FORENSIC FACIAL RECONSTRUCTION: A REVIEW

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Abstract- Facial reconstruction is the method used to aid in building an ante mortem face out of craniofacial remains. A German anatomist Wilheim His in 1895 performed the first facial reconstruction. Facial reconstruction helps archaeologists in their attempts to demonstrate the appearance of the early man and in forensics to identify a person whose body is decomposed, skeletonized or the face is too distorted to be identified. The five basic principles to modify the methods of reconstruction of soft tissues of the face were given by Wilton Maria Krogmann i.e. the relation of eyeball to orbit, the shape of nose tip, the ear location, the mouth width and the ear length. Forensic facial reconstruction is an emerging field and is continuously developing starting from 2D sketching and now to the highly sophisticated, sensitive and fast running computerized software which are capable of giving the precise result of reconstruction and comparison even in 3D form. The purpose of this review is to deliver a better and precise understanding of the forensic facial reconstruction.

Keywords: Craniofacial, Anatomist, archaeologists, 2D, 3D.

Introduction

The face is the first part of the body that we notice and we have the ability to perceive the smallest variation between faces. The face plays an important role in personal recognition and identification. Even the twins who share the same genetic profile have highly similar faces still there are slight differences between them. From birth to death our face undergoes many changes but the individual characteristics remain throughout. Forensic facial reconstruction means the reproduction of a person's face from his facial skeletal remains [1]. This technique is used when other techniques of identification fail. There are various techniques for facial reconstruction such as 2D drawing, 3D clay modeling etc. 3D computerized facial reconstruction is an advanced technology used now a day [2]. Now a day facial reconstruction helps the archaeologists to determine the appearance of early man [3]. Facial reproduction of a person depends upon the average thickness of soft tissue over the different anatomical sites of the skull. There are noticeable differences in the soft tissue thickness of male and female of different races [4]. Forensic soft tissue thicknesses are important guidelines to give a model of face from the skull. [5]. The aim of the forensic facial reconstruction is to get an approximately similar outlook of a deceased person whose body is highly decomposed, skeletonized or mutilated. Artistic skills and

Scientific methods are the two basic ingredients for the facial reconstruction [6].

A Russian paleontologist, Professor Mikhail Gerasimov is known as the father of the facial reconstruction as he coined the "Russian Method" in 1924, in which he told the fundamental importance of the development of skull and neck. He also made a system to measure the thickness of soft tissue of head [7-9]. Forensic facial reconstruction is also known as forensic craniofacial reconstruction (CFR) [10].

Methods and Methodology

Two-dimensional reconstruction- Karen Taylor in Austin, Texas in 1980s developed this technique. It is used to recreate a face from the skull with the help of estimation of the thickness of soft tissue in the ante mortem status. It takes an artist and a forensic anthropologist to construct the face using this method. The estimation of the thickness of the soft tissue is based upon the ante mortem photographs and features of skull found. First the artist marks the landmarks and draws them then joints the landmarks to give the outline of the face and later with the help of soft tissue thickness (suggested by forensic anthropologist), the artist gives the facial features to the drawing. These days computer software such as **CARES** (Computer Assisted Recovery Enhancement System) and FACES (Forensic Anthropology Computer Enhancement System) etc are used to draw the sketches which are easy to operate and are editable.

Figure (a) showing 2D facial reconstruction

https://billinghamforensicimages.weebly.com/2d-facial-reconstruction.html

Photo/ video superimposition- Sir McKenna was the one who first described this method. This technique uses an ante mortem photograph or a video of the person to compare the radiological and odontological features. Basically, the superimposition is done for the comparison purpose. It gives better results when the anterior teeth are visible in the ante mortem image/video [10].

Three-dimensional reconstruction- Three-dimensional facial technique gives the result that can be viewed in all ways which gives the assurance of the accurate result. The classic three-dimensional technique uses clay to make the module of the skull but with the advancement of time computer software (digital remodeling) is used to make the work easier and faster [11].
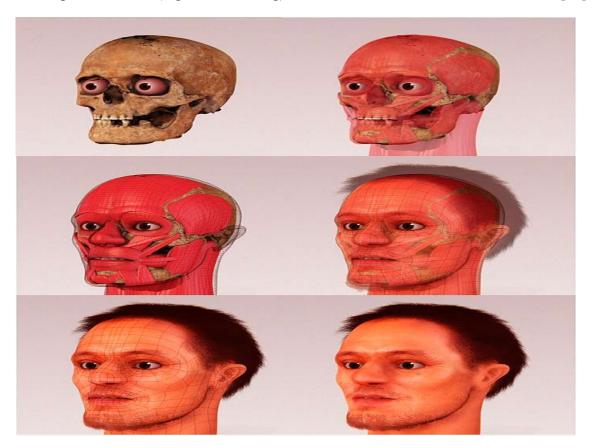

Figure (b) showing a 3D facial reconstruction

https://en.wikipedia.org/wiki/Forensic_facial_reconstruction#/media/File:Forensic_facial_reconstruction_of_Alberto_di_Trento.jpg

Various 3D reconstruction methods are-

 1) Anthropometrical American Method/ Tissue Depth Method- Krogman developed this method in 1946. In this method, soft tissue depth data is considered and clay copy is made for comparison purpose [12]. Tissue depth method is not so desirable as it requires highly trained

examiner [13].

2) Anatomical Russian Method- Gerasimov developed this method in 1971. This method employs the shaping of muscles, glands, and cartilage onto the skull layer by layer. It uses facial muscles in anatomical position over the soft tissue depth data. Although this method is slower than the tissue depth method but it is capable of giving the results even on fossilized skulls. [14]

3) Combination Manchester Method/ British Method- Neave developed this method in 1977. In this method both the soft tissue thickness and the facial muscles are considered. This is widely accepted method as it gives very specific and detailed features for the reconstruction of the face [15].

4) Computerized 3D Forensic Facial Reconstruction- In this method 3D computerized models and computerized 3D animation software's (Free Form Modeling Plus, Wilmington MA and Sensable Technologies etc) are used. This method is the most efficient and cost effective and also gives the results very fast [16, 17]. The data of the live subject can be utilized by using Cone Beam Computed Tomography (CBCT), it is an advancement in three dimensional imaging technique and checks the accuracy of the 3D computerized facial reconstruction technique [18]. Computerized facial approximation (FA) generally needs a complete skull for estimating the general facial appearance of a person but 3D restoration followed by FA proves as an alternative method to manual method of facial reconstruction and is capable to reconstruct facial features even with incomplete facial skeletal remains [19]. Facial reconstruction, forensic arts, and virtual analysis were combined used on the embalmed body of Ferrante Gonzaga to analyze his body in non-invasive way and it also highlighted some unsolved issue related to the ambiguity of the Ferrante Gonzaga's portrait[20]. Facial soft tissue thickness (FSTT) is essential to give the accurate outputs of the facial reconstruction [21]. In the developed countries studies had been conducted to determine the FSTT database for the different group of population [22-30].

Limitations of facial reconstruction

Forensic facial reconstruction also has some limitations such as intensity of aging of an individual inflicted on the face, mixed races, nutritional status, detailed information of eye, nose, ear, lips, chin and cheek is hard to estimate from skeleton of skull. Difficulty in determining facial tissue thickness and low ability of the analyzer are the limitations of facial reconstruction [31].

Conclusion

Forensic facial reconstruction is an efficient, rapid and non-invasive technique. Facial reconstruction is not only used to identify a person from his facial skeletal remains but also helps archeologist in their research purpose. Earlier the traditional ways were used to reconstruct the face which was time consuming and chances of inaccuracy were higher but with the advancement of time this technique has evolved and now we have various techniques such as 2D

software and 3D modeling, different software is available which give the accurate results in no time. This software offer editing over and over without disturbing the integrity of the skeletal remains. Computerized techniques are comparatively easier than manual methods and decreases practitioner training.

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