

Identification of the Remains Belonging To an Elderly Woman By Skull-Photograph Superimposition

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ABSTRACT: Case studies are ideal to test osteological techniques, especially population based standards to individual skeletal remains. At the same time, they could be a way to show the accuracy of digital photographic superimposition in forensic facial identification. The purpose of this paper is to present the methods that were used for establishing the identity of the skeleton remains of an elderly woman and the difficulties encountered in their application. The victim's decomposed and incomplete skeleton was found lying in a woody area. Osteological techniques used for sex determination, include mandibular dimensions the least affected by the absence of teeth. The analysis of the remains indicated that the victim was a female older than 70 years. Based the police information, the victim was thought to be a woman who lived in a village near Montevideo, Uruguay. Two, frontal and lateral photographs were obtained by police. Skull-photograph superimposition techniques were applied to make a positive identification. The skull-photograph superimposition was performed using a personal computer with a graphic program that allowed the mixture of digitized facial and skull images. The determination of the correct distance between the two jaws of the edentulous skull required numerous attempts. These examinations revealed that the skull corresponded consistently with the person from the photographs. The personal belongings also pointed the same individual. In conclusion, in spite of the difficulties due to the total absence of teeth in the jaws, the positive identification was possible to make.

Keywords: case study, skeletal remains, osteological techniques, positive identification, digital photo-skull superimposition, Montevideo, Uruguay.

I. INTRODUCTION

Forensic anthropologists have developed numerous demographic techniques to understand the biology of people around the world. Many of these techniques derived from skeletal remains of

known identity. For this reason, case studies are ideal to test the validity of this techniques and Forensic Anthropology may function as a testing ground for this aspect of Biological Anthropology (1).

Forensic anthropology has been one of the fastest growing disciplines of forensic sciences and its scope has been described (2-5). Its growth in the US has been attributed to scholars such as Wilton M. Krogman and J. Lawrence Angel (6-8). T. Dale Stewart (9) carried out much of the pioneering research and Krogman defined the field (10). The importance of research and practical needs has also been appreciated globally by other forensic anthropologists (11,12). Growth of the field has been chronicled for many countries, including Colombia (13-15), Hong Kong (16); Turkey (17), South Africa (18), Uruguay (19,20), and the United States (21).

For almost three decades, Forensic anthropology has been an active part of the coroner system in Uruguay and the number of cases has increased considerably since the inclusion of a resident forensic anthropologist to the medico-legal team and judicial system (22). This eventually led to a higher rate of positive identification of unknown human skeletal remains (23,24). Since its establishment in 1992, the Laboratory of Forensic Anthropology has been assisted by the coroner and legal authorities in several criminal cases in which the study and identification of human skeletal remains was needed (25), these include skeletonized, decomposed, and burned human remains Generally, forensic anthropology cases are submitted to forensic anthropologists by coroners and legal authorities. When a positive identification is made on the basis of the forensic anthropologist studies, the coroner signs the death certificate based on the official report filed by the forensic anthropologist. Therefore, the forensic anthropologist is an official consultant of the Forensic Medicine Department at Montevideo City (22). It is very important to remark that before 1992, all skeletal remains found were buried like

no name people and no one was identified by the pathologist or medical examiner. Since the creation of the Forensic Anthropology Laboratory at the Judicial Morgue of Montevideo City in 1992, more than 200 people have been identified by skull-photo comparison using digital superimposition techniques (23,25). These positive identifications were later corroborated by dental or DNA studies.

The study of the facial surface has always been of high interest to forensic anthropologists when identifying human skulls (26,27). Now, digital superposition of a photograph over the skull is a common method of identification used by forensic anthropologists around the world (24). This technique has been used to assist in the identification of numerous victims and is accepted in courts in a number of countries (28-57). It is accomplished by comparison and matching of two already existent images, one of the skull and the other of a facial photograph that is thought to belong to the owner of the skull. This method have in view the establishment of a close enough correlation between the images to state with a reasonable degree of confidence that both belong to the same person. Superimposition has an accuracy of 90.4% for lateral view and 91.5% for frontal view. The accuracy could be improved more when two or more photos are available (as much as 99.4%). One of the fundamental difficulties in superimposition is the orientation of the skull in the same position as in the photo image, the usual photograph being almost always a deviated one. The difficulties encountered using superimposition technique is more in cases with total absence of elements to establish the distance between the two jaws. The purpose of this paper is to show that these difficulties in a such a case could be overcome and describe the place of forensic anthropology in the Uruguayan medico-legal system and to show how skull-photograph comparison techniques are successful used to identify human remains and, in spite of the difficulties due to the total absence of teeth in the jaws, the positive identification was possible to make.

II. MATERIALS AND METHODS

The skeletal remains analyzed were found lying in a forest near Montevideo City, Uruguay. The victim was wearing woman's clothing. The skull was almost completely skeletonized and showed no lesion of violence. After application of several morphological and metric procedures to determine sex, race, stature, age at death and time

since death (57-68), as well as cause of death. It was established that the victim was a white female, more than 70 year old, and 159 cm tall, who died more than year ago, the cause of death could not be determined because the skeletal remains did not shown any injuries. Based on personal belongings, the victim might be a woman who lived a few kilometers away from the place where her body was found. Two photographs, in frontal and lateral view, was available from the identity card of the presumed victim. The face from photograph seemed to be without any rotation. This fact was demonstrated by Can and Lan's method (69-71), dividing the distance between right ectocanthus and glabella by the distance between left ectocanthus and glabella, the result of 1 corresponding to 0 angle of deflexion. For establishing tilt of the head, it was used the proportion between the two segments of the nose obtained by a line that unites the centres of the two external auditory meatus. The image of the skull was taken by a digital camera from one meter distance. The superimpositions were made using a personal computer, that allowed capturing of the digitized image of the photographs and skull. By means of Adobe Photoshop, the images were converted to a transparency and overlaid on the skull image after their adjustment at the same size. The first image of the skull was taken with 0.5 cm distance between the two jaws, being considered the possible thickness of the soft tissues from the alveolus level. The superimposition of this one with the photo image showed that the inferior contour of the two mandibles didn't fit well. The distance between the maxilla and mandible was gradually increased at every 0.5 cm, and at each new position a superimposition was performed. Every time it was compared the anatomical landmarks on the skull with the landmarks established on the photographs.

According to skull-photo superimposition techniques two photographs showing frontal and lateral view are required to an accurate identification by skull-photograph digital superimposition. Photographs were placed under the video-camera and illuminated by white fluorescent lamps. The images were adjusted on both monitor screens (a conventional high resolution monitor and personal computer monitor) and they were digitized by the video mixer unit and stored in the computer as a JPG file using the Pinnacle capture card software. Then, using the computer and Adobe Photoshop software several key anatomical landmarks on the face were traced, as well as the eight examining lines by Cai and Lan (69-71). Taking account these anatomical

landmarks and the eight examining lines several comparison were made. The photographs were still from both monitors using digital mixer unit and the skull was placed under the video-camera and illuminated by fluorescent lamps. The skull was manipulated by a servo motor until the position approximated that of the individual in the photographs. After the skull has been correctly oriented using the video camera zoom, the size of the skull image was adjusted that it was as close as possible to that of the individual of the photographs. After comparing anatomical landmarks in the skull with their counterparts of the photographs the image of the skull was digitized using the digital video mixer unit and then stored as JPG file in the computer using the Pinnacle capture software. Then, both images stored in the computer (skull and photographs) were superimposed using the Adobe Photoshop software for a more detailed comparison. This permitted the desired combinations of skull-photo comparison, including removal of soft tissue to view the underlying skeletal structures such the auditory canal, zygomatics, and jaw bones, nasal root, dentition, chin, skull contours and so forth. The entire process may be recorder by the computer DVD unit and good quality photographs can be made by the computer printer to attach a forensic report.

III. RESULTS AND DISCUSSION

The analysis showed that there was a concordance between the landmarks of the face from the photographs and those from the skull. All proportions of the head, face, eyes, nose and mouth on the photographs were submitted for comparison. So, the outline of the skull was found congruent with the facial contour. After a few trials, a correct distance between the two jaws was found to be 1.6 cm. In conclusion, in spite of the difficulties in appreciation of the distance between the maxilla and mandible, when the photograph of the edentulous skull was taken, the identification by photo-skull superimposition is possible. Although there was a high level of accuracy of matching a skull with the photograph, one should be careful to make sure that additional supportive evidence is available. Today, forensic anthropology has been integrated into forensic teams in the majority of countries in the world, and the specialty is working its way into medico-legal systems around the world as well. Scientific literature has described numerous times in which forensic anthropology has solved crimes or identified skeletal remains. Clearly, it is important to have a well-trained

forensic anthropologist available when human skeletal remains are found and a positive identification must be made. In Uruguay, the rate of identification depends on a number of problems. First, law enforcement agencies may not be knowledgeable about which data are relevant to obtain a positive identification from skeletal remains. Second, positive identification may be very difficult when no missing people are reported to the police (24), therefore, a positive identification could not be established when there is no comparative records. Third, dental records are particularly difficult to obtain in Uruguay, as well as many other countries in Latin America (1) because dental health is poor and minimally maintained for the majority of the people because of its very expensive. However, forensic anthropological contribution to the medico-legal system has increased considerably in the last 30 years, in Uruguay (20,25). The number of cases identified increased to a level obtained in some other more technologically advanced countries. One way to judge the contribution of a field is to quantify its practical application. Before 1991 forensic anthropological studies were not given serious consideration in Uruguay. When human remains were discovered they were analyzed by coroners with little training in anthropology. Most examinations were only limited to the determination of possible cause of death. Generally these remains could not be positively identified and thus buried as unknown. As a solution to this problem, the Forensic Anthropology Laboratory was created at the Morgue Judicial of Montevideo City in 1992. Since its establishment, as a section of the Morgue Judicial, the number of anthropological cases analyzed have increased and forensic anthropology has become an integral part of the medico-legal disciplines and its investigative branch. It has been shown that participation of a trained forensic anthropologist can contribute considerably to the speedy identification of unknown cases and resolution of the crime. This is probably because of the establishment of a forensic anthropology laboratory in the medical examiner's complex. Without a doubt, this increase in case studies can be attributed to the familiarity of the service this new field can offer to law enforcement agencies and coroners. The location of the laboratory at the Morgue Judicial of Montevideo gave an opportunity to medico-legal offices to have an easy access to this service. The rate of positive identification has also improved considerably and comparable to other statistics in the U.S.A (21). In the majority of cases the remains were found by

police or civilians in forests, fields, parks, lakes, or rivers. Some were found in burned cars, on highways, or in abandoned houses. All of the forensic anthropology cases were analyzed to determine the number of persons, age at time of death, sex, location where the remains were found, stage of decomposition of the remains (fresh, advanced decomposed, burned, or skeletonized), and whether a positive identification was made. Skull-photo digital superposition was used for identification purposes with available equipment at the Morgue Judicial of Montevideo City, together with other methods like DNA or dental studies, the comparisons by digital superposition assisted by computers were the most useful method used in identifying human remains. In Uruguay more than 200 cases were solved and identified using skull-photo comparisons by digital superposition assisted by computer (23). This forensic anthropological investigation started with the initial observation about sex, age, race and stature, time since death and cause of death. Skull-photo comparison was made by digital superimposition assisted by computer. It was demonstrated effectively consistence between the skulls and the frontal and lateral facial photographs submitted by comparisons. Success in identification depends upon the quality of the submitted photographs as well as correct orientation and articulation of the skull and mandible. Although the remains were identified by skull-photo superimposition, another evidence was incorporated like DNA studies, those were later found to be in agreement with the identification based on skull-photo comparison. Forensic anthropology contributions to the Uruguayan medico-legal system have increased in the last years (20) and the number of cases in which positive identifications have been reached is similar to those of European countries and the United States (21). It should be remarked that according to actual tendencies, forensic anthropology cases are increasing. In conclusion, this study shows how positive identifications can be made using traditional osteological analysis and skull-photo comparison by digital superimposition assisted by computer.

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