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FACILITIES AND ENVIRONMENT OF A MODERN DISSECTION ROOM

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ACTA DE MADRID 2015

“Facilities and Environment of a Modern Dissection Room”

The Madrid Act is the translation to a special issue of the European Journal of Anatomy of the conferences presented in the “II Symposium coping with a modern Dissecting Room” hosted in the Complutense University of Madrid the 7th of February of 2015 with the support of the Spanish Association of Anatomy.

A previous Symposium was celebrated in 1996 in Barcelona and a previous Act (Act of Barcelona) was also produced. The document of the Act may be downloaded in Spanish language in the webpage of the Spanish Association of Anatomy (SAE): dissecting room (sala de disección), documents (documentos): http://www.sociedadanatomica.es/index.php/32-documentos/63-la-sala-de-diseccion

In this “II Symposium”, the problems related with the dissecting room have been updated: donation and ethics, running a dissecting room facilities (ventilation system, electrical and light fittings, etc.), use of toxic chemicals for embalming and preservation, cadaver storage in tank of liquid chemicals, teaching with cadavers, clear standard guidelines for work conditions, etc.

Our aim is that this Act of Madrid 2015 will become a basic document for improving work conditions in the dissecting room in terms of security and hygiene with the maximum respect for the donors.

I would like to thank the organizing committee and speakers for their contributions that have made possible the publication of this supplement.

Finally, the help and support given by the Spanish Association of Anatomy and the Complutense University of Madrid is highly appreciated.

José R. Sañudo
Editor-in-Chief
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ETHICAL AND LEGAL ASPECTS OF CORPSE DONATION

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INTRODUCTION

Medical ethics is almost as old as mankind itself. It has been shaped by a combination of traditions passed down through the centuries and religious and moral precepts.

University medical faculties throughout history have contributed to the elaboration of "codes of conduct". Some of these codes, which have guided medical practice throughout history, reflect an ethical sensitivity to medical problems. They include the "Hippocratic Oath" in Western civilization; the "Oath of Initiation" in first-century Hindu civilization; the "Oath of Asaph" from the third/ fourth century in Jewish culture; the "Prayer of Maimonides" and the "Medical Advice" from the Arab world in the tenth century.

Historically, the human body has been a key element in medical education. The bodies used in dissecting rooms were generally those that had not been claimed by relatives. However, they were not always sufficient in number and the so-called "resuscitators" snatched bodies from their graves and traded with them. One of the most gruesome ways of obtaining bodies took place in Edinburgh in 1820, when William Burke and William Hare strangled 16 people to sell their bodies.

On occasion, practices were legally dubious, such as when the Faculty of Medicine in Ohio (USA), among others, approved a "code of silence", stating that "students must not make public the secrets of the dissecting room or they will lose their privilege to access it". In 1878 John Harrison, a medical student at the same Faculty in Ohio, found the body of his own father on the dissecting table! The New York Times echoed the news and this fostered laws in which dissection was considered a form of punishment. The corpses of executed criminals were allowed to be used for medical educational purposes.

During the second half of the twentieth century, statements regarding ethical principles for medical research involving human subjects were drawn up, including the 1964 Helsinki Declaration and the National Commission for the Protection of Human Subjects for Biomedical Behavioural Research. Interestingly, there has been a regulatory gap regarding the use of bodies for the teaching of human anatomy. These activities should be carried out within a framework of respect and in compliance with the same ethical principles which govern the training of the future doctor.

In Spain, there were already rules governing funerary matters, such as the Real Orden (Royal Statute) of October 30, 1835; the Royal Statute of July 18, 1887; the Royal Statute of February 13, 1913 and the Royal Statute of 21July1924. However, specific legislation regulating the use of cadavers in medical education in Spain came very late, as late as 1932.

Act of the Spanish Interior Ministry of October 31, 1932

In the first article of this Act, it is stated that "in those cities which have a medical faculty and whose population does not exceed 500,000 inhabitants, there will be only one morgue to which individuals deceased in charity establishments will be sent" (with the implication that in cities with a larger population, more than one morgue could be established). The novelty of this ministerial Act included: the assigning of exclusive competence of morgue management to the faculty of medicine of the corresponding city; the obligation to return the body to family members, if they existed, and provided that they requested the return of the body; the possibility of using unclaimed bodies for teaching and re-

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search in medical faculties; the requirement for a certificate of the personal history of the deceased, including a diagnosis of the disease causing death and the time when it occurred. These requirements ensured that the deceased body would not be used until at least 24 hours after death. Curiously, there were no prohibitions regarding the use of bodies harbouring contagious diseases.

Subsequently, numerous norms were published which completed this Ministry of Interior Act, such as the Act of October 31, 1938; the Act of November 28, 1945; the Act of April 30, 1951; the Act of March 17, 1952; the Act of February 17, 1955; the Act of February 27, 1956 and the Act of September 1, 1958 (almost all of which are still in force today).

Spanish Decreto (Decree) 2263 of July 20, 1974

On July 20, 1974 the 2263 Decree regarding Policía Sanitaria Mortuoria (Mortuary Health Police) was approved and published in the Boletín Oficial del Estado (BOE; Official State Bulletin on August 17, 1974. This Decree regulates, in a unified and systematic way, virtually every aspect of funeral matters. Thus, for example, after a Disposición General, (general introductory section), in Article 6 the Decree contemplates the use of anatomical parts and corpses for scientific or educational purposes. It also prescribes that the human remains be buried in authorized places or that the ashes be scattered at sea, as appropriate.

This Decree continues with a section that deals with definitions, such as: what can be considered to be a corpse, cadaverous remains, putrefaction, embalming, skeletonization, incineration or cremation, refrigeration, radio-ionization, etc. It presents the division of corpses into two groups based on the cause of death. These are: Group I corpses, whose cause of death was a health hazard (cholera, smallpox, anthrax, and all those diseases that are so defined by the Dirección General de Sanidad (General Health Service). Obviously the bodies belonging to this group would not be suitable for use in medical faculties. Group II is made up of the rest of the deceased bodies. It regulates in detail all matters relating to transfer of the body (at local, national or international levels), coffins, means of transport, etc. In Article 28, it specifies that “the bodies that are to be used for teaching or research may be transported by van and reusable metal casing and with convenient means of short-term preservation, and therefore these services are exempt from provincial and municipal taxes, as well as other health duties which might normally apply”. The characteristics of the coffins and hearses, funeral homes, funeral deposits, cemeteries, crematories, cemetery tombs, etc., are all stipulated. This decree annulled Decree 2569/1960 of 22 December. Nothing more is said about the use of cadavers for teaching and research purposes.

Spanish Constitution of 1978

After the approval of the Spanish Constitution of 1978 and the subsequent development of the Spanish Autonomous State, each Autonomous Community (AC), with the exception of Ceuta and Melilla, developed their own Mortuary Police standards as legal decrees. These are: Decree 106/1996 the AC of Aragon, the first Autonomous Community to officially legislate in this regard; Decree 297/1997 (Catalonia AC); Decree 194/1997 (Madrid AC); Decree 134/1998 (Galicia AC) and Decree 95/2001 (Andalucía AC) among others.

All the Mortuary Police decrees of the different autonomous regions are virtually a copy (in extended or restricted form) of Decree 2263/1974, with few variations, such as the inclusion of new diseases in Group I, including rabies, spongiform encephalitis, Creutzfeldt-Jacob disease, viral haemorrhagic encephalitis, plague, etc.

REGULATORY FRAMEWORK FOR TEACHING AND RESEARCH WITH HUMAN BODIES

Regulations regarding the use of corpses for the teaching of anatomy in medical faculties have practically disappeared from the legislation of the Spanish Autonomous Communities. What is therefore the regulatory environment that affects us as teachers and researchers of Human Anatomy? In my opinion, at present, these regulations pertain to body transportation, incineration or burial, and issues concerning health and safety at work affecting the people who will come into contact with the body (students, administration and service staff and teachers).

Regarding the origin of corpses, I doubt that nowadays there is a single body in any Department of Anatomy in Spain which has been donated by a charitable institution, simply because such charities no longer exist (although homelessness continues to exist). At most, a donated corpse could have died in a public health centre and remained unclaimed. The homeless who die in the street are judicial corpses. Thus, the origin of the bodies used in medical schools is principally via donation.

THE DONATION CONTRACT

The act of donating a body presumes the pre-existence of a legal relationship between the donor and the Department of Anatomy (or the University itself). This legal relationship is formally expressed in a donation contract, which, per se, has a twofold facet. On the one hand, there is the legal aspect which is subject to civil law, whereas on the other, there is an ethical aspect which is subject to the domain of the ethical behaviour of people who will come into contact with the corpse. Like any civil contract, it can be subscribed to in the public or private domains, between the donor and the donee

(e.g. the department that receives the donor), in our case the university institution.

Within the European Union, as far as we have been able to ascertain, all donations are free of charge. The donor gives his/her body to be used for teaching and research in medicine in an altruistic way, and therefore there is no monetary interchange. This is partially true, since in almost all European universities (including Spanish ones), academic institutions assume the costs of the funeral transfers, embalming, cremation etc. Also, there are provisions or agreements in all contracts which can be formulated as rights and obligations of the parties.

Donation contracts have a standard structure, but there are opportunities to incorporate clauses, both on behalf of the University and of the donor. By way of example, at the University of the Basque Country (UPV/EHU), we ask our donors as a *sine qua non* requisite, that they accept that, once used, the body be cremated. The reason for this requirement is based on the fact that, once embalmed, the body is practically incorruptible. All donors without exception have accepted this specific clause.

UNIVERSITY COMMITMENTS

Universities in general are committed to:

- performing all administrative formalities after death, and to collecting the body at home or in the centre where the death occurred.
- transporting the remains of the deceased to the university department morgue, by means of contracting appropriate funeral services and a personal coffin.
- embalming and preserving the corpse on suitable premises until the day of its cremation. In this sense, the exchange of cadaveric material with other universities or research centres can be agreed previously with the donor.

Fig. 1. The Forest of Life (UPV/EHU) is a cemetery for the remains of people who have generously donated their bodies to medical education and research at the Faculty of Medicine, University of the Basque Country (UPV/EHU), Leioa, Spain.

- using the bodies for teaching and research purposes only.
- the removal of the remains, once teaching and/or research has been performed, to premises where the incineration is to be carried out.
- the collection of the ashes and notification to the family, if any, so that they can decide the destination of the ashes. In the case of our University (UPV/EHU), more than 98% of donors choose to deposit their future ashes in a purpose-dedicated space, open to the general public, known as “El Bosque de la Vida”.
- the payment of all costs deriving from the above.

In the case of the University of the Basque Country (UPV/EHU), donation contracts are always signed by the living donor who must be fully conscious of the implications of its effects. The contract is endorsed by two witnesses who are normally appointed by the donor. We never accept corpses donated by the family, in the absence of explicit consent of the donor.

DONOR COMMITMENTS

The donor commits him/herself to informing their family about that part of their last will which is expressed in the donation contract. It should be clear to the family that the donor wishes them to inform the university about their death and to facilitate the transfer, delivery and deposition of their body to the premises that the corresponding Faculty of Medicine has designated for it. In our experience, on at least a couple of occasions, the family has refused to hand over the body to the Faculty of Medicine. Our recommendation is that the will of the family be accepted, although it should be made clear to them that in so doing, they are acting against the will of the deceased. Additionally the donor accepts that the body be used for education and medical research purposes (particularly in the area of Human Anatomy).

However, these stipulations do not cover all the obligations and rights of the parties. Those relating to the ethical behaviour of all those who may come into contact with the cadaveric material must be also considered. Can a person who has lost the status of a civilian due to his/her death, retain legal rights? The answer is clearly yes; the deceased hold exactly the same rights as a testator in a probate court.

ETHICAL RIGHTS OF THE DONOR

Here, I propose the following decalogue of donor ethical rights which should be universally recognized and in particular taught to medical students.

1. The donor is entitled to the execution of that part of his/her last will which is manifested in

the donation contract.

2. The donor is entitled to his/her body receiving dignified treatment while being used for teaching/research activities. Any vexatious or disrespectful conduct towards the corpse by students or anyone else should be prevented and in the event of their occurring, seriously penalized. The bodies used in the Dissection Room must be covered by a sheet upon conclusion of the teaching or research activity.
3. The donor is entitled to the identity of their corpse remaining confidential. No one needs to know their affiliation, or any other information that may directly or indirectly disclose the personal identity of the donor.
4. The donor is entitled to the body (either as a whole or as parts) being at all times identifiable by relevant staff. It is ethically unacceptable that the identity of a body, or of any member therefrom, be unknown. Identification can be implemented by labelling the body or its parts with indelible markers (tattoos of different types, encoded labels and even electronic chips).
5. The donor is entitled to facial-disidentification, whenever so requested. This situation has arisen only once in our experience. Nevertheless, a socially well-known donor who has lived in a small town or a neighbourhood may not want to be identified by students in the local dissecting room. Facial-disidentification can be achieved by placing a facial plaster cast of an unknown person on the face of the donor prior to intravascular infusion. In this way, the facial features adapt to those of the mask upon fixation.
6. The donor is entitled to his/her body, either entirely or in part, not being used as a commercial object, except in cases involving the interchange of cadaveric material between academic centres and researchers, in which the receiving centre has to economically compensate the sending centre for transport expenses incurred. In training courses in which new surgical, prosthetic or other techniques are being evaluated, participants can contribute financially to compensate the university, not only for the costs associated with the cadaverous or instrumental material, but also for the dedication of the medical staff and for the services from which benefit is derived.
7. The donor is entitled to having his/her body stored in appropriate facilities. Nowadays, the use of milder and less toxic chemical fixatives has reduced the need for dipping containers (except when techniques such as Thiel are required). Consequently, the use of large refrigerating chambers appears to be the most appropriate and adequate choice for storage. The facilities must be neat and clean, avoiding the proliferation of fungi, bacteria or insects. This right must be safe guarded for the entire duration of the teaching/research activity, that is, before, during and after the use of the body, until cremation (which we consider to be the most appropriate end for the teaching/research activity).
8. The donor is entitled to having his/her body cremated in an individual or identifiable manner, in such a way that the family receives the remains (ashes) of their beloved and not those of another person. The practice of mass cremations is a violation of the unique dignity of the person of the individual donor.
9. The donor is entitled to having his/her remains laid to rest in a suitable location. Mass graves should be prohibited since their intrinsic depersonalized nature fails to recognize the extraordinary generosity implicit in the act of donation.
10. The donor has the right to social recognition of his/her act of donation. Universities should therefore provide purpose-designed spaces, open to the general public, which facilitate and enhance this recognition. This would serve to preserve the dignity of the person of the donor and thank them for their generosity. Showing them the social recognition they deserve also contributes to enhancing the sensitivity and tone of the society in which we live.

More than 12 years ago (2003), at the University of the Basque Country (UPV/EHU), we inaugurated the “Forest of Life”, a funeral monument intended for the deposition of the ashes of all our donors. At its entrance an epitaph can be read which is familiar to anatomy teachers all over the world. It reads:

“Este es un lugar de paz. Aquí reposan las cenizas de aquellas personas que generosamente donaron su cuerpo a la ciencia. Aquí la muerte se recrea ayudando a la vida. Descansen en paz”.

(This is a place of peace. Here lie the ashes of those who generously donated their body to science. Here death rejoices in helping life. Rest in peace).

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CONTROL OF EXPOSURE TO FORMALDEHYDE AND OTHER CHEMICALS

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INTRODUCTION

Formaldehyde (HCHO) is marketed extensively in large amounts, among other reasons for its variety of industrial applications and low cost when considering other preparations as replacements. However, and because of its high toxicity, there exists a tendency lately to replace it by less harmful products, although this possibility is not evident in all fields of application.

In healthcare contexts, in particular, it is still used in a generalized way in most medical schools of Spanish Universities to embalm and preserve corpses, as well as in dissecting rooms. For its good proprieties as a preservative, as a bactericide and as a cell tissue fixative, a clear substitute that combines all its characteristics and its low price has not been found yet.

Embalming is a typical procedure in morgues, funeral homes, forensic laboratories, medical schools and research laboratories. In the Complutense University of Madrid, the embalming mixture used for dissection has the following approximate composition:

- Methanol: 62.5%
- Glycerol: 17.5%
- Phenol: 12.5% (from 80% phenol)
- Formaldehyde: 7.5% (from 37-38% aqueous solution).

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The Imperial College, London, uses an embalming mixture (without formaldehyde) only for courses with surgeons, because the bodies were not hardened, but these samples need attention so they will not dry or contaminate. The mixture used for prepared corpses for students until their third year has the following composition: 2 litres of formalin; 1 litre of phenol; 2 kg of polyethylene glycol, and16 litres of industrial ethanol denatured with methanol.

From there, HCHO is no longer reemployed. Once the body is dry, it is sprayed with a medical solution ("Distel"), and to preserve it in tanks industrial ethanol is used to 70% – denatured with methanol – and phenol to 0.5%. Levels of HCHO in air are checked regularly, and they rarely exceed 2 ppm and often do not reach 0.5 ppm.

Formaldehyde at room temperature is a colourless and pungent gas, of suffocating odour, very soluble in water, with <1 ppm as olfactory index, which polymerizes rapidly.

It is marked in aqueous solutions (30-55% wt) and methanol (15%) to inhibit spontaneous polymerization. In liquid form it has a pH of 4.3 and low volatility. Typically, it is sold in an aqueous solution, 37% by weight, but can be sold as hydrated para-formaldehyde (CAS 30525-89-4) or trimer trioxane (CAS 123-63-7), both solid polymers.

Its most relevant physicochemical characteristics are:

- Reactive, flammable and likely to form explosive mixtures in air. Violently reactive (fire, explosion) with strong oxidants.
- Incompatible with acids, alkalis and anhydrides.
- Aggressive to steel and reactive with hydrochloric acid, generating bis chloromethyl ether.

RECOMMENDATIONS GIVEN IN THE PREVIOUS SYMPOSIUM, IN ORDER TO ELIMINATE OR REDUCE THE RISKS IDENTIFIED IN DISSECTION TASKS AND, SPECIFICALLY, TO CONTROL THE VAPORS OF FORMALDEHYDE EXPOSURE

1. Remove any sources of risk by replacing the process or HCHO by another process, agent or alternative product less harmful to health.
- Use preparations containing less HCHO.
- Replace the system of storage in "pools" by shelves with the corpses into bags of polyethylene (PE), and avoid the product as preservative fluid. In the case of small parts, use airtight containers which do not suffer deterioration during the usage time and the minimum possible amount of liquid preservative.
- Maintain local storage at a temperature below 10° C to reduce evaporation.

2. Isolate the contaminant at the source:
- Use general mechanical ventilation in rooms ensuring at least 20-30 air changes per hour.
- Apply exhaust ventilation systems in perfusion rooms, storage, teaching and research for effective and adequate control of the vapours of HCHO.
- Restrict access and exposure time.
- Use work equipment and personal protective equipment (PPE) such as: apron, cap, boots, goggles, gloves and masks with filter for organic and specific to HCHO vapours.

3. It is recognized that the system of traditional storage pools have serious problems:
- Difficult identification and deterioration of parts.
- Physical overstrains and risks in handling.

For these reasons the recommendations were:
- Use trays to deposit the bodies using hydraulic crane.
- Use wheel litter and drainage systems and drainage of liquids where required. The cleanliness of the facility must be made easily.
- The use of shelves and trays facilitate the identification and handling of stored material and, in turn, prevent damage.
- Store small parts in boxes, tanks and cabinets with shelves, sealed and with a minimum amount of preservative.

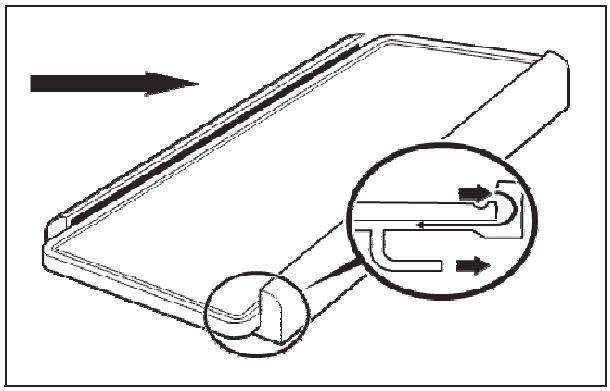
DESCRIPTION OF TASKS AND FACILITIES

The following procedures describe characteristic tasks with reference to the venues where they are carried out.

1) When entering a corpse, the first thing that is done is the perfusion. Blood is drawn previously, and then the solution is injected with formaldehyde. How is the mixture prepared? HCHO commercial 40% is diluted to a concentration of 10% or somewhat less. This is done in the hall itself in an area for that purpose, by manual transfer and assisted by an electric mixer to homogenize the mixture with other reagents added.

Using an automatic or semi-automatic machine, equipped with a pump unit, the HCHO is perfused normally through the carotid (once through the femoral artery). This operation is not quite tight so that vapours are generated.

- Keep the workplace well ventilated – at least 10 air changes per hour with a constant draught.
- Use an embalming table fitted with extraction via slots running along the long sides of the table. You need an extraction rate around 3.5 meters per second at the slots.
- Make sure a manometer or pressure gauge is fitted near the extraction point, to show that the extraction is working properly.



- Discharge extracted air to a safe place, away from doors, windows and air inlets. Have a supply of clean air coming into the workroom to replace extracted air.

Local exhaust ventilation (LEV) has two slits uptake of 1.85 m in length located on either side of the table. The fan is located outside the room, provides 0.33 m^3/s, the slot 25 mm wide air speed is about 3.5 m/s. Dilution ventilation alternatively needs a flow 4-6 times higher, depending of the constant mixing of the room. The figure shows the feedback type.

Furthermore, the room usually has an extraction by a hood placed on a wall that functions permanently. This measure only serves to complement other, producing a small renewal of room air without removing effectively the fumes generated during the operation.

In certain cases Thiel solution is used (a mixture of high saline components concentration), causing denaturation of proteins, as an alternative to HCHO, which hardly contains formaldehyde. The body has a pale and pinkish o reddish skin with detachment of superficial epithelial layers and nails. Compared with “vivo” the skin remains smooth, oiled, hairless but firmer. The subcutaneous adipose tissue retains its yellow colour and differentiation in adipose cells of different sizes. The shiny appearance and strength of fascias, as

well as the permeation of intermuscular spaces by vessels and neural structures is no different from the living in colour or texture.

The body has more flexibility than with the mixture of formaldehyde, since this creates bridges with the proteins, but for the study of soft tissue (especially the brain) it does not work.

The UAM has begun to use this preparation for fixation and preservation with less formaldehyde (0.015% instead of 10%) but, for now, it is only used for seminars and post-doctoral practices. Other components are: sodium sulfite, boric acid, potassium nitrate, ammonium nitrate, propylene glycol, morpholine, 4-chloro-3-methylphenol and ethanol.

Almost no odour of the embalming fluid, ability to maintain a long-term conservation, and very minor morphological changes of the cadaveric material and disinfection efficacy are confirmed by bacteriological tests without release of harmful substances to the environment.

2) From the perfusion room, the corpses are carried to the tanks and dipped in a pool with formaldehyde. This is done using hoists and hoist stretchers. How to control the risk of inhalation? By decreasing evaporation through temperature control (low evaporation, even when working with open tops) and closing the pools with lids.

3) Another place to store corpses is the cold room; the bodies to be used in the practice of dissection are stored in polyethylene bags. Workers stay here as long as needed to place the bodies in shelves. How to control the risk of inhalation? By decreasing evaporation through temperature control and ventilation prior access to the room. HCHO concentration in that atmosphere is very low.

4) Finally, in the dissecting room there are both teaching and research staff. How to control the risk of inhalation? Ensuring the flow of ventilation and pocketing the bodies that are not used.

In the dissecting room, HCHO vapours were measured with the ventilation partially stopped (over 400 m3 / h), and the results were significant, even reaching over the limit reference value.

Following the specific evaluation revealed the poverty of ventilation. An improvement of the conditions was achieved by:

- A change of the ventilation and exhaust systems reduced the concentration.
- More powerful equipment, greater sealing rooms, with negative pressure and return air at the same level of the tables. Air inlets were on top, spread throughout the room, on both sides. The exhaust air is arranged in the same way but at the level of stretchers' practices.
- Changing habits, because the pieces were left overnight to drain and then left on the tables.

Apparently, with ventilation at full blast, bodies are resected, conservation deteriorates, and it becomes necessary to promptly add HCHO "in situ".

PREVENTIVE MEASURES

Preventive Measures in accordance with the Carcinogens Directive (90/394/EEC) to avoid or reduce exposure to formaldehyde vapours are:

A: Reduce the use of a carcinogen at the working place, in particular by replacing it, in so far as is technically possible, by a substance, preparation or process which, under its conditions of use, is not dangerous or is less dangerous to the workers' health or safety, as the case may be.

B: Determination and assessment of risks. Assess the type and level of risk on a regular basis, with special attention to workers at particular risk. Consider all routes of exposure, including skin absorption. Take measures to prevent and reduce exposure.

B1. The degree and duration of workers' exposure must be determined in order to make it possible to assess any risk to the workers' health or safety and to lay down the measures to be taken. Keep as low as possible the number of workers exposed or likely to be exposed.

B2. Avoid unnecessary pollution sources such as:

- Design work processes and engineering controls to eliminate or reduce the generation of carcinogens at the workplace.
- Limit the quantities of a carcinogen at the place of work.
- Buy the product into suitable containers and possibly not requiring manipulation. Use containers that can be handled in a fume hood.
- Label the containers with product and periodically review the status of packages.
- Implement procedures and appropriate working methods.
- Establish a protocol in case of spillage.

Access to risk areas

- Restrict access to those people who need to be there. Mark risk areas.
- Clear areas to facilitate the use of mechanical aids for handling bodies.
- Provide equipment for handling heavy weights.
- Keep the work areas clean.

Application of suitable working procedures and methods:

- Keep products containing chemicals safely in a dry, cool, dark place able to retain spills. Do not keep far more than you need.
- Keep hygiene and individual protection (PPE and RPE).
- Apply health surveillance of workers in accordance with the principles and practices of occupational medicine.
- Provide information and training to workers and students.

Other measures

- Handling and Storage: Work in fumes hood. Use containers in stainless steel, galvanized or polyethylene.
- Use appropriate containers for storing small parts.
- Stability and Reactivity: No heat; avoid acids, alkalis and anhydrides; stabilizer: methanol.
- Fighting Measures: Dust, foam, spray water and CO2.

Workwear and personal protective equipment

Workers will have suitable protective clothing or other special clothing. Keep the work clothes in different site of street. A contracted service shall be responsible for washing work clothes.

- Respiratory, eye and skin (do not inhale) protection. BP3 filters.
- Gloves: contact (nitrile or butyl); Splash (polychloroprene).

Actions in case of spills or accidental spillage

- Spills and neutralization: absorbent material and sodium bisulfite. If the amount spilled is big, use absorbent marketed (See Safety Data Sheet adsorbent) and regard it as chemical waste. Keep absorbent blankets to absorb spills – ask your supplier.
- Clean up spills promptly. Practice how to do this.
- Write down your procedures for dealing with clinical waste. You need a clinical waste container and a contract for safe disposal.
- Provide welfare facilities: showers, washrooms, storage of the clothes and refreshment areas. Clean these areas every day.
- Deal with spills immediately. Absorb liquid spills. This needs coveralls, respiratory protection and single-use gloves.
- Provide safe and empty containers for wastes.
- Change clothes if contaminated. Protect skin and eyes. Wash hands and face.

FINAL RECOMMENDATIONS

In view of the results, the following recommendations are suggested:

- Develop the HPLC analytical technique and participate in international quality controls of formaldehyde. Propose an analytical method updated and to review IOELV, if necessary.
- Promote that method applied to specific cases with significant exposures to formaldehyde by inhalation. Apply simplified methods and assess cases of skin contact (COSHH Essentials or similar).
- Make a critical study of equipment direct reading, highlighting the most reliable and indicate its advantages and limitations.
- Replace the products with other mixtures or procedures less dangerous, studying case by case. Seek the least amount of workers involved and reduce their exposures to these processes.
- Take immediate preventive measures and apply the principles of health surveillance for exposed workers. Apply health protocols.

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A GENERAL VIEW OF OCCUPATIONAL HAZARDS IN DISSECTION HALLS

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INTRODUCTION

This article approaches the occupational hazards to which persons working in Dissection Rooms are exposed. For this purpose, in general, I will highlight the presence of risks in safety, hygiene, ergonomic and psychosocial conditions. It is absolutely necessary to establish preventive mechanisms of information and continuous training in order to eliminate or minimize occupational risks in the Dissection Rooms. I will also discuss the major risks included in the categories above.

RISKS RELATED TO THE SECURITY CONDITIONS

Excluding aspects of building and structural safety conditions, which will be the subject of another article, the following risks will be highlighted:

1) Falls. We differentiate between falling from height and falling at the same level. Falls from heights can come from the use of ladders and scissors stairs, which are used to store or take stored products. For this purpose, it is necessary to equip workers with non-slip footwear fastening behind. It is also convenient to carry out a maintenance plan of stairs, to train workers for using stairs, and to limit the weights and heights that they move on stairs.

Falls can happen at the same level, mainly because of slippery floors of emerging fluids or cleaning operations. Containers must be placed to collect the potential fluids of the bodies or anatomical pieces under the drainage of the tables, which must have an adequate slope to allow the exit of fluids to buckets, preventing spilling to the sewer system. It is also necessary to signal cleaning activities ("Caution: slippery floor").

2) Impacts with objects. Order in the Dissection Room is essential for the success of the task and for maintaining optimal security conditions, avoiding shocks and setbacks with goods, products, buckets, etc. For this purpose, it is also necessary to observe cleaning measures, and conduct proper storage on shelves or other structures that eliminate the placement of objects in soils or hallways.

3) Storage. Dissection Rooms are not storehouses, although halls must have the necessary products required for the activity, avoiding going out of hall to fetch products anytime that someone needs to use anything. In this way, downtimes and accidents (caused by falls, losses of concentration, frequently occurring when taking off and putting on personal protective equipment, pollution of different areas, etc.) can be avoided. In closets, shelves and storage areas it is necessary to select an appropriate location of products, i.e., the heaviest at an optimum height for placement or removal (on a half-height, neither on the upper nor on the lower, relative to the height of the shoulders and mid-calf of a person), delimiting areas and lighting them properly, and preventing reactions between incompatible products. To this end, there will be proper ventilation.

4) Order and cleanliness conditions. It is essential in any activity, work place and, of course, in Dissection Rooms. Not necessary accessories and products must be stored out of the Dissection Room, counting strictly with the necessary for the activity in the hall. There are storehouses outside of the room where products are classified, and there are procedures for waste disposal and unnecessary products. Thus, a habit of not accumulating unnecessary materials and of not having

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them disordered is created. The places for storing products will be easily accessible and must be ordered for an easy identification of the necessary objects. Without prejudice to any protocols that may exist for this purpose, we will try to avoid any soiling, cleaning it immediately.

5) Electrical hazard. Electric instruments and water are very much used in dissection halls. It is very necessary to maintain halls unpolluted, cleaning continuously everything in them and wetting anatomical parts for their correct conservation. It is very important to advise workers to take special care of electric risks. To this end, it is very important to avoid jumping above extension cords, as well as to forbid the use of power tools with wet hands or wet feet or on a soaked surface. We must also take special care in the use of electrical panels to operate extraction systems, lighting, etc. These operations will never be performed with wet hands or wet feet, and the switchboard must have the proper protections and be signposted. All equipment with metallic parts must be plugged to an earth connection.

6) Fire risks. The hall and, in general, the space dedicated to the anatomical activity will have to be provided with a self-protection plan and of the first aids. To this end, it must have a first aid kit, properly signposted, containing at least authorized disinfectants and antiseptics, sterile gauze, absorbent cotton, blindfold, Band-Aid, adhesive dressings, scissors, tweezers and disposable gloves. This kit will be used for any small accident. In addition, there must be a protocol for action in case of an accident, for the earliest health care to the injured (contact telephone number with the mutual of accidents, health services, emergency, etc. In the case of the University Complutense of Madrid, we have an exclusive, free emergency telephone. The Dissection Room will also have showers and eyewash with proper slope and drainage in soil that prevents the ponding of the area in case of use.

The self-protection plan will contain all the necessary measures to act in case of fire or any other threat that advises the evacuation of the room, taking into account the existence of chemical, physical and biological risks. It will have to be implemented and the personnel instructed and trained as regards the same one. The sectoring of the spaces is fundamental, with fire-resistant doors that open in the direction of the evacuation, signposted routes of evacuation, emergency exits, attack forces (fire extinguishers adapted to the possible types of fire and fire hydrants), alarm bells, systems of automatic detection, and illumination systems. The corridors and dissection tables must have a minimum separation of 1 meter. It is advisable to do periodic evacuation simulacra for the training of the personnel in this activity.

It is necessary to make a special reference to the maintenance of all the means destined not only to self-protection, but also to the activity as a whole (systems of lighting, extraction and ventilation, machines, etc.), which is one of the main concerns of the Technical Staff in Safety. It is necessary to guarantee that repairs and other maintenance work are carried out by suitable personnel, intended for that purpose. In this regard, an optimal coordination procedure between business activities and the maintenance companies is essential.

HYGIENIC RISKS

1) Chemical risks. Hygienic risks have special relevance, in particular risks of chemical origin in the labour environment of the Dissection Rooms. The use of formaldehyde and other chemical substances present in embalmer fluid, used for fixing and the maintenance of anatomic parts advise a separate analysis of this, and hence we will not get into evaluations on these risks.

2) Physical risks. Among these risks at work in Dissection Rooms we will emphasize the possible existence of noise as result of the machines. Sometimes they are close to freezing chambers, which may make sounds due to alarms or to poorly maintained systems. To this end, a good maintenance is recommended, as well as convenient isolation of the dissection areas to ensure concentration and avoid the annoyance of noise. It is also suitable to adopt measures as for the temperatures, which are low as the result of the activity of conservation of corpses and anatomic pieces, and it is advisable to use appropriate clothes. It is especially important to have good natural lighting, through windows, as well as electrical lighting for activity in Dissection Rooms; to secure this there should be general lighting systems for the entire room and special lighting on each of the dissection tables. If necessary, one should resort to portable lighting, for example floor lamps, which must be removed when not in use. It must be borne in mind to avoid dazzles as a result of the excess of light or of the angle through which lights are projected on the objects. Radiation should be also taken into account. In order to proper isolate areas of possible radiation from Dissection Rooms, as well as periodic environmental evaluations should be carried out, as well as specific monitoring of the health of workers exposed to such risk.

3) Biological risks. In general, an embalmed corpse does not present any known danger to health. Although it is true that, before carrying out this activity, the appropriate preventive measures must be taken. Among others, it is recommended that the medical history of the deceased be known, and to carry out a post-mortem study to determine the causes of death (necropsy), determining if the body is a bearer of high-risk infectious diseases and their power of contagion, such as viral hepatitis, HIV/AIDS, spongiform encephalopathy, tuberculosis, gangrene, etc.. In this case the donation should be rejected.

As regards health monitoring, persons exposed to biological risks are subject to mandatory medical examinations to determine and track general health status and risk incidences.

There are risks by possible splashing, hence the need to use protective equipment. Workers must wear shoes with non-slip rubber sole entirely protecting the foot (without holes or grids), health gown – surgical or laboratory robe – in proper hygienic conditions, latex or nitrile gloves and safety glasses. In case of splashing into eyes, they must be washed immediately. If the sprinkling is projected to the skin, it should be washed with water and soap immediately.

Hygiene is essential: workers will have to wash their hands with soap and water, at least to start and complete the activity in the Dissection Room.

It is also necessary to bear in mind that one works with cutting material, avoiding poor handling of surgical material. In case of injury, the injured will have to wash immediately its cut with abundant water and soap, letting the wound bleed a little while. Blows, cuts, punctures, contamination by microorganisms, etc., are possible risks, and hence it is necessary that the workers have updated, appropriate vaccinations, having been previously informed of the advantages of vaccination and non-vaccination. We will try, to the best extent possible, place protective elements at points of possible risk (cornering of stretchers, for example), and inform and train workers about the working procedures and the handling of equipment and machinery.

We must pay special attention to spills of liquid human material, removing it immediately, as well as to preventing the manipulation of the body, especially by the thorax.

Scalpel blades will always be handled with appropriate instruments. It is necessary to deposit sheets scalpel and needle used on vessels destined for the effect (regulatory material cutting and stabbing biocontaminated containers) for its collection as waste, and save cleanly and safely all the instrumentation used in the Dissection Room at the end of the activity. The surgical instruments should be always on flat stable and surfaces when not in their own cases. If it is necessary to use "special" instruments (gouges, chisels, hand-saws, power saws, surgical trimming), these tasks will be carried out exclusively by the main researcher assisted by a technician, protected with the appropriate personal protective equipment (safety glasses with integral frame that protects from splashes and projections, apron and neoprene gloves with mechanical resistance against cut and puncture).

Correct storage and collection of organic waste should be also carried out (biowaste).

ERGONOMIC RISKS

1) Physical efforts. Effort is one of the more common risk factors in a great number of work activities, and it is not a stranger in the Dissection Room. For this purpose, it is convenient to adopt measures to avoid it. It is necessary to avoid the handling of heavy weights manually, storing the heavier parts, whenever possible, on shelves, whose height is not necessary to crouch or raise arms to pick them up. It is convenient to use mechanical means to move corpses or heavy anatomic parts, in order to reduce to a minimum the physical effort. Training in manual handling of loads is necessary for those who carry out activities of transport and storage of anatomic parts and products in Dissection Rooms.

2) Postural. The position in the dissecting activity can lead to overloads in neck, shoulders, spine, legs, etc. For this reason, it is convenient to enhance these areas through the corresponding exercises, as well as to avoid exposure for a long time. It is advisable to make regular stops every 2 hours. Dissection tables and spotlights should adjust their height and position to those people working in the halls.

PSYCHOSOCIAL RISKS

1) Monotone and repetitive work. It happens fundamentally in technical personnel, who carry out tasks of support to the activity of dissection and anatomical parts work. It is very important, as you will see later, to develop a good organization of work that avoids monotone and repetitive work. Most of the accidents occur as a result of monotonous and repetitive work, involving excessive relaxation and a disconnection from the activity, making the worker lower the guard.

2) Mental load. The main risk factors that determinate mental load are the quantity and quality of information received by the worker, the complexity in the response required of the worker, the time available to the worker to give a response, as well as the capacities of the worker (adaptability to the situation, personality, training, etc.). As has been mentioned previously, the mental load is also in line with the organization of work, which will be analysed below.

3) Emotional demands. Dissection is an erosive work emotionally. In the case of teachers and researchers it offers the possibility of a closer contact with the real object of study, being a valuable instrument of medical education. But the technical staff lacks, in principle, this motivational element because of the monotonous nature of its tasks, as I have argued above.

4) Organization of work. The organization of work is essential in any job, not only because of the results that are derived from a good organization, but because of the improvement that occurs with regard to the conditions of safety and health of their workers. Through a good organization of work not only the monotonous and repetitive work will be

avoided, but the mental load, labour dissatisfaction, fatigue and stress will be reduced. All of them are elements that appear frequently in the labour activity in Dissection Rooms, and this is because of a bad organization of the work in many cases. The first thing you should have is a person responsible of the Dissection Room who, directly or through another person, will organize and will be perfectly informed about the activity that takes place and by whom in any time in the room. This person will coordinate the aspects relating to the activity, as well as health and safety issues that must be integrated in all the phases of the activity. At the same time, this person will inform and communicate to the technicians and other users of the room the activities to be performed, previous evaluation of these tasks, means to be used, preparation of samples, corpses, etc. Communication with regard to the involvement of all employees in the task is essential. The recognition of this task is necessary and must be perceived by all. Good results are achieved only through teamwork and must be perceived by all. The research activity, which acts as the driver and motivational element of the researcher, not always acts in the same way in other persons that assist in this activity if they are not involved in it and, for this reason, communication and appropriate leadership are crucial, informing and giving the precise instructions through the appropriate channels, developing flat structures, with career development plans for the technical staff well-defined, in which all feel familiar with the goals, recognized in their tasks, identified with the project and, therefore, integrated in its success.

FINAL REMARKS

We cannot conclude this work without paying attention to the waste that is generated as a result of the anatomical activity, as well as its collection. Mainly, and in general, according to the classification established by the Madrid Autonomous Government, by Decree 83/1999 of the Comunidad de Madrid, three types of waste are generated in the work of dissection in rooms:

a) Waste of class III (special biomedical waste) group 9 (remains of little human anatomical entity). This is the waste generated from the work with human material not fixed with formaldehyde of entity not recognized as such.

b) Waste belonging to class VI (cytotoxic). This group includes anatomical remains fixed with formaldehyde if it is not human remains from "entity enough" to be recognizable.

c) Waste belonging to class IV (corpses and human remains with entity enough to be recognized as such).

Because the corpses are used following the principle of maximum use, they are dissected in a finished way, which generates a large number of anatomical remains. The majority of residues belongs to this group.

The withdrawal of the residues will be carried out by an authorized agent, who will transport them to the corresponding plant for its treatment in accordance with the requisites marked by the legislation.

In this case, if we were applying the beginning of the preventive action to the activity in Dissection Rooms, we might reach the following conclusions:

a. Avoiding risks. The first thing to be done is to design the activity taking into account the existing risks, trying to avoid them *ab initio*. The distribution of the spaces and the constructive characteristics of the spaces destined for this activity are crucial. It is also essential to perform serology to corpses and to apply a protocol allowing the rejection of those corpses that may suppose a risk to the health of those who are going to work with them.

b. Evaluating those risks that could not be avoided. All the risks that have not been avoided in origin must be properly evaluated, taking into account that this is an ongoing activity. Depending on new activities, new risks emerge and, therefore, it is necessary to adopt new preventive measures about protection equipment, specific training, etc. For example, the activity with bone materials is completely different from the activity courses in oral implantation. Before working it is necessary to evaluate; it is very important to know the previous illness of a corpse.

c. Combating the risks at source. Since the moment in which a risk arises or is known, it is necessary to combat it, adopting the corresponding preventive measures.

d. Adapting the job to the individual, in particular with regard to the design of jobs, as well as the choice of equipment and methods of work and production, with a view, in particular, to mitigate the monotonous and repetitive work and reducing its effects on health. Take into account at this point all the recommendations in terms of ergonomic and psychosocial risks. Hence the need to be able to adjust height of tables of dissection, lighting systems, and to develop a proper organization of the work, involving the people in the objectives, which are adapted to their profiles, to their physical characteristics, their personality and abilities, and to promote teamwork and the conciliation of work and family life.

e. Adapting to technical progress. Anatomy must incorporate elements and work procedures safer through innovation and the incorporation of technical elements. In this sense, it is necessary to emphasize all the work that it is possible to develop related to the design and implantation of mechanical media that improve and avoid the manual charges manipulation, as well as the focused to reduce the hygienic risk.

f. Replacing the dangerous by the non- or the less dangerous. In this sense, the main challenge is work focused on the developing of fluids for em-

balming to incorporate products that do not suppose risks for the health of those who work with corpses and anatomical pieces.

g. Developing a coherent overall prevention policy plan integrating in it technology, organization of work, working conditions, social relationships and the influence of environmental factors at work. Under this heading we include again all the aspects commented above concerning ergonomic and psychosocial hazards, working in team, the importance of developing working protocols to prioritize health and safety. It is advisable to underline activities that cannot be done by a person alone. It is always necessary to have near communication systems in case an accident occurs. Existing risks must lead to a suitable planning of the preventive activity, always directed to the continuous progress of the working conditions and to the elimination or reduction of the risk.

h. Prioritizing collective protective measures (over individual protective measures).

Regarding the application of this principle, it is important to mention measures such as placement of extraction of fumes and ventilation devices, which allow working in healthier work environments. However in a Dissection Room all workers, in my opinion, must have and use, if necessary, the following personal protective equipment:

1. Facial mask series 6800, shaped 6899T, with filter CE0086-A2B2E2K2P3R, which protects the finished face, including the eyes.
2. Neoprene rubber apron.
3. Gloves of PVC that it protects for mechanical, chemical and biological risk.
4. Safety boots S5 of class II quite gum or quite polymer with anti-skid and top safety sole.
5. Buconasal mask with filters A2B2E2K2P3R for tasks that need it together with safety glasses against projections or sprinklings.
6. Safety glasses with integral frame, which protects from splashes and projections.
7. Neoprene Gloves risk protection mechanical, chemical and biological 40cm long if they need to take material of deposits, etc.
8. Full-face screen for risk of splashing or projections of particle.
9. Cold-resistant gloves to work in the cold chamber. They include mechanical resistance to the cut and puncture resistance, chemical and biological.
10. Workers also will use, if they need it, plastic muffs up to the elbow, protection caps of hair and adapted clothes of work type finished pyjamas, and shelter garments.

i. Giving appropriate instructions to the workers. It is essential that the worker knows what he has to do and what for. He/she needs to be trained and informed of his activity for its realization.

j. The employer will take into account the professional skills of the workers in the field of health and safety at the moment of entrusting them tasks. For this reason it is essential for workers to have received the required training, which integrates the specific training in safety and health. In this moment, the Complutense University has developed a specific training programme for staff that works in rooms of dissection.

k. The employer will adopt the necessary measures in order to guarantee that only the workers who have received sufficient and suitable information could get into the areas with serious and specific risk. It is necessary to emphasize that both the training and the information have to be received before carrying out the activity.

l. The effectiveness of the preventive measures will have to foresee the distractions or non-reckless imprudence in which the worker could incur. It has to be taken into account in the application of this principle the above-commented issues, such as monotonous and repetitive work which can lead to distractions, lowering of guard as a result of the relaxation or fatigue, which can lead to accidents; hence the desirability of a good organization of work.

There is no doubt that the most important thing to guarantee high standards of safety and health in a Dissection Room is to integrate the prevention of labuor risks in its daily activity, evaluating permanently the new activities that arise, complying with the planning of the preventive activity approved, forming and informing the workers, who have to be involved, motivated and recognized through teamwork and a leadership style that facilitate it, as well as a good coordination of activities with collaborating companies and people from other institutions who could in a moment be collaborating in the hall.

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THE PHYSICAL SPACE AND THE ESSENTIAL ELEMENTS OF THE DISSECTING ROOM

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INTRODUCTION

The architectural characteristics of the human anatomy dissecting room were discussed in the so called “Acta de Barcelona” (1996). The conclusions of that meeting have been a reference in the field, but now, due to the technical advances, legal regulatory modifications, and the development of new social sensibilities, some aspects of those conclusions should be reviewed in order to update them, as the energy-saving design and handicapped accessibility.

SPACE AND FACILITIES

The space allocated to the practical study of human anatomy will be assigned depending on the number of students attending the courses and the number of corpses utilized. Thus, every work module will be composed of the dissecting table, the space around it –occupied by the students involved in the activity – and circulation space in the room. To calculate the work module, some dimensions can be attributed to those elements:

Length: dissecting table 2m + 0.8m hallway

Width: dissecting table 0.7m + 0.6m * 2 sides (occupation by person each side) + 0.8 hallway

Thus, the work module sizes 2.8m * 2.7m = 7.6 m2 and this is adequate for 4-6 students per module. The number of the total modules depends on the criterion of the centre. To these modules should be added 10-15 m2 for the education staff, to store the working instrumental, and for the control of the room. The paraments of the dissecting room have to be covered by aseptic and easy-cleaning materials. In vertical walls, the recommended claddings are ceramic enamelling, epoxy painting, or vinyl finishing. On floors, small floor ceramic tiles, porcelain clay tiles, hydraulic floor tiles, or continuous cladding as chemicals-proof like epoxy, all of them with a grade 2 of the slippery index materials (DBSUA 1 Technical Code of Building). The junctures between the floor and the walls should be finished in a rounded fashion, in order to facilitate the cleaning-up. Ceilings will be preferably continuous, cladding with plastic paints, and containing boxes for the electrical, or other, installations. Indoor joinery could be finished in phenolic resins or stainless steel panels, with a sliding opening system, or by pushing button, and equipped with return spring. In any case, doors have to be equipped with door-guards panels in stainless steel, to avoid scratches produced by the stretchers. It is very relevant to control the air conditions inside the room, so the doors have to be airtight as possible, class 3 or 4 EN 12207:2000 regulation, and bear draught excluder in both sides. There are no necessary intermediate differential pressure chambers. Outdoor joinery has to be airtight following the UNE-EN 12.207 class 3 regulation. The window will be equipped with an insect-proof net and any type of blinds to protect against the sunlight.

It is important to realize that the air renovation ratio depends on the volume of the room, so to achieve the maximum energetic efficiency the height of the hall has to be reduced to the minimum, always maintaining the adequate comfort conditions for the work. The electrical conductions, as well other service conductions, have to be above the false ceiling in order to procure less total volume to the hall. Free heights between 2.60 and 3.00 meters are considered acceptable.

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ACUSTIC CONDITIONS

The acoustic conditions of the dividers depend on the regulatory standards. Isolation of 45dB is reasonable, and is achievable with a divider made of double air brick cladding with gypsum, or with a gypsum wallboard partition plus mineral wool insulation.

FIRE RISK

The rooms themselves cannot be considered fire risk areas, thus the constructive elements will have the characteristics determined by their positions in the building where, due depending on the surface of the room and its use this is divided in different fire sectors. Also, the enclosures and spaces between them must obey some conditions of fire resistance. The structure of the building has to be treated in the same way.

COLOUR, ORIENTATION, AND ACCESSIBILITY

Other relevant items to be considered in the dissecting rooms are the colour treatment, orientation, and accessibility. Colour of the vertical paraments has to be clear, light reflecting, and giving an aseptic and relaxing sensation, helping to minimize tension when the students address, for their first time, this kind of practices. The adequate palette range from white to very pale violets, blues or greens. Also the floor has to be of a neutral clear colour, and the ceilings white.

The orientation of the dissecting room must be that less influenced by the insolation, taking into account the latitude, shadows, woodland, etc. Dissecting rooms have to be accessible, and actuations go directed to every group of visual or auditory impaired people, or physical disability. For the first ones, the illumination of the room has to be as continued as possible, avoiding focal points that can produce dazzle, the skirting should perfectly mark the limits between the floor and the vertical paraments; also, a blind-designed signalling will be adopted both in the building and in the room. Auditory impairment can be solved with a magnetic loop, in the adapted area of the room, connected to the speaking and multimedia amplifier and to the user`s auditory aid system. The doors wide and the opening mechanisms in the dissecting room and its facilities should be designed to allow the use by physical impaired people; thus, the height in the working areas and services has to be taken into consideration. At least one of the dissection tables should be adapted, hence the structure can allow the user to close up to the table, with the legs positioned under it, with 0.80 m. free eight and the prosection pieces at no more than 1.00 m. The work module size designed above considers this situation.

ASSISTED-AIR RENOVATION

The dissection practices imply the use of embalmed cadaveric material, and embalming solutions are made of organic-based liquids such as formaldehyde, ethanol, methanol and other organic solvents; thus, necessity of assisted-air renovation is mandatory. As the “Acta de Barcelona” stated, the need for renovations of the whole air volume of the room oscillates between 20-30 renovations per hour but, for security, it has to be marked in the superior range. For plastinated specimens the renovation can be lowered to 5 renovations per hour. However, the renovation has to be adjusted taking into consideration the limit values of formaldehyde in air, as well as for the other organics, determined by the European laws. In general, the ventilations system will be designed with rotational air supply diffusers over every dissection table. Characteristically, these diffusors create turbulent flows, no direct flows, that avoid obstacles, as luminaries, and is less annoying to the users; also individual diffusors not in use can be closed to raise the flow in those being used. Aspiration will be located in the perimeter of the room, disposed at an inferior height of the level of the tables, and has to be a little be more powerful than the air impulsion, to create a small depression environment that facilitates the air renovation. Ventilation should be completed with a warming system, electrical or with a water intercooler, because the number of renovations per hour makes difficult to acclimatize the air; the ideal is to equip one unit of air treatment with a heat recovery device to adequate the installation to the environmental laws in energy saving. All the mechanical elements should be disposed in the roof of the building, avoiding the users the noise, foul air, or maintenance actions. Both the airway inlets and outlets have to be equipped with filter devices, with their characteristics depending on the environmental laws and fixed by the type of the renewed air and its volume. Active carbon filter or aluminium oxide impregnated in potassium permanganate to control the emissions. The system has to be regulated in intensity. The container of the filters will be equipped with a small fan that derives the air flow to a small practicable door; this device allows introducing a sounding line controlling the level of formaldehyde contained in the air, to check the time to change the filters. It is possible to use filters inside the cadaver bags to act as catalysers to minimize the formaldehyde emissions. The room has to be sealed as far as possible to maximize the renewal function of the system. During the maintenance and cleaning operations, without cadaveric specimens, natural ventilation will be desirable.

ELECTRICAL INSTALLATION AND ILLUMINATION

The chapter devoted to the lighting is also particular. General illumination is of 600 lux, slightly daylight (5000º K), with recessed luminaires in the suspended ceiling and IP65 protection. This can be complemented with a surgical lamp, articulated and ceiling suspended, slightly warm (3500º K) up to 70.000 lux. Because of economic reasons less specific luminaries can be installed, always of a minimum of 2000 lux. Illumination will be operated from the technician or teacher control. General illumination is distributed in circuits, with a photoelectric cell with control depending on the external illumination.

The electrical installation has to match the considerations of wet room, with the plug bases higher than 1.10 m. and category IP44. The electric box is protected with super immunized Residual-current Circuit Breaker with Overcurrent protection (RCBO). It is possible to consider installing ceiling plug-bases, and HDMI and USB connections for the multimedia systems. The multimedia system will be connected to external sources, with RJ45 connectors in the lecturer control.

FINAL REMARKS

Finally, the dissecting room will be equipped with emergency eye wash, and emergency safety shower. For the hose below the room an installation of drain trap connected to a sewage trap is necessary, with a removable pouring system with stainless steel tank, before connecting to the general sanitary sewer. Close to the dissecting room, one room will be devoted to the cleanliness of the users, with mixer water taps, with cold and hot water, soap dispensers, and hand dryers. Around the dissecting room specific areas have to be developed for the management of the bodies, changing rooms for the staff with clean and unclean areas, laundry, lockers area and toilets for the students, chemicals warehouse, and administrative services.

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Designs and installations have to follow all the rules and laws that concern the building, such as the general Spanish rules to these projects: Código Técnico de Edificación (CTE), Reglamento de Instalaciones Térmicas (RITE), Reglamento Electrotécnico de Baja Tensión (REBT), and others as the Reglamento de Almacenamiento de Productos Químicos or the Notas Técnicas de Prevención (NTP) edited by the Instituto Nacional de Seguridad e Higiene en el Trabajo (INSHT).

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GUIDES AND PROTOCOLS FOR A GOOD PRACTICE. I. ACT OF DONATION AND DONATION CARD

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INTRODUCTION

The analysis of the present situation on donations indicates that there is no clear regulation which develops the use of the cadaver for medical instruction. Although the possibility to use the cadaver for medical research and educational purposes is provided by Article 6 of the "Reglamento de Policía Sanitaria Mortuoria", Decree 2263/1974 from July 20th, the autonomous regions of Spain, in accordance of their competences (Royal Decree 1359/1984 from June 20th), have their own regulations, similar to or copies of those from 1974.

In our opinion, all this legislation is incomplete, so it does not entirely cover and give uniformity to the actual needs of the Human Anatomy Departments in the complicated process of donation. In these regulations, the use of human cadavers for research and educational purposes is indicated whenever no records of the opposition of the deceased, family or court exists. Consequently, an informed consent such as the Act of Donation must be a necessary requirement in the donation of a body for research and educational purposes. It is necessary in numerous countries, as reflected in a report of the Trans-European Pedagogic Research Group for Anatomical Sciences (McHanwell et al., 2008; Riderer et al., 2012).

In our opinion, the use of unclaimed bodies is totally contrary to the free exercise of the willingness that is expressed by the informed consent. Even though the use of unclaimed bodies was legal and accepted in certain places (Dasgupta, 2004; Cunningham, 2009) or in certain regulations ("Reglamento de Policía Sanitaria Mortuoria de Andalucía", Art. 25), the anatomists must not accept unclaimed bodies. Jones and Whitaker (2012) noted that we have the duty to be ethically conscious and not accept blindly the imposed rules by politicians. Blakely and Harrington (1997) claimed that those who have been treated unequally in life should not be treated unequally in death.

The event of donation is marked by the desire to donate the body, and this respect means the respect of the cadaver. It must be a confluence between the informed consent and ethics. If the informed consent of the deceased has to be a requirement for anatomical purposes, it follows that the use of unclaimed bodies is unjustified (Wilkinson, 2014).

ACT OF DONATION

An analysis on the more important aspects that should be included in the Act of Donation has been conducted. The information to the donors has to be understandable, rigorous and accurate. We consider the following items:

a) A brief explanation of the discipline of Anatomy and the importance of the donation for its study.

b) It has to be indicated that donations are legally provided by the Regulations of the "Policía Sanitaria Mortuoria" of the Autonomous Regions in Spain. As an example, the donations for research and educational purposes are provided by the Article 4.1 of the Decree 124/1997 from October 9th of

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the Community of Madrid.

c) The donor has to know that his/her personal privacy is guaranteed and the confidentiality of his/her personal data are protected (Art. 5. Law 14/2007from July 3th of Biomedical Research). The donor refuses the right to claim economic benefits or other from investigations (Art.7. Law 14/2007from July 3th of Biomedical Research).

d) Every research on the deceased is going to follow the ethical code of Helsinki (2013).

e) Clear information on the qualification that the deceased has to fulfil for his acceptance for educational and research purposes, and which are the causes for exclusion.

f) Instructions on the required documentation.

g) Report that the receiving Department is responsible for the preservation, care and safety of the cadaver, with the maximum respect, dignity and anonymity until the remains have been cremated. The cadaver is not just a scientific model for human anatomy but a person who lived, and deserves suitable dignity and respect. The Department of Human Anatomy is “the guardian” of the deceased and has to enforce the wishes of the death. In this sense the donor has rights after death, even from an emotional point of view, the deceased has a post-mortal personality (Prof. Brenner in Riderer et al., 2012).

h) All costs from the donation, if it fulfils the established conditions of this document and there are no grounds for exclusions and in the case of insurance death, shall be borne by the Department which receives the cadaver. In cases where the body was on loan to another University, the costs shall be borne by the receiving University. It is advised to keep the death insurance if any.

Like in other countries, Cremation has been considered the best option (Pérez Gálvez, 1995) to eliminate the cadaver or cadaveric remains; thus they belong to the III and IV groups.

FINAL REMARKS

A model of Act of Donation is proposed in which the consent of the donor is required. In addition to these formal aspects, it should also include the use of graphic material from research and the transfer and assignment of his body to another University, whenever used to the same scientific and educational proposals. The donor card is constantly in our environment, and must be saved in the donor documents to demonstrate his decision after death.

A desire of anatomists would be to reach a legal framework, precise, wide and without ambiguities on the donation of a body for scientific and educational purposes, but with uniformity, trying to achieve a certification of the process of donation, as Padua University does (Porzionato et al., 2012).

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GUIDES AND PROTOCOLS FOR A GOOD PRACTICE. II. TRACEABILITY OF THE CADAVER: FROM RECEPTION TO REMOVAL

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INTRODUCTION

If the cadaver is essential in the learning of Human Anatomy in any discipline of Health Sciences, if continuous training for health professionals from many disciplines is inaccessible without the cadaver, if certain lines of clinical research can be only developed after the detailed study of the cadaver, then we can conclude that, since the entrance of a body in a department of Anatomy, the dignity and respect due to donors and their families has to be expressed with a fully professional and accurate development of the tasks of reception, preparation, conservation and removal of the body and cadaveric remains.

For proper development of all the activities outlined in this technical document, an absolute respect for the common sense and the Law 31/1995 "Ley de Prevención de Riesgos Laborales" is essential. Therefore, all the obligations and recommendations in this field have to be scrupulously followed in the development of all activities; concretely, on the tasks in which it is mandatory or recommended, staff that develop it will be equipped with regulatory personal protection equipments, and will operate the facilities for renewal of air, heating or any measures required for the proper development of the activity. On the other hand, this text fully respects the European, Spanish and Community of Madrid laws on handling bodies, general waste, and biological and sanitary waste (Council Directive 91/156/EEC of 18 March 1991 amending Directive 75/442/EEC on waste; Council Directive 91/689/EEC of 12 December 1991 on hazardous waste; Spanish government Decree 2263/1974 on "Reglamento de Policía Sanitaria Mortuoria"; Comunity of Madrid Decree 124/1997 on "Reglamento de Policía Sanitaria Mortuoria"; Comunity of Madrid Law 5/2003 on "Residuos"; Comunity of Madrid Decree 83/1999 on "Actividades de producción y de gestión de los residuos biosanitarios y citotóxicos").

This document is intended, with the humility and gratitude due, to be the heir of the "Acta de Barcelona" (1996), a document resulting from this meeting of experts that was pioneer in Spain, compiling and efficiently articulating the knowledge, experience and common sense in managing the body donation for the teaching and research in the health sciences.

RECEPTION AND PREPARATION OF THE BODY

Throughout the process the presence of two people is required for the tasks.

The cadaver is deposited on the autopsy table of the injection room, and its clothes, or shroud, are removed, placing the garments in a suitable bag, or container, for disposal and incineration of class II biological waste (Comunity of Madrid Decree 83/1999 on "Actividades de producción y de gestión de los residuos biosanitarios y citotóxicos";

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Comunity of Madrid Law 5/2003 on “Residuos”). After the shaving of the corpse and the disposal of the remains of hair in the same container of the garments, it has to be thoroughly washed with antibacterial and antifungal soap.

Before starting the embalming protocol, 10 cc of blood need to be extracted for determination of HIV and hepatitis B/C by an external laboratory. One study, from a spanish Faculty of Medicine, developed over two years in 180 donations with 'clean' medical records, detected positive serology in 8% of cases (personal communication). The blood sample is immediately sent to the laboratory, whereas the embalming procedure routinely proceeds. Once the referral laboratory report is received, within 48 hours, if the result is positive for any of the serological determinations the body will be removed as remains of the class IV, which are destined to incineration (Comunity of Madrid Decree 83/1999 on “Actividades de producción y de gestión de los residuos biosanitarios y citotóxicos”; Comunity of Madrid Law 5/2003 on “Residuos”); whereas, if negative, the body may be processed or stored.

If a corpse cannot be injected immediately, it can be stored, after performing the shaving and washing procedures, a maximum of 48 hours in a chamber at 2°C; after that, the embalming protocol can be resumed.

EMBALMING

The embalming protocol described here is based on the one developed and used at the University of Cambridge (Logan, 1983; Logan et al., 1989).

It includes two phases: venous and arterial. Usually the selected vessels are the femoral vein and artery; thus, in the middle third of the left thigh, the procedure starts with a longitudinal incision, and dissecting by planes, to locate and identify the sartorius muscle covering the femoral artery and vein. Once the femoral vein is identified, proceeds the first phase, the venous cannulation, and two litres of physiological saline solution are perfused through the vein, in order to clean up the venous system from thrombi. After that, the second stage addresses an arterial cannulation, usually the femoral artery, which is then checked for the possible presence of calcified atheroma plaques that could difficult the cannulation. If that event occurs, it would proceed to seeking the contralateral femoral artery; if that event persists, it would locate the femoral artery in the femoral triangle. The sequence would continue in the neck, first the left common carotid artery and finally the right. Once the suitable artery is chosen and located, the vessel is longitudinally incised, never in a cross section, and the cannula is introduced and secured with a knotted twine.

The cannula is inserted into a polyethylene tube connected to the injection pump; the free end of the tube, submerged in the container of the embalming mixture. The embalming fluid, which is commercially available from several companies, is an alcohol-based liquid (either methanol or 96% ethanol) serving as a diluent for phenol, formaldehyde (in the final mixture it does not reach the 3% of the total solution), and glycerine (Thompsett, 1970; Logan, 1983; Logan et al, 1989; Acta de Barcelona, 1996; Brenner, 2014).

The injection starts with the pump at very low flow rate, allowing to check that the ligation of the tube is well sealed and there are no leaks in the artery or in the system, and if the process is going successfully, some intravenous fluid will flow from the open vein and it will be continued to infuse about 2 litres, moment at which the vein is sutured and, after that, the flow is increased to the maximum speed of the pump.

During the injection is has to be checked if it goes properly by observing the abdominal swelling, engorgement of the superficial veins of the neck, and leakage of fluid from the nasal, oral and anal mucosae; also, the presence of white patches on the skin is a good perfusion signal because it indicates phenol settle from the peripheral vasculature. Once the favourable injection is verified, the lower limb distal to the injection point should be perfused by redirecting the cannula in a distal orientation. Once the procedure is finalised, the cannula is removed and the artery and skin are sutured.

Embalming can be improved with local injections of fixing mixture in the following regions: hands and wrists, feet and ankles, popliteal regions, genital region, buttocks, chest, shoulders. The process is completed by injecting the brain, through the inner angle of the orbits, depositing half litre of solution in several injections. Completed the perfusion, the body receives a second wash with antibactericidal and fungicide soap, further rinsing any trace of embalming fluid. The body will remain in the injection room during the 48 hours after the injection, standing on a cotton pieces to avoid the damage of the contact areas on the table. It should be remembered that if the serological proofs confirmed the presence of HIV or hepatitis B/C infection, the cadaver has to be incinerated.

FREEZING

All the steps from the blood sampling for serology of HIV and hepatitis B/C, shaving, and washing of the corpse should be done before, and without interruption since the arrival of the cadaver, to place the body in the freezing tunnel or the freezing chamber. The protocol for HIV and hepatitis B/C should be carefully followed and, if some positive is confirmed, the body has to be immediately incinerated.

A corpse can be frozen to keep it up and, a time later, develop the embalming process.

STORAGE

The body, with its identification code (this identification should contain information on whether the body has a prosthesis to facilitate the work of technicians) tied or sewn on it, is put into a transparent polyethylene bag, so it is easier to monitor its condition along the time, and is placed in a refrigerated chamber, around 11°C, remaining in the chamber a minimum of six months until further use.

Preparation, storage and maintenance of the anatomical pieces

Both the anatomical specimens obtained after the cutting process and the prosections should be stored and preserved, wrapped in cotton cloths, in containers suitable for such use, with a small amount of preservative solution (aqueous glycerine 25%, ethanol 96%, 10%; phenol 2%; Thompsett, 1970). Cotton cloths must be soaked in the preserving liquid. The containers, which must be hermetic seal, must be equipped with wheels for its ergonomic displacement, and are chosen depending on the size of the parts to maintain. The frozen pieces have to be stored in freezers, or freezing chambers, conveniently stored individually in polyethylene bags.

Embalmed anatomical parts that are used frequently can be stored both in refrigerated cabinets at 10°C or in containers at room temperature, always wrapped in cotton cloths and with a small amount of the preservative solution. In all cases, it is necessary to replenish the preservation solution once a week, because failure to do so, the deterioration and spoiling of the pieces occurs in few weeks.

REMOVAL AND DISPOSAL OF CADAVERS, REMAINS AND WASTES

Legislation on health or medical waste depends on the autonomous communities (Canalejas-Pérez et al., 2009). From a legal point of view, a medical school or a research centre using corpses or pieces is considered as a health centre (Canalejas-Pérez et al., 2009). In Madrid, Decree 83/1999 classifies wastes into seven classes which, according to this legislation, a department of Anatomy and Human Embryology generates the following:

a) Class II: residues similar to urban waste.

In this type of waste nursing material, surgical and, in general, all waste material in contact with patients, body fluids, biological samples and other animals are included. The risk of infection is limited within health centres and is not included in the group-specific risk waste. Among them are the following: gauze with traces of body fluids; surgical gloves and other disposables; disposable clothing; disposable lab material.

Packaging and removal of waste Class II.

Containers for medical waste comparable to urban waste must be opaque, waterproof and moisture proof; if they are plastic bags the gauge minimum is 200, and must be green, and its volume not exceeding 70 litres, also it cannot generate toxic emissions by combustion. These wastes are considered urban waste, so it can be disposed in containers for organic residues (Decree 83/1999 of the Community of Madrid).

b) Class III: special medical waste.

Group 9: Tissue or body parts of small entity, except teeth, including products of conception, obtained as a result of trauma or during surgery or forensic activities, not preserved by formaldehyde or another chemical.

Packaging and removal of waste from class III.

Containers for Class III medical waste may be deposited in rigid, or semi-rigid, maximum of 60 litres containers, which must meet several requirements of constitution and labelling (free lift, opacity, impermeable, moisture resistance, sealing, which do not generate toxic combustion emissions, with the pictogram "biohazards" and its associated text), or bags (minimum gauge is 300, red colour, opaque, waterproof and moisture proof, not exceeding 80 litres volume, and which do not generate toxic combustion emissions). These wastes must be removed and disposed of by authorized agents (Decree 83/1999 of the Community of Madrid).

c) Class IV. Corpses and human remains of sufficient entity.

The removal and disposal of group IV (regulated by Decree 2263/1974, the Spanish State, and Decree 124/1997 of the Community of Madrid) must be done by an undertaker's, and their destination is the incineration.

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GUIDES AND PROTOCOLS FOR A GOOD PRACTICE. III. THE DISSECTION

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INTRODUCTION

Dissection is an anatomical technique that lets us, by the use of different instruments, to show systematically the different elements that constitute the human body areas. These areas are topographically organized in several layers from the surface to the depth.

In order to make a good dissection we need to accomplish the following seven principles:

1. Bibliography: Before starting a dissection it is necessary to carry out an exhaustive study of its limits, layers, content and anatomical variations of the area to dissect. It is advisable that the student does a dissection protocol explaining, by drawings or images, the steps to follow and the structures to dissect. Thus, we can clarify to him or her the doubts that have arisen, so the student will know exactly what to do in all time.

2. Equipment: The student should be dressed with gloves, rubber closed shoes to avoid injuries (if the surgical instrumental drops, etc) and slips and in a white fastened coat in which his or her name appears to facilitate relationship. The hair should be tied, better in a chirurgical hat to avoid contamination of the cadaveric piece.

3. Suitable cadaveric material: The dissection in grades is carried out in embalmed cadaveric material. This material must be in good conditions (cleaning, fixing, maintenance) and perfectly identified, so that we know from which cadaver the anatomical piece that we are dissecting is, so that we can look up his or her clinical story if necessary (genre, age, chirurgical operations, diseases, etc)

4. Suitable instrumental: Taking into account the area to dissect, we will use a type of instrument or another. The dissection basic kit is composed by a scalpel, two tweezers (one with and other without teeth), and a pair of scissors. As complementary material we will have an autotatic separator, a hammer, a chisel, Kocher tweezers, etc. For especially delicate areas, such as the orbit, the autonomous nervous system plexus, or the vascularisation of the base of the brain, we will use microdissection material and magnifying glasses.

5. Workstation: It must be a smooth and completely clean surface, well illuminated and airy. It must be equipped with a marking pen to mark the incision lines on the skin, a spray water to wet the anatomical piece and to avoid it gets dry, a tray where to put the anatomical piece, one or several structures that stabilize the anatomical piece, so that it does not move while we dissect, a bowl with either a sanitary towel or paper to put the remains that we are extracting, a reading desk where to put the protocol with the drawing or the plane photo that we are going to dissect, pins to hold the delicate or slight structures, a container of sharp objects (used scalpel blades, etc.), and finally, an organic waste container where to put the accumulated remains in the bowl.

6. Method: We will make sure that the student holds the dissection instrumental correctly. We will ensure that the student knows how to put on and take off the scalpel blade. It is imperative that students always know what they are looking for,

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where they must look it and how they must look it. The student must not stumble by chance with the anatomical structures because in that case, the practice of dissection does not make sense. The dissection of the different layers will be carried out methodologically from the surface to the deep layer, following the three main principles of the Dr. Bartolome Ferreira:

a. Recognition of structures: differentiation by the texture and coloration of the different elements that constitute the layer (muscle, vein, artery, nerve etc.)

b. Identification of the structures: to specify exactly which structure is (radial artery, jugular vein, ulnar nerve etc.)

c. Cleaning of structures: to eliminate the fat that cover the anatomical structures in order to leave them well exposed and to show their relations with the adjacent elements.

7. Exposition: Finally, the students do an oral communication in which they expose with pictures of their own dissection all the procedure they have made and they explain their experience during the dissection procedure (difficulties, anatomical variations found, mistakes etc.). Students complete exposure with two sections in which they explain the most common anatomical variations and diseases of the dissected area, regardless of the fact that they have found them or not.

WHAT IS IT PROVIDED TO GRADE STUDENTS BY DISSECTION?

1. Transversal or general competences:

- Analysis capacity, information synthesis and integration.
- Development of written and oral communication.
- Teamwork; coordination, cooperation, equitable distribution of work.
- Development of observation, association and deduction.
- Development of the spatial orientation and disposition.
- Generation of interpersonal relationship abilities (tolerance, sociability, empathy, patience, etc.).
- Development of critical thought.
- Manual ability in the handing of chirurgical material.
- Management and optimization of time.
- Order, organization and neatness.
- Encourages self-criticism.
- Honesty, responsibility and self-critical spirit.
- Attention, concentration and perseverance.
- Ethic compromise; respect to the cadavers and to the work of others (technical staff of the dissecting room, cleaning staff, partners, teachers, etc.).
- Personal engagement; responsibilities and obligations (Proper care of cadaveric material, surgical instruments, the workstation, etc., completion of the assigned work properly and in time established, etc.).
- Decision-making.
- Photography, computer and languages knowledge.

2. Specific competences

- Detailed knowledge of human body and its variations.
- To know how to differentiate, locate and identify the different types of structures that form it.
- Suitable knowledge and use of anatomical nomina.

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GUIDES AND PROTOCOLS FOR A GOOD PRACTICE. IV. POSTGRADUATE AND CONTINUING PROFESSIONAL DEVELOPMENT

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INTRODUCTION

Continuing education is sometimes a non-regulated kind of training that is basic for scientific progress. It has a direct effect on medical-sanitary organization and proper management.

Both postgraduate and continuing education in the field of health sciences are basically directed to reinforce the qualification level of all sectors of health professionals, improving their professional conditions answering society's specific needs, strengthening the competitiveness of institutions and companies, and adapting human resources to technical innovations.

In other countries there are specific institutions dedicated to control and institute this kind of education. It is worth to mention the United Kingdom, where the Royal Colleges of Surgeons are responsible for a complete continuing education process for health professionals (from accreditation until evaluation). Annual continuing education programs are available and professionals can apply depending on individual preparation, need and time availability. This lend to elaborate almost "personalized designed" programs.

In Spain it is educational centres (mostly universities and university hospitals) that are mainly responsible for continuing education. There is high number of continuing education activities developed in relation with the health sciences, and ensuring their quality is a responsibility for the public administrations, which have established voluntary accreditation competence systems, nowadays deputized to autonomous communities.

The public administration collegiate body assigned to Human Resources Commission of the Health National System is the Sanitary Professions Continuing Education Commission (SPCEC). To this commission the following purposes are assigned:

1.-To elaborate reports and pronouncements in issues of continuing education after the Ministry of Health, Equality and Social Services, the Health Office of the Autonomous Community, or any other office or institution.

2.-To study, inform and propose procedures, criteria and requirements for accreditation and health professionals advanced accreditation in a specific area of a profession or specialty as a consequence of the development of continuing education activities.

3.-To elaborate proposals to establish different mechanisms of mutual recognition between different accreditation systems to maintain, when necessary, relationships with international organizations and accreditation entities.

This last aspect, a mutual recognition between university and ministry, would facilitate the management of this kind of activities, as well as ensure common quality standards. On the other hand, duplicities and contradictory situations during accreditation processes (different number of credits, or non-recognition by the institutions…) would be

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avoided.

Usually, the SPCEC accreditation process is simple. A standardized formulary should be completed (in-person activity, distance activity or mixed activity) by the responsible person at the organizing institution and later sent to the technical secretary of the corresponding autonomous community. Applicants should be careful to apply at least two months before the beginning of the activity because, on the contrary, the application will not admitted. In case of in-person activities, the student's attendance control will be mandatory to validate the application.

Activities should be proposed to health professions included in Spanish law 44/2001, November 21st. Training activities presented by commercial entities are not admitted.

Continuing education activities, in person or not, organized by a supplier located in an autonomous community and performed in this community will be accredited by the local competent office.

The teaching and learning related to those activities are not classified like "official education" and/or graduate or postgraduate education and specialty will be creditable as continuing education. Furthermore they should be performed by graduated or specialized health professionals. They will not orient to interns.

Formative subjects applying to be accredited are growing up, and maintenance and improvement professional competencies are individual and voluntary. They are defined by knowledge area and by the kind of professionals the activity is directed, although social, professional and institutional requirements are also taken into account.

Formative subjects are included into the following areas:

- Continuing education in Public Health.
- Continuing education in Research Investigation.
- Continuing education in Clinical Practice.
- Continuing education in Sanitary Management and Quality.
- Continuing education in Teaching.

Basic criteria for continuing education evaluation can be summarized in two types: qualitative and quantitative.

The qualitative component is mainly based on:

Formative activity objectives: General (the educative objective) and specific (which area of the continuing education is being considered more imperative: acquisition of abilities or concrete skills; acquiring or improving attitudes, etc.…)

Activity organization and logistics: detailed description of the teaching program, teachers, additional human resources, material resources, calendar, participant selection criteria and adaptation between activity duration and objectives.

Activity appropriateness: generated need by the formative activity.

Teaching methodology: methodology adaptation to proposed objectives and available resources should be valorized, as well as participants and teacher interactions.

Evaluation: any evaluation related with participants, teachers, activity, objectives or process should be specified.

Other criteria that should be considered are the professional group to which the activity has been directed and the activity financing procedure.

The quantitative component: this is based on activity duration and can be corrected to weigh impact on the final number of credits for long-duration activities.

In conclusion, the proposal system is based on a qualitative component as a result of the application of former criteria multiplied by a quantitative component adequately corrected. The final result is a determined number of credits for each activity.

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REAL DECRETO 1142/2007, de 31 de agosto, por el que se determina la composición y funciones de la Comisión de Formación Continuada de las Profesiones Sanitarias y se regula el sistema de acreditación de la formación continuada.

LEY 44/2003, de 21 de noviembre, de ordenación de las profesiones sanitarias.

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EXPERIENCE OF MANAGING THE DISSECTION ROOM OF THE FACULTY OF MEDICINE AT THE UNIVERSITY OF BARCELONA

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INTRODUCTION

The Body Donation Service of the Faculty of Medicine of the University of Barcelona (UB) was founded in 1967 by Professor Domingo Ruano Gil. In 2004, the UB legal services, together with professors from the Department of Anatomy and Human Embryology and personnel of the Dean's Office, drew up a set of proposed regulations for the Dissection Room. This proposal was approved by the UB Governing Board in October 2004. The purpose of these regulations was to define the organizational structure of the Dissection Room and regulate the different activities carried out there.

This presentation will cover several structural and functional aspects of the Dissection Room, such as a) History and the organic structure; b) Donor reception and information; c) Receipt of bodies and elimination of remains; d) Regulations for use of the body donation service and safety regulations and e) Financial management.

HISTORY AND THE ORGANIC STRUCTURE

The Body Donation Service of the UB Faculty of Medicine was founded in 1967 by Professor Domingo Ruano, following the model of the Paris Faculty of Medicine. Since the creation of the program, the Catalan people have always given an excellent response to our request for whole body donation for education and research. Thanks to the altruistic citizens, the UB Faculty of Medicine is now the University centre with the greatest number of body donations. This has enabled us to provide our health science students with a high quality of medical education and to offer invaluable resources to researchers and practitioners of medical science.

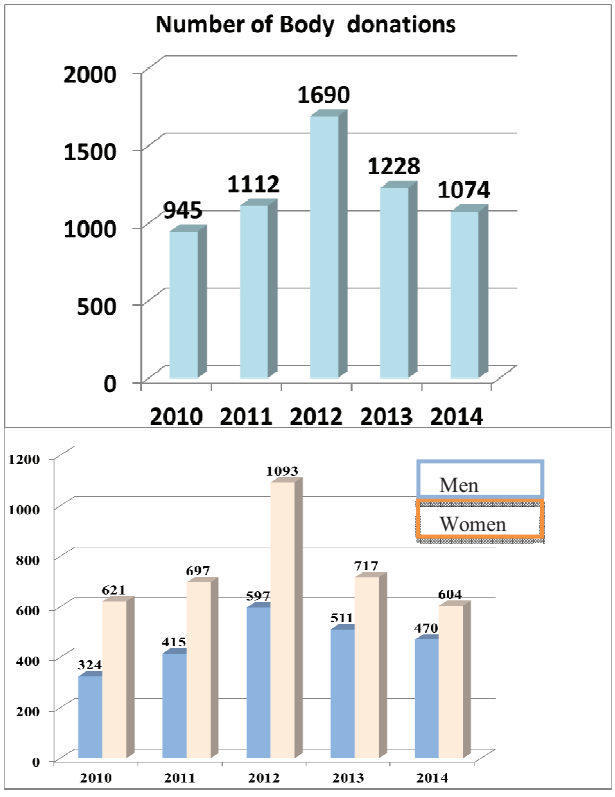

Fig. 1. Number of body donations during the last five years.

Because of a rise in the number of body donations, a set of rules and regulation was drawn up to govern the practices associated with the Body Donation Service and the Dissection Rooms. The regulations for the Body Donation Service were approved by the Board of the Faculty of Medicine,

and ratified by the UB Board of Governors on 6 October 2004.

Three crucial points are included in our regulations for the Body Donations Service.

1. The Body Donation Service is affiliated to the UB Faculty of Medicine.
2. The activities and programs of the Body Donation Service are governed by a Director, who is selected by the University Rector from the Professors of the Department of Human Anatomy
3. The Committee of Dissection Room Users is included in the Body Donation Service

Director's responsibilities

- Act as director and representative of the Service.
- Coordinate the activities of the Dissection Rooms.
- Schedule and chair the meetings of the Committee of Users of the Service.
- Draw up proposals and budgets for Service activities.
- Propose regulations for the use of the Dissection Rooms to the Board of the Faculty of Medicine.
- Control and enforce the safety regulations of the Service.
- Draw up the annual report of the Service and present it to the Dean of the Faculty of Medicine.

Members of the Committee of Dissection Room Users

The activities and programs of the Dissection Room are coordinated by a board of the members who are all health care professionals and regular users of the Dissection Room.

Members

- The Director of the Dissection Rooms – President of the Committee.
- A representative of the Area of Human Anatomy.
- A representative of the departments that use the Dissection Rooms.
- The Head of Studies of each of the university years whose students use the Dissection Rooms.
- The technician responsible for the Dissection Rooms.
- The administrator of the Faculty of Medicine.

Functions

- Report on the regulations for the use of the Dissection Rooms proposed by the Director.
- Agree on the plans for the use of the Dissection Rooms and the order of priorities: university year, research, post-graduate students, non-university activities.
- Be aware of any problems related to the use of the Dissection Rooms and help to resolve the problems.
- Receive an annual report of the activities of the Dissection Rooms.
- Hold biannual meetings and also meet at the request of the Director or of 50% of the members of the Committee.

DONOR RECEPTION AND INFORMATION

Prior to donation, the Body Donation Service must inform donors of the following:

- The purpose of the donation.
- The use of the cadaver exclusively for teaching and research activities.
- The possibility of cancelling the donation at any time and the steps to follow for cancellation.
- Health and hygiene requirements for accepting the cadaver.
- Geographic limitations on the transfer of the cadaver.
- Instructions for the transfer of the cadaver (including addresses and telephone numbers).

Every Body Donation Service must keep a registry of donors. The Director is responsible for this registry, which must contain the following information:

- personal data of the donor: first and last names, ID number, date of birth.
- the date of donation.
- the date of cancellation of the donation, if applicable.
- personal data of the donor, including any relevant health information.
- the date of death: certificate.
- information on the transfer of the cadaver.
- ***All information on donors and cadavers will be held strictly confidential, in accordance with the stipulations of the general health law and the law 15/1999 of 13 December on personal data protection.***

RECEIPT OF BODIES AND ELIMINATION OF REMAINS

Bodies will only be accepted if they have a donation card and if, while alive, they had agreed to the conditions of the Body Donation Service of the Faculty of Medicine.

- The bodies must arrive at the Body Donation Service in funeral cars and with the required documents.
- All bodies received will be tested for hepatitis B/C and HIV.
- Bodies testing positive for hepatitis B/C or HIV will be cremated by the funeral services.

Fig. 2. Donation Card.

- Any remains of bodies will be wrapped in shrouds and kept in a freezer until they are collected for cremation.
- Every Thursday, the remains will be collected by the funeral services for cremation.

REGULATIONS FOR USE OF THE BODY DONATION SERVICE AND SAFETY REGULATIONS

Regulations for use of the Service

- Students, professors, staff and health professionals who use the Dissection Rooms must wear a lab coat and gloves and tie their hair back when touching the anatomical specimens.
- Students who wish to use the Dissection Rooms outside of normal Anatomy class hours must be accompanied by a Human Anatomy teacher.
- It is strictly forbidden to remove specimens or anatomical pieces from the Dissection Rooms.
- The Dissection Rooms are open from 8.00 am to 9.00 pm.

Safety regulations for the correct maintenance of the Body Donation Service

- Biannual treatment of the floor.
- Odour control system.
- Sterilization and cleaning of lab coats (outsourced).
- Daily cleaning of the Dissection Rooms.
- Fingerprint-activated entry.
- Closed-circuit security cameras.
- Annual inspection of formaldehyde levels.
- Biannual inspection of radiological protection.
- Inspection of temperature and alarms.

FINANCIAL MANAGEMENT

The sources of income of the Body Donation

Fig. 3. Activities in the Dissection Room of the UB Faculty of Medicine.

Service and Dissection Rooms of each campus are:

a. The general assignment of funds from the University of Barcelona.
b. Any subsidies, financial aid and donations that may be received.
c. Fees charged to cover costs involved in the use of the Dissection Rooms, in accordance with existing regulations.

Monitoring and assessment

The Director of the Body Donation Service will present an annual report to the Dean of the Faculty of Medicine and the Campus Administrator. The report will contain a detailed list of all expenses and revenues related to the activities of the Dissection Rooms.

The Body Donation Service will make its accounts available upon request to the Faculty of Medicine, the academic committee, the financial committee or the research committee of the Governing Council or other governing bodies of the University of Barcelona.

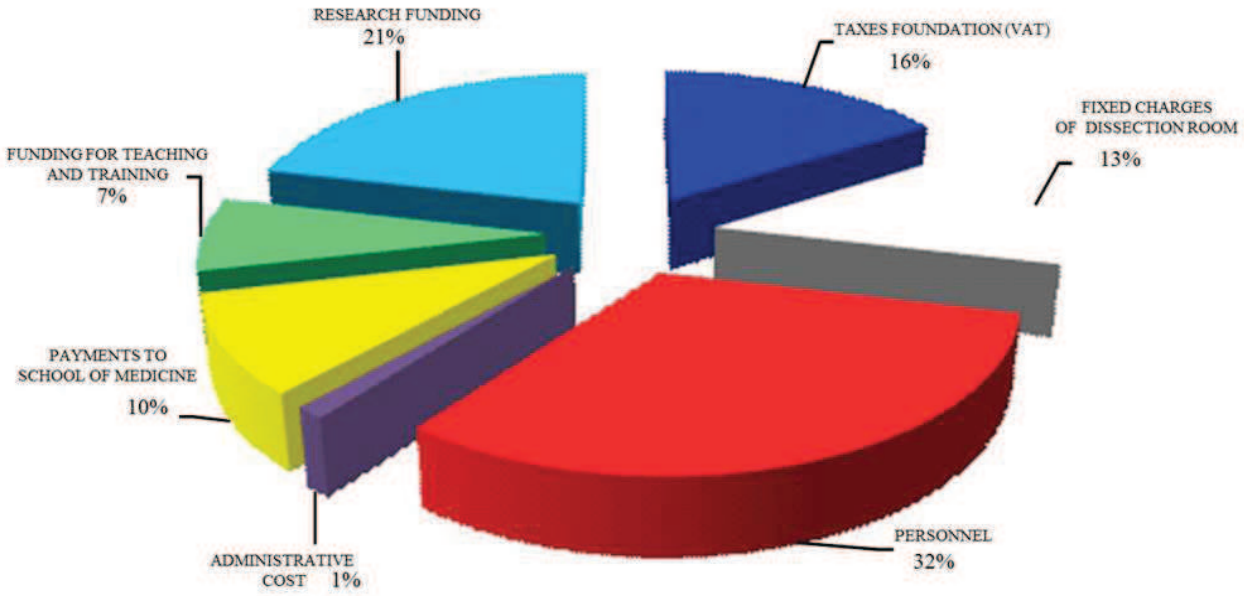

Fig. 4. Example of Summary of Expenditures of the Body Donation Service, as submitted to the Dean and the Administration of the UB Faculty of Medicine.

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GUIDES AND PROTOCOLS FOR A GOOD PRACTICE. V. PREPARATION OF THE OSTEOLOGICAL MATERIAL

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INTRODUCTION

The bone is the only component of the vertebrate body which generally remains throughout the time, although many times this is not so if the environmental conditions are not favourable like the exposure to the weather agents or chemical characteristics of the land. Bones are an invaluable source of information of the individual who was in life and therefore are many the disciplines interested in the knowledge of osteology. Osteology is essential for the studies of medicine and veterinary, especially if we take into account the new technologies of diagnose through picture which allow us to see showings which are impossible to be seen through conventional X rays. In physical anthropology, paleontology, paleopathology, zoology and forensic sciences, to be able to have osteologic collections makes knowledge much easier and facilitates research. Osteologic collections are a historical reference for the study of disappeared populations or for the comparison of species throughout time, and it is very useful for ecologists, climatologists and general historians.

The collections of biological materials are a first-class scientific patrimony which we should not waste, as it is scientifically better valued in the long run, produces wealth, and is the point of attraction for investigators. In the case of the exhibited material, they generate attitudes in the future professionals.

These are the methods of preparation normally used in the collection of the Museum of Anatomy of the University of Valladolid, although in some occasions we experienced other methods.

In the case of preparation of animal skeletons, there is a Legislation of Animals Subproducts not Destined to Human Consumption, which authorises and regulates the points of origin, destination, transport and destruction of the remains of dead animals. Besides this, in the case of animals included in the International Convention of Threatened Species, these should be accompanied by the corresponding permission (Compulsorily if they are Appendix I).

SKELETONS TAKEN FROM BURIALS

This consists exclusively of the cleaning of the skeleton bones so that they are handy. In the case of human skeletons, it is previously necessary to have the adequate permissions and these skeletons can never come from the burials of less than 10 years since their death. The temporary burials are of at least 10 years after death, after which the relatives have the option of renewing the grave or not, in which case the burial ground reduces the remains which can go to an ossuary, mass grave or be cremated. Each autonomous Community has its rules about the transport of the remains.

- Immersion of the bones in water for a week
- Soft cleaning with a brush and running water
- Immersion in oxygenated water of 20 vols. from 3 to 7 days depending on the whiteness we want to get.
- Rinse with a lot of running water to eliminate the remains of oxygenated water. It is convenient to leave the bones in water for two days.
- Drying at a normal temperature. Make sure they are dry before storing them. If it is not done like that, it is possible that we can see fungi.
- Store them in dry places preferably in cardboard boxes. Do not use airtight packages which can favour the growing of fungi.

Skeletons from soft specimens (without previous fixing)

- Individualisation of hands and feet.
- Defleshing.

- Boiling in water with sodium tetraborate at 3%. The whole skeleton should be placed with hands and feet in net bags or crystal recipients with the cover with holes in the same recipient. Boiling time varies depending on the size. As an example, the human skeleton should be boiled for about 6 hours, and the squirrel about 3 hours.
- Rinse with running water. Use nets and colanders so that small teeth and bones are not lost.
- Immersion in oxygenated water of 20 volumes until the desired whiteness is obtained. We only take this step if the bones are going to be exhibited or articulated.
- Immersion in running water for one day changing it two or three times.
- In case the bones remains greasy, immersion in xilol (acetone, toluene or petrol can also be used). Human skeleton for 2 months, squirrel for 15 days.
- If they have been put in xilol, before drying them they must be boiled for 30 minutes, placing the bones in the water already boiling. This step must be inevitably done under an exhaust hood with a face mask, or preferably *in absentia* during the boiling, owing to the high toxicity of the steams of xilol. If after this step they are still greasy, small drillings can be done in the diaphysis so that the thinner penetrates better.
- Drying at room temperature. If they are placed in very hot areas or on radiators, the bones can be deformed and the teeth can fall apart.
- Storing in dry paces preferably in cardboard boxes. Do not use airtight packages so as not to favour the growing of fungi.
- Enzymatic method with Neutrase (Pepsina, indicated for small animals or human hands and feet)
- Defleshing
- Immersion in water with Neutrase at 1% to 35% at 45% C for three days (in a stove).
- Rinsing with a lot of running water.
- Drying

Method of maceration (It needs a space apart and well ventilated)

- Defleshing.
- Immersion in a water tank (the time depends on the water temperature and the rhythm of water changing): hands and feet can be individualised.
- Daily changing of water is advisable.
- The package must be in a dark place and airtight to avoid the proliferation of seaweeds.

Method with dermestids (for small skeletons which we want to maintain in anatomical connection, like a bird or lizard)

The dermestids are small beetles which take part in the final phases of putrefaction.

- Defleshing
- Drying of the cases
- Insertion in a terrarium with some humidity and a temperature of 28 to 30ºC.

The skeletonisation depends on the number of insects and their grubs

- Once we have the skeleton we have to freeze at a temperature of-20ªC during six hours to destroy the insects and grubs, as they could become a plague.

The terrarium must be protected from the direct light, and it must always have food so as to maintain the colony. So as to maintain the temperature, it is advisable to have at the bottom a thermal blanket like the ones used to maintain the reptiles.

The dermestids can be obtained by placing a case in the field in a summer day.

Bodies and fixed pieces

The skeletonisation of fixed specimens (formol, glutaraldehyd, etc.) is difficult, and the results are extraordinary. We have to do it with useful pieces because of their characteristics as single samples for investigation or exhibition. It is not advisable in order to obtain osteologic material for teaching.

- Defleshing
- To follow the same process as for the Borax but at a concentration of 30% and using double amount of time.
- It is possible that we need to repeat the process two or three times

CONSOLIDATION OF FRAGILE BONES

In the case when the bones are broken while being manipulated but we want to keep them because of their characteristics, we must compact them with hardening thinners. Apart from expensive products destined to fossilized bones like the Paraloid, the cheapest method is to soak them in colourless latex.

- Submerge the bones in dissolution of latex (Alquil® at 50% for two days).
- Dry and drain at a room temperature until it gets dry.

It is convenient to change the position while they are drying, leaning on one or two points.

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GUIDES AND PROTOCOLS FOR A GOOD PRACTICE. VI. PLASTINATION

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INTRODUCTION

In 1977 Dr G. von Hagens, after several years of research on how to apply polymers in the conservation of biological material, decided to use the term plastination to describe this new method of preservation. After the first publications in the late seventies and early eighties [1, 2], there was a rapid expansion of these techniques, which resulted in the creation of numerous plastination laboratories located mainly in Medicine and Veterinary Faculties.

The first conference on plastination was organized in 1982 in San Antonio (Texas, USA), entitled: "Preservation of Biological Materials by Plastination", and attended by eighty people. In 1986, during the third congress, the International Society for Plastination (ISP) was established, nominating as its president Dr. Harmon Bickley (University of Texas at San Antonio, USA), who was one of the pioneers of Plastination in USA. Thereafter, ISP congresses have been held biannually over the last 32 years. In 2004 it was organized in Spain (Murcia) and most recently, in July 2014, the seventeenth edition was held in St. Petersburg. Parallel to these international conferences, the ISP organizes Interim Meetings every two years, mainly for training purposes.

The ISP has a website (http://isp.plastination.org), where all organized activities as well as any other information of interest related to plastination are announced. On the other hand, since 1987 the ISP publishes the Journal of Plastination (formerly Journal of the International Society for Plastination), freely accessible via the ISP web site (http://journal.plastination.org). This journal contains the proceedings of conferences and original articles related to plastination techniques and their applications. It is noteworthy that the ISP also has the Plastination Index, http://isp.plastination.org/plastinationindex/index.html, grouping different types of publications (articles, communications, reviews, theses, books) related to plastination techniques. This tool is very useful and easy to use, as it allows bibliographic searches according to different criteria such as author, subject, journal, year, etc.

TECHNIQUES PROTOCOLS

In general, plastination techniques consist of a process in which tissue fluids and some fat are replaced by a curable polymer, under vacuum and usually at low temperature. In essence, the protocol is based on the four classic phases that characterize the histology tissue processing: fixation, dehydration, impregnation and polymerization or curing. Each phase can be modified depending on the specific technique. Plastination yields clean, dry, odourless and resistant biological preparations of unlimited duration in time, which can be examined without gloves or any other preventive measure, and does not require special treatment or storage conditions [2, 3]. The quality of these specimens not only depends on the correct performance of the plastination technique, but also it is essential to work with specimens that are worthy of preservation. We should not forget that plastination is just a method of preservation of biological material, and therefore only quality prosections or organs allow us to obtain high quality plastinated specimens, but always slightly lower quality than the original, due to tissue retraction and damage suffered during processing. In particular, it is necessary to mention shrinkage and rigidity as the main limitations of plastination [4]. Both negative factors are unavoidable, although, largely depending on the type of tissue, they can be controlled and minimized. On the other hand, the use of plastinated specimens has the advantage of reducing the daily exposure of students and teachers to tox-

ic products, as they remain free of toxic substances like formaldehyde, phenol, alcohols, etc.

Although all plastination techniques have a similar basic protocol, depending on the type of polymer used and the type of anatomical preparation, the general classification is: silicone techniques to produce three-dimensional specimens; polyester techniques for brain sections, and epoxy techniques for transparent body sections.

SILICONE TECHNIQUES

They are mainly used to preserve three-dimensional organs or complete body regions of different size, as well as anatomical sections with a thickness higher than 0.5 cm. They are the most popular plastination techniques; particularly the S10 technique (Biodur ®), which is broadly used in plastination labs around Europe and USA. Its main advantage is the protocol, which has been developed and standardized by G.von Hagens and has been extensively reviewed by other authors [5]; while its main disadvantage is the need of using cold temperature (-15 / -25ºC). Other silicone techniques have been described, some of them using cold protocol [6] and others that allow impregnation at room temperature and, therefore, simplifies the equipment required [7]. However, this room temperature protocol is not as standardized as S10, so that the results are less stable. Using the S10 as a reference technique we refer below the most significant technical aspects for each of the stages.

1. Fixation and preparation of the organ: Any biological material is liable to be preserved by the silicone techniques. In general, a previous fixation with classical techniques is necessary. Although any fixation method is valid, the best option to achieve stable results and avoid problems during the process of plastination is to use formaldehyde at different concentrations [8, 9]. The use of embalmed solutions containing products such as glycerine, phenol or others implies the need to first remove these components from the tissues by washing in ethanol and running water to prevent interference during the plastination process. In the case of hollow organs, fixation by dilation allows the correct preservation of the lumen, so that once plastination is finished the endoscopic exploration is available. Vascular injection with silicone, latex or radiopaque substances is compatible with plastination. The only precaution is to use solvent resistant pigments, as specimens remain several weeks in acetone for dehydration [10]. Similarly, it is possible to plastinate brain sections stained specifically to distinguish gray matter [11].
2. Dehydration by freeze substitution: It is based on solvents such as acetone, but can also be done with other water soluble solvents such as alcohols. It is during this phase that the highest percentage of shrinkage occurs, especially in certain organs such as the brain. However, the use of acetone at -25 ° C and regular monitoring of the dehydration degree of the specimens reduce the level of shrinkage. In prosections and organs with abundant fat tissue, except the brain, it is necessary to partially remove the surface fat, either keeping the specimen at room temperature in acetone or in stronger degreasing solutions such as methylene chloride. This allows the fat to remain stable over time and do not become oxidized after plastination.
3. Forced impregnation: The physicochemical characteristics of acetone allow, besides acting as a desiccant for dehydration, its progressive substitution by the impregnation solution under vacuum conditions. This solution contains silicone S10 plus a catalyst (S3) that acts as silicone chain extender. This is the most critical stage. The acetone within the tissues of the dehydrated pieces is replaced in a controlled way by the impregnation solution. This replacement is done at cold temperature (-15 / -20) and under vacuum conditions, therefore it is known as forced impregnation. Adjusting the pressure into the impregnation chamber through the valves makes possible to control the impregnation speed by adjusting some manometers to monitor the pressure. The impregnation rate is reflected in the number of acetone bubbles that appear on the surface of the impregnating solution. Impregnation over speed represents an imbalance between the amount of acetone removed from the specimens and the volume of impregnation solution that reaches the tissues, and consequently, a higher degree of shrinkage. In general, the impregnation phase is considered complete when the pressure reached in below 5 mmHg, which occurs after several weeks. Small pieces and hollow organs can be impregnated in a week, while solid organs or large items such as whole cadavers may take several months.
4. Polymerization or curing: The aim of this last step is to solidify the silicone in the tissues of the impregnated organs. During polymerization it is possible to recover the shape of hollow organs, improve the dissection, open new windows in cavities, keep vessels and nerves positioned, etc. In addition, curing may vary depending on the type of specimen. Thus, in solid organs such as brain, liver, muscles, etc., fast curing is normally used to avoid excessive loss of silicone and therefore volume of the organ, for this type of curing S6 hardener is used in gas form. It is a cross-linker that establishes cross-links bridges between molecules of silicone and allows the polymerization in the surface of the specimens within a few days. On the other hand, slow curing is used in hollow

organs such as lungs, the gastrointestinal tract, etc., where flexibility is required. In this slow curing the S3 catalyst that has been incorporated into the tissues with silicone S10 during impregnation. It increases the viscosity of the silicone within the specimen. This chain extensor (S3) is very active at room temperature and allows achieving elasticity in hollow organs after several weeks or months. After the surface of the organ is cured, the technique can be considered complete, although the final curing inside the specimen does not occur until several months later.

Applications of s10 technique.

a. Education: The main application of plastinated organs processed with S10 or any other silicone technique is education [3, 12, 13]. A large number of universities uses these resources in their anatomy lectures in Medicine [14], Physiotherapy, Dentistry [15], Veterinary [13], Pathological Anatomy [16, 17], Parasitology, etc. Similarly, there are many references about the application in postgraduate teaching and specialized courses, particularly in the training of minimally invasive surgical techniques, where it is possible to obtain organs like lungs and gastrointestinal tracts prepared for endoscopy [18-20]. Plastinated body serial sections or three-dimensional dissections in neuroanatomy are used as a basis for the interpretation of diagnostic imaging techniques [11, 21-23]. Complete plastinated cadavers injected with radiopaque substances are helpful as a tool to learn vascular anatomy during the training in endovascular interventional radiology techniques. The benefits of plastination as a complementary tool in teaching and learning of anatomy and other subjects are undoubted and it has been quantified in opinion surveys with groups of students from different subjects and universities [13, 24, 25].
b. Research: Numerous research papers mainly related with clinical considerations, using plastinated specimens have been published. New surgical approaches in complex anatomical territories and unknown anatomical variations, etc. [26] have been described. In recent years one of the applications with further development has been the conservation of the archaeological heritage. There are plastination labs linked to this activity working mainly with underwater material. The use of these techniques to preserve wood scraps, leather, bone, etc., has been described. Currently, we are developing a project in collaboration with the National Museum of Underwater Archaeology aimed at using the S15 plastination technique in the conservation of elephant tusks from the Phoenician period (seventh century BC) [27].

POLYESTER TECHNIQUES

These plastination techniques were designed to preserve brain sections with a thickness between 3 and 5 mm, enhancing the distinction between gray and white matter. The best-known polyester techniques are P40 and P35 (Biodur ®) [28, 29], the former technically easier and therefore much more known and used. The P40 protocol [28] can be used to highlight some important aspects.

1. Brains preparation and slicing: The protocol of this technique starts with fixation of the brain in progressively increasing percentages of formaldehyde. As discussed above, the use of embalming solutions greatly limits the final quality of the plastinated slices. Specifically, it has been largely described that the presence of phenol or glycerine remains in the brain sections causes the appearance of orange spots and deformation of the slices in a few weeks after plastination [22, 29]. If vascular injection is needed, the use of pigmented silicone instead of latex or epoxy resin is recommended. The sections from the fixed brains are obtained with a disc saw or rotary meat slicer. Sometimes gelatine can be used to keep the position and orientation of each of the portions that make up the same cut.
2. Dehydration by freeze substitution: The dehydration protocol is substantially similar to the one described in the S10 technique, with the difference that in this type of thin sections dehydration is completed in less than one week. As discussed above, acetone at room temperature is never used with nervous tissue, which minimizes shrinkage.
3. Forced impregnation: Dehydrated brain sections are impregnated with polyester P40 at room temperature and under vacuum. During impregnation it is important to keep the impregnation chamber in darkness because the polyester is sensitive to ultraviolet light. By progressively adjusting and monitoring the pressure with the valves and manometers the impregnation ends in 48h or less, once the pressure reaches 10mmHg and acetone evaporation ceases.
4. Polymerization: Ultraviolet light is used as a polymerization agent. The impregnated sections are introduced in flat glass chambers surrounded by P40. After the curing chambers are sealed they are exposed to ultraviolet light under specific conditions of time and distance from the light source, so that polymerization is done in 4-6 hours. After dismantling the glass chambers the polymerized sections should wrapped with cling foil so as to facilitate manipulation.

Applications of P40 technique:

Most of the articles published in relation to this technique highlight education in neuroanatomy as its main application [3, 22]. However, in the last

few years there have published several papers on the possibility of using this technique to process body sections. In this sense the P40 technique allows maintaining the transparency of the sections over time without turning to orange tones, which is an advantage compared to the epoxy techniques [30 31]. However, when using P40 transparent body sections for research shrinkage is the main limitation.

EPOXY TECHNIQUES

Epoxy plastination techniques were designed to preserve transparent body sections. Although several techniques have been described, the E12 (Biodur ®) is the best known and widespread technique [2]. Some technical aspects are now emphasized regarding the E12 protocol [32].

Preparation of specimens and slicing:

Usually we work with fixed specimens to obtain the sections. However, fresh material is also an option. In case of performing vascular injection, it is desirable to use epoxy resin with solvent resistant coloured pigment instead of latex or silicone. To obtain the transparent sections the specimen should be frozen at the lowest possible temperature, at least -70 or -80ºC. The sections are made in a band saw and it is recommended to use dry ice or liquid nitrogen to keep cold the top of the saw on which the specimen is displaced in each cut. Thus, 1.5-3mm thick sections are obtained. The use of -40°C acetone during the cleaning of the sawdust prevents sections from thawing.

Dehydration by freeze substitution and defeating:

Dehydration is carried out similarly as in P40. The main difference is the need to remove the fatty tissue to get the highest transparency, especially in the areas of connective tissue. This is done with several baths in acetone or methylene chloride at room temperature.

Forced impregnation:

The impregnation solution employed consists in epoxy E12 plus the hardener E1. The dehydrated sections are immersed in the impregnation mixture and forced vacuum is performed at room temperature for 6-12h. Impregnation is completed when pressures reached are below 5 mmHg.

Polymerization:

Polymerization, into flat glass chambers, must be done immediately after finishing the impregnation, which prevents the slices from polymerizing in the impregnation chamber. The protocol to build the flat chambers is similar to the one used in the P40 technique, however, in this case the temperature combined with the hardener E1 acts as polymerization agent. Sections within the flat glass chambers must be placed in an oven at 40 °C for 4-6 days. There are alternatives to the flat glass chambers like the sandwich method [32], which saves time and is easier.

Applications of E12 technique:

Although this technique has positioned itself as the best choice for learning the sectional anatomy as the basis for diagnostic imaging [14], its main application is the anatomical research. The low refractive index of the epoxy resin E12 with its minimal shrinkage during polymerization makes it the method of choice to study different tissues, in different planes of cutting from macroscopic to microscopic levels. The absence of manipulation and decalcification makes the topography of anatomical structures not affected. The removal of fat tissue allows that connective tissue, blood vessels and nerves are identified quite clearly without suffering any manipulation.

Using this technique new anatomical structures and topographical relationships have been described, i.e. the posterior atlanto-occipital membrane and its binding to the spinal duramater rather than to the atlas, which may result a potential aetiology of headaches of cervical origin [33]; the medial wall of the cavernous sinus [34]; the nuchal ligament and its relation with the supraspinous ligament of the neck [35, 36]; the relation of trigeminal nerve root with neighbouring structures as the aetiology of trigeminal neuralgia [37], etc. In the same way, these techniques help identify wrong anatomical descriptions such as to prove the absence of nuchal ligament in the space of atlanto-occipital posterior or deny that the cervical fascia is a barrier in the cervical plexus block in the region anterior of the neck [38].

In the area of imaging diagnosis this technique has been widely used for macro and microscopic interpretation of anatomical structures in sections obtained in the same planes as the imaging techniques, in regions such as temporomandibular [39-42], tarsus [43] and elbow [44, 45] joints, as well as to identify neuromuscular bundles in the planning of arthroscopic approaches in the tarsus [46, 47] or in carpal joints [48], and to evaluate pathologies in animal models [49].

An E12 ultra-thin technique has been developed [50] [51] in order to obtain plastinated sections of a thickness around 400-500 µm in a diamond saw without decalcification. It is even possible to get sections that include metal or ceramic implants to study the interface of these biomaterials. These sections, with sizes up to 10x10 cm, can be carried below 100µm in thickness after proper grinding, enabling the implementation of histological stains that allow a transition from macro- to micro-study in the same preparation. Using this technique, microscopic studies of complete larynxes have been published [52], as well as more specific studies by microCT and MRI in the cricothyroid joint and its relationship with the fibrous joint capsule [53]. Many of these works, besides using histological staining of plastinated sections, use the confocal microscopy and the endogen autofluorescence of the plastinated tissues as the basis for histology research [34, 54].

Specific anatomical regions present a complex morphology to be studied in 2D sections. Transparent plastinated sections obtained with the E12 ultra-thin technique are widely used for 3D reconstruction of not only bone structures, but also other tissues in regions such as the skull [55], the tarsus [56], the hip [57], etc. The accuracy of these reconstructions is superior to that obtained by CT scans or MRI, and are characterized by: 1) allowing all structures to be represented individually or together and rotated in any plane, 2) permitting measurement of diameters and angles of any structure, and 3) allowing morphometric data to be directly extrapolated to potential clinical and surgical findings. Thus, it has been described, for example, that the *levator ani* does not surround the ventral side of the urethra and has no action in continence in both sexes [58], which determines the design of the urethral sphincter surgical reconstruction techniques. Moreover, the surgical techniques for female incontinence are based on the fixation of the urethra to the pubis or other surrounding structures. However, studies based on plastinated anatomical serial sections show that the female urethra has no direct fixation to the pubis, and that it remains free in its pelvic topography [59]. In this sense, various studies comparing pelvic connective tissue from foetuses and adults with plastinated anatomical sections conclude on the need to review the surgical techniques of this region in a multidisciplinary way [60].

The museum application of specimens preserved with any of the plastination techniques listed above is by far the most controversial issue of plastination, due to its social repercussions, especially when it comes to human biological tissue. Many editorials in journals of Anatomy have reviewed the ethical aspect of displaying plastinated human bodies to the general public [61-64]. Perhaps as a main idea, and to finalize this review, we recall the conclusion pointed out by Gareth Jones & Whitaker (2009): "There is an urgent need for anatomists to use what is being presented to the general public in exhibitions and build upon this in their own teaching and research "[63].

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