ORIGINAL ARTICLE

Facial soft tissue thickness database of Gujarati population for forensic craniofacial reconstruction

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Abstract   The forensic facial reconstruction is a scientific art to construct the ante-mortem face from the human skull. The facial recognition is made by reconstructing the contours of the facial soft tissue thickness (FSTT).These FSTT data are essential for probable face reconstruction but the data of FSTT at particular anthropological landmarks differ in various ethnic groups. Until now several works have been reported on different population but no study exists in which the FSTT of a Gujarati population has been measured. The aim of this study is to compile a set of soft tissue depth data of Gujarati population of India to add to existing literature on FSTT. Computed tomography (CT-scan) has been utilized to measure the 25 different FSTT landmarks of 324 male and 165 female. Present study shows significant differences in certain FSTT of Gujarati population from that of other populations. Our compiled data set of FSTT for the Gujarati population is important in understanding craniofacial characteristics of the Gujarati population and potentially be helpful in forensic identification.

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1. Introduction

Personal identification of unknown human skeletal remains is a constant challenge in routine forensic investigation in India. As it is common that a person is murdered and the body is buried, thrown or burnt in remote places and when that body is found after some time, facial features are so distorted, or are absent, that the identity of the deceased cannot be perceived.[1,2]

In such cases to fix the identity of the unknown human skeletal remains, ante-mortem medical records are to be compared in the usual practice of forensic investigations.[1–3] These methods are helpful, but do not specifically indicate that the bare skull in question is definitely belongs to a specific person.[2] However, in cases where identification is difficult, efforts are made to reconstruct the face of a bare skull devoid of soft tissue.[2,3] Forensic facial reconstruction or forensic facial approximation is most useful for probable facial recognition by reconstructing the contours of the skull's soft tissues where only skulls are found.[4] Facial reconstruction is a scientific art to construct the ante-mortem face from a human skull. The morphology of the skull is sufficiently distinctive and provides an efficient frame for unique facial appearance. Even small variation in

the shape, form and proportions of the skull leads to significant variation in facial appearance. Utilizing this presumption, reconstruction of face can be carried out even by applying the average facial soft tissue thickness.[5] Markers of facial soft tissue thickness are the lines projecting from cranial landmarks to facial landmarks. The length of these lines corresponds to the thickness of the soft tissue at that particular location.[5]

A number of methods have been studied out to measure facial soft tissue thickness (FSTT). In earlier time, soft tissue thickness was measured on cadavers by sliding a double edged blade of scalpel or by the needle in which a needle was put through the skin until the bone was encountered by the tip of the needle.[3,9–14] Recently, many medical imagining techniques like RTG-roentgenography, MRI-magnetic resonance imaging, CT-computed tomography and US-ultra sound, were used to study the FSTT.[2,15–25] Of all these methods, CT and MRI are most accurate methods.[2] The utilization of CT and 3D reconstruction offer a more reliable location of soft tissue thickness measurement.[6,15,16] Due to cadaver limitations, the use of clinical facial CT data proved to be the ideal data set for modern living. Due to its accuracy and distinguishability between bone and soft tissue, computed tomography is widely used for measuring the FSTT.[16]

Age, race and sex can be obtained from the skull which is essential for the reconstruction of face as there is not only a wide range of variation depending on the sex, body built, biological group and age of the subject, but also simply on individual differences.[3,6–9] The data of soft tissue thickness at particular anthropological landmarks differ in various ethnic groups and, therefore, other region's tissue thicknesses cannot be applied to any other region's population. And hence, it is important to compile a set of soft tissue depth for each population. A survey of literature reveals that studies have been conducted on American Blacks,[3] American Caucasoid,[9] Australian,[12] Brazilian,[14] Buryat, Korean, Kazakh, Uzbek,[17] Chinese,[18] Colombian adult,[19] Turkish,[20] Portuguese,[13] Egyptian,[21] French,[22] Northwest Indian,[2] Japanese,[10] South African black,[23] Zulu population,[24] mixed racial population[25] etc. to compile the data set of FSTT. It is a fact that the faces vary among the population of Indian states and not any dataset except Northwest Indian is available for facial reconstruction. However, there is no any work done on Gujarati population of India. Reports show that there is a total 38,821 unidentified dead bodies recovered and inquest conducted during 2013 in all over India, from which 2219 is from Gujarat state.[26] Driven by the need to assess the skeletal remains to recognize the cause of death and to identify the unknown remains, recently we developed the sensors for detection of clonazepam and codeine sulfate from skeletal remains[27,28] and utilized CT scan images to determine the craniofacial indices of Gujarati population.[29,30] These[27–32] prompted us to develop the soft tissue depth dataset of Gujarati population. The main aim of this
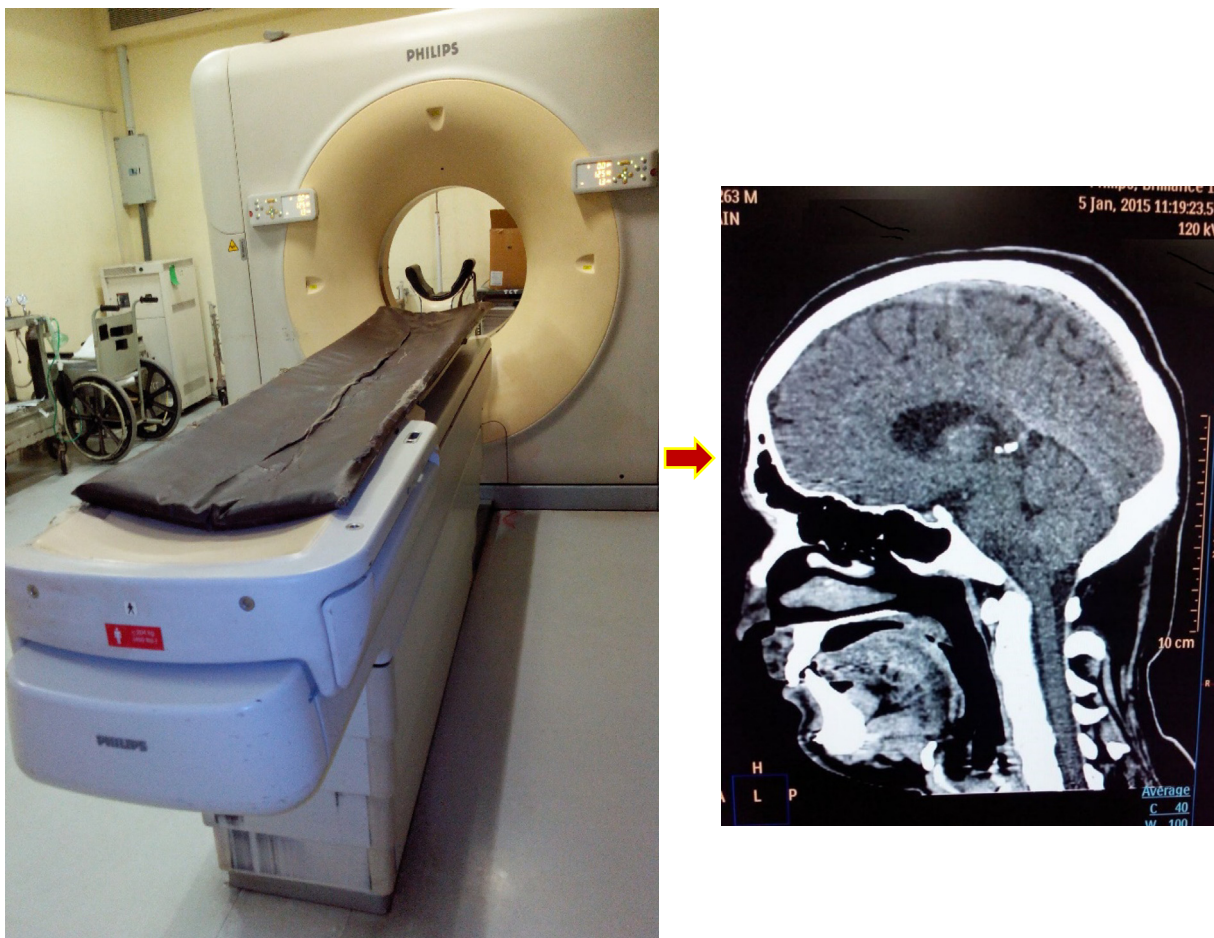
Figure 1 CT-scan machine, Philips Brilliance 16 Slice MDCT at Department of Radiology, Sheth V.S. Hospital, Ahmedabad, Gujarat and the CT-scan images of the subjects.