Sex discrimination from orbital aperture dimensions using computed tomography: Sample of Egyptian population

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ABSTRACT

The present study was designed to measure and compare various measurements of orbital apertures between male and female subjects using digital computed tomography. Also to assess the usefulness of orbital aperture measures as an aid in sex determination in sample of Egyptian population. The study included 92 subjects (44 males and 48 females) with age ranged from 18 to 65 years. The results showed that males exhibited greater mean values for all the measurements except for left orbital width that was slightly increased in females. There were significant differences ($p < 0.05$) between males and females regarding right orbital height, right and left area and inter zygomatic distance. The accuracy of correct sex classification was achieved up to 74.7%. Discriminant analysis revealed that inter zygomatic distances showed significant discrimination ($p = 0.028$) between both sexes. Receiver operating characteristic (ROC) curve analysis for sex discrimination demonstrated that inter zygomatic distance at a cutoff of 96.7, had sensitivity of 76.7%, specificity of 65% and accuracy 71% ($p < 0.001$). In conclusion, inter zygomatic distance was found to be the best reliable parameter and achieved the highest accuracy 71%. So, it was seen that inter zygomatic distance could be used for the sex determination from computed tomography.

1. Introduction

The identification of human skeletal remains in forensic investigations is crucial for further analysis [1]. Sex determination of the adult skeleton is an important initial step as estimation of age and stature of individual is sex dependent [2]. Previous studies reveal that skull is the most dimorphic and easily sexed portion of skeleton after pelvis, with accuracy up to 92% [1]. Human skulls have been used to measure the orbital aperture and morphological variations of orbital aperture and orbital bone may be used in forensic medicine as a parameter for sexual and ethnic determination in human identification [3].

Radiographs have been used to identify unknown human remains since the early 1900s [4]. Metric analyses on the radiographs are often found to be of superior value due to their objectivity, accuracy, and reproducibility. Several radiographic techniques are used to determine the dimensions of the craniofacial structures [5]. Studies involving orbital aperture morphometry have been conducted on dry skulls for sex determination, [6–8] but literature search hardly revealed any study with regard to orbital aperture measurements in Egyptian population.

2. Aim of the work

The present study was designed to measure and compare various measurements of orbital apertures between male and female using digital computed tomography. Also to assess the usefulness of orbital aperture measures as an aid in sex determination in samples of Egyptian population.

3. Material and methods

3.1. Subjects

Comparative Cross Sectional study was conducted in the period from March 2016 to February 2018. The subjects were recruited from those attend to radio diagnosis out-patient clinic, Mansoura University Hospital, for the purpose of computerized tomography (CT) scanning on brain for diagnosis of the cause of headache.

The study included 92 adults subjects (44 males and 48 females) with age ranged from 18 to 65 years. The anatomic integrity of the orbits was the main inclusion criteria. Patients with head injury or

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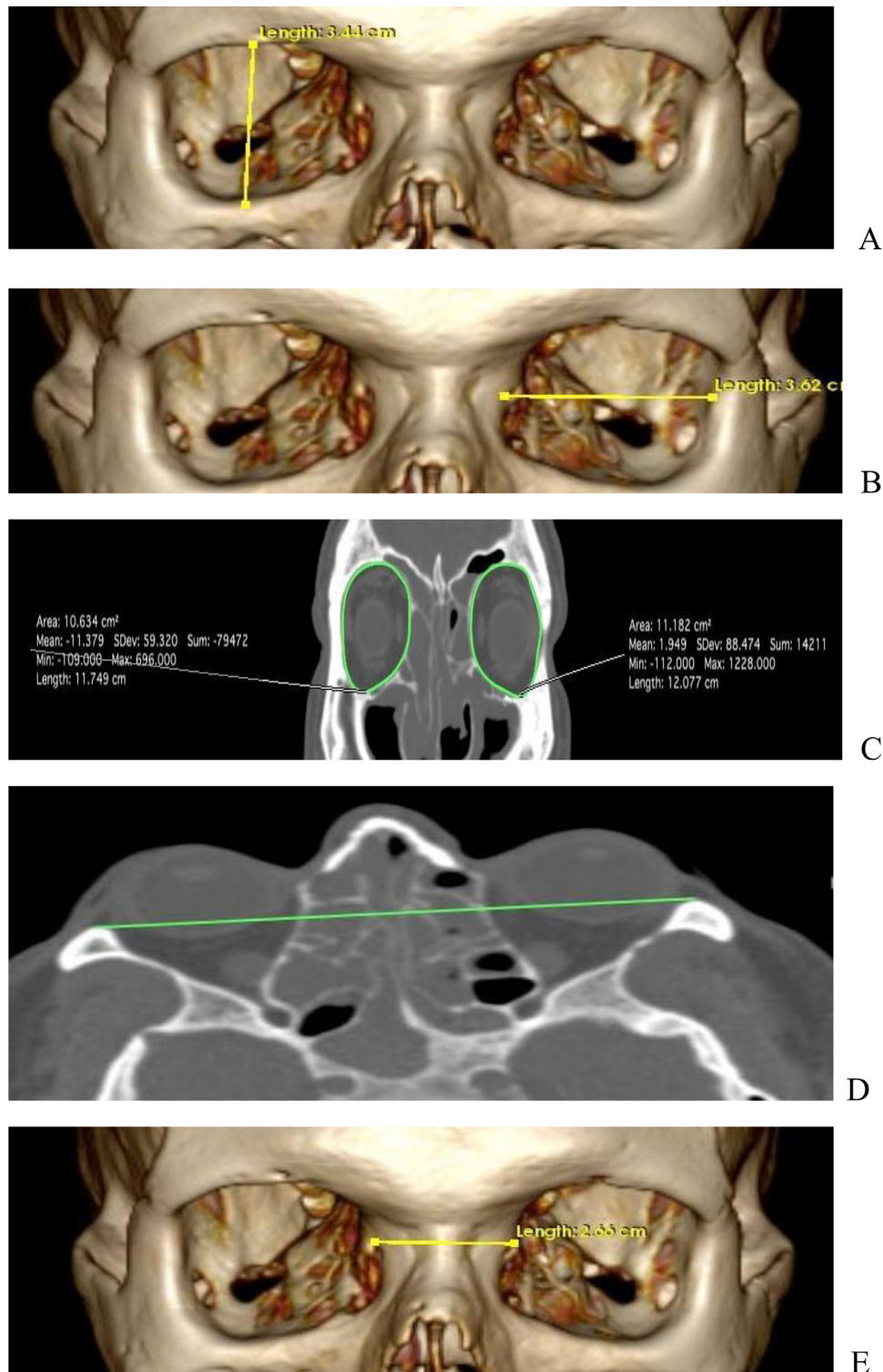
Fig. 1. The studied orbital measurements: orbital height (A), orbital width (B), orbital area (C), inter-zygomatic distance (D) and inter-orbital distance (E).

orbital injuries were excluded from the study. Prior to imaging, the patient was informed about the investigation and instructed not to move or swallow during scanning.

3.2. Methods

All patients were examined using a 128 detectors scanner (Inginia, Philips, Netherland). The scanning parameters were tube voltage (120 kV), tube current (208–276 mAs), and rotation time (1 s) slice

acquisition (3 mm).

From the volumetric data, contiguous axial, coronal and volume rendering images are reconstructed at 5 mm intervals and were analyzed by using Philips extended work space release 2.6 workstation. The measured parameters were maximum height (right and left) of the orbit (Fig. 1A), maximum width (right and left) of the orbit (Fig. 1B), the orbit area (right and left) (Fig. 1C), inter-zygomatic distance (maximum distance between the most prominent points on the right and left zygomatic arches) (Fig. 1D), inter-orbital distance (minimum distance