A Study on Computerized Three-Dimensional Facial Reconstruction

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Abstract:

Facial reconstruction is the method used for the purpose of identification of unknown human remains. The facial techniques are developed day by day and hence with the manual method of facial reconstruction, there introduce computerized three-dimensional facial reconstruction method for the purpose of identified the unknown skeletal remain. These method are used in the cases related with mass disaster, accidental cases, archeological research of skeletal remains etc.This technique comprises of both the scientific as well as artistic method skill. In the present study, there discuss about the advancement of 3D technology because of its cost effective, efficient and moreover fast services. The paper followed on the basis of the role of computer modeling skills in the anthropological search of the reconstruction of the face. There is also a need to be the high rate of improvement and validation in the working of computerized 3D technique of facial reconstruction so as to make the identification more efficient and quick and less labor intensive.

Keywords: Facial Reconstruction, Skeletal remains, computerized, anthropological

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Introduction

The face has been considered as the one of the most identifying and significant feature of an individual. The three dimension shape of face is the combination of hard skeletal structure which contain the skull and cartilage in nose, skin, muscles and soft fatty tissues. The facial reconstruction also termed as facial approximation is often working as a catalyst for the purpose of human identification. In present era of time, with the increase in the technological features, the application of computer also combine both the craniofacial reconstruction as well as the comparison of skull with large set of photographs. These practice involves both the artistic as well as scientific skills and helpful in reconstructing the soft tissue onto the skull in a manner to provide the image of individual for the purpose of identification and recognition (Gupta, 2015).

The one practicing facial reconstruction usually require a method free from the practitioner subjectivity and moreover for the anthropological training and because of that they are easily surrounded with an idea of an automated computer system that have a very great advantage on the manner of speed as well as efficiency. Previously, the first computerized system was established in 1980 at the University College London and is completely based on the cranial reconstruction surgery. Besides that there are many more computerized system which represent its existence and one of the working of Vanezis including his colleagues consider the facial and skull surface data which they collected with both 2-D and 3-D method like photography, laser scanning, magnetic resonance imaging and other computer tomography scanning. Hence with the advancement of the computerized 3-D modelling technology, the facial reconstruction have tried to imitate the manual method of the facial reconstruction (Wilkinson, 2005).

As discussed above, with the last span of time there various system that have been developed to produce the facial reconstruction with the help of computer software keeping the objective of increase the levels of speed, flexibility and efficiency. In present time, the computerized facial reconstruction are further divided into two groups:

- Automated System

- Three-dimensional modelling system

Automated System – The automated systems are overall dependent on the anthropometrical data as well as templates of both the facial and skeletal morphology. The collection of tissue data is done form clinical images and the facial template which is on the basis of age, race and sex of the skull are morphed so as to adequate for the skull. It is also possible to add the manual involvement which may be possible to put on the external detail of the facial.

Three-dimensional modelling system – This system have been done in a manner of imitating the manual facial reconstruction method. The method is done in a way to model the face onto the skull and other than that, the other system employ virtual sculpture systems with that of haptic feedback. This is helpful in feeling the surface of skull at the time of analysis which is dealing with the some significant skeletal details for the facial reconstruction like purpose of malar tubercle or other related muscle attachment strength (Thompson and Black, 248).
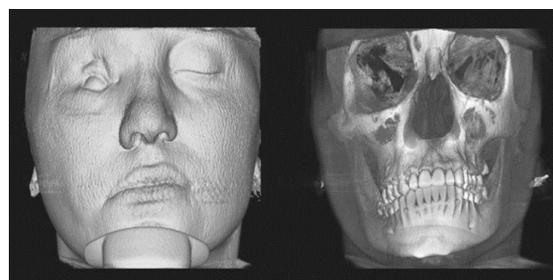

Figure: Computerized 3D Facial reconstruction

There are step wise procedure required for the computer aided reconstruction procedure:

1. Scan of skull from CT (Computed Tomography): For the purpose of digitalization of the skull find this method is used and hence became established for both the anthropological and forensic sciences. In this technique the crest lines or geometric features of skull form is defined by the differential geometry.

2. Soft Tissue Template Matching: The next step is characterized by the adequate soft tissue template from the database with the help of retrieving information. The information include the all the detailing of the body from where it was discovered. With the soft tissue template landmark and with that to the anatomical landmarks of skull, the matching is done. The database of soft tissue template may include the MRI, facial laser scans and low-dose CT.

3. Template onto Skull fing warping: On the basis of the anatomical landmarks, registration of the template with the skull is passed out. It is necessary most of the time that the subsequent interactive corrections of part of face of individuals.

4. Virtual Makeup: It is also known as tecture mapping and consist of application of shading, colors and patterns to the surface. The only problem occur with that of the scope of artistic design (Buzug, 2006).
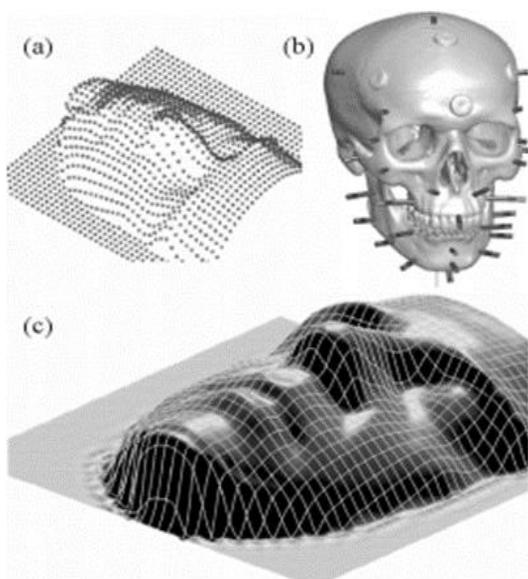

Figure: Computer-assisted facial reconstruction examples

Anthropological Examination

The facial reconstruction deals with the study of unidentified body to reveal the identity of the person. The set of properties of skull consisting the race, stature, sex or age determine with the process of examination of the identity. It is also possible to identify the estimation of the body mass index on the dependence of the left over layers on the skull and other related evidence found at the place of accident or any disaster. The computer assistance for the purpose of examination of race and gender deals with the package of software to FORDISC 3.0. As per as it is concerned, there is no completely automatic aided method which is helpful in supporting such examination which exists till date.

Review of Literature

Wilkinson, 2005 discussed about the forensic investigation which often helpful for facial reconstructions for the purpose to stimulate the identification and recognition. He consider the historic as well as recent advancement of computer technology in a manner to claim the huge level of objectivity, flexibility and efficiency. The study basically focus on the future perspective of computerized facial reconstruction which have to be accepted for the purpose of investigation in the field of forensic science as well as in the identification of skeletal remains. There also discuss about the continuous re-evaluation and assessment which will later promote the upcoming improvement and increase in the reliability.

Pascual et al. 2011, stated about the identification of human from the skull which is found to be difficult in the process of both legal as well as forensic medicine. This paper objectively focus on the 3D craniofacial reconstruction technique consisting the graphic application without the use of any facial template. In this the information required by the software tool is usually 3D image of the skull which is subject and its related three basic parameters i.e. gender, BMI (Body Mass Index) and age. This method projected in the paper dependent on the graphic application for dealing with the craniofacial reconstruction is restricted to focus on the skull geometry and related parameters. They also highlight about the focusing work have to be implemented so as to improve the validation process and comparison with that to the real skin meshes which was extracted from TAC images.

Claes et al. 2010, discussed about the overview the present computer dependent CFR methods with its updated defined date and common framework with the help of general taxonomy. The craniofacial reconstruction is basically balance among the science and art and with lots of work on the system the practical relevance of craniofacial reconstruction among the unidentified remain or for the purpose of criminal investigation. The paper also focused on progress in the computer science as well as graphics and the other improvement of the medical imaging technologies.

Miranda et al. 2018, focused on the facial reconstruction technique which targets to reproduce the individual facial characteristics depending on the analysis of skull with the purpose of recognition

foremost to identification. This paper studied about the level of accuracy and recongnition level of the 3D computerized forensic craniofacial reconstruction i.e. CCFR which is performed with the help of software which is open source i.e. Computed Tomography. The method in the paper discussed is basically used different tissue thickness and use of other alternative to examine the further method.

Conclusion

The facial reconstruction is considered as the method which is non-invasive, efficient and more rapid where the process of reconstruction can be repeated at any time whenever required. The present review study focus on the developing work of facial reconstruction with the technique i.e. computerized 3D facial reconstruction. The computerized method is basically mimic the manual method of the facial reconstruction and found to be easier and efficient as comparing with that of the manual method. It is also helpful in providing the appropriate imaging of the person who is unidentified and hence helpful in revealing the identity of the person. The present paper also focus on the validating and improvement in the system so as to provide more adequate and standard form of the image after the analysis. The evidential value of the craniofacial reconstructions when combined with the appropriate facial identification and recognition technique is one the significant aspect and currently active.

References:

Buzug, Thorsten M. "Special Issue on Computer-Assisted Craniofacial Reconstruction and Modeling." *Journal of Computing and Information Technology*, vol. 1, 2006, pp. 1–6.

Claes, Peter, et al. "Computerized Craniofacial Reconstruction: Conceptual Framework and Review." *Forensic Science International*, 2010, pp. 138–145., mirc.uzleuven.be.

Gupta, Sonia, et al. "Forensic Facial Reconstruction: The Final Frontier." *Journal of Clinical and Diagnostic Research*, vol. 9, no. 9, 2015, pp. 26–28.

Miranda, Geraldo Elias, et al. "Assessment of Accuracy and Recognition of Three-Dimensional Computerized Forensic Craniofacial Reconstruction." *PLOS One*, 2 May 2018, journals.plos.org.

Pascual, Leticia Carnero, et al. "Computerized Three-Dimensional Craniofacial Reconstruction from Skulls Based on Landmarks." *Federated Conference on Computer Science and Information Systems*, 2011, pp. 729–735, annals-csis.org.

Thompson, Timothy, and Sue Black. *Forensic Human Identification: an Introduction*. CRC Press, 2007.

Wilkinson, Caroline. "Computerized Forensic Facial Reconstruction A Review of Current Systems." *Forensic Science, Medicine, and Pathology*, 2005, pp. 173–177., pdfs.semanticscholar.org.