THE TECHNIQUES OF FACIAL RECONSTRUCTION: A HISTORICAL PERSPECTIVE

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Abstract: **This paper focuses on the historical perspectives of the technique of facial Reconstruction employed by several investigators and researchers for detecting identities and other forensic purposes in the past. These techniques are the Death mask, the Wax modeling technique, the Portrait Parley or Speaking likeness technique, Artistic technique of Sculpture based on clay modeling, the Strip plastic facial reconstruction, the Two- dimensional technique of facial reconstruction, the skull/photo video superimposition, the Computerized 3D facial reconstruction, and the three-dimensional Manual facial reconstruction. Amongst them few are highly relevant even today.**

Keywords: **Forensic Anthropology, Anatomy, Artistry, Recognition, Investigating crime, Sculpture, Victim, Plaster Scalp Reconstruction. Skull/Photo Video Superimposition.**

Introduction: -

Facial reconstruction is the way of recreating the face, whose identity is not known. Facial reconstruction is very important part of forensic science as well as criminology, and also helpful in artistry and physical anthropology. The main aim of facial reconstruction is to recreate the known or unknown human face. Face recognition and reconstruction are very important aspect of forensic investigation and crime. Facial reconstruction is used to try to positively identify the victim. It has been done by three dimensional reconstructions or two dimensional reconstructions in the past by employing photography and sketching to try to create an approximate reconstruction of human face. Facial recognition and facial reconstruction cannot go along with. Both of these are work to the same goal, to try to identify the unknown human face and they do this by using points on the face to help guide them so that the image can hopefully be matched or so that the sculpture can make the reconstruction as accurate as possible.

Using a plaster cast model of the skull the anthropologist will attempt to recreate the face in clay taking it to account such thing as the size of ocular cavities (eye socket), shape and angle of the nose with the mouth depth and height of cheek bones and other measurement. Many victims have been identified years after their disappearances or murders by using this technique: In forensic anthropology facial reconstruction has a significant place- It is easy to identify whole body by face reconstruction which plays an important role in these cases.

Several unknown bodies are recovered as well as crimes have gone up so the disputes related with these matters can be solved easily by method of facial reconstruction.

The Facial Reconstruction; Historical observation: -

The criminal investigations were done in ancient time too in record by creating features for remains believed to be of value the study conducted on and remains of prehistoric hominids and humans are of such category. In the past, mummies and bones of the deceased person were regarded by some cultures.

The first evidence of facial reconstruction when the skull was used for remembrance of the deaths of Neolithic age, the skull plastering was used for the task and apparently followed by pre-pottery of Neolithic culture.
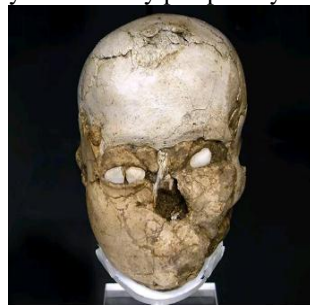

Source: Plastered human skull with shells eye from Jericho, pre-pottery Neolithic B, c. 7200 B.C.E The British Museum.(http://www.britishmuseum.org/)

Culture 'B' 7500-5500 in 1953 in Jericho found deposit in the house flooring in the pre pottery of Neolithic age, nine skull has built the face of plaster over the skull with the shells set into orbit (Eye socket) example of reconstruction the face modeled upon a skull was from the new Hebridian Island (AD1700).(Prag J, Neave R, 1999

But the Neolithic model is neither accurate nor systematic.

Death mask: -

The Death masks have been made in view of facial identification among many cultures of middle ages. It may have been one of the purposes of the Jericho skulls. The result was realistic and individual however, they were modeled upon the superficial features of the face and they had more in common with a sculpture created from outside in word rather than built outward from the bones (Verze Laura 2009) 'The first to taking plaster cast direct from face as bases for portrait sculpture in the late forth century' Pliny Lysistrato.
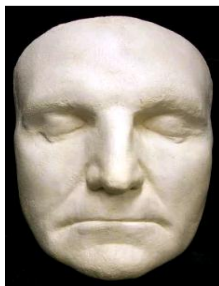
Death mask of Eighteenth century
Laurence Hutton Collection (C0070)
Source: https://Library.princeton.edu/libraries/firestone/rbsc/aids/C0070

Two men in the process of making
Life and deathmask,
New York, c.1908
Source: https://en.m.wikipedia.org/.../Deathmask

Death mask of Samuel F.B Morse

It was observed that the death marks were used identification of people in middle age of particular criminal or missing person has always been a problem. In the middle ages, dead bodies were lain out for identification in public streets. Later on only head was displayed under spirit to avoid decomposition.

Wax modeling: -

Death masks art was highly appreciated during the Italian renaissance of eighteenth century. Artistic fact from northern Italy were the first to provide wax models for doctors and surgeon. In the fifteenth century human dissection was practiced to study anatomy and in the same period as interest in how the human body moved and constructed began.

Andrea del Verrocchio and Michelangelo are known to have used wax model, either for documentation or for preliminary. Andrea Vesalius (1514-64) radically transformed anatomy teaching, and making wax models common place in medical schools, and life size waxes become substitute for cadavers.

A. Polychromatic rubber anatomical model the human head, ca. 1935 (Collection Librairie Alain Breux, 1995, with kind permission).
B. Wooden anatomical model by Felic Fontana (Detail, taken from Lemire,1990)

Sources: Journal International plastination Vol 15,1:(31,35),2000.

The Anatomica plastic: -

0ther artists were Giulio Gaetano Zumbo (1656-1700) and Abraham Chanet (1704-1790) in the seventeenth century in Italy was modeling of the anatomy or anatomica plastic was born. This art, which constructed the whole body using the skeleton as framework was developed by ErcoleLelli(1702-1766) whose work is on display in the anatomy museum in Boloqna.

The tissue data most suitable for the skull are selected using anthropological criteria and circumstantial evidence. Markers (rubber or wooden pegs) are then placed at the landmark sites corresponding to tissue depth value dictated by reference tables. The angle of the nose is extrapolated from the angle of the nasal bones and ands nasal spine and a simple support produced. The muscles, glands and known fatty areas are than overlaid onto the skull, taking care to interpret the muscle the insertion where possible. The aim is not to make an accurate anatomical model, but to utilize the positioning. Directions of pool deduce size of the muscles to aid the reconstruction process. These structures are covered with a layer of clay replicating the tissue overlying the muscles. In this stage that the tissue depth act as guidelines, since the clay should not project above the markers. It may be questionable that spending time carefully replicating the anatomical structures only for them to be covered by a layer of clay is a futile exercise.

It is seen in the anatomical structure the Anatomical plastic techniques not to accurate model only utilize the positioning of the muscles.

In nineteenth century the aims of facial reconstruction have been changed a little bit. It was thought that the face presents a set of intriguing characteristics that create a pattern of identifiable features. From this physiognomy, a person is able to recognize thousands of faces, often linking names, personality, background, etc. to them. In fact, a person is able to mentally encode hinge gallery of faces and store them for later retrieval, since no two faces are exactly alike, the facial feature (along with head shapes) lend themselves to a classification system.

Portrait Parle or Speaking likeness: -

In the 1880's Alphonse Bertillon's, sometimes called the father of scientific detection developed an identification system   referred   to   as "Portrait Parle" or "Speaking likeness" This system was a complication of facial features taken from photographs with descriptive detail provided. Originally, Bertillon was meant for the catalog to be an identification aid for the recognition of local prisoners but it later was found to be useful to retain it as an identification system.

Alphonse Bertillon'sID sheet, facial frontal view and facial profile view

Source: This photograph is taken by forensic art in Karen Taylor's publication Forensic art and illustration.www.forensicartist.com/history/

The Bertillon system is descriptions of unknown suspects. Bertillon's classification provided a basis for modern recall systems that would aid the artist in producing sketches as well as the development of composite kits, catalogs and computer system.

A research of FBI archives revealed an early use of the composite sketch. The sketch was done in 1920 for bombing incidents that took place at an office on Wall Street. The investigation developed a witness from a nearby blacksmith shop who had shod the horse of a stranger observed carrying a covered object in back of his wagon. An Interview with the blacksmith indicates he felt capable of providing enough facial detail to have an artist prepare a drawing of the stranger. A commercial artist was hired to make a sketch that provided a sufficient likeness to develop leads with subsequent identification and arrest of the perpetrator.

In this technique are useful for preparing & drawing (enough facial details) of the criminal description by victim. In this case sketching was very important. Here the somatoscopic observation rather than description of the skull.

Artistic technique of Sculpture based on clay modeling: -

Drawing is the principal foundation of sculpture, and a good sculptural works depends largely on good drawing, another important point on which artistry insist, is the through study of Artistic Anatomy. You must begin your work with some knowledge of the form of the bones and muscles, and go on with the study of it while as work. In clay modeling these tools are used: Two turn table, two wooden board, wooden tools, iron compass.

First studies; the mouth- The best models for the details of the human face. Artists considered to be taken from the mask of Michel-Angelo's "David" They are executed with such precision, so much knowledge of form and Anatomy, that in copying them the student is seized with the desire to know the reason for these forms, and thus urged on to the study of human anatomy is necessary for sculpture.

Firstly, to prepare clay with modeling and learning &preparing the shape of facial feature such as- skull, lip, ear, eye, nose. Then making the face in this angle and ratio is given below.
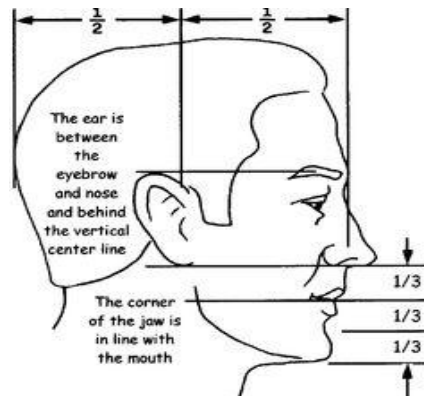
Source: www.mywibbles.blogspot.com

The artist technique of sculpture is very useful for 3D manual facial reconstruction. This technique is given with the idea & knowledge to recreate the human face and scientifically proved.

Strip plastic facial reconstruction: -

Soft tissue depth markers are used in the same manner as described in Section 2.1 and strips of clay are placed between the landmarks to graduate between adjacent markers. This process continues between landmarks or strips until very few gaps remain and the whole skull is covered. The skin is formed by filling in any gaps and smoothing the whole surface.

The main disadvantage of this method is that is relies on graduating the soft tissue between two depth points. In regions where the landmarks are sparsely placed, this may not accurately depict the changes in contour over the soft tissue surface of the face, thus creating a reliance on soft tissue depth measurements alone. Any inference made from the skull (such as muscle insertions) must be secondarily manipulated onto the facial surface.

Two- dimensional technique of facial reconstruction: -

The anatomist Welcker (1884), used two-dimensional techniques; he provided accurate orthogonal perspective drawings as an outline of the skull and the death mask, also did the first documented research, in 1883, on facial tissue depth as an accompaniment to the facial reconstruction technique.

Crime detection began to play a more sophisticated in the nineteenth century Identify an unknown body was sometime problem. Anatomist Welker (1884) compared what was thought to be Raphael's skull of Kant with his death mask, and found that the respective correlation was too good for change. Welker used two-dimensional technique; he provided accurate orthogonal perspective drawing as an outline of the skull and the death mask, and then attempted to superimpose the outlines, while making allowance for the outer tissues. Welker also did the first documented research, in 1883, on facial tissue depth as an accompaniment to the facial reconstruction technique.

Source: Two-Dimensional reconstruction conducted by forensic artist Karen T. Taylor and the subsequent identification, April Dawn lacy.(Taylor 2001)
https://en.m.wikipedia.org/.../forensicfacial/

The first scientific reconstruction was in 1895 by anatomist His aim was to identify the supposed remains of johan Sebastian Bach (1685-1750). He took measurements of facial tissue from a small number of cadavers; using this data he modelled a bust onto a plaster cast of the skull of Bach. The final reconstruction was favorably compared with contemporary portraits and bust of Bach.

Skull/photo video superimposition: -

This method was first described by Mc Kenna. This method is useful when ante-mortem photographs of 1 or more possible decedents are available. It entails the careful superimposition of key anatomical landmarks of a facial photograph of the subject upon a photo graph of the properly oriented skull.

In the identification process, it is critical to establish the correct enlargement factor of the photograph to the skull. This enlargement factor has been based on the linear measurement s of fabric on a victim, items within a room in which the photograph portrait was taken or the focal length of the camera lens. The result is more satisfactory when the anterior teeth are clearly visible in the ante mortem photograph. With a magnification factor established from the anterior teeth, life- size transparencies of the photograph are superimposed with the skull's dental landmarks and subsequently, skeletal and facial features. The method was first described by **Mckenna** The difficulty is establishing a correct angulation of the skull to the photograph.

The materials needed in superimposition are a skull and a ante-mortem photograph, supplemented with a skull radiograph. Extraneous soft tissue and foreign matter should be removed from the skull.

The reliability of this method is also based on quality and the details of the photographs of the deceased person Video Superimposition will provide quicker and greater flexibility in both these areas than other technique. This method is useful when ante-mortem-photographs of 1 or more possible decedents are available.

Computerized 3D Facial Reconstruction: -

Facial reconstruction has emerged as an increasingly important tool in forensic pathology and anthropology. Hence computerized methods for 3D facial reconstruction have been attempted to be established. These methods employ computer programs to transform laser-scanned 3D skull image into faces. Although the results are more reproducible than sculpted reconstructions, some subjectivity could remain in the 'pegging' of a composite facial image on to digitized skull matrix. The use of such a standardized image will reduce the influence of the individual shape of each skull, which is, after all, fundamental to the person's appearance. Computerized methods may be repeatable, fast and precise, but as long as they employ the old data, the equality of the reconstruction will be undermined.

The general goal that the computerized method wants to achieve is to have model-based reconstruction of the face of a given skull. A database of head model (both skulls and faces) and soft tissue depth with their personal characteristics (age, sex, race, and nutrition status) is required. By using the same relationship between soft tissue depth and the underlying bone –as used in clay reconstruction- the computer generates an image. (Tyrrell 1997)

The remain of the diseased are first unrestricted examined by a team of a forensic pathologist (post-mortem examination), a forensic anthropologist (Osteologist study), and a radiologist (radiographs and CT scanning). The information provided by the osteological analysis, such as the determination of the sex, age, and ethnic identification, metric and dental analysis is utilized by the model in order to choose the appropriate skull and soft tissues templates.

Quatrehomme recommends a different method and does not use tissue depth. He chooses from the skull/facial database the most 'similar' head as a reference in such a way that the given and the given and the reference skulls should have the same characteristics. Under the assumption that "if skull has similar forms, the corresponding faces should have main characteristics in common" he purposes a face of a given skull whose reconstruction is guided by the reference head. (Quatrehomme 1995,97.)
It is important to point out that 3D imaging does not create new data; creating 3D images allows for the exploration of more data (already present but not observable), better presentation of the data and directs attention to further investigation. (Myres 1999, Oliver 1995.) Computer assisted facial reconstruction has many benefits compared to the other methods.

3D facial reconstruction (Manual Reconstruction): -

The anatomist Kolloman & Buhly employed sculptors to produced further 3D facial reconstruction. Kolloman (1898) reconstructed the face of Dante from the purported skull, and from the likeness obtained he authenticated the skull as indeed that of Dante Kolloman also reconstructed the face of a Stone Age woman from Auvenier, France. This reconstruction is considering to be one of the first real scientific reconstruction. Kolloman measured flesh thickness from hundreds of woman of the area and produced technical drawings, which were then brought to life by Buchly (Krogman)

Three dimensional manual reconstruction: this method also need both an artist and a forensic anthropologist.
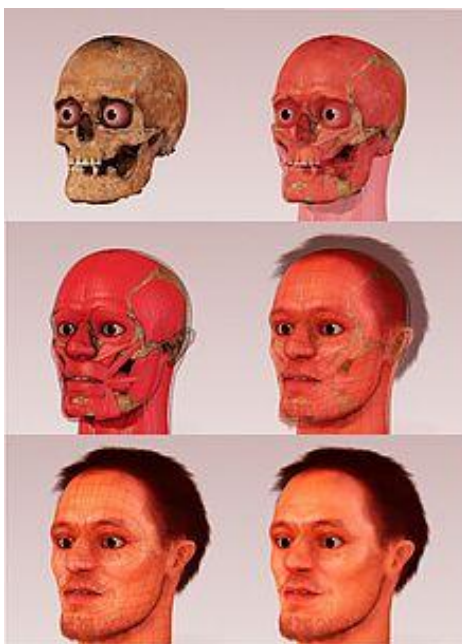
Three-dimensional clay reconstruction
Forensic facial reconstruction at the University or Dundee Scotland.
Source:https://commons.m.wikimedia.org/wiki/file:forensic_facial_reconstruction_of_Alberto_di_Trento.jpg

The American School (Krogman method): -

This method was developed by Wilton M. Krogman in 1946 that popularized facial reconstruction application to the forensic field. Krogman presented this method for reconstruction in his 1962 book detailing his method for approximation.

Fine measurement was obtained by the use of needles, x-ray or ultrasound. As facial muscles are recorded in a proper anatomical manner, this method requires highly trained person. Other who helped popularize three-dimensional facial reconstruction includes Cherry (1977) Gatliff (1984) snow (1979) and Iscan (1986). Krogman formulated 5 general principals to standardize methodology in reducing the unpredictable soft tissues of the facial features, which defined the eyeball to the orbit, the shape of the tip of the nose, location of the ears& ear length the width of the mouth.

The advantages of this method is truly scientific, more schematic, rapid & less expensive

The Russian School(Gerassimov method):-

This method was developed by Gerassimov in 1971. Here soft tissue data was not considered but facial muscle was used in anatomical position. In this method, reconstruction was done by shaping muscles, glands and cartilage onto the skull layer. This technique is not commonly used in these days. This method is much slower than the American method and a greater degree of anatomical knowledge is required.

Michail Gerasimov was probably the first to attempt palaeo-anthropological facial reconstruction to estimate the appearance of ancient peoples. He reconstructed over 200 heads of our prehistoric ancestors and worked on the faces of the earliest known fossil men: Neanderthaloid and Pithecanthropus. In 1950, he founded the laboratory for plastic reconstruction at the Ethnographical Institute of USSR Academy of Science in Moscow, called now a day Laboratory of Anthropological Reconstruction at the Institute of Ethnography and Anthropology of the Russian Academy of science. He was awarded the unique degree of Doctor of Facial Science. He also had the opportunity to exercise his skills in the solution of a murder case.

Through this Reconstruction of fossilized skulls has been achieved by this method. it is Very time consuming and more expensive. Whole reconstruction based only on muscle knowledge where they began & end

The UK Manchester School method (The manual facial approximation using the combination Technique): -

This method was developed by Rechard Neave in 1977and is the most accepted method for facial reconstruction today. In this technique, both soft tissue thickness and facial muscle are taken in to consideration.
Rechard Neave (Prag& Neave1997) and (Wilkinson 2004) and some researchers suggest that facial reconstruction technique are too reliant on average data inflexible standards (Brue's 1958) and therefore will only produce a facial type rather than characteristics likeness (Wilkinson 2008)

In 2004 it was noted by Adrew Nelson of the University Of Western Ontario Department of anthropology that noted Canadian artist Christian corbet created the first forensic facial reconstruction on an approximation of 2200 year old mummy on an approximation based on CT and Laser Scans this reconstruction is known as the Sulman Mummy project.

In twenty century for many year anatomist have been able to determine the sex and race of a skull and race of a skull and the approximate age at death of the individual to whom it belonged, but it was not until the beginning of the twentieth century that medico-legal expert began to seriously consider the possibility of reconstructing the features of a dead man upon the facial bones. The first attempt in the USA at such a reconstruction took place in New York in 1916,and was judged remarkably successfully. In

the same year, bones were discovered in a Brooklyn cellar and brought to the mortuary; measurement taken indicated that they were probably those of an Italian.

The manual facial approximation using the combination approach includes Photograph, drawing, computerized or manual 3D approximation or the anatomical method, and tissue depth method. (Krogman and Iscan1986)A manual three-dimensional facial approximation using the combination method was carried out in order to stimulate a situation of unknown identification CT Scan of skull were provided by Dr Alena Kranioti. There after, this method was followed by several investigators (Mannion, Zamora, Kranioti.) and it was found that the level of reliability and accracy increases is most of time when this method was used (Mannion, Zamora, Kranioti.)

It has been truly scientific with artistic advantage. Plaster casting examine the muscle attachment evidence based on the skull and their robustness

Discussion and Conclusion: -

The conclusion it may highlighted the facial reconstruction is a combination of the techniques of the science and art based on human morphology. These techniques are highly valuable for identification of human face in the disputed cases in forensic science and criminology. Use of the computer is of great advantage in reconstruction. Digital reconstruction with the help of other manual techniques of it is a great achievement that gives better results. Besides there are many techniques of facial Reconstruction & Recognition of human face that were in use in Neolithic phase in Jericho but Neolithic model is neither accurate nor systematic. In the middle ages the death mask was made after death of a person. In the middle age particularly criminals or missing person were always a major problem before experts. In eighteenth century the wax models were commonly placed in medical schools and life size waxes become substitute for cadavers. Wax modeling was not an accurate model, which utilized for positioning only. In nineteenth century recall system was developed the artist producing sketches with the help of the victim was popular. Sketching is useful for preparing & drawing enough facial details of the criminal introducing by reported the victim. This technique could not help for identification of the face from the skull. The artist technique of sculpture is very useful for 3D facial reconstruction. It gives the idea & knowledge to recreate the human face on skull only.

The Strip facial reconstruction method relies on graduating the soft tissues between two depth points. In those regions where the landmarks are sparsely placed the technique may not accurately depict the changes in contour over the soft tissue surface of the face, thus indicating a reliance on soft tissue depth measurements alone. Any inference made from the skull (such as muscle insertions) must be secondarily manipulated onto the facial surface.

In two dimensional reconstructions to use a life size out line drawing of the skull in two views, most commonly a frontal and right and left lateral part and soft tissue data could be added to produce a drawing of the face. However, only a limited number of soft tissue points or indicators could be used in this two dimensional methodology because the soft tissue depth table were created for working on three-dimensional reconstructions and many depth indicators were not relevant on a two dimensional reconstruction.

The skull photo video superimposition provides quicker and greater flexibility in both these areas than other technique. This method is useful when ante-mortem-photographs of one or more possible decedents are available.

Three-dimensional Manual/Traditional Plastic Facial Reconstruction (The plaster scalp reconstruction) technique is the important help of casting the face. Clay, or wax directly use on the skull or more often of the replica of the skull has been up to now the most popular method of three dimensional reconstructions.

Thus these methods require the use of tissue depth markers cut to specific length to represent the different soft tissue depth. The modeming's of the superficial features make a face look alive. This method is Very useful for future studies. Used as a combination of the two techniques first to build the face, that's to say both soft tissue thickness and facial muscle are taken into account. (Prag & Neave 1997, Taylor 1998, Wilkinson 2004). Computerized 3D Facial Reconstruction is relevant to pinpoint out its 3D imaging does not create new data; It allows for the exploration of more data (already present but not observable), better presentation of the data and directs attention to further investigation. Computer assisted facial reconstruction has many benefits compared to the other methods. Lastly the manual facial approximation using the combination approach is very useful for future studies & gives more accuracy in the field of facial reconstruction.

In conclusion it may be highline that there are several reasons to reconstruct the face in artistry, forensic Science, criminology, anthropology and archaeology. In forensics and criminology to identify the lost or criminal persons, which identifies and rebuilt the giving skull. The artists also have used the technique of facial reconstruction for modelling and teaching. For the passage of time there are many changes occurs in the technique of traditional facial reconstruction and few more reliable methods are introduced too but several old techniques are concrete guidelines even now for us. However, in future the challenges would certainly create a road map to increase the degree of accuracy of facial reconstruction which may give a better result.

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