

# Anthropometric Facial Evaluation for Medico-Legal Purposes

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## Abstract

The most easily recognizable way to identify someone is from their face and therefore the methods of identification that cater to the face are all very important to forensic application. Each method of identification has its purpose depending on which type of evidence is available. Whether the evidence available is from a video recording or eye witness, the application of facial Identification techniques are vital to the investigation of crime and crucial to the well-being of family, friends and the victims themselves. The morphological traits are more subjective and sex determination depends on the skill of the researcher as unskilled researcher or investigator may lead to the inaccurate findings due to lack in knowledge while taking the measurements. The purpose of the review on the medico-legal perspectives through facial features is to bring together different techniques and points of view to draw the attention towards need of the facial anthropometry due to variation in facial features resulted from disparity in human population. The paper also discusses the importance of the facial anthropometry not only in forensic application but also in medical field such as facial surgery.

**Keywords:** Facial Features, Identification, Anthropometric Facial Evaluation, Medico-Legal Significance

## 1. Introduction

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. Personal identification is a normal practice in our everyday lives. One can 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 (Lopez et al, 2017). The quantitative analysis of the human face has always received a large attention from both scientists and artists as the face allows to communicate and interact with the environment. On one hand, it is used to identify the persons while on the other hand; it can carry information about the health state of an individual (Sforza, 2013). Studying intra and inter population variations in different morphological characters have long been an interest of anthropologists. The evaluation and measurement of human body dimensions are achieved by physical anthropometry. The dimensions of the human body are affected by ecological, biological, geographical, racial, gender and age factors and on the basis of the above factors, anthropometrical studies have been conducted on the age, gender and racial groups in certain geographical zones. Cephalometry is used in forensic medicine, plastic surgery, oral surgery, paediatrics, dentistry, and diagnostic knowledge between the patient and normal populations (Jadav et al, 2011). The most easily recognizable way to identify someone is from their face and therefore the methods of identification that cater to the face are all very important to forensic application. Each method of identification has its purpose depending on which type of evidence is available. Whether the evidence available is from a video recording or eye witness, the application of facial Identification techniques are vital to the investigation of crime and crucial to the well-being of family, friends and the victims themselves. For many years, anthropologists studying forensic and archaeological remains have considered human body size including weight, stature and sex as separate parameters of human biodemography. These are integral parts of human biology and therefore to make identification or assessment of physical characteristics, the sex and stature have been evaluated together (2005).

Sexual dimorphism has been of great interest for many years and such data has been used to analyze size differences between males and females and the social implications thereof. The morphological traits are more subjective and sex determination depends on the skill of the researcher as unskilled researcher or investigator may lead to the inaccurate findings due to lack in knowledge while taking the measurements. The purpose of the review on the medico-legal perspectives through facial features is to bring together different techniques and points of view to draw the attention towards need of the facial anthropometry due to variation in facial features resulted from disparity in human population. The paper also discusses the importance of the facial anthropometry not only in forensic application but also in medical field such as facial surgery.

## 2. Methods used for Medico-legal Evaluation

Determination of sex and estimation of stature is one of the most important aspects of anthropo-forensic perspectives. There are several methods for determination of sex using different parameters. When sexual characteristics of the soft parts are not available, the diagnosis of sex can be based only on the characters displayed by the skeleton. The techniques used in sex determination have been primarily focused on the pelvis where reproductive difference is best seen and the cranium where the size and morphology are varied and best represented. Recently, long bones became the most actively studied part of the skeleton. To these, one would add the ribs, vertebrae, clavicle, and bones of the hand and foot. Next to pelvis, skull is the most easily sexed portion of the skeleton, but the determination of the sex from the skull is not reliable until well after puberty. The cranio-facial structures have the advantage of being composed largely of hard tissue which is relatively indestructible. In establishing the identity of sex from a defleshed skull, lateral cephalograms and PA radiographs assumes a predominant role, as they can provide architectural and morphological details of the skull, thereby revealing additional characteristics and multiple points for comparison. Discriminant function analysis of skeletal measurements is increasingly utilized for sex diagnosis. The recent introduction of computer-aided analysis of cephalometric data extends the utility of this method. The stature of an individual being genetically predetermined is an inherent characteristic, the estimate of which is considered to be an important assessment in the identification of unknown human remains. When the skeleton is incomplete or severely disintegrated, the probable stature may be estimated by applying mathematical formulae to the length of the long bones like humerus, femur etc. However, in the

present study approximate stature is estimated from skull. There are few studies for estimation of stature from the skull alone (Patil and Modi, 2005).

In general, people are thought to be reasonably good at recognizing faces via comparing them. Facial comparison is a wide - ranging forensic technique: it involves disciplines such as image analysis, anatomy, anthropology, photogrammetry, 3D technology, statistics, and cognitive psychology (human as a measuring instrument). The issues "quantification of image quality," "human as a measuring instrument," and "individualizing value of features" are the issues needs to be discussed in the context of man and machine's functioning as a measuring instrument (Ruifrok, 2009).

## 3. An overview on Facial Parameters for Medico-legal

The Bertillon system of anthropometric measurements was based on three fundamental ideas:-

1. The fixed condition of the bone system from the age or twenty until death.

2. The extreme diversity of dimensions present in the skeleton of one individual compared to those in another.

3. The ease and relative precision with which certain dimensions of the bone structure of a living person can be measured using simply constructed caliper.

Knowledge of ethnic and gender specific normative data, including the mean and standard deviation of key facial measurements, is extremely useful in surgical procedures such as osteotomies, craniofacial corrections and reconstructive surgery. These procedures can change the overlying soft tissues and subsequently the facial appearance. Thus, raw baseline craniofacial anthropometric data of ethnicity, age and gender can lead to better clinical assessment and diagnosis. The data can be used to better plan surgical symmetry, predict post-surgical results, and compare pre-surgical goals with post-surgical results. More effective and comfortable ergonomic products such as helmets, masks, eyeglasses and respirators can also be designed using the data. It can also be valuable in forensic reconstructions and identification of missing persons (Othman, 2016).

Many studies have been conducted to identify a person for medico-legal purposes. Use of facial parameters (features and measurements on living) has been found less as compared to cranium or other parts of the body. Studied face shapes in different parts of Iran and stated that the geographical factor, similar to ethnical factor, can affect the form of the face. Normally, various facial types are encountered in every population so that a certain number of people have thin, broad or small faces. The knowledge of the most striking facial characteristic of each ethnic group is a key to successful corrective

surgery or analysis of postoperative as well as characterization of individuals in the context of Human Biology (Jahanshahi et al, 2008; Graaff, 2001; Ferdousi et al, 2013).

Direct anthroposcopy (observation) and anthropometry (measurement) had therefore still continued to be the unique methods for in-vivo analyses of facial morphology in several basic and applied fields that cover a wide range of life and medical sciences (Farkas, 1994).

A further advantage of conventional anthropometry is the existence of normal databases for almost all craniofacial measurements, at least for Caucasoids (Allanson, 1997; Farkas, 1994; Zankl et al., 2003), while norms for other ethnicities are more scanty (Farkas, 1994; Farkas et al., 2005b). A study conducted on two different populations of North India suggested that cephalo-facial dimensions supplemented by facial morphological features can be employed in determining age, sex, stature and race in Indian population (Krishan & Kumar, 2007; Krishan, 2008).

A detailed study of the morphologic features, position, orientation and the metric analysis of the external ear is also essential for forensic experts, physical anthropologist and for surgeons. Though the differences in the ears between males and females have been largely acknowledged, none of the studies have explored the sex discrimination potential of these parameters (Murgod et al, 2013).

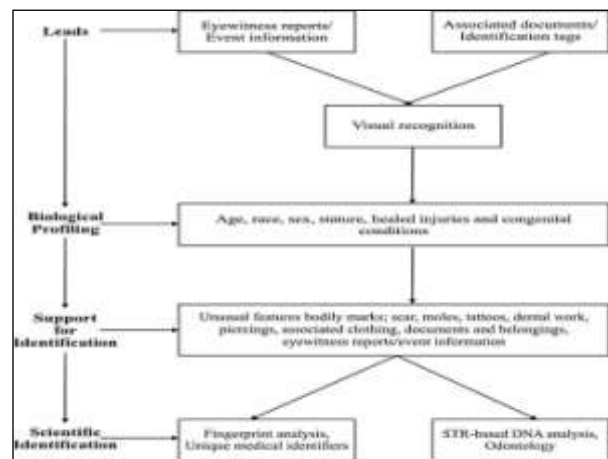
Forensic, commercial and security identification of persons is increasingly using virtual images, like photographic or video records, and digital images could supplement conventional anthropometry to determine the identity of pro-bands. A similar field of research is the generation of computerized facial models from anthropometric measurements. A set of conventional anthropometric distances and proportions is obtained, and they are used as constraints on a parameterized surface using mathematical techniques like the variational. These facial models are used both in medical practice (forensic medicine) and in computerized human simulations (television, cinema, virtual reality, computer games). The use of well-constructed databases could also be advantageous to the scope (Sforza & Ferrario, 2006).

**4. Significance of Anthropometric Facial Evaluation**

Today’s society is overwhelmed with the importance of being attractive through a variety of media. That fact brings facial standards together with the perception of beauty associated with a sense of social acceptance. In recent studies, many linear and

angular measures of soft tissue profile and variety of cephalometric analyses were developed to determine ideal proportions and it was shown in the results that confidence is closely related to physical appearance (Milutinovic, 2014). Using a comparison of facial anthropometric measurements may be especially helpful in cases involving comparisons of a suspect’s photograph and surveillance crime footage of the offender. The government in the United Kingdom uses video surveillance systems to prevent crime and to monitor high-risk areas. However, many video surveillance systems used produce images that can be of poor quality and not easily recognizable. Digital systems disadvantage is that when the images are exported: they are compressed and essential details may be lost (Kleinberg et al, 2007). The most easily recognizable way to identify someone is from their face and therefore the methods of identification that cater to the face are all very important to medico-legal purposes. Each method of identification has its purpose depending on which type of evidence is available. Whether the evidence available is from a video recording or eye witness, the application of facial identification techniques is vital to the investigation of crime and crucial to the well-being of family, friends and the victims themselves (Kleinberg, 2008).

Figure-1: Systematic schematic presentation in Identification Process



Source: Wilder, H.H. and Wentworth, B. (1918). Personal Identification: Methods for the Identification of Individuals, Living or Dead. RG Badger.

Figure-1 displays the schematic presentation in identification process. From the figure, it can be deduced that visual recognition can be facial features while identifying a person as face is the direct and quick way to recognize the person. So, while leading the path, an expert firstly collects the eyewitness report/event information along with the associated documents or identification tags to identify the person for medico-legal evaluation. If there is a need,

then the expert tries to determination the age, race, sex, stature, injuries, or congenital conditions and it can be achieved through facial features as well.

A person can be identified through various techniques such as fingerprints, skeleton, dental records, blood and DNA analysis, anthropometry and biometrics etc. Before taking into consideration any newer or older techniques to identify a person, the first mechanism comes into mind (either directly or through witness) is face of the person. The facial observation broadly includes- forehead, eyes, ear, nose, cheek, lips and chin. One can determine the identity of person through these features as these are unique characteristics of a person which makes him/her different from another. The figure 2 (a) shows the observational difference in male and female's facial features.

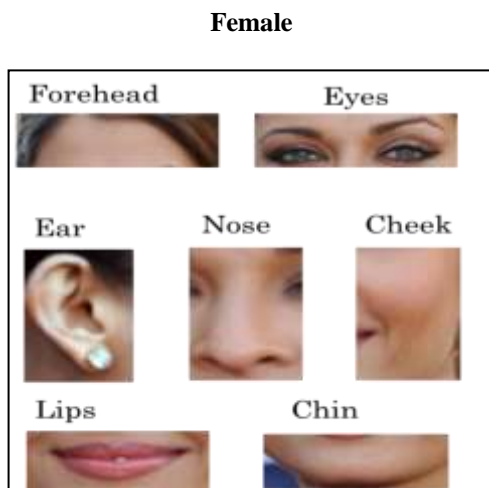
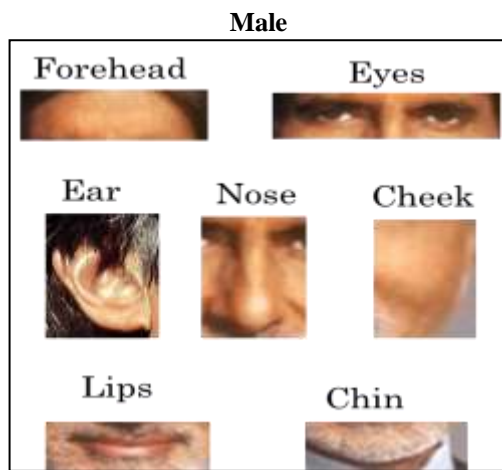


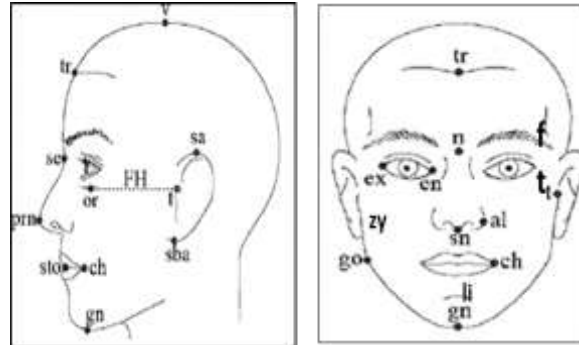
Figure-2(a): Identification through Facial Observation

Source: [www.googleimage.com](http://www.googleimage.com)

The identification through anthropometry has been used by anthropologists or other researchers to establish the identity of a person in living and dead also these measurements are useful in surgical or reconstruction procedures as shown in figure 2 (b).

In the era of technology, the facial photography has been used for identification rather than using the direct anthropometry on face. But this modern method also requires the landmarks on the face or to make a facial biometric system.

### Landmarks on Living



Source: [www.googleimage.com](http://www.googleimage.com)

### Landmarks on Cranium

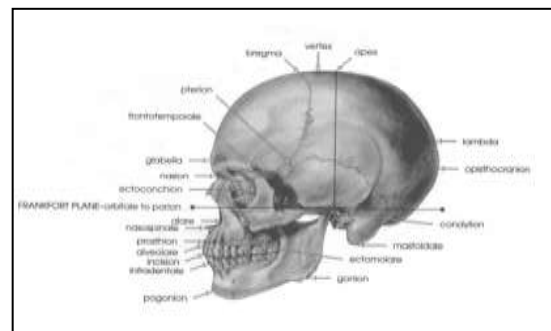


Figure-2(b): Identification through Facial Anthropometry

Source: [www.googleimage.com](http://www.googleimage.com)

The advantages of direct methods include access to measurements of areas covered by hair (e.g., circumference, width, length, and height of the head) or areas that would be distorted by indirect anthropometry (e.g., the depth of the face in photogrammetry); measurements that require special positions of the head (e.g., the base view when measuring the soft nose structures and the nasal root depth); and those that require a special technique such as pressing the tip of the instrument to the underlying bone surface when a measurement is made between bony landmarks for example; the modified width of the forehead between the fronto-temporale points located laterally from the temporal lines, the width of the face between the zygions, and the width of the mandible between the gonions (Farkas and Deutsch, 1996).

Figure-3 presents the importance of facial measurements for medicolegal purposes and biometrics. From the figure, it can be said that to

make a biometric system, there are prerequisites such as unique individualistic parameters, easily measurable and which stays stable over time. Any biometric system needs the database of the people against in a “one-to-many” search. There is a need of the facial measurements to determine the identity of a person as well as to create the data base for an accurate biometric/digital system. In the current scenario, reference databases on every ethnic group are needed in forensic investigations (Murgod et al, 2013).

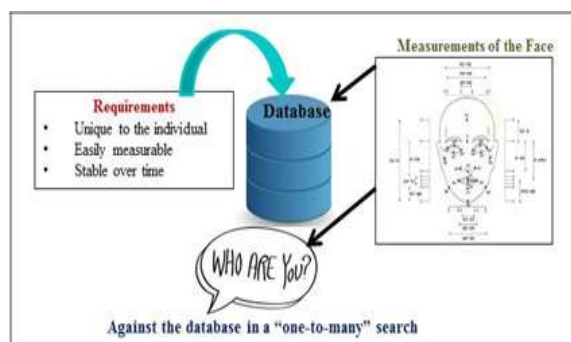


Figure-3: Importance of Facial Measurements for Medicolegal purposes and Biometrics

Source: [www.googleimage.com](http://www.googleimage.com)

The facial anatomy of different ethnic groups must be well understood to achieve maximum facial aesthetic results after plastic/orthognathic surgery. The knowledge of the most striking facial characteristic of each ethnic group is a key to successful corrective surgery or analysis of postoperative as well as characterization of individuals in the context of human Identification for medicolegal purposes.

To successfully treat congenital or post-traumatic facial disfigurements, surgeons require access to craniofacial databases based on accurate anthropometric measurements. Normative data of facial, measurements are indispensable to precisely determine the degree of deviation from normal. Due to international migration in the contemporary world, it is important for professionals from various medical and dental specialties to be aware of differences in facial characteristics among ethnic groups; especially those whose work involves correction of facial anomalies and enhancing aesthetics. Craniofacial anthropometric measurements require high quality measuring tools in order to get the highest possible measurement accuracy.

In the field of facial anthropometry, Farkas et al (2005) had compiled the single most comprehensive survey of ethnic groups from multiple regions around the world. Despite this comprehensive approach, the global range of variation for each facial measurement was not well documented. Beyond the linear

distances; the surface projection of certain facial features was also appreciated in the literature among different populations. The facial angles were the common parameters used in this regards. The angular measurement of the face has also been used to provide an insight into the variability that exists in the ideal facial profile. Both facial linear distances and angles have been utilized across different populations for personal identity and can serve as a way of revealing information with respect to biological profiles like ancestry, sex, the age of an individual. Due to vast ethnic variation in the facial profiles and ethnic-specific facial model (for Hausas) is needed in order to accommodate the application of this model in the field of human identification and characterization. For forensic purposes relatively few studies have considered facial assessment, although a promising result has been obtained especially in the field of age estimation of the living, defining sexual dimorphism and traits specific to ethnic groups (Adamu et al, 2016).

Most anthropometric studies have indicated that normal measurements for one group should not be considered normal for other ethnic groups. It is well established that human faces differ from one another based on ethnicities. Hence, it is important to acquire anthropometric data for different ethnicities. Few studies have been undertaken on this subject.

#### 4. Discussion

Forensic development cannot be achieved without a safe and secure society and structures within that society must ascertain that safety and justice are readily available to even the person at the farthest fringe of the society. While forensic anthropology illustrates the distinction among peoples to take into account the variety and divergence. Thereby, forensic anthropologists enable a society to walk towards a secure and just system where the justice is meted out on the basis of scientific evidences and accuracy. It further facilitates the detection and findings of possible crimes and empowers the security agencies. India has been populated human groups which carry a diversity of genes and cultural traits. Naikmasur et al (2010) stated that Indian population shows spectra of heterogeneous and homogenous sub-populations across various regions and there is scarcity of forensic data onto facial parameters on Indian population.

Specialists in charge of the facial region are noticing a growing demand for the treatment mainly based on aesthetic principles. Today's most common reason for seeking orthodontic treatment is enhancement of facial beauty through orthodontic and orthognathic procedures. Unlike the 1980, when 25% of patients required orthodontic treatment for aesthetic reasons,

today this percentage has risen to over 75%, which means that 3 out of 4 patients specifically request an improvement of facial appearance. Beauty is not an exact science but according to some plastic surgeons there is a specific proportion system that includes facial height, width, and symmetry. However, the definition of an attractive and beautiful face is subjective, with many included factors—social, cultural, ethnic, and age. The beauty of the person's face is determined by the harmony of proportions and symmetry and as a result, orthodontists and maxillofacial surgeons should have a great understanding for quantitative, objective facial features, which are widely considered as attractive and beautiful (Milutinovic, 2014).

In the era of technological advancement, biometric technologies are coming on front for identification dynamics. The facial biometrics is not used as much as finger biometrics. The Probable reasons behind it would be expensive or unavailability of facial data base. Ruifrok (2009) studied that facial biometrics in many steps such as comparison process are still mediocre, poorly or not supported by scientific data. Research on humans as a measuring instrument in facial comparison is limited; however, it is difficult to match images of unfamiliar faces: the process of facial comparison. Performance of current automated biometric systems is still too low to be of use for forensic purposes, although biometric systems may be useful for automated investigation of standardized image databases. The evidential value of surveillance material is severely limited by the quality of most surveillance material. In world where crime, murders, accidents rule the roost, the investigative measures and techniques should not only be precise but also competent enough.

## 5. Conclusion

In a country like India, where we have multitude of societies, social practices and therefore difference in appearance of the people, it is a mammoth task to devise a single or uniform approach to bring out the safety for the people or a secure society or to implement facial biometrics. We need to take every difference and every similarity in consideration before we initiate any programme or idea towards the identification process. Facial anthropology facilitates the required knowledge or to put it humbly, ground work before we put our schemes to execution, it broadly addresses the concerns such as variation in observation on facial features and differences in facial measurements within the people as well as population wise. So, it can be said that it is need of the hour to conduct the research on the facial parameters form anthropological point of view among Indian population to provide an accurate data and also to prepare the data base for identification on

facial parameters as facial biometrics also need the data base to identify a person with precision and accuracy.

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