Facing society : A study of identity through head shaping practices among the indigenous peoples of the Caribbean in the ceramic age and colonial period

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5 METHODOLOGY

Many physical anthropologists seem to believe unconsciously that cranial deformity exists solely to thwart their studies
T. Dale Stewart (1937:170)

The previous chapters have shown the complexities that surround the study of intentional cranial modification. The accurate documentation of the resulting changes to the shape of the human cranium provides the necessary basic information for studying both the physical consequences for the development of the skull as well as the wider social implications of head shaping practices in society.

This chapter provides information on the methods used throughout this study and will start by discussing several relevant archaeological factors, followed by the osteological standards used in this study. A separate section will discuss cranial modification, including a discussion on various classification systems for head shaping and a detailed look at the changes to cranial morphology resulting from cranial modification practices. This is followed by a brief discussion on the manner of data documentation in forms, photographs and the Access database. Finally, a short section will cover the statistics used to analyse the data produced in this investigation.

5.1 ARCHAEOLOGY

Sample Selection Criteria

The sampling strategy of this study has attempted to optimise the overall sample size, while taking into account the temporal and geographical distribution of the skeletal assemblages as well as the state of preservation, since the latter has a marked impact on the amount of data that can be gathered. Secondarily, skeletal collections with known archaeological contexts on an individual level were preferred.

Selection of Assemblages

The selection of skeletal assemblages or sites was predominantly aimed towards obtaining a representative sample of prehistoric Caribbean populations, with regards to both geography and chronology. Numerous Caribbean skeletal assemblages have little to no contextual information on specific individuals, either because this information was not recorded during the excavation or because data gathered by the excavator was never published or made accessible in another manner. Excluding such collections from this study would have resulted in a marked reduction of the overall sample size and a severe decline in the geographic and temporal representability.

All regions of the Caribbean are represented in this sample, except the Southern Caribbean Region. Not all islands or countries in the research area have yielded skeletal material, but a concerted effort was made to include as many locations as possible. This means that certain islands are only represented by a single skull or a small numbers of individuals. Even though social motivations cannot be determined for these assemblages due to the limited data available, these skulls do provide information on larger scales of analysis.

The temporal range of this sample starts at the beginning of the Ceramic Age and continues into the early colonial period, spanning from approximately 500 BC to AD 1800. This period of Caribbean history encompasses important social, political, and cultural developments in the indigenous societies as well as the tumultuous events and upheaval brought about through intercultural contact with European settlers and African slaves. As such, this period forms a dynamic backdrop against which cranial modification and identity formation and expression can be investigated in indigenous Caribbean communities.

Selection of Individuals

Several factors influence whether an individual skull was selected for study. First and foremost among these was the state of preservation. Cranial material from the circum-Caribbean region varies widely in this regard, depending among other factors on the geological conditions in which the skeleton was buried, taphonomical processes, excavation methods, and conservation and curation practices after excavation.

Best practice would be to exclude any incomplete or fragmented crania from this analysis to ensure better accuracy in the determination of cranial modification. However, this would have resulted in a skewed sample as skeletal material from the Lesser Antilles is generally poorly preserved and much more fragmentary than materials from the Greater Antilles and the South American mainland. In order to enhance the geographical spread of the sample, the reconstruction of fragmented crania was undertaken in a temporary manner using tape. This method was chosen as it does not alter the skeletal material in a permanent fashion and care was taken to ensure the cranial fragments were not damaged during the reconstruction. A full cranial midline, running from glabella to opisthion, was preferred but otherwise the majority of either the frontal or the occipital had to be present in order for the skull to be included in this study. All crania that did not meet these criteria, and therefore could not be assessed with any degree of certainty, were removed from the sample.

Pathological crania were not excluded from the analysis, since few bony responses to disease impede the recognition of head shaping practices. However, great care was taken to ensure that the cranial modifications recorded were not the result of pathological conditions, such as craniosynostosis or positional plagiocephaly. If pathology was considered to be a potential factor in the observed skull shape, this was clearly noted and recorded.

Multi-scalar Approach

Studying an issue as complex as identity in a region defined by interaction and exchange between different communities cannot take place solely at the level of the individual. This investigation has opted for a multi-scalar approach in order to uncover the intricate and dynamic relationship between cranial modification and identity.

This approach starts at the level of the individual and the community, looking at altered head shapes and their social implications on a micro level. Moving up to the level of the assemblage will allow the study of local patterns. Patterns found in the different locations will be compared to determine whether the traditional regional boundaries defined within the Caribbean through previous investigations – in this case the Greater Antilles, the Lesser Antilles, and the Mainland – are of importance within this investigation. The patterns within each of these regions will be investigated to look at wider social contexts and compared to one another to determine if regional differences exist and, perhaps more importantly, are pertinent in relation to cranial modification and identity. After all, it is the boundaries between groups at each of these scales of study where identity is negotiated, (re)defined, and confirmed.

Chronology

This investigation aims to study the motivations behind the practice of intentional cranial modification on multiple scales and in different time periods of Caribbean prehistory and early history. Two issues must be dealt with to successfully achieve these aims: the complex and varied chronological and cultural classification systems developed during the course of Caribbean archaeology and the disparity in the available contextual data for each of the skeletal assemblages in the sample. This was overcome by a dual approach, assigning individuals and sites to the regional developmental scheme of different ages and the more detailed classifications of material culture.

Placing skeletal assemblages into the broader regional chronology permits the examination of head shaping practices against the backdrop of the larger scale social and material developments on which the scheme is based. These classifications are supported by radiocarbon dates wherever available, obtained directly from the skeletal material itself or from associated archaeological materials. However, it is important to keep in mind the dynamic and shifting nature of Caribbean history. As people move through the region, they arrive on different islands at different times creating temporal shifts for the same period between locations. Radiocarbon dates may thus provide general indications, but must preferably be combined with proper knowledge of the material context.

Wherever possible, individuals and sites were also related to the more detailed classification based on diagnostic traits of material culture and particularly ceramics proposed by Rouse (1992). Despite the shortcomings of this chronology, this is still the most convenient way to correlate and contextualise this disparate dataset stretching across different islands and periods.

5.2 *OSTEOLOGY*

Age-at-Death and Sex Determination

The determination of the age-at-death and biological sex of an individual represent the basic biological information provided by physical anthropology and are important for the assessment of cultural patterns related to intentional cranial modification in the different populations investigated in this dissertation.

The data on age and sex used in this study come from a variety of sources. A number of larger skeletal assemblages in the insular Caribbean have recently been reinvestigated by physical anthropologist Dr. Darlene A. Weston[1] and her skeletal reports have provided much of the data on sexing and ageing used in this study. In other cases, this data has come from collection inventories and databases, where the data from previous investigations of the material is stored. In all cases, a concise study of age and sex was executed by the author to ensure the reliability and compatibility of all previous data. The different methods used for the establishment of age-at-death and biological sex are discussed in the following paragraphs for each of the archaeological sites in the sample. Table 2 provides an overview of the sources of the data for each site.

Table 2 **Overview of source data for the sites in the sample. Abbreviations stand for: B:Bahamas; C:Cuba; DR:Dominican Republic; GR:Grenada; G:Guadeloupe; H:Haiti; J:Jamaica; PR:Puerto Rico; SA:Saba; SK:St. Kitts; SJ: St. John (USVI); SU:Suriname; T:Trinidad; V:Venezuela.**

Researcher	Sites (Location)	Source
Edwin Crespo Torres	Duey Bajo (PR), Hacienda Grande (PR), Monserate (PR), Punta Candelero (PR), Rio Arriba (PR), Sorce, Vieques (PR), Tecla, Guayanilla (PR), Trujillo Alto (PR), UPR US1 (PR)	Crespo Torres (2000), personal communication (2011)
Jouke Tacoma	Hertenrits (Su), Kwatta Tingiholo (Su), Okrodam (Su), Saramacca (Su), Waterkant/de Mirandastraat (Su)	Tacoma (1963, 1991)
Anne van Duijvenbode	Abingdon (J), Anse Bertrand (G), Watling Island (B), Barbados US1, Barrio Camas (PR), Barrio Viva Bayo (PR), Bloody Point (SK), Cabeza de Muerto (DR), Camburito (V), Caneel Bay Plantation (SJ), Carache (V), Constanza (DR), Cuba US1, Cueva Andres (DR), DR US1, Cueva de los Indios (C), Cueva de los Muertos (PR), El Atajadizo (DR), El Cabo (DR), El Soco (DR), El Zamuro (V), Folle Anse (G), Great Exuma Cay (B), Guadeloupe US1, Halberstadt (J), Jamaica US1, Jamaica US2, Juan Dolio (DR), La Cabrera (V), La Cabrera 1 (V), La Caleta (DR), La Gonave Island 1 (H), La Gonave Island 2 (H), La Hoyada (V), LA US1, Lago Valencia (V), Limestone Caves (J), Maisi (C), Mayaguez (PR), Morne des Mammelles (H), Norman's Pond Cay (B), Pedro Bluff Cave (J), Petit Canal (G), Pinas (PR), Pointe Canot (G), Portland Hills (J), Punta Macao (DR), Reference Collection (DR), San Mateo (V), San Pedro (J), Santo Domingo (DR), Savanne Suazey (GR)	-
Darlene Weston	Anse à la Gourde (G), El Chorro de Maíta (C), Kelbey's Ridge 2 (Sa), Morel (G), Manzanilla (T), Spring Bay 1c (Sa),	Weston (2010, 2011, 2012, 2013)

Age

The determination of the approximate age of an individual at the time of his or her death uses a variety of different methods to study the developmental age of the skeleton.

1 These studies were carried out as part of the NWO VICI project 'Communicating Communities' (NWO-277.62.00) led by Prof. Dr. Corinne L. Hofman.

As the human skeleton grows and develops in a predictable and sequential manner, osteologists try to connect the developmental stage to the chronological age of an individual at death (Buikstra and Ubelaker 1994; Scheuer and Black 2004; White and Folkens 2005). However, age-at-death is not a variable that can exert any influence on the presence or absence of intentional cranial modification. The practice must be started during the first months of life and thereafter cannot be affected in a substantial manner. Therefore, the age at which an individual dies is not directly relevant to the study of the social motivations behind head shaping practices in past societies.

The age category to which an individual skull belongs may, however, affect the applicability of other methods used in this investigation. For example, the observation of cranial non-metric traits in infants and children is of little use as these traits develop and mature during the cranial development and therefore may not yet be present in younger age groups (Saunders and Rainey 2007). Therefore, this study has chosen to place individuals into broad age categories following Buikstra and Ubelaker (1994:9), which can be seen in Table 3. This has the additional benefit of eliminating the different age categories produced by the different methods described below and substituting these for a single uniform manner of recording.

Table 3 The age categories used in this study and their correlation to chronological age (Buikstra and Ubelaker 1994:9).

Age Category	Chronological Age
Foetus	<38 weeks
Perinate	38 - 42 weeks
Infant	42 weeks - 3 years
Child	4 - 12 years
Adolescent	13 - 18 years
Adult	>18 years

Crespo Torres

Non-adult age was estimated using dental development, epiphyseal fusion, and long bone length (Crespo Torres 2000:93). Adult age-at-death was determined using ectocranial suture closure (Meindl and Lovejoy 1985) and the auricular surfaces of the os coxae (Lovejoy et al. 1985).

Tacoma

Age-at-death estimations were based predominantly on the degree of ectocranial suture closure and the degree of dental attrition, and occasionally augmented with the stage of epiphyseal fusion in case of adolescents and young adults (Tacoma 1963:67, 1991:50). Tacoma himself questions the accuracy of these methods and suggests that the results should be 'looked upon as mere arbitrary approximations'(Tacoma 1963:67).

Again, since this research translates these age-at-death assessments into very broad categories, Tacoma's findings could easily be incorporated into the current study.

Van Duijvenbode

Adulthood was determined by an assessment of cranial suture closure[2] (Meindl and Lovejoy 1985), the fusion of the basooccipital-basosphenoid synchondrosis, the eruption of the 3rd molar, and if necessary the degree of dental wear (Brothwell 1981). Again, these methods were chosen only to assess whether the cranium had reached maturity, not to determine a more precise skeletal or chronological age. An additional advantage was the fact that these methods can be used if only cranial remains are present, which was the case for several large assemblages in this study. The age of infants, children, and adolescents was established by assessing the dental eruption (Ubelaker 1989), determining the stage of epiphyseal fusion (Scheuer and Black 2000, 2004), and measuring long bone length (Schaefer et al. 2009).

Weston

Adult ageing was achieved using anthroposcopic changes seen in the pubic symphyses (Katz and Suchey 1986; Todd 1921a,b), the auricular surfaces of the os coxae (Lovejoy et al. 1985), and the sternal ends of the ribs (Işcan and Loth 1986a,b). Dental attrition (Brothwell 1981) and ectocranial suture closure (Meindl and Lovejoy 1985) was also used. Juvenile or sub adult ages were estimated using epiphyseal fusion (Scheuer and Black 2000), long bone length (Sundick 1978; Ubelaker 1989), and dental development (Smith 1991).

Biological Sex Estimation

Human sexual dimorphism is more readily apparent in soft tissues than it is in skeletal remains, yet sufficient morphological differences exist to differentiate males from females in the majority of cases. These anatomical variations are present most clearly in the pelvic area and the skull of the adult human skeleton. Generally, males will be more robust and larger than females, however, one must take into account that normal individual variation may produce smaller males and larger females (Buikstra and Ubelaker 1994; White and Folkens 2005). The morphological differences between the sexes only develop after sexual maturity is reached. Consequently, the estimation of sex in individuals under 19 is generally considered extremely problematic. Although several methods have been developed in recent years, the accuracy of these methods is much

2 Despite the unresolved debate regarding the influence of intentional cranial modification on the timing and pattern of cranial suture closure, this remains one of the few relatively reliable methods to produce an age-at-death estimate in those cases where only cranial remains are present. Furthermore, as this study only looks at extremely broad age categories and tries to combine multiple methods of ageing wherever possible, the potential impact of intentional cranial modification on the cranial sutures can be considered negligible.

lower and there are significant issues with both intra- and inter-observer error (Cardoso and Saunders 2008; Scheuer 2002). Therefore, this study will only estimate the sex of adult individuals.

The highest accuracy is achieved if multiple skeletal elements and methods are used to determine biological sex (Buikstra and Ubelaker 1994; White and Folkens 2005). However, this process may be hampered by several factors. Firstly, the loss of the sexually dimorphic features due to poor preservation of the skeletal material may influence the estimation of sex. The morphological features of a single individual may also be ambiguous or conflicting, resulting in different assessments of sex based on the observed skeletal element. In such situations, the features of the pelvis are usually considered the most accurate for sex estimation (Buikstra and Ubelaker 1994; Mays and Cox 2000; White and Folkens 2005). However, many museum collections consist solely of crania, as it was common practice in the early days of archaeology to save predominantly skulls and any bones with interesting pathologies or deviations. Furthermore, comingling of skeletal remains due to burial practices, archaeological excavation methods, or conservation practices in museums means that it is not always possible to assess multiple skeletal elements of a single individual. In all of these cases, this research has taken the skull as the proxy for the individual, and assessment of other skeletal elements was only executed if these clearly belonged to the same individual.

Before the methods of assessing sex in this sample are discussed, it should be noted that the terms sex and gender, despite their occasional analogous use in anthropological literature, are in fact two very separate issues. The term sex, as used here, refers to the biological differences between males and females visible in both the reproductive organs and the genetic sequence. Gender, on the other hand, is a social construct (Díaz-Andreu et al. 2005; Gowland and Thompson 2013; Joyce 2004; Mays and Cox 2000; Meskell 2007; Moore 1994). Thus, it should be stressed that the methods presented here only aid osteologists in determining the biological sex of an individual but do not shed light on gender roles and gender-based identities in the past.

Crespo Torres

This assessment was based on sexually dimorphic features found in the skeleton, with particular emphasis on the pelvis traits (Crespo Torres 2000:94).

Tacoma

The estimations were based on the overall degree of robustness of the crania (and the pelvis if present), including features such as the orbital rim, development of glabella and supraorbital ridges, and the muscular insertions (Tacoma 1963:66-67, 1991:50).

Van Duijvenbode

These estimations were produced by studying the sexually dimorphic features of the skull and pelvis, following the method outlined in Buikstra and Ubelaker (1994).

Weston

Sex was determined through analysis of the anthroposcopic traits of the skull (Ascádi and Nemeskéri 1970; Buikstra and Ubelaker 1994) and pelvis (Buikstra and Ubelaker 1994; Phenice 1969), as well as measurements of the clavicle (Jit and Singh 1966), scapula (Iordanidis 1961), humerus (Stewart 1979), and femur (Pearson and Bell 1917/1919; Stewart 1979). Due to the issues indicated earlier, juvenile skeletons were not assessed.

Ancestry Assessment

The concept of race is intertwined with the earliest development of physical anthropology as a discipline and has a long and infamous history within the field. Early work attributed biological variation in humans to racial distinctions, even though the minor and often inconsistent differences between human populations do not match the technical definition of race as a genetically distinct subset of a species. Modern studies view race as a social construct, which is based on actual or perceived biological differences between groups that are deemed important within specific social settings. In this sense, race can be viewed as just another socially constructed group identity, although such a view does not do justice to the detrimental consequences of racism in many settings. From the 1960's onwards, a concerted effort was made in academia to move towards more neutral theory and terminology, in the case of physical anthropology terms like geographic ancestry were favoured (Brues 1992; Byers 2008; Caspari 2003; Cornell and Hartmann 1998; Hagen 1996).

This is obviously an extremely simplified account of a complex matter and those wishing to read more are encouraged to start with the AAPA Statement on the Biological Aspects of Race (Hagen 1996). This study expressly does not take into account geographic ancestry in the study of prehistoric identities. However, during the analysis of the skeletal material it became apparent that in a handful of cases an approximation of geographic ancestry was necessary. Not all skeletal material stored in museums comes with proper contextual information: several cases were only identified by (rough) geographic provenience such as 'Limestone Cave, Jamaica', 'Cuba', or even the broader 'Lesser Antilles'. Sometimes, crania were identified as Amerindian or African, but in other cases any context was lacking. These provenance issues are problematic in the current study, as such matters are important to produce correct patterns of cranial modification in indigenous Caribbean societies. In these dubious cases, an assessment of ancestry was undertaken and if any doubts were raised, crania were marked as of suspected non-Amerindian ancestry.

Methodological advances in the determination of ancestry from human bone were made despite the increased awareness of the socially unacceptable issues surrounding racial bias, as those working in forensic anthropology found ancestry characteristics useful when identifying human remains of unknown origin (Brues 1992; Byers 2008; Bass 1987; Gill 1998; Gill and Rhine 1990). However, it should be noted that ancestry determination methods, particularly when applied to archaeological remains, only provide an approximation of geographic ancestry, which should be used in a cautionary and conservative manner (Elliot and Collard 2009).

This study chose a combination of cranial metrics and morphological features of the skull to determine ancestry. If contextual information was inconclusive and morphological features indicated a potential non-Amerindian ancestry, Forsdisc 3.0 was used. This is a computer program developed to provide an indication of ancestry based on a standardised series of cranial measurements (Jantz and Ousley 2005). Fordisc 3.0 cannot be used on modified crania, so this option was only available if cranial modification was absent. If the combination of cranial metrics and morphology gave any reason for doubt, the skull was classed as suspected Non-Amerindian in the database and excluded from analyses of head shaping practices.

Cranial Metrics

A standard suite of cranial measurements was recorded for each skull in order to allow an investigation into the quantifiable differences produced by cranial modification. These measurements are described in Buikstra and Ubelaker (1994) and were initially developed by Moore-Jansen and Jantz (1990) based on earlier work on metrics and landmarks by Martin (1928), Bass (1987), and White and Folkens (1991). These cranial measurements are considered as the minimum of documentation necessary in physical anthropology. They were selected for this study as the widespread use of these particular measurements and the additional capability to calculate common cranial indices facilitate potential comparisons with skeletal assemblages studied by other physical anthropologists.

The suite of measurements is shown in Table 4. A full description of the measurements and cranial landmarks can be found in Buikstra and Ubelaker (1994:71-77). Measurements were taken to the nearest millimetre using a tape measure and sliding and spreading calipers. Bilateral measurements are indicated in bold in the table and should be taken on the left side. If the left side is absent or damaged, the right side may be substituted and indicated with an R. Distorted or warped crania, including crania with reconstructive errors that could not be corrected, were not measured.

Table 4 **The standard suite of cranial measurements used in this study.**

Cranial measurements (mm)	
Maximum Cranial Length (G – Op)	Nasal Height (N – Ns)
Maximum Cranial Breath (Eu – Eu)	Nasal Breadth (Al – Al)
Bizygomatic Diameter (Zy – Zy)	Orbital Breadth* (D – Ec)
Basion – Bregma Height (Ba – B)	Orbital Height*
Cranial Base Length (Ba – N)	Biorbital Breadth (Ec – Ec)
Basion – Prosthion Length (Ba – Pr)	Interorbital Breadth (D – D)
Maxillo – Alveolar Breadth (Ecm – Ecm)	Frontal Chord (N – B)
Maxillo - Alveolar Length (Pr – Alv)	Parietal Chord (B – L)
Biauricular Breadth (Au – Au)	Occipital Chord (L – 0)
Upper Facial Height (N – Pr)	Foramen Magnum Length (Ba – 0)
Minimum Frontal Breadth (Ft – Ft)	Foramen Magnum Breadth
Upper Facial Breadth (Fmt – Fmt)	Mastoid Length*

The problems regarding the varying degrees of modification and the occasional difficulties in accurately establishing the presence of cranial modification have already been indicated. Several researchers have attempted to solve this classification issue using metric analysis and discriminant functions. This study will test two recently developed methods, the first by Clark and colleagues (2007) and the second by O'Brien and Stanley (2013) on the Caribbean sample.

The method developed by Clark and colleagues (2007) relies on six cranial measurements on the median sagittal plane of the skull: the frontal arc and chord, parietal arc and chord, and occipital arc and chord. The extremely conservative discriminant function uses these measurements to determine whether crania are modified or normal. The conservative nature of the function means that crania with mild degrees of modification are likely to be classed as normal, but should never result in normal crania being considered modified (Clark et al. 2007).

The method by O'Brien and Stanley (2013) establishes whether a cranium is modified and what type of modification it has undergone using four measurements, maximal cranial length, breadth, height, and the frontal chord. This method takes into account the longitudinal and lateral dimensions of the skull, as opposed to the method by Clark that looks only at the cranial midline. The cranial measurements are put into two discriminant functions and the results can be plotted on a territorial map to show the presence and type of modification.

Cranial Non-Metrics

Cranial non-metric traits are epigenetic in nature and may thus be influenced by pathological variations in cranial shape or head shaping practices. The continued scholarly debate regarding the potential influence of cranial modification and natural cranial deformations on the expression of cranial non-metric traits has already briefly been touched upon.

Cranial and mandibular non-metric traits have been scored during this study. The scoring system is based on Buikstra and Ubelaker (1994) and Hauser and Destefano (1989). The cranial traits recorded during this study and the standardised manner in which they were scored can be seen in Table 5. Similarly, the mandibular non-metric traits and their scoring system can be found in Table 6. Most traits are bilateral in nature and these were scored separately for the left and right side. In all cases, traits will be scored Absent if they are not present and Unobservable if damage to the cranium made assessment of the trait impossible or unreliable.

Wormian bones are scored separately and in more detail, as previous studies have already indicated the probable influence of cranial modification on this trait. The system for scoring wormian bones can be seen in Table 7.

Table 5 **The scoring system for cranial non-metric traits used in this study. All sizes in mm.**

Non-Metric Trait		**Score**
Metopic Suture		Present
Supraorbital Notch	Number	#
	Position	Medial / Lateral
	Size	Small (0.3) / Medium (1) / Large (1.2) / Excessive (>2.0)
	Shape	Blurred / Acute
Supraorbital Foramen	Number	#
	Position	Medial / Lateral
	Size	Small (0.3) / Medium (1) / Large (1.2) / Excessive (>2.0)
Infraorbital Suture		Partial / Complete
Accessory Infraorbital Foramina		Present
Zygomatico-facial Foramina	Number	#
	Size	Small / Large
Parietal Foramen	Number	#
	Position	Parietal / Sutural
	Size	Small (0.3) / Medium (1.0) / Large (1.2) / Excessive (>2.0)
Inca Bone		Complete / Bipartite / Tripartite / Partial
Condylar Canal	Patent	Patent / Not Patent
	Number	#
	Size	Small (0.3) / Medium (1) / Large (1.2) / Excessive (>2.0)
Divided Hypoglossal Canal		Trace / Incomplete/ Partial / Total
Flexure of Superior Sagittal Sulcus		Left / Right / Bifurcate
Foramen Ovale Incomplete		Trace / Partial / Complete=Vesalius
Foramen Spinosum Incomplete		Trace / Partial / Confluent Spinosum and Ovale
Pterygo-spinous Bridge		Trace / Incomplete / Complete
Pterygo-alar Bridge		Trace / Incomplete / Complete
Tympanic Dihiscence/ Huschke		Foramen only / Full defect
Auditory Exostosis		<1/3 occluded / 1/3-2/3 occluded / >2/3 occluded
Mastoid Foramen	Number	#
	Position	Temporal / Sutural / Occipital / Multiple
	Size	Small (1) / Medium (2) / Large 2.6) / Excessive (>2.6)

Table 6 **The scoring system for the mandibular non-metric traits employed in this study. All sizes in mm.**

Trait		**Score**
Mental Foramen	Number	#
	Size	Small (1) / Medium (2) / Large (2.6) / Excessive (>2.6)
Mandibular Torus		Trace / Moderate (2-5) / Marked (>5)
Mylohyoid Bridge	Location	Superior / Inferior / Superior and Inferior
	Degree	Incomplete / Complete Partial / Complete Total

Table 7 Scoring system for ossicles following Hauser and DeStefano (1989:212).

Trait		Score
Epipteric Ossicle	Number	#
	Position	A / B / C / D / E / F / G / H / I *
	Size	Small (<1 cm, < 0.5 cm^2) / Large (>1 cm, > 0.5 cm^2)
Coronal Ossicle	Number	#
	Position	Equal / Frontal / Parietal
	Size	Small (<1 cm, < 0.5 cm^2) / Large (>1 cm, > 0.5 cm^2)
Bregmatic Ossicle	Number	#
	Position	Bregma / Frontal / Sagittal suture / Left Coronal suture / Right Coronal suture
	Size	Small (<1 cm, < 0.5 cm^2) / Large (>1 cm, > 0.5 cm^2)
Saggital Ossicle	Number	#
	Position	Equal / Left Parietal / right Parietal / Connected to Bregmatic ossicle
	Size	Small (<1 cm, < 0.5 cm^2) / Large (>1 cm, > 0.5 cm^2)
Apical Ossicle	Number	#
	Position	Lambda / Sagittal Suture / Left Lambdoid suture / Right Lambdoid suture / occipital squama / connected with Lambdoid ossicles
	Size	Small (<1 cm, < 0.5 cm^2) / Large (>1 cm, > 0.5 cm^2)
Lambdoid Ossicle	Number	#
	Position	Equal / Left Parietal/ Right Parietal / Occipital
	Size	Small (<1 cm, < 0.5 cm^2) / Large (>1 cm, > 0.5 cm^2)
Asterionic Ossicle	Number	#
	Position	Central / Occipito-Mastoid suture / Parietal / Occipital / Temporal
	Size	Small (<1 cm, < 0.5 cm^2) / Large (>1 cm, > 0.5 cm^2)
Occipito Mastoid WB	Number	#
	Position	Central / Occipito-Mastoid suture / Parietal / Occipital / Temporal
	Size	Small (<1 cm, < 0.5 cm^2) / Large (>1 cm, > 0.5 cm^2)
Parietal Notch Bone	Number	#
	Position	Mastoid process / parietal / Posterior margin temporal squama / occipital (asterion)
	Size	Small (<1 cm, < 0.5 cm^2) / Large (>1 cm, > 0.5 cm^2)

5.3 CRANIAL MODIFICATION

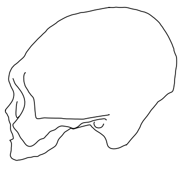
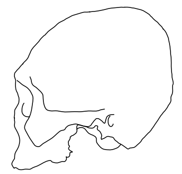
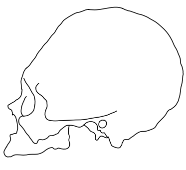
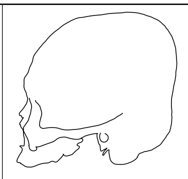
Classification

Despite the existence of numerous classification systems to describe the cranial alteration created through head shaping practices, the terminology proposed by Hrdlička (1919) and Imbelloni (1930) is most prevalent in modern studies. The earlier discussion of these typologies in Chapter 2 has already proven that despite differences in terminology, these systems are compatible as the underlying cranial shapes are the same. Both systems have been used in the previous Caribbean investigations, but this research prefers the more descriptive nature of Hrdlička's terms.

An important addition in any classification system are subtypes representing minor differences in the direction of occipital flattening which in fact result in distinctly different cranial shapes. Neumann (1942) has taken these differences into account in his expansion of Hrdlička's classification and they are also present in Dembo and Imbelloni's typology (1938). These additions on the direction of occipital flattening are considered essential in this research, based on earlier studies signalling the importance of such differences in Mesoamerica (Tiesler 2010, 2012), the Andes (Torres-Rouff 2003, 2009; Hoshower et al. 1995) and the Caribbean (van Duijvenbode 2010).

Therefore, the terms proposed by Neumann, parallel and vertical, are added to the original scheme by Hrdlička to allow for a better understanding of these variations in cranial shape which may indicate different modification devices or cultural traditions. Table 8 shows these additions in an overview of the classification system supplemented with visual representations of each shape.

Table 8 **Classification system for cranial modification used in this study.**

				
Fronto-Occipital		Frontal Flattening	Occipital Flattening	Circumferential
Parallel	Vertical			

Assessment

A visual inspection of cranial shape will be the main manner of determining the presence or absence of intentional cranial modification. The assessment of the cranial vault will focus on any alterations in contour corresponding to the main shapes in the classification system, described in more detail for each type below. Particular attention will be paid to the presence of flattened planes, including the exact location, size, and direction.

In addition, the visual inspection will also take note of any asymmetry in the overall shape of the skull or in the flattened planes. Other features which may indicate the presence of intentional cranial modification are the post-bregmatic depression, a depression along the sagittal suture, or sagittal keeling. The presence of absence of these traits will be noted, as well as the degree of expression.

Fronto-Occipital Modification

Fronto-Occipital modification is created, as the name implies, by pressure placed on the front and back of the skull through a solid material. These pressure points will be marked by flattened planes. Fronto-occipital modification results in a shortening and compensatory broadening of the cranium, the latter marked by parietal bulging, and a wider and shallower cranial base. There are two subtypes distinguishable through the angle of occipital flattening. Fronto-occipital parallel modification has a direction of occipital flattening (roughly) parallel to frontal plane of flattening, whereas the vertical subtype has an occipital plane of flattening (roughly) at a 90 degree angle to the frontal plane (Cheverud et al. 1992; Dembo and Imbelloni 1938; Hrdlička 1919; Oetteking 1930).

Frontal Flattening

Frontal flattening is created by a tablet or board pressed to the frontal. This would leave a frontal plane of flattening, but have little to no impact on the occipital depending on the construction of the device. If the board is placed on the forehead using a band tied at the back of the skull, minor occipital changes or band impressions may be visible (Rivero de la Calle 1966).

Occipital Flattening

Occipital flattening can be caused by a cradleboard, cradle with a hard surface, or freestanding occipital board. The extent and placement of the occipital plane of flattening are directly correlated with the modification device. The flattening can be asymmetrical, in which case compensatory changes may be present similar to those seen in positional plagiocephaly (Kohn et al. 1995).

Circumferential Modification

Circumferential modification is created by compressing the skull in a circular manner. This can be achieved by tight wrapping of textiles, bandages, string, or traditional headgear. This restricts the cranial growth in a lateral direction and creates compensatory longitudinal growth, resulting in a narrow and long skull and base (Dembo and Imbelloni 1938; Hrdlička 1919; Kohn et al. 1993; Oetteking 1930).

5.4 Documentation

Each skull was given a unique identification code, used to identify it on the recording form, in photographs, and in the database. This code was created based on the site name and the burial, find, or catalogue number of the individual. A recording form was filled out for each individual and photographs were taken of all skeletal material studied.

Forms

A standard cranial recording form was designed specifically for this project. Different forms were created for infants, children, and adolescents/adults to ensure the best possible documentation for each category. These can be seen in the appendices. Each form consisted of several sections: cranial inventory, age and sex determination, cranial modification, cranial metrics, and cranial non-metric traits.

The cranial inventory depicted a cranium from the six standard perspectives (frontal, lateral, occipital, vertical, and basilar), which was used to document the areas of each skull that were present and available for study. In addition, the general state of preservation and any reconstructive techniques and materials were recorded. The burial context and contextual information sections were used to describe any archaeological information present on the burial position, grave goods, period, and cultural affiliation of the individual. Any indications of pathology were also described.

The sex and age determination sections were used to record basic impressions of these two factors using the limited methodology previously described. This information was later compared to the sex and age determinations from reports or collection databases wherever present. The age determination for infants and children was more extensive than for adult skulls, whereas sex was omitted for these age categories as it cannot be established with any degree of certainty before puberty.

The section on cranial modification recorded the presence or absence of cranial modification established through a visual inspection. This analysis determined whether cranial modification was present or absent by observing the cranial vault outline and the potential presence features related to cranial modification and described previously. The determination of cranial modification in this study was relatively conservative in nature. Crania were only considered modified if substantial evidence – in the form of flattened planes, cord impressions or a distinctly different cranial outline – was present. Crania were scored as ambiguous if the cranial outline varied from the expected norm within the population, but no clear planes of flattening or cord impressions could be determined.

This conservatism in scoring is important, as several factors may influence the determination and recognition of cranial modification in archaeological assemblages. A key factor that must be taken into account is the state of preservation of cranial remains, though even complete crania may not be assessed accurately due to various reasons. Firstly, mild forms of cranial modification are difficult to detect within the archaeological record. Moulding or massaging of the skull in the weeks after birth is employed in various cultures yet these types of practices result in minor changes to cranial skull shape, which cannot be conclusively differentiated from normal cranial variation within a population. Furthermore, the inherent plasticity of the human skull means that the same cranial modification practice may have different results depending on the individual (Hughes 1968:42; Oetteking 1930). Variations in the construction of the modification device, the pressure applied to the skull, the moment of initiation of this pressure, and the duration of application may all lead to considerable differences in the degree of modification, ranging from mild forms almost indistinguishable from normal cranial variation to marked cranial alterations immediately apparent to the general public (Littlefield et al. 2005; Oetteking 1930:15-16). All of these factors combine to create a continuous range in the degree of modification, which creates an intrinsic difficulty in any attempt to simple divide a sample of crania into only two categories.

If an altered head shape is present, cranial deformations with a pathological aetiology must be ruled out. To determine this, the sutures were evaluated to determine the degree of suture closure and rule out craniosynostosis. These abnormal patterns of premature suture closure produce different cranial shapes depending on the synostosed suture, as discussed previously. Any asymmetry in the skull is studied to rule out taphonomic warping of the skull, although this is usually immediately detectable. Occipital asymmetry may also point to deformational plagiocephaly as a side-effect of other child care practices.

Once it had been established that the observed cranial modification was likely produced intentionally, types and subtypes were determined through the classification system described above. A drawing of the lateral cranial vault contour was produced through observation, indicating the points of pressure and any features associated with cranial modification. Occasionally, additional drawings were made to clarify features which did not photograph clearly, such as mild asymmetry of the skull. A brief description of the cranium is provided, again focusing on the overall shapes, location of flattened planes, and any related features.

The remaining sections were only present on the adolescent/adult forms, as these were not relevant for juvenile remains. The section on metrics used the standard cranial metrics derived from Buikstra and Ubelaker (1994) and several cranial indices (Bass 1987). The measurements necessary for the discriminant function by Clark et al. (2007) were recorded separately as they are not all part of the standard suite. Non-metrics traits were separated into cranial and mandibular categories and recorded in a table following the classification of these traits as previously described. Wormian bones were reported in more detail in a separate table due to the well-known influence of cranial modification on this specific trait. Finally, post-bregmatic and sagittal depressions were scored as they are also often associated with cranial modification.

Database

A database was constructed in Microsoft Access 2010 to organise and analyse the data produced by the standard recording form. The arrangement of the database followed the organisation of the cranial recording form, using separate sub-tables linked to the main table, which contained general information on the individual specimen. Tables were linked using the unique identification code given to each skull during the analysis. Data from these different tables could be combined in a single query within Microsoft Access 2010 to allow statistical analysis of all information within the database.

Photography

In addition to the documentation of the cranial shape on the recording form, each cranium was photographed by placing it in the Frankfort plane wherever possible and photographing it from the six standard planes: norma frontalis, norma lateralis (left and right), norma occipitalis, norma verticalis, and norma basilaris. Close-up photographs were taken of any abnormal features, whether they were the (potential) result of cranial modification or pathological in nature. Occasionally, crania were photographed from different angles in order to capture features not clearly visible in the standard perspectives. Abnormalities on the postcranial skeleton were also photographed, as well as artefacts found in association with the skeletal remains in storage.

The photographs in this project were produced by a succession of cameras: a Canon Ixus 70, a Panasonic TZ8, and a Panasonic TZ25. The photo numbers assigned by the respective cameras were noted on the recording form of each cranium. Additionally, a card displaying the ID code of each skull was visible in every image.

The photographs in this dissertation have undergone only limited alteration, such as conversion to black and white, removal of the original background, or an alteration to the angle of the photograph in cases where preservation hindered the proper positioning of the skull in the Frankfort plane. None of these digital alterations affected the shape of the crania in the image in any way.

5.5 STATISTICS

Statistical methods have been used to analyse the data on altered cranial shapes gathered during this study. All tests were run using the computer program IBM SPSS Statistics version 23 and the level of statistical significance for all tests is $p < 0.05$. The selection of the correct statistical test depends on the type of variable under investigation. The major distinction is between continuous or categorical data.

Quantitative or continuous variables are values on a measurement scale, such as the cranial metrics taken for each skull in this study. These data can be analysed using parametric or non-parametric tests. The first requires a normal distribution of the data, whereas the latter should be used if the data is not normally distributed or if sample sizes are small. The drawback of the latter is that the non-parametric analyses are generally less powerful and produce more conservative results (Field 2013; Fletcher and Lock 2005; McDonald 2014; Sokal and Rohlf 2012).

Two parametric tests were used to assess the metric data: the Independent Samples t-test and one-way Anova. The Independent Samples or Student's t-test compares the means of a measurement variable between two different groups, whereas the one-way Anova does the same for two or more groups. From a mathematical perspective, a one-way Anova with two groups is identical to an Independent Samples t-test, but since many people are familiar with the latter term it will be used here (Field 2013; McDonald 2014).

The second type of data are categorical variables – also known as qualitative or discrete – that consist of assigned categories with no inherent mathematical potential (Fletcher and Lock 2005; McDonald 2014; Sokal and Rohlf 2012). The majority of the social traits under investigation here consist of categorical variables, like the determined sex of an individual (female, male, undetermined) or the presence of cranial modification (yes, ambiguous, no).

Categorical data are generally analysed using the Chi-Square test or Fisher's exact test. The first is not very accurate in small samples (i.e. below 1000). Expected frequencies must be above 5 for every cell in 2×2 contingency tables and in larger tables all counts should be above 1 and less than 20% of counts below 5 (Field 2013; McDonald 2014). These assumptions were violated in almost all cases in this dataset, resulting in an unacceptable reduction of test power and reliability. Most categorical variables were therefore analysed using a Fisher's exact test, a more exact manner of calculating chi-square in small samples. This test can is defined for 2×2 contingency tables and in the case of three or more categories the Fisher-Freeman-Halton test must be applied. Both are referred to as a Fisher's exact test in IMB SPSS v23 and this terminology is followed throughout the dissertation for the sake of clarity, but any cases with three or more variables have been done using the Fisher-Freeman-Halton extension. The Fisher's exact test requires a lot of intense calculation and occasionally insufficient memory was present in SPSS to compute a Fisher's exact test. In these cases, a Monte Carlo Simulation was run to estimate the p-value (Field 2013; McDonald 2014).