Chapter 4
Reconstructing Ancient Head-Shaping Traditions from the Skeletal Record

Now they are gone with all their songs and sins, Women and men, to dust; their copper penny, Of livings, spent, among these dusty inns; The glittering one made level with the many.

Their speech is gone, none speaks it, none can read The pictured writing of their conqueror's march; The dropping plaster of fading screedCeils with its mildred the decaying arch.

John Masefield (2005 [1920–1923], p. 96)

Past performance of head-shaping traditions is prone to leave tangible expressions in archaeologically retrieved skulls. Their systematic examination allows scholarship to recreate the ancient modeling techniques and their morphological results, even in those populations of the remote past that have left no written record. This chapter examines the different natural and cultural origins of human cranial shape. A brief review describes those typologies that have been employed in classifying artificially modified crania, techniques and compression implements in the Americas and specifically Mesoamerica. The cranial typology adapted from the taxonomy of the Italo-Argentinian anthropologist José Imbelloni (1885–1967) is described at length here (Comas 1970a; Dembo and Imbelloni 1938), as are some complementary metric criteria, originally proposed by Frédérique Falkenburger (1890–1965; Falkenburger 1938).

Today, this classification system, proposed 80 years ago, is still employed in most studies on Mesoamerican and Andean cranial modifications. Its standardized use benefits comparisons within and between areas and warrants inferences of Mesoamerican shaping techniques and implements, which are explored subsequently in this chapter (Dembo and Imbelloni 1938; Dávalos 1951, 1965; Falkenburger 1938; Romano 1965; Romano 1974; Tiesler 1998, 2012a). From here, I outline skeletal and contextual criteria that provide useful points of departure for deducing the social dimensions and temporal trends of past head practices, such as skeletal sex and age estimates and the evaluation of associated mortuary attributes, shown in the form of graves' construction and offerings, architectural associations and orientation.

4.1 Sorting Out the Different Origins of Human Skull Shape

Given the multifold origins of cranial alterations in archaeologically retrieved human skeletons, it is problematic to surmise a priori any cultural origin, as Table 4.1

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Table 4.1 Different origins of morphological change in the human skull vault

1	Postmortem modification
	1.1 *Taphonomic damage*
	1.1.1 Mechanical pressure
	1.1.2 Biochemical substitution
	1.2 *Faulty restoration of fragmented skulls*
	1.2.1 Faulty fitting of cranial fragments
	1.2.2 Faulty restitution of missing cranial areas
2	Antemortem modifications
	2.1 *Pathological conditions*
	2.1.1 Congenital defects
	2.1.2 Metabolic disease
	2.1.3 Unknown etiology (primary premature surture closure, etc.)
	2.2 *Populational morphological diversity of skull shapes*
	2.3 *Cultural modifications of the infant skull*
	2.3.1 Occupational causes (tumpline use, postural flattening)
	2.3.2 Modern therapeutical measures
	2.3.3 Cultural manipulation of the infant head (head shaping)

illustrates. Changes in dimensions of the skull vault are often part of posthumous degradation processes. Extrinsic pressure, caused by the weight of the overlying soil and earth compaction, may lead to mechanical suture separation and the displacement, fragmentation, and re-shaping of bone. Likewise, biochemical disintegration and extrinsic substitution may de-naturalize the organic tissue and cause changes in contour (Crist et al. 1997; Gervais 1989, pp. 79–80; Hansen 1919). Tensile and compression stress may result in cranial bending during the early stages of decomposition, as do moisture and changes in humidity and temperature, as actualistic research has shown (Crist et al. 1997, pp. 324–232). Under these circumstances, the thin ductile skulls of newborns show especially pronounced warping effects due to their original flexibility.

Postexcavational deformation, which may also resemble antemortem cranial modification, commonly happens during the curation process. Nonalignment of edges between two adjoining segments occurs when the surfaces to be united are covered with earth or are eroded. Also the restorer's restitution of missing cranial areas may result in unintended changes of its original vault contour (Roberts 2009, p. 95). Distinguishing these artifacts from antemortem modeling is sometimes difficult and requires experience by the observer, although the appearance of postmortem changes differs from those originating in the organic, i.e., living substrate. Posthumous changes of dimension in neurocranial contour and surface tend to be isolated and lead to discontinuities when the skull is assembled, the lines of fracture can no longer be united.

Also antemortem modifications in head form are not always cultural (see Chap. 3). Pathological changes in head morphology sometimes mimic artificial modeling, such as systemic birth defects (Down syndrome, achondroplasia, microcephaly, etc.). Also synostoses, caused by the premature fusion of skull sutures, or some metabolic diseases that intervene in bone formation (such as acromegaly or rachitis), influence the expansion of the cranial vault. In healthy individuals, skull shape is strongly controlled by biological factors which relate to their populational affiliation.

Among those head alterations that are extrinsically induced, some are the circumstantial side-products of occupational stress, adornment, or head posture. These changes are cultural indeed, but are not customs per se, as they stem from unrelated habitual daily activities, such as crib positioning, fitting tight hair ribbons on baby heads, or tumpline use. As mentioned in Chap. 3, posturally induced anteroposterior shortening or plagiocephaly occur when the infant habitually sleeps in the identical supine position on a rigid surface (Graham et al. 2005). This position can lead to the visible flattening of the baby's occipital bun. This sort of restraint is distinguished from anteroposterior compression by the absence of any anterior flattening by definition and, as I follow, of any secondary effects from extrinsic splinting, such as postcoronary grooving.

A more active form of occupational head shaping relates to the use of tumplines (carrying bands), as has been argued for some of the very early cases of frontal flattening (Trinkaus 1982, 1983). Also, some Mesoamerican cases of irregular parietal and frontal flattening may suggest the carrying of heavy loads initiated at a very young age (Gervais 1989; Tiesler 1999). In each of the cases documented from Mesoamerica, the flattening affects both the frontal bone and the anterior portion of the parietals. Conversely, there are no bipolar constrictions or any morphological changes in the occipital counterpart, which appear rounded. The anterosuperior flattening is convex but leads to a generally reclined appearance of the overall skull shape. The rounded occipital silhouette and the joint fronto-parietal flattening, which are not seen in skull modification practices, suggest that the flattening might be the inadvertent effect of tumpline use at an early age, although the growth physiology raises questions on the exact age tumpline use must have started to leave permanent traces in the forehead.

Recent actualistic research by Veronique Gervais (2001) on seven habitual tumpline carriers from Guatemala confirms our ideas and adds information on the side effects of customarily suspending weight from the forehead. Her radiographic observations suggest that tumpline use led indead to forehead flattening. She found also vertebral shortening, shifts in spine curvature and agnesia in some of the habitual carriers she study. Tumplines, called *mecapal* in Nahuatl, were the common forms of transportation in pre-Hispanic Mesoamerica, where no wheels or animals eased the burdens of humans. Boys and girls were initiated early in life in the matters of physical transport. Fraile Gerónimo de Mendieta (1997, pp. 227–228) specifies, for instance, that Aztec parents initiated their children well before the age of five in carrying burdens suspended from a *mecapal*.

Apart from tumpline use, there are still more forms of changing head morphology inadvertedly by habitual use. This may result from the quotidian adjustment of hair bands, hair circlets, or other tight head gear on the baby's head. Also, these may lead to permanent changes in the bone, as it has been documented in historical studies on French folklore (Foville 1834). A bone relic of this type will appear on the head as an isolated groove that tranverses the calvarium at the height of habitual collocation. In France, this hairdo stands at one end of a much broader range of local traditions, most of which were indeed directed to the shape of the infant head and therefore are classified as head shaping (Dingwall 1931, pp. 46–61).[1] This distinction, which is never clearcut, introduces the last category to be discussed here: those head modifications that were the object of cultural practices (Table 4.1).

So far in this section, we have characterized different types and origins of skull changes that are unrelated to infant head-shaping practices. Also some of the antemortem cranial imprints of human behavior are unrelated. They may be indicative of day-to-day practices, but their morphological imprints on the neurocranium hardly communicate any choices by their practitioners that are directed to the head itself and its shape; their object is not the body. Separating them from the marks likely left from infant modeling is not always easy or categorical. Careful case-by-case examination of relevant morphological evidence, contextualization, and patterning are required and only after excluding all possible alternative causes of skull modifications, may artificial infant shaping be surmised by exclusion.

Confirmed infant head treatments by themselves also denote diversity and complexity. These are prone to lead to conflation, bias and confusion upon examination. It is possible that some of this confusion is generated by the artificial distinction according to the criterion of assigned intentionality, which some authors support by distinguishing between what they consider purposeful head modifications from those cultural head alterations that are considered "unintentional," as for example artificial flattening due to cradleboard use (Neumann 1942; Saul 1972). As I have argued in Chap. 2, it may be less problematic to decide whether the objective of infant head manipulation is the head, thereby qualifying as body practice, than to assume cultural purposes *a priori*. What is more, it may be misleading to comprehend the morphological changes in the head as the expression of one single practice. This may be especially problematic in those cultural frames where more than one technique, implement or practitioner is involved, such as is the case in Mesoamerica. In this cultural frame, in particular, the dichotomy of "intentional" vs. "unintentional" oversimplifies the nuanced and often multi-layered meanings and roles that the body practice(s) once held in the native ideology (Chap. 6). Here, infant head manipulations express multifaceted goals and meanings, some of them protective, others preventive and phenomenological, most of them being unrelated to the visible end result in the head (Tiesler 2011, 2012a, b).

4.2 A Review of the Anthropological Literature on Cranial Classification

Over the last centuries, a host of criteria has evolved to classify culturally induced head shapes of the past. Most classifications rely on the formal qualities of the modification, some have attempted to correlate specific head shapes to the ethnicity,

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[1] During the nineteenth century, in most French regions or *departments*, infant heads were still molded with hair ribbons or bandages (*bandeau* or *crémé*). In some areas, tight caps and preformed head-dresses (*serre tê tes*, *béguins*, *fromages*) were put on daily. Head restrictions of this kind were widely distributed in rural France and many of the resulting forms were recognized as characteristic of certain areas, confirming their cultural quality as head modification (Delisle 1880, 1902; Dingwall 1931, pp. 46–61; Pereira da Silva and Miya 1994).

area of use, or social distinction of their human carriers (Delisle 1902; Dingwall 1931; Weiss 1967) or to their intentional or unintentional nature (Neumann 1942). Some taxonomies have aimed at assuming specific compression techniques and apparatuses by combining metric and nonmetric criteria (Dembo and Imbelloni 1938; Falkenburger 1938). More recent quantitative classification parameters have recurred to landmark studies and three dimensional statistical models (Anton 1989; Arnold et al. 2008; Cheverud and Midkiff 1992; Cheverud et al. 1992; Gómez-Valdés et al. 2007; McNeil and Newton 1965; Stojanowski and Euber 2011). Still other classifications are founded on detailed descriptions of overall skull form or examine the appearance of constriction grooves or compression planes (for example Buikstra and Ubelaker 1994, pp. 160–163).

As regards the study of New World cranial-vault modifications, it was not before the nineteenth century that interest in native head-shaping practices arose. The new attention is evident in some early reports by naturalists, anatomists, and curious travel reporters, such as Stephens and Catherwood (1963). These descriptions were founded mainly on the analysis of skull collections, because head shaping had long disappeared from most native repertoires by the nineteenth century (Armas 1885; Boas 1890; Morton 1839; Morton 1841; but see also Comas (1958) on modern Conibo Shipibo from Ucayali, Perú; see Chaps. 5 and 11). The early accounts largely reflect the Zeitgeist of the times when antiquarianism thrived and filled the magazines of natural history museums, anatomy departments, and hospitals of the US and overseas. Soon, the New World became known as the main territory of head modifications (Flower 1881; Imbelloni 1933) thanks to its near omnipresence in the Americas and the puzzling diversity of artificial head forms herein produced (Fig. 4.1).

The pioneering volume Crania Americana (1839), *by* Samuel G. Morton, isolates four formal types in the Americas: cylindrical and conical shapes and frontal and occipital flattening. Alternative taxonomies, valid also outside the Americas, were established by Magitot, who distinguished ten skull types in a paper presented in 1880 at the Congress for Anthropology and Prehistoric Archaeology in Lisbon, Portugal (Magitot 1884). Hrdlička would cut these down to two (Hrdlička and Lumholtz 1912). Additional taxonomic systems were established by Gosse (16 types and 2 varieties), Lunier (10 types), Tschudi (3 types), Wyman (2 types), Topinard (5 types), Virchow (3 types), Lehnossek (6 types), and Sergio Sergi (4 types) (Gervais 1989). Naturally, this inflationary number of classifications of head modifications, each of which established to cover specific regions and respond to diverse anthropological interests, was destined to cause unreconcilable confusion on broader scales of comparison. Evident contradictions among different classification systems were decried by Rudolf Virchow (1988, 1890) and by Dembo and Imbelloni (1938, p. 251; see also Imbelloni 1925) who specified that:

> *… until recently, craneologists had access to a growing number of classifications. The disparity of criteria that was taken into account by the taxonomists was such that only confusion could result out of the coexistence of so many systems and nomenclatures. Each author has deemed correct to ignore the foundations of previous classifications in order to pronounce the basis of a new one, obliviating that for this purpose, the anterior classifications need to be deconstructed first by way of constructive criticism.* (Dembo and Imbelloni 1938, p. 249; translation from the Spanish by the author)

Fig. 4.1 Cultural areas which staged the most visible cranial modifications in the Americas; shaded in dark grey (adapted from Imbelloni 1933, p. 218; drawing by B. Ceballos)

As skull shapes were being meticulously described and measured during the nineteenth century, their geographic distributions were examined in the light of diffusionist theory. Lamarckian and Darwinistic ideas on evolutionary mechanisms inspired some authors to address the question of the heredity of acquired traits from the focus of cranial modeling. While Gosse (1855) still considered the possibility of hereditary transmission of artificially produced shapes, Delisle (1880, pp. 18–22) concluded his blant parental analysis of French families, who still practiced head modulation, with the statement that artificial head form was not inherited. Additional questions regarding possible neurological side effects were examined, especially with the advent of neurological sciences in the second half of the nineteenth century. These were correlated to phenomenological ideas by attributing a specific function to each area of the brain. In this frame, also artificially modeled skulls were the object of speculations with racist undercurrents and interpretations that now appear obsolete and unfounded, some of them unbearable transgressions.

At least methodologically, most of the taxonomic foundations in modern Latin American research on head shaping were established during the 1920s and the 1930s. These were the years during which cranial research grew more systematical and breached different cultural spheres. Geographically overarching research on the topic was published by Dingwall (1931), Imbelloni (1925, 1930, 1933, 1938; Dembo and Imbelloni 1938) and Falkenburger (1938). While Dingwall assembled

Fig. 4.2 Portrait of Italo-Argentinian anthropologist José Imbelloni, who developed a systematic taxonomy for classifying artificially modified cranial vaults in the Americas. Wikipedia website: http://commons.wikimedia.org/wiki/File%3AJos%C3%A9_Imbelloni.jpg

over one thousand publications to synthesize ethnological work on artificial head shaping around the globe (with important input also on the New Continent), José Imbelloni meticulously gathered metrical, osteological, and ethnic criteria to establish suitable foundations for studies on modified skulls in the Americas, consigning importance, distribution patterns, and changes through time (Fig. 4.2). In tandem with his Argentinian colleague, Frédéric Falkenburger (1938) recorded metric findings from a detailed analysis of 302 South American skulls. He correlated cranial indices and angles with different modification techniques and provided metric ranges for each. His parameters and those originally established by Imbelloni are detailed in the following section (Sect. 4.3).

North of the Mexican border, Neumann (1942) published a different classification system, designed to put order among the different cranial shapes that characterize the eastern United Sates, while for ancient Perú, Pedro Weiss (1961, 1962) proposed a classification that is still being applied in Andean research and therefore deserves mention. Weiss (1893–1985) was a distinguished physician trained in Perú. During his career, he developed a passion for pre-Hispanic Andean archaeology and osteology and developed an approach to skeletal studies known as “Cultural Osteology”

(*Osteología Cultural*). For his taxonomy of artificial cranial shapes, Weiss chose a more *emic* classification than Imbelloni and names each head type according to the native group, arguing that Imbelloni's categorical distinction between annular and tabular modification types would not fit well with ancient Peruvian practices. Here, many cultures combined rigid, semirigid, and soft head implements that resulted in complex head shapes that are characteristic for each cultural area (Weiss 1961, pp. 10–12). In fact, the emblematic function of Andean cephalic models would turn into a recourse for classifying different skull shapes in South American "cultural osteology" (Weiss 1962). Here, the taxonomies of cranial vault shaping borrowed heavily from ethnic divisions and horizons of Andean cultural evolution. These are still being adopted by more recent scholarship to examine ethnic composition, residence, mobility, and migration in the pre-Columbian Andes (Allison et al. 1981; Lozada 2011; Torres-Rouff 2002, 2003; Weiss 1962). Weiss' system starts out by establishing a broad distinction between those peoples who employed cradleboards and others who used *llautus* (head apparatuses). From here, and based on the observations of preserved head implements and skull shapes, each head type is characterized according to the cultural area it represents. Although, this classification adapts well to the Andean cultural sphere, it is regionally too specific to be transferable to other areas of the world, such as Mesoamerica.

Post-WWII research on Old and New World cranial modifications has addressed also an increasing number of specific morphological topics, most of them related to anatomy and physiopathological cranial growth (Moss 1958; Pardal 1938). Conducted mostly by medical practitioners, the studies generally draw on measurements or morphological observations obtained from series of artificially modified skulls, which are compared to the craneometric impact of pathological growth induced by premature suture closure for instance, as was explained in Chap. 3.

The second half of the twentieth century saw also more anthropologically motivated general studies on New World head modifications, which discussed various general and regionally relevant mechanical and formal aspects and their cultural distribution. There is a diverse orientation in the anthropological work by Rogers (1975), and Stewart (1941, 1958, 1963, 1975) for North and Central America, by Romano (1965, 1974), Weiss (1967), Saul (1972) and Stewart (1943b, 1975) specifically for Mesoamerica, and Pedro Weiss (1961, 1962, 1981), Allison et al. (1981), Munizaga (1974) and Stewart (1943a, 1963), among others, for the Andean Region. Note that in the last two decades, anthropological work on head shaping in the New World has relied increasingly on archaeological and sociological theory in the interpretation of skulls as part of the mortuary record and has reappeared in new conceptual frames anchored in native schemes of cosmology, semiotic and in general cognitive approaches, body theory, and embodiment (Blom 2005; Geller 2006; Lozada 2011; Tiesler 2007, 2010, 2011; Torres-Rouff 2002; Yépez 2006, 2009; see Chap. 2).

In Mexico, specifically, it was Eusebio Dávalos (1909–1968), who gave academic recognition to pre-Hispanic cranial vault modifications. Dávalos started out in the mid-twentieth century on this subject. He first conducted research on a skull collection from Aztec Tlatelolco (Dávalos 1951; Dávalos and Romano 1965) and later in

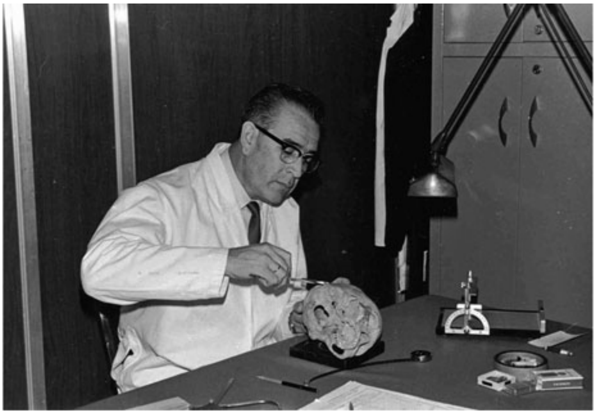

Fig. 4.3 Portrait of Mexican anthropologist Arturo Romano Pacheco, who has promoted the anthropological study on pre-Hispanic head-shaping practices in Mesoamerica and specifically in Mexico. (Photo: Archives of the Dirección de Antropología Física/INAH; courtesy of M. T. Jaén Esquivel)

his career actively promoted the study of Mesoamerican cranial modeling in general. Also, Juan Comas (1900–1979) covered pre-Hispanic head-shaping practices in different parts of Mexico, mainly collections from the Mexican state of Veracruz (Comas 1960, 1970b; Comas and Marquer 1969). Also, noteworthy is his engaged case study of head flattening among recent Peruvian Amazon communities (Comas 1958).

After 1960, Mexican research on Mesoamerican skull modifications was consolidated and has been dominated since by Arturo Romano Pacheco (born in 1921) of the National Institute of Anthropology and History (Fig. 4.3). Trained as a physical anthropologist at the Mexican National School of Anthropology during the 1940s, Romano specialized in osteology from the beginning of his career and showed a profound academic passion in Mesoamerican craniometry, for what he establised an impressive database during his long professional career. For this purpose, Romano designed his own approach to measuring skulls, which he called "craneotrigonometry." His approach is founded mainly on detailed morphological descriptions of the skull and complemented by a series of measurements, oriented in quadrilateral skull polygons, as established by the German physician Hermann Klaatsch. The subject of cranial vault modifications soon became one of Romano's preferred lines of research and teaching. His profound grasp of the subtleties involved in cranial morphology and variation, not only permeates his own research but has left a lasting imprint of many generations of Mexican colleagues and students who over half a century have received Romano's training on cultural craniology (Bautista 2004; Jaén 1962; Martínez 2009; Sánchez 1971; Tiesler 1998, 1999; Yépez 2001, 2006).

Since the seminal volume titled Estudio morfológico de la deformación craneana en Tamuín, S.L.P., y en la Isla del Idolo, Veracruz of 1965, Romano himself has published prolifically on the subject of Mesoamerican cranial vault modifications, although most of the distribution of his work is limited to Hispanic media. For studying Mesoamerican skull modifications, Romano adopted Imbelloni's classification and adapted it to the regional skeletal record of native practices. Here, he combined its parameters with a set of specific craniometric distinctions, which he derived from the work of Falkenburger (1938), Moss (1958) and his own detailed craniometric work (Romano 1965, 1996). This combined approach allows him to generalize on types, forms, and techniques in the skull series he reports. By combining the craniological approaches with iconography the work by Romano already observes some of the complex cultural and specifically cosmological associations that different Mesoamerican head forms once held. Romano establishes some of these connotations in a Preclassic "olmecoid" skull from Pampa el Pajón for example (Romano 1977, 1980), which he interprets as manifestations of ideologically conferred beauty ideals expressed in Olmec imagery. Also, the strong superior flattenings in skulls from El Zapotal (Romano 1977) and the conical head shapes of the Huasteca (Romano 1987) are interpreted in terms of visible assimilations of native sacred entities.

On a more technical note, Romano affirms that Mesoamerican compression gears correspond almost exclusively to rigid devices and it follows that cradleboards and head splints could be combined to produce "mimetic" shapes, their compression effect sometimes being enhanced with horizontal (pseudocircular) or sagittal constriction, the latter being designated "bilobular variety" (Romano 1965, 1973). His distribution map of cranial shapes within the confines of native Mexico, published in 1974, is supported by a review of the literature and his own studies of the voluminous skeletal collections curated in the National Museum of Anthropology.

Also, scholarship—north of the Mexican border—has contributed importantly to the study of Mesoamerican cranial modifications. Seminal work has been conducted, for instance by T. Dale Stewart. Among his work on the topic counts his early treaty, titled Human Skeletal Remains from Dzibilchaltún, Yucatán, Mexico, with a Review of Cranial Deformity Types in the Maya Region (Stewart 1943b, 1953, 1975), published in 1975. In this work, the author compares artificial head forms between different time periods and between regions and concludes that the distribution of head forms varies significantly between the times. Comparing the scholarly approaches from both sides of the border, the lack of integration between local work and international studies becomes apparent. This separation is underlined by the irreconciliable classifications employed in documenting head shapes. Still today, the international community has only reluctantly adopted the prominent Mexican classification system, based on Imbelloni's taxonomy (Duncan 2009; Duncan and Hofling 2011; Saul 1972). A noticeable lack of cross references between Hispanic, French, and Anglo-Saxon publications on Mesoamerican head shaping has come to limit the amount of comparable data, a restriction already voiced by Stewart (1975; see also Gervais 1989; Tiesler 2012b).

Apart from language barriers or national boundaries, the bioarchaeological study of Mesoamerican head shaping is surely also restrained by the degree of deterioration, which usually affects organic substrate, such as bone much more than most inorganic remains and translates into a lack of analytical possibilities and reduced sample sizes available for study. Also the topic's interdisciplinary quality challenges any academic coverage. Placed at the point between physical anthropology and archaeology, biocultural or bioarchaeological studies on head shapes depend both on contextual information and the anatomical knowledge of the observer. In research practice, this disjunction has resulted in the separation or omission of findings on head-shaping practices from those derived from mainstream archaeological research. Many archaeological site reports do not mention head-shaping practices or distinguish them only in the dichotomic terms of presence vs. absence even if quantifiable.

4.3 Classifying Ancient Mesoamerican Cranial Forms

The following paragraphs summarize the classification scheme currently used in Mexico, which goes back to the work of Argentinian anthropologist José Imbelloni (Dembo and Imbelloni 1938, pp. 258–259) and whose taxonomy is presented in an adapted version in Table 4.2. Although not suitable for describing the most complex annular shapes, such as those common in Europe, Melanesia, or Africa, it benefits the classification of most tabular modifications in the Americas and specifically in Mesoamerica. The classification system facilitates assumptions of modeling techniques from the formal properties. Tabular compression is distinguished categorically from annular forms, accomplished by constriction bands, single strings, bandaging, or tightly fitted hats. Conversely, tabular modifications are associated to rigid compression devices (Dembo and Imbelloni 1938, pp. 289–303). According to Imbelloni's scheme, head splints result in tabular oblique shapes with their characteristic backwards inclination showing parallel compression planes (Fig. 4.4a). Cradleboards (or body kits) determine the tabular erect type and its corresponding shortened head forms (Fig. 4.4b). This association does not exclude the possibility of obtaining oblique forms by cradling or, inversely, erect shapes from head splinting (Romano 1974, p. 204). Sometimes, more than one compression implement was used, and therefore the formational effects on the skull vary accordingly. Also, the duration of compression and the applied pressure determined the severity of formal changes in the skull cap, ranging from invisible to extreme.

4.3.1 Visual Recording and Craniometrics

To characterize and comprehend the artificially produced changes in skulls, both formal (visual and craniometric) and procedural (technical) criteria are relevant. Useful points of departure in studying cranial vault modifications are standardized descriptions of the presence, extent, and anatomical relationship of each flattening. In this endeavor, the definition of contours (straight, convex, or concave) and the degrees of compression (ranked in each plane and assigned to the overall alteration) facilitate distinctions of cultural flattening and their formal qualities. Apart from the flattened areas, associated attributes, such as bilateral bulging vs. reduction of bilateral width, suprainiac impressions, assymetry, and postbregmatic changes, provide complementary indications on ancient head-shaping procedures. Graphic representations of the overall cranial silhouette in sagittal, vertical, and dorsal schematic drawings are enormously helpful to visually comprehend the head shape. This careful assessment facilitates the assumption of technical procedures and classification

Table 4.2 Taxonomic criteria, adapted from Dembo and Imbelloni (1938, p. 275)

Type	Distinctive compression technique	Degrees (0–4)	Distribution of compression (in degrees ≤ 3)	Circular wraps (0–3)	Sagittal constriction (0–3)
Tabular oblique modification	Fronto-occipital compression with help of head splints	Extreme (> 3)	Intermediate	Absence	Absence
			Occipitally curved	Presence of horizontal constriction (pseudocircular)	Presence of band (> 0–2)
			Frontally curved		Bipolar separation (> 2)
		Intermediate (≤ 3)	Parallelepiped (or obelionic)		
			Mimetic		
Tabular erect modification	Posterior compression in supine position	Extreme (> 3)	Intermediate	Absence	Absence
		Intermediate (≤ 3)	Occipitally flattened	Presence of horizontal constriction (pseudocircular)	Presence of band (> 0–2)
			Frontally flattened Parallelepiped (or obelionic)		Bipolar separation (> 2)
			Mimetic		
			Conical		
Annular modification	Symmetric annular constriction through elastic bands or wraps	No information	No information	No information	No information

To avoid conflation, all varieties in this scheme are subdivided in four columns according to their criteria of distinction (severity, form, presence of circular constriction, presence of sagittal constriction)

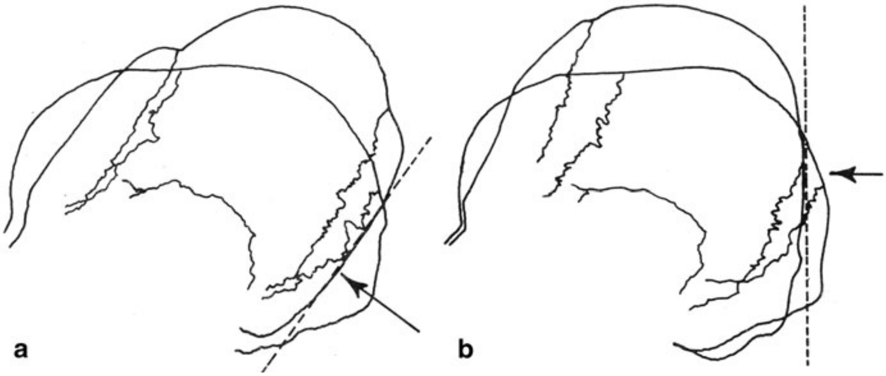

Fig. 4.4 Compression vectors in the **a** tabular oblique modification and **b** tabular erect modification (adapted from Dembo and Imbelloni 1938, p. 250; drawings by V. Tiesler)

assignment. Given the complexity involved in reconstructing living practices from organic substate, it is clear that all classification efforts cannot be more than encouraging approximations toward understanding broader patterns and behaviors sustained by the ancient head-molding practitioners. No categorical distinction, however well-founded, will be enough to account for the real complexity of the processes involved in head shaping and their expression in the bony substrate. With this cautionary note in mind, the following paragraphs make a set of general criteria available for distinguishing head shapes and for surmising modeling techniques from the skeletal record.

4.3.1.1 Basic Modification Types

Apart from the *annular* (artificial orbicular) type, the taxonomy developed by José Imbelloni identifies two basic types of modification: *tabular oblique* and *tabular erect shapes* (Fig. 4.5a, b). Annular head forms produced exclusively by infant head constriction constitute one of these groups, which are either erect or oblique and always lead to a round cross section of the cranial vault and to its reduction in bipolar width. In Mesoamerica, the oblique annular form has been documented in Western Mexico (Gómez-Valdés et al. 2007, pp. 121–122). However, bandaging must also have clearly dominated the practitioners' constriction routines among those groups who practiced cradling or head splinting. These cases are called "pseudocircular" in Imbelloni's taxonomy and will be described in Sect. 2.3.1.3.

Regarding the two tabular types, they are differentiated by their final appearance in the cranium: in tabular erect shapes, the opposing compression planes are usually not parallel to one another due to the position of the posterior plane which tends to cover *lambda*. Here, front-and-back flattening results in a high and broad configuration of the cranium (brachycephalic) when not combined with lateral constriction. In *tabular oblique* shapes, the posterior compression plane centers on the occipital bun or inion crest, situated below *lambda*. The back compression vector opposes directly

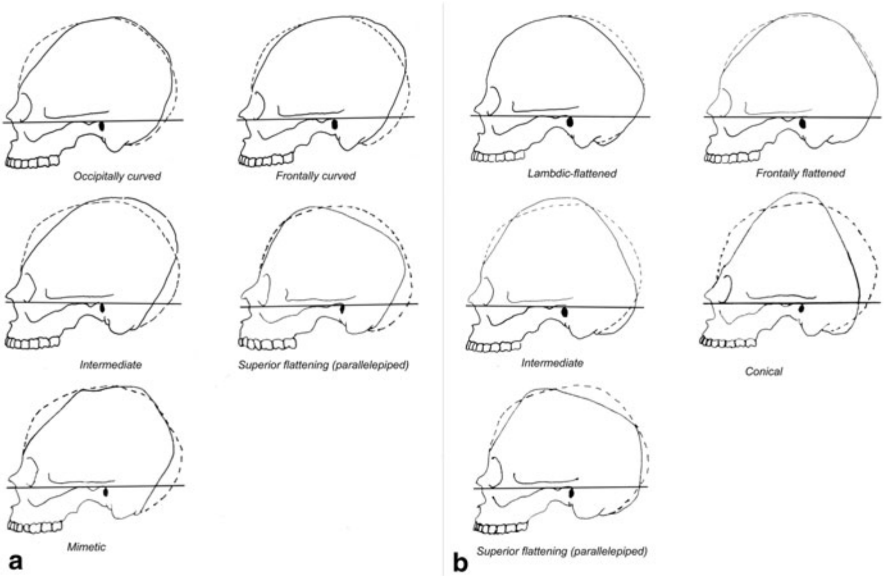

Fig. 4.5 Different formal varieties of tabular oblique modifications (a) and tabular erect modifications (b) (drawings by V. Tiesler)

the frontal vector of mechanical force, commonly resulting in the parallel orientation of both planes and a backward inclination of the cranial vault.

Typical expressions of tabular oblique and erect types were coined by Imbelloni *intermediate variants* of anteroposterior compression. In these classic forms of tabular oblique and erect modeling, both compression planes (front and back) are visible and are shown to a similar degree. In Mesoamerica, most intermediate forms of tabular oblique and erect head shapes describe moderate to severe forms of artificial modeling. Imbelloni's category of *extreme* modifications also matches this touchstone of balance. In this case, both compression planes are expressed in their highest possible degree of modification, being the final result of the daily pressure applied and the yearlong span of compression (see Chap. 3).

4.3.1.2 Craniometry and Landmark Studies

In complete skulls, the morphological findings and their classification and technical interpretation are confirmed and complemented metrically. To this end, cranial landmarks are commonly recorded and now digitalized prior to statistic processing (Barrientos and L'Heureux 2009; Béguelin et al. 2006; Clark et al. 2007; Gómez-Valdés et al. 2007; Manríquez et al. 1884; Pomeroy et al. 2010; Pérez et al. 2009; Rhode and Arriaza 2006). Most of these measurements, which are recorded using 3D digitizers, craniophores and/or callipers, are designed to distinguish presence from absence of cultural flattening and to differentiate general head types. In Latin America, systematic metric evaluations of artificially modeled skulls go back to the efforts by Falkenburger (1938) and Imbelloni (Dembo and Imbelloni 1938). Early work proposed the vertical and horizontal foraminal *clivus* angles as convenient classificatory parameters to distinguish different forms of tabular and annular modification. Also, the angle between basion-nasion and its cord toward *vertex* (highest point on the cranial vault) is considered a useful metric parameter to establish the vault's degree of backward inclination and therefore the type of head modification (Romano 1965; Fig. 4.6a, b; Table 4.3)

Other distinctive morphometric traits used in current research include the anatomical location of the apex and the distance of the opistocranium from lambda and opistion (Tiesler 1999). Proportional measurements of bilateral width provide indications on bipolar constriction vs. bilateral bulging. The angle between the Frankfurt Plane and orientation of the occipital aperture provides an indication of basicranial bending (see Chap. 3), while the angle established between the Frankfurt plane and the cord between *porion* and *vertex* expresses the level of cranial inclination in relation to its highest point. In tabular erect types, this point is located above or below the compression plane, while in oblique and mimetic specimens it tends to be located in the area of compression.

Recent approaches have also successfully used multivariate calculations of cranial landmarks and distance measurements to evaluate either continuous change in skull form or to examine and compare the morphological features of previously assigned modeling types in subscribed areas in Mesoamerica and South America (Gómez-Valdés et al. 2007; Pérez et al. 2009; Pomeroy et al. 2010; Rhode and Arriaza 2006). Also on a more general level the sophisticated digital measure meuts of coordinates, angles and cords, aligned according to the culturally flattened areas of the cranium, offer useful objective tools to distinguish the vault's shifts, bulges and reductions, reclination and heightening (see Fig. 8.2).

4.3.1.3 Varieties of Tabular Oblique and Tabular Erect Shapes

Not all anteroposterior compressions fall clearly into the two basic tabular categories described above. Some specimens may instead show characteristics that identify both erect and oblique attributes. Imbelloni describes these hybrid forms as *tabular mimetic* or "cranial specimens that share their formal characteristics with the family to which they belong, but also manifest accessory attributes that make them visibly similar to another type of modification" (Dembo and Imbelloni 1938, p. 277). Such is the case when more than one compression plane is observed in the back of the skull.

In Mesoamerica, most mimetic modifications are expressed in this form in fact. In these specimens, the superior area of posterior flattening typically suppresses the surface around lambda, whereas a second, inferior compression zone flattens the central and lower portions of the back of the skull. When both occipital compression planes are combined in a sagittal drawing to generate one single composed line of posterior compression, this is almost always reclined and finds itself roughly parallel to the anterior compression plane, as described for the tabular oblique category (see Fig. 4.5a). In fact, the contour of the mimetic cranial vault, modified in the

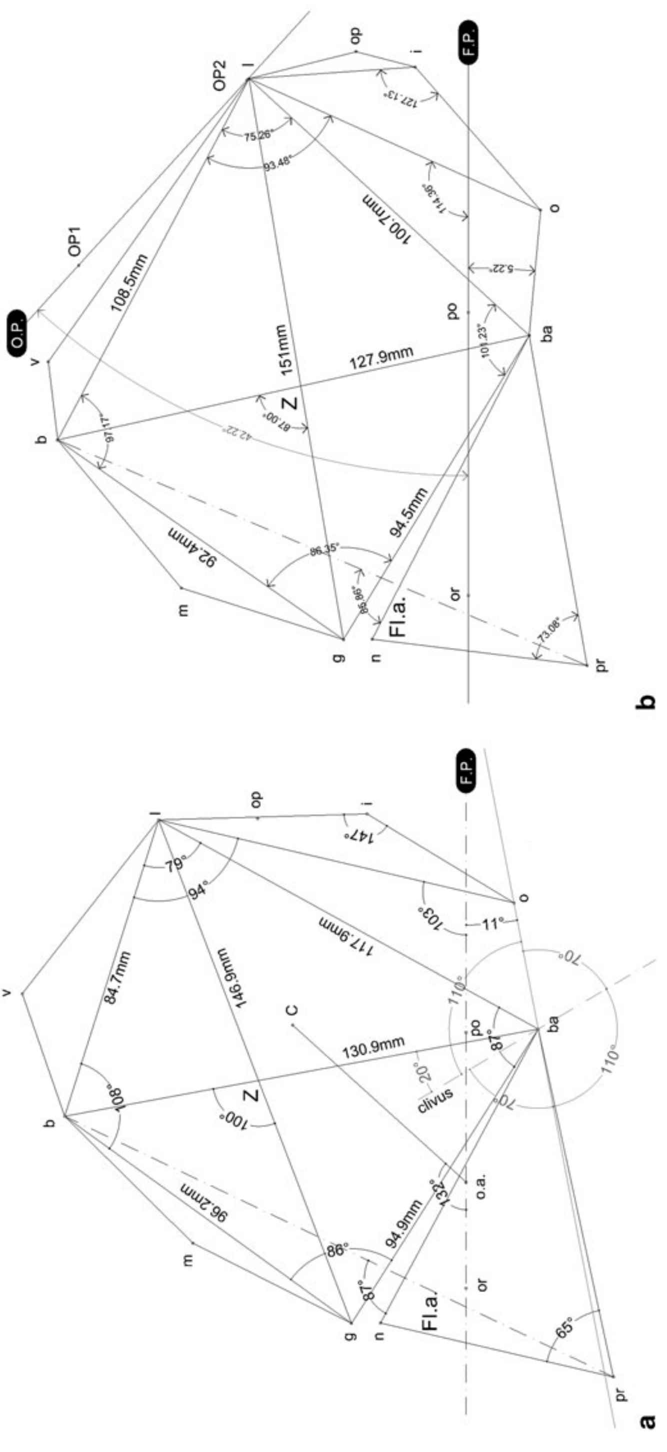

Fig. 4.6 Klaatsch quadritateral on skull with corresponding measurements, obtained from digital 3D landmark recording of different artificial head shapes **a** Tabular oblique, **b** Tabular erect with superior flattening (measurements and digital drawings by J. Gómez-Valdés)

Table 4.3 Metric parameters in distinguishing different types of pre-Hispanic Maya cranial modifications

Parameters	Tabular erect[a] (N: arithmetic average ± standard deviation)	Tabular oblique[a] (N: arithmetic average ± standard deviation)	Total[a] (N: arithmetic average ± standard deviation)
Foraminal *clivus*	26: 52.71 ± 11.15	5: 60.75 ± 12.09	36: 152.67 ± 9.50
Horizontal *clivus*	9: 56.61 ± 6.11	2: 52 ± 0	14: 54.61 ± 6.10
Vertical *clivus*	9: 22.17 ± 4.34	2: 33.50 ± 9.19	14: 25.68 ± 7.40
Angle of reclination with *vertex* as reference point	10: 109.75 ± 5.25	2: 123.25 ± 7.42	15: 113.47 ± 7.78
Angle of reclination with *opistocranium* as reference point	9: 173.22 ± 7.79	2: 161.25 ± 3.89	14: 168.5 ± 10.23

[a]Only adult crania were included

described form, achieves a posterior inclination that is characteristic of all oblique modifications. Craniometry appears to confirm this association on most mimetic skull silhouettes, the proportions and angles of which approach or even exceed the arithmetic averages assigned to the tabular oblique category (Tiesler 1999, pp. 212–213). It follows that mimetic modifications of this sort should be comprehended as a formal variety of tabular oblique shapes rather than a separate type.

This oblique mimetic configuration, which dominates in many Classic Maya collections, is different from other mimetic skull contours, which appear broader and less inclined and therefore seem to stem from cradleboard use instead of free head compressors (Fig. 4.5b). In the latter case, both posterior planes are centered around, or even above, lambda, although they do not encompass much of the parietal surfaces of the upper skull vault, which distinguishes them from skulls with obelical or superior flattenings. It is significant that there are still other *mimetic* head forms, although there are few that do not fall within the oblique or the erect categories. Maybe, the latter express the combination of separate rigid devices on the infant head. Naturally, for the observer, these undefined "tabular" specimens also signal the practical limitations in determining modification techniques from head morphology alone. From all of the above, it seems wise to consider "mimetic" skull shapes not as a separate entity but rather as variants of either tabular oblique and tabular erect types, depending on the inclination and technique used (Dembo and Imbelloni 1938, p. 275).

A variety that is similar to mimetic forms equally implies the implementation of a third compression plane; however, this additional area of complression is not situated on the back of the head but flattens its top (Fig. 4.6b). In this case, the superior plane usually covers the majority of the sagittal cord and often leads to postbregmatic bulging in front. In its severe expression, the entire upper parietal area (from bregma to lambda) appears flat, acquiring the contours of a round, flat plate. This specific shape has been coined *obelical, obelionic* "Zapotal" type, parietal or *superior flattening* by scholarship (Dembo and Imbelloni 1938, p. 273; Martínez 2009; Nelson and Mandimenos 2010; Romano 1973, p. 59; Stewart 1939; Tiesler et al. 2013, p. 55). The description of this morphology closely resembles the tabular erect *parallelepiped* variety that Imbelloni's system characterizes as a cubic (or parallelepiped) appearance of the head (Dembo and Imbelloni 1938, p. 273). Unfortunately, Imbelloni's original definition leaves doubts on whether this form (apart from its front-and-back reduction) is limited to a single superior plane or if additional bilateral compression was used in order to ensure a more cubic appearance. This ambiguity and the discrepancies with Falkenburger's (1938) diagnostic angles led Arturo Romano (1973, p. 59) to substitute the term "parallelepiped" in favor of "superior flattening" in his study on skulls with strong superior flattening from the site of El Zapotal, in the state of Veracruz. More recent work has returned to the original term (i.e., parallelepid) to assign superior head flattening, because these resemble the cubic formation that results from the combined application of anterior–posterior and superior pressure (Tiesler 2012a; Yépez 2001).

Similar to mimetic skull shapes, some forms of superior flattening appear on reclined skulls which show approximately parallel compression planes, associated with free head-compressor devices and the tabular oblique type. Other specimens that show the superior compression plane appear to stem from cradling instead, as is likely the case of the skulls from El Zapotal. Their foreheads do not show any backward inclination and, when the cranial polygon is drawn and craniometric landmarks measured, their discriminant values align with erect, not with oblique head types (Fig. 8.2; Tiesler et al. 2013, pp. 59–60). However, also in the case of the "Zapotal" like obelionic flattenings in the Mixtequilla area and as a generic form, there is controversy in the literature as to the device responsible, which some authors hold to be head splints (Martínez 2009; Nelson and Mandimenos 2010), and others to be cradleboards (Stewart 1939; Tiesler et al. 2013). An enlightened opinion on the devices responsible for parietal flattening is provided by T. Dale Stewart (1939, p. 464–465), who comments on crania from Southern Florida, which is worth transcribing at length here.

> "Except where [head modification] is caused simply by the weight of the head upon a hard surface, some intentional pressure must be exerted to hold the head against the [compression] surface. In the present case the point of counter pressure appears to be the chin or some part of the anterior trunk. Perhaps, therefore, the child was bound to the cradleboard in such a way that the head was pressed against an inclined endpiece. This view seems more logical than that which envisions a bandage passed under the chin, for the simple reason that the latter mechanism would have deformed the jaw also," and, as the author is quick to point out "there is no evidence of this in the present collections" (Stewart 1939, pp. 464–465).

So, to the point, given the diverse formal criteria of top flattened heads, it is most likely that superior flattening was reproduced both by tabular oblique and erect techniques, leading to different degrees of head reclination and distinctive anatomical distributions of compression planes (Fig. 4.5). Grégory Pereira (1999) comes to a similar conclusion after examining cranial collections from pre-Hispanic Western Mexico and separates top-flattened reclined skulls from unreclined ones on the basis of technical differences in compression devices. Both top-flattened forms appear to have made their appearance in the Mesoamerican cultural repertoire in the latter part of the Classic period (Pereira 1999; Tiesler 2012a, b; Tiesler et al. 2013).

Apart from mimetic and obelical varieties, there are other tabular head formations. These evaluate the expression of each front-and-back compression plane with each other. According to Imbelloni's system, *occipitally curved* and *frontally curved tabular oblique* varieties imply that the cranium is round and convex in this part, while a more pronounced, usually straight of concave compression plane and compare them is observed on the opposite side. Similarly, *frontal* and *lambdic flattenings* are distinguished in *tabular erect morphologies*. These imply that the plane in question is noticeably more defined or more pronounced than the opposing posterior or anterior compression plane. The four variants described here usually relate to slight or moderate degrees of cultural modeling, although they also may occur in severe forms of shaping. The four varieties have in common that, when compared, the front-and-back planes are expressed to a dissimilar degree. This becomes apparent when the extension of both compression planes and their contours are compared with each other (straight, convex, or concave). Unfortunately, there are no established specific measures in the literature that distinguish each of the above varieties metrically.

Although not described in the classification system by Imbelloni, a particular expression of tabular erect head shapes gains relevance in the Mesoamerican cultural sphere and deserves mention. In this form, both compression planes include an important parietal component. Frontal flattening reaches bregma or may extend beyond this point, while posterior flattening is centered over lambda and expands across at least half of the parietal chord. Converging in the postbregmatic area, both planes produce a *conic form* when observed in profile, which recalls Romano's (1980) characterization of Huastec sculptured portraits from Tamuin. The "roof-like" appearance, described here, should not be confused with the conical shape assigned to annular variants by Imbelloni, which implies bipolar constriction and therefore reduction (Dembo and Imbelloni 1938, p. 276; also see Yépez (2006) for the conic shapes identified in the Andean region).

4.3.1.4 Annular and Sagittal Grooves

Annular wraps and sagittal grooves appear abundantly in the Mesoamerican skeletal record. In contrast to Imbelloni's original taxonomy, I prefer to treat these as a separate third classification category to avoid confusion with other variants with which they may concur. Regarding narrowed head forms, these make up one group of artificial head forms in the taxonomy established by Imbelloni (Table 4.2) and have already been briefly described above. In Mesoamerica, pure annular forms are very rare, although flexible devices clearly combine with rigid head compressors in subscribed areas of practice, such as the Olmec-dominated Isthmus areas, the Maya Usumacinta Basin or parts of the Gulf coast during the Classic period (Tiesler 2012a, b; see Gómez-Valdés et al. 2007). Here, many of the severely elongated skulls acquire a tubular form and are clearly reduced bilaterally, a point to be taken up in the next section. But also where rigid compressors were used, bands and ribbons, semirigid pads or cushions—once adjusted on the head—would tighten and mediate the pressure of compression boards or complement their compression effects on the skull. When expressed on the skull, this complementary constriction defines the *pseudocircular* variety of tabular types.

A second form of constriction secondary to tabular compression is referred to as *bilobed* or *trilobed* in Imbelloni's taxonomy and is produced when a tight band connects the front-and-back planes over the top of the skull. Its basic expression consists in an isolated sagittal sulcus that divides the posterior portion of the parietal bones visibly into two lobes. When this sort of cranial adjustment is severe and prolonged past fontanelle closure, a postcoronal furrow may ensue as a physiological consequence of altered growth (see Sect. 3.2.2), giving the final shape a trilobed appearance when observed from above. The so-called trilobed skulls have been a preferred subject of academic interest during much of last century and have lead to several case studies on Mesoamerican skull colections, such as the Mexican Gulf Coast area (Comas and Marquer 1969; Dávalos 1965; Stewart 1948). One head shaper possibly responsible for the sagittal ridges is shown in a Maya figurine from El Salvador (Cavatrunci et al. 1992; Fig. 4.7). The tablet on the forehead, which is similar to that used recently by Peruvian *shipibo-concibo,* appears to be held in place by an occipital band and a sagittal strip that runs over the top of the head.

4.4 Head-Shaping Devices in Ancient (Meso) America

The taxonomy of Imbelloni associates each morphological type to a specific head or body implement. Head splints produce tabular oblique formations, while tabular erect forms are interpreted as the result of cradling (Dembo and Imbelloni 1938, pp. 289–303). Naturally, in practice, this correlation is not a categorical one, as oblique head forms may be obtained also by use of cradleboards depending on the support beneath the occiput and collocation of the frontal plane. Inversely, erect shapes may also be the product of head splinting, as has been argued for the case of the narrow and high head forms of Olmec traditions (Romano 1974; Tiesler 2010). Even within each type, variation in the apparatuses, or additional constriction with strings translate into diverse appearances. When an occipital head board is held in place by strings around the forehead, a frontally curved tabular oblique form will result. When the posterior plane is part of a cradleboard device and tied in front, the tabular erect modification is identified with its lambdic variety (Dembo and Imbelloni 1938).

On a more general note, cushions inserted beneath the compression board produce depressions in the flattened surface, while the joint application of free boards with circular bands results in what is called "pseudoannular" or "pseudocircular" tabular shapes (Romano 1965). In many cases, it appears that more than one compression implement was used, as was already argued for mimetic head shapes. Also, the duration of compression forces and the pressure applied introduce diversity as they condition the visibility of formal change, ranging from invisible to extreme.

The following paragraphs will complement the information on artificial head forms by discussing different implements used in the Americas and specifically in Mesoamerica, where numerous figurines from different times and cultural regions decode for us the technical specificities of this practice. Each of these implements

Fig. 4.7 Head splint displayed by Classic period Maya figurine (The Museo Popol Vuh, Universidad Francisco Marroquín, Guatemala; adapted from Cavatrunci et al. 1992; drawing by B. Ceballos)

will be cautiously related to the anatomical location and morphology of flattened or constricted surfaces and put in context with the classification of head formations that these implements presumably produced.

4.4.1 Cradleboards

In most parts of the American continent, cradleboards or cribs once carried babies during their first few months of lives (Dembo and Imbelloni 1938; Dingwall 1931; Mason and Porter 1889; Romano 1974; Weiss 1961). These carriages basically consisted of a framed backboard, which could be padded with soft plant fibers. Cradleboards could also include foot- or buttock-rests. Hoods over the head of the infant would provide protection against the cold, sun, wind, or rain and provide a candy frame for cloth and other shields. Surrounded by lateral contentions, rims, or head pieces, the crib would protect the little also from the exterior toward each side (Fig. 4.8).

Safeguarded this way, the infant would rest in an extended supine or prone position, firmly strapped to the support with cords or strips of cloth. Thus, cradleboards

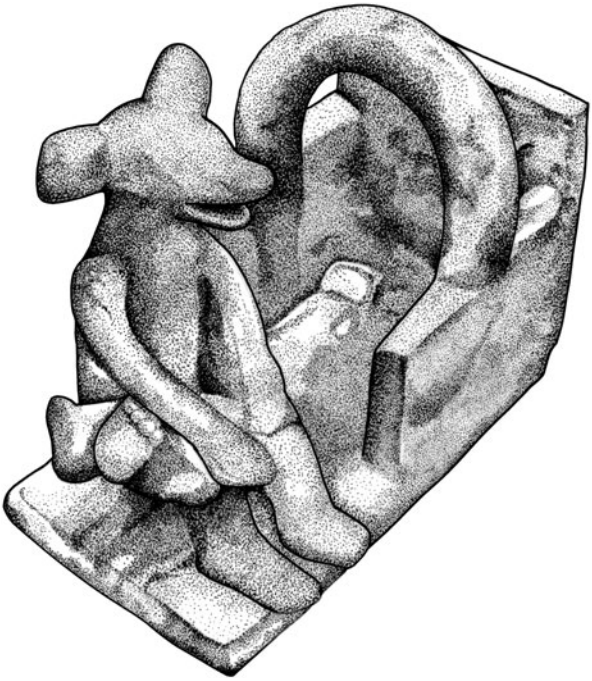

Fig. 4.8 Figurine representations of crib device with handles and side protection, Cempoala, Veracruz (adapted from figurine exhibit of the National Museum of Anthropology/INAH, Mexico City; drawing by B. Ceballos)

usually confined the mobility of babies and at the same time protected them without impeding day-to-day feeding and cleaning by their caretakers. As multipurpose kits, cradleboards were employed also as head compressors. To serve as a modeling device, the headpiece of the cradleboard needed to incorporate two juxtaposed compression planes. Often, the backboard itself or an inserted ring-shaped roll or pad squeezed the head from beneath. The opposite upper plane could be either flexible or rigid and was usually tied directly to the backboard. This compression mechanism usually produced lambdoid flattenings or visible front-and-back reductions of the infant head, expressing the classic tabular erect category developed by Imbelloni. Here, the baby could be tied to the cradleboard in such a way that the head was pressed against the bottom plank, sometimes also against an inclined endpiece, potentially producing the top-flattened head forms known from parts of Veracruz, from Florida and the Southwestern USA and Panama and Chichén Itzá (Nelson and Mandimenos 2010; Stewart 1937, 1939, 1958; Romano 1977; Tiesler 2012a; Tiesler et al. 2013),

Unlike further north or south, concretely in the Andes, no secured body compressors are known for pre-Hispanic Mesoamerica. Instead, its many ceramic sculptures bear witness of cradleboard lore and at the same time inform about head-shaping procedures. Many cradleboard scenes are depicted in the form of naturalistically sculptured pairs of infants and their female caretaker. The cradleboard may rest on the lap of the woman, in her arms or over her shoulder. Some children are being nursed, others are attended by mystical beings while resting inside the cradleboard (Fig. 4.8). Their shape and equipment identify many of them more as steadfast pieces of furniture than mobile carriages (Fig. 4.9). Most appear to be small but bulky cribs, some of which stand on legs. Stiff footrests, hoods and body straps, lateral restraints, handles, or protective hoods over the head and leg area of the infant complement the baby kits. It is assumed that those cradleboards in the figurative record that appear more austere and compact were employed for daily transportation during daytime errands. It is also noteworthy that many of the cradleboard sculptures originally functioned as whistles or flutes, suggesting their uses either as children's toys or as instruments that accompanied infant transition rituals, as argued elsewhere (Tiesler 1999, 2012a).

The above descriptions characterize ancient cradleboards as multifunctional care units beyond doubt, most of which facilitated child protection, immobilization and care. The Mesoamerican folklore images also illustrate some of the compression procedures involved. Tablets or thick strings of cloth cover the forehead of the little one and appear to squeeze the baby's head (Fig. 4.9). Some heads rest on cushions; others are wrapped or carry head compressors that are not directly attached to the cradleboard itself, as several scenes from Teotihuacán demonstrate (Fig. 4.10). In still other figurative settings, a female caretaker hovers over her infant and appears to manipulate its head with her hands. Hence, the depicted settings show a broad range of compression mechanisms, ranging from hand pressure to free head wraps and splints, and to proper cradling, when the compression was conditioned directly by the backboard. Lambdic flattening likely stems from tying the forehead back to the body board. More severe intermediate or extreme erect shapes must have relied on a rigid frontal tablet. Bilobal reduction is conditioned in this process by lateral constraint in the form of complete head wrapping and its side stringing, manifesting pseudocircular shapes. Cushions on the infant forehead are sometimes depicted and may have led to depressions within the flattened area.

Still other questions concern the orientation of the child's head within the crib, which is shown to look sideways and up and backward in some scenes. Surely, the habitual head posture during the modeling procedure left an imprint on the head: some compressors flattened the back of the head in its upper section, others in its lower part. As already explained previously (Sect. 3.3), the slipping of the head toward one side may have caused the compression boards to shift and produce secondary cranial asymmetry (Björk and Björk 1964; Dembo and Imbelloni 1938; Kohn et al. 1995). More than the head apparatuses, cradleboard straps are at risk of becoming loose and side-slipping by opposing the natural movements of the baby's head and body. Their crib's additional uses in infant transportation, cleaning and nursing, in all probablility still increased the chances of slackening (Dingwall 1931; Gervais 1989; Romano 1974).

4.4.2 Head Splints

Free head splints with a clamp-like effect usually bear different results from those obtained by cradling. In contrast to compression cradleboards, head apparatuses do

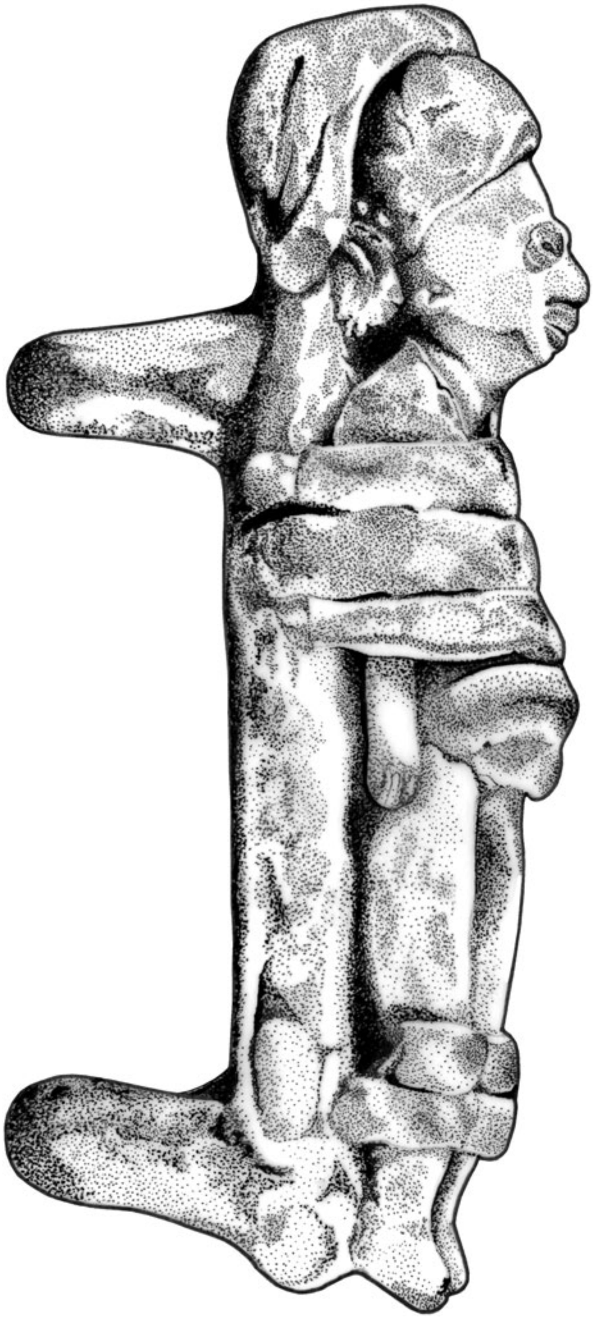

Fig. 4.9 Figurine representations of crib device with legs, Western Mexico (MNA/INAH; redrawn by B. Ceballos from courtesy photograph by A. Romano)

not affect infant mobility during use. Here, the fundamental compression mechanism consists in compressing the skull between two free boards that are allocated on opposite sides of the head and tied together firmly, often resulting in two flat planes that

Fig. 4.10 Figurine representations of infant cradle held by adult female. Note that the baby is compressed by head splints inside the cradle (Teotihuacán, Veracruz; adapted from Musée de Quai exhibit, Paris, France; drawing by B. Ceballos)

are approximately parallel to each other (Fig. 4.4a). The produced overall formation of the vault is typically broad and inclined backwards. That is why the classification system by Imbelloni identifies this technique with the tabular oblique type.

Head splinting was constrained to certain areas of Mesoamerica and on the whole was practiced much less in native lore than cradleboarding. Accordingly, head compressors are much less represented in the pre-Hispanic imagery than compression cribs. The former appear mostly in Classic period figurines from Teotihuacán, the Gulf Coast and the Maya area, where different forms of head elongation were in vogue (Fig. 4.11). Just like the ceramic sculptures of cradleboards, also many of the figurines of children with head compressors originally served as whistles, attesting to potentially similar uses as for cradleboard figurines (Tiesler 1999, 2012a).

In the Maya area, the few portraits of rigid head shapers appear mostly in scenes of female caretakers interacting with their infant. Sometimes, it is a narrow plank, in other cases a broad tablet that is strapped tightly to the forehead by the use of different arrangements of straight or crossed fastenings. It remains unclear in most arrangements, whether there is a rigid implement in the back of the head or if the fastening of the frontal head compressor actually rested on the occipital plane.

The fastening of the front board by occipital constriction, perhaps mediated by cushions, would lead to curvo-occipital forms of oblique shapes, similar to the device still recently employed by Shipibo mothers in Peru. Conversely, inclined mimetic shapes are the likely result when two pairs of upper and lower strings appear to cross over the head and cause a double restraint of the head's back. This arrangement seems to be the most feasible pressure mechanism that is represented in a number

Fig. 4.11 Head board in place on the forehead of an infant that rests in the lap of an eldery woman (The Museo Popol Vuh, Universidad Francisco Marroquín, Guatemala; photo by V. Tiesler)

of Maya figurines (Figs. 4.11 and 4.12; see also Tiesler 1999). In these cases, the resulting head proportions are prone to be restricted in bilateral width when compared to classic all-rigid head compressors, such as the ones from Teotihuacán (Fig. 4.10). These front-and-back squeezers resemble the head supports described by Imbelloni (1933) and Weiss (1961, p. 4) for the Andean Humahuaca or Lambayeque.

A further question concerns the role of head splinting not in elongated oblique head shapes but in high and narrow head forms, assigned by Imbelloni as pseudocircular tabular erect shapes (Dembo and Imbelloni 1938, p. 292). These play a role in ancient Lambayeque culture, where erect head splints have been represented as a large occipital board that is fastened to the forehead by slings that cross over the sides and the top of the head. This device is shown to result in a shortened cranial vault. In the Mesoamerican pictorial record, similar headwear appears frequently in Olmec and Teotihuacán subadult portraits, although, it cannot be distinguished beyond doubt if the headgear was functional or purely ornamental. We remind that head compressors often appear similar in style and shape to the headgear worn by grownups in the Mesoamerican figurative repertoire. This is obvious in Teotihuacan, for example, where long flat pieces of board are carried by many female adults the same way as they appear adjusted on their infants' heads. If we believe the figurative record, infant head splinting was performed in Teotihuacan, while the babies rested in their crib. Also, the artists of the Maya Usumacinta basin would sometimes copy the mother's head gear in her infant's outfit, as smallscale figurines appear to communicate.

Still unique is the ceramic Mesoamerican head compressor that has been published recently by Carlos Jácome et al. (2013, p. 8) for of El Tropél, Colima. This is an archaeological site in Western Mexico that had been settled during the Pre-Classic or Classic period. Among the recovered burias lay a one and a half old infant in a

Fig. 4.12 Infant head board on infant sitting on the hip of a female caretaker (The Museo Popol Vuh, Universidad Francisco Marroquín, Guatemala; photo by V. Tiesler)

lateral prone position. Still in place rested what the authors hold to be a ceramic head compressor. Indeed suggestive is the peculiar form of the artifact, which adapts to the artificial curvature of the neck. Upon discovery, it was still in touch with the little one's neck. In the living baby and toddler, this ceramic valve should have been suitably pressed against the occiput by help of straps or bandages (see also Fig. 2.13).

4.4.3 Wraps and Strings

When constriction complements front-and-back rigid constraint, Imbelloni (Dembo and Imbelloni 1938) speaks of *pseudocircular* varieties. The complementary annular compression of the skull is accomplished with bands, belts or strings of cloth that are either attached directly to the compression boards, as described above, or may have been applied separately during the shaping procedure with the infant. Possibly, tight wraps maintained the visible result of the modeling process and avoided physiological growth re-compensation after the compression boards had been removed (Sect. 3.2.7). This is suggested at least by the Classic period Usumacinta iconography around Bonampak and Palenque, which shows toddlers who frequently wear a head wrap sitting on the hip of their female caretaker (Miller 1995, pp. 52–53; Fig. 4.12). In the Maya figurative repertoire, these horizontal wraps appear again similar in style and shape to the headdresses worn by adults and therefore we do not know if they are adornments or had a constricting role in infants. Imbelloni describes pseudocircular forms in tabular erect and oblique formations (Dembo and Imbelloni 1938, pp. 271–272). In Mesoamerica, the pseudocircular erect shapes characterize for example the pear-shaped "Olmec" head form, which visually divides the vault into an upper and lower part. The mechanism for producing this pear-shaped head formation is still under discussion and both body and head compressors are cited as Olmec devices (see Chap. 7). Lastly, also secondary sagittal bands can create bone furrows or grooves, which visually divides the vault into two hemispheres on the level of the sagittal and/or coronal sutures and has been described as part both of cradling and head splinting (Comas and Marquer 1969; Imbelloni 1933; Weiss 1961; Yépez 2006).

4.4.4 The Role of Suprainiac Depressions

Related to head modeling also are the round depressions and grooves that are frequently observed in the central part of the occipital squama of pre-Hispanic cranial series. They have been described in the literature either as suprainiac depressions, occipital lytic lesions or trephination marks (Curtin 2007; Holliday 1993; Kato et al. 2007; Lagunas 1974; Stewart 1976; Tiesler 2006; Weiss 1981). In Mesoamerica, where these marks are common, they are closely related to cranial modeling, although some few specimens with suprainiac lesions have been documented also in naturally curved crania (Tiesler 1999, 2006). Usually, these indentations appear right above the occipital eminence and vary widely in depth, contours and extensions. Some are shallow and hardly visible on the bony surface, whereas others are deep, their borders being clearly delineated.

There are also documented cases of symmetrically paired, geometric lateral depressions that appear on both lateral wings of occiput and the parietals right above (Fig. 4.13). Their geometric outline and paired appearance suggests they were imprints of the protruding margins of a posterior compression tablet. Other more centrally located occipital depressions appear either directly beneath the occipital flattening (Lagunas 1974; Tiesler 2006; Weiss 1981; see also Romano 1975 on a different case of vault thinning fom Teotenango, Mexico State). Interestingly, the position of the indentation also may vary according to the vector of the flattening. It is probably no coincidence that the depressions of the external bone plate appear not in the suprainiac area but in the obelical region above lambda in many superior flattenings from Veracruz, implying that the depressions are, in fact, associated to the compression plane by whatever mechanism. Although, there seems to be no direct

Fig. 4.13 Bilaterally situated supra-inial depressions in an elongated skull from Jaina, Campeche (DAF/IANH; photo, V.Tiesler)

correlation, *per se,* between their presence and the type or degree of vault modification by itself, suprainiac indentations tend to be deeper and larger when the occipital bun is severely flattened. Their characteristics also appear to be more noticeable in certain pre-Hispanic areas and sites, suggesting that specific local shaping traditions played a role.

Several suprainiac indentations are pathologically altered, showing healed or unhealed lithic resorptions or periosteal reactions (see Sect. 3.3.2; Fig. 3.8). Some suprainiac lesions penetrate the bone plate above inion completely, which has led to interpreting some of these extreme expressions as the result of occipital trephining in newborns. Decades ago, Pedro Weiss (1967) found similarities between these Mesoamerican suprainiac lesions and probable suprainiac trephinations in several mummified heads from Peruvian Chancay and Chimu, including subadults, in which Weiss observed "scars over the scalp" (Weiss 1981, p. 206, 1967, p. 24–25). He concludes his cultural comparison by assuming that trephining in the form of suprainiac scraping during first infancy was known both among the Andean and Mesoamerican cultures.

This interpretation sparked controversy in the academic community. Authors such as T. Dale Stewart (1967) and Diane Holliday (1993), prefer to regard suprainiac lesions more as the inadvertent results of modeling apparatuses instead. These instruments may damage the compressed soft tissue by generating ischemic ulcers and infections, which are transmitted to the underlying bone, leading to localized necrosis. More recent studies have suggested that extrinsic intervention (although rare), intrinsic reactions, or purely biomechanical forces may condition suprainiac depressions (Curtin 2007; Kato et al. 2007; Tiesler 2006).

Another question concerns the role of head compression mechanisms in the origin of occipital depressions, especially in view of those skulls that bear these marks but are un-modeled. Some authors have argued that suprainiac indentations might be related to—but do not need to be necessarily—a direct expression of cranial compressors (Lagunas 1970, 1972, 1989; Serrano 1973; Tiesler 2006). The latter interpretation aligns with ethnohistorical sources, as the statement by Francisco Paso y Troncoso (1926, p. 25):

> *Se caracterizan por su modesta presencia física, por el color pardo, por los grandes ojos, por la frente amplia, por la nariz, por la nuca plana aunque esta se debe a la acción de los padres [. . .] (ellos) consideran de hecho que sea un indicador de belleza las frentes pequeñas y ricas de cabellos y la nuca prácticamente inexistente que viene comprimida por el obstetra (las parteras) por medio de la aplicación de un peso desde cuando ven la luz, cuando el cráneo es tierno y mantiene esa forma cuando el niño viene depositado supino en la cuna" [. . .].*[2]

The chronicler suggests that midwives applied weights on the occipital eminence immediately after birth and prior to initiating its compression in cradleboard devices. This last scenario would be functional in commencing occipital compression, when taking into consideration the convex shape of the occipital emminence and the resistence of the basicranium which unites with the softer desmal vault on the height of the occipital emminence (Chap. 3). It would make sense, therefore, to prepare a centrally located flattened spot to facilitate the ensuing symmetrical compression of the back in the spot of increased anatomical resistence. I will take up this last idea again in connection with the practices, roles, and meanings in Chap. 6.

In synthesis, it appears that the host of manifestations of suprainiac depressions in different head shapes, sites, and regions, expresses different possible origins, compression techniques used by the practitioners, and day-to-day circumstances. These identify organic biomechanical reactions, as may be imprints of the rigid head compressor itself, or any hard object that may underly it. Others should relate to extrinsic action in the form of conservative cure or trephining; still others should express possible local side effects of the compression process itself.

4.5 Contextualizing Head-Shaping from Archaeological Records

Bioarchaeology is the most suitable approach to deducing broader patterns of past human cultural behavior from artificial skull modifications. This line of research is inherently interdisciplinary in that it examines skeletal remains as part of archaeological contexts (Buikstra 2006). The integration of the human biological substrate from the material record with other sources of information allows bioarchaeological studies to conveniently combine different data-sets, with lenses of approximations according to time and geography. These approximations are facilitated in most cultural

[2] The original Latin version reads: "medioci constant corpais habitudine colore frisco ocuis magnis fronte navibus, plano occiputio, quaquarium parentens hos fiat indishia. . . ad pularitudianaum apectare puntuant frontes parvas et refetas capillis ac fire nulum occipitum quod eneris quo que ferendi causa deprimitus unión cal < varia et teenrrina servatuga en figura sipinis lascatibus in canis. . . "

frames where human vestiges constitute central elements of mortuary assemblages and express the individual of the past as a central analytical unit for exploring collective behavior. Thus, regional bioarchaeological reviews of head shaping embrace wider social structures and dynamic social change by combining and patterning representative cranial series from culturally defined areas of the past. On a smaller scale, cities or communities with documented mortuary records decode local customs and their assimilation or rejection of regional ways of enactment or looks. This idea, in turn, introduces notions of social tensions and change. Still more focused are excavated house units or patio groups, which ideally provide punctual glimpses on head shaping as a family practice and in the cycling of individual lives in their sometimes capricious motions. Specifically eloquent is the decoding of gender expression and their role in child rearing and social integration.

On an analytical level, the variables that distinguish individual and collective qualities related to the head-shaping practices (as materialized in the bony skull), confer importance on vital information from the skeleton, such as sex and age-at-death. To carry out these examinations, bioarchaeology combines techniques, methodologies and concepts derived from physical anthropology and archaeology. The latter tends to assign value to the mortal depositories of the dead and their contents, their location and chronology. In some cultural ambits, he funerary attributes may warrant cautiously drawn inferences regarding the social roles played by the individual before death. In Mesoamerican burial contexts, for example, correlates for vertical and horizontal ascription have been prominently applied to tha study of the mortuary record, either scored by individual contexts or processed as part of a multivariate matrix (Welsh 1988; Wright 2006). As for the Classic Maya, relevant status markers include the presence of tomb architecture, container burials or inclusion of exotic materials, such as ambar, cinnabar, jadeite or obsidian (Krejci and Culbert 1995; Tiesler 1999, p. 106). Naturally, these static attributes cannot be more than simplistic approximations to the complexity involved in the multi-tiered social spheres that characterize most of Mesoamerica.

In conclusion, scrutinizing head-shaping practices from the perspective of bioarchaeology shows even greater potential when examined jointly with additional sources of non-archaeological information, gleaned from health sciences and cultural studies. The first acknowledges cranial plasticity, neurology, growth and morphology while the latter warrants a closer look at ideology and the body, gender, ritual performance, social structure, and even at ancient aesthetics and constructed beauty (Chaps. 2, 3). The feasibility of including non-archaeological cultural data-sets in this type of research, naturally depends on the cultural expressions of the past society under examination, their written record and permanence. In the case of the data-rich Mesoamerican study environment, interdisciplinary cultural generalizations are facilitated by a host of additional fields, like, ethnography, iconography, glyphic, ethnohistorical, and semiotic studies. Here, the combination of the bioarchaeology of head-shaping traditions with other sources of information, are suitable points of departure not only to understand the deeper underlying cultural meanings of skull modifications by themselves. Beyond that, they are capable of tracing the underlying long-lasting social dynamics and cultural and ethnic undercurrents that head shapes may express in the form of variety vs. homogeneity, trends, and continuity, frequency vs. scarcity and social distinction. It is this double goal of comprehending the roles of head-modification practices *per se* and exploring the underlying age, guides, social and ideological trends they express in Mesoamerica (and Latinamerica in general), which sets the stage and tempo of the second part of this volume.

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