## RECONSTRUCTING BEHAVIOR IN ANCIENT CHINA FROM HUMAN SKELETAL REMAINS

Ekaterina Pechenkina, Ma Xiaolin, Jacqueline Eng, Rachel Shoichet, Wei Dong, Zhang Quanchao, Li Xinwei, Fan Wenquan, and Zhu Hong

Ekaterina Pechenkina is with Queens College – CUNY. Ma Xiaolin and Fan Wenquan are at Henan Provincial Institute of Cultural Relics and Anthropology. Jacqueline Eng is with Western Michigan University. Rachel Shoichet is with City University of New York. Wei Dong, Zhang Quanchao and Zhu Hong are with Jilin University in Changchun. Li Xinwei is with the Institute of Archaeology, CASS.

s attested by this paper's long list of coauthors, bioarchaeological research in China involves a substantial collaborative network linking institutions and specialists in zooarchaeology, mortuary analysis, ceramic analysis, as well as physical anthropology. Although the majority of bioarchaeological projects carried out in China over the past decade have focused on changes in community health over time (e.g., Eng 2007; Pechenkina et al. 2007), we would like to underscore the capacity of human skeletal remains to provide evidence that allows for reconstructing many aspects of behavior and for tracking the effects of sociocultural change.

A human skeleton recovered from an archaeological context is an invaluable source of information about the past. While still an integral component of a living person, bone tissue responds to a wide range of external influences, recording many of the events of life. Changes in bones and teeth can be provoked by a variety of experiences, including accidents, display and identity-related practices, acts of cruelty or mercy, certain kinds of occupational-related physical activity—or the lack thereof—as well as by childbirth, aging, the effects of climatic shifts, pathogen invasion, and/or the specifics of food composition, caloric intake, and cooking techniques, among other things. Inevitably modified by the individual's behavior during life, a human skeleton recovered from an archaeological context is, in a manner of speaking, an artifact.

In ancient China, many cultural practices were aimed specifically at artificial modification of bones and teeth. The most renowned such practice was footbinding, which appeared rather late in the full temporal span of Chinese civilization, apparently during the time of the Southern Tang Dynasty toward the end of the first millennium A.D. Footbinding profoundly affected the shape of the toe bones, resulting in their thinning and a loss of bone density. Bioarchaeological research has yet to address the full specifics of the timing, introduction, and expansion of this practice among the different social strata and ethnic groups enmeshed in the world of imperial China during the second millennium A.D.

Artificial body modification in China was not limited to footbinding. Artificial cranial deformation (Han 1980), extraction or ablation of the lateral incisors (Han and Nakahashi 1996; Han and Pan 1982), and trephination (Han and Chen 1999) all were of much greater antiquity. Each of these practices seems to have originated in a different part of China during the Late Neolithic. As one result of skeletal and archaeological analysis being carried out across much of modern China, the distribution of each such modification within specific regional populations, whether between the sexes and/or among age groups, is fairly well understood. The earliest evidence of intentional tooth ablation dates to around 6,500 years ago from Shandong and the northern Jiangsu region; this practice later became commonplace during the Dawenkou (6,000 to 4,600 years ago) period (Han and Nakahashi 1996). Wherever tooth ablation was practiced, both sexes were affected in roughly equal proportions, although evidence of ablation is far less common in cranial series from archaeological sites distant from the apparent centers of origin. Most evidence of ancient Chinese body modification has been documented through study of skeletal collections for which little information was recorded on the specific context of individual burials, making it difficult to assess the possible role of such practices in demarcating social and/or cultural boundaries.

In other parts of the world, contrasting techniques of body modification often typified geographically defined communities or cultural entities (DeBoer, 1990; Hoshower et al. 1995; Hrdlicka 1914; Torres-Rouff 2002). A cranial series examined by us from the Xishan site in eastern Henan is particularly interesting as a case study for the interpretation of ancient Chinese body modification. Based on specific components of the pottery assemblage at Xishan, it is estimated that the site was occupied during the Middle and Late phases of the Yangshao period (ca. 6,000–5,000 years ago). Xishan is located near the eastern edge of the region of documented Yangshao influence and is also very near to the Dahecun site, which contained some Dawenkou cultural elements. Interpreting the human remains from Xishan helps



Figure 1. Human cranium from Xishan showing signs of artificial cranial deformation, likely of the annular type, with a small flattening device attached to the occiput. Notice the post-bregmatic, saddle-like concavity and flattening of the occipital bone.

us better appreciate the possible role of body modification for identity negotiation in a situation of cultural contact.

A juvenile cranium, M178 (Figure 1), and an upper dentition with intentionally removed lateral teeth (Figure 2), illustrate the types of alterations found in the Xishan series. The cranium (M178) exhibits the unambiguous markings of artificial and intentional deformation, particularly with respect to a post-bregmatic saddle-shaped depression, demarcated by a low bulge of the frontal bone. Coupled with a pronounced flattening and slant of the occipital bone, this peculiarity suggests use of a head-shaping device attached with ligatures to the cranium during childhood. A wide ligature was probably passed behind the bregma to affix the device to the occiput. While no other skull recovered from Xishan evidences unequivocal evidence of artificial cranial deformation, at least six other skulls have structural peculiarities suggesting it. They display a pronounced occipital flattening but little specific evidence of a device attached to the frontal bone to apply pressure. In another case, pressure apparently was applied continuously to the top of the head, resulting in reduced cranial height and an increase in cranial breadth, which suggests deployment of a very different appliance.

Evidence of intentional tooth removal was fairly infrequent in the Xishan cranial series and there is little consistency or obvious patterning in its distribution relative to sex or other

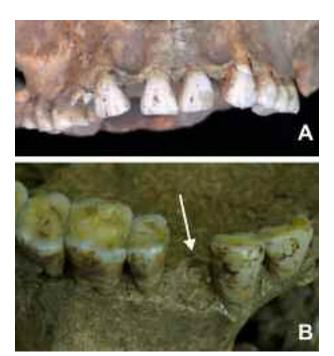


Figure 2. Ablation of upper lateral teeth from Xishan. (A) represents a classical "Dawenkou" type tooth ablation of an adolescent. (B) is an atypical case: the arrow points toward the root of the upper left first premolar.

differentiating characteristics. In the typical mode of Dawenkou tooth removal, the upper lateral incisors were ablated at around the beginning of adolescence (Han and Nakahashi 1996). Of 43 largely intact dentitions examined from Xishan, only two individuals would seem to have had their lateral incisors intentionally removed (Figure 2a). Two more cases were atypical. In one instance, the upper first premolar on the left side was intentionally broken off at the root, in addition to removal of the upper right lateral incisor (Figure 2b). One cranium (T5033) showed evidence of both deformation and tooth extraction. Roots were still present in the dental sockets and little bone remodeling had taken place, suggesting that tooth removal occurred close to the time of death. Considering that we estimated this individual to have died during the mid-30s to late 40s, a tooth extraction ritual took place at a much later age than was typical for Dawenkou, if such was even the case.

Relatively low frequencies of evidence for intentional body modification at Xishan, along with inconsistency in the means of carrying them out, might suggest imitation of foreign practices, rather than well established traditions, perhaps reflecting the precarious position of a community at the fringes of Yangshao influence. A detailed analysis of the corresponding funerary contexts would help test whether body modifications marked either immigrants and/or a particular occupational or social group.

## **COLLABORATIVE RESEARCH IN EAST AND SOUTHEAST ASIA**

The influence of human behavior on skeletal and dental tissues is certainly not limited to the results of intentional modification. Occupation-related activities may lead to unusual modes of dental wear or a patterned distribution of traumatic injuries all over the skeleton. Although generally present at low frequencies, several peculiar forms of dental wear are found consistently in Neolithic cranial series from the Yellow River Valley and its environs. Recognized effects include: disproportionately severe wear of the lower anterior teeth with labial rounding, a pattern best known to students of bioarchaeology from the classic study by Merbs (1983); matching grooves in adjacent interproximal surfaces of the rear teeth; lingual surface attrition of the anterior maxillary teeth; and uneven wear affecting only a single tooth in the whole dental set, as well as enamel chipping and tooth fractures. As considerable disagreement exists as to whether some or all of these unusual forms of wear are reliable indicators of non-dietary tooth use (e.g., Lukacs and Pastor 1988), we examined casts of affected dental surfaces under a scanning electron microscope, looking for markings that could not have been caused by ordinary chewing of food.

Severe wear of the lower incisors and canines (Figure 3a) was found at a low frequency in all cranial series from Henan that we examined. Examples included one case from Jiahu, an Early Neolithic Peiligang site, three cases from the Middle Yangshao site of Xipo, and two cases from Xishan. Such a pattern of wear is usually attributed to use of the anterior teeth in processing animal or plant material. Indeed, microscopic analysis of the lingual surface of affected upper incisors revealed deep parallel scratches running toward the edge of the tooth, which probably indicates that some hard fibrous material was pulled between the clenched teeth using a forceful anterior thrust (Figure 3b).

Examination of dental microwear, coupled with stable isotope analysis, also holds considerable potential for helping to reconstruct foodwebs created by ancient Chinese communities. Stable isotope analysis of a limited sample of human and animal bone from Yangshao sites (Pechenkina et al. 2005) has demonstrated that millets were an important source of calories for both humans and monogastric domesticated animals, including pigs and dogs. It seems almost certain that people consumed millet directly, perhaps in a variety of forms. It also seems nearly certain that people were secondary recipients of additional millet-derived calories as a result of consuming the flesh of cereal-fed domesticated animals. Pigs could have been fed millet directly and/or acquired millet calories through consumption of household refuse or even human excrement. Further dental microwear analysis will help reconstruct the respective positions on the food chain occupied by Yangshao farmers and their domesticated animals. In addition, we hope that this approach can help elucidate changes in cooking practices, as well as in the selection of weaning foods, both of which would add to our



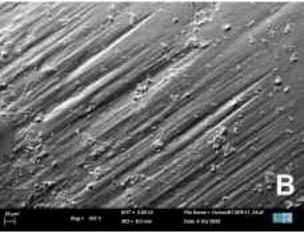


Figure 3. A: Mandible from Jiahu burial M363. Notice the severe wear of the anterior teeth, with labial rounding. B: Microwear on right upper central incisor (labial surface), distal aspect of tooth. Xishan burial M136.

understanding of Neolithic demographics and the distribution of diet-related diseases.

Analysis of the postcranial skeleton also carries considerable potential for the reconstruction of habitual postures and occupation-related physical activities. Instances of rare postcranial pathologies that tend to be linked to specific habitual postures were found on the remains of some individuals in skeletal series from Xipo, Xishan, and Chenjiagou. From Xishan, there were two identified cases of complete spondylosis, as well as one case of partial spondylosis that affected the lumbar segment of the vertebral column, resulting in separation of the neural arch from the vertebral body. As previously documented by Merbs (1989) for an Inuit skeletal series, lumbar spondylolysis is associated with hyperflexion of the body, possibly from habitually working while bent for-

ward, or lifting heavy loads. From the Xipo and Chenjiagou series, several instances of the dorsal expansion of distal articular facets on the metatarsals most likely constitute evidence of habitual squatting.

In addition to specific activity markers found on human skeletons recovered at Yangshao sites, there were marked changes in the distribution of fractures across the Yangshao skeleton over time (Pechenkina et al. 2007). Examination of Early Yangshao skeletons from the Jiangzhai and Shijia sites rewarded our efforts with evidence of a high frequency of cranial fractures, as well as cutmarks. Some of these occurred around the time of death, suggesting a fairly high rate of interpersonal violence, which corroborates the observations of Mary Jackes (2004). On the other hand, Middle and Late Yangshao skeletons from Xipo, Xishan, and Guanjia yielded virtually no evidence of cranial trauma. A majority of the traumatic injuries recognized on the remains of individuals from those sites might be attributable to simple accidents associated with daily life; most appear to have been well healed. One exception is found in the Xipo series, where healed fractures of the ulnae in male individuals may have been caused by the parrying of blows. When considered together with a lack of cranial injuries, these forearm fractures tentatively suggest a form of face-to-face combat following established rules, without annihilation of the opponent as a goal. Xipo is thought to have functioned as a regional center (Ma 2003) and may have served as a locus for community gatherings where displays of ritualized violence took place.

In this brief survey of the objectives and results of some recent collaborative bioarchaological projects being carried out in China, we have attempted to emphasize the potential contribution that analysis of the human skeleton can make toward reconstructing human behavior in the past. Collectively, these projects represent the nexus of multiple efforts at cooperation among an international cast of investigators. In closing, we would like to suggest that more systematic collection of all available skeletal elements from archaeological contexts is as vital for understanding past human societies, as is the meticulous collection of artifacts. Missing elements or the effects of selective curation of skeletal parts-which unfortunately was standard practice during the previous century—represent considerable impediments to successful bioarchaeological analysis. Furthermore, targeted analysis of excavated human remains has the capacity for becoming considerably more informative when and if more detailed attention is paid to funerary contexts. In a 1961 paper, Yan Yan discussed the potential utility of skeletal analysis as a component of archaeological interpretation, specifically as a means for establishing the relationship between social institutions and human daily life. Nevertheless, to date, the overwhelming majority of bioarchaeological studies carried out in China have been performed with little reference to funerary context, except for the specific purpose of refining sex assessment. As one consequence, interpretation of particular activity and health markers is generally restricted to comparisons either of the frequencies at which these markers are found to occur in skeletal series recovered from multiple archaeological sites or between sex and age groups. Conceptually putting human skeletons back into their graves would add a great deal of depth to our understanding and interpretation of many skeletal indicators, as well as allowing us to address the possible effects of social stratification, gender or age related divisions of labor, ethnic heterogeneities, and long-distance contact, on both individual and collective life experience during the ancient Chinese past.

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