



# Forensic Facial Reconstruction to Identify Skulls-A Review



**Sankeerti Mala Bonda\***

*Department of Oral Pathology, Pt. Deendayal Upadhyay Memorial Health Sciences and Ayush University of Chhattisgarh, India*

**\*Corresponding author:** Sankeerti Mala Bonda, Department of Oral Pathology, Pt. Deendayal Upadhyay Memorial Health Sciences and Ayush University of Chhattisgarh, India

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## Abstract

Facial Reconstruction- making faces is an old story which has undergone many changes in the techniques mentioned in the literature. Identification of skulls when all other evidence is destroyed or limited requires the usage of facial reconstruction for the forensic team. This review article is a summary of the different facial reconstruction methods and their role in forensic science to identify the individual.

**Keywords:** Facial reconstruction; Forensic science

## Introduction

Facial reconstruction-making faces are an old story. In ancient Egypt, great efforts were made by scientists to preserve as many details of their ancestors as they could. Late in the 19<sup>th</sup> century, anatomists, anthropologists and forensic odontologists began to study the correlation between the surface soft tissues of the face and the underlying bony structure of the skull. In modern times, facial reconstruction has been developed in order to help archaeologists in their attempts to demonstrate the appearance of early man. Also, recently in forensic science in order to produce an image from a skull, which offers a sufficient likeness of the living individual [1].

Skulls can survive for centuries, even millions of years and can provide an unrivalled means of identification [2]. If a skull is accidentally recovered from a garden, forest etc, a positive identification will be needed. In cases where traditional methods of identification like dental records examination, radiography, DNA analysis etc, cannot be used or have been ineffective, forensic facial reconstruction can be used as an important tool which may help in facial recognition of the skull and lead to identification of an individual [3].

Faces are fascinating. The bones of the skull are a key determinant of facial appearance. They form the basic framework to which other tissues are attached and how a person looks depends on all these factors together-skin, muscle, fat and bone. In human beings, the basic look is similar but we are very sensitive to the small differences that can be used for identification purposes [2].

### Techniques of facial reconstruction [1,4]

- a. Plaster skull reconstruction (combination Manchester method/ British method)

- b. Skull / photo video superimposition
- c. Computerized 3D facial reconstruction
- d. Anthropometrical American method/ Tissue depth method
- e. Anatomical Russian Method.

Each approach utilizes either a manual or computer generated method. Computer generated models are particularly important to focus on in light of technological advances that have been made in recent years and the increasingly heavy reliance on these methods.

Regardless of the method used, approaches can be broken down into three basic schools of thoughts: anatomical, anthropometrical and combination. The anatomical view is heavily influenced by the prevalence of musculature in defining the shape of the reconstructed face, while anthropometrical view focuses on the average tissue depth of the face as the key factor. The combination view is a way of merging the anatomical and anthropometrical, with average tissue depth serving to confirm details obtained by looking at the muscle and bone structure. The method chosen determines the measurements and formulas that one uses and the level of objective and subjective influences [5].

### Plaster scalp reconstruction technique

This is a traditional technique which requires the eyes and hands of an artist and the specialized knowledge of an anatomist. The method involves the preparation of a cast of skull (both cranium and mandible together fit with false eyes). On the cast, 3 mm diameter pegs are fitted to the distance according to the thickness

of the soft tissues regarding the age, sex, ethnic group and mainly the appropriate set of measurements.

- a. Medial and Lateral canthi of the eyes is marked with a copper pin.
- b. 1 or 2 pegs from the nasal aperture.

The progression of muscle building in temporal muscle, masseter, buccinators, orbicular oris. Position and strength of muscle insertions should be noted. The width of the mouth is determined by the outer borders of the canine teeth. When teeth are missing, the distance between the inner borders of the iris is considered next the expression muscles are added-levator anguli oris, levator labii superioris, zygomaticus major and minor, depressor labii inferioris and depressor anguli oris. Space between them should be supported to prevent them from collapsing.

The width of the nasal aperture in the skull is equal to the three fifth of the overall nose's width. Then the whole cast is to be covered by a layer of clay to simulate the outer layers of subcutaneous tissues and skin. The modelling of the superficial features makes a face look alive. The average success rate is between 50% and 60% [1,6-8].

### Skull/photo video super imposition

This method was first described by Kenna [9]. This method is useful when ante-mortem photographs of 1 or more possible descendants are available. The skull to be identified is mounted on an adjustable support. A high resolution video camera is aligned at right angles with the ante-mortem photograph. A second video camera is aligned with the skull. The center of the lens must be at the same level as the horizontal center of the photograph. The 2 images from each camera are processed in a vision mixer; for horizontal, vertical wiping and super imposition and negative stimulation.

If teeth are present, the enlargement can be carried out until the teeth in the ante mortem photograph exactly overlaps the teeth in the super imposed video picture. If teeth are not present, estimation should be made by adjusting the vertical height of the photograph of that of the skull [1,9,10].

### Compterized 3D facial reconstruction

This method employs computer programs to transform laser-scanned 3D skull images into faces. Although the results are more reproducible than sculpted reconstructions, some subjectivity could remain in the pegging of a composite facial image onto the digitized skull matrix [1].

A database of head models (both skulls, faces and soft tissue depth with their personal characters (age, sex, race and nutrition status) is required. The remains of the deceased are examined by the forensic team and the information provided is utilized in order to chose the appropriate skull and soft tissue templates [11-13].

The skull is positioned in a padded head holder. The longitude changes as the skull rotates on the platform and the radius is measured for each latitude. A wire frame of 256 x 256 radii is musconstructed which must be transformed using tissue

depth measurements to generate the foundation of the facial reconstruction. The facial features not predicted by the skull contours ( nose, eyes, mouth) must be added with separate means to generate a wire frame face onto which colour and texture are rendered [11,14].

### Anthropometrical american method/ tissue depth method

This technique first developed by Krogman in 1946, uses soft tissue depth data which are obtained by the use of needles, x-rays or ultra sound. Facial muscles are recorded in a proper anatomical manner. This technique is not preferred now-a-days as it requires highly trained personnel [4].

### Anatomical Russian method

This method developed by Gerasimov in 1971, does not uses soft tissue depth data but facial muscles were used in anatomical position.

### Discussion

Several forensic scientists have criticized facial reconstruction for the accuracy of the method and its failing to create exact replicas of an individual. However forensic facial reconstructions will only produce images that are a gross approximation which may be an alternative method in the identification process where no other evidence is available.

However the choice of method of facial reconstruction depends upon the information provided by the team of a forensic pathologist, forensic anthropologist, forensic odontologist and the investigation team.

The technique of plaster face reconstruction requires the information of age, race, sex, nutrition status, to assess the soft tissue thickness data. Furthermore the details of nose, eye, ear, lips and chin cannot be constructed exactly from the skull and are largely guess work [13].

However in case of ante mortem photographs to be matched with the skull remains, the skull/ photo video super imposition technique can be of great advantage as the operator's ability to fade either the skull or ante mortem photograph in and out of the video screen and can assess how well they match [9,10,15].

But the possibility that other skulls could fit all the facial features of a photograph could occur and therefore this technique is best used in exclsion rather than identification and to supply corroborative evidence [1]. In Australian courts of law, video super impositions has been accepted as a means of identifying skeletal remains when other methods of identification are not reliable [1,10,15].

Computer assisted facial reconstruction has many benefits compared to classic methods. It eases the procedure, the amount of time spent on proposing a facial model is greatly reduced. Several possible models can be moved under several angles increasing the probability of identification of individual [14].

Characteristics of facial features, namely the eyes, nose, mouth, and ears. Efforts have been made to produce standards that can be used for feature prediction. Research has shown that there exists a “significant correlation between eyeball protrusion and orbital depth” for instance [5].

The nose has proved more difficult to reliably assess, with the best method proving to be the two-tangent method first proposed in 1955 [5]. The width and thickness of the mouth have been demonstrated to be positively correlate to the distance between the irises or an inter canine width and teeth height respectively [5]. Despite the many ways to predict the specific characteristics of facial features, a great deal of the accuracy is still attributed to the discretion of a skilled analyst.

### Conclusion

Facial reconstruction is a delicate mixture of art and science and with the evolution of innovative methods of facial reconstruction has evolved tremendously. Even though the accuracy of these techniques are questionable, these techniques prove to be a major tool for the forensic team in the identification of the individual when no other source of evidence is available.

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