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FSI-8448; No. of Pages 5

ARTICLE IN PRESS

Forensic Science International xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Forensic Science International

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

Forensic Anthropology Population Data

The study on facial soft tissue thickness using Han population in Xinjiang

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ARTICLE INFO

Article history:
Received 17 July 2015
Received in revised form 27 January 2016
Accepted 26 April 2016
Available online xxx

Keywords:
Forensic science
Facial reconstruction
Facial soft tissue thickness
Skeletal classes
Body mass index
Forensic Anthropology Population Data

ABSTRACT

Facial profile is an important aspect in physical anthropology, forensic science, and cosmetic research. Thus, facial soft tissue measurement technology plays a significant role in facial restoration. A considerable amount of work has investigated facial soft tissue thickness, which significantly varies according to gender, age, and race. However, only few studies have considered the nutritional status of the investigated individuals. Moreover, no sufficient research among Chinese ethnic groups, particularly Xinjiang population in China, is currently available. Hence, the current study investigated the adaptability of facial soft tissue to the underlying hard tissue among young adults of Han population in Xinjiang, China; the analysis was performed on the basis of gender, skeletal class, and body mass index (BMI). Measurements were obtained from the lateral cephalometric radiographs of 256 adults aged 18–26 years old. Differences in soft tissue thickness were observed between genders and among skeletal classes. With regard to gender, significant differences in soft tissue thickness were found at rhinion, glabella, subnasale, stomion, labrale superius, pogonion, and gnathion among different BMI groups. Thus, nutritional status should be considered when reconstructing an individual's facial profile. Results showed that the thinnest and thickest craniofacial soft tissues existed in rhinion and lip regions, respectively. Overall, this research provides valuable data for forensic facial reconstruction and identification of young adults in Xinjiang, China.

1. Introduction

Science and technological developments offered convenient techniques to measure facial features and soft tissues for various applications in biological and medical fields, such as forensic anthropology, craniofacial restoration [1], archeology, cosmetic surgery, oral medicine, orthodontic surgery, and forensic individual identification [2,3]. Previous research accumulated a large amount of data focused mainly on soft tissues of different ethnic and age groups [4]. These studies progressively found that the relationship between hard and soft tissue changes is complicated [5,6]. Soft tissues investing teeth and bones are highly variable in thickness [7]. These variations result not only from the distinct features of dental and skeletal structures but also from individual variations in soft tissue thickness and tension [8,9].

The need to study facial soft tissues has increased with the development of three-dimensional (3D) forensic facial reconstruction technique, in which facial soft tissues are rebuilt to an unknown skull to identify its previous owner. Therefore, each key site of facial soft tissue thickness should be well elucidated to enhance the accuracy of restoration. This evaluation involves the characterization of facial soft tissues in terms of race, gender, and age [10]. As such, extensive research on facial soft tissue thickness has been conducted using several populations [11–13]. However, individual nutritional condition is rarely considered [14].

The differences in facial features of the Chinese population have been reported [15]. However, to our knowledge, facial features of the Xinjiang population have not been investigated. Xinjiang is an autonomous region in China inhabited by approximately equal proportions of two major ethnic groups, namely, Han and Uyghurs. Owing to large size of Han population in Xinjiang, the study on their facial profiles is very important especially in forensic science. For the purpose of achieving more accurate facial reconstruction, the present work evaluated the average facial soft tissue thickness

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http://dx.doi.org/10.1016/j.forsciint.2016.04.032
0379-0738/

Please cite this article in press as: J. Wang, et al., The study on facial soft tissue thickness using Han population in Xinjiang, Forensic Sci. Int. (2016), http://dx.doi.org/10.1016/j.forsciint.2016.04.032

of young adults of Han population in Xinjiang with respect to gender, Steiner's analysis, and body mass index (BMI). The findings of studies on soft tissue thickness may provide useful information in forensic science, craniofacial reconstruction, orthodontics, and other applications.

2. Materials and methods

The current study involved 256 adult subjects (121 males and 135 females) aged 18–26 years old. None of the patients had undergone orthodontic treatment or craniofacial surgery. In addition, the patients showed neither evident deformity nor traumatic history in the maxillofacial region. Moreover, all the subjects were born in Xinjiang Province, and three generations of their parents' family belonged to Han nationality. The lateral cephalometric radiographs of these patients were obtained from the First Affiliated Hospital of Xinjiang Medical University. The cephalograms were part of diagnosis records for suitable orthodontic treatment planning, and also used for relative research. An informed consent was obtained from each patient prior to the treatment. This consent states that the cephalometric radiographs will be used for diagnosis, treatment, clinical research, and scholarly purposes, including publication in professional journals. Thus, all ethical and legal requirements were met during data collection. Cephalometric X-ray images were acquired with a film-to-tube distance of 165 cm, the head was rigidly fixed, with the molars in habitual occlusion with closed lips, and the soft tissues were subjectively determined to be unstrained. Lateral cephalograms with both hard and soft tissues were selected. The magnification of each radiograph was also standardized before analysis. Cephalometric tracings were achieved using NemoCeph NX software, and the images were classified into three skeletal classes based on the patient's ANB angle and BMI. The following points were assessed during evaluation [16]: A-Point: the point at the deepest midline concavity on the maxilla between the anterior nasal spine and prosthion; B-Point: the point at the deepest midline concavity on the mandibular symphysis between the infradentale and pogonion; and the nasion, which is the most anterior point of the frontonasal suture in the median plane. Three skeletal classes were classified as follows: class I, ANB angle = 0–5°; class II, ANB angle > 5°; and class III, ANB angle < 0°. BMI was calculated as follows "weight in kilograms divided by body surface area in square meters" [17], and subjects were classified according to the following scale [18]: underweight (BMI: <18.5), normal (BMI: 18.6–24.9), and overweight (BMI: >25).

Soft tissue thickness was measured in 10 facial points (glabella, nasion, rhinion, subnasale, labrale superius, stomion, labrale inferious, labiomentale, pogonion, and gnathion) which were identified by some researchers [6,7,19–21]. Soft tissue thickness measured at these landmarks is presented in Fig. 1. Soft tissue thickness refers to the distance between hard tissue landmark and soft tissue surface. The following distances were measured as soft tissue thickness in various sites:

Line 1. GLs–GL: Linear distance from the most prominent on the frontal bone to the soft tissue prominence on the forehead
Line 2. Ns–N: Distance from bony nasion to the soft tissue nasion
Line 3. Rh: Perpendicular distance from the intersection of nasal bone and cartilage to soft tissue
Line 4. Sn–A: Distance between subnasale and A-point
Line 5. Ls–Pr: Distance between the most prominent point of the upper lip and prosthion
Line 6. St–U1: Distance between the most prominent point of the upper incisor and stomion
Line 7. Li–Id: Distance between the most prominent point of the lower lip and infradentale
Line 8. Lm–B: Distance from point B to labiomental sulcus
Line 9. Pogs–Pog: Distance between bony pognion and soft tissue pognion
Line 10. Mes–Me: Distance between bony menton and soft tissue menton.

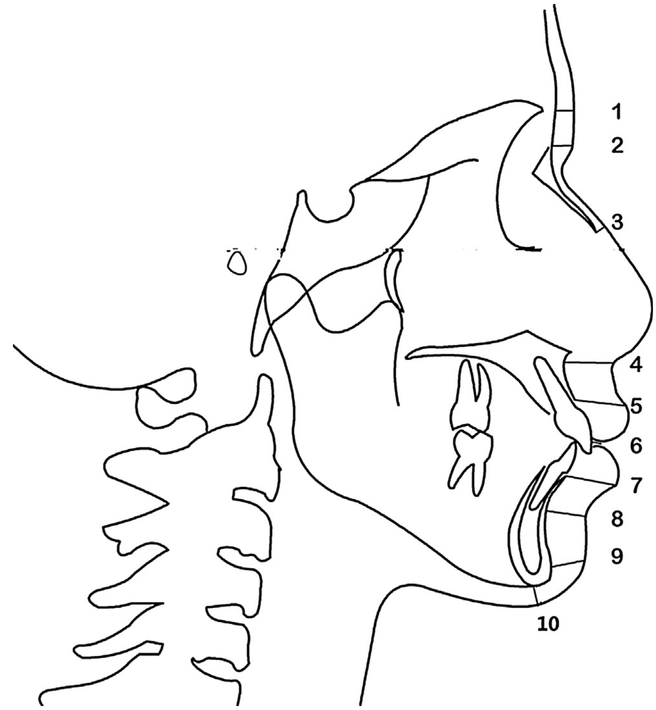

Fig. 1. Location of measurement points for facial soft tissue thickness: (1) glabella, (2) nasion, (3) rhinion, (4) subnasale, (5) labrale superius, (6) stomion, (7) labrale inferious, (8) labiomentale, (9) pogonion, (10) gnathion.

Intra-observer reliability was determined by comparing the repeated measurements obtained by each examiner, whereas inter-observer reliability was determined by comparing the mean of the measurements obtained by two observers. To test the intra- and inter-observer reliabilities, 50 cephalometric radiographs were randomly selected, and the landmarks were identified thrice by the same investigator in an interval of one week, and the linear distances were re-measured.

The mean and standard deviation was calculated for each group, i.e., gender, ANB, and BMI groups. Analysis of variance (ANOVA) was performed to assess the differences among the skeletal classes (I, II, and III) and BMI classifications. Variations in terms of gender were statistically analyzed using *t*-test. A value of $P < 0.05$ was considered statistically significant. All statistical analyses were performed using Statistical Product and Service Solutions (SPSS 17.0).

3. Results

The intra-observer reliability of two observers ranged from 0.985 to 0.998, and the intra-observer reliability ranged from 0.924 to 0.996. The technical error was less than 0.4 mm. These data indicated the reproducibility of the measurements, and no significant differences were observed.

Table 1 shows the descriptive statistics for facial soft tissue thickness in both genders. The mean facial soft tissue thickness