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Ethical limits to confirming identity by morphological features

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Abstract

Technological advancements have generated tools to help with identifying individuals, allowing to verify identities and solve crimes by confirming found missing persons or accident victims, for example. An important ethical question, however, arises: do the ends always justify the means? Can facial identification from images collected by closed-circuit television cameras or analysis of photographic records confirm someone's identity unequivocally? Can fingerprints or lip prints be used for any dactyloscopy? Knowing the limitations of scientific technical methods used in morphological comparisons allows examiners to comply with two fundamental constitutional principles: that of legality and right of the human person. By respecting them, examiners will be acting according to ethical limits.

Keywords: Ethics. Facial recognition. Dermatoglyphics. Lip. Expert testimony. Forensic anthropology.

Resumo

Limite ético para confirmar identidade pelos caracteres morfológicos

O desenvolvimento de novas tecnologias fez nascer ferramentas que auxiliam no processo de identificação de indivíduos, possibilitando confirmar identidades e ajudando a solucionar crimes, ao permitir confirmar o encontro de pessoas desaparecidas ou vítimas de acidentes, por exemplo. Entretanto, um importante questionamento ético precisa ser observado: os fins sempre justificam os meios? A identificação facial a partir de imagens coletadas por câmeras de circuito fechado de televisão ou a análise de registros fotográficos são capazes de confirmar a identidade de alguém inequivocamente? Impressões digitais ou labiais podem ser utilizadas, em qualquer hipótese, em um confronto dactiloscópico? O conhecimento sobre as limitações dos métodos técnicos científicos utilizados em comparações de caracteres morfológicos permite que o resultado do perito papiloscopista atenda a dois princípios basilares constitucionais: a legalidade e o direito da pessoa humana. Ao respeitá-los, estará agindo conforme os limites éticos.

Palavras-chave: Ética. Reconhecimento facial. Dermatoglifia. Lábio. Prova pericial. Antropologia forense.

Resumen

Límite ético para confirmar la identidad por caracteres morfológicos

El desarrollo de nuevas tecnologías dio lugar a herramientas que ayudan en el proceso de identificación de personas, lo que posibilita la confirmación de identidades y contribuye a la resolución de delitos al permitir confirmar, por ejemplo, a personas desaparecidas o víctimas de accidentes. Sin embargo, es necesario observar una cuestión ética importante: ¿el fin siempre justifica los medios? ¿La identificación facial desde imágenes captadas por cámaras de circuito cerrado de televisión o el análisis de registros fotográficos puede confirmar inequívocamente la identidad de una persona? ¿Se pueden utilizar huellas dactilares o labiales, bajo cualquier circunstancia, en un enfrentamiento dactiloscópico? El conocimiento sobre las limitaciones de los métodos técnicos y científicos utilizados en las comparaciones de caracteres morfológicos permite que el resultado del perito en papiloscopía responda a dos principios constitucionales básicos: la legalidad y el derecho de la persona humana. Al respetarlos se estará actuando dentro de los límites éticos.

Palabras clave: Ética. Reconocimiento facial. Dermatoglifia. Labio. Testimonio de experto. Antropología forense.

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Research

Menezes [1] defines ethics as a part of the philosophy that seeks to understand how humans behave and guide their conduct. The term originates from the Greek word *éthikos*, which means "way of being." Issues involving ethics and morality cannot be linked only to a specific rule, that is, to what is provided in law: a more holistic view is required [2], which allows us to argue that the discovery of new technologies or techniques cannot be used as an excuse to disrespect human autonomy and dignity [2].

Ethics and its branches are responsible for guiding the behavior of certain professionals, offering counsel in issues related to medicine, business and the public sector, among other areas [3]. In the last case, they analyze how public entities should act, so that their decisions honor society's trust in them and aim to protect important issues. Their conduct should be based on the following question: what purpose legitimizes those who provide services to the State? Public ethics underpins actions that promote equality and justice, respecting individual freedoms [3].

The goal of scientific development is not to undermine the evaluation of ethical precepts. The State can and should be held responsible for actions that violate protected legal goods. From this perspective, a technical identification process that aims to confirm an identity based on specific theoretical and scientific knowledge should seek to resolve conflicts, but in compliance with ethical standards and limits [4]. This should not be changed, even with the improvement of identification techniques.

A few years ago, identification drew on data such as height, skin color, scars, tattoos and body marks to confirm or disprove an individual's identity. After numerous errors, this methodology was replaced by a more assertive one: fingerprint matching. This improvement is the result of the loud demand of individuals for respect for their intrinsic human rights, arguing that the end cannot justify the means—which shows that these people wanted their vital needs to be observed and respected [5].

The use of scientific methods in the process of human identification to confirm the identity of an individual clearly provides important tools to achieve this end: criminals can answer for their crimes, the victim can be compensated, missing people can go back to living with their families and illnesses can be previously diagnosed. However, as already mentioned, the end does not justify the means.

In its eagerness to find culprits, for example, the State must observe ethical limits, understand and know the tools at its disposal and their limitations. This study aims to establish the distinction between recognition, identification and identity, as well as to describe—not comprehensively—the main limitations of some methods of human identification and how they impact the confirmation of identity, thus seeking to promote respect for individual rights and legislation, always within ethical limits.

Differentiating recognition, identification and identity

"Who are you?" That is the main question asked by a fingerprint, criminal or medical expert when studying fragments collected at crime scenes or analyzing the fingerprints of a victim of a mass-casualty incident.

Several studies conceptualize recognition, identification and identity. A logical process that must be implemented to confirm or disprove a given identity should be: recognition→identification→identity. It is sequential and therefore cannot start with identity since that is the ultimate goal. Thus, starting with recognition, it will proceed to identification, which, depending on the technique used, will confirm or disprove the identity of the individual. It is possible to start with identification and obtain the same result: the confirmation or not of identity.

Does this mean that recognition, identification and identity are completely different actions? Yes, which is in fact corroborated by França [6], who presents the following definitions:

1. Recognition: from Latin *recognoscere*, which means *separating a person from another by some specific trait*, *detailing a certain fact*, *certifying* [7]. It is the act of confirming or

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guaranteeing something; to review; to claim to know a certain individual.

2. Identification: scientific or technical means with specific characteristics used to confirm or disprove an identity. It is divided into the areas of legal medicine and criminal investigation [6]. The latter, in order to match morphological characters, uses anthropometric or anthropological data, and must present the following particularities:
   - Uniqueness: characters that differentiate or match individuals;
   - Immutability: morphological elements cannot undergo intrinsic or extrinsic action;
   - Perennity: ability to survive over time, even after death;
   - Practicality: easy to obtain and record; and
   - Classifiability: can be classified and archived according to its characteristics.

It is important to stress that, even without having all these characteristics, the sample or image can still be used. Limitations and interruptions in the identification process may occur. An example of morphology that does not present all the aforementioned traits is the face, which will be exposed *a posteriori* to changes caused by the action of intrinsic and extrinsic factors. Even in this condition, there is no impediment to its use in the identification process; however, there will be no unequivocal confirmation of the identity.

3. Identity: identity is the set of unique morphological and psychic characteristics of a person; they are traits that make someone or something equal only to themselves, being defined through an objective process grounded on scientific bases. It comes from the Latin word *identitas*, whose meaning is precisely "identity."

França [6] subdivides it into two areas: objective and subjective. Subjective identity is related to how individuals sees themselves, in the present, past or future, and concerns psychological and sociological aspects. Objective identity is confirmed by the technical analysis of the existence of elements with characteristics that do not change over time and make it possible to differentiate one individual from another.

One can thus conclude that the terms "recognition," "identification" and "identity" are used in a completely wrong way. These are different practices that generate different results.

One of the foundations of the expert report is trust, or its reliability. This latent element is what conveys to the one who will judge the case the certainty that it can be used as evidence, obviously considering all the other elements.

The goal of the expert report is not to determine the culprit, but to offer scientific elements that make it possible to describe the fact objectively and present data to guide other actions that clarify what happened. In the case of the fingerprint expert, their role is only to indicate whether there is a match between the fingerprints of two individuals or whether a certain face belongs to the same person.

Castillo and collaborators [9] reveal the concern that exists in courts about the degree of reliability of expert testimony, due to the lack of knowledge of judges about the scope and methods used to prepare reports. The goal is undoubtedly to reduce errors in sentences, seeking to comply with ethical principles related to the dignity of the human person. It was with this in mind that the United States Supreme Court, in 1993, in Daubert v. Merrell Dow Pharmaceuticals [10], issued a number of parameters that must be observed for evidence to be accepted in the process:

1. Whether the theory or practice used could be tested;
2. Whether there was a review by other peers;
3. Whether there is acceptance of the technique used in the scientific community; and
4. Whether there is an analysis of the error rate.

Concerning the last requirement, Dass and collaborators [11] teach that, with regards to fingerprints, the aim is to address the issue of their singularity or individuality; the level of uncertainty associated with the expert testimony, or the probability of a decision being based on a mistaken latent fingerprint. In fact, the US court is not questioning the objective issue of individuality, but the analysis of the fingerprint expert, who does not bear this obligation, since, as already explained, their role is merely to indicate

whether the fingerprint belongs or not to a specific individual, which naturally requires expertise.

In addition, one must respect the chain of custody, previously analyze the quality of the evidence, use appropriate techniques and submit the result to two-step verification. An objective way to verify the error rate is to find the percentage of correspondence between the result of the report and that obtained in the process, that is, whether the culpability was ascribed to the individual whose morphological data was analyzed. With the same understanding, Duce Julio [12] suggests that it is necessary to regulate the use of expert testimony without demonizing it, for the following reasons:

1. To prevent experts from exceeding their function by giving an opinion on the guilt or innocence of the accused, thus replacing the work of building procedural truth; and
2. Non-explanatory information given by experts may impact the decision of judges, especially regarding evidence that is difficult to understand.

The Chilean Code of Criminal Procedure, cited by Duce Julio [12], provides that evidence will be accepted if the following can be ascertained: expertise (ability of the expert to explain to the court any procedural issue); suitability of the expert (correlation between this professional's skills and what is declared in the report, that is, whether they have the knowledge required to carry out the examination); and reliability of the information (provision of information accepted by the scientific community) and its relevance.

The evidence will be relevant when it is pertinent to the case, that is, when synergy between the evidence presented and the facts discussed exists. There must also be legal relevance, that is, using it must be cost-effective, considering the favorable aspects and potential damages or costs.

Raise questions about evidence is very important, for example, how the suspect's image was obtained, the lighting, the distance or height of the surveillance camera, whether the fingerprint had good matching conditions, whether two-step analysis was performed, etc. These are questions that, when answered, protect the fingerprint expert and ensure compliance with ethical principles.

In short, to be legally accepted, the evidence must meet minimum standards, as it will be the basis for the adoption of actions that may have good or bad consequences.

Morphological analysis methods

Facial recognition

One of the scientific methods that has been widely employed to find people is facial recognition. It basically consists of seeking to establish an identity based on facial features [13]. The term "recognition" is misused, including in the Science Descriptors Database. As already explained, the correct term is "face identification," because recognition is not a technique to confirm an identity.

In a controlled environment, the success rates of facial identification are higher than in outdoor areas, where it is practically impossible to control luminosity and/or positioning of cameras, for example. Facial identification is thus hindered and made unfeasible.

Facial morphological analysis is influenced by intrinsic and extrinsic factors. Intrinsic factors are subjective in nature and relate to expression, aging (short and long term), sharp weight changes, changes in health and intentional changes (plastic surgery, use of dental prostheses, etc.) [14]. Of those, the most important are facial aging and intentional changes (plastic surgery).

The face can be divided into areas with high, medium (base region of the nose, nasal wing and columella, chin region and gonial angle) and low (regions of the philtrum, general mouth, upper and lower lip) stability [14]. The face's structure is formed by anatomical units called fat compartments, supported by the cranial bones, which are also responsible for the three-dimensional contour of the face.

Over time, bone resorption causes changes in volume and position (ptosis) in these regions, causing facial muscle tension. The face becomes more elongated, widened and deeper in the anteroposterior plane [15]. This dynamic explains

the aging process, which does not occur in a uniform manner, as the points on the face have different stability, which is a very important aspect in facial morphological matching [14].

For a facial morphological analysis, five years and over is considered a long-term period. Therefore, it can be inferred that photographic images of such age will present important divergences, especially in the medium and low stability areas, and one must consider the possible occurrence of intentional superficial facial changes—such as the use of piercings and tattoos—or internal ones, such as dental prostheses or facial reconstructive elements.

Extrinsic factors, in turn, are related to capture obstructions; distortions; lighting; pose or positioning of the face in relation to the camera or of the camera in relation to the face; camera sharpness and resolution [16].

Distortions are mechanical or physical actions that produce changes in facial appearance. They can be caused by [16]:

1. Mirage effect due to thermal activity, which is very common in images captured outdoors;
2. Proximity to the camera (less than 2 meters away), called perspective distortion; and
3. Image obtained when the capture device or the object is moving.

Lighting is a key element, as it directly impacts visibility, exposure, contrast and colors of facial elements [16]. An image captured under unfavorable light will have areas that are too bright or excessively dark, preventing the observation of facial details such as moles or spots, considered intersection elements of images.

Finding these elements is extremely important, as facial identification is not restricted to analyzing the contour of the face, which varies in images obtained in different lighting directions—which can lead to misinterpretation during identification and decreases the matching accuracy between the faces under analysis. That is why the best results in face matching experiments were obtained at an angle of ±30°; outside that limit, the identification process becomes more difficult [17], which suggests that lighting direction is the most determining factor in the facial identification process [17].

The individual's pose in relation to the camera is the orientation of the face when the image is captured, and is related to rotation, tilt and yaw [16]. Images of faces captured on video usually contain poses that are not in a frontal position, in addition to being influenced by lighting. Automated facial recognition systems have the ability to choose the face with the best quality, which are considered those in the frontal position and with a neutral expression. This situation is common in places with public access, as long as the cameras are installed in suitable positions.

On this subject, Edmond and collaborators [18] address facial mapping from two points of view: quantitative and qualitative. The quantitative perspective is based on metric and angular distances between two facial points; the qualitative viewpoint, in turn, focuses on the existence of morphological traits, the degree of similarity and whether there is proportionality between the images. These two aspects are compromised by the face pose, as facial features are covered up and distances between characteristic facial points are altered, which even interferes with automated facial comparison systems.

As with fingerprints, in the case of using the face as evidence, Australia enacted the so-called Uniform Evidence Law [19], which provides that it can only be used if it is relevant, that is, if it directly or indirectly influences the proof of the occurrence of a fact. Thus, it can be inferred that, for an image to be considered evidence in Australia, it must have enough quality to enable identification.

Why is it important to harbor doubts about the validity and reliability of evidence in face matching? Edmond and collaborators [18] explain some situations that may raise questions: photographic capture in a controlled location; machine resolution; possible existence of distortions; quality lighting.

Other factors to be observed are the type of lens and the position of the camera (angle) in relation to the face. As already explained, angulation may totally prevent a facial morphological match. One can argue that the greater the extrinsic similarities of the images, the greater the chances of obtaining a good result. But what is the influence of this rotation, whether in the direction of the Frankfurt plane (horizontal plane that divides the face into upper and lower parts) or of the sagittal (vertical plane

that divides the face into right and left sides) and coronal (vertical plane that divides the face into dorsal and ventral parts) planes? These rotations change perspective, shift the examiner's focal points, distort contours and shapes, and cover up morphological points.

Angulation is the biggest issue when it comes to images captured with a CCTV camera. In this case, the problem involves both the pose and the angle and relates to the way the camera is installed in a street (usually in a high position). Does this mean that CCTV footage or facial identification systems should be banned? No. It is clear that the use of technology helps in the identification process, but the intrinsic and extrinsic conditions of the images are important barriers to confirming identity.

An example of the effective use of these systems is their ability to find differences between the faces of identical twins, despite the great facial similarity [20], which is why Sun and collaborators [21] argue that biometric facial analysis of such individuals is inferior to the same type of analysis with fingerprints and iris.

Priya and Rani, in a study analyzed by Mousavi, Charmi and Hassanpoor [20], present data on a facial morphological analysis between monozygotic twins performed by automated systems, concluding that the best results were obtained in images with neutral expression, without rotation and with good quality. For poses with rotations above ±45°, satisfactory results were not obtained. Thus, the image must necessarily be captured in the frontal position, respecting the angular limitations responsible for distortions that influence facial identification.

Therefore, one can infer that automated systems can be used, but always understanding that they have important limitations and that the images provided by them should not be the only means used to confirm an identity. Positioning is just one of the influencing conditions in the process of facial morphological matching, and even if the image was captured in the frontal position, other limiting factors exist.

Even observing these conditions for using images in facial morphological matching, there is no unanimity among scholars and professionals regarding the use of photographs and images as evidence [18], as they are often considered neutral and mechanical facts whose analysis should not be considered a truth. Therefore, using them as independent and unique evidence is very dangerous.

This understanding is corroborated by decisions taken by the 6th Panel of the Brazilian Superior Court of Justice (STJ) [22], which returned 89 judgments, 28 of them collegiate and 61 individual, of which 78 were decisions based on photographs only and one was based on video surveillance footage, motivated by non-compliance with formal recognition [23]. In another decision, the same panel decided to reject a conviction based on a photograph recognition [24].

Thus, to avoid possible problems caused by the use of an image, whether a photograph or CCTV footage, it is always necessary to be guided by codes of ethics and observe [18]:

1. Inclusion of facts, assumptions or inferences by the author of the report;
2. The reasons that led to the result;
3. Literature references and supporting material; and
4. Submission of trials or tests performed during the work.

When studying images produced by CCTV cameras, Porter [24] concluded that they are incapable of recording details, for the following reasons:

1. Optical system resolution;
2. Degree of compression and decompression of the digital image;
3. Ability of the software to capture still images; and
4. Dynamic range of the image

Thus, understanding how this equipment works, its limitations and the influences of extrinsic factors can minimize or dismiss future doubts about the validation of these tools and the certainty that they will fulfill their purposes. That is, the objective of image mapping must be limited by the observation that the images are not collected under the same extrinsic conditions and that there is a time lapse between them. The reliability of the evidence presented is related to the perennity of the results, that is, the current result must be confirmed *a posteriori*, attesting its accuracy [18].

Facial identification is a very powerful tool; however, given the intrinsic or extrinsic limitations, it is reckless to use the facial identification phase to confirm someone's identity, presenting only a probabilistic result regarding the confirmation of identity.

Palatoscopy

Palatoscopy is the study of palatal rugae as a method to establish a person's identity [25]. Palatal rugae have a very characteristic organization in the anterior region of the palate. They are made up of asymmetric ridges and are formed from the third month of gestation. Over time, they only change their position and length, due to upper jaw growth, with no other type of change over a person's life [25]. Even in pathological situations or third-degree burns in the facial region, they are not modified or mischaracterized, conserving their typical design for up to seven days after death.

Despite being used as synonyms, the terms "palatoscopy" and "palatal rugoscopy" refer to different techniques. According to Ratnakar and Singaraju [26], palatoscopy studies patterns, grooves and ridges, being a technique for analyzing the characteristics of structures that allows the creation of individual patterns; it is precisely such patterns that make it possible to distinguish one individual from another. Tornavoi and Silva [27] cite typical characteristics of palatal rugoscopy that are in line with those presented by França [6]:

1. Uniqueness: each palatal rugoscopy is unique;
2. Immutability: the rugoscopy pattern is not altered, whether by pathology or the individual's will;
3. Perennity: ability to remain unchanged over time, even after death;
4. Practicality: easy to obtain and record; and
5. Classifiability: possibility for data to be collected, classified and archived.

And what ensures the permanence of these characteristics over time? Bing and collaborators [28] teach that the oral structure, composed of teeth, mouth, cheeks and tongue, creates a protective framework that prevents trauma and decomposition under high temperatures. It is noteworthy that, even between twins, palatal rugae patterns are diverse and that, despite not being considered unanimity among scholars, palatal rugoscopy, as highlighted by Basnet, Parajuli and Shakya [29], makes it possible to determine an individual's sex and skin color.

Palatal rugoscopy is an identification process that can be used in living and dead people, requiring a dental record or a prior image of the palate [30].

However, despite having characteristics that would meet the conditions for an effective human identification process, according to França [6], palatoscopy is not part of criminal identification, but only of legal medicine. The latter requires technical knowledge of medicine and ancillary sciences, and is exclusive to coroners; criminal identification, on the other hand, does not require medical knowledge and is based on anthropometric and anthropological data [6]. Identification experts conduct this activity, and it is a subjective distinction of the identification process.

There is also the objective aspect of the expert examination, which is related to the existence of visible or latent traces left at crime scenes. This condition does not exist when it comes to palatal rugoscopy, as there is no possibility for an individual to leave a visible or latent impression in that region—thus making criminal expertise unfeasible, restricting it to legal medicine, which makes palatoscopy an important tool in this area of knowledge.

Cheiloscopy

"Cheiloscopy" is a word of Greek origin (*cheilos*, "lip" + *skopein*, "to observe"). It is, therefore, the study of lip prints, which present characteristics—such as lip grooves—that are useful for human identification [25]. The analysis is carried out on these traces formed on the upper and lower lips from the sixth week of gestation, undergoing changes in length and placement only.

According to Ferraz and collaborators [31], cheiloscopy patterns are practically immutable, even when affected by lip infections, inflammation, trauma or disease. Burns are the only occurrences capable of altering

those patterns and, therefore, are the main impediment for the lip to be used as a tool for human identification [25].

Lip prints have characteristics in common with fingerprints. They are so important that, according to Oliveira [32], the USA's Federal Bureau of Investigation (FBI) uses cheiloscopy as a method of human identification for the purpose of producing evidence. The author also notes that even in homozygous twins, lip prints do not have the same design. It is important to note that, in addition to analyzing lip grooves, lip identification can be performed by analyzing the thickness of the lips and the shape of the commissures [32].

França [6] considers cheiloscopy a legal medicine identification method. As already explained, this kind of identification uses anthropometric and anthropological data and can be carried out by fingerprint experts. Therefore, to the extent that it is possible to leave visible or latent traces of the lip pattern at the crime scene—for example, on glasses or cigarette butts—this method can be considered a criminal identification procedure.

Although lip prints have the same characteristics as fingerprints, the quality of the lip print left at the crime scene must be analyzed because, depending on its condition, its use is limited. The main aspects to consider are:

1. Overlapping: there is a great possibility of overlapping of these prints when the primary support is a glass;
2. Lip contraction: this occurs when the individual smokes, which alters the lip pattern; and
3. Wiping: tissue paper is an important support, as long as there is only one compression, with subsequent removal from the lip. However, most individuals do not press the tissue against the lips, but use it to wipe the lip surface.

According to Prabhu, quoted by Oliveira [32], there is no unanimity in courts regarding the possibility of using lip prints as evidence. The aforementioned problems may support this understanding, which, at first, seems to be quite wrong, for the following reason: prior screening is carried out by an identification expert who has the necessary expertise to consider the lip prints as suitable for matching. The doubt, therefore, should not relate to the object, but to the examiner, whether they have technical knowledge in the area of identification, and to whether there was, for example, a second analysis.

If the lip print shows fully suitable conditions, cheiloscopy morphological matching is a tool capable of confirming or disproving an individual's identity. This requires establishing an objective method for this confirmation.

Fingerprints

What is a fingerprint? Before addressing the definition, it is important to know the structure of the body's largest organ. The skin structure contains two layers that are responsible for the formation of fingerprints, or dermatoglyphs [33]. The dermis, the innermost layer, intervenes in the formation of papillary patterns, and it contains the papillae, neurovascular projections responsible for the embossed designs that will originate fingerprints, or friction papillae.

The second layer, epidermis, has an outer surface, on which hairs and fingerprints are found, and an inner layer, which covers the epidermis papillae. It should be noted that there are differences between papilloscopy and dactyloscopy: the former is the science that studies fingerprint patterns, while the latter consists of using identification techniques to analyze fingerprints and confirm whether they belong to the same individual or not [33]. This analysis is called fingerprint matching.

Dactyloscopy has several branches, including clinical dactyloscopy, which is based on temporary or permanent changes in papillary designs; for example, the so-called white lines [33], formed by the folding of the dermal papillae and which do not belong to the anatomy of papillary patterns, as they vary in size and shape, in addition to appearing and disappearing, and therefore cannot be classified as identification morphology.

Papillary patterns have many characteristics. One of the most important is called delta, a structure formed by the union of the marginal, basilar and nuclear lines. Its presence or absence is what makes it possible to define the four basic types of papillary designs:

1. Arc: when there is no delta;
2. Outer loop: delta to the viewer's right;
3. Inner loop: delta to the viewer's left; and
4. Whorl: bilateral delta.

In addition to those, there is the anomalous, which does not fit into the basic types, the scar and amputation [33].

One of the most important characteristics of fingerprints is their individuality, that is, the guarantee that there are no two individuals with the same patterns, or even between an individual's own fingers. But what guarantees this? The way they are formed. The process bears a resemblance to the formation and growth of blood vessels and capillaries.

General features begin to appear with the fingertip differentiation process, which is influenced by the movement of the amniotic fluid surrounding the fetus. Another factor that influences the formation of fingerprint patterns is the position in the uterus, which changes during the process of forming pads on the palms and fingertips. So many variables, modifications and alterations occur during the formation of fingerprints that it is virtually impossible to find two alike [34].

This is the understanding of Guízar-Sahagún, Grijalva-Otero and Madrazo-Navarro [35] when they state that fingerprints or dermatoglyphs are formed during the gestational period, with patterns established by genetic characters that only determine the formation of the design in the dermis. The location and shape of ridges and furrows, in turn, are defined by skin tension exerted on the hands and feet.

This information is important to rule out the idea that fingerprints have a genetic origin. This is explained in studies that concluded that there was similarity in the fundamental types of fingerprints in monozygotic twins, but not in the fingerprint patterns, thus proving the individuality of fingerprints [36] and the non-genetic origin of the constitution of dermatoglyphs, for otherwise they would be the same in these cases, since such individuals have the same genetic load. This is confirmed by Tao and collaborators [37], who claim that, despite having the same DNA sequence, monozygotic twins have slightly different fingerprints.

Fingerprint analysis is called matching. In Brazil, an identity is confirmed when there is a match in at least 12 of the so-called minutiae points. However, as established at the 58th Annual Conference of the International Association for Identification [38], it is concluded that there is no scientific basis that determines the minimum of matching points to confirm an identity.

The existence of unusual papillary lines individualizes a fingerprint much more than finding a hundred minutiae in a finger pattern, and if there is a fragment that convinces the fingerprint expert of a positive identification, the allegation of the non-existence of the 12 points can be considered a great mistake [33].

As mentioned above, França [6] listed five morphological characteristics required for a good identification method. Fingerprints have all of them and, given their importance, are considered a means of primary identification by the International Criminal Police Organization (Interpol) [39]. Among those characteristics, it can be said that the most important in the criminal identification process to confirm an individual's identity, are:

1. Perennity: fingerprints are formed in intrauterine life and preserved throughout the individual's existence, until cadaver putrefaction;
2. Immutability: fingerprints never change, whether by pathology or the individual's will, remaining the same from their formation to death; and
3. Variability: no fingerprints are the same between two people, not even between a person's own fingers.

It is worth mentioning that fingerprints are not only used to identify people. Studies seek to associate fingerprint patterns with individual talents, whether athletic or academic [40], or with the presence of a specific clinical abnormality [41].

Nevertheless, Alter [41] points out that there are individuals with unusual dermatoglyphs and chromosomal abnormalities, although there is no current knowledge that can correlate this situation with some physical abnormality. Fingerprints are such a powerful morphological characteristic that, even in the case of skin diseases, it does not mean that there will

be an alteration in fingerprints, but rather a temporary disappearance—or, in some cases, definitive, if the disease reaches the baseline of the epidermis and dermis [42]. In this situation, the papillary lines will not grow, or, if they grow, will have a different pattern.

This type of illness does not occur frequently, as in most cases it is temporary and once its effects are over, the fingerprint pattern reappears normally. Some variability in fingerprint patterns may occur over time. Does not that mean that there is a change in the dermatoglyphs? Yoon and Jain [43] conclude that there is a decrease in the number of matching points between fingerprints, but that, nonetheless, the probability of confirming that the fingerprints belong to the same person (identity) remains close to 1, that is, even under such conditions it is possible confirm an individual's identity.

Fingerprints are undoubtedly the most important tool in confirming a person's identity. Given the characteristics that ensure matching, it is undeniable that it is very important evidence to identify criminals and disaster victims, answering the question posed at the beginning of this article: "Who are you?"

Final considerations

To what extent is it ethical to study a person's potential from the analysis of a fingerprint? In view of the above, it does not reveal the level of an individual's intelligence or emotional quotient. It is important to knowing the predisposition to contract a given disease; but what if an employer, using fingerprint patterns, obtains such information and refuses to hire someone because of that data? Would he be acting ethically?

The same line of reasoning can be used when someone's right to freedom is restricted because their identity was confirmed based solely on a photograph or CCTV footage. In all these examples, the end is justified by the means, even if limits and ethical values are disrespected. But how far does that limit go? Up to the boundary between legality and the identification technique used.

To confirm an individual's identity by analyzing a finger or lip print is not unethical because, given the characteristics presented in this study, these are the only techniques that can unequivocally confirm someone's individuality. However, despite having this ability, they will not determine if someone committed a crime, but only to whom the prints belong—an ethical action in which the ethical boundary was observed.

The limit cannot be only in the law, but also in the conscience of who provides the expert testimony, seeking to solve a certain situation that occurred to meet the desires of the victim and society.

The proper use of scientific techniques—knowing what their limitations are, what result can or should be obtained, in addition to showing compliance with the principle of legality—denotes respect for the person, as it is more important for a miscreant to go free than for an innocent person to be convicted.

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