



Forensic Genetics as a Tool for Forensic Investigation at the Crime Scene

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Abstract

The 21st century will bring us, as the 20th century brought us the specialization of forensic medicine, an increasing integration of subspecialties. The importance of DNA testing in the forensic field as a method of identification lies in its potential applicability to solve many cases that would be difficult to clarify by conventional investigative procedures and in the very high reliability of its results, only comparable with dactyloscopic expertise. The application of this profile allows the use of any fluid from the same person since it presents the same genetic code regardless of where the print comes from such as blood, saliva, semen, hair, sweat. The present research consists of a descriptive investigation that started with a transversal observational study of the application of DNA expertise for identification purposes. A bibliographic review of specialized sources on the subject was carried out, and an assessment was made of the importance of the application of DNA expertise as evidence in criminal proceedings and its impact on due process. It was analyzed the vulnerabilities that threaten the quality of the expertise and how the evaluation of the evidence can be thundered doubtful or inconclusive if the established protocols are not fulfilled, in addition the importance and perspectives of the genetic bank for forensic purposes were widely discussed, as well as the care to be taken by the risks that this has if the security measures provided for this purpose are not met.

Keywords: Genetic Material for Identification in Criminal Proceedings; Due Process; Gene Bank for Forensic Purposes; Quality of Expertise; Genetic Code

Introduction

Identity constitutes the characteristics or particularities that serve to distinguish something, it is based on the individuality of an object or person, the process through which the identity is carried out is called identification, this process includes a group of staggered and planned procedures with scientific basis through which the sciences and disciplines involved provide specific techniques, also known as the procedure through which a whole process is carried out that can be absolute or relative, aspects that we

will define later on [1].

Identification is one of the greatest challenges of Forensic Sciences since its emergence, until the end of the last century the universal method of identification was dactyloscopy dating from the late 80's in the nineteenth century, from 1989 DNA was applied for the first time in the hearing of an oral trial for forensic purposes in a rape case, but even so the identification by palm prints remains today as a method of absolute identification [2,3].

DNA for forensic purposes is the most convincing method to prove identity, it is increasingly demanded by the administration of justice, not only in criminal but also in civil cases of paternity, but undoubtedly the greatest challenge is in criminal cases due to the impact that the clarification of these facts has on society and the complexity of the expert material once they are found at the crime scene due to the circumstances and factors that threaten the quality of the evidence and fingerprints [4].

The biologists Watson and Crick in 1953 first discovered the structure with two DNA chains that replicated in the same way in humans, because it was the coding DNA, this means that it was the basis of genetic coding of each gene, so the cell replicated, for example the hepatocyte which is the liver cell replicates and multiplies on that same code which allows transplants and multiple therapies to be done today using molecular biology which according to experts is the future of medicine [5].

In 1984, the English geneticist Alec Jeffreys developed a method for identification based on a non-coding part of the DNA, whose configuration is different for each individual, thus discovering the non-coding part of the DNA which constitutes the principle of the variability of this segment which we will not refer to later.

Development

Analysis and processing of the crime scene: The crime scene or crime scene is the geographic frame where an alleged crime has occurred, which deserves to be treated with extreme care to obtain in a scientific and lawful manner the traces and clues that may link the possible perpetrator or perpetrators and be able to judge them by legal means, in addition this site allows to clarify useful circumstances for the investigation.

From another perspective, the crime scene is understood as the space or geographic frame where an alleged crime has occurred that requires special technical and scientific treatment to obtain from it in a scientific and lawful manner the elements that incriminate a person and to be able to judge it by legal means, it is a procedure of vital importance to ensure the quality of all the work to be done later, this goes through several stages, the first is the preservation of the place itself which prevents the contamination and adulteration of traces and clues.

If there is a delay in the work, all evidence and traces must be covered by specialized personnel so that they are not adulterated or contaminated.

The inspection of the crime scene should be planned in

order to work in a careful and planned manner, guaranteeing that the expert material that is worked on at the crime scene is preserved, the experts should decide what is worked on at the scene and what is collected is packed and sent to the laboratory after being fixed and filmed, as well as describing and labeling each print and clue that is sent to the laboratory.

Handling will depend on the state of preservation of the prints and evidence found, their physical state, their quantity and quality and the possibility of possible contamination. Preservation until the work phase arrives at the scene will depend on the expertise of the people who act from the beginning and their skills in preserving the forensic material before it is lifted, remember that one of the most important aspects of this stage is the chain of custody of everything that is going to be lifted and forensic.

Sampling at the Scene of the Crime: This procedure requires experts trained in the analysis of patterns in which traces and evidence can be found at the crime scene, not only because of the quantity, which can be very scarce, but also because they must have the expertise and intuition to search for and discover them.

It is necessary to remember that the perpetrators of criminal acts do not expose their traces easily, but hide and mask them or try to clean them with abrasive substances that apart from disappearing them, contaminate them and destroy their active principles, which disables the expertise, for example detergents, organic solvents, among others.

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The hair is collected with rubber-tipped tweezers because after the extraction of the genetic material this hair must be subjected to other tests to determine circumstances such as poisoning, burns, pulling, cuts, among others. If the sample is a suspect and other comparative studies are going to be done, it is preferable to pull it out, otherwise we proceed with the study of the cells of desquamation of the mouth as we have already mentioned.

Semen is often mixed in sheets, underwear, handkerchiefs, etc., in this case if these supports are white or light yellow they are masked and it is necessary to apply alternative light for its visualization with UV light, once located they are cut and this fragment is poured in saline solution to detach the sperm cells that are already deflagellated by lysis, this means that the head is already free of the neck and tail.

Cigarette butts, chewing gum, bladed weapons, firearms, condoms and other supports are packed in suitable wrappings and sent to the laboratory. As a general

principle, it is necessary to work insitus on site that which cannot rationally be transferred to the laboratory and requires a screening during the survey or visual inspection of the event.

In the case of cadaveric remains it depends on the state in which they are found, the state of putrefaction attempts against all the determinations of forensic medicine, however in this case DNA can be isolated from muscles and bones at the bone marrow level if the case allows it, dental pieces are also extracted for extractions of the bulb and obtain cells from the bone marrow [6].

Nails are an important element especially in cases of rape and homicide, often the victim in his act of defense causes excoriations on the victimizer, which leaves fragments of epidermal tissue in the lower part of the nail bed containing cells which can be determined, scraped and in the case of corpses they should be cut and isolated in the laboratory.

Those involved in this activity must constantly review and update themselves due to the modifications of the technical standards on which the subsequent results will depend.

Preservation of the Place of the Fact

We have talked about this section before, but we are going to focus on an aspect that is of vital importance, we must take into account that at an international level the specialized experts are not the ones who approach the place of the fact from the beginning, generally the local police initiates the process, from this stage of the investigation begins to guarantee the quality of the final results, the tangible limitation of the place.

The tangible limitation of the place, the prohibition of the access of intruders, the protection of the traces and indications that can be contaminated by the environment or the action of people in a voluntary way or by imprudence, the losses by the air or subtractions, the adulterations among others are elements that this personnel must take into account and they require of a preparation and possession of the means and technical resources to proceed.

Speed is an essential factor in this stage of work, both for the police and for the specialists who must work at the scene of the crime.

Sample Analysis and Laboratory Techniques

DNA is a very stable molecule that allows its polymorphisms to be traced in almost any type of biological sample containing moderately conserved genetic material.

This is one of its most advantageous characteristics for forensic medicine, since the samples to be investigated in this discipline come from a wide variety of sources and are not usually the best in terms of quality, but only the best possible. In addition to being the only ones possible, they are irreplaceable due to their legal value [7].

For a better understanding of the subject, we will detail how the samples to be analyzed are taken and subsequently analyzed.

In the case of cadaveric material Bones (the different types of bone can be useful).

- Teeth in their natural state.
- Epidermis or dermis in a good state of preservation; in the case of putrefaction, striated muscle is preferable because it is quite resistant to putrefaction.
- Hairs.

Interpretation of the Results

The results have to be correctly interpreted, it is enough to remember that the defense attorneys in the case of the perpetrators can recuse the expertise in case of doubt, to the extent that the quality and transparency of the expert work is not guaranteed. We must be aware that the material that was amplified corresponds to the object of study and not to a contamination as it usually happens in prints where fluids are mixed with vaginal extractions.

A positive or negative sample does not prove anything until its quality is verified, for example, semen is taken from the vagina of a woman allegedly raped and the result is negative when compared with the suspect's sample, there is doubt if a cell from the woman multiplied and not from the man's semen, or the same happens when there is multiple ejaculation inside the vagina of a woman victim of several men [8].

Once the rigorous observance of the quality management processes to which all forensic genetics laboratories must adhere is verified, a comparison is made to verify the concordance between genetic profiles, and to establish whether an accused individual is the source or origin of biological evidence found at the scene of a crime.

An incorrect expert procedure can trigger a false legal interpretation, in both cases the judge exonerates a guilty or punishes an innocent person, while a victim is left unprotected from legal protection.

Future of DNA for Forensic Purposes

It is well known that developed countries and others in

emerging economies such as Chile are working hard on the genetic bank of potential criminals, this step has advantages and disadvantages such as the falsification of fingerprints in a fact or the seeding of the genetic material of a person to incriminate him for a fact he did not commit, anyway there is talk of biochips.

Genetic analysis techniques are aimed at carrying out hundreds of interpretations at the same time, which implies the analysis of a large volume of information, reducing the time of expertise and lowering the not cheap cost of this technique, the interdisciplinarity between genetics and informatics is decisive in this project.

Since the discovery of DNA for forensic purposes, it has undergone various modifications and updates, the increasingly accelerated demand, the accuracy and guarantee of its results lead us to consider that the next innovation may be biochips.

Biochips arise as a result of a combination of microelectronic techniques used for the manufacture of computer microprocessors and biological materials.

At present the forensic expert can leave more 190 samples in the run technique and return after 12 hours to just read the results, but the chips would minimize this possibility with more number of applications and deepen the study of DNA polymorphisms, very soon with just pouring the sample the equipment will perform the reading of the material making by itself the multiplication through PCR, but this demands quality in the previous processes with the corresponding quality certifications [9].

Conclusions

DNA expertise is the expertise that demands the highest quality control due to the high specificity it provides in the identification of persons under criminal investigation, where its guarantee starts from the preservation and conservation of the crime scene, as well as being governed by a rigorous protocol of chain of custody of all the expert material that is collected from the crime scenes without presenting a single discontinuity and duly documented.

It is the responsibility of the experts from the crime scene to the laboratory specialists to comply with the protocols of action supervised by the Prosecutor's Office, the quality control are constant procedures to be performed by the central crime laboratories during the expertise as a guarantee of due process, the high costs of this expertise also influence the need to apply the rationality with which this technique is applied.

The lawfulness and reliability of the evidence, throughout the whole process with its procedures is based on the respect for due process rights, as well as on the use of techniques that ensure its maximum possible reliability at every stage with constant training of the professionals in charge. In the case of bodily interventions, compliance with the requirements and presuppositions in their realization is especially relevant, and this is based on the principle of legality.

DNA databases for criminal investigation purposes are currently of the greatest interest to forensic laboratories. From the accumulated experience of different countries that have developed specific legislation, it is known that the systematic comparison of DNA profiles from different criminal cases, structured in the same database, are of great help to government bodies as possible evidence that allows a possible resolution in a criminal case.

However, the conservation by legal order of the genetic profile of the detainees creates legal insecurity and originates inequalities in the treatment of persons by the legal system, since there is no difference between them and those who have never been detained by the police, often due to inefficiency of this system, especially in third world countries, and this can be pre- or post-criminal, the former by operational or administrative decision and the latter as a consequence of a criminal legal action.

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