

Abstract

During the course of her research in Belize, Dr. Heather McKillop discovered a female individual in Burial 10 from Wild Cane Cay that she believes to be a sacrificial victim based upon the positioning in the grave and the items with which she was found. To determine whether this female individual is of a different origin than other individuals discovered in the area, those discrete dental traits that were used by Frank Saul to study a Maya population from the nearby inland city of Lubaantun were utilized in this study. These traits were examined for the female individual and six other selected individuals that were discovered in Wild Cane Cay and Moho Cay, another island site farther north along the coast in Belize. The purpose of my study was to discover if the comparison of these discrete dental traits among individuals could help demonstrate that the female individual from Burial 10 is of a different origin. After examination, there were a few traits that could possibly show a disparity in origin, but there is not enough information to form a definitive conclusion.

Introduction

In the course of excavating while studying archaeology, finding human burials is nearly inevitable. Archaeologists explore past cultures based upon their material remains; human burials are one of these material remains. Nearly every culture has traditions and beliefs linked to the burial of the body. The way in which an individual was laid in their grave, the depth of the grave, the materials with which the individual was buried, and morphological features on the skeleton can all reveal important information about not only the individual found in the grave but also the culture.

In the course of her research at Moho Cay and Wild Cane Cay in Belize, Dr. Heather McKillop has discovered many burials, but the one of most consequence to my study is Burial 10 from Wild Cane Cay (McKillop 2005: 60). This female individual has been dated to the Early Postclassic period in the Maya history of Belize (McKillop 2005: 74). However, the reason this individual is important to this study is

not because of her sex or the period in which she was buried; she is of import because McKillop suggested that she was a sacrificial victim. This individual was found face down in the bound captive position with her arms and legs behind her, knees flexed, next to an elaborately decorated pot that did not originate in Wild Cane Cay (McKillop 2005: 62). All of these traits are indicators of a possible sacrifice. The purpose of this study is to determine more about her origin. McKillop wondered if this individual was indeed a sacrificial victim, she may not have originated from Wild Cane Cay. To attempt to discover the validity of this idea, the discrete dental traits on the female individual have been examined and compared to other individuals found at Wild Cane Cay and Moho Cay to see if there is some significant difference, which would indicate a disparity in origin. For my honors thesis research, I examined discrete genetic traits of teeth from two ancient Maya island sites to investigate whether or not these were outsiders in the populations. The burials for Wild Cane Cay date to the Postclassic period (AD 900-1500; McKillop 2005: 68-84), whereas the burials for Moho Cay are Classic (AD 300-900; McKillop 2004: 262). Comparisons were made with teeth from an inland population at Late Classic (AD 600-900) Lubaantun (Saul 1975: 390). My study is part of a collaborative project with my advisor, Heather McKillop, Zoe Morris, and Kellye French, so I was given access to unpublished descriptive statistics of the burials.

The study of teeth is important in many fields, including archaeology. One reason teeth are critical in the study of humans is because they are composed of dense material, which resists physical and chemical decay and can often outlast other bones (Bass 2009: 271; Türp and Alt 1998: 71; White and Folkens 2005: 127). Teeth tend to be overrepresented in the fossil record (Bass 2009: 271). Another reason teeth are important in anthropology and paleontology is because they can provide an abundance of information about the individual to which they belonged. Teeth provide insight into “age, sex, health, diet, and evolutionary relationships of extant and extinct mammals, hominids included” (White and Folkens 2005: 127). One final reason teeth are so useful in the study of humans is their

heritability. The development of teeth and their expression of discrete traits have a strong genetic basis (Scott 2008: 265); teeth can provide information at the individual level as well as on a larger scale.

Before the discrete genetic traits can be examined, however, one needs to have a decent understanding of the human dentition. This knowledge includes knowing the types of teeth in the mouth and how to refer to them using proper anatomical terms and numbers.

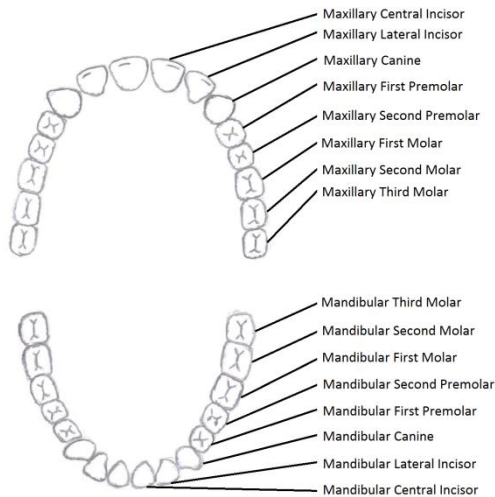


Figure 1: This diagram shows the teeth in the adult human mouth, labeling each tooth by its specific name and type.

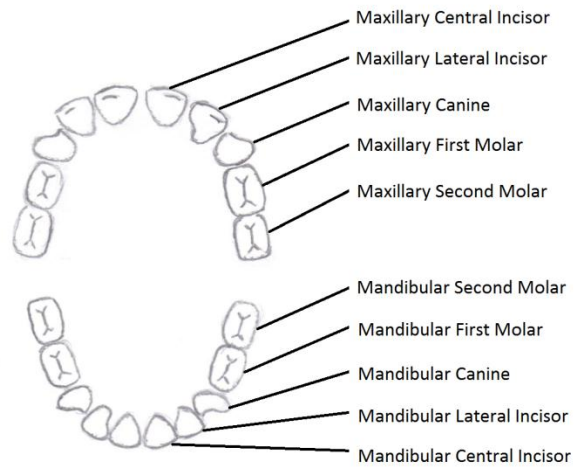


Figure 2: This diagram shows the teeth in the juvenile human mouth, labeling each tooth by its specific name and type.

Teeth serve to aid in the mastication of food, allowing it to be mechanically broken down to ease the chemical breakdown in the digestive system. Incisors, the front four teeth in the maxilla and mandible of both juvenile and adult humans, serve to cut food. An unworn incisor exhibits either a spatula or chisel shaped edge (Bass 2009: 271; Türp and Alt 1998: 78; White and Folkens 2005: 128). Canines are the next teeth in the dental formula. In both juvenile and adult humans, one canine can be found next to each lateral incisor in the maxilla and mandible. Canines are designed for holding food, tearing, and incising, so they are more pointed and conical than the incisors (Bass 2005: 271; Türp and Alt 1998: 78). The next type of tooth is a premolar, also referred to as a bicuspid. The premolar is the only type of tooth that cannot be found in the mouth of a juvenile human; two premolars are located behind the canine in the maxilla and mandible of adult humans. The function of a premolar is to grind

and reduce food to aid in digestion, so the surface of premolars is wide with multiple cusps rather than narrow or sharp (Bass 2009: 271). The final type of tooth found in the human mouth is a molar.

Juvenile humans have two molars behind each canine in the maxilla and mandible. Adult humans have three molars behind the premolars in the maxilla and mandible. A molar serves the same function as a premolar, crushing and grinding food (White and Folkens 2005: 128). The differentiating characteristic between premolars and molars is that molars are larger and have more than two cusps, the actual number varying from four to six (Turner II, Nichol, and Scott 1991: 23).

The numbers of each type of tooth found in the human mouth can be described using what is referred to as the dental formula. This formula is a set of numbers that describes the amount of each type of tooth in the maxilla (the number above the line) and the mandible (the number below the line) in one half of the mouth, starting from the central incisor and continuing backwards through the last

molar. The dental formula for an adult human is $\frac{2.1.2.3}{2.1.2}$, while the formula for a sub adult human is $\frac{2.1.2}{2.1.2}$.

To determine the total number of teeth, the dental formula must be multiplied by two, translating into 32 teeth in the adult human mouth and 20 teeth in the sub adult human mouth (Bass 2009: 271).

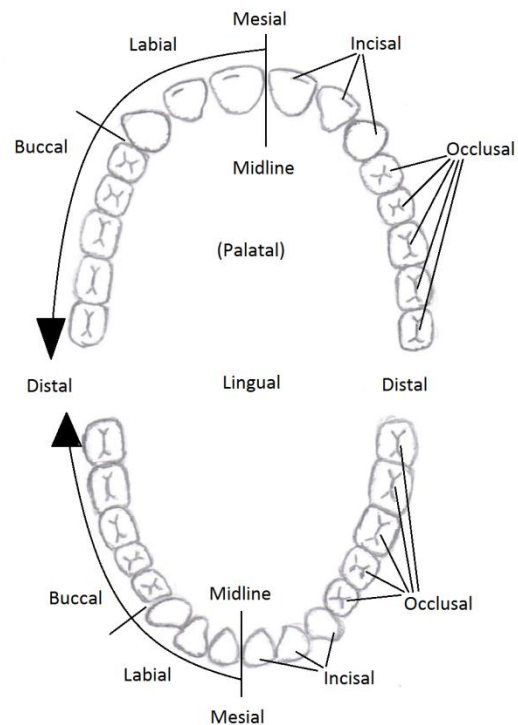
Individual teeth are referred to by their number in the mouth. The numbering system for teeth begins with the distal-most tooth in the right maxilla, the third molar in the adult human mouth. This tooth is assigned number one; the right second molar is number two; the right first molar is number three; and so on until the third molar in the left maxilla is assigned the number 16. At this point, the numbering continues with the third molar on the left side of the mandible. This tooth is assigned the number 17; the left second molar is number 18; the left first molar is number 19; and so on until the last tooth in the mouth, the third molar in the right side of the mandible, receives the number 32. Because there is also a juvenile individual in this study, numbering teeth for the juvenile mouth should be discussed. The numbering also begins with the distal-most tooth in the right maxilla, but in a juvenile human mouth, this is the second molar. This tooth is assigned number one; the right first molar is number two; the

right canine is number three; and so on until the left maxillary second molar receives the number ten. The same basic principle applies with the jump to the left mandibular teeth until the final tooth, the right mandibular second molar, receives the number 20.

In the study of anatomy, the human skeleton has a set of universal directional terms; they allow scientists to be as specific as possible when referring to a part of the body to avoid confusion. Teeth also have directional terms in order to orient any given tooth in terms of its position in the mouth. The midline is a line on the sagittal plane between the central incisors that allows the maxilla and mandible to be divided into left and right sides (Scott 2008: 267). The side of a tooth that is closest to the midline is called the mesial side. The side of the tooth furthest from the midline is called the distal side. These are the two directional terms that are the same for every tooth in the human mouth; the rest vary depending on which tooth is being discussed. The next two directional terms describe if the side of a tooth is closer to the inside of the mouth or the outside.

When dealing with the incisors and canines (or the anterior teeth), the direction closest to the lips is called the labial side. For the premolars and molars (or posterior teeth), this same direction is the buccal side because it touches the cheeks (Scott 2008: 267). The side of a tooth nearest the inside of the mouth is nearly always referred to as the lingual side because it is closest to the tongue. Some people refer to this side as palatal when talking about the teeth in the maxilla because the side is closest to the bones of the palate (Türp and Alt 1998: 72). The final surface of a tooth is the top surface that performs the task of masticating food. On the anterior teeth, this

Figure 3: This diagram shows the different surfaces of the teeth in a human mouth.



surface is called the incisal surface because it is sharper and intended for cutting and tearing food. With the posterior teeth, however, the top surface is called the occlusal surface because it is wider and designed for chewing food (Scott 2008: 267).

Methods and Materials

The traits chosen by Frank Saul in his study on the Maya at Lubaantun in Belize were selected because they have been shown to have genetic significance on an individual basis (Saul 1975: 390); Wild Cane Cay is from the same area and consequently also deals with a Maya population. The traits selected for this study are the same ones that Saul chose to use. A difference between these two studies is the manner in which the presence of the traits was graded. Instead of recording the trait as present or absent or using grading terms like “slight” and “severe”, the grading system created by the Dental Anthropology Laboratory of Arizona State University (ASU) was utilized for many of the traits. Not all traits explored by Saul were graded by ASU, but the ones that were allow for more precision and reproducibility of results than the present/absent dichotomy does. Building upon Albert A. Dahlberg’s work on devising a standard of comparison for a number of dental traits, ASU has formed plaster plaques to be distributed to others working on related topics so that results can be replicated between individuals (Turner II, Nichol, and Scott 1991: 13). Louisiana State University possesses a set of these plaques, so they were utilized whenever possible in the examination of the individuals studied.

The discrete traits examined by Saul that were graded by ASU are Carabelli’s trait, shovel traits, and caries. Carabelli’s trait is the name for a supplementary cusp on the lingual surface of the mesiolingual cusp on maxillary molars. The minimal expression of this trait, graded as 0 by ASU, occurs when the lingual surface of the cusp is smooth, while the maximal expression of this trait, graded as 7, is described as a large freestanding cusp (Turner II, Nichol, and Scott 1991: 19).

The two manifestations of the shovel trait are referred to as shoveling and double-shoveling. Shoveling is defined as the presence of lingual marginal ridges on the maxillary and mandibular incisors

and the maxillary canines. Double-shoveling denotes labial marginal ridges on the same teeth plus the maxillary first premolar. Shoveling can range anywhere from a flat lingual surface, graded as 0, to a marked shovel, graded as 6. There should be comparable expressions of the shoveling trait within a single individual. ASU suggests examining only one tooth, the central maxillary incisor if present. However, the furthest possible expression of shoveling only occurs on the maxillary lateral incisors; this extreme manifestation of shoveling is referred to as a barrel, and when present, it is given a grade of 7 (Turner II, Nichol, and Scott 1991: 14-15). The expressions of double-shoveling described by ASU range from a smooth labial surface with a grade of 0 to an extreme double-shovel with a grade of 6. On heavily worn teeth, a grade of 6 is the only one that can be safely determined (Turner II, Nichol, and Scott 1991: 16).

Caries can be defined as “a progressive demineralization of the enamel, cementum, and dentine of the tooth by organic acids” (Hillson 2008: 313). Caries are simpler to grade than either Carabelli’s trait or shovel traits. Caries are described as being present or not present, and they are recorded based upon their location on the tooth. For example, a carious lesion present on the occlusal surface of the tooth would be recorded as “Oc,” whereas a carious lesion present on the mesiolingual surface would be recorded as a combination of the two directions, “ML” (Turner II, Nichol, and Scott 1991: 27). While this is not a discrete genetic trait, the presence of caries is significant in the study of ancient populations because they can provide a clue as to the diet of the individual. The prerequisites for caries to form in the mouth are dental plaque and a diet including fermentable dietary carbohydrates (White and Folkens 2005: 329). The rate of caries in past populations saw a significant increase with the move from a hunter/gatherer foraging style to an agricultural one (Caselitz 1998: 205). A significant presence of caries in an ancient population can be an indication of an agricultural foraging style laden with starchy carbohydrates.

The next traits utilized in this study that were also investigated by Saul are the presence of

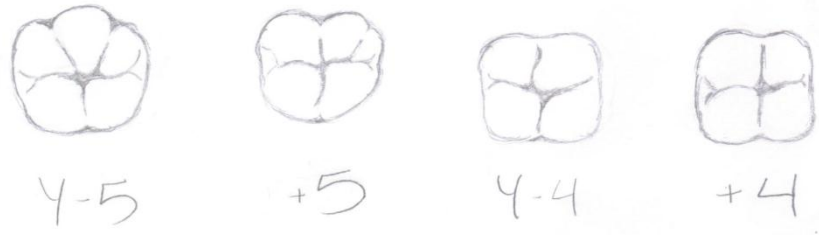
enameloma, fused roots, and enamel hypoplasia. Enameloma is a specific manifestation of a trait referred to as an enamel extension that occurs when the enamel of a molar or premolar extends past the cemento-enamel junction between the roots (Bass 2009: 297; Scott 2008: 279). An enameloma, also referred to as an enamel pearl, is defined as an enamel extension which has culminated in a spherical mass of enamel attached to the roots. The maxillary teeth are affected more often than the mandibular ones (Alt and Türp 1998: 109). If an individual's teeth are still in the alveolus, the enameloma will be blocked from view by the surrounding bone (Bass 2009: 297). The only teeth graded for enameloma in this study were those that were disarticulated from the maxillae or mandible.

Fused roots are a result of an excess deposition of cementum between the roots of a single tooth. Because a tooth must have multiple roots to be affected, the premolars and molars are the only teeth in consideration; however, this trait is said to occur most often on the second molar (Alt and Türp 1998: 103). Again, because this is a trait only visible when the teeth are disarticulated, those are the only ones that were examined for fused roots during this study.

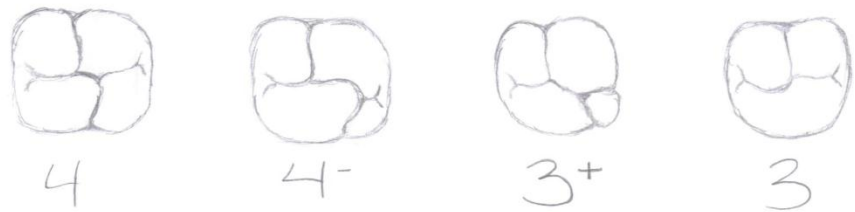
Enamel hypoplasia is a pathological condition that causes an interruption in the development of enamel. If an individual experiences stress in the form of disease or a temporary lack of nutrients in their diet, the development of enamel on teeth is disrupted, causing a visible defect. Enamel hypoplasia can take many different forms, including a single pit, lines, or even grooves in the surface of the enamel (White and Folkens, pg. 329). In my study, the presence or absence of enamel hypoplasia was noted for each individual.

The final traits examined by Saul that were utilized in this study were the cusp pattern on the lower molars and the cusp number on all molars. There are four types of possible cusp patterns on the mandibular molars. The two acknowledged by Saul are the "Y-5" pattern and the "+4" pattern (referred to in this study as the "+" pattern). The other two mandibular cusp patterns are known as the "+5" pattern and the "Y-4" pattern, but these are simply variations between the Y-5 and the +4 patterns (Bass

2009: 291). The Y-5 cusp pattern is a molar with three buccal cusps and two lingual cusps. The second buccal cusp is separated from the mesial and distal cusps by fissures on the occlusal surface, as are the two lingual cusps. The fissures between the cusps form a “Y” shape, hence the pattern’s



Figures 4 and 5: The above picture shows the four types of mandibular cusp patterns found in the human mouth, while the picture below shows the distinction between the maxillary cusp numbers.



name. The +4 cusp pattern can be defined as a molar with two buccal cusps and two lingual cusps, all separated by fissures in the shape of a “+” sign. The Y-5 cusp pattern is most commonly found in human ancestors, whereas the other three patterns, including the +4 pattern, are recent evolutionary developments (Bass 2009: 291). Commonly, the cusp number in maxillary molars is either three or four, whereas the cusp number for mandibular molars is either four or five. In early primate history, the maxillary molars had three cusps; the addition of a fourth cusp is a more recent evolutionary development (Scott 2008: 277). The cusp numbers acknowledged by Saul were originally designated by Dahlberg. They can be explained as follows: “4 designates four well developed cusps; 4- indicates a reduction in the size of the [fourth cusp]; 3+ indicates absence of the [fourth cusp] but the presence of a cuspule on the distal border; 3 indicates total absence of the [fourth cusp]” (Bass 2009: 291). As with the fourth cusp on the maxillary molars, the fifth cusp on mandibular molars is a more recent evolutionary development from the four cusps that were originally present (Scott 2008: 281). However, unlike with the maxillary molars, Saul does not acknowledge intermediate cusp numbers for the mandibular molars. Instead, he grades molars as having four, five, or six cusps. There is some ambiguity

as to whether extra cusps are included when examining the cusp number. To clearly define the cusp number for this study, it should be noted that extra cusps were included.

If teeth were disarticulated from the maxillae or mandible during this study and there was difficulty determining from where the tooth originated, William M. Bass's (Bass 2009: 275-287) method for identifying teeth was used. An additional problem when studying teeth from this era comes in the form of wear and tear. Through a lifetime of consuming a diet filled with gritty foods, the enamel on the incisal or occlusal surface wears away, exposing the layer of dentin underneath (Bass 2009: 291). The loss of enamel, and often consequently dentin, causes problems identifying a few of the traits in this study. When examining cusp number and cusp pattern of the molars, the loss of definition on the occlusal surface makes observation of these traits difficult. If a molar was worn, an educated guess was made about the expression of the trait based upon the morphology of the sides of the tooth.

Results

The results of the study using Saul's traits from his examination of the Maya population at Lubaantun are recorded in Table 1. The individuals studied are from two different areas in Belize where Dr. McKillop does her field research, Wild Cane Cay and Moho Cay. The individuals discovered in Wild Cane Cay included in this study are the female individual presumed to be a sacrificial victim from Burial 10, individuals one and two from Burial 6, and the individual from Burial 7. The individuals discovered in Moho Cay included in this study are individuals one, two, and three from Burial 4. If there was difficulty on the part of the examiner determining the manifestation of any trait due to wear on the occlusal or incisal surface of the tooth, a note was made during the recording process and it will be designated in the following table by an asterisk (*). If there was difficulty determining the grade a trait should be assigned because of great discrepancy between teeth, a note was made during the recording process

and it will be designated in the following table by a degree sign (°). When a trait was noted on a tooth, the tooth's number was used to identify on which tooth the trait could be found.

Table 1: This table represents the results from the examination of the seven individuals selected for this study. A series of abbreviations were used to describe the place each individual was found and the directional terms for the human mouth. They mean as follows: WCC – Wild Cane Cay; MC – Moho Cay; Lin – Lingual; Lab – Labial; B – Buccal; O – Occlusal; M – Mesial; D – Distal. More than one directional term in use for a single trait means that the directional terms should be considered in conjunction with each other.

	WCC Burial 10	WCC Burial 6 Ind. 1	WCC Burial 6 Ind. 2	WCC Burial 7	MC Burial 4 Ind. 1	MC Burial 4 Ind. 2	MC Burial 4 Ind. 3
Enameloma	28 B	-	-	-	-	-	-
Fused Roots	32	-	-	-	-	12	15 B
Carabelli's Cusp	-	-	-	-	-	-	-
Lower M3 Cusp Pattern	Both +	Left +	-	-	-	Left +	-
Lower M2 Cusp Pattern	Both +	Both +	Left +	Both +	Right + *	Left Y-5 *	-
Lower M1 Cusp Pattern	Left + *	Left Y-5 Right +	Left +	Both Y-5	Right + *	Both Y-5	-
Lower M3 Cusp Number	Both 4	Left 5	-	-	-	Left 5	-
Lower M2 Cusp Number	Left 4 Right 5	Both 4	Left 4	Both 4	Right 4 *	Left 5 *	-
Lower M1 Cusp Number	Left 4 *	Left 5 Right 4	Left 4	Both 5	Right 4 *	Left 6 Right 5	-
Upper M3 Cusp Number	-	-	-	-	-	-	-
Upper M2 Cusp Number	Right 4-	-	Left * 3+/4- (+1)	-	-	Both 3+ *	Left 3+ * Right 4 *
Upper M1 Cusp Number	-	Right 4-	Left 4 *	Both 4-	-	Both 4	Left 4- * Right 4
Maxillary Shoveling	4	3	-	3	-	1	Left 3 ° Right 6 °
Double Shoveling	3	4	-	-	-	-	Left 3 ° Right 0 °
Mandibular Shoveling	2	1	-	2	2	1	-
Enamel Hypoplasia	6 Lab 19 Lin	-	-	6, 22, 24, 25 Lab	-	21 B	-
Carious Lesions	17 M 19 DO 31 DB	-	-	-	31 O	15 O 17 Lin 18 LinO	2 MLO 14 O

Wild Cane Cay Burial 10

The first individual examined in this study was the presumed sacrificial victim from Burial 10 in Wild Cane Cay. The majority of this female individual's teeth were disarticulated; only six teeth were

found in three segmented pieces of the maxillae and mandible. This individual has some manifestation of every trait examined in this study apart from the Carabelli's cusp. There is an enameloma present on the buccal side of tooth 28. The roots of tooth 32 are fused. The mandibular third molars both display a + cusp pattern, as do the mandibular second molars. The left mandibular first molar appears to display a + cusp pattern as well, however the presence of an occlusal distal carious lesion made it difficult to determine the actual pattern. All of the mandibular molars present possess four cusps with the exception of the right mandibular second molar. This tooth has a distal accessory cusp, and so the cusp number is five. The only maxillary molar present with these remains is the right second molar; this tooth possesses a cusp number of 4-. The shovel trait and the double shovel trait are present in the maxillary incisors with grades of expression of three and five respectively. Only the shovel trait is present in the mandibular incisors with an expression of grade two. Enamel hypoplasia is present on the labial surface of tooth 6 and on the lingual surface of tooth 19. Carious lesions are present on the mesial surface of tooth 17, the occlusal distal surface of tooth 19, and the distal buccal surface of tooth 31.

Wild Cane Cay Burial 6

The next individual examined was the first individual from Burial 6 in Wild Cane Cay. The dental materials representing this probably female individual are a full mandible, part of the right maxilla, and three disarticulated teeth. An identifiable feature of this individual worth noting is the presence of dental modification. The maxillary incisors present have had the mesial and distal incisal edges removed, and the right maxillary canine has had the mesial incisal edges removed. There are no teeth present on which fused roots can be observed; the majority of the premolars and molars are in their alveoli, and the only disarticulated molar, tooth 14, has roots that are too damaged to infer any fusion. Other features which were not observed in this individual include enameloma, Carabelli's cusp, enamel hypoplasia, and carious lesions. The right mandibular third molar is not present and so cannot be observed, but the left mandibular third molar and both mandibular second molars display a + cusp

pattern. The right mandibular first molar also displays a + cusp pattern; however, the left mandibular first molar displays a Y-5 cusp pattern. The left mandibular third molar possesses five cusps with the inclusion of an accessory cusp on the mesiobuccal side of the tooth. Both the mandibular second molars possess four cusps, as does the right mandibular first molar. However, the left mandibular first molar possesses five cusps. The only maxillary molar found with this individual was the left first molar, and it possesses a cusp number of 4-. Both shoveling and double shoveling were present on this individual's teeth. The grade of shoveling for the maxillary teeth was based upon the central incisor, and it was assigned a grade of 3. There was also double shoveling present on the maxillary teeth, and based upon examination of the same tooth, it was assigned a grade of 4. The mandibular shoveling was not as defined as that of the maxilla; however, it was still present and was assigned a grade of 1.

The second individual from Burial 6 in Wild Cane Cay is represented by a piece of the left maxilla and the mandible with both rami broken. There is an excessive amount of wear on all the teeth that were found with this probably male individual, and the occlusal enamel has completely worn away on teeth 13, 14, and 19. This wear caused difficulty in the determination of cusp number for the maxillary molars. However, an estimate was made based upon the presence of fissures between cusps on the exposed dentin. This individual has no evidence of enameloma, Carabelli's cusp, enamel hypoplasia, or carious lesions. Additionally, because all the premolars and molars discovered for this individual are in their alveoli, determination of fused roots was impossible. Since no incisors or canines were discovered with this individual, there is no possibility of grading for the shoveling trait. As such, the only traits examined for this individual were the mandibular cusp patterns and the maxillary and mandibular cusp numbers. Both mandibular third molars and the right mandibular second and first molars were not found with this individual, so the two mandibular molars examined were the left second and first molars, both of which possessed a + cusp pattern and four cusps. In the piece of the left maxilla present for this individual, the second and first molars were the only ones present. The left maxillary second

molar appears to have had a cusp number of either 3+ or 4-; however, with the occlusal enamel completely worn away, it is difficult to say how large the fourth cusp really was. This molar also has a buccal accessory cusp. The left maxillary first molar appears to have had a cusp number of 4.

Wild Cane Cay Burial 7

The next individual examined was from Burial 7 in Wild Cane Cay. The facial remains found for this probably male individual were quite numerous. The nasal bones, some of the frontal bone, some of the right zygomatic bone, both the maxillae, and an almost complete mandible were found. Another notable feature of this individual is the presence of dental modification similar to that of individual 1 in Burial 6. The mesial incisal edges of the maxillary canines and both the mesial and distal incisal edges of the maxillary incisors were cut out to shape the teeth. However, because the mandible was found in Burial 7 and the presumption is that the mandible and the facial portion of the skull belong to the same individual, both were examined in this study. This individual shows no evidence of enameloma, Carabelli's cusp, or carious lesions. Also, all the premolars and molars are in their alveoli, so examination for fused roots is impossible. The mandibular third molars and the maxillary second and first molars were not found with this individual, so they could not be examined. Both of the mandibular second molars display + cusp patterns and possess four cusps, while both of the mandibular first molars display Y-5 cusp patterns and possess five cusps. The maxillary first molars both have a cusp number of 4-. The shoveling trait is present in both the maxillary teeth and the mandibular teeth; based upon the central incisors, the maxillary shoveling was assigned a grade of 3 while the mandibular shoveling was assigned a grade of 2. Enamel hypoplasia is also present in this individual. It can be seen on the labial sides of teeth 6, 22, 24, and 25.

Moho Cay Burial 4

The next individual examined was the first individual from Burial 4 in Moho Cay. This individual is a juvenile, so sex could not decisively be determined. The individual is a juvenile, so the numbering

for the teeth is different from the other individuals in this study. This individual is represented in this study by a mandible with a broken left ramus. There is a maxillary premolar crown present, but as any trait a premolar could be examined for is not applicable without roots, this crown was not examined during this study. A notable feature of this individual is the presence of dental modification in the form of a filling located around the alveoli for the left mandibular first or second molar. There is no evidence of enameloma, Carabelli's cusp, or enamel hypoplasia on the teeth present for this individual. Additionally, the premolars and molars are in their alveoli, so the presence of fused roots could not be examined. The only molars present are the right mandibular second and first molars. Both exhibit significant wear causing difficulty for the observer. They each appear to display + cusp patterns and possess four cusps. The shoveling trait is present in this individual, but because the only tooth present that can be graded for shoveling was the right mandibular canine, that is the one that was used. Examining this canine, the mandibular shoveling was assigned a grade of 2. There is a single carious lesion present on the occlusal surface of tooth 20, the right second mandibular molar.

The second individual from Burial 4 in Moho Cay is represented by a mandible, pieces of the left and right maxillae, and a number of disarticulated teeth. This probably male individual shows no evidence of enameloma or Carabelli's cusp, but the rest of the traits being examined in this study are present in this individual. Of the disarticulated premolars and molars, tooth 12 does exhibit fused roots. The right mandibular third and second molars were not found for this individual, so they were not studied. The left mandibular third molar displays a + cusp pattern, while the left mandibular second molar displays a possible Y-5 cusp pattern. This tooth has a carious lesion on the occlusal lingual surface that destroyed what cusps may have been in that spot; based upon surrounding morphology, the molar has been classified as a Y-5. Both of the mandibular first molars display a Y-5 cusp pattern. The left mandibular third molar possesses five cusps with the inclusion of a distal accessory cusp. Based upon surrounding morphology, the left mandibular second molar has five cusps. The right mandibular first

molar possesses five cusps, whereas the left mandibular first molar possesses six cusps with the inclusion of a distal accessory cusp. There are no maxillary third molars present for this individual. Both of the maxillary second molars exhibit significant wear, but they appear to possess 3+ cusps. Both of the maxillary first molars possess four full cusps. The shovel trait is present in both the maxillary teeth and the mandibular teeth. Based on the central incisors, the maxillary and mandibular shoveling have both been assigned grades of 1. There is an instance of enamel hypoplasia on the buccal surface of tooth 21. This individual has many carious lesions; there is one on the occlusal surface of tooth 15, one on the lingual surface of tooth 17, and one on the occlusal lingual surface of tooth 18.

The third individual from Burial 4 in Moho Cay is represented in this study by both maxillae. A notable feature of this probably female individual is the presence of an impacted maxillary canine. An impacted tooth is one that does not erupt as nature intended but instead stays in the mandible or maxillae without ever breaking through the gingiva. The most common teeth to become impacted are the third molars, but the maxillary canines are second. In this individual, rather than the left maxillary canine standing upright as it normally would, the tooth is sideways inside the maxilla above the roots of the premolars and molars. There is no evidence of enameloma, Carabelli's cusp, or enamel hypoplasia in this individual. Also, because this individual is represented only by the maxillae, the cusp pattern and number for the mandibular molars cannot be examined. Of the disarticulated premolars and molars, tooth 15 exhibits fusion of the buccal roots. The maxillary third molars are not present for this individual. The right maxillary second molar is broken in such a way that the mesial lingual cusp is missing. The tooth appears to have possessed four full cusps. The left maxillary second molar has significant wear. The tooth appears to have a cusp number of 3+. The right maxillary first molar possesses four full cusps. The worn left maxillary first molar appears to have a cusp number of 4-. There was great discrepancy between the left and right central incisors in terms of maxillary shoveling and double shoveling. Rather than distort the conclusion by wrongly averaging the data, both numbers

were reported. The grade for the shoveling is 3 based upon the left central incisor. However, based upon the right central incisor, the grade is 6. For the double shoveling, the left central incisor was assigned a grade of 3, while the right central incisor possessed no double shoveling. There is a carious lesion present on the mesial, lingual, and occlusal surfaces of tooth 2 and on the occlusal surface of tooth 14.

Interpretation

The first comparison that should be made utilizing the data collected from these seven individuals concerns the question that is the heart of this paper: can the data about these discrete dental traits demonstrate that the female individual from Burial 10 in Wild Cane Cay is of a different origin than the other selected individuals? This individual is thought to be a sacrificial victim because of her positioning in the grave and the expensive pot with which she was discovered (McKillop 2005: 62). Can her teeth demonstrate this idea? To determine whether or not she is of a different origin, her discrete dental traits were compared to those of the six other individuals. If she is of a different origin, she would display different manifestations of the traits examined than the other individuals. This comparison was done utilizing Table 1 from the Results section.

Enameloma and Fused Roots

The first trait compared across individuals was the presence of enameloma. The female individual from Burial 10 in Wild Cane Cay was the only individual in this study that possessed any manifestation of this trait. The presence of fused roots was also a trait that was not shared by many individuals; only the female individual from Burial 10 in Wild Cane Cay and the second and third individuals from Burial 4 in Moho Cay possessed this trait. However, neither of these can be considered definitive results. The only teeth examined for the presence of enameloma or fused roots were those that were disarticulated.

Wear on Maxillary Second Molars

The cusp number and cusp pattern evaluated for the mandibular molars do not appear to be significantly different between the female individual from Burial 10 and the other six individuals. As such, they will not be of any use in attempting to prove that she is of a different origin. In the examination of the cusp number of the maxillary molars, one difference was noted. There was extensive occlusal wear on the maxillary second molars in the second individual from Burial 6 in Wild Cane Cay and the second and third individuals from Burial 4 in Moho Cay. The female from Burial 10 possessed minimal wear, if any. In ancient populations, the wear and tear of enamel is said to often be a product of a very gritty diet. If the wear was less extensive on this maxillary molar for the female in Burial 10, then she had a different type of diet than the other individuals. The excessive wear is not only a product of a gritty diet but also simply of a greater amount of use due to an older age.

Enamel Hypoplasia

The next trait examined during the course of this study, the presence of the shoveling trait, did not appear to yield any significantly different results for the female from Burial 10 as compared to the other individuals being studied. The presence of enamel hypoplasia, however, did show that of the seven individuals examined, she was one of only three that displayed this trait. She did not possess a manifestation of the trait either significantly greater or less than that of the other individuals displaying enamel hypoplasia. The presence of enamel hypoplasia means that these individuals suffered some nutritional interruption during tooth formation, and because the trait is present on different teeth for each individual, this means that they experienced this interruption at different points during their developmental lives. This finding could be interpreted to mean that because these individuals did not experience the same episodes of nutritional interruption, they could not have lived in the same place with the same causation. However, the individuals cover a wide range of dates. The individuals from Wild Cane Cay are dated to the Postclassic period of Maya history, whereas the individuals from Moho

Cay are dated to the Classic period. Because the dates vary so greatly, citing the experience of different episodes of nutritional interruption cannot be a definite conclusion regarding her origin.

Carious Lesions

The female from Burial 10 in Wild Cane Cay is not in the minority in possessing carious lesions among the individuals selected for this study. In fact, all of the individuals found in Moho Cay possessed carious lesions. Of the individuals in this study from Wild Cane Cay, she is the only one to possess carious lesions. The two factors necessary in the formation of carious lesions are dental plaque and fermentable dietary carbohydrates. If the female individual is the only one found in Wild Cane Cay that possesses carious lesions, she may have had a different diet than the others in this area, one more heavily supplemented by carbohydrates. This finding could be an indication that she was originally from a group whose subsistence pattern consisted of agriculture rather than hunter/gatherer or foraging. If this is the case, caries would certainly be a significant trait in demonstrating her difference in origin from the other individuals.

Methodological Implications

The second comparison that can be made using this data is one that does not pertain to the question of the assumed sacrificial victim's origin but rather to the method by which this study was conducted. Frank Saul's study of the Maya population at Lubaantun focused on a population that was also from Belize. A commonality between groups was expected, which was the reason the traits he utilized were chosen for this study in the first place. However, there were traits that Hammond examined and discovered in significant proportions that were either very scarcely represented in this study or not represented at all. Conversely, there are also traits that were hardly represented in the Lubaantun population that were well represented in this study. The first disparity between the studies is Saul's findings on the Carabelli trait. Of 24 individuals whose dental remains were discovered, there were eight individuals that displayed at least some manifestation of this trait at Lubaantun. During the

examination of individuals found in Wild Cane Cay and Moho Cay, however, not a single individual of the seven selected possess Carabelli's trait. Even during the course of other studies utilizing material from Wild Cane Cay, no Carabelli's trait has been found (Spence 1987: 293). There were accessory cusps, but none of the maxillary cusps were mesiolingually located, the definition of Carabelli's trait. The next difference noted between studies is the cusp patterns found on the mandibular first molar. Saul's study reported that all of the 13 mandibular first molars discovered possessed the Y-5 cusp pattern. The results for this study were split nearly equally, with four mandibular first molars possessing a + pattern and five possessing a Y-5 pattern. Concerning the same teeth, the cusp numbers for the mandibular first molars in this study ranged from four to six including accessory cusps. The population at Lubaantun was reported as all having five cusps.

Summary

Neither the maxillary molars nor the shovel trait reveal any significant differences between the population from Lubaantun and those individuals selected from Wild Cane Cay and Moho Cay. The proportions of individuals experiencing multiple episodes of enamel hypoplasia and those experiencing a single episode were also comparable. Multiple episodes were experienced by 14 of the 24 individuals examined at Lubaantun and three of the seven individuals from this study. Single episodes were experienced by five of the 24 individuals from Lubaantun and one of the seven individuals from this study. The presence or absence of carious lesions was also similar between populations, with a ratio of ten to four at Lubaantun and a ratio of four to three in this study; the presence of carious lesions was in the majority in both studies. Because the rates of enamel hypoplasia and carious lesions were similar between the population from Lubaantun and those individuals selected from Wild Cane Cay and Moho Cay, these results do not demonstrate any significant difference.

Conclusion

The comparison of the traits examined between the assumed sacrificial victim from Burial 10 and the other individuals selected from Wild Cane Cay and Moho Cay reveal that there are some possibly significant differences that could help to indicate a difference in origin, though certainly not enough to make a definitive conclusion. The presence of enameloma and fused roots, the amount of wear on the maxillary second molar, and the presence of enamel hypoplasia are all characteristics that seem to show this female individual could be foreign and different from the other individuals' dentitions. However, each of these traits has an alternative explanation that could easily cast doubt upon the theory that her teeth can demonstrate that she is of a different origin. The fact that she is the only individual from Wild Cane Cay selected for this study who possesses carious lesions is probably the most significant difference. This finding indicates that she may have experienced a different subsistence pattern for a great deal of her life, which would help demonstrate that she was of a different origin than at least the other individuals from Wild Cane Cay, supporting the claim that she is a sacrificial victim not originally from the area.

Of course, a single strong argument and many weak ones does not provide any sort of conclusive answer to the question of the assumed sacrificial victim's disparity in origin. To more fully support the theory that the female individual from Burial 10 in Wild Cane Cay is of a different origin than the other individuals discovered during the course of Dr. McKillop's work in Belize, more research will have to be done. There have been significantly more individuals discovered in Wild Cane Cay and Moho Cay; the seven individuals selected for this study is a good start, but it cannot claim to be a representative sample. To truly understand if or how the female individual differs from the others, it would be best to study all the individuals available. The proportion of individuals whose burials are later discovered is so small to begin with, it would be beneficial to utilize all the available resources. This does not apply exclusively to the individuals discovered, either; the utilization of different methods of

study would also strengthen any conclusion made about the female individual's origin. This study examined discrete dental traits. Many of these traits did lend themselves to the conclusion that the female individual from Burial 10 in Wild Cane Cay is of a different origin than the other individuals from Wild Cane Cay and Moho Cay, but there is not enough data to form a definitive conclusion. More research will have to be done in the future to determine whether this assumed sacrificial victim was indeed an outsider not originally from the society that buried her.

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