Facial Reconstruction Using Lateral Cephalogram X-Ray Image of Women of Lucknow District

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Abstract- Facial reconstruction is the process of recreating a person's face from their skeleton that remains through a mixture of artistry, anthropology, osteology, and anatomy. Facial reconstruction is a forensic anthropological technique based on a database of soft tissue thickness. Facial reconstruction has been done with the help of the soft tissue depth and thickness of the face of 25-34-year-old women of Lucknow district using the data obtained by the cephalogram technique. The study also studied the relevance of the Manchester technique for facial reconstruction of 25–34-year-old women.

Key Terms- Facial Reconstruction, Individual Identity, Soft Tissue Thickness.

INTRODUCTION

Facial reconstruction is a method of reconstructing a person's face from their skull. It is a combination of artistry, anthropology, osteology, and anatomy. This technique may be the last resource used in forensic investigation and crime detection when techniques such as DNA analysis, fingerprints, and radiographic comparisons cannot be used to identify the remains of a body or skeleton. Facial reconstruction is a method used to reconstruct a person's lost or unknown features on the skull. The purpose of this process is to reveal the identity of an unknown person, especially in the forensic field. This method is based on the fact that a special relationship exists between facial morphology and the morphology of a skull beneath it. On the one hand, we use the average values of the soft tissue depth measured in the defined points of the face and on the other hand, we apply various guidelines to determine the shape of the face, following the skull morphology and facial anatomy. Reconstructive practitioners must have experience and have a thorough understanding of facial anatomy, anthropology, physiology, and related pathology. In addition, reconstruction must have practical skills in sculpture and of specialized knowledge about the connection between the soft and hard tissues of the face. Some scholars considered facial reconstruction as a method of facial approximation.

OBJECTIVES OF THE RESEARCH –

1. To obtain the unknown female face from the female skull
2. Study of the utility of facial reconstruction techniques in the context of a crime against women.
3. To find out of facial soft tissue depth thickness for 25–34-year-old women of Lucknow district
4. To find out the utility in facial reconstruction using data obtained from the cephalogram technique.
5. To study the relevance of lateral cephalogram technique for facial reconstruction of 25-34-year-old women
6. To obtaining tissue depth data for facial reconstruction of 25-34-year-old women.
7. To study the relevance of Manchester technique for facial reconstruction of 25-34-year-old women.

MATERIAL AND METHODS

Measurements will be taken from diagnostic cephalometric X-Ray films (Lateral view) obtained from 200 females aged 25-29, 30-35 who will be undergoing orthodontic treatment at K.G.M.U. Soft tissue depth at

predetermined anatomical points will be recorded. Using this facial reconstruction will be attempted manually using clay to give an outline to the skull.

TOOLS AND TECHNIQUES

For data analysis the information collected during fieldwork were entered on a master chart using MS Excel. The collected data were analyzed by using various relevant statistical tools for objective interpretation of the data. The mean, median, mode, standard deviation, range, etc. have been used in the present study.

LANDMARKS FOR TISSUE DEPTH THICKNESS -

Landmarks for soft tissue depth measurements are located on the lateral radiographs. Radiographs are oriented with the EAMAS line as the horizontal axis and perpendicular to this line at the external bony meatus as the vertical axis. The landmarks LR.1to LR.16 will be situated on the lateral cephalogram. Landmarks on the Lateral Cephalogram (Lr-1 to Lr-16)

LR-1 Supra-glabella, LR-2 Glabella, LR-3 Nasion, LR-4 Mid-nasal, LR-5 Rhinion, LR-6 Anterior nose tip, LR-7 Inferior nose tip, LR-8 Mid- columella base, LR-9 Mid philtrum, LR-10 Mid –upper-lip margin., LR-11 Mid- lipline, LR-12 Mid –lower-lip margin, LR-13 Mid- labio-menta., LR-14 Anterior symphyseal, LR-15Intermediate symphyseal, LR-16 Inferior symphyseal.

After taking the sample, the study will be divided into two parts.

- Metric Phase
- Morphological Phase

Metric Phase- This phase is based on measurements taken from the lateral cephalogram. This process is based on tracing manually.

Figure 5.6

In this, hard and soft lines were traced with the help of tracing paper of the lateral cephalogram. The landmarks were identified. The distance between each hard and soft milestone is measured by vernier calipers. After that, the data of each predetermined landmark of the face of all the samples are tabulated systematically.

Morphological Phase- Based on the above soft tissue thickness data obtained the morphological analysis includes facial reconstructions. In this research, the manchester method has been used for facial reconstruction. The Manchester method is divided into two phases, the Technical, and the Artistic.

a)   Technical method- During the technical phase, the facial musculature is developed, muscle by muscle following their origins and insertions. Indicates the facial muscles that are built upon the skull. According to collected data of tissue depth markers are applied to the skull prior to developing the muscles to serve as an advantageous guide to the contours or outline of the face.

b)   Artistic method- The artistic phase, wherein all the anatomical modeling is covered up by a layer of clay laid over the surface to simulate the outer layers of subcutaneous tissue and skin then the facial features and final touches are added to create the life-like facial appearance.

DATA COLLECTION AND INTERPRETATION

The first researcher obtained permission to collect samples from Dr. Ranjeet Patil, Head of The Radiology Department, King George Medical University for his research. He then established a good relationship with the visiting women and urged them to support him for his research. After that, I took the measurement of head breadth and head length to know the pattern of the head of those women. Then, with the help of the cephalic index, the mensuration identified the pattern of har head. After that, I ask the women with dolichocephalic head to fill in their questionnaire for their age and birthplace. Based on the information received from the questionnaire, I select 200 samples suitable for my research. I then take the lateral cephalograms of those sample faces with the help of the Radiology Lab.

For the first hypothesis, 200 samples divided into two parts, first group 25–29 years and the second group 30–34 years. 100–100 samples are taken in both groups the following is the mean obtained after statistical analysis.

The metric analysis includes measurements that are taken from predefined landmarks on lateral cephalograms. Radiographs of a total of 200 patients are used for this purpose.

Table: I

The basic descriptive statistics for measurements are summarized as follows

Code	Name of Landmarks	Mean Of 25-29 Age Group	Mean Of 30-34 Age Group
LR 1	Supraglabella	5.04	5.06
LR 2	Glabella	5.86	5.88
LR 3	Nasion	4.95	4.95
LR 4	Mid nasal	2.94	2.96
LR 5	Rhinion	3.25	3.25
LR 6	Nose tip Front	27.34	27.36
LR 7	Nose tip Bottom	22.30	22.10
LR 8	Nose base	13.40	13.60
LR 9	Mid-philtrum	11.50	11.50
LR 10	Upper lip margin	10.63	11.67
LR 11	Lipline	3.20	3.00
LR 12	Lower lip margin	10.5	10.5
LR 13	Chin-lip fold	10.45	10.45
LR 14	Mental eminence	11.10	11.08
LR 15	Mid chin	7.38	7.34
LR 16	Beneath chin	9.27	9.23

Basic descriptive statics for the measurements of 200 females from Lucknow District between the age of 25–34 years

Table: II

Code	Name of point	Mean	S.D.	Min.	Max.	Mode	Range
LR 1	Supra glabella	5.05	0.68	4.0	6.0	5.0	3.0
LR 2	Glabella	5.87	0.62	5.0	7.0	6.0	3.0
LR 3	Nasion	4.95	1.37	4.0	8.0	4.25	5.0
LR 4	Mid nasal	2.95	0.17	4.0	2.5	3.0	2.5
LR 5	Rhinion	3.25	0.97	2.0	5.0	3.0	4.0
LR 6	Nose tip Front	27.35	1.34	25.0	32.0	28.0	8.0
LR 7	Nose tip Bottom	22.2	7.56	17.0	25.0	23.0	9.0
LR 8	Nose base	13.5	2.45	12.0	17.0	13.0	6.0
LR 9	Mid-philtrum	11.5	1.25	10.0	13.0	12.0	4.0
LR 10	Upper lip margin	10.65	4.45	8.0	15.0	9.0	8.0
LR 11	Lipline	3.1	0.14	2.5	4.0	3.0	2.5
LR 12	Lower lip margin	10.5	10.25	8.0	19	10.0	12.0
LR 13	Chin-lip fold	10.45	7.63	8.0	12.0	11.0	5.0
LR 14	Mental eminence	11.9	3.69	8.0	15.0	12.5	8.0
LR 15	Mid chin	7.36	1.05	6.0	12.0	7.0	7.0
LR 16	Beneath chin	9.25	8.08	8.0	15.0	8.0	8.0

The smallest values shown in the sites include LR1- Supraglabella (5.05) and LR3- Nasion (4.95), which fall in the area on the forehead, and LR4-middle nose (2.95), LR5-Rhinion (3.25) which is the nose. And fall on LR11 - lip line (3.1). The largest values were measured at LR6-Nose Tip Front (27.35), LR7-Nose Tip Bottom (22.2), LR8-Nose Base (13.5), LR9-14mental Eminence (11.9).

Table: III

Code	Name of point	Present Study mean (mm)	SAB mean	USA mean (mm)
LR 1	Supraglabella	5.05	4.68	4.50
LR 2	Glabella	5.87	6.28	6.0
LR 3	Nasion	4.95	6.00	5.25
LR 4	Mid nasal	2.95	-	-
LR 5	Rhinion	3.1	2.72	3.75
LR 6	Nose tip Front	27.35	-	-
LR 7	Nose tip Bottom	20.52	-	-
LR 8	Nose base	13.5	-	-
LR 9	Mid-philtrum	11.5	10.92	11.25
LR 10	Upper lip margin	10.65	13.30	12.50
LR 11	Lipline	3.1	-	-
LR 12	Lower lip margin	10.5	14.65	15.00
LR 13	Chin-lip fold	10.45	12.21	12.25
LR 14	Mental eminence	11.9	10.61	12.50
LR 15	Mid chin	7.36	-	-
LR 16	Beneath chin	9.25	6.72	8.00

Table- III compare data gathered in the median plane. There are additional measurements at the landmarks LR. 4, LR.6, LR.7, LR.8, LR.11 and LR.15.Measurements at forehead, glabella and nasion in the twonstudies exhibit a "cross over" or reversal of values. In one sample the thickness of forehead tissues is greater than in the other whereas the reverse is true of tissues over the glabella.

RESULTS OF THE RESEARCH

Facial reconstruction is very useful for personal identification. Evidence obtained suggests that the practice of facial reconstruction was found from the Neolithic age itself, this Reconstruction was quite rough and unformed in view. The beginning of fully scientific and systemic reconstruction is considered since the 19th century. Facial reconstruction is mainly used in the forensic area, which is the most prevalent. But along with forensic areas, many fields require facial reconstruction. By studying various fossils under palaeoanthropology, we can tell about his facial appearance and how he used to appear in its life. Facial reconstruction has also been of great importance in the area of the museum; it was only through facial reconstruction that the faces of old kings and famous people were made. Facial reconstruction has a very important place in physical anthropology. The entire human body is identified through the face. If a skull is received, its identity can be detected by reconstructing that skull.

In the present study, the researcher selected women from Lucknow in her research. In this study, 200 samples were selected, which was a woman with a dolichocephalic head of 25 to 34 years. All the samples divided into two parts, first group 25–29 years and the second group 30–34 years. Of these, 59% are married and 41% are unmarried. The distribution is shown on the basis of caste variation of women. In the study presented, 49 specimens of Brahmin caste, 52 of Kshatriya, 51 of Vaishya, and 48 of Shudra were taken. The percentage of which is 24.5, 26.0, 25.5 and 24.0 respectively. Female BMI 25–26, 27–28, 29–30, 31–32 and 33–34 are divided according to age group respectively. There are 41 samples in the first group, 38 in the second, 42 in the third, 40 in the fourth and 39 in the fifth. B.M.I are 21.5, 20.5, 21.5, 20.0 and 21.0 respectively. They are all normal BMIs. Has the distribution of women based on their occupation is shown. Of the samples obtained, government jobs 22, private jobs 45, businesses 23 and non-working 110 are included. The percentage of which is 11.0, 22.5, 11.5 and 55.0. B.M.I of those women was normal.

The present study is a numerical description of the distance taken at 16 points of the face of 200 women of Lucknow aged 25–34 years. Which is in the form of LR-1 to LR-16. The mean, mean mode, standard deviation and range of each measurement are derived. LR-1-This is a measurement of the forehead.The mean value was 5.05 mm (SD= 0.68, range= 3.0) LR-2- Glabella- This is a measurement on the most prominent point on the forehead. The mean value was 5.87 mm, (SD= 0.62, range= 3.0), the mode is 6.0, a fairly good reflection of the mean. LR-3- Nasion- This is a measurement on the forehead in the mid line on the suture between the frontal bone and two nasal bones.The mean value was 4.95 mm, (SD= 4.25, range= 5.0, Mode 4.25). LR-4- Mid nasal- This is a measurement on the nasal bridge. A point lying midway between nasion and rhinion. The mean value was 2.95 mm, (SD= 0.17, range= 2.5, Mode 3.0). LR-5- Rhinion- This is a measurement on the most anterior tip of the bony part of the nasal bones, the lowest point on the internasal suture. The mean value was 3.25 mm (SD= 0.97, range= 4.0). The mode is 3.0, a fairly good represntatiion of the mean. LR-6- Nose tip Front- This is a measurement on the nose aperture. The acanthion. The mean value was 27.35 mm, (SD= 1.34, range= 8.0, Mode 28.0). LR-7- Nose tip Bottom- This is a measurement on the nasal aperture. the acanthion. The mean value was 22.2 mm, (SD= 7.56, range= 9.0, Mode 23.0). LR-8- Nose base- This is a measurement on the end of nasal aperture. The acanthion, The mean value was 13.5 mm, (SD= 2.45, range= 13.0, Mode 4.25). LR-9- Mid philtrum-This is the measurement in the midline on the maxilla, the landmark is the orthodontic point called point-A or subspinale. The mean value was 11.5 mm, (SD= 1.25, range= 4.0) the mode is 12.0. LR-10- Mid –upper-lip margin- This is a measurement on the midline on the maxilla, a point on the maximum labial curvature of the crown of what appears on the radiograph to be the more anteriorly placed upper central incisors. If the surface is flat, then on the outer surface at the midpoint of the anatomical crown length. The mean value was 10.65 mm (SD= 4.45, range= 8.0, mode= 9.0).LR-11- Mid- lipline- This is a measurement of incisors. a point on the maximum lower curvature of the incisal edge of what appears on the radiograph to be the more anterior of the two upper central incisors, or if the edge is worn down then midway between the anterior and posterior edges of the wear facet of that tooth.The mean value was 3.1 mm, (SD= 0.14, range= 2.5, Mode 3.0). LR-12- Mid –lower-lip margin - This is a measurement on the midline of the mandible, A point on the maximum labial curvature of the crown of what appears on the radiograph to be the more anteriorly placed lower central incisor. If the surface is flat, then on the outer surface at the midpoint of the anatomical crown length.The mean value was 10.5 mm (SD= 10.25, range= 12.0, mode= 10.0). LR-13- Chin-lip fold- This is a measurement on the mandible. Equivalent to point supramentale. It was measured in 200 individuals. The mean value was 10.45 mm, (SD= 7.63, range= 5.0, Mode 11.0). LR-14- Mental Eminence- This is a measurement on the midline of the mandible, a point is on the maximum forward curvature of the mental prominence, called pogonion. The mean value was 11.9 mm (SD= 3.69, range= 8.0, mode= 12.5). LR-15- Mid chin- This is a measurement on the mandible. A point on the outer surface of the bone midway between anterior and inferior symphyseal point (LR.14 and LR.16). The mean value was 7.36 mm, (SD= 1.05, range= 7.0, Mode 7.0). LR-16- Beneath chin- This is the measurement on the lower border of the mandible, A point at the lowest point on the curve of the bony chin, at the menton. the mean value was 9.25 mm (SD= 8.08, range= 8.0, mode= 8.0).

Many methods of traditional facial reconstruction have been used, but the Manchester method is the most prevalent and in the present research, this method has been selected. The biggest role in performing facial reconstruction is soft tissue thickness. Reconstructing the face from the Manchester method without soft tissue thickness knowledge is impossible.

In Manchester method, the soft tissue thickness of the face of the population in which the group is to be reconstructed should be known. This thickness population varies. Collecting soft tissue has been in circulation since the old times.

In the early stages, facial soft tissues were taken from the cadaver by the needle. As the technology has grown, several methods have been discovered to collect soft tissue in which X-ray or lateral cephalogram, C.T scan, ultrasound are prominent. This method is used in the living population. Lateral cephalogram method has been used by the researcher in the present study to collect soft tissue, only women with dolichocephalic head were selected to collect soft tissue. The researchers then selected the dolichocranial skull and reconstructed the obtained skull using the Manchester method.

In this study, both metric and morphological analysis was attempted. Metric data included measurements that were obtained from lateral cephalograms, and then developed a soft tissue thickness (STT) standard for use on facial reconstruction.

The morphological analysis involves facial reconstructions, constructed from a variety of data sets including new developing values (STT), that evaluate the usefulness of these measurements when applied to facial reconstructions. The result are as follows

Objective- 1

To obtain the unknown female face from the female skull.

Finding

Based on hypothesis 3 and 4, it appears that the face of a woman can be made from a woman's skull.

Objective- 2

Study of the utility of facial reconstruction techniques in the context of a crime against women.

Finding

After examining hypotheses 3 and 4, studying the usefulness of facial reconstruction techniques in the context of crime against women, it was found that the reconstruction technique seems to be helpful in the creation of women's face. Due to which the technique of facial reconstruction is proving helpful in solving the mystery of crime against women.

Objective- 3

To find out of facial soft tissue depth thickness for 25–34-year-old women of Lucknow district.

Finding

Thickness of facial soft tissue depth for 25-34 year old women of Lucknow district is being identified based on hypothesis 1. With the help of which it has been possible to perform facial reconstruction of the women's skull.

Objective- 4

To find out the utility in facial reconstruction using data obtained from the cephalogram technique.

Finding

This was revealed after examining hypothesis 1,2,3,4 of the utility in facial reconstruction using data obtained from the cephalogram technique. In which it was found that facial reconstruction can be done very well using data obtained from the cephalogram technique.

Objective- 5

To study the relevance of lateral cephalogram technique for facial reconstruction of 25-34-year-old women

Finding

This was revealed after examining hypothesis 1,2,3,4 of the utility in facial reconstruction using data obtained from the cephalogram technique. In which it was found that facial reconstruction can be done very well using data obtained from the cephalogram technique.

Objective- 6

To obtaining tissue depth data for facial reconstruction of 25-34-year-old women.

Finding

Tissue depth data for facial reconstruction of 25–34-year-old women were obtained after examining hypothesis 1.2. Using which made it easier to do facial reconstruction

Objective- 7

To study the relevance of Manchester technique for facial reconstruction of 25-34-year-old women.

Finding

The study of the relevance of the Manchester technique for facial reconstruction of 25–34-year-old women was revealed after examining 1,2,3,4 hypotheses. All hypotheses have proved that the Manchester technique is easy and accessible for facial reconstruction of 25–34-year-old women.

CONCLUSION

From the above description, it appears that the face of the woman can be made from the skull of the woman, with the help of which facial reconstruction techniques seem to be helpful in the context of a crime against women. Due to which the technique of facial reconstruction is proving helpful in solving the mystery of crime against women. Facial reconstruction can be done with the help of the soft tissue depth and thickness of the face of 25-34-year-old women of Lucknow district using the data obtained by the cephalogram technique. The study also studied the relevance of the Manchester technique for facial reconstruction of 25–34-year-old women. This research has proven that the Manchester technique is easy and accessible for facial reconstruction of 25–34-year-old women.

BIBLIOGRAPHY

Aulsebrook, W. A., Becker, P. J., and Iscan, M. Y. Facial soft-tissue thickness in the adult male Zulu, Forensic Science International (1996) 79:83-102.

Broadbent, H. (1931): A new X-Ray technique and its application to orthodontics. Angle Orthodontist, 1:45-66.

Caldwell, M. C. (1981)The relationship of the details of the human face to the skull and its application in forensic anthropology. MA thesis, Arizona State University.

Cavanagh D, Steyn M. (2011) Facial reconstruction: Soft tissue thickness values for South African black females. Forensic SciInt Mar;206(1-3):215.e1-7.2.

De Greef S, Claes P, Vandermeulen D, Mollemans W, Suetens P, Willems G. Large-scale in-vivo Caucasian facial soft tissue thickness database for craniofacial reconstruction. Forensic Sci Int. 2006; 159S:S126-S146, doi: 10.1016/j.forsciint.2006.02.034.

Gatliff B.P. (1984) Facial sculpture on the skull for identification. American journal of Forensic Medicine and Pathology 5: 327-332.

George, RM. (1987)The lateral radiographic method of facial reconstruction. Journal of Forensic Science 32 (5):1305-1330.

Gerasimov, M. (1971) The face finder. Hutchinson & co., London.

Iscan M.Y. & Helmer R.P. (1993)The relationship of skull morphology to facial features. In: Iscan M.Y. & Helmer H. (eds) Forensic Analysis of the skull. New York: Wiley-Liss, Inc. pp 199-213.

Krogman W.M. & Iscan M.Y. (1986) The Human Skeleton in Forensic Medicine. 2nd ed. Springfield, IL: Charles C. Thomas, LTD.

Lebedinskaya G.V., Balueva T.S & Veselovskaya V.S. (1993) Principles of facial reconstruction. In: Iscan M.Y. & Helmer H. (eds) Forensic Analysis of the skull. New York: Wiley-Liss,Inc. pp 183-198.

Neave RAH. (1989) Reconstruction of the skull and the soft tissues of the head and face of Lindow Man. Canadian Society Forensic Science, 22:43-53.

Prag J, Neave R. (1997) Making faces using forensic and archaeological evidence. British Museum Press, London,

Rhine J.S., Moore C.E. & Weston J.T.(1982) Facial reproduction: Tables of facial tissue thickness of American Caucasoid in forensic anthropology. Maxwell Museum Technical series No. 1, University of New Mexico, Albuquerque.

Rhine JS, Campbell HR. (1980) Thickness of facial tissues in American blacks. J Forensic Sci. 25(4):847-858. 22.

Facial Sahni D, Sanjeev G, Singh I, Singh JP.(2008) Facial soft tissue thickness in North-West Indian adults. Forensic Sci Int 176:137-46.6.

Sanjeev, Indech, G. D., Jit, I., and Johnston, F. E. (1991) Skinfold thicknesses, body circumferences and their relationship to age, sex and socioeconomic status in adults from northwest India, American Journal of Human Biology 3:469-477..

Taylor K.T. (2001) Forensic Art and Illustration. CRC Press.

Taylor R. & Angel C. (1998) Facial reconstruction and approximation. In: Craniofacial Identification in Forensic Medicine. Britain: Arnold. Pp 177-185.

Vandermeulen D, Claes P, Locks D, De Greef S, Willems G, Suetens P. (2006) Computerized craniofacial reconstruction using CT-derived implicit surface representations. Forensic Sci Int 159: S164-S74.

Verze Laura.(2009) History of Facial Reconstruction. Journal of ACTA BIOMED, 80:5-12.

Walker, G.F (1972) A new approch to the analysis of craniofacial morphology and growth. American journal of orthododontics, 61:211-230

Wilkinson C. (2004) Forensic facial reconstruction, Cambridge University Press.

Wilkinson CM, Neave RAH, Smith D, (2002) How important to facial reconstruction are the correct ethnic group tissue depths? Proceedings of the tenth meeting of the international association for craniofacial identification; Sep 11–14; Bari Italy. Bari: Università degli Studi di Bari.

Wilkinson CM.(2002) In vivo facial tissue depth measurements for white British children. J Forensic Sci. 47:459-465.