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A PARTICULAR HERITAGE

The importance of identified osteological collections

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One of the main pillars of bioanthropological studies are identified osteological collections. The goal of this article is to describe this heritage and show its importance. Since the nineteenth century, several countries have collected sets of skulls and skeletons from people for whom we have some biographical data; among other details, their age and sex at death. There are currently around fifty collections in different countries in North and South America, Africa, Europe, and Asia. Their research has applications in the study of human evolution, past populations, palaeopathology, and the history of medicine, among others. The need to increase the number of individuals and extend the geographic distribution of such samples has led to the continuous development of these collections.

Keywords: physical and biological anthropology, forensic anthropology, skeletal biology, palaeopathology, history of medicine.

INTRODUCTION

Since prehistoric times, humans have manipulated the skeletons of the deceased. A good example are the pre-Neolithic skulls (dated from 9,600 to 7,000 years BC) found at the archaeological site of Göbekli Tepe in the Anatolia region of Turkey; these skulls present deep cuts along their sagittal axes and are the most ancient known evidence of intentional *post mortem* modification of human bones (Gresky, Haelm, & Clare, 2017).

Over time, this interest gradually became more scientific, especially in medical fields, which were essentially based on the work of the Belgian physician Andreas Vesalius (1514–1564), now considered the father of modern anatomy. During the eighteenth and nineteenth centuries, there was an increasing interest in the natural history and diversity of the human populations of each continent, leading to the creation of collections and studies of human skulls and/or skeletons in a more systematic way (Spencer, 1997). Since then, numerous collections have been created in museums and universities around the world (Quigley, 2001).

The goal of this article is to present the so-called «identified osteological collections» and show their importance for scientific advancements in the fields of anthropology and the history of medicine.

WHAT ARE THE IDENTIFIED OSTEOLOGICAL COLLECTIONS?

«Until the middle of the 20th century, identified osteological collections were used mostly to make anatomical comparisons»

«Identified osteological collections» – also known as «documented» or «reference collections» – are sets of skulls or skeletons from people for whom we have some biographical data such as their sex and age when they died. Apart from these essential elements, other frequent parameters are the place of birth and the cause of death. Depending on the composition of the collection and the objectives that led to its creation, other information about the individuals might be available, such as their place of death and place of inhumation and their occupation

– which indirectly provides information about their socio-economic status – as well as their name, marital status, height, and the name of their parents.

It should be noted that, even though biographical data about these individuals is available, both publications and oral presentations of the results of studies conducted on identified individuals are presented without their identification. Although some of these collections are stored in museums, they are not usually exhibited in public, although skulls, bones, and skeletons can be shown to the public as part of a certain type of expository discourse.

The more information there is about each one of the individuals, the more versatile and important the collection will be, because it will allow them to be used to answer broader research questions. For instance, knowing the names of the individual's parents allows experts to establish kinship, and access to the person's names can be useful when searching for complementary information about that individual's life.

However, we should also warn about the potential problems and biases of these collections. Skeletal sets are not representative of the population to which they belonged, even when these collections comprise hundreds of thousands of individuals. This is because the sample was selected according to factors other than the representativeness of the living or dead population present during a given period. The reliability of data about the cause of death should also be questioned based on the medical knowledge and diagnostic tools used at the time. Similarly, the use of diffuse or inconsistent terminology that does not correspond to current nosological classifications should also be called into question.

These collections try to show the normal variability of the population, and so they differ from anatomical collections that register pathologies, particularly rare ones such as gigantism, dwarfism, congenital problems, or characteristic lesions of certain diseases, like the destruction of the spine due to bone tuberculosis, also known as Pott's disease (Santos & Suby, 2012). These specific collections were created for medical education or to document and show «oddities» or «anomalies» which science – especially from the eighteenth century to the first

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Osteological collections are of great scientific interest in anthropology research. Many collections have been used to create methods to estimate the sex of individuals by observing or performing metric analyses of certain anatomical regions such as the pelvis, skull, or long bones. The image shows identified skulls at the University of Coimbra (Portugal).

«The existence of identified individuals from different chronologies within the same country allows us to diachronically compare metrical aspects such as height and robustness»

half of the twentieth century – could not explain. In other cases, phrenologists created skull collections in Europe and the United States. They believed that the shape of the brain was related to the shape of the skull and, consequently, to an individual's moral traits and intellectual capacities (Quigley, 2001; Spencer, 1997). Finally, we should also mention mummies, skeletons, heads, and skulls – often obtained through armed conflict – that could often be found in «cabinets of curiosities», created in museums in the eighteenth and nineteenth centuries. These were usually considered as representative of «lower races» or the traditions of «primitive peoples», as they were called at the time (these terms were refuted in the following decades thanks to scientific advances that disproved the existence of races within the human species). However, these collections are not the object of the present text.

HOW WERE THEY CREATED?

Identified osteological collections come mostly from municipal cemeteries which, when faced with the need for more burial space, disinterred the human remains from graves from graves that showed no evidence of maintenance or visits. After the legal burial time allowance, and when families did not renew the burial lease, the bones were removed and placed in collective ossuaries within the cemetery or, alternatively, they were cremated (Chi-Keb, Albertos-González, Ortega-Muñoz, & Tiesler, 2013; Quigley, 2001).

Other collections, such as the Skull Collection of the Medical School of the University of Coimbra (Portugal), come from individuals who passed away in hospitals and whose relatives did not claim the body. There are also sets of skeletons used in dissections, like the ones in the Hamann-Todd Human Osteological Collection in Cleveland (USA), or from autopsies, as in the case of a set of foetuses in Hungary (Fazekas & Kósa, 1978; Quigley, 2001). On the other hand, the Spitalfields collection in London was created because the crypts of Christ Church, a place of burial in the eighteenth and ninteenth centuries, had to be emptied (Molleson, Cox, Waldron, & Whittaker, 1993). Another means of obtaining identified individuals was the donation of bodies, either following the wishes of the deceased themselves or of their families, as was the case in the collections of the Universities of Khon Kaen and Chiang Mai in Thailand or the Dr. William M. Bass and Maxwell collections in the United States.

In circumstances such as the ones presented above, the regulations of many countries authorise the receipt of skulls and skeletons by research and education institutions. The most recent collections must follow good practice guidelines and check with internal and external ethics committees (see, for instance, Chi-Keb et al., 2013). In Switzerland, the families and descendants of the individuals were also consulted before creating the Simon Collection (Perréard-Lopreno, 2006).

Country	Name	Institution
Argentina	Prof. Dr. Rómulo Lambre Collection	National University of La Plata
	Chacarita Collection	Chacarita Cementery and University of Buenos Aires
Austria	Weisbach Collection	Natural History Museum, Vienna
Belgium	Schoten Series	Royal Belgian Institute of Natural Sciences
Canada	Grant Collection	University of Toronto
	St. Thomas Collection (Belleville)	University of Ontario
Chile	Santiago Subactual Collection	University of Chile
Colombia	Collection of the University of Antioquia	University of Antioquia
	Reference human skeletal collection of the modern Colombian population	University of Bogota
France	Brest bone collection	University of Brest
	Modern humans' remains collection (Portal collection and 140 fetal skeletons)	Musée de l'Homme, Paris
Germany	Virchow Collection	Humboldt University of Berlin
Greece	Reference human skeletons collection (includes the Wiener Laboratory Collection)	University of Athens
	Collection of the University of Crete	University of Crete
Hungary	Hungarian collection of fetuses	University of Szeged
Italy	Collection of the Certosa Cementery Sassari Collection	University of Bologna
	Florence skull collection	National Museum of Anthropology and Ethnology of Florence
	Milano Cemetery Skeletal Collection	University of Milan
	Collection of the Institute of Normal Human Anatomy	University of Siena
	Collection of the University de Turin	University of Turin
Japan	Jikei School of Medicine Collection	Jikei University
	Modern Japanese Osteological Collection	Tokyo University
Mexico	Saint Nicholas of Tolentino Catalogue	National School of Anthropology and History
	Osteological collection	National Autonomous University of Mexico
	Collection of Documented Human Skeletons of Merida	Autonomous University of Yucatan
Philippines	Skeletal collection	University of the Philippines
Portugal	Medical School Skull Collection International Exchange Skull Collection Identified skeletons collection Twenty-first century collection-Santarém	University of Coimbra
	Identified collection	University of Évora
	Identified collection of the National Museum of Natural History, Lisbon (also known as the Luís Lopes Collection or Museu Bocage Collection)	University of Lisbon
	Mendes Correia Collection	Natural History Museum, University of Porto
	North Delegation Collection	National Institute of Legal Medicine and Forensic Sciences
Romania	Francis J. Ranier Collection	Anthropological Research Centre, Romanian Academy
South Africa	Raymond A. Dart Collection	University of the Witwatersrand
	Pretoria Bone Collection	University of Pretoria
Spain	Collection of identified human skeletons	Autonomous University of Barcelona
	Identified osteological collection	University of Granada
	Collection of the Legal Medicine School	Complutense University of Madrid
	Osteological collection of the Museum of Anatomy of the School of Medicine	University of Valladolid
Switzerland	Spitalfriedhof St. J Collection	Natural History Museum Basel
	Simon Collection	University of Geneva
Thailand	Identified collection	Khon Kaen University
	Identified collection	Chiang Mai University
United Kingdom	Spitalfields Collection St. Bride Church Collection	Natural History Museum, London
USA	Robert J. Terry Collection	Smithsonian Institute
	Dr. William M. Bass Collection	University of Tennessee
	Hamann-Todd Collection	Cleveland Museum of Natural History
	W. Montague Cobb Skeletal Collection	Howard University
	Maxwell Collection	University of New Mexico
	Trotter Collection	University of Washington

AROUND THE WORLD IN IDENTIFIED COLLECTIONS

Table 1 includes some of the most emblematic «classic» collections; i.e., those created in the nineteenth and early twentieth centuries, whose importance lies in factors such as the number of individuals they include, an equitable sex and age distribution, skeleton preservation and integrity, and the number and quality of studies carried out with them. Thus, research can add new information to the existing data about each of the individuals included in these collections, increasing its reliability. In addition to these classic collections, other reference collections used for forensics were also included here. These derived mostly from people who died in the last decades of the twentieth century or in the early twenty-first century.

Given the limited number of references that can be included in this publication, Table 1 briefly presents the collections identified in each country (in alphabetical order) without mentioning any publications that describe and/or present them. More information about these bone collections and their characteristics can be found elsewhere, including in work by Ardagna, Bizot, Boëtsch, & Delestre (2006), Henderson & Alves-Cardoso (2018), Molleson et al. (1993), Quigley (2001), Santos (2018), and Ubelaker (2014).

These collections are studied not only by the students, researchers, and professors at the institutions that house them; they are also available for other professionals to carry out their research. Several of these collections are often simultaneously analysed to increase the number of individuals studied in research projects looking, for instance, for more specimens of the same sex or age group – or to evaluate the bone reaction to a particular disease.

WHY WERE THESE COLLECTIONS CREATED? STUDY EXAMPLES

Until the middle of the twentieth century, identified osteological collections were used mostly to make anatomical comparisons between populations from different regions of the world and with the fossils being gradually discovered in Europe, Africa, and Asia (Santos, 2018; Spencer, 1997). At the same time, the physical-biological anthropology field started to study them in order to create methods to estimate sex, age at the time of death, and height, so these data could later be applied in the study of skeletons from archaeological excavations or in forensic identifications. This type of research continues today because, contrary to what we see on TV series, high-accuracy methods are not easy to find.

Many of the classic collections, such as the Hamman-Todd Collection or the Robert J. Terry Collection, both in the United States, as well as the Collection of Identified Skeletons at the University of Coimbra, have been used to create methods that have later been applied all around the world to estimate the sex of individuals through the metrical analysis of anatomical regions such as the pelvis, skull, or long bones. In adult individuals, observable sexual dimorphism in the skeleton provides some certainty about the results obtained, while this process is considerably more difficult for non-adult skeletons. Therefore, collections like the one at the University of Granada (Alemán et al., 2012) are essential to improving these methods.

«Developing and testing reference methods for forensic identification is essential, which implies creating collections in different countries»

Another essential biological parameter, both in forensic cases and in the bioanthropological or bioarchaeological study of human osteological remains from excavations, is the estimation of age at the time of death. In this case, age estimations made through dental development and eruption or the length of the bones in foetuses, children, and adolescents are similar to their chronological age. Conversely, the confidence intervals obtained for adults via different methods that analyse, for instance, the degree of cranial suture obliteration, dental wear, and joint metamorphoses in the ribs, auricular surface, and pubic symphysis of the hip bone, range in decades. What the skeleton registers and tells researchers is its biological age, but what anthropologists need is the chronological age, that is, the number of years that person lived. Among others, Spanish collections are also being studied to help

Table 1. The previous page shows a list of identified bone collections presented in country alphabetical order. As indicated, these collections are associated with particular universities or institutions but are often available to professionals from around the world for research purposes. Many of them have been, and still are being used to develop reliable methods for forensic research, among other aims. A map showing the worldwide distribution is available at http://forensicanthropology.eu/osteological-collections/

perfect these methods (Del Río Muñoz, 2000; Rissech & Steadman, 2011).

Since we are dealing with anatomically modern humans of the *Homo sapiens* species, these sets of individuals are particularly useful in comparisons made with our closest ancestors, such as the fossils found in the African, Asian, and European continents, including those from the Atapuerca archaeological site in Spain.

Collections made up of individuals who lived before the creation of modern chemotherapy are important in discovering how diseases progress – via bone manifestations – before cures or interference from effective treatments such as antibiotics were available. When several individuals with the same cause of death are available, some lesions that do not usually present in clinical practice can even be found. For example, in people who died from tuberculosis, statistically significant new bone tissue was found on the visceral surface of the ribs in both non-adult and adult individuals. Later, this became a possible indicator of the disease (Santos & Suby, 2012).

From a different perspective, individuals who were born and died in the eighteenth, nineteenth, and early twentieth centuries (therefore, before the third epidemiological transition) will be more suitable for comparisons with ancient populations than other more recent individuals who benefited from great medical advances which led to a significant increase in life expectancy or a continued increase in body height, to cite some examples.

Although it is very difficult to make direct and unambiguous connections between lesions and a specific occupation, the fact that many collections include information about the individuals' occupations is of great interest in the research of degenerative alterations in joints and enthesis (the point where tendons and ligaments insert into the bone) because the development of these injuries is related to the performance of certain functions (see, for example, Henderson & Alves-Cardoso, 2018).

In addition to studies aimed at creating methods to evaluate the biological parameters of individuals found in archaeological and forensic contexts and

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The individuals in a reference osteological collection may have very different origins. In many cases, these remains come from exhumations carried out by municipal cemeteries when more space for new burials was required. In other cases, the skulls and skeletons come from individuals who died in hospitals and whose families did not claim the body, as was the case for the collection at the Medical School of the University of Coimbra (Portugal). The picture shows a cabinet with identified skulls from the collection.

to identify diseases that affect bones and teeth, identified collections provide important elements for the history of medicine, particularly for surgical practice and legal medicine or thanatology. In the case that a skull or skeleton shows signs of having undergone an autopsy – a craniotomy or a thoracotomy –, this allows experts not only to evaluate the techniques used in the *post mortem* diagnosis or a legal medical expert report, but also to be more certain about the registered cause of death of the individual.

On the other hand, developing and testing reference methods for forensic identification is essential, which implies creating collections in different countries (Cattaneo, 2007; Spradley, Jantz, Robinson, & Peccerelli, 2008; Ubelaker, 2014). Thus, the creation of identified skeletal sets has recently gained new global momentum, especially in collections that include the genealogy of its individuals, as well as metrical aspects (such as body height) that correspond more directly to the variability of current human populations.

The existence of identified individuals from different chronologies within the same country allows us to diachronically compare metrical (height, robustness, etc.) and pathological aspects. For instance, they allow us to assess the frequency of tooth cavities and other oral diseases and relate them to dietary changes and to the improvement of medical care over time.

FINAL REMARKS

Here we have tried to disseminate the value of the skulls and skeletons included in so-called «identified osteological collections» and show the importance of their study, both in research attempting to reconstruct the life of past populations and in forensic work. The recognition of their scientific interest is evident in the continuous creation of new collections in several countries over the last two centuries.

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