Legal Medicine 17 (2015) 459–466

Contents lists available at ScienceDirect

Legal Medicine

journal homepage: www.elsevier.com/locate/legalmed

Variations of midline facial soft tissue thicknesses among three skeletal classes in Central Anatolian adults

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ARTICLE INFO

Article history:
Received 29 May 2015
Received in revised form 5 September 2015
Accepted 8 September 2015
Available online 12 September 2015

Keywords:
Forensic anthropology
Facial reconstruction
Facial soft tissue thickness
Lateral cephalograms
Central Anatolian adults

ABSTRACT

Facial reconstruction is a technique employed in a forensic investigation as a last resort to recreate an individual's facial appearance from his/her skull. Forensic anthropologists or artists use facial soft tissue thickness (FSTT) measurements as a guide in facial reconstructions.

The aim of this study was to develop FSTT values for Central Anatolian adults, taking into consideration sex and skeletal classes; first, to achieve better results obtaining the likenesses of deceased individuals in two or three-dimensional forensic facial reconstructions and, second, to compare these values to existing databases. Lateral cephalograms were used to determine FSTT values at 10 midline facial landmarks of 167 adults. Descriptive statistics were calculated for these facial soft tissue thickness values, and these values were compared to those reported in two other comparable databases. The majority of the landmarks showed sex-based differences. Males were found to have significantly larger landmark values than female subjects. These results point not only to the necessity to present data in accordance with sexual dimorphism, but also the need to consider that individuals from different geographical areas have unique facial features and that, as a result, geographical population-specific FSTT values are required.

1. Introduction

Facial reconstruction is the process of recreating a face from the skull. It is conducted to help with identification in forensic investigations [1–6] as a last resort when DNA analysis, fingerprint comparison, or radiographic and dental record examination have been unable to identify the skeletal remains [7–15].

The skeletal structure and osteological analyses of the skull give essential information about the facial morphology, but these are not enough when used alone. Modeling soft tissue structures covering the skull is a significant part of the process of facial reconstruction [16–20].

Facial soft-tissue thickness (FSTT) data can be collected using different methods. FSTT is measured not only by using the puncture method on cadavers, but is also collected from living individuals by using computed tomography (CT), ultrasonography, magnetic resonance imaging (MRI) and X-ray images [9,21–36].

Many studies have used these methods for collecting the FSTT data on different populations [20,21,23,25,27,28,31–37]. Three studies, by Sipahioglu et al. [37], Kurkcuoglu et al. [38] and Bulut et al. [39], on the FSTT of the Turkish adult population have been previously published. However, Turkey has seven geographical regions, distinguished from each other by climate, location, human habitats, agricultural diversity and topography. The Central Anatolian region is located in the steppe sub-region of the inner Anatolian ecoregion. It is surrounded by the Black Sea region to the north, the Marmara region to the northwest, the Aegean to the west, Eastern Anatolia to the east and Mediterranean to the south (Fig. 1). The native people of Central Anatolia are known as the Hattians. An indigenous tribe called the Hattis was the first distinct race of people to live in Central Anatolia. Typical of this geography, Central Anatolia has a dry climate with sunny summers and cold, snowy winters. The inhabitants have unique eating habits and a traditional lifestyle.

The purpose of this study was to collect facial soft tissue thickness data for Central Anatolian adults based on three different skeletal classes. This study aims to: (1) report general descriptive statistics, including means, standard deviations and ranges of tissue thicknesses for adult males and females of different skeletal classes; (2) examine the relationship between tissue thickness, sex and skeletal classes; and (3) compare the results of this study to Turkish [38] and Japanese [40] population studies.

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http://dx.doi.org/10.1016/j.legalmed.2015.09.001
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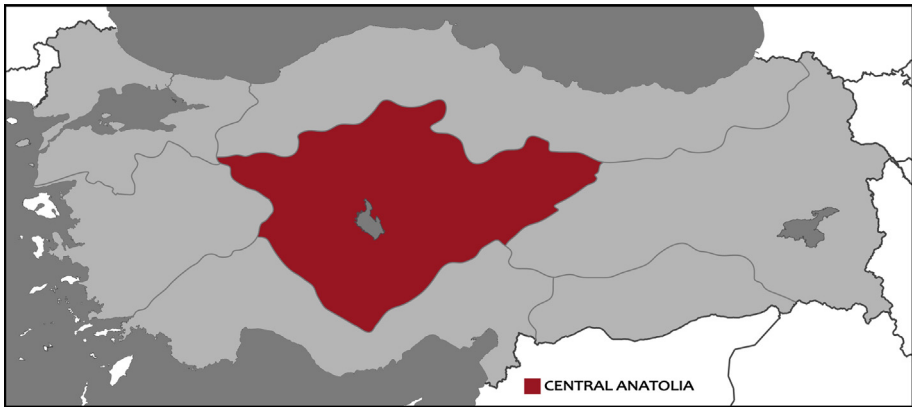

Fig. 1. Map of Turkey (Central Anatolia region in red color). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 1
Ages of individuals by sex and skeletal classes.

Sex	Skeletal classes		
	I	II	III
Male	18–35	20–32	19–33
Female	20–33	19–35	18–35

2. Materials and methods

2.1. Materials

This study was approved by the Ethics Committee of Diskapi Yildirim Beyazit Training and Research Hospital, Ankara, Turkey. Measurements were taken from diagnostic cephalometric X-ray films, which were the only materials available to use for this study, obtained from 167 Central Anatolian individuals (75 males and 92 females) aged between 18 and 35 years (Table 1), who visited Gazi University, Faculty of Dentistry, Department of Dento-Maxillofacial Radiology for orthodontic treatment. Lateral cephalograms were taken in a cephalostat (Orthophos XG 5 DS/Ceph; Sirona Dental System, Bensheim, Germany) in maximal intercuspation with the lips in repose and the Frankfort plane horizontal to the floor.

2.2. Measurements

The lateral cephalometric X-ray images were imported into Denta Pacs 8.1 software (Garanti Yazilim Inc., Konya, Turkey), to measure the thickness of 10 anatomical landmarks. To begin the measurement process, true measurements were calibrated after enlargement of the X-ray images by 10%. After the calibration, FSTTs were measured using the scale tool. The length of the line was then measured by the menu command "Scale/linear line".

The images were classified into 3 skeletal classes (Fig. 2) based on the ANB angle, which indicates the relative position of maxilla to mandible and allows the measurement of the extent of jaw position discrepancy (Fig. 3). The 3 skeletal classes were classified as follows: Class I (ANB angle = 2–4°), Class II (ANB angle > 4°) and Class III (ANB angle < 2°) (Table 2).

After setting the Frankfurt horizontal plane (FHP), the soft tissue thickness was measured at the following anatomical landmarks: (1) glabella; (2) nasion; (3) rhinion; (4) subnasale; (5) labrale superius; (6) stomion; (7) labrale inferius; (8) labiomentale; (9) pogonion; and (10) gnathion (Fig. 4). These landmarks were measured perpendicular to the bony surface.

2.3. Statistical analysis

General descriptive analyses such as mean, standard deviation and range were calculated for each anatomical landmark, and average soft tissue thicknesses were calculated, taking into consideration the sex and the skeletal classes of the individuals. To assess the intra-observer error, cephalometric X-ray films from 30 subjects were selected randomly, and the measurements repeated by a single practitioner at 3-week intervals. Technical errors of measurements (TEM) are presented in Table 3.

Homogeneity of the group variances was tested using Levene's test. The normality of the distribution of the variables was tested using Shapiro–Wilk and Kolmogorov–Smirnov tests. Parametric test assumptions were valid. Therefore, the dataset was analyzed using independent sample *t*-test, one-way and two-way ANOVA tests. One-way analysis of variance (ANOVA) was used to assess the differences among skeletal classes I, II and III. LSD test was used

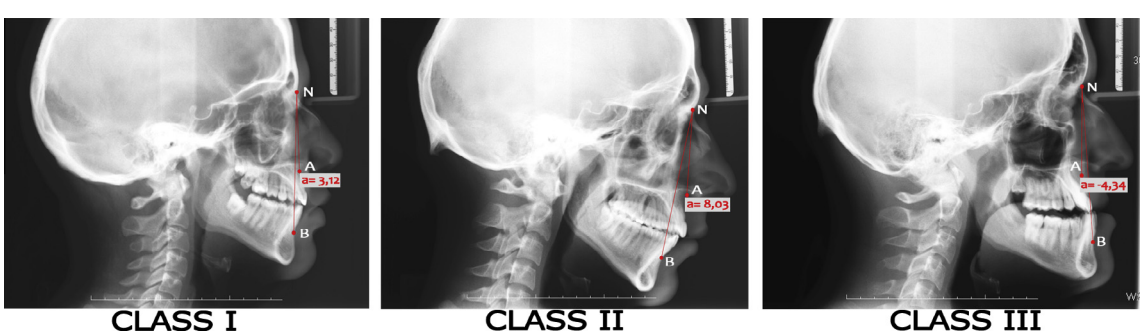

Fig. 2. Lateral view of three skeletal classes.