

Another application of stable isotope analysis is the analysis of nitrogen isotope ratios. $\delta^{15}\text{N}$, while showing some indications of plant type, is a strong indicator of trophic levels amongst animals and humans. Ratios of nitrogen isotopes increase through the process of biomagnification as nitrogen is passed from trophic level to trophic level through the food chain (Schoeninger and DeNiro 1984). One can identify what sort of animals an individual prefers by identifying those animals that share similar $\delta^{15}\text{N}$ values. We can also identify individuals eating terrestrial animals such as deer from their lower $\delta^{15}\text{N}$ levels, individuals eating marine fish exhibit higher $\delta^{15}\text{N}$ levels and those eating freshwater fish the highest $\delta^{15}\text{N}$ levels. By measuring $\delta^{15}\text{N}$ values in osteological remains we can garner a rough idea of the primary source of an individual's animal protein and thus can determine whether individuals are eating higher or lower status animals.

Dental Indicators of Diet

Dentition has also been used to identify patterns of diet. We can use dentition as an indicator of diet in two distinct ways, the first and most widely used and studied is dental hypoplasia, the other is a comparative analysis within a population of the instances of dental carries. While both techniques are not quite as scientific as isotopic analyses they are both quite easy to perform and can be quickly accomplished in the field without a nuclear reactor or bulky chromatographs.

Hypoplasia

Enamel hypoplasia occurs during tooth development when an individual is affected by dietary stress through malnutrition caused by famine or prolonged illness during adolescence (Chavez and Martinez 1982). During this period of metabolic inactivity the body literally stops producing enamel thus leaving the tooth with a transverse area of depressed enamel (Cucina and Iscan 1997). By looking at the positioning and width of the hypoplasia band we can infer the relative age of the individual, length and severity of the period under which the stress occurred. By looking at the number and width of hypoplastic bands on the teeth we can identify individuals who encountered limited access to food in their developmental years, ie commoners who may have been more affected by food shortages than higher status individuals.

Dental Pathology

The other side of dietary dental evidence involves the analysis of the presence/absence of dental caries and other oral pathologies as a whole. Caries

are formed when bacteria secrete acid during their metabolism of carbohydrates and sugars left on the teeth in the form of food particles (White 1975). The acid demineralises the enamel in the teeth and causes a cavity to form; this in turn traps more food beginning the process all over again. If caries are able to continue to burrow into the tooth to the pulp the pulp may become infected resulting in the eventual loss of the tooth. The high levels of simple carbohydrates (sugars) in maize are perfect fuel for these bacteria making a diet high in maize evident through a relative increase in the number of carries in the individual's teeth (Cucina and Tiesler 2003). This rise in dental pathologies is often compounded by the gritty nature of maize which additionally wears down the teeth making infection of the pulp much easier.

Dietary Indications of High Status

The concept of social status and diet is rather murky amongst the ancient Maya. Many studies using both isotopic and dental analysis have noted differences in the osteological remains of individuals of differing social statuses, and each have illustrated different issues that need to be addressed before these analyses can be used to accurately determine the social status of osteological remains. Previous studies into isotopic evidence of diet in the Maya region have brought up interesting issues. It is apparent that the diet of individuals differs between sites, as should be expected in a region as diverse geographically and environmentally as the Maya region. Individuals living in close proximity to the

ocean or to major rivers tended to have a higher reliance on fish as is indicated by higher ratios of ^{15}N . At the same time it is also evident from $\delta^{13}\text{C}$ that the majority of the carbohydrates eaten by the Maya came from maize (Powis et al. 1999). The problem becomes, can we determine a class of foodstuffs that are specifically limited to elites?

Maize is the staple of all Mesoamerican diets from the late archaic period through to today. It was the primary cultigen in the region and we can safely assume that all levels of Maya society relied heavily upon it for their daily carbohydrate requirements. The main area of dietary contention that arises amongst Mayanists is the role of animal protein in the Mayan diet. An analysis of faunal material from four domestic contexts representing the full range of Mayan society at the site of Aguateca Guatemala, an inland terrestrial site, identified over 30 different identifiable species, both terrestrial and marine (Emery 2003) suggesting a very wide dietary range.

This data does suggest that elites may have consumed more white tailed deer than most other individuals which would in turn skew the $\delta^{13}\text{C}$ closer to that of the of C_3 plants such as the shrubs preferred by deer than to the values for maize a C_4 plant, assuming of course that the deer are not eating from the maize crops. This is further complicated by the fact that elites throughout Latin America are known to have also drank a large quantity of corn-based beer, a reason some have hypothesized as being the stimulus for maize's initial domestication (Clark and Blake 1994). Previous isotopic analysis of mortuary

remain from Ecuador has suggested that heavy corn beer consumption by elites may actually skew $\delta^{13}\text{C}$ further towards the values associated with maize (C_4) than someone who ate maize strictly as part of their diet (Ubelaker et al. 1995).

So we have two suggested lines of isotopic evidence as to the isotopic signature of a Mayan elite diet. Perhaps, thus, the best way to identify an elite is to identify individuals that exhibit $\delta^{13}\text{C}$ either below, indicating high consumption of animal protein, or above, indicating heavy corn beer consumption, those expected for a normal maize based diet.

This high reliance on terrestrial animals such as deer amongst elites would have also have produced a much lower $\delta^{15}\text{N}$ in elites than commoners who would have been more dependent on marine and freshwater fish which would have produced a greater $\delta^{15}\text{N}$. This line of reasoning is backed up somewhat by the faunal evidence in commoner settings (Emery 2003).

In terms of dental evidence the differences are much more clear-cut. Male Maya elites exhibit much higher levels of dental caries and less overall dental wear than female elites and both non-elite males and females (Cucina and Tiesler 2003). This is attributed to a higher consumption of ground processed corn meal and more cacao that would have encouraged caries to form much more readily. These males also would have consumed more soft animal protein than others leaving their teeth less worn. Both elite women and non-elite men and women have very similar rates of caries with commoners exhibiting more dental wear than their elite female counterparts suggesting that these individuals had a

similar carbohydrate diet that differed mostly on the level of preparation and processing.

Cultural Skeletal Modifications

-A headache waiting to happen

Physical modification of the skeleton and dentition amongst the Maya was a quite common phenomenon amongst the elites and that over time became adopted by commoners as well (Haviland and Moholy-Nagy 1992). Both represented major alterations to the physical appearance individuals and in essence were viewed as permanent badges of status. From a functional standpoint one can imagine that only families with some level of wealth would be capable of bearing the burden of a young son or daughter who were unable to work due to head bindings. Individuals with significant dental modifications would also have required additional processing of food to prevent the filed or drilled teeth from shattering during mastication.

High Status Modifications

High status modifications, like high status diet, appear to have been highly variable between regions (Tiesler 1999). This, again, makes status identification difficult as the morphology of modified cranium can often be quite different from one type to the next (see fig 1 and 2) with no one form having more or less status associated with it. To start with, craniometric studies throughout Mesoamerica have shown that there existed a fair amount of

noticeable variation in cranial morphology before modification took place (Ross et al. 2002) to say nothing about the variation in modified cranium. This statement is echoed by the debates on the types of dental modification. While there exists a multitude of different types of dental modification from inlaying of jade and other precious stones (fig 3) to decorative filing and shaping (fig 4) we have no evidence of one type holding more status than another.

Social and Osteological Implications of Cranial and Dental Modifications

Cranial modifications appear to have been limited early on in Mayan society to elites, yet due to the relatively simple procedure involved in shaping a child's head it eventually spread to other parts of Maya society (Haviland and Moholy-Nagy 1992). From what we understand about the process it appears to have been a strictly cosmetic modification without any specific ritual or ideological purpose (Tiesler 1999). Studies have shown that cranial modification can have significant impacts on the structure of the cranium itself by increasing the stress placed upon the sagittal suture (White 1996). This in turn may cause an adaptive response to delay the closure of suture to allow the cranium more flexibility to adapt to the increased pressure. This then may result in the development of wormian bones or ossicles to fill in the space. Studies have found that Maya individuals with cranial modifications are significantly more likely to have these Wormian bones than those without the modifications suggesting a genetic adaptation to this cultural practice that may have developed over multiple generations (White 1996). As a result, the presence of wormian

bones in a modified skull may indicate descent through an elite bloodline that practiced cranial deformation for generations.

Dental modification on the other hand is a little more clean cut in its differentiation between high and low status individuals. Extensive dental modifications, by definition, require a higher level of skill to accomplish especially when the modifications cut into or near to the root of the tooth. Unlike cranial deformation, dental modifications can occur at any time during an individual's life. Dental modification also differs from cranial modification as it affects the functionality of the teeth, should a hole for an inlay be drilled too deeply the root may become infected resulting in extreme pain and a high probability that the tooth will be lost. In the same way, should an individual with heavy filing of their teeth be forced to eat anything too hard or gritty they risk either breaking or splitting the tooth, again not a pleasant occurrence. In this way we can see that the more complex the dental modifications are the higher social status the individual is likely to be due to the shear, shall I say, danger of the process.

Discussion

The major problem with the analysis of both cranial and dental modification is that the analysis of both is relatively subjective and without a baseline to determine the social significance and symbolism of each modification. We can tell that dental filing tended to be more common among women while encrustation was more common among men (Tiesler 1999) yet we have no idea

of the ideology behind this. Thus was also cannot say what the significance of men with filing is nor women with encrustations. Cranial modifications are no different, we have no clue if regional variations also displayed status differentials or if they were merely seen as an indication of ethnicity. We cannot observe cranial modification on a major level and thus have no direct proof as to whether the corresponding wormian bones are the result adaptive pressures or just reflect a common genotype.

What we need to do with these indicators of status is to see them in relation to one another. When osteological remains are analysed we must look for skeletal modifications, it is safe to say that the more modifications that are present the higher status the individual is likely to be for the same reasons previously mentioned. Yet we must remember that these modifications are not limited strictly to elites, we know of no cultural taboos against non-elites performing these modifications as is illustrated by the rising rates of both types of modifications over time (Haviland and Moholy-Nagy 1992, Tiesler 1999).

Antemortem Skeletal Condition

-squatting facets, broken arms and tapeworms, oh my!

Reasons for Differing Skeletal Conditions

It is safe to say that the overall condition of the remains themselves can be related to the individual's status. If we go beyond the obvious differences in preservation between an individual buried in a stone lined crypt to another

buried in a midden and look at the overall antemortem health of the individual we may come up with some indicators of social status. Warfare, for instance, was strictly an elite affair throughout Mesoamerica (Webster 2000). The result of this would be that male individuals exhibiting trauma wounds (ie parrying wounds on the radius or ulna, blunt trauma to the head or legs or decapitation) received in battle would almost certainly be elites. The major object of most Mayan conflicts was the capture of high status individuals for sacrifice making actual death during combat a relatively rare occurrence in relation to European or Asian conflicts of the time. This most likely resulted in elites returning from wars wounded but not dead which would be illustrated in high levels of healed injuries. The presence of multiple injuries showing different stages of healing would suggest multiple conflicts and thus higher status. If the injury was severe enough or even crippling the fact that the individual survived long enough to begin healing may itself be evidence of elite status.

Another aspect that may have differed among elites and non-elites would be their overall health. Elites had better access to better foods, they also performed less physical labour than non-elites resulting in less evidence of stress related injuries. In fact elites spent so much of their time sitting or squatting rather than working they often formed what are called 'squatting facets' on the upper and lower legs, ankle, and heel as the bones are remodelled due to the stresses invoked by squatting (Haviland and Moholy-Nagy 1992). Due to this

lack of work, elite remains would have exhibited overall better health than non-elite remains.

Ubelaker (1992) hypothesized that social status also resulted in differing levels of sanitation and food quality and thus was responsible for a higher rate of parasitic infections such as tapeworms among non-elites in Ecuador. These same sorts of processes were occurring throughout the Maya region as well. The heavy variation of diets that existed between social groups, as illustrated by Emery's (2003) faunal analysis, suggests that the same sorts of parasitic infections that existed in Ubelaker's Ecuador population also existed among the Maya.

Discussion

We should expect a high level of diversity between the antemortem condition of individuals from different levels of Maya society. As discussed, elites and non-elites were subject to very different types of physical pressures in their daily lives and this had a major affect on the morphology and overall condition of their remains. It should be pointed out that though most individuals buried in well built crypts and tombs, which normally result in better preserved remains, do tend to be elites there is a growing concern among Mayanists that some of these individuals are actually sacrificial offerings and thus we need to better differentiate between burials and offerings in the form of caches (Kunen et al 2002). This is also why the overall preservation and condition of the remains cannot be used effectively to determine status.

Discussion of Osteological Evidence of Social Status

-this is the end my friends, women children and elites first

The major point that I have tried to get across in this paper is that osteologically based analyses looking for indicators of status must focus specifically and solely on evidence of how the individual lived leaving how they were treated in death to the archaeological analysis of the context the remains were found in. An individual's social status, regardless of where they lived or the culture they belonged to is manifested in how they lived rather than what they are in death. It is this aspect of mortuary studies in which archaeology is severely lacking in skill and ability; it is also a realm in which modern osteology excels and thus one that should be embraced by more archaeologists studying social differentiation.

This paper has illustrated just some of the methods used by modern osteologists, dentition experts and bone chemists to better understand a person's life from their remains. It is evident that none of these methods are capable of answering questions of social status on their own yet if used as a suite of tests, each providing a small part to the puzzle of who these individuals were, we will be able to identify these individual's position in society.

Conclusion

-who cares about some dumb old bones anyway

Basic concepts of social complexity are the basis of all interpersonal relationships. Archaeology has always attempted to explain this process through material culture yet the explanations don't go far enough. Regardless of that well known and often repeated archaeological mantra, (Gasp! Sacrilege!) ceramics can lie and fancy stone crypts aren't always elite burials. In our pursuit of social status archaeologists must turn the criticisms we often lay on cultural anthropology of not being scientific enough back onto ourselves. If we want to talk about high status burial lets lay out exactly what we mean by that and build our case using multiple lines of evidence. That means that if we are talking about elite individuals we must prove that these individuals are elite, that they ate elite foods, decorated themselves as elites and led elite lifestyles. All these aspects of elite life are visible in their osteology. We must remember that what made these individuals elite was the way they lived their lives not the way they were remembered in death.

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Appendix A



Fig 1 -(Tiesler 1999)



Fig2 -(Tiesler 1999)



Fig 3 -(Tiesler 1999)



Fig 4 -(Tiesler 1999)