RECOMMENDATIONS IN FORENSIC ANTHROPOLOGY

SPANISH ASSOCIATION OF FORENSIC ANTHROPOLOGY AND ODONTOLOGY

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Introduction

Since the eighties, in which Forensic Anthropology take its first steps in Spain as a discipline embedded in Forensic Science, a number of concerns were outlined among the professionals dedicated to it that are tackled initially in an individual way and later collectively. This makes us consider, on the one hand, the need to organize ourselves and have a series of activities and tools that allow us to get to know each other and the works and activities we develop in our respective centers, on the other hand, the desire to overcome this first stage through agreements that will enable all of us to have and to use if necessary, some protocols that might be used as basis for the reports carried out in each laboratory.

The first of these concerns, the need to organize ourselves, is reflected after a number of attempts and the start up of the creation of the Spanish Association of Forensic Anthropology and Odontology (AEAOF) in 2006. The second one, to have some available protocols, begins to be developed with the proposal of creating some working groups among the AEAOF's members who will be in charge of drawing what at first was proposed as "AEAOF's protocols". Subsequently and following analysis and discussion of the proposals it was concluded most appropriate to establish a number of recommendations to assist and inspire the elaboration of anthropological-forensic reports. Finally, at the meeting held in May 2012, at the National Institute of Toxicology and Forensic Science in Madrid (IV Scientific Meeting), great unanimity was achieved on the final text that under the name "Recomendations in Forensic Anthropology" we offer to all AEAOF's members and also to those professionals who might be interested in this discipline.

I would only like to add that I hope and we all hope that this protocols will be found useful for everyone.

Jose Antonio Sánchez Sánchez.
President of the AEAOF.

Recommendations

This text has been drawn up in the 2nd Scientific Meeting of the Spanish Association of Forensic Anthropology and Odontology (AEAOF) held in Donostia-San Sebastián in 2010. It's the result of the need to standardize procedures as a step towards the accreditation of professionals and laboratories in Spain. This need is recognized by the majority of professionals of Forensic Anthropology in Spain.

The work was divided among several partners who showed their interest in the different topics raised and after the elaboration of a basic text for debate, it was forwarded for consideration by all the members of the association, by e-mail and during the 3rd and 4th Scientific Meetings of the AEAOF. Efforts have been made to ensure that the authors highlighted in every topic the internationally accepted methods.

At the 3rd Scientific Meeting held in Madrid, the different topics provided were intensively discussed, and some specific issues were decided by the majority (age-range, terminology of the age,…). With many of the modifications proposed it was agreed to differentiate on the one hand what we called 'Diagnostic Criteria for Identification' (sex, age, size and ancestral origin estimation and identification criteria) and the rest of recommendations.

With all of these we get to the 4th Scientific Meeting held at the National Institute for Toxicology and Forensic Science Headquarters in Madrid, during which little proposals were made for changing the text of Diagnostic Criteria for Identification. Aditionally, during this meeting it was also decided a change of the term "protocols" as it was originally written in the document by the term "recommendations".

During 2013 the rest of the documents have been subject to discussion ending up with a few little modifications.

We thank to the team of the Twinning Project in Turkey (Pedro Garamendi, Hande Arli and Pinar Çelebioglu) for his kindness, dedication and time in the English translation of the "Recomendations in Forensic Anthropology".

It is also necessary to thank all our authors for their efforts, not only for drafting the texts but for accepting the modifications and critics done during these years too. Therefore it is already a document that belongs to everyone and is for everyone.

It is as well, an open document, that is to say, a not definitive document, a document that will have to be improved over the years to come with the contributions of those willing to make them.

Fernando Serrulla Rech
Coordinator of the document

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REMOVAL AND EXHUMATION OF SKELETAL REMAINS

PROTOCOL	REMOVAL - EXHUMATION OF SKELETAL REMAIN
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The scope of Forensic Anthropology has grown over time, due to the growing problem of corpse identification. A clear example is the so-called events with multiple fatalities from natural disasters, collective accidents or terrorist attacks.

However, most elements under study in an anthropological-forensic laboratory belong to one or a few corpses which can be found partially or totally skeletonized, in bad conservation status or in advanced process of putrefaction.

These remains can be found above ground or buried. From the forensic point of view, most cases belong to the first group, while those in the second one are often found as a result of building works or as a result of a confession or testimony obtained during a police investigation.

On the other hand we need to take into consideration, and above all, depending on the work organization from the different Institutes of Legal Medicine, that not all medical-forensic experts have in-depth anthropology knowledge.

Due to all the above is necessary to set out the guidelines when finding a corpse to identify, that allow to collect as much information as possible from the corpses, the environment, the surrounding circumstances and its subsequent transfer to the anthropological and forensic laboratory.

Needless to say, the importance of this information for a judicial investigation.

May serve as an example that the study of the area of the discovery and the way the remains were found may lead to the origin of death. Moreover, data on death may be better reached if we study the scene's elements and if we relate those with the corpse.

1. GUIDELINES

At the news of the appearance of remains to identify, the first thing to do be done is to contact the anthropological-forensic Unit. The unit will consider, in the light of the preliminary information provided, the need to have a Forensic

Anthropologist on the scene, and if he goes, he will act as adviser to the medical-forensic expert and will provide guidance on the different stages of the removal.

One point that has to be mentioned, it will be an action that will require time, therefore there is no rush. It can even be postponed if environmental or personal security circumstances are adverse.

Our actions will depend on whether the remains are above the surface or buried.

1.1. Above ground corpse.

We will establish two phases; a non-invasive one and an invasive one, depending on whether we enter or not the area surrounding the remains.

The area will be cordoned off.

In the non-invasive phase, we will be on the periphery of the remains and we will make an orderly and meticulous observation of the scene.

We will set the scene through sketches, photography or video. When using sketches, we will always point out the geographic north and measurements shall be made taking fixed not removable elements as reference.

The observation has to include the zone where the elements to study are (apartment, empty field, outdoors, stream, etc), the circumstances of the finding (first report, previous contamination), the actual environmental conditions (temperature, season), the annual environmental conditions (rainy, sunny, wet, dry climate), the circumstances previous to the finding (floods, works on public or private spaces), characteristics of the remains (corpse in deep decomposing, in conservation status or skeletonized), when finding bone remains will be relevant any abnormal distribution, concentration or position.

In the invasive phase, we will get into the perimeter where the remains to study are. Without touching, we make a first assessment of the origin (whether are or not bones or remains) and specie (human or animal). We are looking for elements that provide data about the identity. Thus, we pay special attention to the clothing, of which we shall describe type, fabric, size, brand, drawings, particular details (zippers, pockets), identification labels (particularly in persons who are institutionalized). Personal items (glasses, jewelry), personal documents (identity, social security number, credit cards). Surveys for biological signs like dry spills (blood, sperm, etc).

The next step would be to focus on the body or remains and conduct a preliminary study, on the basis of which some answers may be advanced that,

although provisional, can shed light on the possible identification. Thus, for example, we could point out the sex and the approximate age interval. In the same manner, with minimal handling we may see if it is its original place or if there is the possibility of a previous transfer. We will study the loss of skeletal remains valuing a vital or postmortal origin in that loss.

If we notice any injury we will make the same assessment about whether or not its origin is vital. As an example, sometimes the position of a fractured limb offers guidance on this subject.

When this preliminary observations have been made, the collection of every fragment or remain will take place. This collection shall be carried out in an orderly manner, so that the bones and feet will be placed separately and indicating the side they belong to. Special protection shall be taken with ribs and head, given its fragility.

Pack must be made of a dry material such as paper bags. In the case of using plastic, we need to make sure there are small holes to allow ventilation. Concerning the teeth, we must always consider that they are easily detachable due to attachment loss, and we need to make sure that they are not to be lost.

All packaged bones will be put in a box designed to transfer remains or, failing this, in a shock-absorbing material box. Together with the remains shall be sent a judge's order to do an anthropological study and all kind of questions that may be raised. Likewise, the documentation consisting of the removal report or the collecting of remains report, that shall contain all the information about the activities taken on the place of the finding, will be sent. Obviously, this information is crucial to the forensic analysis.

1.2. Buried corpse.

In the case of buried remains, it will be necessary the involvement of an archaeologist or of qualified persons or with sufficient archeological knowledge, since the exhumation shall be done following the methods and techniques of this discipline.

First an appropriate planning is to be achieved, preventing in advance any contingency from the meteorological ones to the necessary materials and utensils.

All possible ante-mortem information need to be gathered, like identifying characteristics of the buried person (age, gender), clothing, associated pathology, dental work, particular features, complimentary clinic tests (image mainly), type of violence suffered, disappearance time, etc.

If the grave has to be located, careful attention would need to be paid to the

characteristic of the terrain, irregularities, vegetation, etc.

It needs to be established whether the burial is individual or collective, isolated or adjacent to other places of burial or graves, primary or secondary (depending on whether or not there has been a previous transfer), if the burial is intact or has been altered (due to human actions, animals or other events). In the latter case we must point out that many forensic cases are altered exhumations due to the existence of previous construction work.

2. STEPS:

The area shall be clearly delimited using stakes and ropes, fixating the area, with photographs, mapping of the area through global positioning system.

Elimination of waste products and vegetation. Special care of the biological remains in the surface such as hair and clothes must be taken.

Uniform and horizontal elimination of the soil's upper layer. The outlines of the grave will be delimited. Any color change at the zone will be examined.

Elimination of excess soil. As the first remains appear, they will be determined by description, photography and cartography. Excavation taking special care not to damage skeletal remains. Avoid tool marks. Sift the soil for evidences (projectiles, ammunition shells, cigarettes, paper tissues or handkerchiefs, wrappers, cigarette butts, etc).

Ensure every finding. Confine the corps digging by its sides up to 50cm deep.

Display everything without altering the evidences. Special care must be taken when collecting the soil around the skull for any hair to submit it later to the laboratory.

Collect related remains and evidences. An inventory has to be conducted. Hands and feet kept separately, indicating laterality. Special care should be taken with the teeth since they may easily be lost. Record every evidence found, both those that may identify both the victim and those that may identify the aggressor.

Excavation must be continued up to the intact soil layer.

Package with caution. Use paper bags and cardboard boxes. Be cautious when using plastic bags since encourage the appearance of moisture and thus of microorganisms. Every evidence must be numbered.

Final photograph.

Keep the chain of custody at all times.

Annex

FIELD NOTEBOOK / REMOVAL REPORT / ABOVE THE SURFACE REMAINS

Court of origin
Prosecution
Municipality of origin
Medical-forensic expert in charge (name and e-mail)
Date and time of discovery or exhumation
Date of despatch

Types of remains (skeletal remains, putrefaction, conservation)
Description of the circumstances and the way they were found (who found them, background of the place, preliminary proceedings, manipulations)

Geographical characteristics of the area (rural, urban, others)
Climatic characteristics (general, previous days, the day of the discovery)
Location of the remains
Above the surface: covered (material), uncovered, spread range, position.
Buried: burial type and description grave, characteristics), position of the remains, previous manipulations, technique of extraction.
Fauna of the area (scavengers) and observed at the scene
Supplementary remarks
Sketch of the area with coordinates.

Data for guidance on how to identify the remains (suspicion of identity, previous information, documents found, personal belongings, clothing)
Circumstances of the death
Data of the death (cadaveric fauna). In case of identity suspicion, last time it was seen alive.

Samples collected on the area.
Remains above the surface: material covering the corpse, soil from under the corpse, others.
Buried: samples of the soil covering the remains, of the lower area, of inside its cavities (thoracic and abdominal), others.
Remains collected from the water: temperature of the water, vegetation, sample of the water, others.

Inventory of the remains (diagram and description)
Inventory of the bone pieces (diagram)

Chain of custody
Responsible for the collection: (identification, day/time)
Responsible for the packaging: (identification, date/time, packaging materials)
Responsible for the transport: (identification, date/time)

FIELD NOTEBOOK / REMOVAL REPORT / BURIED REMAINS

Court of origin
Prosecution
Municipality of origin
Medical-forensic expert in charge (name and e-mail)
Date and time of discovery or exhumation
Date of despatch

Place: without grave, simple grave, others

Stratigraphy: stratigraphic unit, related, description of the filling.

Burial
type: primary, secondary, individual, collective
position: prone, supine, right lateral, left, fetal, others.
Orientation: N-S, S-N, E-O, O-E, others
Levels
Decomposition: in clogging media, in empty media
Shroud and associated clothing
Head: left, right, front, on the chest, facing down
Arms: pressed against the body, crossed pelvis, crossed abdomen, at head level, under the body, others.
Legs: extended, semi-flexed, flexed.

Inventory of objets and clothing
Others observations: about the place, position and deposition, observable macroscopical lesions, objects and clothing description.

Soil and filling samples

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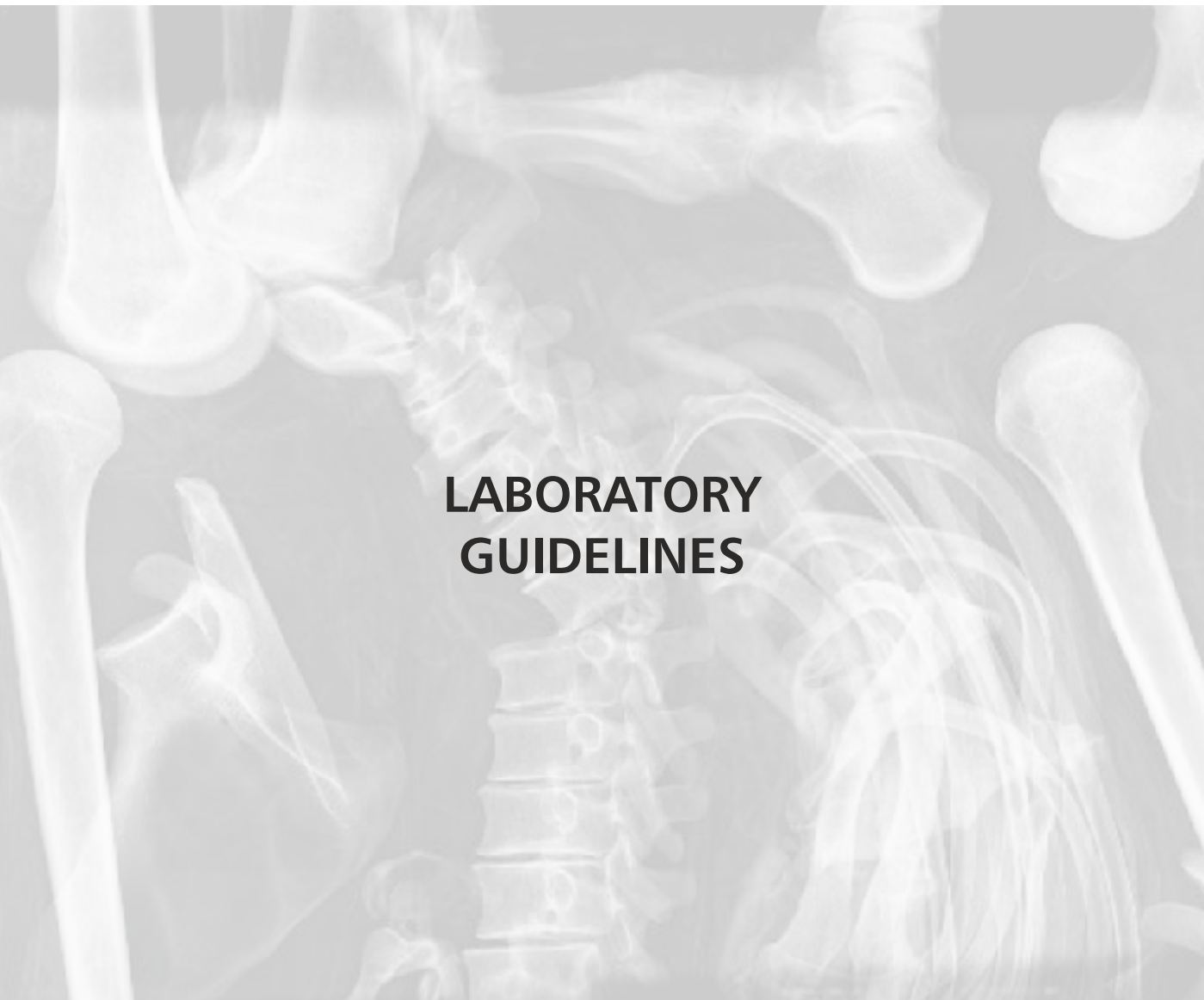

LABORATORY GUIDELINES

PROTOCOL	**LABORATORY GUIDELINES**
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This section includes information about the routine laboratory work before the anthropological analysis take place. Aforementioned laboratory work comprises of the traditionally applied techniques including the bibliographic search, the recommendations of anatomists who have sound professional background and craftsman coming from diverse places of the world such as Granada, Mexico and Brazil. In addition, the section sheds light on the mistakes that have been committed in this field and the lessons learned from those malpractices.

It is important to apply practical techniques that shall give rise to more efficiency at the workplace while taking into account that there are other existing methods/techniques that are in use and provide equally credible results.

1. ADMISSION OF THE MATERIALS TO THE LABORATORY:

All the materials to be admitted by the laboratory should be accompanied by affidavits both signed by the deliverer and recipent and these documents should include the number of the containers, the content of each chest, the origin, chronology and the date of the delivery.

In the archaeological cases, it is essential to record the excavated findings and/or discoveries. Ideally, the graves that are under the investigation should be marked level by level in line with the chronological phase accompanied by photographs and if it is necessary , stratigraphic profile is recommended. If it is not possible, archeological sites are identified with numbers to indicate the histo-chronological period that the findings belong. It is the only way to conduct a research that provide reliable paleodemographic results. Findings without any references should not be accepted.

If the received material is a forensic case, the measures concerning chain of custody should be taken. It is essential to comply with the Act JUS/1291/2010 BOE 122 dated 19th of May. The below mentioned points should be addressed in the documents;

- The date and the hour of the admission
- The judicial authority that sends the materials
- The person and/or the company that delivers the material
- The type of packaging and seal and the method of conservation
- The person that receives the exhibits, deals with the opening procedures and allocating identification numbers.
- The place where the materials are kept until the opening process.
- The description of the package, the type of the containers, possible damages or anomalies detected , the attached documents etc.
- The description of the label, whether it is complete or incomplete, readable or not, without label etc.
- Type of manipulation
- The place where the exhibits are kept until the analysis start

It is recommended to unpack the materials (exhibits) and lay them on the metal trays covered with blotting paper in order to compare the nature of the exhibits received.

Most probably the bones are received in plastic and airtight bags and prior to the packaging, they might have lost their humidity. If they are left as mentioned above, the bones will become more fragile and brittle or it will result in proliferation of fungi, which results in destruction of the exhibits. In other words, effective measures should be taken to avoid information loss stemming from deterioration of the materials.

Each tray should be labeled by the laboratory so that the materials under investigation can be traced in all process. The materials shall be traced with the numbers displayed on the labels in cleaning , analysis and research phases of the entire process. This issue requires constant emphasis and constitutes the most fundamental part.

The exhibits should be kept in an environment where the temperatures are controlled, it is recommended to place the exhibits in the shade until they get completely dried.

Although the very first step of the process is to dry the bones completely, the marks of humidity can go unnoticed. In our laboratory, we have a drying closet that provides improved ventilation and heating with the capacity of 12 trays functioning simultaneously and result in complete dryness in few hours.

Once the bones reach complete dryness, they shall be kept in a stable environment where their conservation is assured until the laboratory analysis starts.

2. CLEANING OF SKELETAL REMAINS:

The bones received are usually fragile and sometimes brittle. It is important to know that preliminary drying should take place in the shade or in the closet, which will increase the consistency in terms of humidity and therefore, the bones will be more durable against manipulation. After the drying process in the shade or the closet , if it is necessary, the bones can be moisturized again. The bones will be less likely to get detoriated in this way.

If the bones are archeological remains, the important point is to get rid of the sediments on the bones. In order to wipe off the sediments, little brushes wih soft bristles can be used. The most appropriate way to wipe off the sediments is to sop the brush in weak stream and to clean the surface of the bones. Please take into account that the humidity can easily cause layers of mud. It is better not to immerse the bones into water. In order to remove the soil from the interior part of cranium or from the small cavities (orbits, nasal opening, medullary canal). It is essential to moisten the soil slowly to soften and remove the soil particles using odontologic tools. The use of spray gun is recommended.

Skeletonized remains are generally brought with soft tissues and putrilageous tissues.If these remains go through anthropological investigations, it is convenient to disinfect the remains before manipulating the bones however there should not be any loss of forensic information.

In order to preserve them well, the remains are immersed in soapy water and then cleaned with the help of a brush in the running water. Later on, place them in %30 diluted sodium hypochlorite during 15 minutes and rinse the remains well until the residues of the solution completely vanish. The reason is that the solution residues may destroy the bones when they crystallize in time. The better solution to this problem is to sink the remains into a container filled with water for a few hours and to keep on changing the water constantly. After taking them out, ph of the water used should be checked.

3.CADAVER REMAINS.

The samples should be softened in order to remove the soft tissues. In the past, the anatomists would scrape the flesh from the bones and they would leave them in the water which would be refreshed every 3 or 4 days until get to reduce body any decomposed remains soft, and then the anatomists were able to remove the soft tissues along with the ligaments. Nowadays, the process of scraping the flesh from the bones is shorter as chemical products are used as accelerants. Previously the same process used to take almost 3 months and it

was long and tedious process. After experimenting with different substances and methods, we prefer to boil the remains for 4 hours with running water in which we add 2 grams of sodium hexametafosfate (Calgon, registered brand mark) for each liter of water. Once they are boiled, the soft tissues are scraped easily however you may need bistoury (scalpel) especially for the parts where ligament insertion is seen.

Right after this process, the bones may turn darkner. For this reason, we sink the bones into hydrogen perixode, 100 volume of oxygen wáter,diluted %30.This process should be controlled because the time required for the bones to change their color varies. The time range for the bones to change the color is between 45 min.to 2 hours.If the bones are exposed to the solution for a longer time, there is a risk of decalcification.

It is posible that all the long bones and diploe protect fat and fat can penetrate into the interior part of the bones after a long time of exposure unless the necessary precautions are taken. We preserve the bones dated XIX century as they contain a lot of fat. This is common when they are complete because in the fragments are evacuated through the medullary canal

In order to solve this issue, we keep the remains in trichloroethylene for about 10-15 days. This product does not alter the conservation and it is not necessary to monitor the remains constantly. However it is very hard to find trichloroethylene as it is classified as carcinogenic and substituted with percholoroethylene. Based on our experience, the latter does not serve to remove fat from the bones.

Other specialists have used and are still using different methods:

- Heat with sodium hydroxide in a iron container almost to the boiling point. Remove from the heat source and cool the container again. Repeat the process up to three times.
- Boil with ammonia
- Use wood ashes rich in potassium hydroxide
- Immerse in benzene

4. STUDIES OF FORENSIC INTEREST:

It is highly recommended to take bone-tissues in all the forensic cases before starting with any kind of manipulation .

In compliance with the National Toxicology and Forensics Institute norms (Act JUS/1291/2010, BOE 122, 19th of May), at least 4 dental pieces which are

unharmed should be kept concerning the simple admission and preparation. When possible, molars and a long bone,preferably femur, are recommended to be kept for the genetic identification studies.

According to the protocols set by the United States in 1991, it is recommended to have all the skeleton X-rayed before the cleaning process kicks off in order to handle the investigation and prevention of illegal executions and referees and summaries.

Keeping the dental radiographies of the bitemarks, periapicals as well as panoramics and of all the bones of the skeleton is vital. Attention should be attaced to the documentation of the fractures and anomalies of growth and surgical interventions. In addition, the radiography of front sinus can help the identification phase.

It is important to keep some of the bones in their original state as stated in the protocol. In line with the protocol, two lumbar vertebras shall be sufficient. Then it is only possible to wash the rest of the bones but without being rinsed nor scrubbed.

In these cases, we had better not wash the bones, we can only get rid of the dirt on the surface of the bones using brushes. We should not use water or any other product. While manipulating the bones in all the stages we use nitril gloves.

If the bones are just received prior to the identification , it is important to preserve the followng samples for post analysis

- Transverse cut in the middle of each femur , 2 cm height or more de 2 cm.
- Transverse cut in the middle of each fibula, 2 cm height or more.
- A 4cm cut on the extremity of sternum and one of the ribs (the sixth one,if it is possible).
- A tooth, preferably a mandibular incisor.
- Molars for a possible subsequent identification in genetic analysis.
- Plaster cast of the cranium in case of a facial reconstruction.

In our laboratory, we have substituted the last phase of forming a cast for facial reconstruction with an IT supported system of three dimensional modelling of a cranium with the help of 3D scanner (vivid 910 Konica-Minolta)

Make sure that all the exhibits are given an identification number, the date and the name of the person dealing with them

Once all the precautions are taken for the samples to remain unaltered, the cleaning method of cadaver remains shall continue.

Before we start to work on the remains, it is advisable to create an inventory by marking the remains with an undeletable marker indicating the origin and when possible, the bones of the different individuals should be separated. To exemplify, attached please see the inventory that we use for sub adults.

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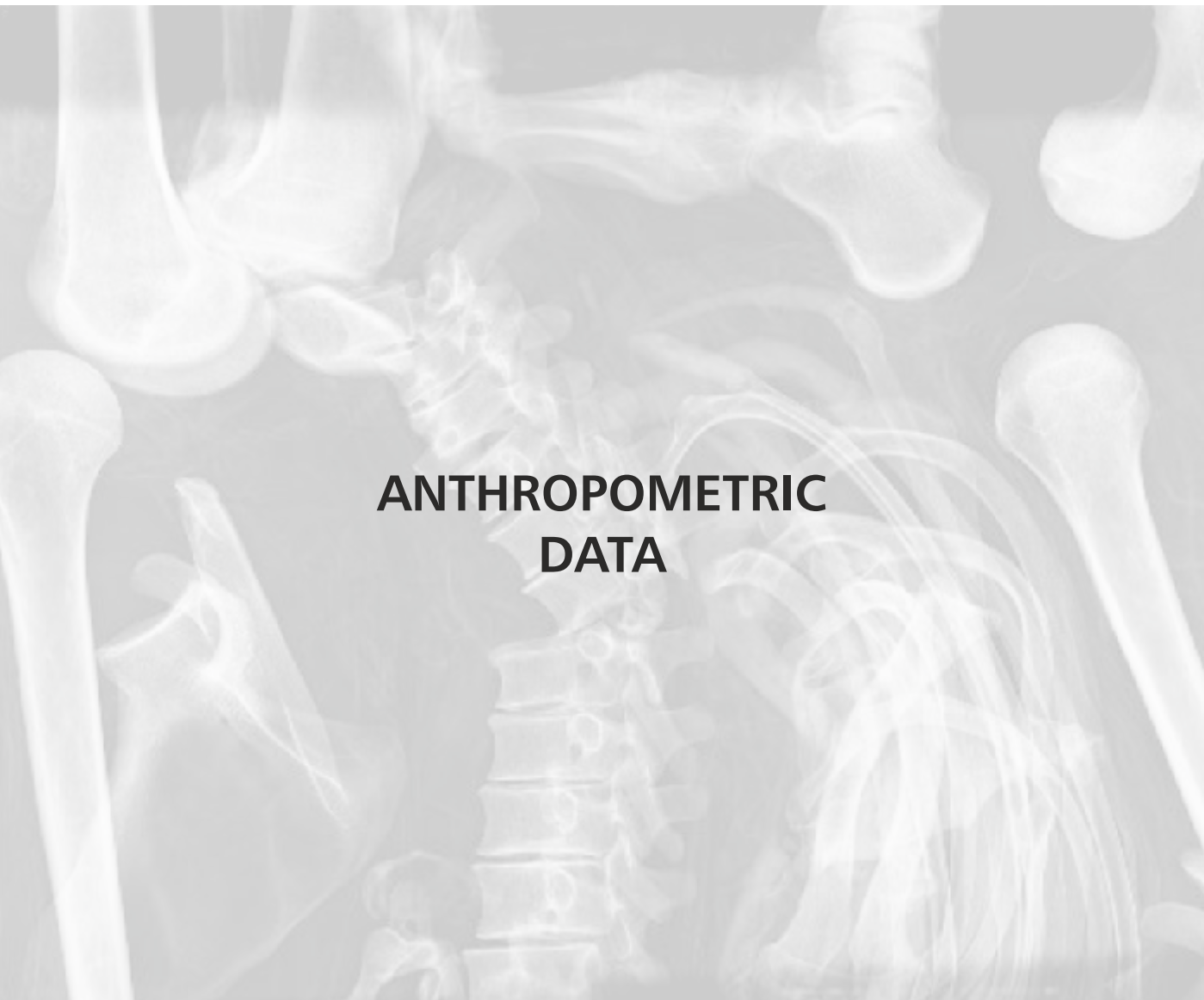
FICHA INVENTARIO
INDIVIDUOS SUBADULTOS

Cementerio	Número
Sexo	**Edad**

Hueso		Fase de unión	Hueso		Fase de Unión
Ver. Cervicales	Cuerpo	Arco Neural uno con otro	Costillas		
	Arco	Arco Neural con el cuerpo	Esternón		
Ver. Torácicas	Cuerpo	Arco Neural uno con otro	Occipital	Escama	
	Arco	Arco Neural con el cuerpo		Porción lateral	
Ver. Lumbares	Cuerpo	Arco Neural uno con otro		Porción basilar	
	Arco	Arco Neural con el cuerpo	Temporal	Porción petrosa	
Ver. Sacras	Cuerpo	Arco Neural uno con otro		Escama	
	Arco	Arco Neural con el cuerpo		Anillo timpánico	
Hioides			Esfenoides	Cuerpo	
Escápula	Coracoides			Ala mayor	
	Acromion			Ala menor	
Clavícula	Epífisis Esternal		Parietal		
Húmero	Cabeza		Frontal		
	Distal		Maxilar		
	Epicóndilo medial		Mandíbular		
Radio	Proximal		Dientes		
	Distal		Nasal		
Cúbito	Proximal		Etmoides	Laberinto	
	Distal			Lamina mediana	
Coxal	Ilion	Ilion-pubis	Concha nasal inferior		
	Pubis	Isquion-pubis	Lacrimal		
	Isquion	Isquion-Ilion	Vómer		
Fémur	Cabeza		Zigomática		
	Trocánter Mayor		Palatino		
	Trocánter Menor		Huesos del oído		
	Distal		Manos	Cuerpos	
Rótula				Metacarpos	
Tibia	Proximal			Falanges	
	Distal		Pies	Tarsos	
Peroné	Proximal			Metatarsos	
	Distal			Falanges	



ANTHROPOMETRIC DATA

PROTOCOL	**ANTHROPOMETRIC DATA**
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ANTHROPOMETRIC DATA.

Measuring the bones has historically been the main study method in Physical Anthropology. Used as method for documenting the findings, facilitates the description of the individual as well as comparing the groups. This will allow us, in the practice of Forensic Anthropology, the estimation of various features, especially the size, sex and race.of the bones has historically been the main study method in physical anthropology. Used as method for documenting findings facilitates the description of the individual as well as comparison of groups. This will allow us, in the practice of Forensic Anthropology, the estimation of various features, especially the size, sex and ancestry.

Until the 60s comparisons between groups, and therefore their assignments, were made based on; *individual* or so-called *indexes* measurements, which combine two individual measurement, allowing an approximate estimation of the form. Meanwhile, the development of statistical methods and information technology currently has carried out the calculation of parameters using the *multivariate* analysis, as reflected, for example, in the FORDISC (Jantz and Ousley, 2005). Today, the systematic use of that software, is very recommended, provided that we apply with due caution when accepting its inferences, which sometimes have severe limitations, mainly due to the reference populations used (Elliott and Collard, 2005 Ramsthaler et al., 2007). At the moment, the development and the application of complex mathematical methods, such as Fourier analysis, which aims to reduce the form to a mathematical curve, goes even further and allows to start from the 90s a boom in *morphometric* studies (Claude , 2008) in Physical Anthropology, whose future applications already starting to be reflected in forensic anthropology work (Gonzalez et al., 2009, Wilson et al., 2011).

Historically, the utmost importance has also been given the to cranial measurements and measurement proposals were multiplied to infinity. Today, however a consensus has been reached in terms of the importance of postcranial measures and the necessity of reducing the number of mandatory measures to those which have proven to be truly useful in practice, leaving as optional those that are only of interest in research or in exceptional circumstances.

In this chapter, after an introduction to the general techniques of measurement and instrumentation, we will describe the measurements considered standard in -Forensic Anthropology from those listed in *Standards for*

Data Collection from Human Skeletal Remains (Buikstra and Ubleaker, 1994) -, by proposing 24 cranial, 10 mandibular and 44 postcranial, as well as corresponding reference points. However, it should be pointed out, that these set of measurements were designed for the comprehensive data collection in Physical Anthropology in previous studies to the return of remains to indigenous communities in North America. Therefore, while maintaining its reference value and completeness, rarely it will be required as a whole in a Forensic Anthropology case.

For specific aspects of data collection, such as identification of single bones, laterality, etc., we refer to the consultation of the typical manuals of general osteology whose international references are those of William Bass (2005) and Tim D. White (1999 and 2005).

1. GENERAL CONDITIONS OF MEASUREMENT.

A good measurement in order to be useful, must provide homogeneous and repeatable results, by trying to limit the most, the error in both intra -and also- interobserver. For this you need to start from reference points whose determination leave the least space possible for ambiguity. For the same reason there is also a tendency to use maximum measurements, which is easier to obtain than minimum measurements and if necessary, can be obtained by trial and error techniques with the usual instruments, and are more reproducible than arbitrary measures.

The measurements shall always be taken in millimeters not fractional rounding up or down to the most immediate.

In general, for measurements in bilateral structures, we will take the ones on the left and only if that take is impossible, will carry out the measurements on the right side, always outlining this circumstances-with an "R" next to the measurement if collected a data sheet. Fragmented or deformated bones must not be measured in dimension corresponding to the measurement. However, we do need to estimate the measurements for remains slightly eroded or rebuilt, outlining this situation with an "*" - star-in the data sheet.

2. MEASUREMENT INSTRUMENTS.

Multiple measuring instruments are suggested which are useful without doubt in most specialized research. However, for our purposes, and for the collection of the proposed measures, the list above is sufficient:

- Tape measure: an ordinary metallic or non-distensible material is sufficient. It is

used to measure circumferences and it is not recommended to use it for other measurements.

- Calibre or vernier caliper: Formed by a ruler which has a fixed branch at one end and another that, when sliding on the ruler allows to read on itself, on a dial or a digital display, the distance between the branches. Many models have different branch points to measure both external diameters of an object placed between the ends and internal diameters ends of a hole wherein the points are introduced.

- Calliper compasses : derived from pelvimeters used by obstetricians, comprise of two question mark shaped branches connected by the edge of the straight side. Connected to one of the branches, it is a ruler marked with a scale and with a sliding support for the other branch, so that it allows to read in the opening between the extremes of the branches.

- Osteometric table: This is millimetric horizontal surface with a longitudinal ruler and, a perpendicular fixed stop at one end and another slide at the other end, which by moving on the millimetric surface, the ruler allows to measure the opening between the stops.

- Jaw meter: is, in fact, a modified osteometric table, in which the fixed stop is not, nevertheless perpendicular to the horizontal surface, but rather tilting on it, and with a sliding stop at the opposite side of the joint. Thus we can put in the jaw on the horizontal surface and, by adjusting the tilt stop, we can read the scale on height of the branch, as well as the angle it forms with the horizontal by an incorporated goniometer.

3. MEASUREMENTS OF THE SKULL.

3.1. The Frankfurt plane.

It is the standart atomic orientation and measurement of the skull, established by Congress of Anthropology in Frankfurt in 1877. It is defined by a horizontal plane passing through the two porion and the left orbital. All positions and measures in the skull will refer to this plane.

3.2. Odd or mid craniometric points:

1. Bregma (b): T Center formed by the intersection of the coronal suture and sagittal.
2. Vértex: Highest point of the skull, located it in the Frankfurt plane, and thus,

the farthest from the basion.
3. Glabela (g): Most prominent point in the interciliary area.
4. Nasion (n): T Center formed by the intersection of frontal-nasal suture with the suture of the nose bones.
5. Nasoespinal (ns): The point where a line drawn tangent to the most inferior points of the pyriform aperture cuts the midsagittal plane.
6. Prostion (pr): Lowest point on the midline of the maxillary alveolar process between the two upper middle incisors.
7. Alveolon (alv): Point of the hard palate located at the intersection of the midline with the line tangent to the most posterior edges of the maxillary alveolar process.
8. Infradental (id): Upper most point on the midline of the septum between the media mandibular incisors. Opposed to prostion.
9. Gnation (gn): Lowest point of the mandible in the midline.
10. Opistocranion (op): Most posterior point of the skull in the occipital region, not in the external occipital protuberance and instrumentally determined as the one corresponds to the maximum distance from the glabella.
11. Lambda (l): Point of intersection of the sagittal suture and the lambdoid suture.
12. Basion (ba): Point of the anterior edge of foramen magnum located in the midline, thus it is the most anterior of the foramen magnum.
13. Opistion (o): Point of rear edge of the foramen magnum located in the midline, thus opposed to the basion.

3.3. Pairs or laterale craniometric points:

1. Porion (po): Is the uppermost point of the margin of the ear hole.
2. Asterion: Is the point of intersection of the occipital, parietal and temporal sutures.
3. Dacrion (d): Point of binding of the frontal, maxillary and tear in the mid rim orbital
4. Orbital (or): The lowest point of the orbital rim.
5. Ectoconquion (ec): Most anterior point of the lateral rim of the orbit.
6. Zigion (zy): Most lateral point of the zygomatic arch, determined instrumentally by measuring the width-maximum-bizygomatic.
7. Eurion (eu): Most lateral point of the skull. Determined instrumentally by measuring the maximum width of skull. Its location may vary, between the parietal and temporal.
8. Lateral Condilon (CDL) Most lateral point on the mandibular condyles.
9. Ectomolar (ecm) most lateral point on the outer surface of the alveolar process of the maxilla, usually at the level of the second molar.
10. Gonion (go): Lowest, most posterior and most lateral point of the mandibular angle, at the junction of the ramus and mandibular body.
11. Alar (al): It is determined instrumentally such as the most lateral points of the

nasal opening, thus corresponding to the maximum width of the hole piriformis.
12. Front temporal (ft): Most anterior-medial point of the timeline, in the zygomatic process of the frontal.
13. Front malar-temporal (fmt): Most lateral point of the front-malar suture.
14. Atrial (au): Point located above the ear hole in the root of the zygomatic arch at its deepest incuvation area.
15. Mastoid (ms): Lowest point of the mastoid process.

3.4. Measurements of the skull.

1. Maximum skull length (g-op) GOL: Measured with callipers between glabella and the farthest point in the midsagittal plane of the skull (opistocráneo).
2. Maximum skull width (eu-eu) XCB: Maximum width measured with callipers in the horizontal plane, excluding the lower temporal lines.
3. Bizygomatic width (average facial width) (zy-zy) ZYB: Distance measured with the callipers or calibrate between the two lateral points of the zygomatic arches.
4. Maximum skull height (ba-b) BBH: Distance measured with callipers between bregma and basion.
5. Length of the cranial base) (ba-n) BNL: Measured with the calibrate or callipers between nasion.
6. Length of basion - prosthion (b-pr) BPL: Measured with callipers or calibrate between the basion and prosthion.
7. Maxiloalveolar Width (ecm-ecm) MAB: Measured with the the caliber between both ectomolares.
8. Length of maxilla - alveolar (pr-alv) MAL: Length between the prosthion and alveolon. Measured with the caliber only if there is loss of incisors and, otherwise, with the callipers .
9. Biatrial width (base of the skull) (au-au) AUB: Measured by the calliper or calibrate between both auricular points.
10. Height of upper face (n-pr) UFH: Measured by the caliber between the nasion and prostion.
11. Minimum front width (ft-ft) WFB: Minimum horizontal measurement between the two frontal temporary lines using the caliber.
12. Upper facial width (fmt-fmt) UFB: Measured by caliber between the two most lateral point of the suture frontomalar.
13. Nasal height (n-ns) NLH: Measured by the caliber between nasion and nasospinal.
14. Nasal width (al-al) NLB: Maximum distance measured by the caliber between the lateral edges of the pyriform aperture.
15. Orbital width (d-ec) OBB: Distance measured with the caliber between dacrion and ectoconquion drawing a line that divides into equal parts the orbit.

16. Orbital height OBH: Distance measured caliber between the upper and lower edge scanning perpendicular to the Orbital OBB width of.
17. Biorbital Width (ec-ec) EKB: Distance measured with the caliber between both ectoconquion.
18. Interorbital width (d-d) DKB: Distance measured with the caliber between both dacrion.
19. Front Cord (n-b) FRC: Distance measured with the caliber between nasion and bregma in midsagittal plane.
20. Parietal Cord (b-l) PAC: Distance measured with the caliber between bregma and lambda in midsagittal plane.
21. Occipital Cord (l-o) OCC: Distance measured with the caliber between lambda and opisthion in midsagittal plane.
22. Foramen magnum length (ba-o) FOL: Distance measured with the caliber between basion and opisthion.
23. Foramen magnum width FOB: Maximum width with the caliber between the lateral edges.
24. Mastoid length MDH: Vertical projection of the mastoid process under and perpendicular to the plane of Frankfurt.

3.5.- Mandibular Measurements.

25. Length of the chin (id-gn) GNI: Distance measured with the caliber between gnation and infradental.
26. Height of the body HMF: Distance measured with the caliber between the edge of the alveolar process and the lower edge of the jaw taken perpendicular to the base level of the mental foramen.
27. Thickness of the mandibular body TMF: Maximum thickness measured with the caliber of the the mandibular body at the level of mental foramen.
28. Bigoniáca Width (go-go) GOG: Distance measured with the caliber between both gonion.33
29. Bicondilar width (CDL-CDL) CBD: Maximum distance measured with the caliber between the outer edges of the condyles.
30. Minimum Width of the ramus WRB: Minimum distance measured with the caliber between the anterior and posterior edges of the mandibular ramus perpendicular to the maximum height XRH.
31. Maximum width of the ramus XRB: Distance measured with the caliber between the most anterior points of the ramus and the tangent that connects the most posterior point of the condyle with the angle of the mandibular.
32. Maximum height of the ramus XRH: Distance from the uppermost point of the condyle to the gonion, measured by the caliber or jaw meter.
33. Mandibular length MLN: Distance measured by the jaw meter between the pogonio and the midpoint of the line connecting both gonion.
34. Mandibular angle MAN: Angle formed by the lower edge of the body and the posterior edge of the ramus, measured with the jaw meter.

4. POSTCRANIAL MEASUREMENTS.

4.1. Clavicle.

35. Maximum length: Maximum distance between the outermost points with the osteometric table or caliber.
36. Medium sagittal diameter (anterior-posterior): Distance measured with the caliber between the anterior and posterior surfaces at the level of the midpoint diaphyseal specified in the osteometric table.
37. Medium vertical diameter (upper-lower): Direct distance between the upper and lower surfaces of the collarbone at the level of midpoint diaphyseal.

4.2. Scapula.

38. Scapular height (anatomical width): Distance measured with the caliber between the uppermost point of the cranial angle and the lowermost point of the caudal angle.
39. Scapular width (anatomical length): Distance measured with calliper compasses between the midpoint of the dorsal edge of the glenoid cavity to the point between the lips of the scapular spine at its medial border.

4.3. Humerus.

40. Maximum length: Distance between the most proximal -superior- point of the head and the most distal-inferior-point of the trochlea in the osteometric table.
41. Epicondylar width: Distance measured with the caliber or osteomteric table between the most lateral points of the epicondyles.
42. Vertical diameter of the head: Measure with the caliber between the most upper and lower points of the edge of the articular surface.
43. Maximum diameter of the diaphysis: Measured with the caliber at the midpoint level of the diaphysis, specified in osteometric table.
44. Minimum diameter of the diaphysis: Measured, like the previous one, with the caliber at the midpoint level the of the diaphysis, specified in osteometric table.

4.4. Radius.

45. Maximum length of the radius: Distance measured in the osteomteric table between the most proximal point of the head and the most distal point of the styloid processes.

46. Sagittal diameter (anterior-posterior) of the diaphysis: After the determination of the midpoint of the diaphysis in the osteometric table, the distance at this level between the anterior and posterior surfaces is measured by the caliber.
47. Transverse diameter (medial-lateral) of the diaphysis: Maximum diameter between the medial and lateral surface of the diaphysis at the midpoint level the of the diaphysis, as in the previous case.

4.5. Ulna.

48. Maximum length: Maximum distance between the uppermost point of the olecranon and the lowest point of the styloid process in the osteometric table.
49. Dorsum-fly diameter (anterior-posterior): Maximum diameter with the caliber of the diaphysis at the point of greater development of the ridge.
50. Transverse diameter (medial-lateral): Diameter at the point of greater development of the ridge perpendicular to the previous measure.
51. Physiological length: Measured with the calliper compasses between the most distal-lower point, which is, the deepest point of the concave-on the coronoid process surface and the most distal point of the lower surface of the distal epiphysis.
52. Minimum circumference: Measured with tape measure proximate to the distal end.

4.6. Sacrum.

53. Anterior Length: Distance measured with the caliber between the point of the promontory located in the midsagittal plane and the point of the same plane at the top of the sacrum.
54. Anterosuperior Width: Maximum transversal width measured with the caliber of the sacrum at the level of previous projections of the auricular surfaces.
55. Maximum width of the base: Distance measured with the caliber between the most lateral superior articular surface - sacral base, measured perpendicular to the midsagittal plane.

4.7. Pelvis.

56. Height: Distance measured with calliper compass between the uppermost point of the iliac crest and the lowest of the ischial tuberosity.
57. Iliac Width: Distance measured with calliper compasses between the anterior-superior iliac spine and the posterior superior iliac spine.
58. Length of Pubic: Distance measured with the caliber between the point of the

acetabulum where the three parts of the hip bone and the upper edge of syphilis join.
59. Ischial Length: Distance measured with the caliber between the point of the acetabulum where the three parts of the hip bone and lowest point of the tuberosity of the isquiátca join, approximately perpendicular to the length of the pubic.

4.8. Femur.

60. Maximum length (anatomical): Maximum distance in osteometric table between uppermost point of the head and the lowest point of the distal condyles.
61. Bicondylar length (physiological oblique): Distance in osteometric table between the uppermost point of the head and a plane tangential to the lower surfaces of both distal condyles.
62. Epicondylar width: Distance in the osteometric table between the most lateral points of the epicondyles.
63. Maximum diameter of the femoral head measured with the caliber.
64. Subtrochanteric sagittal: Diameter (anterior-posterior) distance measured with the caliber between anterior and posterior surfaces at the proximal end of the diaphysis, measured perpendicularly to the medial-lateral diameter.
65. Subtrochanteric transverse diameter (medial-lateral): Distance measured with the caliber between lateral and medial surfaces on the proximal end of the diaphysis, perpendicular to the previous measurement of the sagittal diameter at the highest level of lateral expansion under the lesser trochanter.
66. Diaphyseal sagittal diameter (anterior-posterior): Distance measured with the caliber between the anterior and posterior surfaces at approximately the midpoint diaphyseal level, located at the maximum point of development of the linea aspera.
67. Diaphysial transversal diameter (medial-lateral): Distance with the caliber between the medial and lateral surfaces, measured perpendicular to the previous measurement.
68. Circumference of the diaphysis: Measured with a tape measure at the level of midpoint of the diaphysis as the two previous measurements.

4.9. Tibia.

69. Maximum length: Distance in osteometric table between the superior articular surface of the lateral condyle and the tip of the medial malleolus.
70. Maximum width in the proximal epiphysis: Maximum distance in osteometric table between the most lateral and medial point of the condyles of the proximal epiphysis.
71. Maximum width of the distal epiphysis: Maximum distance in osteometric

table between the most lateral point of the medial malleolus and the lateral surface of the distal epiphysis.

72. Maximum diameter at the level of nutrient foramen: Maximum distance with the caliber between the crest anterior and the posterior surface at the level of the nutrient foramen.
73. Transversal diameter (medial-lateral) to the nutrient foramen: Direct distance measured with the caliber between the medial edge and interosseous crest at the level of nutrient foramen, perpendicular to the previous measurement.
74. Circumference at the height of nutritional hole: Measured with tape measure at the level of the nutrient foramen.

4.10.Fibula.

75. Maximum length: Maximum distance in osteometric table between the proximal end of the head and the distal end of the lateral malleolus.
76. Maximum diameter of the diaphysis: Maximum distance measured with caliber at a semicircular mid-diaphysis level, located by osteometric table by determining the maximum length.

4.11. Calcaneus.

77. Maximum length: Distance measured with the caliber between the posterior most prominent point of the tuberosity and most anterior point of the upper edge of the facet joint with the cuboid. Measured on the midsagittal plane and projected onto the underlying surface.
78. The medium width: Distance measuered with the caliber between laterally most prominent point of the dorsal facet joint and the most medial point of the sustentaculum tali. Since these two points do not have the same height nor in the same plane perpendicular to the sagittal, the measurement must necessarily be projected in both dimensions.

5. RECOMMENDATIONS.

Only standard measures collected here will be taken, which are basically the accepted ones for data collection in Physical Anthropology by Buikstra and Ubleaker (1994). If it is necessary to supplement them, for example due to lack of materials or its fragmentation, in the case of the postcranial skeleton, the alternative measures proposed by the aforementioned authors (Table 1) can be applied.

Generally in forensic cases, only postcranial skeleton measurements which lead us to calculate the size or estimate the gender will be of interest. In the case

of the size thus, we focus on the maximum lengths of the humerus, radius, ulna, femur -physiological length -, tibia and fibula, the latter (tibia and femur) being the most reliable.

For the estimation of gender, we are interested especially in maximum diameters of the head of the humerus and femur.

Minimum diameters are generally not very useful in Forensic Anthropology and also are very susceptible to error in its determination therefore they should be avoided.

All possible standard measures of the cranial segment should be taken, the more mesurement the more reliable FORDISC inferences, particularly useful in the estimation of race (Jantz and Ousley, 2005).

Table1 (Buikstra and Ubleaker, 1994)

Supplemental List of Postcranial Measurements

Measurement	Code	Source
1. Scapula: spine length	(SLS)	Bass 1987: 117, #3
2. Scapula: supraspinous length	(SSL)	Bass 1987: 117, #4
3. Scapula: infraspinous length	(ISL)	Bass 1987: 118, #5
4. Scapula: glenoid cavity breadth	(GCB)	Zobeck 1983: 133, #39
5. Scapula: glenoid cavity height	(GCH)	Zobeck 1983: 133, #40
6. Scapula: glenoid to inferior angle	(GIL)	Zobeck 1983: 133, #41
7. Sternum: manubrium length	(MML)	Bass 1987: 112, Fig. 64
8. Sternum: body (mesosternum) length	(MSL)	Bass 1987: 112, Fig. 64
9. Sternum: sternebra 1 width	(S1W)	Bass 1987: 112, Fig. 64
10. Sternum: sternebra 3 width	(S3W)	Bass 1987: 112, Fig. 64
11. Humerus: proximal epiphysis breadth	(BUE)	Zobeck 1983: 129, #2
12. Humerus: least circumference shaft	(LCS)	Bass 1987: 148, #5
13. Radius: maximum head diameter	(RDH)	Zobeck 1983: 131, #17
14. Radius: neck circumference	(MCS)	Zobeck 1983: 133, #46
15. Ulna: maximum breadth olecranon	(BOP)	Zobeck 1983: 131, #18
16. Ulna: minimum breadth olecranon	(MBO)	Zobeck 1983: 131, #19
17. Ulna: maximum width olecranon	(WOP)	Zobeck 1983: 131, #20
18. Ulna: olecranon-radial notch	(ORL)	Zobeck 1983: 131, #21
19. Ulna: olecranon-coronoid length	(OCL)	Zobeck 1983: 131, #22
20. Femur: trochanteric length	(FTL)	Zobeck 1983: 130, #7
21. Femur: a-p diameter lateral condyle	(APL)	Zobeck 1983: 132, #29
22. Femur: a-p diameter medial condyle	(APM)	Zobeck 1983: 132, #30
23. Femur: bicondylar breadth	(BCB)	Zobeck 1983: 133, #44
24. Femur: minimum vertical diameter neck	(VDN)	Zobeck 1983: 133, #48
25. Tibia: position of nutrient foramen	(CFL)	Zobeck 1983: 132, #33

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INTEGRATED FORENSIC ANTHROPOLOGY REPORT

PROTOCOL	**INTEGRATED FORENSIC ANTHROPOLOGY REPORT**
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1. DEFINITION AND GENERAL CONCEPTS:

The Integrated Forensic Anthropological Report (IAFI) is the document that gathers together all the scientific and technical actions of the professionals involved in the researches within the competence of Forensic Anthropologist and which may include-if the report already has not -a final inclusive document by way of conclusion, of all the results obtained.

It is both an expert report and a document that allows to have a global vision, composed of all the research conducted. The Spanish Association of Forensic Anthropology and Odontology (AEAOF) recommend using this type of report in cases where possible.

It would therefore be right to issue a joint report or to issue separate interim reports but with a common synthesis report which answers for scientific consensus to at least five basic issues of all Forensic Pathology expert report: 1) Identification, 2) Origin of death: Natural or violent (Accidental, Suicide or Homicide) 3) Time of death 4) Causes of death and 5) Circumstances of death.

It is recommended that the integration of all the information is coordinated by the forensic anthropologist who shall be obliged to:

1) Incorporate to the IAFI all interim reports of the different professionals involved.
2) To highlight the agreements and disagreements between them.
3) To prepare a synthesis document of scientific consensus among all the professionals involved.

In addition to the study of remains, Police Report or certain data of legal medical interest of the same, Historical Research, Reports, protocols or *Antemortem* files, Archaeological Report, Report of lifting of corpse or bones remains, Technical Reports of Ground Penetrating Radar or other close remote sensing systems, conclusive samples sampling report with its corresponding sheets of informed consent, report of chain of custody for each of the samples submitted, dental-forensic report, reports from results of the analyses performed as the radiological, chemical, toxicological, entomological, histopathological, biological, genetic, experimental, criminalistic, environmental, etc...are considered eligible to join the IAFI.

2. GENERAL OUTLINE OF THE IAFI:

The reports will tend to be drafted in a way that it is possible that other experts with the results obtained can reach conclusions. It is recommended that the reports that are responsible of Forensic Anthropologists are structured with the following outline:

2.1. Identification of the expert and the institution to which he belongs:

This section must include the name or identification code of the expert, his basic data of professional accreditation and the institution to which he belongs with his postal address and contact telephone number.

2.2. Equipment and Methods:

It is recommended to include in this section, at least, the relationship of the material received with explicit reference to its abbreviations, and the data referring to the chain of custody and all the methodological aspects that are considered to be of interest. It is recommended to use a neutral descriptive language without any evaluative reference.

2.3.Results:

In this section all positive and negative findings of interest will be described without employing any evaluative language. It will not be possible to ignore any result that has been used in support of the conclusions.

2.4. Discussion of the results or Forensic Anthropological analysis:

Evaluative section of the report that integrates all the information obtained from the case by analyzing all the results obtained so that it is possible to hold scientific or reasonable conclusions.

2.5.Conclusions:

Final section of synthesis of all the information obtained that must respond at least to the following questions. 1) Medical legal origin of death; 2) Time of death; 3) Causes and/or mechanism of death; 4) Circumstances of death and 5) identification.

2.6. References:

It is recommended to use a final section with used or recommended bibliographical references.

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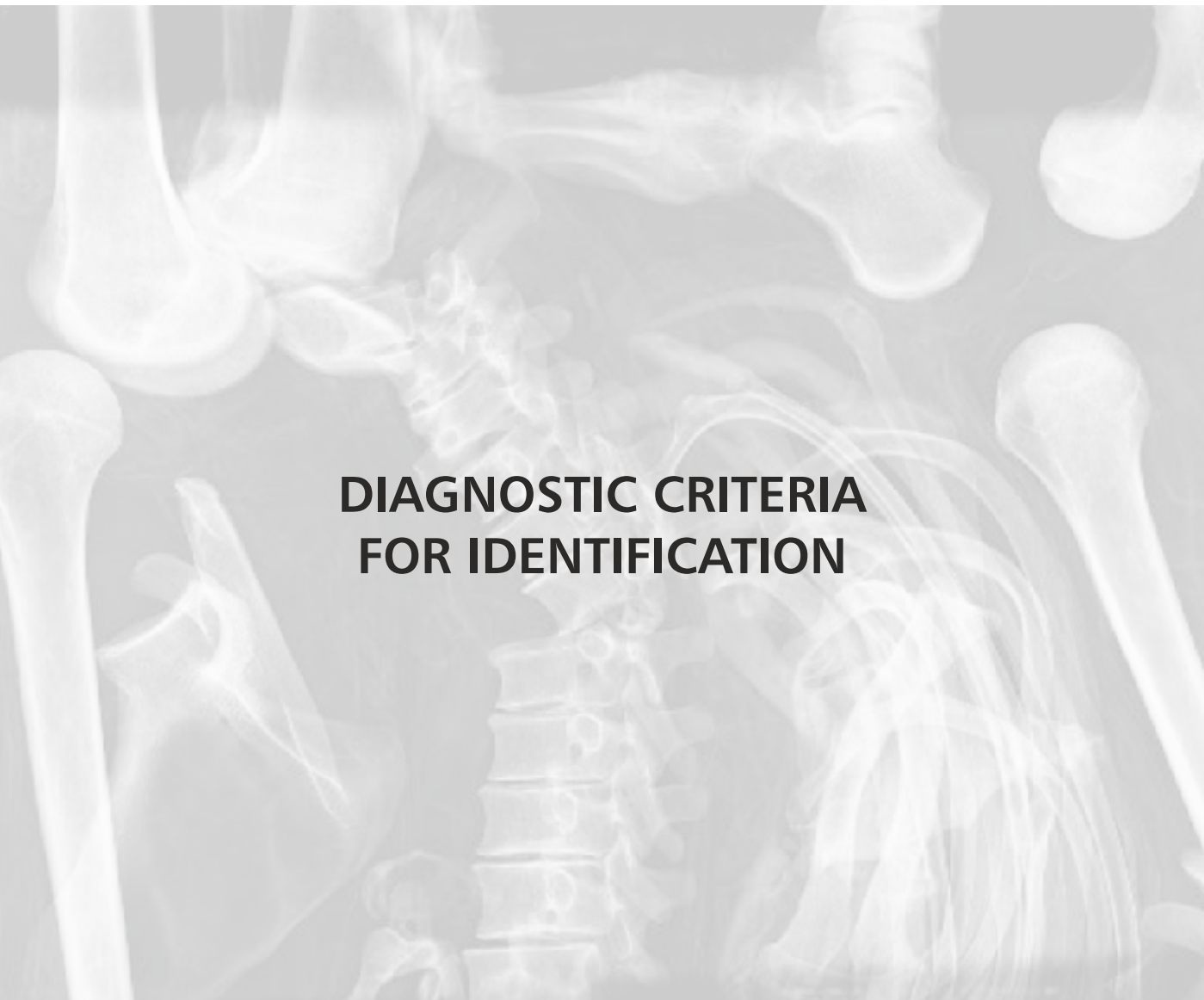

DIAGNOSTIC CRITERIA FOR IDENTIFICATION

SEX ESTIMATION CRITERIA

PROTOCOL	**SEX ESTIMATION**
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RECOMENDATIONS FOR SEX ESTIMATION.

Sex determination is one of the basic tasks when studying skeletal remains, of both ancient collections for the possibility of establishing the demographic conditions of past societies and personal identification in forensic cases.

To estimate sex differences, it is always recommended to analyze the skeleton as a whole; however, this is not generally possible, since in many cases there is only a part of it or isolated and fragmented bones are encountered.

Overall, it could be applied as a rule that the more remains there are, the easier the sex determination will be. In practice there are key elements in the analysis that allow to estimate sex with great precision.

In general, male bones are bigger and more robust, with more pronounced muscular insertions and reliefs than the female.

If a detailed inspection of the bones is made, the sex can be established with close to 100% reliability, in case of conserving the whole skeleton; the results are less satisfactory when working with isolated remains, even though it has been estimated that the sex can be properly identified in 98% of the cases when conserving only the pelvis and in 92% if considering only the characteristics of the skull.

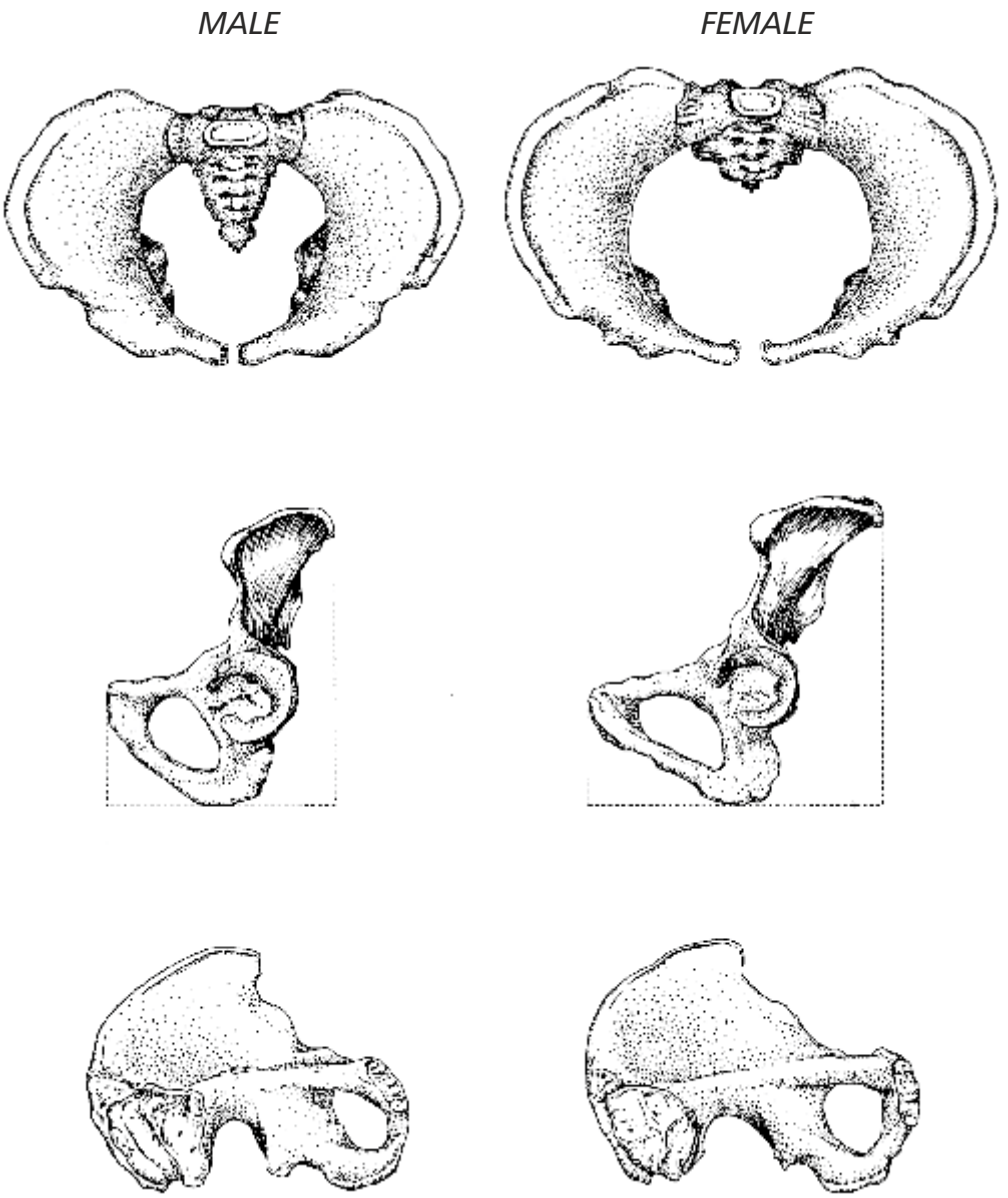
Although it is recommended to evaluate all the bones as a whole, the pelvis is the anatomic region in which sex differences are best reflected. If observed in anatomical connection, in other words, both innominate bones articulated by the sacrum, the female pelvis is wider and the lateral projection of the iliac bones is more pronounced than in males; the sagittal and transverse dimensions of the inner pelvis are bigger in women than in men, and it could be said that in the former ones, there is a horizontal predominance, while in men, it is the vertical one.

In order to clearly expose the criteria that would allow the establishment of sexual differentiation based on the pelvis, a table containing the specific characteristics of each gender has been developed.

Table 1: Features of sexual differentiation in the pelvis.

	MALE	FEMALE
Ischiatica major incisure.	Narrow, tending to adopt a V shape. Usually its angle doesn't exceed 30º.	Wide and open, U-shaped. Describes an angle of about 60º .
Sulcus preauricularis.	Generally absent, if it appears, it is very slightly marked.	Always present and well defined.
Acetabulum.	Large and deep, with tendency to be directed laterally.	Smaller and located anterolaterally.
Foramen obturatum.	Big and ovoid.	Smaller and triangular.
Os pubis.	Narrower and higher.	Lower and wider.
Arcus subpubianum.	Forms a steeper angle, V-shaped.	Forms a more open angle.
Ramus isquiopubianum.	Wide and flat area.	Narrow with a medial crest.
Articulatio sacrum-iliac.	Big.	Small and oblique.
Os iliacum.	Tall and with a tendency to verticality. The iliac crest is sinuous and adopts a pronounced S-shaped.	Lower and more diverging laterally. The iliac crest is less sinuous.

Figure 1: Morphological characteristics of sexual differentiation in the pelvis.



These criteria would define a hypermasculine or hyperfemenine pelvis; nevertheless, another possibility is that not all the features are present or that they are not equally emphasized.

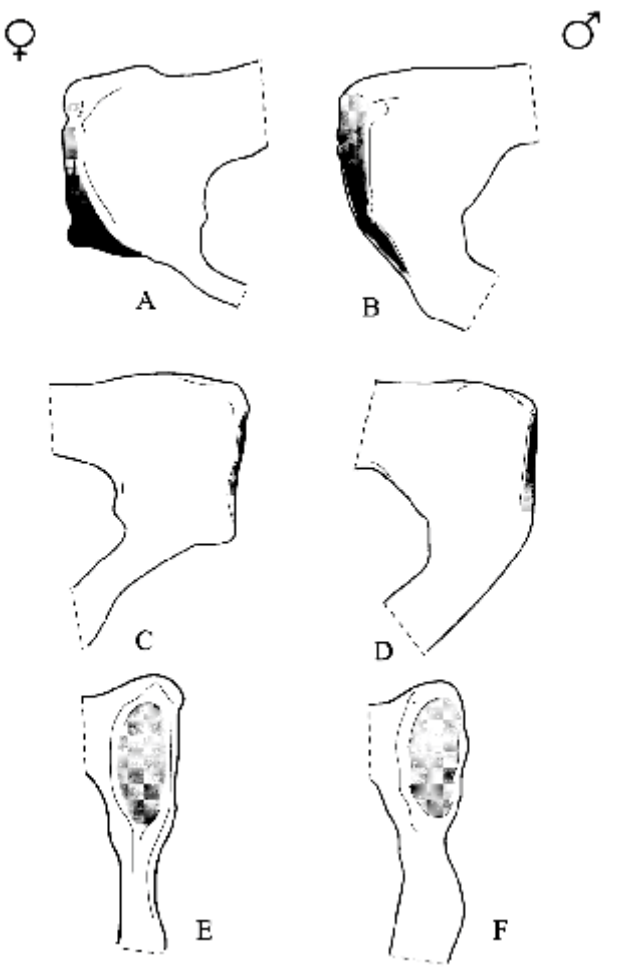
Phenice (1969) established the gender in a multigrupal sequence, paying attention only to the following structures: ventral arc, subpubic concavity and

medial aspect of the ischiopubic ramus.

The ventral arc is a bone roughly located on the ventral part of the pubis and it descends through the subpubic ramus, it is without a doubt the best gender indicator, since it is always present in women and is absent in men. With this method, he correctly classified 96% of the individuals. He indicated that the medial aspect of the ischiopubic ramus is the most variant element and therefore, it is the least efficient for the determination.

As we have verified, the percentage of success of untrained persons who were only taught about this feature is 92%, while those who trained and worked with bones -once they received the explanation- reached the 96%.

Figure 2: Gender variations in the pubis: A. Female ventral arc; B. Male light parallel ridge; C. Female subpubic concavity; D. Male pubic dorsal aspect; E. Female crest and narrowing of the ischiopubic ramus; F. Male wide ischiopubic ramus. (Modified from Phenice, 1969. Figure 1).



Skull morphology also varies in either sex. Just as in the rest of the skeleton, the female skulls are more graceful and rounded than the male, in which muscular insertions are more pronounced. These differences also affect the size and it is considered that cranial capacity is of 150 to 200 cc. higher in men than women, and it oscillates widely due to the variability and sexual dimorphism in human groups.

The male skull in sagittal view show a front profile that is usually slightly oblique, with a glabella and supraorbital arcs more pronounced, so are the temporal muscle and supramastoid crest. The mastoids are medium to large sized and generally rough, rounded and protruding. The occipital region is often rough and it shows a prominent inion; all this because the neck muscles are inserted in this zone, which tend to be more developed in men. In the facial region orbits have rounded edges and are relatively thick; the nasal opening is bigger, higher and the massive malar has a rough lower edge. The palate is generally wider, longer and deeper, with an U shape.

In women the frontal is more vertical and it usually shows rounded frontal protuberances more pronounced than in men; so it is with the parietal protuberances. The zygomatic arches are smaller and weaker, so are the mastoid process, smoother, smaller and more pointed; the orbits are generally more oval, with sharp edges. The palate is relatively shorter and narrower, with a tendency to adopt a parabolic shape.

The foramen magnum is generally bigger in men than in women, and so are the occipital condyles and the glenoid cavity.

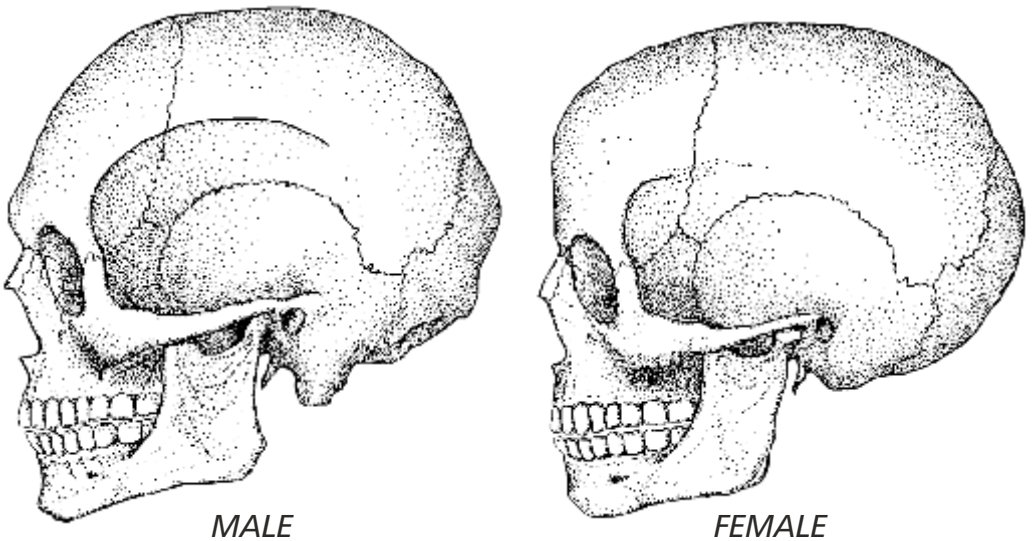
Regarding the jaw, the male is more massive than female, with a higher body, wider ascending ramus and longer condyles. In men, the angle formed by the arm and the body is more closed than in women. The male chin tends to be square and thick, while in women is sharper and thinner.

Table 2: Morphological characteristics more common in male and female skulls.

SOME SEX DIFFERENCES IN THE SKULL		
	Men	**Women**
Cranial capacity Occipital.		150 to 200 cc. Less.
Frontal.	Well marked muscle attachments.	Rounded, without roughness.
Superciliary arches.	More inclined.	Convex and high.
Orbits.	Strong.	Minimal or absent.
Zygomatic arches.	Rather low; quadrangular.	Higher and more rounded, with the upper sharp edge Little robust.
Mastoid apophysis.	Strong.	Less developed and pointed y puntiagudas.
Jaw.	Well developed. Massive, high and robust.	Less robust, graceful appearance, more obtuse mandibular angle and reduced condyles.
Teeth.	More bulkier.	Less bulky.

These features are reliable for the sex determination of the people aged between 20 to 55 years or so. For the infants, the traits are not yet completely developed and some of them may be affected by the changes due to advanced age.

Figure 3: Morphological characteristics of male and female skulls.



MALE *FEMALE*

As the male dimensions are bigger than female, studies that demostrate metric sexual differences have also been conducted. Plenty of tables have been developed from different populations in which average values of men and women, as well as the range of variation found in each group and for each of the variables considered have been established.

Based on these data and using multivariate statistical analysis, discriminant function formulas have been developed for sex determination with complete or fragmented bones which display satisfactory percentages of reliability. The following are the works that offer specific formulas for determining Mediterranean population:

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SEX ESTIMATION IN SUBADULTS.

Sex determination in subadults is one the biggest challenges that Physical Anthropology currently faces and involves a significant hurdles in forensic expertise because it is necessary to have very accurate results. Children are not sexually mature, which results in the absence of secondary sexual characteristics -that are not discernible before puberty- hinders greatly the discrimination between boys and girls.

Several morphological and metric methods have been proposed for determining the sex of skeletal and rental remains of subadults. The metric ones have been used a lot and for a long time due to their objectivity, but they have a limited use, while methods based on skeletal morphology have shown great advantages. This may be due to the difficulty in locating anatomical reference points and reproducing the measurements, but also because morphological methods take into consideration the whole, it is possible to estimate the relationships between segments and offer a more complete view. It is true that it can be more subjective and that it requires training and more experience, but they are superior because they integrate a greater amount of associated data.

The best available methods based on metric characteristics refer to dental size (Ditch and Rose, 1972; Black, 1978; De Vito and Saunders, 1990; Cardoso, 2008), because teeth crowns are developed early in life (the first permanent molar crown its development at age 3). The size of the crown may be determined by direct measurement or by using radiographs.

Numerous papers have documented this difference in size, and usually emphasize that the tooth showing a greater sexual dimorphism is the permanent canine whose crown is completely developed at the age 7. For the children under the age of 3, primary dentition must be used. However, sexual dimorphism in the primary dentition is minor compared to the permanent dentition, and therefore it is preferable, whenever possible, to use permanent dentition.

Apart from teeth, there are several morphological characteristics of the skull and pelvis that can and should be evaluated.

Several skeletal nonmetric traits proposed by Schutkowski (1993) and Weaver (1980), subsequently reassessed by Loth and Hennenberg (2001) and Sutter (2003) show promising results in sex determination in subadults , and it is observed that these characteristics are more precise for assigning sex in boys than in girls. This may be due to the expression of skeletal characteristics associated with sex, especially in the pelvis, related to differential growth in women. Furthermore, sexual expression of the various features is related to

age, so at certain age groups, some characteristics are more convenient to use than the others.

For children between the ages of 2 to 5, the depth and angle of the greater sciatic notch and the curvature of the iliac crest show acceptable accuracy for forensic applications. For children aged between 5 to 15 , the depth and angle of the greater sciatic notch, the criterion of the compounded arc and the shape of the anterior mandible arc can be considered.

Special precautions must be taken with individuals younger than 2 years old, since it does not offer any acceptable security for its application in forensic cases except the atrial surface elevation. However, there are several papers that show that some morphological characteristics of the pelvis and the skull present sexual dimorphism.

The morphological analysis of the humeral distal epiphysis has shown an acceptable sexual dimorphism for its use within the forensic context. It was proposed by Rogers (1999) and reassessed by Rogers (2009) and Falys et al. And it is applicable to adolescents between the ages of 11 and 15. The method is based on the fact that the observed sexual dimorphism would reflect the carrying capacity of the elbow. Given that women usually have narrower shoulders and wider hips than men, the angle that the elbow describes is greater in women than in men.

The following tables gather the characteristics that must be taken into consideration when determining the sex of children, according to the estimated age group.

Table 3: Morphological and metric sex differences in subadults.

Feature.	Girls.	Boys.
Pelvis.		
Depth of the greater sciatic notch.	Shallow.	Deep.
Angle of the greater sciatic notch.	Greater angle of 90º.	Narrower angle, approaches 90°.
Compound arch.	The line crosses the auricular surface.	The solid line along the lateral edge of the auricular.
Iliac crest curvature.	The crest forms an attenuated S.	The curvature is more pronounced, and draws a sharp S.
Auricular surface elevation.	High.	No high.
Jaw		
Prominence of the chin.	Smooth and flat surface.	Prominent, quadrangular, wider.
Anterior dental arch form.	Arch rounded, parabolic.	Wider arch, U-shaped.
Diversion of the region goníaca.	Angle not diverted, flat.	Angle diverted.
Dentition.		
Dental size.	Smaller.	Larger.
Humerus.		
Constriction of the trochlea.	Notably constrained, loop shaped.	Slightly constricted.
Symmetry of the trochlea.	Symmetric.	Asymmetric.
Shape olecranon fossa.	Oval, deep.	Triangular, shallow, not very deep.
Angle of medial epicondyle.	Clearly high.	Flat or slightly elevated.

Tabla 4: Morphological and metric characteristics most important to evaluate distributed by age groups.

Fetuses - 2 years old
Auricular surface elevation
Size of dental deciduous dentition

2 - 5 years old
Depth of the greater sciatic notch
Angle of the greater sciatic notch
Iliac crest curvature
Size of dental temporal and permanent dentition

5 - 11 years old
Depth of the greater sciatic notch
Angle of the greater sciatic notch
Compound Arch
Shape of the anterior mandible dental arch
Size of temporal and permanent dentition

11 - 15 years old
Constriction of the trochlea
Symmetry of the trochlea
Shape of olecranon fossa
Angle of medial epicondyle
Dental size, permanent dentition

RECOMMENDATIONS.

1. If the conservation of the material allows, it is better to use skull and pelvis morphological characteristics rather than the metric data.

2. In adults, the pubic ventral arc and the subpubic concavity are the elements that offer greater reliability; differences of its morphology depend only on the sex and don't show variations related to population origin of individuals.

3. An overall evaluation of all morphological features must be made. It is true that some of them are easier to observe than the others, but not all are equally pronounced in every person. We must not forget that variability is an inherent characteristics of the population.

4. Methods for estimating sex in subadults are less accurate and its reliability depends on the state of development of the skeleton to identify.

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CRITERIA OF AGE ESTIMATION

PROTOCOL	**AGE ESTIMATION**
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1. INTRODUCTION.

According to the dictionary of the Royal Academy of the Spanish Language (RAE), the concept of age has several meanings, and in reference to the topic at hand, the RAE conceptualized a person's age as "time that a person, certain animals or vegetables have lived" or "each of the periods in which human life is considered divided". From the point of view of Forensic Anthropology, we have to differentiate chronological age, which is referred by the above definition, from the biological and in particular from the bone age. Indeed when we face a case in which a person must be identified from the skeletal remains found, what we have to do is to infer which may be the age of person at the time of death from the characteristics shown by the bones, in order to do so, what we consider is the bone age that we transfer into the chronological age. This transfer is inevitably approximate, since the variability of bone characteristics in terms of aging make it impossible to establish beyond any doubt the exact chronological age, so what we do is an estimation of that chronological age. The better or worse, approximation depends on a large number of variables such as: personal characteristics, nutrition, diseases, ancestral origin of the subject, etc.

We must consider these conditions when we are about to carry out the study of a case and we have to be prudent enough not to venture to estimate beyond what can be, that is we will always have to give an age period and not an exact age. This age period will depend on the method that we can use, its reliability and of course the age period in which the subject is in addition to the conditions that we have previously indicated. With this protocol or guidelines established by AEAOF, we are trying to offer the most general and easiest to apply methods for the researcher to make the age estimation with the strongest possible guarantees.

As also the dictionary of the RAE points out in another of its definitions: "each of the periods in which human life is considered divided", in our case the

methods to apply for age estimation are divided into age groups and because it is not the same the bone of a fetus than one of a child in formation and growing or one of a young adult in which the bone even though is fully formed, it has not yet begun to be altered, a situation that occurs in a subject of middle or advanced age.

2. AGE RANGES OR GROUPS.

The age ranges proposed are:

SUBADULTS:
- **Fetal <0**
- **Children: 0-14 years**
- **Juvenile: 15-18 years**

ADULTS:
- **Young: 18-35 years**
- **Medium age: 36-60 years**
- **Advanced age: > 60 years**

With this age groups we try to limit, to the extent possible, the different periods that occur during the human bone development but by definition, any division of a continuum is arbitrary. Therefore we must take into consideration that age estimation methods implemented by various authors, may overlap among different age ranges.

METHODS OF AGE ESTIMATION.

3.1- Subadults.

3.1.1 Fetuses.

Although for the age calculation in fetuses the onset of ossification cores is mentioned, this method is not useful for studying the skeletized fetus since those cores have disappeared. The metric of the bone remains that we find is what will give us an approximate age. In this regard the method followed by Fazekas and Kosa (1978), based on the study of 138 human fetuses (17 males

and 67 females), aged from the third to the tenth lunar month is the most complete available publication. This work has been developed using 67 measures on 37 bones and although there are other papers (Balthazard and Dervieux 1921, Olivier and Pineau 1958), these are partial unlike Fazekas and Kosa which is systematic.

3.1.2 Children.

a) Dental eruption. Probably dental eruption, by visual inspection, has been the most widely used and although there is a variability mediated by genetic and environmental factors, continues to be an useful and fast method.

b) Dental mineralization. The mineralization of the crows in the deciduous teeth starts at 3, 4 months in utero and continues after birth during the neonatal period (Burdi in Moyers, 1992). For its part the development of permanent dentition mineralization takes approximately 9 years, beginning with the first permanent moral (Evans and Knight, 1981). In our geographical setting the dental eruption of both dentitions is published by Barberia (1995). We must consider in this paper that the data from the eruption were obtained in the clinic, while in the case of skeleton remains the valuation of the eruption is made according to the bone.

Another of the most used methods is Demirjian's et al (1973), based on a sample of French-Canadian children. Subsequently this same author developed updates of the original method (Demirjian, 1976). In any case, since maturational development is different in both sexes, the sex must be determined previously. Subsequent to this paper, many others have been published in which the accuracy of it is put to test, showing a slight delay in the maturation of the French-Canadian population, leading to an overestimation when applying this method to other populations. In 2007, Cameriere et al compared Cameriere methods (Cameriere et al, 2006), Demirjian y Willems (Willems et al, 2001) studying radiographs of Spanish, Italian and Croatian children between 5 and 15 years old and they indicating that the best method is the one advocated by Cameriere.

3.1.3 Children and youth.

When dentition is not available for age estimation the length of the long bones and the age can be related. In this regard there are several papers such as those by Mares (1943, 1955, 1970, 1972). This method can be applied between 2

months and 18 years old, therefore covers the child and the juvenile period. It would be a method to apply in cases where the study of the dentition was not possible. Besides Maresh, there are other authors like Giunhart (1973), in radios and tibia, Anderson et al (1964) in femur and tibia, Hoffman (1979) who studies bone growth in relation to age between 2 months and 12 years. Maresh, Guinhart and Anderson papers can be found in Scheuer and Black (2000).

3.2. Adults.

3.2.1 Synostosis of the cranial sutures.

The closure of the cranial sutures and its relation to the individual's age has been studied since Todd and Lyon in 1924 and 1925 published the first studies in this direction, subsequently there are a number of authors who try to implement and modify this method to achieve greater accuracy, Meind and Lovejoy (1985) are who applied the method of study that provides most reliability. This study was conducted on 236 skulls from the Hamann-Todd collection, proposing a method based on the study of 10 points located in the cranial vault, establishing four closing stages.

3.2.2 Morphological changes of the fourth rib.

Iscan et al (1984) studied 230 right ribs extracted from white men who have been autopsied whose age and sex are known. It is a method that has proven to be reliable and relatively easy to use. This method has been also seen that is dependent population.

3.2.3. Changes in the public symphysis.

The changes in the pubis symphysis were studied first by Todd (1920) who studied a collection of skeletons of known age white males and proposed 10 stadiums for study in relation to age.

Mackern and Stewart (1957) presented a method based on the study of the pubic symphysis divided in three fields of study (dorsal facet, ventral wall and symphyseal ring) for males. Acsadi and Nemeskeri (1970) studied the pubic symphysis of 61 men and 44 women, that later extended with skeletons extracted from cemeteries in Hungary.

Gilbert and Mckern (1973), set the standards for women, based on the same components that had been previously established for men by Mckern and Stewart. Suchey (1979), points out that applying the test of Gilbert and Mckern only 51% of the cases fall withing the expected age.

Suchey et al (1986), indicate that the symphyseal surface of men is not a good indicator for ages over 40 years. Meindl et al (1985), compare the methods of Todd (1920), Mackern and Stewart (1978), Gilbert and Mackern (1973) and Hanihara and Suzuki (1978), in the Hamman-Todd collection and conclude that Todd method is the best one.

Brooks and Suchey (1990), using a sample of 739 males and 273 females, whose symphysis were obtained of a modern and well documented sample of autopsied individuals in Los Angeles County, and they establish 6 phases with its features, both for male and female, with the standard mean and deviation and range of age, and they compare their results with those obtained by Acsadi and Nemeskeri, which until then was the method recommended by the Workshop of European Anthropologist, concluding that the technique of Acsadi and Nemeskeri does not adapt to the data of the modern sample they study.

3.2.4 Changes in the auricular surface of the ilium.

(Lovejoy et al, 1985), they develop a method based on the changes in the auricular surface of the ilium, and as previously studied by Iscan and Derrick (1984) and St Hoyme (1984), who conducted a study on growth of the pelvis. Lovejoy et al (1985) study an extensive sample of 250 skeletons from the Libben collection (Ohio, Indian population), and 500 from the Hamman-Todd collection. Subsequently they carry out a test with 216 ilium. According to the authors there are no differences in the evolution of the features of this surface between men and women. After this, other authors such as Buckberry and Chamberlain (2002), Osborne et al (2004), Mulhern and Jones (2004), make revisions on the method ob Lovejoy et al (1985), or apply it to other populations as Hens and Belcastro (2012) do to Italian population.

3.2.5. Dental study.

Periodontosis and root transparency (Lamendin et al, 1992). These authors conduct their paper on 306 single-rooted teeth, from 208 individuals aged between 22 and 90 years and value the periodontosis and the root transparency. This study shows no significant differences in gender, the minimum error occurs

in the group of 50-59 years and the maximum in 13,1 years in young groups (30-39 years), so its use in young individuals is not advised. Baccino et al (1999), comparing in French population various methods of age estimation, observe a better performance of the method of Lamendin when facing skeletal changes (pubis, rib, histology).

Other authors that study the teeth in relation to age are Solheim (1993), López Nicolas et al (1996), Kaal and Solheim (1994), Martínez de Mandojana (1999). There are also papers based on biochemical methods, there are a large number of publications Heman and Bada (1975), Ohtani (1992), Mornstad (1994), based on the study of the D and L forms of amino acids and Martin de las Heras (1999) based on the study of deoxypyridinoline. These methods show a good correlation with age and we can consider them as an alternative to the usual methods.

RECOMENDATIONS.

1. Always consider that what we are doing is an estimation and therefore put the range of age given as the most likely.

2. Methods proposed:

2.1. SUBADULTS

2.1.1 Fetuses.

In the fetal remains the method of choice for age estimation is the one proposed by Fazekas and Kosa, in their book Forensic Fetal Osteology.

2.1.2. Infants.

- Method Demirjian et al (1973, 1976).
- Method Maresh (1943, 1955, 1970, 1972), and collected in its entirety in Sheuer and Black (2000).

2.1.3. Juveniles.

- Method Demirjian et al (1973, 1976).
- Method Maresh (1943, 1955, 1970, 1972), and collected in its entirety in Scheuer and Black (2000).

2.2. ADULTS.

- Synostosis of cranial sutures: Method Meinld y Lovejoy (1985).
- Changes in the cost-sternal union of the fourth rib (Iscan y cols, 1984, 1985).
- Changes in the auricular surface (Lovejoy and cols, 1985).
- Dental study (Lamendin et al, 1992).

3. Summary and considerations.

As noted in the introduction, when facing an anthropologic-forensic case, in which we try to estimate the age, we must never forget the conditioning factors that the proposed methods have, regarding the source population that has given rise to this method and the particular constraints of each case. As to the fetuses, the method of Fazekas and Kosa, is the only full one existing in the biography for this age group, and therefore its application is mandatory. At older ages, ie from birth, the methods that have been implemented are more numerous and we must choose the one that offers greater reliability, and in these cases is proposed the use of Demirjian method for children and young ages based on the mineralization of teeth and more widespread among researchers and the one of Maresh, in the case that we do not have teeth. In adult subjects, that we have divided into young 18-35 years, medium age 36-60 and advanced age > 60 years, it has to be noted that actually with the existing methods we can approximate the age at the first two groups, while for the third there are no reliable methods. We also have to take into consideration that the estimation of age only by cranial sutures should not be done, this method will be used always as a complementary to another, and in terms of the cost-sternum union of the fourth rib and the study of the pubic symphysis, if it is possible to conduct the study of the fourth rib this would be the method of choice. The study of the atrial surface has the advantage of being independent of sex, so if sex is unknown this method would be the one to apply.

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CRITERIA FOR HEIGHT ESTIMATION

PROTOCOL	**HEIGHT ESTIMATION**
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CRITERIA FOR HEIGHT ESTIMATION IN FORENSIC ANTHROPOLOGY

1. INTRODUCTION.

It is meant by height the distance between the highest point of the head (vertex) and the ground while the individual is standing, with the head oriented in the Frankfurt plane.

Sex, along with age and race create the basic identifying parameters in forensic anthropology.

Early studies about height determination based on skeletal remains date back to Sue in the eighteenth century and to Orfila. In 1888 Rollet correlates height with long bones in 50 French corpses, sample that subsequently Manouvrier modifies eliminating those older than 60 years, and based on this one Pearson creates in 1899 the first regression formula. Countless studies on different populations, different bones and new methods of measurement have happened since then, including the studies of Genoves in 1967 on Amerindian population, of Stevenson in 1929 on the Mongoloid race or of Yung-Hao in 1970 on Chinese population. Stand out for its greater interest in the field of Forensic Anthropology the publication of the regression formulas by Trotter and Gleser in 1952 and 1958, the ones of Mendonça MC in 1998 on Iberian population, and the creation of the Fordisc computer system by Ousley and Jantz.

The height is the result of the interaction of multiple exogenous and endogenous factors, there are variations in bone proportions between races, sexes and populations, which forces us to be cautious with the resulting estimates. Authors like Steyn and Smith, advice to simply speak of tall, medium or low height depending on the percentile on which is situated within a population.

The formulas available for height determination are the result of studies carried out on specific samples, which implies, when discovering some bone remains, searching for the formula based on a population as similar as possible.

2. ISSUES ON TABLES AND FORMULAE CONSTRUCTION.

Estimates of the height will be based on the application of formulas and tables. We will discuss some issues related to its development and the difficulties involved, as it provides an overview of the current status of this issue in the field of Forensic Anthropology.

Influence of secular changes: it has been noted the influence of secular changes in populations, which in the last century has resulted to an increase in the average height along with a earlier termination of growth (Klepinger 2001). In this respect, the growth of the upper extremities has been categorized as isometric and of the lower ones as allometric, larger in tibia than in fibula (Meadows and Janz 1995). Which implies the potential for error when using for current population the formulas developed based on older populations.

Asymmetry among members: although the asymmetry between the bones of both extremities, right and left, is generally irrelevant, it has been revealed that when is pronounced, the use of one formula for both sides may lead to erroneous estimates (Krishan et al 2010).

Small sheight of the samples: typically the height of the sample used in studies for human height determination is small. Manouvrier for his famous table was based on a total of 24 men and 25 women, while Telkka did ti on 114 men and 39 women, Genovés on 22 men and 15 women and Fully in a total of 102. The sample of Trotter and Gleser is an exception, reaching over 7000 bodies. All of which have raised doubts about its statistical validity. Samples are also limited by the age of the deceased, since the bodies of persons who have not finished growing and elderly adults are excluded, as they may cause distortions, unless of course they are the specific object of study.

In this regard it should be noted too the difficulty involved in having large samples which height is well documented. In an exhumation can be easy to have data on sex and age but not on the height.

Bones analyzed: the most important works have targeted the calculation of the height based on the long bones of the extremities, with better correlation with the lower ones. In relation to this, it would be preferable the femur for white race and the tibia for black race.

However, other bones have also been studied, usually without sufficiently satisfactory results, such as the metatarsals (Cordeiro 2009, Byers 1989), the metacarpals (Musgrave and Hameja 1978, Meadows and Janz 1992), the calcaneus and talus (Holland 1995), the spine (Janson and Taylor 1995, Terezawa

1990, Tibbetts 1981), as well as the clavicle, the scapula, the hips, the sacrum or the height of the femoral head (Jit I. And Singh S. 1956, Shulin P. and Fangwu Z. 1983).

Neither the different craneofacial measures (Krishan 2008, Pelin 2010, Ryan and Bidmos 2006) or the dental ones (Ferreira 1993), have achieved valuable results to calculate the height.

Measurement methods: the bone measures in which the studies are based, have been carried out in different ways. Usually by direct measurements of the bone with the osteometric table or caliber. Some authors have taken them on specific anatomical points that they release by the dissection of the body (Celbis, 2006) or on percutaneously accessible reliefs in living people, generally limited to tibia and ulna (Agniotri 2009, Allbrok 1961).

Measures have also been conducted on radiographic images, with the disadvantage of determining accurately the coefficients of expansion. It has also been suggested (Petrovecki 2007, Lowet and Van Der Perre 1996) the taken of ultrasound measurements.

On other occasions anthropometric measurements of specific body parts in live persons, such as hands or feet, of forensic utility in circumstances such as major catastrophes or dismemberments, have been chosen. Even pointing its application to the traces left on a surface (Habib 2010, Bradley 2009).

Knowledge of the height in life: an important problem when selecting a sample of skeletons or bodies on which formulas calculating height are going to be carried out, is to know which one was this in life, this data can be obtained from many different sources. Thus, by directly measuring the corpse, case in which should be considered as potential sources of error the rigor mortis (apparently minor, but often it is chosen to take the measurements once that is resolved) or the loss of muscle tone and lack of weight over the spine in the decubitus, which motivate that the lying corpse has a larger height, estimated by some authors in 2.5cms.

Several studies have been carried out on collections of skeletons that have anthropometric data of the deceased, as the Raimond A Dart Collection (University of Witwatersrad, Johannesburg), the Hamann-Todd (Natural History Museum of Cleveland), the W. M. Bass Donated Skeletal Collection (University of Tennessee, Knoxville) and the Ferry Collection (Smithsonian Institute).

Sometimes, in the absence of previous anthropometric data, Frank method is used to estimate the theoretical height in life, considering it very good.

Official records or manifestations of relatives and acquaintances are other possible sources to ascertain what was the height in life, obviously with a large margin of error because the height shown in the documents is usually not meticulously taken and statements suffer from subjectivity. And moreover, height is not a constant value throughout the day, but decreases along with loss of muscle tone. Furthermore, several studies have evidenced that height declared by persons themselves in life tends to be bigger than the real one (Janz 2008, Willey 1991). Ousley refers to these heights as "forensic height", more precise to him, since in the process of identification we make the comparison with such documents or statements.

3. METHODS FOR HEIGHT DETERMINATION.

They are based on measuring one or more bones (mathematical methods) or the skeleton (anatomical methods)

3.1. Mathematical.

The most interesting ones in the field of Forensic Anthropology are discussed below.

Manouvrier tables (FIG. 1 y 2): are based on French population of the late nineteenth century. They are included because even today they are used, although on current population, it may give distorted results, calculated by some up to 10 cms. The height obtained is the one corresponding to the corpse, so that 2 cm has to be subtracted from the result to obtain the height in life.

Telkka regression formulas and tables (FIG. 3, 4 y 5): conducted in 1950 on Finnish population, so they are of little use on Mediterranean population. The physiological length is measured on the ulna and the radio, while in the femur is the maximum length.

Trotter-Gleser regression formulas and tables (FIG. 6 to 10): both researchers published their results in 1952, based on the study of bodies of American soldiers killed in World War II and on skeletons of the Terry collection, 2055 bodies in total. In 1958 they expanded the samples with 5517 bodies of American soldiers killed in Korea, bringing a total of 7572 bodies analyzed. They take into consideration the difference of 2,35 between the height of a live person and the corpse and from the age 30 applied to the height reduction of 0,06 x (age-30). In 1977 they published the corrected from a transcription error in the measurements of the radius of black women ones.

In 1995 Jantz et al. expose errors in the measurement of the tibia, where probably would not have been included the malleolus, leading to an underestimation of the height.

Mendonça MC regression formulas and tables (FIG. 11 to 13): this Portuguese anthropologist makes known her regressive formulas for size calculation in 1998, based on the study of 200 autopsied in the National Institute of Legal Medicien (Oporto) bodies. She measures the maximum length of the humerus and the maximum and physiological length of the femur, always on its right side. They are all contemporary individuals, Mediterraneans Caucasians, originating in the Iberian Peninsula, what makes clear her interest in the field of Spanish Forensic Anthropology.

Belmonte MT regression formulas and tables (Figure 14). In recent publication (Belmonte, 2012), calculate height from maximun lenght of tibia, shich is measured in the cadaver through incisions in anatomical points. Usefull in our geographical area cause being based on contemporary spanish population.

If measurements are taken in dry bone, we need add 2mm. to the length obtainded. In any case, we must add 2cm. to extrapolate height in the living subject.

FORDISC: software developed by Stepphen Ousley and Richard Jantz, currently at version 3.1.

The formulas to calculate the height are elaborated considering the height in life as the one shown by various official records (such as driver's licenses or police records).

Depending on which osseous measures have been introduced, the program will allow the choice between different equations. It also gives the option to choose the "group" (race and sex), as well as permissible margin of error.

In case of black or white race males, the program allows to choose the calculation using Trotter and Gleser formulas, through the same procedure. Due to the characteristics of the sources used the result of the forensic height is going to be higher than the one offered by Trotter and Gleser formulas.

B.2. Anatomical

Based on the skeleton height, they have their preceding in Dwigh method, that "articulated" in a specific way in a metric table, proposed its height, adding to the result a correcting factor of 32 mm for lost of soft tissues.

Although several methods have been proposed in this regard, like Niscanen and Junno or variations to method of Fully by Fornicola or Raxter, the most commonly applied is still the one proposed by Fully. His method allows a more accurate determination of the height, presenting a clear advantage over mathematical method in the case of individuals with atypical body proportions or with very long or very short height, while obviating the need to know the sex or race. However it requires having a serie of bones in good condition, which together with its greater complexity of realization has limited its use.

More specifically, the method establishes the sum of:
- Basion-bregma cranial height.
- Maximum height of the vertebral bodies L5 C2, measured separately.
- Height previous to the first sacral segment.
- Physiological length of the femur.
- Maximum length of the tibia (boneless intercondylar including malleolus).
- Articulated calcaneus and talus height, from the uppermost point of the talus to the lower one of the calcaneus.
- The previous three measures are taken on both sides and the average value is used.
- To the result we add a correction factor whose value is:
- Height equal or greater than 153.5 cm: 10 cm.
- Heights between 153.6 and 165.4 cm: 10.5 cm.
- Height equal to or greater than 165.5 cm: 11.5 cms.

Subsequently Fully and Pineau (1960) have been proposed as a better fit of the correction factor:

Height = Height of skeleton + 10.8 + / - 2.015

The same authors developed a more simplified method, and therefore more inaccurate, from only measurements of lumbar spine and femur or tibia:

Height = 2.09 (L1-L5 Femur +) + 42.67 + / - 2.35

Height = 2.32 (L1-L5 Tibia +) + 48.63 + / - 2.54

Fully method has been criticized, often noting that it would underestimate the actual height. Modifications have been proposed, such as measuring the height

of the vertebral bodies or of the calcaneus/talus set, as well as new values of the correction factor (Rexter 2006, Byers 2001, Maijanen 2009).

3.3 Determination of height in fetal period and subadults.

The main objective to determine fetal height is find out gestational age, which constitutes the obvious interest in forensic investigations.

While different formulas relating fetal bone measures and height exist, such as Oliver and Pineau, Scheuer and Black or Balthazard and Dervieux, those provided by Fazekas and Kósa (Fazekas and Kósa 1978) are still commonly used. We annexed as example on the long bones (Fig. 15).

Determining the height of subadult skeletal remains is as important as determining the age, albeit in certain cases (such as major disasters) the height can be an important identification data itself. Nevertheless, the available studies in this area are scarce as growth and bone development has always been discussed by a great variety of people and little has been done in the field. Until the age of 6 years old,the growth is fast, the bone development gets slower and uniform until the age of 10 years old. Again the development gets faster from 10 to 15 for men and 16 for women. There are different formules that are recognized for each group. Another drawback lies in anthropological studies on the frequent lack of epiphyses (lost or deteriorated), which makes it difficult to know the total length of the bone.

Some of the studies carried out in this field, such as Maresh and Smith, are displayed (Smith 2007): The latter is about North American population and follows the consultation of the formulas set forth by Telkkä (Telkkä 1962). The latter, made from Finnish subadult radiographs, distinguishable in terms of age and sex, and includes the margins of statistical confidence. They are included in the annex (FIG.16).

3.4. Determination of the height based on osseous fragments.

When finding incomplete bones, an estimation of the height based on its fragments may be performed, but always evaluating the results cautiously.

The first studies on the subject are Muller's, in 1935, who calculated the percentage that particular fragments, delimited between a certain number of points established by the author, represent in relation to the total length of the bone. It was developed on femur, humerus and radius. And after obtaining the length of the bone, he deduced the height using Manouvrier tables.

Subsequently MacKern and Steel, in 1969, developed a parallel method, in

which the bones studied correspond to the humerus, tibia and femur.

They define 5 points in humerus and femur, and 6 in tibia. Some fragments are delimited among these points. Using suitable formulas, based on the length of these fragments the total length of the bone is obtained.

Following is the description of each segment for each bone and its corresponding formula:

HUMERUS:

- **H1:** between the most proximal point of the humeral head and the most distal of the circumference of the head.
- **H2:** between the most distal point of the circumference of the head and the most proximal margin of the olecranon fossa.
- **H3:** between the most proximal margin of the olecranon fossa and the most distal margin of the olecranon fossa
- **H4:** among the most distal margin of the olecranon fossa and the most distal point of the trochlea.

MALES	FEMALES
2,0 H1 + 25,22 +/ - 1,18	1,4 H1 + 25,89 +/ - 0,13
1,1 H2 + 5,23 +/ - 1,17	0,9 H2 + 9,16 +/ - 0,84
1,8 H3 + 27,4 +/ - 1,23	2,0 H3 + 25,03 +/ - 1,18
2,4 H4 + 28,66 +/ - 1,23	1,2 H4 + 28,35 +/ - 1,26
1,4 H1 + 1,0 H2 + 1,74 +/ - 0,28	1,5 H1 + 1,0 H2 + 1,95 +/ - 0,32
1,0 H2 + 1,4 H3 + 2,37 +/ - 0,34	1,0 H2 + 1,2 H3 + 3,86 +/ - 0,37
1,7 H3 + 2,3 H4 + 24,28 +/ - 1,16	1,9 H3 + 1,0 H4 +24,02 +/ - 1,14
1,1 H1 + 1,0 H2 + 1,0 H3 + 0,38 +/ - 0,17	1,2 H1 + 1,0 H2 + 0,8 H3 + 1,01 +/ -0,26
1,0 H2 + 1,4 H3 + 1,2 H4 + 1,55 +/ - 0,26	1,0 H2 + 1,4 H3 + 1,1 H4 + 1,89 +/ - 0,22

FEMUR:

- **F1:** between the most proximal point of the head and the center of the lesser trochanter.
- **F2:** between the center of the lesser trochanter and the maximum proximal extension of the popliteal surface at the place where the medial and lateral supracondylar lines get separated in parallel below the rough line.
- **F3:** between the most proximal extention of the popliteal surface at the place where the medial and lateral supracondylar lines get separated in parallel below the rough line and the most proximal point of the intercondylar fossa.
- **F4:** Among the most proximal intecondylar fossa and the most distal point of the medial condyle.

MALES	FEMALES
1,6 F1 + 32,94 +/ - 1,39	0,8 F1 + 36,55 +/ - 1,23
0,7 F2 + 26,20 +/ - 1,31	0,6 F2 + 28,46 +/ - 1,02
0,3 F3 + 42,18 +/ - 1,67	0,3 F3 + 38,90 +/ - 1,23
2,1 F4 + 37,44 +/ - 1,56	1,1 F4 + 37,98 +/ - 1,24
1,2 F1 + 0,6 F2 + 20,63 +/ - 1,09	1,3 F1 + 0,7 F2 + 17,99 +/ - 0,86
1,2 F2 + 1,1 F3 + 5.89 +/ - 0,75	1,0 F2 + 1,0 F3 + 10,52 +/ - 1,16
0,3 F3 + 2,1 F4 + 34,77 +/ - 1,52	0,5 F3 + 1,6 F4 + 32,45 +/ - 1,16
1,1 F1 + 1,0 F2 + 1.0 F3 + 1,36 +/ - 0,33	1,0 F1 + 1,0 F2 + 0,9 F3 + 3,64 +/ -0,28
1,1 F2 + 1,0 F3 + 1,4 F4 + 2,58 +/ - 0.58	0,9 F2 + 1,1 F3 + 1,0 F4 + 7,53 +/ - 0,44

TIBIA:

- **T1:** between the most prominent point on the lateral side of the lateral condyle and the most proximal point of the tibial tuberosity.
- **T2:** between the most proximal point of the tibial tuberosity and the place of confluence of the lines extending from the lower edge of the tuberosity.
- **T3:** between the place of confluence of the lines extending from the lower edge of the tuberosity and where the anterior crest of the tibia intersects above the medial border of the axle above the medial malleolus (the measurement is taken on the point where the crest intersects the middle section of the axle).
- **T4:** between the spot where the anterior crest of the tibia intersects above the medial border of the axle above the medial malleolus (the measurement is taken on the point where the crest intersects with the middle section of the axle) and the proximal edge of the inferior articular facet (measured from the point opposite to the medial malleolus).
- **T5:** between the proximal edge of the inferior articular facet (measured from the point opposite to the medial malleolus) and the most distal point on the medial malleolus.

MALES	FEMALES
0,8 T1 + 34,85 +/ -1,64	1,4 T1 + 30,935 +/ -0,98
0,4 T2 + 34,14 +/ - 1,60	0,6 T2 + 37,26 +/ - 1,02
0,6 T3 + 28,73 +/ - 1,38	0,5 T3 + 25,73 +/ - 0,74
0,6 T4 + 31, 40 +/ - 1,58	-0,3 T4 + 36, 41 +/ - 1,13
1,1 T5 + 35,26 +/ - 1,64	1,7 T5 + 31,50 +/ - 1,09
1,2 T1 + 0,5 T2 + 30,67 +/ - 1,53	1,0 T1 - 0,3 T2 + 33,23 +/ - 0,97
1,0 T2 + 0,9 T3 + 15,48 +/ - 0,96	0,8 T2 + 0,8 T3 + 16,09 +/ - 0,64
0,8 T3+ 1,1 T4 + 13,57 +/ - 1,07	0,8 T3+ 0,9 T4 + 12,88 +/ - 0,51
0,6 T4 + 1,2 T5 + 29,30 +/ - 1,55	-0,1 T4 + 1,5 T5 + 32,96 +/ - 1,09
1,3 T1 + 1,0 T2 + 0,9 T3 + 11, 35 +/ - 0,83	0,9 T1 + 1,0 T2 + 0,8 T3 + 13, 07 +/ - 0,57
0,9 T2 + 1,0 T3 + 1,0 T4 + 4,24 +/ - 0,54	0,8 T2 + 1,0 T3 + 0,8 T4 + 6,58 +/ - 0,43
0,8 T3 + 1,1 T4 + 0,8 T5 + 12,82 +/ - 1,05	0,8 T3 + 1,0 T4 + 1,0 T5 + 11,05 +/ - 0,48
1,2 T1+1,0 T2+1,0 T3+1,0 T4+0,60 +/-0.3	1,0 T1+0,9 T2-1,0 T3+0,9 T4+24,68 +/-0,26
0,9 T2+1,0 T3+1,0 T4+0,7 T5+3,49 +/-0.51	0,6 T2+1,0 T3+0,9 T4+0,8 T5+5,31 +/-0,40

Once obtained the length of the bone, height can be deduced. However, the authors also developed formulas to obtain directly the height for Negroids and Amerindian caucasoids (based on several fragments of a bone)

Subsequently, several studies have insisted on this area, such as those from Holland, Simmons, Prasad, Mendonça MC or Bismos, generally with uncertain or poor results.

RECOMMENDATIONS

1. The first step to estimate height we must estimate sex, necesary date in most formulas.

2. When enough material of the skeleton is available, height must be determined by the anatomical method proposed by Fully in atipical cases of skeletal proportions, high height and cases with osteopathology too.

3. In contemporary skeletal remains of Mediterranean origin, the equations proposed by Mendonça MC will be preferentially used, or Belmonte MT.

4. For central or northern European populations may be of interest to exhibit the result according to the formulas developed by Telkka.

5. For American population, Trotter and Gleser formulas are useful as well as FORDISC computer program.

6. The formula used with the population on which is based, as well as the margin of error ,if available, will be indicated on the reports.

7. It would be of great interest to run a more coordinated approach of new studies in order to have specific formulas for the current Spanish population.

FIG.1. Manouvrier tables for men. Long bones length and height in milimeters.

TABLA DE MANOUVRIER

Longitud de los huesos largos y talla correspondiente (en milímetros)

Hombres

Húmero	Radio	Cúbito	Talla	Fémur	Tibia	Peroné
295	213	227	1530	392	319	318
298	216	231	1552	398	324	323
302	219	235	1571	404	330	328
306	222	239	1590	410	335	333
309	225	243	1605	416	340	338
313	229	246	1625	422	346	344
316	232	249	1634	428	351	349
320	236	253	1644	434	357	353
324	239	257	1654	440	362	358
328	243	260	1666	446	368	363
332	246	263	1677	453	373	368
336	249	266	1686	460	378	373
340	252	270	1697	467	383	378
344	255	273	1716	475	389	383
348	258	276	1730	482	394	388
352	261	280	1755	490	400	393
356	*264*	*283*	*1767*	*497*	*405*	*398*
360	267	287	1785	504	410	403
364	270	290	1812	512	415	408
368	273	293	1830	519	420	413
Coeficiente medio para huesos más pequeños de los indicados en la tabla:						
5,25	7,11	6,66	-	3,92	4,80	4,82
Coeficiente medio para huesos más largos de los indicados en la tabla:						
4,93	6,70	6,26	-	3,52	4,32	4,37

FIG. 2. Manouvrier tables for women. Long bones length and height in milimeters.

TABLA DE MANOUVRIER

Longitud de los huesos largos y talla correspondiente (en milímetros)

FEMALES

Húmero	Radio	Cúbito	Talla	Fémur	Tibia	Peroné
263	193	203	1400	363	284	283
266	195	206	1420	368	289	288
270	197	209	1440	373	294	293
273	199	212	1455	378	299	298
276	201	215	1470	383	304	303
279	203	217	1488	388	309	307
282	205	219	1497	393	314	313
285	207	222	1513	398	319	316
289	209	225	1528	403	324	320
292	211	228	1543	408	329	327
297	214	231	1559	415	334	330
302	218	235	1568	422	340	336
307	222	239	1582	429	346	341
313	226	243	1595	436	352	346
318	230	247	1612	443	358	351
324	234	251	1630	450	364	356
329	238	254	1650	457	370	361
334	242	258	1670	464	376	366
339	246	261	1692	471	382	371
344	250	264	1715	478	388	376
Coeficiente medio para huesos más pequeños de los indicados en la tabla:						
5.43	7.44	7.00	-	3.87	4.85	4.88
Coeficiente medio para huesos más largos de los indicados en la tabla:						
4.98	7.00	6.49	-	3.58	4.42	4.52

FIG. 3. Telkka regression formulas. T: Height; R: Radius; C: ulna; F: femur; T: Tibia; P: Fibula

FÓRMULAS REGRESIVAS DE TELKKA

Cálculo de la talla en el vivo a través de la longitud de los huesos largos

MALES

$T = 169.4 + 2.8\ (H - 32.9)$

$T = 169.4 + 3.4\ (R - 22.7)$

$T = 169.4 + 3.2\ (C - 23.1)$

$T = 169.4 + 2.1\ (F - 45.5)$

$T = 169.4 + 2.1\ (T - 36.2)$

$T = 169.4 + 2.5\ (P - 36.1)$

FEMALES

$T = 156.8 + 2.7\ (H - 30.7)$

$T = 156.8 + 3.1\ (R - 20.8)$

$T = 156.8 + 3.3\ (C - 21.3)$

$T = 156.8 + 1.8\ (F - 41.8)$

$T = 156.8 + 1.9\ (T - 33.1)$

$T = 156.8 + 2.3\ (P - 32.7)$

T- Talla; H-Húmero; R-Radio; C-Cúbito; F-Fémur; T-Tibia; P-Peroné

FIG. 4. Telkka table for men.

TABLA DE TELKKA

Cálculo de la talla en el vivo a través de la longitud de los huesos largos

Talla (en centímetros) a la que corresponde la longitud de cada hueso (en milímetros), en los finlandeses

MALES

Húmero	Radio	Cúbito	Talla	Fémur	Tibia	Peroné
278	185	186	155	387	293	303
281	188	189	156	391	298	307
285	191	192	157	396	302	311
288	194	195	158	401	307	315
292	197	198	159	406	312	319
296	199	202	160	410	317	323
299	202	205	161	415	322	327
303	205	208	162	420	327	331
306	208	211	163	425	332	335
310	211	214	164	430	336	339
313	214	217	165	434	341	343
317	217	220	166	439	346	348
320	220	224	167	444	350	352
324	223	227	168	448	355	356
328	226	230	169	453	360	360
331	229	233	170	458	365	364
335	232	236	171	463	370	368
338	235	239	172	468	375	372
342	238	242	173	472	379	376
346	241	245	174	477	384	380
349	244	249	175	482	389	384
353	246	252	176	487	394	388
356	249	255	177	492	398	392
360	252	258	178	496	403	396
363	255	261	179	501	408	400
367	258	264	180	506	412	404
371	261	267	181	511	417	408
374	264	270	182	515	422	412
378	267	274	183	520	426	416
381	270	277	184	525	431	420
385	273	280	185	529	435	424

Krogman (1956)

FIG. 5. Telkka table for Women.

TABLA DE TELKKA

Cálculo de la talla en el vivo a través de la longitud de los huesos largos

Talla (en centímetros) a la que corresponde la longitud de cada hueso (en milímetros) en las finlandesas

FEMALES

Húmero	Radio	Cúbito	Talla	Fémur	Tibia	Peroné
263	170	177	145	352	268	276
267	173	180	146	357	274	280
271	176	183	147	362	280	284
274	180	186	148	369	285	289
278	183	189	149	375	290	293
282	186	192	150	380	295	298
285	189	195	151	386	300	302
289	192	198	152	392	306	306
293	196	202	153	397	311	311
297	199	205	154	403	316	315
300	202	208	155	408	321	320
304	205	211	156	414	327	324
308	209	214	157	419	332	328
312	212	217	158	425	337	332
315	215	220	159	430	343	337
319	218	223	160	436	348	341
323	222	226	161	441	353	345
326	225	229	162	447	358	350
330	228	232	163	453	364	354
334	231	235	164	458	369	358
337	235	238	165	463	374	363
341	238	241	166	469	380	367
345	241	244	167	474	380	372
348	244	247	168	480	390	376
352	247	250	169	485	395	381
356	251	253	170	491	400	385
360	254	256	171	496	405	389
362	257	259	172	502	411	394
367	260	262	173	508	416	398
371	264	265	174	513	421	403
374	267	268	175	518	426	407

Krogman (1986)

FIG. 6. Trotter y Gleser´s Regressive formulas.

FÓRMULAS DE TROTTER PARA LA DETERMINACIÓN DE LA TALLA A PARTIR DE LA LONGITUD DE LOS HUESOS LARGOS

Medidas en centímetros

	HOMBRES BLANCOS	MUJERES BLANCAS
Fémur	2.38 x Fe + 61.41 ± 3.27	24.7 x Fe − 54.10 ± 3.72
Tibia	2.52 x T + 78.62 ± 3.37	2.90 x T + 61.53 ± 3.66
Fíbula	2.68 x Fi + 71.78 ± 3.29	2.93 x Fi + 59.61 ± 3.57

	HOMBRES NEGROS	MUJERES NEGRAS
Fémur	$2.11 \times Fe + 70.35 \pm 3.94$	$2.28 \times Fe + 59.76 \pm 3.41$
Tibia	$2.19 \times T + 86.02 \pm 3.78$	$2.45 \times T + 72.65 \pm 3.70$
Fíbula	$2.19 \times Fi + 85.65 \pm 4.08$	$2.49 \times Fi + 70.90 \pm 3.80$

	HOMBRES MONGOLOIDES	HOMBRES MEJICANOS
Fémur	$2.15 \times Fe + 72.57 \pm 3.80$	$2.44 \times Fe + 58.67 \pm 2.99$
Tibia	$2.39 \times T + 81.45 \pm 3.27$	$2.36 \times T + 80.62 \pm 3.73$
Fíbula	$2.40 \times Fi + 80.56 \pm 3.24$	$2.50 \times Fi + 75.44 \pm 3.52$

FIG. 7. Trotter and Gleser´s table for white American male.

TABLA DE TROTTER Y GLESER

[illegible]

Húmero	Radio	Cúbito	Talla	Talla	Fémur	Tibia	Peroné	Fémur+Tib.
mm	mm	mm	cm	pulgadas**	mm	mm	mm	mm
265	193	211	152	59^{7}	381	291	299	685
268	196	213	153	60^{2}	385	295	303	693
271	198	215	154	60^{6}	389	299	307	701
275	201	220	155	61	393	303	311	708
278	204	222	156	61^{4}	395	307	314	716
281	206	224	157	61^{8}	402	311	318	723
284	209	227	158	62^{2}	406	315	322	731
288	211	230	159	62^{6}	410	319	326	738
291	214	232	160	63	414	323	329	746
294	217	235	161	63^{4}	419	327	333	753
297	220	238	162	63^{8}	423	331	337	761
301	222	240	163	64^{1}	427	335	340	769
304	225	243	164	64^{5}	431	339	344	776
307	228	246	165	65	435	343	348	784
310	230	249	166	65^{4}	440	347	352	791
314	233	251	167	65^{8}	444	351	355	799
317	235	254	168	66^{1}	448	355	359	806
320	238	257	169	66^{4}	452	359	362	814
323	241	259	170	66^{7}	456	363	366	821
327	243	262	171	67^{3}	461	367	370	829
330	246	265	172	67^{6}	465	371	374	837
333	249	267	173	68^{1}	469	375	378	844
336	251	270	174	68^{4}	473	379	381	852
339	254	272	175	68^{7}	477	383	385	859
343	257	276	176	69^{2}	482	386	389	867
346	259	278	177	69^{5}	486	390	393	874
349	262	281	178	70^{1}	490	394	396	882
352	265	284	179	70^{5}	494	398	400	889
356	267	286	180	70^{7}	498	402	404	897
359	270	289	181	71^{2}	503	406	408	905
362	272	292	182	71^{5}	507	410	411	912
365	275	294	183	72	511	414	415	920
369	278	297	184	72^{4}	515	418	419	927
372	280	300	185	72^{7}	519	422	422	935
375	283	303	186	73^{2}	524	426	426	942
378	286	305	187	73^{6}	528	430	430	950
382	288	308	188	74	532	434	434	958
385	291	311	189	74^{3}	536	438	437	965
388	294	313	190	74^{6}	540	442	441	973
391	296	316	191	75^{2}	545	446	443	980
395	299	319	192	75^{5}	549	450	448	988
398	302	321	193	76	553	454	452	995
401	304	324	194	76^{3}	557	458	456	1003
404	307	327	195	76^{6}	561	462	460	1010
408	309	330	196	77^{2}	566	466	463	1018
411	312	332	197	77^{6}	570	470	467	1026
414	315	335	198	78	574	474	471	1033

* [illegible]

** [illegible]

FIG. 8. Trotter and Gleser´s table for white American female.

TABLA DE TROTTER Y GLESER

Talla máxima calculada a partir de las longitudes (máximas) de los huesos largos, para mujeres americanas de raza blanca*

Húmero	Radio	Cúbito	Talla	Talla	Fémur	Tibia	Peroné	Fém+Tib
mm	*mm*	*mm*	*cm*	*pulgada***	*mm*	*mm*	*mm*	*mm*
244	179	193	140	55^{1}	348	271	274	619
247	182	195	141	55^{4}	352	274	278	632
250	184	197	142	55^{7}	356	277	281	639
253	186	200	143	56^{2}	360	281	285	646
256	188	202	144	56^{6}	364	284	288	653
259	190	204	145	$57^{}$	368	288	291	660
262	192	207	146	57^{4}	372	291	295	668
265	194	209	147	57^{7}	376	295	298	675
268	196	211	148	58^{2}	380	298	302	682
271	198	214	149	58^{5}	384	302	305	689
274	201	216	150	59	388	305	309	696
277	203	218	151	59^{4}	392	309	312	704
280	205	221	152	59^{7}	396	312	315	711
283	207	223	153	60^{2}	400	315	319	718
286	209	225	154	60^{5}	404	319	322	725
289	211	228	155	61	409	322	326	732
292	213	230	156	61^{3}	413	326	329	740
295	215	232	157	61^{6}	417	329	332	747
298	217	235	158	62^{2}	421	333	336	754
301	220	237	159	62^{5}	425	336	340	761
304	222	239	160	63	429	340	343	768
307	224	242	161	63^{3}	433	343	346	776
310	226	244	162	63^{6}	437	346	349	783
313	228	246	163	64^{1}	441	350	353	790
316	230	249	164	64^{5}	445	353	356	797
319	232	251	165	65	449	357	360	804
322	234	253	166	65^{3}	453	360	363	812
324	236	256	167	65^{6}	457	364	366	819
327	239	258	168	66^{1}	461	367	370	826
330	241	261	169	66^{4}	465	371	373	833
333	243	263	170	66^{7}	469	374	377	840
336	245	265	171	67^{3}	473	377	380	847
339	247	268	172	67^{6}	477	381	384	855
342	249	270	173	68^{1}	481	384	387	862
345	251	272	174	68^{4}	485	388	390	869
348	253	275	175	68^{7}	489	391	394	876
351	255	277	176	69^{2}	494	395	397	883
354	258	279	177	69^{5}	498	398	401	891
357	260	282	178	70^{1}	502	402	404	898
360	262	284	179	70^{5}	506	405	407	905
363	264	286	180	70^{7}	510	409	411	912
366	266	289	181	71^{2}	514	412	414	919
369	268	291	182	71^{5}	518	415	418	927
372	270	293	183	72	522	419	421	934
375	272	296	184	72^{4}	526	422	425	941

** La talla máxima calculada debe corregirse restando 0,06 (edad en años–30) centímetros en los individuos mayores de 30 años.*

*** El exponente indica el numerador de la fracción de pulgada expresada en octavos, por ej. 59^{3} debe leerse 59 3/8 pulgadas.*

FIG. 9. Trotter and Gleser´s table for African American male.

TABLA DE TROTTER Y GLESER

Talla estatura calculada a partir de las longitudes (máximas) de los huesos largos, para hombres americanos de raza negra*

Húmero	Radio	Cúbito	Talla	Talla	Fémur	Tibia	Peroné	Fém+Tib
mm	*mm*	*mm*	*cm*	*pulgada***	*mm*	*mm*	*mm*	*cm*
276	206	223	152	59^{7}	387	307	307	704
279	209	226	153	60^{2}	391	306	308	713
282	212	229	154	60^{5}	396	310	312	721
285	215	232	155	61	401	315	317	730
288	218	235	156	61^{3}	406	320	321	739
291	221	238	157	61^{6}	410	324	326	747
294	224	242	158	62^{2}	415	329	330	756
297	226	245	159	62^{5}	420	333	335	765
300	229	248	160	63	425	338	339	774
303	232	251	161	63^{3}	430	342	344	782
306	235	254	162	63^{6}	434	347	349	791
310	238	257	163	64^{1}	439	352	353	800
313	241	260	164	64^{5}	444	356	358	808
316	244	263	165	65	449	361	362	817
319	247	266	166	65^{4}	453	365	367	826
322	250	269	167	65^{6}	458	370	371	834
325	253	272	168	66^{1}	463	376	376	843
328	256	275	169	66^{4}	468	370	381	852
331	259	278	170	66^{7}	472	383	385	861
334	262	281	171	67^{3}	477	388	390	869
337	264	284	172	67^{6}	482	393	394	878
340	267	287	173	68^{1}	487	397	399	887
343	270	291	174	68^{4}	491	402	403	895
346	273	294	175	68^{7}	496	406	408	904
349	276	297	176	69^{2}	501	411	413	913
352	279	300	177	69^{5}	506	415	417	921
356	282	303	178	70^{1}	510	420	422	930
359	285	306	179	70^{4}	515	425	426	939
362	288	309	180	70^{7}	520	429	431	947
365	291	312	181	71^{3}	525	434	435	956
368	294	315	182	71^{6}	529	438	440	965
371	297	318	183	72	534	443	445	974
374	300	321	184	72^{4}	539	447	449	982
377	303	324	185	72^{7}	544	452	454	991
380	305	327	186	73^{2}	548	456	458	1000
383	308	330	187	73^{5}	553	461	463	1008
386	311	333	188	74	558	466	467	1017
389	314	336	189	74^{3}	563	470	472	1026
392	317	340	190	74^{6}	567	475	476	1034
395	320	343	191	75^{3}	572	479	481	1043
398	323	346	192	75^{5}	577	484	486	1052
401	326	349	193	76	582	488	490	1061
405	329	352	194	76^{3}	586	493	495	1069
408	332	355	195	76^{6}	591	498	499	1078
411	335	358	196	77^{1}	596	502	504	1087
414	337	361	197	77^{4}	601	507	508	1095
417	340	364	198	78	605	511	513	1104

* La talla estatura calculada debe corregirse restando 0.06 (edad en años-30) centímetros en los individuos mayores de 30 años

** El siguiente indica el numerador de la fracción de pulgada expresada en octavos, por ej. 59^{7} debe leerse 59 7/8 pulgadas

FIG. 10. Trotter and Gleser table for African American female.

TABLA DE TROTTER Y GLESER

Talla máxima calculada a partir de las longitudes (máximas) de los huesos largos, para mujeres americanas de raza negra*

Húmero	Radio	Cúbito	Talla	Talla	Fémur	Tibia	Peroné	Fém+Tib
mm	*mm*	*mm*	*cm*	*pulgada***	*mm*	*mm*	*mm*	*mm*
245	165	195	140	55^{1}	352	275	278	637
248	169	198	141	55^{4}	356	279	282	645
251	173	201	142	55^{7}	361	283	286	653
254	176	204	143	56^{2}	365	287	290	661
258	180	207	144	56^{6}	369	291	294	669
261	184	210	145	57^{1}	374	295	298	677
264	187	213	146	57^{4}	378	299	302	685
267	191	216	147	57^{7}	383	303	306	693
271	195	219	148	58^{2}	387	308	310	701
274	198	222	149	58^{5}	391	312	314	709
277	202	225	150	59	396	316	318	717
280	205	228	151	59^{4}	400	320	322	724
284	209	231	152	59^{7}	405	324	326	732
287	213	235	153	60^{2}	409	328	330	740
290	216	238	154	60^{5}	413	332	334	748
293	220	241	155	61	418	336	338	756
297	224	244	156	61^{3}	422	340	342	764
300	227	247	157	61^{6}	426	344	346	772
303	231	250	158	62^{2}	431	348	350	780
306	235	253	159	62^{5}	435	352	354	788
310	238	256	160	63	440	357	358	796
313	242	259	161	63^{3}	444	361	362	804
316	245	262	162	63^{6}	448	365	366	812
319	249	265	163	64^{1}	453	369	370	820
322	253	268	164	64^{5}	457	373	374	828
326	256	271	165	65	462	377	378	836
329	260	274	166	65^{3}	466	381	382	843
332	264	277	167	65^{6}	470	385	386	851
335	267	280	168	66^{1}	475	389	390	859
339	271	283	169	66^{4}	479	393	394	867
342	275	286	170	66^{7}	484	397	398	875
345	278	289	171	67^{3}	488	401	402	883
348	282	292	172	67^{6}	492	406	406	891
352	285	295	173	68^{1}	497	410	410	899
355	289	298	174	68^{4}	501	414	414	907
358	293	301	175	68^{7}	505	418	418	915
361	296	304	176	69^{2}	510	422	422	923
365	300	307	177	69^{5}	514	426	426	931
368	304	310	178	70^{1}	519	430	430	939
371	307	313	179	70^{4}	523	434	434	947
374	311	316	180	70^{7}	527	438	438	955
378	315	319	181	71^{2}	532	442	442	963
381	318	322	182	71^{5}	536	446	446	970
384	322	325	183	72	541	450	450	978
387	325	328	184	72^{4}	545	454	454	986

** La talla máxima calculada debe corregirse restando 0,06 (edad en años-30) centímetros en los individuos mayores de 30 años.*

*** El segundo indica el numerador de la fracción de pulgada expresada en octavos, por ej. 59^{7} debe leerse 59 7/8 pulgadas.*

FIG. 11. Regressive formulas of Mendonça MC.

Determinación de la talla a partir de la longitud de los huesos largos

FEMALES

Fórmulas regresivas

TALLA = [64.26 + 0,3065 LTH] ± 7.70
TALLA = [55.63 + 0.2428 LFF] ± 5.92
TALLA = [57.86 + 0.2359 LPF] ± 5.96

MALES

Fórmulas regresivas

TALLA = [59.41 + 0.3269 LTH] ± 8.44
TALLA = [47.18 + 0.2663 LFF] ± 6.90
TALLA = [46.89 + 0.2657 LPF] ± 6.96

TALLA: height (cm.)
LTH: total lenght humerus (mm.)
LFF: physiological lenght of femur (mm.)
LPF: perpendicular lenght of femur (mm.)

FIG. 12. Table of Mendonça MC for male.

Tabla de consulta para el sexo masculino

Estimación de la talla a partir de la longitud de los huesos largos

MALES

HÚMERO Longitud total (mm)	TALLA MEDIA (cm)	FÉMUR Longitud fisiológica (mm)	Longitud perpendicular (mm)
277	150	386	388
280	151	390	392
283	152	394	396
286	153	397	399
289	154	401	403
292	155	405	407
295	156	409	411
299	157	412	414
302	158	416	418
305	159	420	422
308	160	424	426
311	161	427	429
314	162	431	433
317	163	435	437
320	164	439	441
323	165	442	445
326	166	446	448
329	167	450	452
332	168	454	456
335	169	457	460
338	170	461	463
341	171	465	467
344	172	469	471
347	173	472	475
351	174	476	478
354	175	480	482
357	176	484	486
360	177	487	490
363	178	491	493
366	179	495	497
369	180	499	501
372	181	503	505
375	182	506	509
378	183	510	512
381	184	514	516
384	185	518	520
387	186	521	524
390	187	525	527
393	188	529	531
396	189	533	535
399	190	536	539

FIG. 13. Table of Mendonça MC for female.

Tabla de consulta para el sexo femenino

Estimación de la talla a partir de la longitud de los huesos largos

FEMALES

HÚMERO Longitud total (mm)	TALLA MEDIA (cm)	FÉMUR Longitud fisiológica (mm)	Longitud perpendicular (mm)
247	140	347	348
250	141	352	352
254	142	356	357
257	143	360	361
260	144	364	365
263	145	368	369
267	146	372	374
270	147	376	378
273	148	380	382
276	149	385	386
280	150	389	391
283	151	393	395
286	152	397	399
290	153	401	403
293	154	405	408
296	155	409	412
299	156	413	416
303	157	418	420
306	158	422	425
309	159	426	429
312	160	430	433
316	161	434	437
319	162	438	441
322	163	442	446
325	164	446	450
329	165	450	454
332	166	455	458
335	167	459	463
338	168	463	467
342	169	467	471
345	170	471	475
348	171	475	480
352	172	479	484
355	173	483	488
358	174	488	492
361	175	492	497
365	176	496	501
368	177	500	505
371	178	504	509
374	179	508	514
378	180	512	518

FIG. 14. Regressive formulas of Belmonte MT (2012).

FÓRMULA GENERAL	**E= 69,74 + 2,693.T ± 8 cm**
FÓRMULA PARA HOMBRES	**E= 85,807 + 2,279.T ± 6,9 cm**
FÓRMULA PARA MUJERES	**E= 78,812 + 2,339.T ± 7,5 cm**
E estatura en cms	T longitud máxima de la tibia en cm

FIG. 15. Fazekas and Kosa regression formulas.

Humerus	length (cm)	×	7.52	+ 2.47
Humerus	width (cm)	×	28.30	+ 3.95
Radius	length (cm)	×	10.61	− 2.11
Ulna	length (cm)	×	8.20	+ 2.38
Femur	length (cm)	×	6.44	+ 4.51
Femur	width (cm)	×	22.63	+ 7.57
Tibia	length (cm)	×	7.24	+ 4.90
Fibula	length (cm)	×	7.59	+ 4.68

FIG. 16. Telkkä et al. regression formulas.

UNDER 1 YEAR

MALES	S.D.	FEMALES	S.D.
17.4 + 4.94 (F)	3,1	13,9 + 5,09 (F)	2,7
17,3 − 5,95 (T)	3,8	14,2 + 6,14 (T)	2,7
15,2 + 6.39 (Fib)	3,8	15,0 + 6,25 (Fib)	3,1
7,5 − 7,88 (H)	2,5	6,6 + 7,90 (H)	3,1
2,5 - 10,56 (R)	3,1	7,5 + 9,81 (R)	3,8
-1,1 + 10,14 (U)	3,3	0,49 + 9,91 (U)	4,0

1 - 9 YEARS

MALES	S.D.	FEMALES	S.D.
34,1 + 321 log (1+F/100)	4,1	31,7 + 329 log (1+F/100)	4,1
3,4 + 3,43 (T)	3,3	39,4 + 3,34 (T)	5,2
39,1 + 3,42 (Fib)	3,1	40,1 + 3,35 (Fib)	5,0
28,0 + 4,41 (H)	3.0	30,5 + 4,26 (H)	4,9
23,0 + 6,38 (R)	3,3	25,4 + 6,33 (R)	3,5
21,1 + 5,96 (U)	3,1	24,6 + 5,74 (U)	5,1

10 - 15 YEARS

MALES	S.D.	FEMALES	S.D.
10,0 + 3,73 (F)	5,3	33,5 + 3,12 (F)	5,3
44,0 + 3,35 (T)	7,0	58,7 + 2,90 (T)	6,8
38,8 + 3,59 (Fib)	6,9	44,5 + 3,42 (Fib)	5,3
16,5 + 4,91 (H)	4,2	36,9 + 4,11 (H)	5,7
30,5 + 5,96 (R)	4,6	35,3 + 5,85 (R)	4,7
26,7 + 5,73 (U)	4,3	37,8 + 5,24 (U)	4,81

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ANCESTRY ESTIMATION CRITERIA

PROTOCOL	**ANCESTRY ESTIMATION CRITERIA**
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1. INTRODUCTION. CONCEPT OF RACE VS. ANCESTRY.

The reconstruction of the biological profile constitutes the first phase of the process of identification of human remains. Within this process, one of the elements to evaluate is the race or 'descent(ancestry) ', according to its most recent and frequent denomination in the forensic field.

Unlike other diagnostic elements of the biological profile, such as sex, age or height, this is much more complicated and inaccurate. The ambiguity in its definition is reflected in the use of a variety of denominations (and concepts) such as race, ancestry origin, etnic origin or ancestry and, consequently, the translation of this diagnosis that we perform when it comes to reconstruct the biological profile of a body (skin color, geographical origin, socio-cultural aspect, physical appearance, ...?). Some definitions influence this idea. Since the original terminology is mainly in English-speaking literature, definitions are included in their original language.

Race.- DRAE[1]: Each one of the groups that are subdivided into some biological species and whose differentiating characters are are perpetuated by inheritance.

Race.- MERRIAM-WEBSTER: a: a family, tribe, people, or nation belonging to the same stock b : a class or kind of people unified by shared interests, habits, or characteristics.

Ancestry.- DRAE: 1. m. ancestor; 2. m. inheritance (_ trait or traits that continue warning on descendants).

Ancestry.- MERRIAM-WEBSTER: line of descent: lineage; DIE-NET: 2: inherited properties shared with others of your bloodline.

1 DRAE: Dictionary of Royal Spanish Academy.

Ancestor.- MERRIAM-WEBSTER: a : one from whom a person is descended and who is usually more remote in the line of descent than a grandparent a person's ancestors : the people who were in your family in past times.

Ancestor.- DRAE: 1. f. Series of ancestors or predecessors of someone 2. f. Source, origin of something.

However, the diagnosis of ancient origin is a major factor in the estimation of other elements of reconstructive profile (age, height), whose methods application need to know in advance the ancestral origin or population.

Numerous studies have demonstrated widely that different population groups, subject to different ethnic influences, geographic and / or socio-environmental, among others, show differences in the development of skeletal and dental characters, which would affect the mentioned diagnostic elements. However, the very concept of population origin, race, ethnic origin or ancestry, presents serious conflicts when our intention is precisely to evaluate this population origin.

Human classification in biological races, serves to the sharing of heritable traits that make them similar to each other and different from other biological races.

Since the division of the human beings into three races: white, negroid and mongoloide, as primary races which at the same time could be divided into secondary races, the meaning of the term 'race' has not been accepted universally, and its use in Forensic Anthropology has been criticized due to the recent emphasis of the Biological Anthropology in contradicting the biological concept of race minted by the classical physical anthropology, when the human variation is discussed. Nevertheless, although there has been a change in terminology in the field of Forensic Anthropology, with a much wider use of the term ' ancestry ', many contemporary texts still structure the human variation in the three major classical ancestral groups: Mongoloid, Negroid and Caucasoid, under the concept of the division of a specie based on the frequency with which certain hereditary traits appear among its members. (Brues'77).

On the other hand, the races are also socially defined categories, whose members overlap by social factors (Edgar ' 09). Human Biology results from the interaction of genetic processes, of development and culturels, the 'Biohistory', which reflects the broad sequence of events in the history of the biosphere and the Civilization, from the beginning of life until our days.

Serve as an example, the classification in 5 races and 2 ethnicities that the U.S.

Census Bureau makes to its citizens:

1.- American Indians or Natives of Alaska.
2.- Asian.
3.- Blacks or Africans.
4.- Native Hawaiian and other islands.
5.- Whites.
    1.- Hispanic or Latin.
    2.- Not Hispanic or Latin.

The biological and social definitions of 'race' does not mean the same and both concepts must be separated. In the sense 'American', the term 'race' corresponds to its social definition. Sauer ('92) in an excellent article entitled "If races do not exist, why forensic anthropologists are so good at identifying them?" Concludes that forensic anthropologists are good at recognizing the race in USA because there is good correlation between the American social races and the skeleton biology, especially in the skull between white and black Americans.

When these circumstances are not fulfilled, the diagnosis of race is ineffective. In fact, Goodman ('97) states that "in the best case, the identification of race is depressingly inaccurate, and at worst completely capricious.". In the same sense, authors such as Armelagos and Goodman ('98) or Williams and colleagues ('05) are postulated. Usually, biological phenotypes are associated with concepts and cultural 'labels' of race, something changing over time. Also phenotypical characteristics are altered by the migration and the mixture. Such is the uncertainty of this variable as in investigation of victims of genocide, whose pursuit requires to identify the group (national, ethnic, racial, or religious) belonging to the victims; proposes the use of cultural elements as a reflection of ethnic identity.

For the purposes of this document, only the term ' ancestry' will be used, this is the most widely used in current forensic anthropological literature.

2. METHODS TO ESTIMATE ANCESTRY.

The first attempt to collect a comprehensive reference on the estimation of the ancestry for forensic anthropologists is the text of Gill and Rhine 1990 'skeletal attribution of race: methods for forensic anthropology '(Gill and Rhine '90). The estimation of the ascendancy is usually carried out from the visual observation of morphological elements (especially the skull and jaw) or through

the metric analysis of the cranial skeleton and postcranium.

The non metric or morphological methods are based on the assessment of the presence / absence, form or degree of development of a certain characteristic. The most useful characteristics for morphological analysis, are those whose differences between the various study groups are higher. Given that with only one characteristic it is not possible to determine the belonging to a certain group, commonly combinations of characteristics are used.

3. NON-METRIC METHODS

3.1. Cranials.

Hooton ('26) in a study carried out with students, obtained a very low level of matches when they assessed independently, the different characteristics of the ancestry attribution, which led him to conclude that it was necessary to standardize the observations between different observers. With the intention of reducing the mentioned subjectivity inherent in the process of observation of the morphological characters, developed the so-called Harvard Catalog which consisted of a series of cranial nonmetric characteristics, the majority of which are still used by forensic anthropologists.

In an attempt to reduce the subjectivity of the estimations, he designed illustrative schemes for each of the characteristics, although the latter were never published. Over the years he has been establishing a relationship of non-metric characteristics, the ones, considered most useful, which are summarized in most of the texts. Below you can find in detail, the ones gathered from the text of Ubelaker ('07).

The author, overcoming the difficulties mentioned above regarding the diagnosis of ancestry, refers to the concentration of extreme expressions of some skeletal features could suggest affiliation with one of the following major groups:

Asians and American Indians. The skulls present a very projected forward malar bones and comparatively more flattened faces. The nasal opening is of moderate width and it has a lightly developed nasal spine.The orbits tend to be more circular than those of other groups and the palate is moderately broad. At least among American Indians, the suture between the maxilla and the malar tends to be straight.

Blacks: The skulls tend to show a relatively small projection of the malar, more rectangular orbits and wider interorbital distances.The nasal opening is very wide and lacks nasal spine. The palate tends to be very wide and somewhat rectangular. The maxillary anterior alveoli and jaw tend to be very projected forward (prognathism). Many skulls show a slight coronal depression, just behind the coronal suture.

White. The skulls are typically characterized by a very flattened malar bones, giving the face a sharp appearance.The nasal opening is very narrow and has a prominent nasal spine. The palate is relatively narrow and triangular. The suture between the maxilla and the malar tends to be curved. Metopism frequency (suture from nasion to bregma) is higher than among other groups.

Walker ('08), as already done by Hooton said the utility of using comparative illustrations to reduce inter-observer error, and that the results obtained are integrated and interpreted in a statistical framework.

JT Hefner ('09) conducted one of the most complete works with 11 features, taken from 747 individuals:

- Nasal opening width
- Lower nasal opening
- Interorbital width
- External contour of the nasal surface
- Postbregmatic depression
- Prominence of the anterior nasal spine
- Malar tubercle
- Nasal bone structure
- Zygomatic tubercle
- Supranasal suture
- Shape of the transverse palatine suture
- Shaped of zigomaticamaxilar suture

Each feature was defined and drawn, establishing a range of variability. The frequency of distribution, the correlation between different features is studied, and the inter-and intraobserver error is determined, noting that cranial traits historically used in the diagnosis of ascendancy (1-5 from the list) show a good correlation with the three major ancestral groups (Mongoloid, Caucasoid and Negroid) especially when used in a combined way.

The conclusions of the study indicate that the prediction of ascendancy based on the valuation of morfoscópicos traits is an art, not a scientific process, since it is not repeatable, is unreliable and not valid.

Ten of the 11 traits had distribution frequencies with significant differences, but the range of variation of characteristics far exceeds earlier expectations.

Thus it is demonstrated that the expression of the characteristics are not reliable for estimating ancestors and that these features must also be analyzed within a statistical framework.

3.2. Dental traits.

Although there are significant differences at the population level, they do not have single diagnostic character.

With regard to morphological variations of the crown, the most celebrated feature is called tubercle of Carabelli, small additional cusp on the surface of mesio-lingual of upper molars. In incisors, and sometimes in canines, the marginal flange can be especially prominent causing a deep lingual fossa. These teeths are called "shovel-shaped teeth".

Classical texts gather the observation of a high prevalence of teeth "in Pala" in Mongoloid populations and low prevalence respect to the presence of tubercle of Carabelli, which would be more frequent in Caucasians (Hanihara '67). In a study in which data sex, age and dental size of two populations of Mongoloid origin were recorded, Hsu and colleagues ('97) show that the presence of teeth on blade significantly increases the likelihood of the presence of tubercle of Carabelli, particularly in male subjects.

In a recent work, Edgar ('09) analyze the frequency of presentation of morphological features indicated in the literature (upper incisors,tubercle of Carabelli, mesial crest of the canine and seventh peak, comparing samples of African American, Euro-Americans, Hispanic Americans and Native Americans. The results reveal that these dental traits commonly recognized as the most indicative of ancestry, have no real diagnostic value. From the data evaluated, only the canine mesial ridge was markedly different in African-American population, but it showed no differences between the other three groups. On the other hand, due to its low frequency of presentation in all groups (2-21%) the absence of this feature would not be indicative of ascendancy.

The mandibular molars sometimes present a cusp or tubercle accessory in mesiobuccal surface, called 'protoestiloide'. The frequency of protoestiloides seems to be higher among Asians including American Indians and Eskimos.

Radiologically the finding of radicular enamel pearls, the absence of lower

incisors, and extremely large pulp cavities are traits that have been associated with Mongoloids groups. (Evans ´81).

However, the degree of probability of finding one or another trait in an individual depends on the statistical frequency of this character, judging from the investigations carried out for the population concerned. In this sense, the lack of research evaluating these frequencies in subjects of different ancestry, and the poor results of the few published studies, make the use of dental features, restricted to purely presumptive diagnosis of ancestry, and the poor results of the few published studies, make the use of dental features, restricted to purely presumptive diagnosis.

3.3. Postcranial.

Biological differences are expressed on the curvature of the long bones. In particular, Blacks tend to have relatively straight femurs, with very little torsion or rotation between the neck and head. In contrast, Asian femurs tend to be fairly curved, with a considerable degree of torsion of the neck. Whites are situated in an intermediate position respect to the curvature and torsion. The American Indian femurs often show a marked flattening or platimeria in the anterior zone of the upper end diaphyseal [References].

4. METRIC METHODS.

Metric methods are based on differences in size, both in cranial characters and postcranial, existing between different human groups.

4.1. Cranial.

The skull is considered to be the most useful part of the structure in order to use in the assessment of ancestry (Howells ´73).

The measures used for diagnostic purposes of ancestry, were originally established in the Agreement of Frankfurt in 1882. In this meeting it was intended standardize the points of reference of the skull to be used for anthropometric data.

The indices obtained by the combinations of these measures allowed to classify the skulls, considering the predominant morphology resulting from the measures of the cranial vault (dolichocephalous, mesocephalics,

brachycephalics)of the face (prognathous, mesognato, retrognato), of the orbital morphology (cameconcos, mesoconcos, hipsiconcos), of the palate (leptoestafilino, mesoestafilino, braquiestafilino) or of the nasal passages (leptorhine, mesorhine, platyrhine, hyperplatyrhine), among others.

In 1962 Giles and Elliot ('62) established a scoring method to identify racial affinity. This work was conducted with 1,022 skulls, (187 whites, 221 blacks, and 617 Indians) where they determined sex and race with eight skull measurements:

1. Glabella-occipital length
2. Cranial width
3. Basion-bregma
4. Basion-nasion
5. Basion-prosthion
6. Bizygomatica width
7. Prosthion-nasion
8. Nasal width

Sex determination was correct in 82.9% of cases, and the determination of race was correct in 85.1% of cases. Starting from this work multiple studies have conducted comparing the different groups that exist.

Snow and colleagues ('79) verified the discriminant functions of Giles and Elliot in a sample of 52 skulls of known sex and race. Sex assignment was correct in 88% of cases and the race in 71%. Most errors were committed in the group corresponding to American Indians.

MY Iscan and Steyn M ('99) analyzed a sample comprised of 53 white and 45 black men and 53 white and 45 black women in South Africa. They used 13 cranial measurements and 4 mandibular.

Cranial measurements:
Cranial longitude
Cranial width
Maximum frontal width
Minimum frontal width
Bizigomática width
Basion - nasion
Basion - bregma
Basion - prosthion
Nasion - prosthion
Mastoids height

Biasterionica width
Nasal height
Nasal width

Mandibular measures:
Bicondylar longitude
Bicondylar width
Bigonial width
Minimum width of branch.

The results were correct in 98% of cases with cranial measurements and with the mandibular in 74% of men and 87% of women.

The metric method most used today is the result of the computer application FORDISC. This application was created by Richard Jantz and Steve Ousley and uses discriminant function analysis derived from a base of anthropometric data (Jantz and Moore Jansen '88) containing a number of measures taken from positively identified bodies, from forensic cases. The program was created in 1993 and revised in 1996 and 2005. The database incorporates 21 cranial measurements, and the application calculates the probability that the skull belongs to a certain populational group. The groups represented are: African Americans, Indian Americans, whites Americans and Japanese of both sexes as well as male Chinese, Vietnamese and Hispanics, most of the latter being Mexican Americans).

Although the method is objective, there are still many mistakes, mainly inter and intra observer originating from taking measurements. The results of recent studies (Elliot and Conrad '09) suggest little usefulness of the FORDISC in diagnosing descent, which generally does not pass 40% of accuracy, especially in cases which are not represented in the database.

4.2. Postcranial.

The postcranial skeleton is the result of gene-environment interaction occurred during the processes of intravariación. It is expected that the form and size of the various elements that compose it is reflected in differential form both the genetic information, and the influence of various environmental factors (climate, nutritional, functional, etc.)

Trudrell ('98). Performing a work to discriminate between blacks and whites, with samples of different collections studying the anterior curvature of the femur. The measures used for the study are as follows.

Maximum Length
Oblique Length
Bicondylar width
Anteroposterior diameter mediodiafisario
Transverse diameter mediodiafisario
Subtrochanteric transverse diameter
Distance to the R1 table (proximal part of diaphysis)
Distance to the R2 table (half diaphysis)
Distance to the R3 table (distal part of diaphysis)
Distance to the proximal table
Distance from the proximal block (blocks where you place the femur)
Distance from distal block

These measures were taken in both right and left femur with the following results: 88.1% correct with right femur and 86% with left femur.

Marino ('97) performs a work to discriminate whites of blacks with samples from the collections of Terry and Todd in first cervical vertebra, taking eight measurements of 200 vertebrae, the result is correct in 75% of men and in the 76% of women.

Holliday and colleagues ('99) working with body proportions with a sample of 26 males and 28 females black Americans and 28 males and 28 females white Americans, all from the Terrys' Collection of the Smithsonian Institution. On the other hand they studied thirteen other skeletons which are not belong to the populations mentioned before, 5 women and 7 men from the Antropology Museum of New Mexico and 2 women and 4 men from the Un ı versity of Florida.

Working with the following measures:

1. Anteroposterior diameter of the femoral head
2. Trunk height
3. Bi-iliac width
4. Bicondylar femoral longitude
5. Maximum length of humerus
6. maximum longtitud of the tibia
7. maximum longtitud of the radius

They obtain that of the samples from the Terrys' Collection, 87% of men are classified correctly as well as 100% of women, but of the other thirteen skeletons, 81.8% of men are classified correctly and only 57.1 % in women.

4.3. Dental.

Size. In general, the teeth of Australian aborigines, Melanesians, Native Americans, and Eskimos are among the largest. The teeth of Lapones y Bosquimanos are usually among the smallest, while other populations presents intermediate values (Lasker and Lee '57).

DNA. - Although it is possible to estimate the most probable geographical origin of the variation of a particular polymorphism *(polymorphism variant)* or a profile *(sequence profile)*, it must be emphasized that this probability is not synonymous of the most likely population of origin of a particular person.

It is necessary to be particularly cautious when using skin pigmentation as a factor that may infer ancestry.

It is possible to estimate the ancestry of a person based on DNA analysis, with a reasonable number of genetic markers. But there is the question of how many SNPs are needed to reliably infer the ancestry. One should perform global populational screening to assess the potential of specific SNPs for estimating ancestry, not necessarily related to physical characteristics related to a particular population (Salas and colleagues '06).

RECOMMENDATIONS.

1. Unlike other diagnostic elements of the biological profile, such as sex, age or height, the diagnosis of ancestry is much more inaccurate because of the ambiguity in its definition and the absence of 'pure' populations.

2. Only in those cases where there is a good correlation between social races and skeletal biology (in case of African Americans, white Americans and Native Americans groups in the U.S.), can be useful as integral element of process of identification reconstructive of the biological profile.

3. When these circumstances do not concur, the diagnosis of race is ineffective and should be limited to the assessment of previous hypotheses (confirmation / exclusion of candidates), yet with a relative reliability.

4. In such cases, the combined use of all those methods possible to apply, is recommended, especially the cranial features used historically in the diagnosis of ancestry.

5. Due to the unreliability of the results derived from the application of FORDISC in the diagnosis of ascendancy, in cases of cadavers of unknown identity, its use in this process is not recommended.

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IDENTIFICATION CRITERIA

PROTOCOL	**IDENTIFICATION CRITERIA**
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PREVIOUS CONSIDERATIONS:

In the drafting of this work it has been taken into consideration that the criteria presented here be useful mainly for Laboratory of Forensic Anthropology and Odontology of the Administration of Justice in Spain. Therefore, expert working standards adapted to the Spanish civil and criminal proceedings were raised. However we consider that the criteria established given their general nature can be useful also for application in other areas.

1.THE CONCEPT OF INDIVIDUAL HUMAN IDENTIFICATION:

Identity is the character set that individualize a person, distinguishing it from the others.

In forensic practice, **the identification of human remains is a scientific and technical process by which it is possible to attribute them a certain identity.**

This concept allows us to make the following considerations:

1) *Scientific-Technical Procedure:*
Identification methods should be scientifically sound, reliable, applicable under field conditions, able to be implemented in a reasonable period of time (INTERPOL DVI GUIDE) adapted to each context and applied by skilled and experienced professionals (according to criteria of the document The Missing ICRC)[2].

The investigation process of the individual human identification is governed by scientific principles and sometimes also technical. Therefore all methodological aspects of the process should be recorded and made in a way that they can be reproduced by other experts. Attended to the peculiarities of Forensic Anthropology, it should be considered that the identification

2 ICRC: International Committee of Red Cross.

procedure begins in the investigation phase, it continues in Archaeology (individualization of the remains) and often ends with the introduction of genetic profile obtained in the police database on identifiers obtained from the DNA. In the whole procedure the registration and maintenance the so called 'chain of custody' of the samples has special significance.

2) *Attribution of identity:* The process of identification of human remains is multidisciplinary and includes the collection, integration and comparing all of the information available in each case, classified in antemortem and postmortem records.

Forensic Anthropology and Odontology constitute a part of this process, which should include all disciplines involved and requires comprehensive assessment of all information collected by them.

Whatever the technique used, it must be based on scientific criteria. It is recommended to take into account these effects called Daubert decision criteria[1] used in the legal field in the U.S. to evaluate the expert evidence:

1) *Whether the theory or technique used by the expert can be or has been tested.*
2) *Whether the theory or technique has been subjected to peer review and publication.*
3) *The known or potential margin of error of the method used.*
4) *The degree of acceptance of the method or conclusions between the relevant scientific community.*

For comparative purposes we call Doubted sample any of the samples obtained from human remains that we aim to identify and we call undoubted sample to all the samples that we assign to a known identity, generally with high certainty.

Special interest has the data collection procedure or antemortem registers. The expert must always ensure that the identity belongs to the antemortem record that will be compared in the case.

The antemortem data collection be made by multidisciplinary teams that will include among others professionals from Legal Medicine and as support staff it is considered necessary to obtain the maximum number of antemortem data.

2.IMPORTANCE OF THE IDENTIFICATION.

The process of identification of human remains is one of the most important responsibilities of forensic anthropologist and should be prioritized in all cases, both in legal and judicial significance for the purposes of ongoing investigation, as a humanitarian response to the needs of the families of the missing persons.

3.THE IDENTIFICATION TECHNIQUES:

Identification techniques are considered to be all those technical or factual or circumstantial elements that contribute or could contribute to identifying human remains either because allow us to attribute a certain identity or because they allow us exclude it.

We believe that most of the scientific community share the idea that the various techniques currently used in human identification have different scientific value for identification purposes, whether or not published on its reliability. Some of the techniques shown in Table 1 have contrasted scientific value. Others however do not have scientific studies to support them but they can add value to the identification taken together.

TABLE 1 : Classification techniques applicable in human identification.

CLASS	TECHNICAL
PRIMARY	Fingerprint
	Odontological
	DNA polymorphisms
SECONDARY	Visual Identification
	Radiographic comparison
	Documents and personal objects
	Facial approximation
	Anthropological Profile: Det Sex
	Anthropological Profile: Det Height
	Anthropological Profile: Det Age
	Anthropological Profile: Det Ancestry
	Pathobiography
	Date of death evaluation
	Photographic superimposition
	Circumstances of the death

3.1. Primary:

Primary techniques are considered to be as follows:

1) FINGERPRINTS:

This is a technique of high value identifier but generally they are no generally applicable in Forensic Anthropology.

In some special cases it is possible to obtain fingerprints by mummified tissue regeneration or dried or by obtaining latent prints on some items that have been cut off from sources of deterioration of fingerprints. Expert intervention in Forensic Anthropology should allow to collect these prints in ideal conditions to provide the expert in Lofoscopia obtaining fingerprints in conditions of maximum quantity and quality. In any case the task of obtaining and regeneration of fingerprints must be carried out by experts in Lofoscopia. In general terms individual identification by fingerprints will be accepted if there matching at least 12 characteristic points[3].

2) ODONTOLOGICAL:

Dental techniques are generally recognized as high value identifying technics both because of its individualizing potential and for its exclusion capacity.

That is why in any case of identification of human remains, from the beginning, the dental information of people reported missing should be required. The need to have complete and original antemortem dental records, should be emphasized, all properly labeled with the patient's name, advising dentists to submit all the available information on a particular patient (odontographs, radiographic and photographic records, study models) and perform duplicate for their own archives.

The nomenclature recommended for working context of the AEAOF is the International Dental Federation (FDI) or digit two.

3 The requirement that there be on prints or footprints same twelve points derives from the tradition of Galton, Remus, Balthazard and others. More recent authors as Steinwender and Cooke, are inclined to the opinion that eight to twelve points of comparison may be sufficient for identification, depending on the nature of the points and drawing in general.

However it must be noted that in Spain, the jurisprudence considers that eight or ten characteristic points are sufficient to establish the identity between two fingerprints or impressions, provided they are identical in topographic parameters (located in the same zona), morphological (likewise) and mathematical (same number of ridges between them), and showing no natural dissimilarity (S. de 15-06-88 Ar.5024, S. de 4-7-88 Ar.6477, S. de 25-11-89 Ar.9314, S. de 4-7-90 Ar.6220, S. de 15-3-91 Ar 2156). If several fingerprints are obtained, they can serve as a complement for more solid basis for the questioned authorship of the fact (S T.S de 25-11-99, Ar.9314). On the other side, Spanish identification services, argue that it is possible to establish the identity with a smaller number of characteristic points depending on their qualitative value.

For techniques and procedures recommended by some professional and scientific bodies consult INTERPOL New DVI Guide: **http://www.interpol.int/Public/DisasterVictim/guide/guide.pdf**; International Organization of Forensic Odonto-Stomatology (IOFOS) Quality Assurance in Forensic Odonto-Stomatology: **http://amalgam.uio.no/foreninger/iofos/quality/quality_assuarance.htm**; American Board of Forensic Odontology (ABFO) Reference Manual. Body Identification Information (pág 118-170): **http://www.abfo.org/pdfs/ABFO_Reference_Manual_for_11-2010.PDF**

There is no international consensus regarding the number of mathes of characteristic points. While in this North America it is evaluated individually, depending on the case, in other countries like South Africa a minimum of 12 characteristic points of match is required[1].

In cases where it is necessary to manage a high volume of información, the use of specific computer programs is recommended. In this regard, the program WinID is recommended to use, it can be obtainable free at: **www.winid.com**

3) DNA polymorphisms:

The object of this document is not to describe the genetic techniques of identification. It is well-known by all that genetic techniques have high power of identification with a minimum overall margin of error.

The most extended current criteria in use of DNA as a procedure for identification is limited to cases where other methods are not appropriate (ICRC-INTERPOL).

Some aspects of interest for the anthropologist and forensic odontologist in relation with genetic identification techniques should be emphasized in this document.

In all cases of studies of human remains,bone and / or dental samples are collected for its eventual processing and analysis.

In cases of bodies in advanced putrefaction or skeletonized is it is advisable, as most ideal, the sampling of dense cortical bone of long bones of lower limbs (sections in 'window' of 4-6cm without separation of the diafisis)avoid to include areas that could compromise taking measures, articular margins or fractures, or 10gr of the cortical of other bones available and / or healthy teeth (preferably molars). In case of carbonized bodies, in addition to the above,

impacted teeth or dental roots.

- It is recommended that all Anthropologists and Forensic Odontologists dedicated to studies of human identification and many professionals dedicated to obtain DNA samples have their genetic profile (autosomal STR markers, Identifiler).

- For all types of sampling as well as regarding the chain of custody requirements to be observed in this regard is proposed from the International Society for Forensic Genetic (ISFG) referenced below.

- In cases of disasters, multiple victims incidents or armed conflicts shall take into consideration the specific recommendations made on the matter both the ISFG[16] as Interpol[17] or the International Committee of the Red Cross[4].

- In the case studies of unidentified human remains, forensic anthropology laboratories in Spain request that the profile gene obtained is inserted in the DNA database.

3.2. Secondary:

Secondary techniques are considered among others, the followings:

1. VISUAL IDENTIFICACION:

Although this technique is often not possible to use in Forensic Anthropology, we include it because sometimes it can provide elements of assessment in the identification. A tattoo, a body or facial peculiarity can contribute to facilitate the identification. We have not found specific work to confirm the low reliability of this technique, although many professionals confirm that this technique is capable of causing many errors[1],[4].

2. RADIOGRAPHIC COMPARISON:

Depending on the specific case study, in general the application of radiological and imaging techniques(Conventional Radiology, TAC or RNM) of human identification has long shown to be a valuable technique.

a) Frontal sinuses: There is a belief that are unique for each individual including univitelline twins. They start their development from 6 months to 2 years of age. They are radiographically recognizable starting from 5 years and

continue to develop through puberty. Although they are anatomically stable, once developed, they may suffer pathological and physiological modifications. Usually they present such as bilateral cavities although they can be unilateral, being totally absent in 5% of the population. The projection PA of skull is recommended for its identifying evaluation[1]. For comparison of frontal sinuses it is recommended the digitization of radiographic images and the use of a graphic design computer program which allows to evaluate contour, general morphology, area, volume or symmetry in the case of having a recourse to TAC).

b) Radiological characteristics: In the use of radiographic plates for human identification the following must be taken into account:

- Confirm the identity of the person to whom belongs to plate/ s considered as undoubted sample.
- Consider the date of issue of the plate.
- Consider the position of the subject as well as the projection and the radiological technique used to fit them in the doubted sample as possible.
- Considering the presence of taphonomic phenomena on the doubted sample.
- Considering the presence of the sample taphonomic phenomena dubitada.
- Always consider the possible use of all the useful characteristics to the case (turkish sella, anatomical variations, osteopatological congenital alterations, hereditary or acquired, etc, ...)[7].
- Some authors consider necessary to obtain eight matches to establish a positive identification[1].

3. DOCUMENTS AND PERSONAL ITEMS:

These objects are frequently used in the Judicial field to establish the preliminary identity and they generally constitute a source of essencial information throughout the investigation. However one should always keep in mind in forensic anthropology that documents and personal belongings are not elements of the cadaver but associated with it and therefore can be an important source of error.

4. FACIAL APPROXIMATION:

All those techniques that allow to obtain a good face starting from a skull or from the testimony of a witness are included under this name. Also the artistic

techniques of aging faces are included here. Both sculptural techniques, such as drawings or computer-aided reconstructions are not acceptable as valid techniques for individual identification purposes for the high margin of error shown in published studies[5],[6]. However these techniques can contribute to the identification process and be helpful deinvestigación purposes.

5. OBTAINING THE ANTHROPOLOGICAL PROFILE:

The margin of error for obtaining any of the features of anthropological profile vary depending on the quantity and quality of the skeletal material recovered and existence of standard populations,

- As for sex determination. In **adults** with a complete skeleton the accuracy is 100%, studying only the pelvis the accuracy lowers to 95%, studying only the skull to 90%, with skull and pelvis we got 98%. Studying the sex only from long bones the accuracy ranges between 80-90%. Using long bones and skull we got to 90-95% and studying long bones and pelvis the accuracy exceeds 95%. In subadults the accuracy is around 50% without pelvic remains. Counting with the pelvis accuracy may reach to 75-80%[8]. These degrees of accuracy should be taken into account when performing an identification or exclusion based on sex.

- As regards the determination of the height we have not found general studies that allow us to know the reliability of the techniques. If we have the complete skeleton it is recommended to use the method called Anatomical Method or Fully Method [9] when necessary using the height data for identification purposes. If it is not possible to apply the anatomical method a mathematical method should be used if possible whose data have been obtained from a population as similar as to the case of the study. There seems to be general recognition for the Trotter and Glesser Tables also for those of Manouvrier. In general many authors recognize that in the estimation of the height starting from the length of the long bones reduces the error the more long bones we employ. In our environment, it is recommended to use the Tables de Mendonça MC (1998) whose accuracy in adults reaches 95%[10]. It must also be taken especially into consideration that antemortem data of height frequently have low reliability either by the method used in measuring or by the time elapsed since the antemortem record. Therefore extreme caution it is recommended when obtaining height data for identification purposes.

- As for the age determination it is necessary to remember that the accuracy of the different methods is different and that in the case of study it can be further modified the conditions based on that the

individual is an adult or subadult, in that we count on all the bones or not and also the state of conservation of the bones. Overall, the error decrease from older individuals to younger ages. In general, over 60-65 years the margin of error can be 20 years, in middle age (20-60 years) between 5 and 10 years and in children ages 1 to 2 years[11].

- In connection with the determination of ancestry origin there appears to be no reliable method from the anthropological point of view. Some population differences are apparent in the skeleton, but the variation within same group and the overlap between groups reduces the reliability of identification based on one skeleton[11]. The application of genetic techniques may help to locate the case of study in one of five populational groups (Europoides, Asian, African, Native American and Australioids)[12],[13].

6. PATHOBIOGRAPHIC EVALUATION:

Given the high and varied number of possible cases is not possible to talk about reliability of this technique. Sometimes the comparison is simply morphological, in other cases it can be more complex. There seems to be general agreement that isabout a technique that can have a high identification value. Antemortem pathobiographic data collection must be extremely careful. The expert must confirm the identity of antemortem registration in all cases. The comparative technique employed should be reproducible. The best source of pathobiographic data collection is medical history. Oral sources of pathobiographic information should always be contrasted. In recent years in our country the majority of osteosynthesis material that is implanted includes a registration number that the expert must verify.

7. EVALUATION OF TIME OF DEATH:

Sometimes estimating the time of death can help identify whether done by anthropological methods, biological or purely circumstantial. In general the contribution to the identification takes place because it allows excluding individuals if the error margin of the technique is safe enough.

8. CRANEOPHOTOGRAFIC SUPERIMPOSITION.

Although some authors have claimed the utility of identification of these techniques[14] and even they have situate the reliability of the craneofotografic superposition in 91%[15], the most widely used approach is not to admit them as

reliable methods of human identification, considering them useful only as excluding procedures.

9. CIRCUMSTANCES OF DEATH:

The assessment of the circumstances of death can contribute a very important way to the complex process of individual identification that sometimes appears before the Forensic Anthropology or expert responsible of the case. For this we believe that several conditions should meet:

- The process of investigation of the circumstances of death must be prior to the study of human remains or performed by persons or entities other than who do the forensic anthropological study of the case. The purpose of this condition is to reasonably exclude any methodological contamination in responsible for conducting the identification.

- The forensic expert, who is in charge of the case of identification must take into account the reliability of information sources.

- There should be as detailed as possible registration of the sources of information that support the circumstantial facts that will be subject to assessment for identification purposes. Overall anonymous sources of information are not admissible.

- The research process must gather sufficient conditions so that others as Forensic Expert can come to similar conclusions.

4. FORENSIC IDENTIFICATION PROCEDURE:

4.1. Preliminary aspects:

The anthropologist and forensic odontologist shall always consider all the circumstances of the death that may condition the identification process.

4.2. Sampling and chain of custody:

The rules regarding the chain of custody must be applied to all samples, but you should be especially careful with research samples for DNA polymorphisms.

For samples to be sent to the National Institute of Toxicology and Forensic Sciences, with regard to shipping and chain of custody you should consider the Act of JUS/1291/2010 of 13 May with which the rules for the preparation and submission of samples analyzed by the National Institute of Toxicology and Forensic Sciences is approved (BOE 122 of May 19, 2010).

Download from:
http://www.boe.es/boe/dias/2010/05/19/pdfs/BOE-A-2010-8030.pdf

With error correction from:
http://www.boe.es/boe/dias/2010/06/16/pdfs/BOE-A-2010-9507.pdf

In rest of the cases it is proposed to follow:

1) The recommendations made by the Group of Spanish and Portuguese speakers of the International Society for Forensic Genetic whose recommendations can be downloaded from the links below:
http://www.gep-isfg.org/documentos/Recogida%20de%20evidencias.pdf
http://www.gep-isfg.org/documentos/Documento%20catastrofes.pdf

2) The recommendations proposed by the International Committee of the Red Cross in cases of armed conflict and other situations of armed violence for DNA samples [4] downloadable at:
http://www.icrc.org/WEB/SPA/sitespa0.nsf/htmlall/p4010/$File/ICRC_003_4010.PDF

3) The recommendations of INTERPOL in cases of disasters downloadable at:
http://www.interpol.int/Public/DisasterVictim/guide/guideES.pdf

4.3 Antemortem data collection:

Antemortem data collection should be done in a systematic way and if possible with references on the subject already exist in antemortem police records of missing persons or antemortem INTERPOL protocol. In cases of application of National Forensic Medicine and Scientific Police in multiple victims events Action Protocol[18], will be addressed as specified therein.

The AEAOF recommends the development of anthropological datas of antemortem chips in coordination with the datas that can be introduced into the data base unified for all the Police force in Spain of all missing persons and human remains (PDIRH).

Forensic anthropologist will confirm the identity of all the elements that can be compared in the identification process and considered as undoubted samples (x-rays, undoubted antemortem DNA, etc).

5. IDENTIFICATION CATEGORIES:

As a resume to the criterias previously exposed, the identification of human remains is result of the comparison of the available antemortem and postmortem data, categorized according to their potential identification in primary and secondary. The coincidence of a primary element of identification must never exclude the verification of the coincidence of secondary elements such as sex, age and other personal characteristics.

It is commonly found in expert reports as well as standard designations in some texts or verbal predicates to refer to the level of certainty with which we can express opinions regarding the identification of a case[1]. Often used as follows:

Tentative identification.

Indicates that the identification is suspected because it is based on circumstances or personal items (identity card, wallet, ...). It is frequently used in the field of police investigations, judicial and forensic new cadavers.

Presumptive identification.

Assumes a greater degree of certainty than the tentative, but less than the positive. For example, you can assign a presumptive identification when we found the body of a person in the interior of a house ('his house'), anthropological data coincide and no grounds for exclusion.

Positive identification.

Assumes that for the expert there is enough probative evidence to affirm the identity.

Individualization.

The term itself makes clear that the identity is confirmed also excluding other individuals. The term is usually applied when genetic tests, the Forensic Odontology, the pathobiography or fingerprints confirmed it.

RECOMMENDATIONS:

We propose (at least for the final diagnosis, once integrated all the data from different procedures) to reduce the judgment on the identification is of these three categories:

a) POSITIVE IDENTIFICATION
b) INCONCLUSIVE IDENTIFICATION
c) EXCLUSIVE IDENTIFICATION

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