



# Personal Identification Through Facial Features



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## Abstract

Identification procedures are divided into two large groups: individualizing or objective methods; and complementary or subjective methods. The first include dactyloscopy, radiology (especially oral radiology) and genetic testing. The rest of the methods are considered subjective and are considered as identity determination approximation processes. These must be competed with an individualizing element to confirm a positive result. The complementary methods can be individualizing methods, when an individualizing element appears in doubtful or undoubted samples. Researchers always prefer identification by papillary combs, radiological images or DNA testing. However, frequently, the lack of appropriate doubtful samples, such as the case of recorded images of criminals, or the advanced state of decomposition of corpses, in the case of unidentified deceased people, do not allow the study using these procedures.

A frequently used procedure is comparing faces, captured by means of photographs or video recordings and other images collected in civilian or police files. In the case of skeletonized cadavers, the superimposition method is used by superimposing the picture of the cranium with old pictures of the missing person who's believed to be the corpse. In these cases, the identification of individualizing images in undoubted photographs, allow researchers to reach objective conclusions that can be proven at court. The appearance of dental-facial elements in the compared samples, allow for the procedure to be statistically comparable to the methods that have been traditionally considered as objective. In this article, we have analyzed the work methodology of facial recognition studies both in live people as in corpses. We have determined the conditions in which these procedures are no longer complementary or subjective. We have corroborated the individualizing value of dental-facial elements. Lastly, we have statistically reviewed the forensic cases known in Spain.

## Introduction

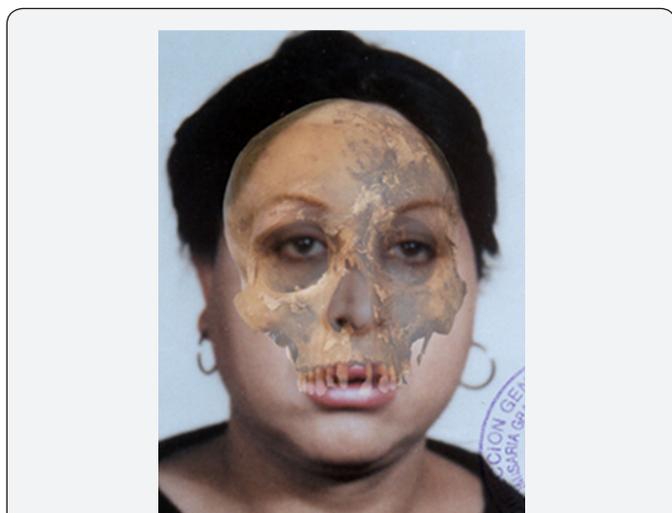
Personal identification is a normal practice in our everyday lives. We recognize a person by comparing them to the image we have stereotypically stored in our minds. The identification of the general elements of the face as a whole does not require prior training or specific knowledge. It can therefore be developed by experts or untrained people alike. We define necro-identification as the comparison between the data obtained from the corpse, known as postmortem data, with the data provided by the family, police or medical files, which are known as antemortem or premortem data [1].

Procedures can be individualizing or complementary. The procedures known as individualizing are completely objective, in other words, the conclusions of the results that they provide can be analyzed objectively by a different expert who isn't the author of the work and can be proven at court. These include: dactyloscopy, radiographic images, dental procedures, genetic testing [2]. Complementary procedures, on the other hand, are

used to perform an approximation to the person's identity, but they always require additional individualizing methods. The obtained results are assumed subjectively by the researcher, who must explain the reasoning behind their methodology. Their results can be questioned by the court in session, since there may be doubts if these features could belong to other people with similar features. Among these, we wish to highlight: Direct recognition of anthropometric studies, tattoos/scars/patches and the study of the facial features [3].

The main goal of somatoscopy or forensic somatology is to identify the individual by analyzing their body. Mantecón [4], highlights the importance of facial features, especially the ears. In his analysis of somatoscopy, he divides it into dactyloscopy, palatoscopy, pelmatoscopy and cheiloscopy. We will analyze the importance of the face for personal identification [4]. The study of the face and its comparison to stereotypical images of a person (Figure 1) is the simplest form of identification, which

usually isn't enough due to the errors it could lead to. Although on many occasions it is the only means for positive identification [5].



**Figure 1:** Facial features can be individualizing elements. The presence of facial asymmetry can be individualizing.

We must be aware of the usefulness of the study of the cranium in the identification of live and deceased persons, due to the variety of elements that it provides for research, becoming in many cases individualizing procedures, while on other occasions it can serve as an approximation method to the person's features. Knowledge of these craniometric points and their location within the face can help us when superimposing cranium-photographic images, which could be individualizing [6].

**Fundamentals for positive facial analysis**

**Table 1:** Craneometric points.

ALAR FOLDS	The most open point to the nasal opening.
ASTERION	The point where the occipital, parietal and temporal bones meet.
BASION	The midpoint of the anterior margin of the foramen magnum.
BREGMA	The point of junction of the coronal and sagittal sutures.
CONDYLION	The lateral tip of the condyle of the lower jaw.
ECTOCONQUIO	The midpoint of the lateral border of the orbital reborders.
DACRYON	The point of junction of the frontal bone, jaw bone and the lacrimal. May be confused with maxilo-frontal.
ECTOMOLARE	The most lateral point on the exterior surface of the alveolar border.
STAPHYLION	The crossing point of the median point of the posterior edge of the hard palate with the tangent uniting the posterior borders of the alveolar crests.

EURYON	The lateral points marking the ends of the greatest transverse diameter of the skull.
GLABELLA	Most external point of the sagittal plane, in the lower margin of the frontal, over the nasal root between the superciliary arches.
GNATHION	The sagittal midpoint of the lower border of the mandible.
GONION	The point on each lower human jaw closest to the vertex of the gonial angle and external mandibular base.
INION	The external occipital protuberance of the skull. Also known as nape crest.
INFRADENTAL	Point between the lower incisors.
LAMBDA	Union of the lamboid and sagittal suture.
MAXILOFRONTAL	Intersection of the margin of the orbit with the frontomaxillary suture.
NASION	The middle point of the nasofrontal suture and the medium-sagittal plane. Corresponds with the nasal root.
NASOSPINALE	Lowest point of the nasal opening.
OBELION	Crossing point of the sagittal and the union of the parietal orifices.
OPISTHOCRANION	The posteriormost point of the occipital bone.
OPISTHION	The median point of the posterior border of the foramen magnum. It is the opposite of the Basion at the Foramen magnum.
PROSTHION	Lower anterior point of the alveolar arch, midway between the median upper incisor teeth.
VERTEX	Highest point of the cranium, the most distant point from the basion.
ZYGION	Craniometric point located on the far side of the zygomatic arch.

Each and every one of the osseous elements that form the cranium has an external expression on the face, drawn by muscle distribution which completes the facial image of the person. Since these are invariable in their structure from the definitive development of the skeleton, there are no variations, except for those caused by disease or voluntary transformations, which then become permanent individualizing elements. This aids the comparison of photographic images of different moments within the lifetime of one person, through the location and comparison of craniometric points. From the age of 20 onwards, the human skeleton is invariable and, according to the authors we have reviewed, it is impossible to find two individuals whose bones are exactly identical [7]. We must remember that the craniometric points of interest for superimposition of facial images (Table 1). The spoken portrait described by [8], which is interesting for facial description, considered the following facial elements (Table 2). The search of facial images captured on video usually comes with complications.

**Table 2:** Facial elements considered in the portrait.

HAIR: Insertion line, color, shape, amount, bald spots, hair style.
FOREHEAD: height, width, shape, special characteristics.
EYEBROWS: color, width, shape, direction, size, insertion.
ORBITS: size, inclination, direction, differential features...
EYELIDS: size, direction, shape...
EYELASHES: size, shape...
EYE: prominence, particular features...
CHEEK BONES: shape (protrusions, depressions)
MOUSTACHE, BEARD: Shape...
NOSE: shape of each area, width, height---
MOUTH: size, shape, specific features...
JAW: height, inclination, shape...
EAR: size, shape, separation, relief (helix, antihelix, tragus, antitragus, lobe)
WRINKLES AND EXPRESSION.
GENERAL SHAPE OF THE FACE: We must extreme care when describing the shape. Round, elongated, square.

The difference of positions makes the study impossible, since it is based on the coincidence of indexes and craniometric points. Under these conditions, one can only subjectively analyze the contour of the face. The most relevant factors are lighting, the use of accessories, aging and the use of copies [9]. The procedure for facial identification, despite its inherent limitations, is being used routinely by private security services, such as banks and public transport. They use computer programs that provide a candidate for a given sample from among a base of people using facial biometry-based algorithms [10].

**Superimposition of cranium-photograph images**

The technique is based on three craniometric characteristics that have been mentioned above when describing the facial features: individuality of the cranium, proportion of the cranium and facial measurements and projective symmetry of facial images. The superimposition of images is directly linked to forensic dentistry; since general cephalometry and knowledge of specific dental elements help us better understand the results of the photographic comparison [11].

Marín [12] described the usual procedures to superimpose images and those obtained from unidentified craniums: static methods, dynamic methods and digitalized methods. Static methods basically consist of obtaining a negative of the antemortem image and compare this picture of the cranium, superimposing the craniometric points. The difference between the known static methods lies in the reference points established for the cranium. Dynamic methods use video cameras that shorten the time used to angulate. Since the cranium is moving

on its support until the researcher matches the image and the antemortem picture. Digitalized methods scan the antemortem image and the cranium, directly or by means of pictures obtained from the remains.

**Superimposition of dental images**

The resistance to destruction of dental elements allows these to remain without visible variations after the person has passed. A simple superimposition of dental morphology images allows finding sufficient reference points to completely determine the identity of the corpse. Superimposition of dental images can be an individualizing procedure, depending on the morphological characteristics of the teeth of the anterior section. If images of dental elements are available, we can obtain results with the same level of individuality as those achieved through other procedures which have been traditionally accepted as individualizing. Similarly, we must reason the discordances that could result from alterations occurred after the antemortem picture was taken: Coincidence of the mesiodistal distance, rotations, cavities, fillings, individual abscesses, lack of canines, partial or total extractions, supernumerary, inclusions, occlusions, coloring, or any other pathology [13].

**Identification of live people**

Image superimposition can also be applied in research with live people, by comparing faces on pictures at different life stages of the same person, solving the problems that could come from the facial study, which we have mentioned above. After recording photographic images with video-cameras, one can determine the biotype of each individual and compare it with pictures that are classified in files by their facial features. Cephalometric facial coincidences are completed by the superimposition of images and the identification of suspects. This procedure is also useful in the comparison of faces of amnesic older people or unidentified corpses, even if these have not become skeletonized [14].

The goals of this study are: To learn the reliability of facial analysis, study facial identification cases and get to know the individualizing elements determining positive results, to establish the results of the Spanish forensic cases, to analyze the identification value of cranium-photograph image superimposition, to analyze the known possible positive cases and to assess the importance of dental elements in facial identification.

**Material and Methods**

**Samples**

To develop our work, we have analyzed 71 expert reports on facial features, from court cases, comparing pictures of people obtained at different moments of their lives, which have been developed at the Forensic Anthropology Laboratories in Spain. We also analyzed 18 cases of cranium-photograph superimposition that also belong to court cases identifying skeletonized corpses.

The doubtful samples in facial feature studies are those belonging to images for criminal investigations that were obtained from security footage. As undoubted samples, civilian archive images were used (National Identification Document), or police files (frontal, and sideways or profile pictures).

In the studies of cranium-photograph superimposition, the doubtful samples were images of unidentified skeletonized craniums. The undoubted samples were obtained from old photographs, recovered from civilian, police or family files. To develop the superimposition of images, both of facial cases as in cranium-photograph superimposition cases, the program Adobe Photoshop was used. Both doubtful and undoubted images were adjusted to have the same resolution on the computer program to match the lineal dimensions.

## Methodology for facial identification

### General study of the face

Coincidences or discordances in facial features: Biotype determination. Contour and general shape of the face. Shape and morphology of the hair. Measurements and facial indexes.

### Individualizing analysis of the elements

- a) Total analogy in all of the fragments that create the face.
- b) Analysis of possible individualizing asymmetries.
- c) Scars, lenticular shapes and similar features.
- d) Study of dental elements.
- e) Peribuccal area.

### Craniometric superimposition

- i. Scaling of the image so the different photographs have the same size.
- ii. Superimposition of known craniometric points.
- iii. Superimposition of particularities, especially teeth.

### Study of discordances

- a. Possible justification for them.
- b. Determination of different identities.
- c. The result frequently is determined by findings that wouldn't be positive individually, but they are together.
- d. Their determination can be further complicated by negative circumstances in the compared images, such as different poses or ages.

### The importance of dental elements

As we stated above, complete identification is achieved when it is possible to demonstrate the coincidence of the compared elements. Teeth at the individualizing element par excellence. Their location within the face, as seen through the lips is

important. Seeing them allows for a completely positive image superimposition, which allows researchers to reach the best conclusions.

### Negative aspects and limitations

Facial research usually presents difficulties because of [15]:

- a. The difference of the position of the archived image.
- b. Poor quality of the photograph due to:
  - i. Lack of lighting
  - ii. Back lighting.
- c. The use of wigs or other accessories.

### Positive identification

Positive identification is solely established if the analyzed craniometric elements are undoubted. Personal identification is an all or nothing judgment, it cannot be qualified by degrees of probability. Frequently, the researcher has difficulties establishing the identity or discarding it. Forensic anthropologies, (Iscan, 1988), established three identification categories:

- i. Positive identification
- ii. Plausible identification
- iii. Undetermined identification

The positive resolution of the IDENTITY RULING is not exclusively based on the facial and anthropometric coincidences, but also on the certainty that there are no discrepancies except those that are attributable to the differences in angles (pose), lighting, picture tweaking, color, etc.

Our conclusions can have three degrees:

**a) Selective exclusion:** if they are black, they cannot be white, if the person is old or young, male or female...

**b) Classification grouping:** by approximation or general similarities. Similar features due to the size, complexion, age, contours, attitude, demeanor, expression...

**c) Identification selection:** A unique feature or several infrequent ones.

### Special considerations.

In the comparison of photographs, we have considered certain circumstances that affect the apparent variations:

- A. Appearance of gray hairs in the hair insertion or hair loss.
- B. Weight loss that enhances the bizygomatic width, the border of the lower jaw and the nasal dorsum.
- C. Loss of canines that results in the drop of the commissure. Lack of natural teeth that depresses the lips, slims and gathers the edge of the mouth.

D. The age, which contributes to the appearance of wrinkles beside the tag of the ear and the lobe, which drops.

E. The loss of the eye globe, that makes the lower eyelid droop even if it has been replaced by prosthesis. The frontal lobe has a small depression.

F. The front variation between the frontal poses in which there are variations in the details.

G. Mono-flash lighting makes the features appear flatter, which results in the loss of certain details.

**Assessment of the results**

We have considered the following possibilities when evaluating the results:

For studies of facial features:

**a) Absolute match:** Described as SUPERIMPOSITION

**b) Plausible match:** upon finding individualizing elements such as beauty marks, spots, moles, that approximate the identification, but it isn't absolute.

c) Coincidence of anthropometric features, without being able to superimpose the face or find individualizing features: The last two are included in the group described as Facial features.

**d) Doubtful identification:** Presents general analogies, but no absolute coincidental element can be determined. DOUBTFUL.

**e) Negative identification:** Due to the lack of matching data, negative identification can be determined.

In this case we include all of the negative cases, due to the absolute discordance of the samples, lack of quality or present totally opposing positions. Regardless of these forms which have been described in the results, the positive results have been analyzed in the cases of superimposition of dental elements.

**Framework of the results of facial cases**

**Table 3:** Cases identified by the photograph-photograph method.

Case	Positive	Plausible	Doubtful	Negative	Criteria
1	X				Superimposition
2	X				Superimposition
3		X			Matching Features
4	X				Matching Points
5				X	Lack of Quality
6	X				Superimposition
7			X		Same Biotype
8		X			Facial Features
9		X			Facial Features
10			X		Same Biotype
11				X	Lack of Quality
12				X	Lack of Quality
13			X		Same Biotype
14				X	Different Pose
15				X	Lack of Quality
16			X		Facial Features
17				X	Lack of Quality
18				X	Lack of Quality
19				X	Lack of Quality
20				X	Different Pose
21	X				Matching Points
22	X				Lack of Quality
23			X		Same Biotype
24				X	Lack of Quality
25			X		Same Biotype
26			X		Matching Features
27				X	Lack of Quality

28				X	Lack of Quality
29				X	Lack of Quality
30	X				Matching Points
31	X				Matching Points
32			X		Same Biotype
33				X	Lack of Quality
34				X	Lack of Quality
35	X				superimposition
36				X	Lack of Quality
37				X	Lack of Quality
38	X				superimposition
39			X		same biotype
40				X	Lack of Quality
41			X		Same Biotype
42	X				Matching Points
43				X	Lack of Quality
44			X		Same Biotype
45			X		Lack of Quality
46	X				Matching Points
47	X				Superimposition
48			X		Same Biotype
49			X		Matching Profile
50		X			Matching Points
51		X			Matching Points
52	X				Superimposition
53			X		Same Biotype
54				X	Lack of Quality
55				X	Lack of Quality
56	X				superimposition
57	X				superimposition
58			X		Same Biotype
59	X				Superimposition
60			X		Same Biotype
61			X		Same Biotype
62		X			Facial Features
63			X		Same Biotype
64			X		Same Biotype
65			X		Same Biotype
66				X	Lack of Quality
67	X				Matching Points
68	X				Superimposition
69				X	Lack of Quality
70			X		Facial Features
71	X				Points-Teeth
72		X			Matching Points
TOTAL	20	7	22	23	

Table 3 shows samples that have been analyzed by means of the photograph-photograph method. These have been numbered 1 to 72. The real images have been attached as auxiliary material.

Four classifications have been made regarding the final result:

i. **The cases considered as POSITIVE:** refer to those cases that were individually and objectively identified, since they showed a total match of craniometric points, personal marks or the presence of dental images.

ii. **In regards to the PLAUSIBLE cases:** these correspond to the cases that were classified by experts as a plausible identity match, since there are no discordances, and there are sufficient individualizing points, such as beauty marks, the shape of facial grooves, characteristics of the facial features such as the nose, the eyes, the eyebrows, etc. but the totality of the craniometric points are not matching.

iii. Regarding the cases considered as DOUBIOUS: these correspond to those that present a match in the biotype, but the anthropometric elements haven't been matched, due to differences in positions or other types.

iv. The cases considered as NEGATIVE: were due to the poor quality of the images or they were different people.

#### Studies of cranium-photograph superimposition

As in the previous group we have divided it into three: Positive,

plausible or negative. In this case we considered as positive those points obtained by the superimposition of craniometric elements, totally individualizing, such as asymmetric bone fragments or seeing the teeth. We have defined as plausible those cases that have been identified by superimposing the craniometric elements with their cephalometric equivalents, located in the face. Individualizing elements have not been described since these cannot be seen directly, due to the existence of soft tissue.

The negative case was related to the research related with a cranium that supposedly belonged to Antonio Anglés, however, superimposition showed complete discordance and determined it belonged to a different person. On our research, after the DNA tests that proved the negative identification.

#### Analysis of Superimposition Results

We have included in the following table the facial features of the results, marking the determining elements for positive, plausible or doubtful and negative results are included under the observations section. The analyzed samples have been detailed, numbered from 1 to 20 (Table 4). Real images have been attached in the annex section. Four classifications have been made regarding the final result: The first refers to those cases that were individually and objectively identified, since they showed a total match of craniometric points or individualizing marks. The second corresponds to the cases that the experts classified as plausible, due to the coincidence of visible dental elements in both dental images.

**Table 4:** Cases identified by the cranial-photographic method.

Case	Positive	Dubious	Plausible	Negative	Criteria
1			X		Craniometric Points
2			X		Craniometric Points
3			X		Craniometric Points
4			X		Craniometric Points
5			X		Craniometric Points
6			X		Craniometric Points
7	X				Craniometric Points
8	X				Craniometric Points
9	X				Craniometric Points
10	X				Dental Superimposition
11	X				Dental Superimp
12			X		Craniometric Points
13			X		Craniometric Points
14	X				Dental Superimp
15	X				Dental Superimp
16	X				Dental Superimp
17				X	Non Matching

18			X		Craniometric Points
19			X		Craniometric Points
20				X	Non Matching
TOTAL	8	0	10	2	

The third table corresponds to those cases that were identified by the superimposition of cranium-photograph, but without seeing specific individualizing elements. The fourth group refers to those that provided a negative result, since they were different people. We must highlight the importance that dental elements have for facial identification. In the results obtained, out of the eight positive cases, five were identified through visible teeth in the antemortem photograph that is comparable to those observed in the cranium.

### Descriptive and analytical results of the sample

We have a sample with 92 cases, of which 72 (78.3%) correspond to facial identification method and 20 cases (21.7 %) to the identification through photograph-cranium superimposition.

According to the result of the identification, of the 92 cases that form the sample, we observed that:

- a) 30.4 % were identified as positive (28 cases)
- b) 27.2 % were identified as negative (25 cases)
- c) 18,5 % were identified as plausible (17 cases)
- d) 23.9 % were identified as doubtful (22 cases)

Another variable used was the criteria by which we have developed the individual identification and we can observe that (Table 5):

Table 5: Personal identification criteria.

Criterion	Frequency	Percentage
Superimposition	11	12.0%
Craniometric Points	13	14.1%
Matching Points	10	10.9%
Biotype	17	18.5%
Dental superimposition	6	6.5%
Facial Features	8	8.7%
Lack of quality	23	25.0%
Different pose	2	2.2%
Non matching	2	2.2%

i. Of the 23 cases in which there is a lack of quality of the pictures, 21 were identified as negative, 1 case was doubtful and 1 case was positive. Therefore, we can assure that the quality of the photographs is an important factor in using them as individual identification methods.

ii. As for the cases identified through the biotype, all of them were doubtful.

iii. All the cases identified through the superimposition of teeth have been positive cases, that is, 100%. Therefore, we can use an individualized method for their identification through dental superimposition.

Table 6: Comparison of identification methods.

	Negative	Negative %	Positive	Positive %	Plausible	Plausible %	Doubtful	Doubtful %
Photograph-photograph	*23	25%	*20	21.70%	*7	7.60%	*22	24%
Photograph-cranium	*2	2.20%	*8	8.70%	*10	10.90%	0	0%

\*X<sup>2</sup>=23.394/ p<0.05

iv. Now we will compare the identifications between studies of facial features and photograph-cranial superimposition (Table 6), to see the differences in terms of the results obtained as positive, negative, plausible and doubtful we observed (all the results below were statistically significant):

v. That 71.4% of the total cases that were identified as positive have been match using the photograph-photograph method, which corresponds to 20 cases of the total samples, that is 27.8% and through the photograph-cranium superimposition, the 40% correspond to 8 cases.

vi. 40% of the cases identified as positive through the photograph-cranium method, compared against 27.8% of the cases that were identified as positive through the photograph-photograph method.

vii. 100% of the total cases identified as doubtful, which are 22, these correspond to cases identified through the photograph-photograph identification method. Therefore we can affirm that by using the photograph-photograph method, all the cases can be identified as positive, negative or plausible, but these will never be doubtful.

viii. Of the 25 total cases identified as negative, 92% correspond to cases identified through facial features studies. That is, 23 cases, contrasting against 2 cases which were identified as negative through the photograph-cranium identification method.

ix. 31.9% of the negative cases are identified through studies of facial features compared to 10% that were identified by photograph-cranium superimposition.

### Discussion

Facial identification by means of comparative analysis of the faces is a controversial procedure for many authors, due to the subjective component that these seem to present and the difficulties related to reach positive conclusions. However, this method is frequently used now to find authors of any type of violent crimes. Work group: *Facial Identification Scientific Working Group* (FISWG), maintains that the application of this procedure due to the high frequency of positive results that could be registered, despite their limitations. The FISWG has set out some very precise rules to develop the method, these regulations are very close to those used in our work method (FISWG, 2013).

In this work on facial identification techniques by means of the superimposition of two-dimensional images with photographic techniques, was analyzed and superimposed through layers of fragments of the cranium and an old antemortem photograph, comparing them. In the analyzed cases, the coincidence of position of craniometric points, which can be located through soft tissue between antemortem photographs and the cranium, has allowed for the application of the technique described by Alemán et al. [16] to develop comparative studies for the photographic comparison in 3 dimensions by means of the use of a Minolta VI-910 surface scanner. The authors concluded that this device can be used daily for the identification of disappeared people and the study of unidentified craniums, but the method should be supported on more reliable methods for criminal cases, highlighting their value as exculpatory proof, but not recommending their use exclusively for an inculpatory procedure.

This study registered 3 variables in the obtained results:

- a) Positive identification
- b) Plausible or doubtful identification
- c) Negative identification

Against the way of expressing the results shown by other authors, Revestido Riera (Revestido, 2014) showed the results with numerical data:

**I. Grade +3:** Higher degree of coincidence, since particularities and coincidental and specific features were found.

**II. Grade +2:** Coincidences were found that approximate the identity in a noticeable way.

**III. Grade +1:** There is a lower degree of certainty.

**IV. Grade 0:** No individualizing elements are found, but there are similar generic features.

**V. Grade -1:** Certain discrepancies appear which could point to different people.

**VI. Grade -2:** The images present certain discrepancies and point towards different identities, without being able to be more specific in determining it.

**VII. Grade -3:** The different identity is proven definitively.

The methodology used in this work has been supported in the analysis developed manually, therefore the coincidences that are done directly seeking the superimposition of craniometric points that frequently do not match topographically with their equivalents in the undoubted sample, due to a variation in the pose. Automated systems using mathematical algorithms that locate similar characteristic points, they can lead to error of matching unreal points, providing false negatives or positive cases that are not. Thus Hayward et al., in their research of the street riots that took place in London in 2011, used manual procedures with facial experts to recognize and identify the rioters [17].

The image superimposition technique, as we have described, is considered as a complementary and not individualizing procedure, which should be associated with more reliable methods. But when the researcher faces the analysis of corpse remains that have been reduced to a skeleton, in which all the soft tissue has been lost, it can be considered as a fundamental identification anthropological procedure, as Casas Sánchez et al. Mentions [18].

From the total of the analyzed sample (n=92) in this work, the image superimposition cases corresponded to a percentage of samples of 21.7%, registering statistical significance ( $p < 0.005$ ) when comparing the use of this technique with the facial study. The highest percentage of results (50%) was located in the cases of plausible identification (n=10), followed by positive cases (40%; n=8). From the literature we reviewed describing the best results of this technique have been obtained when the teeth were visible in the studied subjects. Despite that the procedure is considered as complementary, not individualizing, as stated by Burgué [19] and Ferllini [20], finding teeth in the undoubted picture makes it a highly positive procedure.

In our study on the superimposition of teeth we registered a frequency of 6.5% when analyzing the total of studied cases, resulting that 6 of the analyzed cases using this method obtained a global identification frequency of 100%, which encourages us to conclude that it is a highly reliable resource as an identification method by developing picture superimposition. One of the main difficulties of this method is the location of craniometric points and their coincidence with undoubted cephalometric points in the face, for Ibáñez et al. [21], signaling points must

be developed in the symmetry mean line (4 in the vertical line: nasion, subnasal point, prasion and gnathion) and the rest in the transversal planes (ectocanthion, the center of the orbits, zygion and porion).

The great problem is the precise location of the cephalometric points, since the variation of the photographic pose can make their determination difficult. Therefore, in the cases analyzed in this study we have considered the comparison of frontal photographs as valid. Thus, Valeri et al. [22] described the existence of diffuse points when referring to the difference in the positions of craniometric points. The authors advised selecting the most stable points possible, which do not suffer variations due to different facial expressions, the size or the age of the person. In this regard, we have chosen the following points, nasion, center of the orbits, pogonion or zygion, since these are the points that suffer less variation, as per the doctoral thesis by Merabishvili [23] the author described the superimposition procedures based on literature reviews. Registering this project, we found a frequency of 14.1% when using the variable of craniometric points when developing individual identification.

In regards to the coincidence of the position by means of the superimposition of the images, it appears that the best results are obtained when frontal and profile antemortem images of the subject under study have been analyzed by means of computer systems. In this regard, De Greef [24], recorded a failure rate of just 9.6%. Therefore, we conclude that the superimposition method is very useful to eliminate coincidences, and can be used as a form of identification for unknown craniums. Other authors, for example Serrula [25], on the other hand, highlight the high frequency of false positives due to image manipulation, which would be further proven by the studies shown in this project (10 plausible cases and 2 negative ones, against 8 positive cases) with 50% of plausible cases. But if the antemortem images are taken in a known lateral position, the success prevalence of the positive results increases. This, Brocklebank and Holmgren [26], in their broad review of antemortem cranium-photograph case review, conclude that whenever it is concordant the identification shall be positive.

The same conclusions appeared in the work by Dong-Sheng et al. [27], who recommended making photographs of the cranium and enlarging them until their natural size. Our study, based on expert forensic experience, is based on the comparison between undoubted antemortem samples, associated to postmortem doubtful images. Discarding the measurements of the thickness of soft tissues and focusing on the coincidence of the location of the craniometric points during the analysis of the evidence, and their extrapolation to soft tissue points found in antemortem pictures [16].

Thus, we determined that the positive cases (frequency of 27.8% of the records comparing photographs against photographs, and 40% of the records comparing undoubted

antemortem photographs and postmortem cranium photographs), were those in which the analyzed points could be determined, such as teeth, registering only the cases shown as positive despite considering the following variable as valid: presence of asymmetries registered as individualizing. Another one of the great difficulties in the study of facial features and the comparison of ante- and postmortem photographs is the significant age difference. Therefore, for Buegué the aging process produces inevitable changes that include the reduction of tissue flexibility, loss of fat in subcutaneous tissue and loss of collagen, among others, which result in the skin forming folds and wrinkles that modify the proportions of the face from 30 years of age onwards [19].

### Conclusion

Facial features, which are considered as complementary, are usually the initial way to start researching and are an individualizing procedure when infrequent features are observed. In the analyzed cases, when the position of the person in doubtful photographs is a complete match, and clear craniometric points were visible, the identification was indeed possible. In 20 cases analyzing facial features, concluding results were obtained. In other words, they were identified as positive, which represented 30.6% of the total analyzed cases. 1. 22 of the known cases of facial features were considered as doubtful due to the different positions, but they had identifying features. They accounted for 30.6% over the total. The total percentage for facial identification amounted to 58.6%, which we believe to be acceptable and justifying the usefulness of the method.

The superimposition of cranium-photograph images presents complications when the images have not been taken in the same frontal or lateral plane. The existence of old photographs in these positions allows for the achievement of completely individualizing results. The positive cases of cranium-photograph superimposition were 8, which represented 40% of cases. In 10 cases of cranium-photograph superimposition high approximation results were achieved, which were cataloged as plausible identification cases, despite the doubts in the location of craniometric points. The results were further confirmed by other methods. These accounted for 50% of the total. The results considered as negative that have been exposed; justify the usefulness of these procedures to discard false positives. In the cranium-photograph superimposition 6 individuals were identified thanks to their teeth, which represents 62% of the positive cases. Observation of dental elements, in any facial identification process allows for the achievement of a positive result [28,29].

It is necessary to research further in 3D research procedures, which improve image positioning, avoiding negative magnification.

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