IMPORTANCE OF A NATIONAL ARTHROPLASTY REGISTER FOR IDENTIFICATION BY MEDICAL EXAMINER

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ABSTRACT

Mass catastrophes are realities that come to pass with lamentable frequency. In such situations, one of the fundamental forensic problems is in relation to identifying the victims. All the elements that might be capable of contributing towards this identification process are essential, and among these are orthopedic prostheses, which frequently remain intact. These prostheses consist basically of polymers, ceramics or metals. Metal components, which are usually composed of titanium, chromium, cobalt or steel alloys, are resistant to violent trauma or high temperatures. Human identification is possible if the identity of the implant is established and if this can be correlated with the individual in whom it was implanted. The logo on the prosthesis establishes who the manufacturer was and the serial number can be compared with the clinical process or with a prosthesis register, as has been implemented in several countries. The information in the database should include the patient's name, the implant model and its serial number, for consultation only in cases of forensic identification, while obviously respecting ethical issues of privacy. This article highlights the importance of creating a national prosthesis register.

Keywords – Forensic Anthropology; Disasters; Forensic Medicine; Forensic Pathology

INTRODUCTION

Background

To identify is to determine the identity of a person or thing[1]. Therefore, to identify a person is to determine individuality and establish peculiarities that made this person different from all others and only equal to himself[2].

Identification should not be confused with recognition. The latter is based on comparison between the sensory experience provided in the past and the same experience renewed in the present by the element that is to be recognized. This requires mental comparison between past and present, like in cases in which a surgeon is faced with postoperative radiographs of osteosynthesis procedures that he performed himself, and he recognizes and recalls intraoperative difficulties relating to the nature of the fracture, for example. Obviously, the longer the time that has passed, the greater the possibilities of error will be[2,3].

Identity should only be established when there is certainty and there is no margin of doubt. This is particularly of interest within Law in its various spheres, and it is not uncommon for physicians to be faced with situation in which human identification is required.

A story from the year 1889 can be recalled in this respect. A highly putrefied body was found in the region of Lyon (France) and Professor Lacassagne had the task of identifying it[3]. His first action was to have it taken to the morgue, which at that time was a precarious, depressing, dark and repulsive environment. During the autopsy, he did not find a uterus or ovaries, but found a prostate, thus confirming that this was a male individual. He then used an osteometric table produced by Étienne Rollet, multiplied its constants by the length of the long bones and thus determined the individual's height.

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In removing the muscles from the right leg, he noted that they were more atrophied than those of the left leg. By weighing the bones of the right and left feet separately, he note small differences and also chronic bone infection is the lighter bones. In this manner, he arrived at the deduction that the individual under examination presented claudication of the right leg. From the tooth wear, he estimated that this was a person in his fifties.

With these findings at hand, which were significant for that era, members of the family of the person who had disappeared soon recognized the various similarities.

Lacassagne, who at that time was seen as a sinister man, who possessed knowledge that was regarded until then as frightening and intriguing, limited himself to saying: "The merit belongs entirely to the cadaver itself. The dead tell their own histories"[4].

From the times of Professor Lacassagne to the present day, forensic science and medicine have evolved through major steps forward. Forensic dentistry has consolidated, forensic anthropology has developed and we are now in the era of DNA and its innumerable legal applications. However, development has brought problems that were previously unknown, such as major mass disasters coming from various means of transport that move increasingly fast with hundreds of people on board. What about the use of explosives in car bombs or by suicide bombers that turns a totally innocent civil population into victims? Whereas in the past, in great natural disasters such as the earthquake that devastated Lisbon in 1755 and claimed the lives of thousands of people, burying the dead as quickly as possible was the principal public health response, identifying these victims, which was almost always impossible, took on a secondary role[5]. Today, the value of identification is unquestionable. The possibility of preserving bodies in refrigerated chambers and collecting biological material for genetic analysis has increasingly generated a society that seeks answers. Identification of victims has taken on a fundamental juridical role, in addition to incalculable social value.

HUMAN IDENTIFICATION

There are several means of human identification. These processes not only are used on cadavers and skeletized remains but also may be necessary for living people (people who have disappeared or are on the run, minors or cases of refusal of identity).

In any work of this nature, certain stages are fundamental:

– An initial record, in which certain immutable elements relating to the individual that might distinguish him from others are set out.

– A second record of the same elements, done subsequently, insofar as a comparison is desired.

– Finally, the identification itself, in which the first two records are compared, thus confirming or denying the identity that is sought.

The fundamental techniques that ensure a good identification method are:

– Diversity or individuality: the individual should have certain elements that are specific to him and which no other individual has.

– Immutability: characteristics that do not change and do not become modified over the years.

– Perennity: the capacity of certain elements to resist the action of time and continue throughout life and even after death.

These fundamental concepts will not be of use if they are seen to be overly complex. They need to be practical with regard to obtaining records and should follow a methodology for filing and enable fast and easy searches[2,3].

Among the older methods, fingerprinting continues to be a very safe, cheap and accessible method worldwide. Although Malpighi made a series of observations on fingerprints in 1664, "lophoscopy" started to emerge as the science of studying the designs formed by the papillary ridges on the skin and a means of identification in 1823, through the studies of the anatomy professor Purkinje, who identified the various forms of fingerprints. In 1880, Henry Fauls advocated using fingerprinting as a method for identifying criminals. Eight years later, Francis Galton stated that this was the best method for identification, but it was only in 1892 that Juan Vucetich succeeded in proving the identity of a murderer through fingerprints marked with blood. For this, he managed to develop a classification system that was less complex but was shown to be more practical and efficient[6].

The role of fingerprinting is now well established, but it took many years to refine the technique for taking and documenting fingerprints and even today, there are several classification systems. Computerization has now enabled rapid consultation and com-

parison with preexisting databases.

To make identifications by means of fingerprinting, there needs to be a means of preserving fingerprints and their records in a preexisting official database. Thus, if cadavers are found in an advanced state of decomposition, this may make it impossible to identify them using fingerprints. If cadavers have dental records, such as odontograms or previous radiographs, these may serve as an alternative or as a form of screening for genetic analysis.

It is clear that in cases in which it is necessary to identify cadavers in an advanced state of putrefaction or that are greatly fragmented, as in cases of explosions or air disasters, alternatives to the use of fingerprints need to be sought. Although collection of samples of biological tissues for DNA analysis is slow and burdensome, this has provided a partial solution for this medical-legal problem.

A NEW ERA

The events of September 11, 2001, in which two hijacked airplanes crashed into and exploded in the twin towers of the World Trade Center in New York, thus demolishing them and reducing them to tons of rubble with thousands of victims inside, produced an extraordinary challenge for the forensic teams: to identify the thousands of human fragments buried in the wreckage. Severe fragmentation, advanced decomposition and extreme carbonization, sometimes in association with calcination may even make DNA identification impossible. The finding that several types of metal had melted made it possible to estimate the extreme temperatures reached insider the World Trade Center during the fire caused by the fuel from the airplanes involved[7].

Bones may be reduced to 25% of their size when exposed to temperatures of 700 to 900 ºC, while the metallic materials generally used in present-day implants do not present significant alterations[8] (Figures 1 and 2).

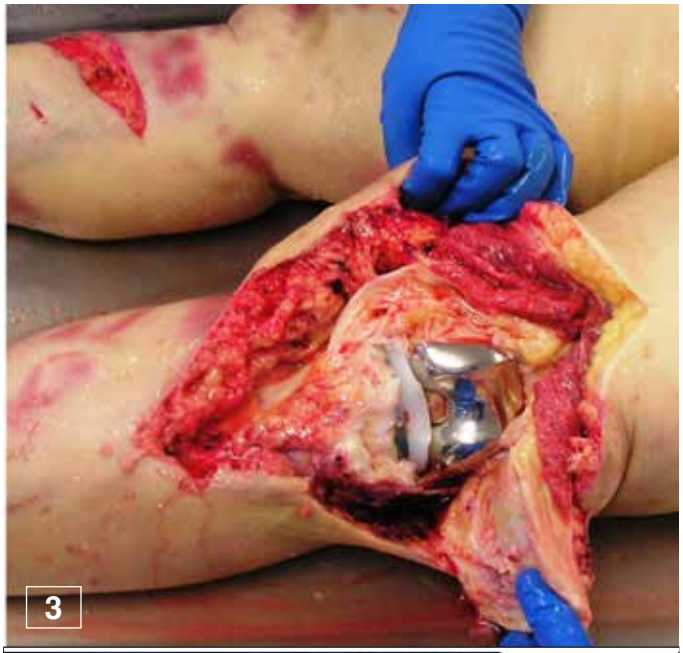
Orthopedic prostheses consist basically of polymers, ceramics or metals. Metallic components are usually composed of titanium, chromium, cobalt or steel alloys[9]. These are elements that resist violent trauma or temperatures higher than 1000ºC, and may sometimes be valuable vestiges of an individual's existence.

Human identification is possible if the identity of the implant is established and if this can be associated with the individual in whom it had been placed[10]. The logo on the prosthesis provides recognition of the manufacturer, and the serial number can be compared with the clinical process or with the prosthesis records, as has already started to be done in some countries. The information in the database should comprise the patient's name, the implant model and the implant serial number, to be consulted only in cases of forensic identification, while obviously respecting ethical issues of privacy[11] (Figures 3 and 4).

Figures 1 and 2 – Necroscopic characteristics of a carbonized body. Note the hardening of the tissues and the loss of the extremities through calcination, thus making the usual identification methods difficult.

ARTHROPLASTY PROCEDURES AND THEIR REGISTRATION

Arthroplasty is one of the orthopedic procedures most performed. It rapidly restores the function of the compromised joint and tolerates a vast margin of technical variability. These characteristics, together



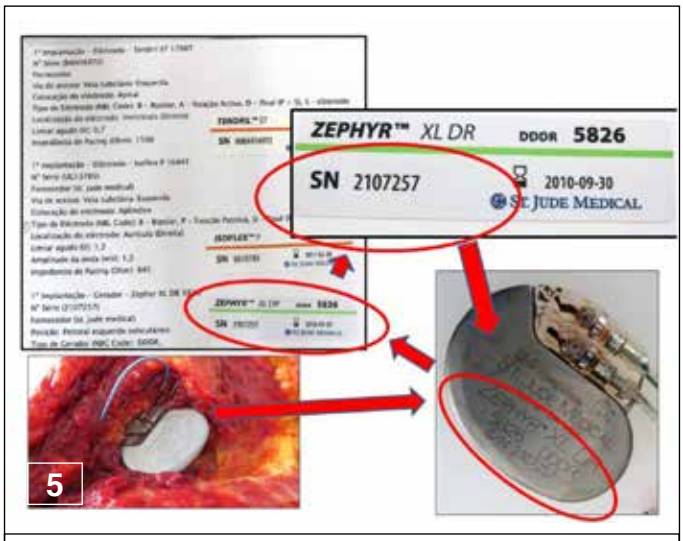
Figures 3 and 4 – Orthopedic prostheses resist violent trauma, thus allowing identification of the manufacturer and making it possible to trace the prosthesis.

with growing life expectancy and the demands for quality within this life, have made arthroplasty extremely popular[12].

These implants, which ideally should be definitive, are conditioned by their design, the quality of the materials used and the type of use to which they are subjected. With increasing life expectancy, in association with the increasing number of arthroplasty procedures performed, the number of complications has grown proportionally, thus creating the need for revision of the prostheses. In view of the need for a tool for monitoring the prostheses in circulation and ensuring their quality, an arthroplasty register was created in Scandinavia in the 1980s.

Such registers may become a precious forensic tool when filled out correctly, including the patient's name associated with the serial number of the prosthesis, thus making it possible to directly determine the patient's identity in situations in which the implant is recovered intact in the midst of severe injuries, like in air disasters[13,14].

This process has already been accomplished in these situations. However, without a database that would enable direct correlation between the implant and the patient, the process is lengthy and dependent on collaboration from the supplier companies, which would be judicially instructed to provide a list of sales to hospitals from the respective batch, or the specific prosthesis is the serial number is unique. Once the hospital has been identified, all the surgical procedures relating to that period would then have to be reviewed, often manually. This is a slow and excessively complicated process[13,14] (Figures 5 and 6).



Figures 5 and 6 – Like pacemakers, orthopedic prostheses have serial numbers associated with barcoded labels that should appear in medical files, thereby enabling rapid identification of the implant and patient.

CONCLUSION

The arthroplasty register is an audacious, promising and very important project. Just like the development of the classification systems for fingerprints, decades may be needed for a consensus to be reached among the many orthopedic, neurosurgical and plastic surgery societies, among others, that undertake arthroplasty within their functions, among other implants, in Europe and worldwide.

Controlling implant placement, whether these are metal implants such as osteosynthesis materials or silicone implants such as breast prostheses, may make it possible to identify adverse reactions or manufacturing defects, thereby avoiding new complications among other patients undergoing surgery.

Breaking through the bureaucratic barrier between data protection and surgeons' own inertia, with their concern regarding taking on yet another task of filling out registers, in the light of ever-shorter time when faced with a panoply of tasks, will be the greatest challenge.

Creation of the National Arthroplasty Observatory, functioning within the Quality Department of the Portuguese General Directorate of Health and supporting the RPA, has made it obligatory to register all implants introduced.

The way in which this will be done and the information that is to be registered is still under study, but the intention is that the information to be registered ensures traceability of the implant. That is: "give me the element identifying the person with the implant and I will tell you which implant he has; give me the identification of the implant and I will tell you who has it". When this has been achieved, we will finally have opened the possibility of forensic identification.

All of this will be done with the absolute respect for privacy and the anonymity required by the CNPD. It should be noted that anonymous information does not need to be simultaneously non-identifiable: it can be identifiable without ceasing to be anonymous.

It will be enough to use the Health User's Number that appears on the Portuguese Citizen's Card, which became obligatory starting in 2012, in replacement for the old BI[15].

Because we recognize that registering all implants that are used seems to be a utopia worthy of any science fiction novel, we need to seek a principle or basis. The arthroplasty register may be the start of a new era, enabling not only identification of complications but also furnishing unquestionable data in developing new prostheses and safer techniques.

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