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The article presents an update of a quantitative analysis of the forensic anthropology cases that occurred in Uruguay from 1992 to 2023. The number of forensic anthropology cases has rapidly increased in Uruguay. Over 30 years this number had rise from 14 cases in 1992 to 75 cases in 2023, reached a maximum number of cases in 2006 and 2013, ascending to 91 cases for each year. Forensic anthropology cases processed between 1992 and 2023 at the Judicial Morgue of Montevideo ascending at the present to 1752. The Laboratory of Forensic Anthropology at the Judicial Morgue of Montevideo City was created in 1992, as a response to the need to address the backlog of cases. Since 1992 all the remains were analyzed to determine sex, stature and age at the time of death and, eventually the identity of the remains. In cases where a positive identification was made, a forensic anthropology analysis was also performed. The purpose of this paper is to describe the place of forensic anthropology in the Uruguayan medico-legal system, the evolution an increase of the number of cases from 1992 to 2023 and, to show its effectiveness in identification of human remains.

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The article presents an update of a quantitative analysis of the forensic anthropology cases that occurred in Uruguay from 1992 to 2023. The number of forensic anthropology cases has rapidly increased in Uruguay. Over 30 years this number had rise from 14 cases in 1992 to 75 cases in 2023, reached a maximum number of cases in 2006 and 2013, ascending to 91 cases for each year. Forensic anthropology cases processed between 1992 and 2023 at the Judicial Morgue of Montevideo ascending at the present to 1752. The Laboratory of Forensic Anthropology at the Judicial Morgue of Montevideo City was created in 1992, as a response to the need to address the backlog of cases. Since 1992 all the remains were analyzed to determine sex, stature and age at the time of death and, eventually the identity of the remains. In cases where a positive identification was made, a forensic anthropology analysis was also performed. The purpose of this paper is to describe the place of forensic anthropology in the Uruguayan medico-legal system, the evolution an increase of the number of cases from 1992 to 2023 and, to show its effectiveness in identification of human remains.

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I. INTRODUCTION

Forensic anthropology has been one of the fastest growing of all forensic sciences, and its scope has been described by several authors (1-3). Its growth in the US has been attributed to scholars such as Wilton M. Krogman and J. Lawrence Angel (4, 5). T. Dale Stewart (6) carried out much of the pioneering research and Krogman defined the field (7). Other forensic anthropologists (8, 9) have also appreciated importance of research and practical needs globally. The growth of the field has been recorded in many countries (6, 10-16).

The study of the facial surface has always been of high interest to forensic anthropologists when identifying human skulls (17). Digital superposition is a common method of identification used by forensic anthropologists around the world (18). The technique of skull-photo superimposition has been used to assist in the identification of numerous victims and is accepted in courts in a number of countries (19-33). The scientific principles of this method were very well described in specialized literature (34-41). Adding a computer to this technique greatly improves it, adding a number of advantages and new possibilities (42-51).

In the last 30 years, forensic anthropology has been an active part of Uruguay's coroner system (52,53). The Forensic Institute at Montevideo City assigns medico-legal studies to the Forensic Medicine Department. Autopsies and other types of forensic studies, such as anthropological, are carried out at the Judicial Morgue of Montevideo City by the resident forensic anthropologist (54). The number of forensic anthropological cases has increased considerably since the 1992 inclusion of a forensic anthropologist to the medico-legal team. This eventually led to a higher rate of positive identification of skeletal remains (16).

Since its establishment in 1992, the Laboratory of Forensic Anthropology has given assistance to the coroner and legal authorities in several criminal involving the study of human skeletal remains (16), this concerns 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 based on a forensic anthropologist official report, the coroner signs the death certificate. Therefore, since 1992 the forensic anthropologist is an official consultant of the Forensic Medicine Department at Montevideo City (16).

It is very important to note that before 1992, all recovered skeletal remains were buried with no name and not anthropology examination was made 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 250 people have been identified by skull-photo comparison using digital superimposition technique. These positive identifications were later corroborated by dental or DNA studies.

The purpose of this paper is to present an update of the position of forensic anthropology in the Uruguayan medico-legal system, the higher amount of cases and, to show successful of skull-photograph comparison techniques are when used to identify human remains.

II. MATERIALS AND METHODS

The period analyzed was from 1992 to 2023 where the Laboratory of Forensic Anthropology had an active role in the study and identification of human remains. The year 1992 was considered as the foundation of the Forensic Anthropology at the Morgue Judicial of Montevideo city.

In 1992 the Forensic Anthropology Laboratory at the Judicial Morgue of Montevideo City was established. Since 1992 until 2023, 1752 forensic anthropology cases were analyzed. The human remains came from all over the country, including Montevideo City. All cases were assessed for the estimation of age at death, stature, sex, racial affinity, cause of death and eventually its identification. Condition of the remnants regarding decomposition and whether or not a positive identification was made was also noted. Most of the human remains were found in woods, fields, parks, rivers and lakes. Other remains were others recovered from locations like burned cars, septic tanks, highways, construction sites and abandoned houses. Those recovering the remains were typically police or civilians. Positive identifications when available were made from the Forensic Anthropology Laboratory at the Judicial Morgue of Montevideo City using skull-photo comparison techniques or by comparison of dental records. According to skull-photo superimposition techniques, two photographs showing frontal and lateral views are required for an accurate identification by the technique. Photographs were the placed under the video camera and illuminated by white fluorescent lamps. The image was adjusted on the computer monitor, and it was digitized by the video mixer unit and stored in the computer as a JPG file using a capture card device. Then, using a computer and an appropriated software, some key facial anatomical landmarks were traced (55). Moreover, eight examining lines introduced by Cai and Lan (39) were considered. Respecting all of these landmarks and lines, several comparisons lines, and other comparisons, are captured using an application of the digital mixer outside of an appropriated software. The skull is illuminated by fluorescent lamps and placed under the video camera. It is then manipulated by a servo motor until its position is seized in that of the individual in the photograph. After the skull has been adjusted in the optimal position, a photograph is captured and adjusted to fit as closely possible to that of the individual on the photograph. Afterwards, the image of the skull is digitized using the digital video mixer unit and then stored as JPG file in the computer. Then, both images are stored in the computer (skull and photo) and superimposed using an appropriated software for a more detailed comparison. This technique permits the desired combinations of skull-photo appraisal, including removal of soft tissue to view the underlying skeletal structures such the auditory

canal, zygomatics, jawbones, nasal root, dentition, chin, skull contours and so on. The entire process may be recorded by the computer unit and good quality photographs can be made by a computer printer to be attached to a forensic report.

III. RESULTS

From the period of analysis (1992-2023) the number of forensic anthropology cases increased from 14 in 1992 to 75 in 2023. About 59% of the cases from this period came from Montevideo Department, this is the smallest and most populated of the 19 Departments in Uruguay, having almost 2 million people within its scope and 41% were from the rest of the country (56).

Forensic anthropology cases increased in the period analyzed (1992-2023) from 12 cases in 1992 to 75 in 2023, reaching a higher number of cases from 2006 and 2013 with 91 from each year. All cases where human skeletal remains were identified using skull-photo comparison techniques assisted by a computer as well as dental records reached 240 cases.

IV. DISCUSSION

The only accurate indicator of assessing a specific method's contribution of the field is to quantify its practical application. Before 1992, forensic anthropological studies were not given serious consideration in Uruguay. Human remains, when discovered, were analyzed by coroners or medical examiners with little or no training in forensic anthropology. Most considerations were reduced to the determination of possible cause of death. Generally, remains could not be positively identified, so they were buried as unknown. As a solution to this problem, the Forensic Anthropology Laboratory was created at the Morgue Judicial of Montevideo City in 1992.

Ever since its establishment as a section of the Morgue Judicial, the number of anthropological cases analyzed has been increasing. Thus, an upward trend is best illustrated by a modest number of 20 cases in 1992 that had gone up in a moment to 75 cases in 2023, reaching 91 cases by 2006 and 2013. Therefore, forensic anthropology has become an integral part of the medico-legal disciplines and its investigative branch all around the world. The scientific contributions of forensic anthropology to identifying human remains and solving crime have been written up in literature by many scientists. 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 paper shows that in Uruguay the number of cases receiving expert evaluation has risen yearly over the last 30 years. This is likely due to the establishment of a forensic anthropology laboratory in the medical examiner's complex. Without 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 officers to have an easy access to this service. The rate of positive identification has also improved considerably and comparable to other statistics in the USA (57).

According to the judicial forensic anthropology's files found at the Morgue of Montevideo City there were 1752 forensic anthropology cases from 1992 to 2023. 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 people, age at time of death, sex, stature, racial affinity, stage of decomposition of the remains (fresh, advanced decomposed, burned, or skeletonized), and eventually when it is possible 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, radiography or dental studies. However, skull-photograph comparisons by digital superposition assisted by computers was the most useful method used in identifying human remains in Uruguay from the period 1992-2023. This included a total of 240 cases which were solved and identified these techniques and, the number of people identified with skull-photo comparison techniques can be easily compared to that provided by others (57,58). This comparison of results confirms that the establishment of the Forensic Anthropology Laboratory at the Judicial Morgue of Montevideo has vastly enhanced the scientific community's ability to identify human skeletal remains in Uruguay.

However, the rate of identification in Uruguay depends on a number of facts. First, law enforcement agencies may not be knowledgeable about what pieces of data are relevant to help obtain a positive identification. Second, positive identification may be very difficult when no missing people have been reported. Factors of individualization are the process whereby a set of unique skeletal characteristics is matched with those of a missing person (2). Therefore, a positive identification could not be established when there are no comparative records. Third, dental records are particularly difficult to obtain in Uruguay as well as many other countries in Latin America. This is because dental health is poor and minimally maintained by most people due to the high cost. However, forensic anthropological work has made a significant positive contribution to the medico-legal system in the last 30 years in Uruguay. The number of cases increased to a level obtained in other more technologically advanced countries (57,58).

V. CONCLUSION

Today, forensic anthropology has been integrated into forensic teams in the majority of countries around the world. It is also working its way into medico-legal systems around the world. 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 positive identification must be made. The number of forensic anthropology cases has growth in Uruguay over the last 30 years, from 14 cases in 1992 to 75 in 2023, reaching the higher number in 2006 and 2013. Hopefully, in future cases, there will be an even higher percentage of positive identifications. All anthropological forensic investigations were commencing with initial observations about the sex, age, race and stature, time since death and cause of death. Skull-photo comparison was made by the digital superimposition using a computer. It showed sufficient consistency between the skulls and the facial photographs submitted for comparison. But the success in identification of human remains using skull-photo comparisons depends upon the quality of the submitted photograph as well as correct positioning of the skull and mandible. Although the remains were identified by skull-photo superimposition, results of another technique were used as evidences and incorporated in the final report, such as radiography, dental or DNA studies. The latter were consequently found to be in agreement with the identification based on skull-photo comparison. Forensic anthropological contributions to the Uruguayan medico-legal system have increased in the last 30 years. The number of cases in which positive identifications have been reached is similar to those of the US and European countries. It should be noted that according to actual tendencies, forensic anthropology cases are increasing. Among the reasons that explain this increase are the following:

- a. The creation of the Forensic Anthropology Laboratory at the Judicial Morgue of Montevideo City in 1992, this made it easier for medical examiners and coroners to contact the resident forensic anthropologist when needed.
- b. The creation of a full-time Resident Forensic Anthropologist position at the Laboratory in 1992.
- c. The ability to have a trained forensic anthropologist working in a forensic team with medical examiners, coroners, dentists and radiologists.

- d. A better knowledge of the scope of this modern branch of forensic science by the medico-legal system as a whole.
- e. The high percentage of positive identifications carried out by the Forensic Anthropology Laboratory from the period 1992-2023.

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