The Hyksos in Egypt: A Bioarchaeological Perspective

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Abstract

The term Hyksos commonly refers to the foreign dynasty that inhabited and held power in Egypt during the Second Intermediate Period, circa 1640–1530 BCE. Recent research has integrated archaeological, artistic and textual evidence, revealing the Hyksos origin and presence in Egypt more complex than previously envisioned. Answers to questions regarding the Hyksos origin (and reasons for migration), ethnic and biological homogeneity, nature of rule and impact on the Egyptian worldview are sought by the 'Hyksos Enigma Project'. One of the research tracks is dedicated solely to the analysis of human remains.

Bioarchaeology is a subfield of archaeology focusing on the analysis of human remains in the archaeological record. Here, bioarchaeology refers to the analysis and contextualization of human remains to answer the questions of Hyksos mobility and life history. This paper focuses on methods available for the investigation of mobility from human remains to illustrate the usefulness of bioarchaeological analyses.

Mobility studies have experienced a new awakening in archaeology, caused by recent theoretical and methodological developments in both non-destructive and biochemical techniques. Ancient DNA analysis can be used to investigate both individuals and populations. Stable isotope analysis using strontium ($^{87}Sr/^{86}Sr$), oxygen ($\delta^{18}O$), carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) act as proxies for provenance and diet. Non-destructive biodistance analysis, using dental non-metric trait analysis and geometric morphometrics, reflects morphological closeness of individuals and groups. The analysis of human remains cannot only reveal movement of the Hyksos but can increase understanding of mobility in the eastern Mediterranean.

Introduction

The Second Intermediate Period saw the rise of the 15th Dynasty, ruled from the ancient town of Avaris by the Hyksos kings of foreign origin. Not only did the presence of the Hyksos have political and technological implications, it also affected the ideological foundation of the following New Kingdom period. According to the Hellenistic historian Manetho, as recounted and repeated by later historians and scholars, the Hyksos were a group of foreign invaders who were able to overthrow the Egyptian rule.[6] Current research suggests the shift in power was much less dramatic, with the weakening of central government enabling regional entities to increase their influence already visible in the archaeological record of the 13th Dynasty.[7]

This leads to a more complex question of the Hyksos identity and origin. Although a north-western provenance is currently commonly accepted, discussion revolves around the more precise origin, or origins, of these people and whether the term Hyksos masks any underlying diversity. For the past few decades, the Hyksos archaeological record has grown from containing mostly textual sources in association with artistic and iconographic representation to vast quantities of primary archaeological source material from original contexts, thereby enabling more elaborate interpretations of the influence and nature of the Hyksos presence in Egypt.

Excavations at Tell el-Dabʿa (ancient Avaris) and other associated sites, such as Tell el-Retaba and Tell el-Maskhuta, have improved our understanding of the structure of the Hyksos urban settlement patterns, burial customs and ritual activity.[8] Material culture has enabled the generation of networks between sites but skeletal evidence has remained poorly utilized in these investigations, which leaves the question whether the material culture included the movement of people as well.

Migration has been called "a key constituent element of human life in virtually all periods".[9] It has socio-economic implications on the migrating population as well as the pre-established community.[10] Mobility and migration studies in archaeology, however, have been criticized for lacking dimensionality and

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6 Manetho's *Aegyptiaca*, Frg. 42: 1.75–76, translated by Waddell 1940, 78–79.
7 Bader 2008.
8 Bietak 1996; Forstner-Müller 2010; Forstner-Müller et al. 2015; Holladay 1982; Redmount 2000; Rzepka et al. 2009.
9 Greenblatt 2010, i.
10 Bader 2012; Kelly 1992.

theoretical vigour, presenting migration merely as an explanation for change, not as an object of research in itself.[11] We aim to address these weaknesses by utilizing a biocultural approach. Within a biocultural framework, the surrounding environment (social, political, economic and ecological) can be considered as an influence on the choices of an actor just as the actor changes the environment he or she lives in.[12] This methodological approach emphasizes that the interactions between human culture and the environment are inherently dynamic, as the cultural adaptations are always changing the social, political, economic and ecological environments, which, in turn, are always challenging the humans living within them.

Investigating Hyksos Mobility

In regions where textual evidence has been abundant, mobility and migration studies have played a minor role in archaeological investigations.[13] However, even though there is a wealth of textual evidence from ancient Egypt, much less is available for the Second Intermediate Period and the Hyksos in particular. Aside from the Hyksos scarabs and their inscriptions, there is a dearth of written sources produced by the Hyksos themselves. Therefore, one has to rely on writings produced by the competing rulers, which are in conflict with the archaeological evidence.[14]

To study the Hyksos migration patterns, skeletal human remains from the Hyksos capital Avaris are analysed and compared with skeletal remains from the eastern Mediterranean and Western Asia. The available Hyksos skeletal sample, forming the basis of the project, was excavated during 1966–1969 and 1975–1980 campaigns in Tell el-Dabʿa Area A/II. A primary analysis of the remains was conducted and published by Winkler and Wilfing (1991).[15] The Hyksos Enigma Project reanalyses the Tell el-Dabʿa material to gain previously unknown biomolecular and morphometric information of the Hyksos and to update the dental non-metric trait data according to current protocol. The resulting dataset forms the basis against which other Bronze Age skeletal collections are compared.

Non-destructive biodistance analysis

The similarities visible in living populations and family members extend to skeletal appearance and can be quantified and analysed statistically. Biological distance, or biodistance, measures the similarity of groups using skeletal and dental variation. It is based on phenetics, the classification of organisms according to their morphological similarity, and rests on the assumption that physical appearance is, at least to some extent, an indicator of biological affinity.[16]

Biodistance methods are commonly used to assess variation within and between sites and continuity in diachronic studies.[17] Dental non-metric trait variation and geometric morphometrics represent two major subfields available in biodistance analysis. They have proven useful in studies of variation in palaeontological,[18] archaeological[19] and modern settings.[20]

Dental non-metric trait variation

The current standard for dental non-metric trait variation is the Arizona State University Dental Anthropology System (ASUDAS) by Turner et al.[21] It considers solely the macroscopic (visual) appearance of teeth, accounting for features such as the presence of additional cusps or tubercles (elevated structures), differences in groove patterns and root shape and number. Although the number of traits in the ASUDAS is not nearly as high as the total number of traits available, the ones included in the system have been selected due to their reliability. They are characterized by durability against (moderate) surface destruction, easy identification, high recording repeatability, strong genetic link and a lack of sexual dimorphism.[22]

To analyse the non-metric information, an array of statistical methods can be employed to take into account any potential correlation between traits, missing data and false positive observations. The most commonly used method is C.A.B. Smith's modified mean measure of divergence (MMD).[23] ASUDAS has been employed worldwide,[24] including in several cases in Egypt and the Levant.[25]

11 Burmeister 2000; Dommelen 2014; Kelly 1992.
12 Levins and Lewotin 1985; Stinson et al. 2012; Zuckerman et al. 2012.
13 Dommelen 2014.
14 Bader 2008.
15 Winkler and Wilfing 1991.
16 Hefner et al. 2016, 3.
17 Zakrzewski 2007.
18 E.g., Gómez-Robles et al. 2012; Guatelli-Steinberg and Irish 2005; Martinón-Torres et al. 2007.
19 E.g., Hanihara 2008; Scott and Turner 1997.
20 Edgar 2002; Hanihara 2008.
21 Turner et al. 1991.
22 Hanihara 1992; Hubbard et al. 2015; Irish 1993; Larsen 1997; Scott 1973; Scott and Turner 1997.
23 Sjøvold 1973; 1977; Smith 1972, modified by Harris and Sjøvold 2004.
24 E.g., Haeussler 1996; Hanihara 1967; Hawkey 2004; Turner 1984; Turner 1992.
25 Elias 2016; Irish 1998; 2006; Sołtysiak and Bialon 2013; Ullinger et al. 2005.

Geometric morphometrics

Geometric morphometrics (GM) has been called a "revolution in morphometrics".[26] It allows for the analysis of shape and size in either two- or three-dimensional space, defining characteristics and variation in both single organisms and groups. The method can be used to analyse the shape of any object, such as pottery, by creating a digital model of the object surface using photography or more sophisticated scanning techniques.[27] GM is included in the study to maximise data acquisition of the highly damaged Tell el-Dabʿa material and compare the efficacy of the method and source material to dental non-metric variation.

Shape investigations are conducted using landmarks, features visible on the organism or object that can be identified in every specimen of the sample. Recently, semi-landmarks have been included in analyses, to investigate curved features. Depending on the selected dimensionality (2- or 3D) and the data collection technique, these landmarks may reside on a single aspect or multiple aspects of the organism. Due to the broad geographic location of collections used in this study, and their various curatorial conditions, 2D data collection was selected for its portability and recording speed. The collected data can be fully analysed using freely available software, such as tpsDig, ImageJ, geomorph package in R and MorphoJ.

The resulting shape is analysed with various multivariate statistical methods, similar to those in non-metric traits analysis. Principal component analysis (PCA), which condenses the large data cloud into its most informative components, is popular in both techniques.[28] Analysis of 2D information tooth morphology has been used especially in the study of hominins with,[29] thus far, only a handful of examples from archaeological contexts.[30]

Biomolecular analysis

In recent years, the lowered cost and increased effectiveness of biochemical analyses has caused the number of studies conducted in archaeology to grow exponentially.[31] The improvement of isotope and DNA analyses can be considered as one of the major reasons for the new awakening and interest in mobility and migration. Migration studies have taken a new turn due to the recent advances in bioarchaeological and biogeographical methods using isotope, DNA and biodistance analyses that estimate the degree or lack of affinity between individuals and/or groups. The arising results have begun to raise new questions and draw attention to the nature of migration itself and its role in society.[32]

Isotope analysis

The skeleton is affected by the surrounding environment and habitual behaviour not only in appearance but also in chemical composition. The food and water consumed by the individual affect stable isotope signatures, retaining a clue of what was eaten and where. Depending on the research question, a combination of bone and teeth can be used to infer information of the individual. Teeth begin forming *in utero* and finish forming around the second decade of life, recording the diet and location of the individual during growth, while bone is constantly remodelling and thus records approximately the last ten years of life.[33] Bone is affected by environmental conditions that may, in some cases, decrease the amount of available bone collagen. In Near Eastern Bronze Age samples, approximately 80–85% yield authentic collagen for isotope analysis.[34]

Strontium ($^{87}Sr/^{86}Sr$) and oxygen ($\delta^{18}O$) stable isotopes can be used to investigate migration and residence in past populations. Strontium readily substitutes calcium in teeth and bone. Strontium signatures in the biosphere are reflective of the underlying geology of the area (i.e., bedrock).[35] The main input of oxygen atoms in the body is drinking water, and the difference in proportions between ^{18}O and ^{16}O isotopes is dependent largely on the location's climate (e.g., mean temperature, altitude) from which the drinking water is sourced.[36] Because of this, $\delta^{18}O$ analysis has been used to track the movement of humans in past populations. As stable isotopes record points in time for a specific individual, tracking mobility relies on the identification of changes in the isotope values.

Differences in diet may also be of use for investigating residential mobility, as differences in subsistence and access to certain foods within a given population may be reflective of non-local cultural food practices.[37] Carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotopic values are dependent of types of plants consumed and sources of protein, respectively, placing humans within their local food web. Together they relay information of the use of marine and terrestrial resources and offer insight into the diversity of culture-based dietary practices.[38]

26 Rohlf and Marcus 1993.
27 Zelditch et al. 2012.
28 Irish 2010.
29 Bauer et al. 2016; Gómez-Robles et al. 2007; Gómez-Robles et al. 2008; Gómez-Robles and Polly 2012.
30 Bernal 2007; Perez et al. 2006.
31 Killgrove 2013.
32 Cameron 2013; Linden 2007.
33 Hedges et al. 2007; Hillson 1996.
34 E.g., Schutkowski and Ogden 2011; Sołtysiak and Schutkowski 2015.
35 Bentley 2006, Szostek et al. 2005.
36 Dupras and Schwarz 2001; Gregoricka 2014; Kenoyer et al. 2013; Kohn 1996; Touzeau et al. 2013.
37 E.g., Stantis et al. 2016.
38 Sandias and Müldner 2015; Sołtysiak and Schutkowski 2015; Touzeau et al. 2014.

Carbon and nitrogen stable isotope analysis can also be used to investigate weaning practices and even periods of extreme physical stress such as starvation.[39]

Ancient DNA (aDNA) analysis

The recent development in aDNA analysis techniques has already begun to transform the field of biodistance analysis, providing much more information of the individual and the population.[40] The introduction of next-generation sequencing (NGS) has removed issues inherent in PCR methods, such as the detection of contamination and ability to analyse lower-quality DNA.[41] With NGS, the whole genome can be sequenced, eliminating bias of prior selection, and one set of sequencing can be used to map out sex, ancestry, kinship and pathology.[42] The samples will be processed at the ancient DNA Laboratory of the EURAC – Institute for Mummies and the Iceman, Bolzano, Italy, which has plentiful experience in the treatment of samples from arid areas of the Middle and Near East.[43]

Another major change in the protocols of aDNA sampling is the shift from teeth to the petrous portion of the temporal bone of the skull. The petrous portion begins forming *in utero* and does not remodel during life but, instead, becomes protected by a dense layer of bone.[44] This makes the petrous portion resilient to post-mortem destruction and, subsequently, the most likely host of DNA.[45] Due to the technological developments mentioned before, the sampling of this bone does not result in full destruction of the element but merely a small drill-hole, circa 1 cm in diameter, on the endocranial from the basal aspect.

Even with the technological development, the rapid degeneration of DNA may decrease extraction success as fragments smaller than 20–30 base pairs become too non-specific to reference.[46] Repetition in the human genome also means not every fragment can be referenced.[47] The age of the samples and the archaeological questions considered here, however, fall well within the parameters where good results can be expected.

Discussion and Conclusions

The techniques mentioned here are all at the forefront of current mobility studies. Stable isotope analysis can ideally pinpoint individuals to certain areas and make broad estimations of dietary practices, while aDNA analysis can reveal information of the individual and the population at large. These two methods, however, produce very different data that answer different questions. Together these methods are the intrinsic and extrinsic, the inherent qualities of the individual and the life experiences of that individual, providing clues to identity. However, the success of these methods is reliant on good preservation of skeletal material, and, although the cost of analyses has decreased considerably, it may still be implausible for small projects. The destructive nature of the analysis also raises ethical questions that must be considered prior to sampling.

Non-destructive biodistance analysis using macroscopic methods can be of great use where other techniques are not available due to access or preservation circumstances. The standardization of data collection and development of powerful multivariate statistical methods have produced impressive results in grouping individuals according to morphological appearance alone. In comparison to biochemical analyses, dental non-metric trait analysis and geometric morphometrics are also cost-efficient, requiring barely more than the expertise of the examiner. However, in order to make any inferences of the population, it requires large enough sample sizes (at least circa ten individuals per group) with moderate to little tooth wear, which can be challenging in archaeological contexts.

Using diverse datasets thus has the benefit of improving data resolution in the search of Hyksos provenance. But although extremely helpful, skeletal analysis by itself does not provide any more definitive answers than any other technique employed by archaeologists. Without context, they are as meaningless as any singular analysis. Mobility and migration are complex, multifaceted phenomena that require a holistic, multidisciplinary approach to understand them. The pursuit of bioarchaeology to contextualize and integrate human remains as part of the interpretation of the past belongs to a larger body of analyses. The Hyksos Enigma Project is attempting to do just this, to consider the Hyksos phenomenon as a whole.

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39 Beaumont et al. 2015.
40 Killgrove 2013.
41 E.g., Keller et al. 2012; Knapp et al. 2015.
42 Stoneking and Krause 2011.
43 Hawass et al. 2010; Hawass et al. 2012; Zink et al. 2003.
44 Scheuer and Black 2000.
45 Hansen et al. 2017.
46 Durbin 2009.
47 Rasmussen et al. 2010.

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