Comparative Assessment of Auricular Measurements in Young Males and Females

Elif Esra Kent; Mehmet Emirzeoglu; Emrah Altunsoy; Mahmut Özel & Ahmet Uzun

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SUMMARY: Personal identification is mostly done by facial assessment. The auricle plays a key role in the evaluation and recognition of the craniofacial complex. The aim of this study was to provide normative database using the measurements of the auricle among young males and females by anthropometric methods. Anthropometric measurements were taken from 115 participants, (56 men and 59 women) between 18-30 years old. Participants were students at Yasar Dogu Faculty of Sport Sciences of Ondokuz Mayis University. Each participant signed an informed consent form and then participated to the study. We found that the mean length of the right and left auricles were 58.30-58.52 mm, the mean width of the right and left auricles were 30.04-29.73 mm, the mean length of right and left lobules were 16.05-16.45 mm, and the mean width of the right and left lobules were 17.61-18.76 mm in female participants. The mean length of right and left auricles were 62.33-62.49 mm, the mean width of the right and left auricles were 33.60-33.96 mm, the mean length of right and left lobules were 18.49-18.11 mm, and the mean width of the right and left lobules were 19.19-20.47 mm in male participants. The data obtained from the present study may be useful for further studies. Also, the results may be useful for reconstructive surgeons to analyze the size and shape of the auricle.

KEY WORDS: Auricle; Craniofacial complex; Anthropometry; Lobulus auriculares.

INTRODUCTION

The auricle is an important component of the natural and symmetrical appearance of the human face and contributes to the aesthetic appearance of the face. It is also an recognizable feature of the face (Brucker et al., 2003). Previously, the parts of the human body are examined anthropometrically and the measurements of these structures are investigated in many studies (Jahanbin et al., 2013; Ahmed & Omer, 2015; Bronfman et al., 2015). The fact that these studies are carried out in different societies and still there is no consensus on the standards of ear anthropometric measurements (Farkas et al., 1992). Anthropometry is considered to be an important method in the evaluation of facial features (Farkas, 1994). It is the basic method to determine the face malformation mathematically (Farkas et al., 2007). The head and face anthropometry is a useful method in numerical determinations and very helpful for clinicians to define the shapelessness and to plan reconstructive procedures for surgeons (Oskarsdottir et al., 2008). Direct anthropometric or indirect anthropometric measurement methods are used in the studies such as three-dimensional laser scanning, two-dimensional photographic evaluation, and radiographic measurements (Farkas et al., 2005). The application of direct anthropometric methods is easy and has an advantage in terms of both cost and avoiding damage to the individuals.

Human face morphology varies depending on the age, race and sex. The harmony, symmetry, equality and proportion of the face are studied by many artists and surgeons (Tamir, 2014; Harrar et al., 2018; Ghorbanyjavadpour & Rakhshan, 2019). Today, the facial rates developed by Leonardo da Vinci and Durer, some of the great Renaissance scholars, have been confirmed by orthodontists, jaw and facial surgeons (Malas et al., 1997). There are few studies in the literature that examined the mean auricular anthropometry in Turkish young population (Bozkir et al., 2004; Barut & Aktunc, 2006).

In this study, we aimed to reveal the anthropometric properties of the auricle in Turkish population. The collected measurements in the present study may provide a guide and database for craniofacial surgeons, clinicians, anthropologic
evaluation, and biomedical engineering. We believe that the present study may further provide beneficial effects in cosmetic and reconstructive auricular surgery in Turkish population.

MATERIAL AND METHOD

A total of 115 healthy students (56 males and 59 females) who were selected by the random sampling method between the ages of 18 and 30 (mean age was 21 for male, 22 for female) participated in the study. The ethical permission of the study was obtained from the Ondokuz Mayis University Medical Research and Ethics Commission. The volunteers were informed about "Informed Volunteer Form" and their consents were received. Participants were selected from healthy individuals who did not have a significant asymmetric appearance in the craniofacial and the auricle area and had no history of disease, congenital anomaly, trauma or surgery that could cause any change in auricular development. For the application of measurements, the volunteers were seated on a chair and heads were aligned in the Frankfurt horizontal plane (Barbera et al., 2014; El Kattan et al., 2018). The landmarks which are previously determined in the literature were used (Farkas et al., 1992; Azaria et al., 2003; Ahmed & Omer) (Table I). The landmarks that were used for measurement from the auricle are shown (Fig. 1). In the study, three different measurements were taken by the two different researchers from the head and face region using direct anthropometric measurement techniques to ensure the reliability of the results. Also, eight different anthropometric parameters were used for the measurement of the auricle (Table II).

Table I. The landmarks and their explanations of the auricle.

| Landmarks                       | Abbreviations | Definitions of the landmarks                          |
|---------------------------------|---------------|-------------------------------------------------------|
| Supraaurale                     | sa            | The highest point of the auricle                        |
| Subaurale                       | sba           | The lowest point of the earlobe                        |
| Preaurale                       | pra           | Anterior point of the auricle close to the face        |
| Postaurale                      | pa            | Posterior point of the auricle away from the face      |
| Concha superior                 | cs            | Upper point of the concha                             |
| Lobulus anterior                | la            | Anterior point of the earlobe close to the face        |
| Lobulus posterior               | lp            | The posterior point of the earlobe away from the face  |
| Tragion                         | t             | Deepest point of the notch just above the tragus of the ear. |
| Incisura intertragica inferior  | inf           | Inner lower notch point of the tragus                  |
| Incisura anterior auris posterior | iaap         | Point of anterior notch of the auricle                 |
| Antihelical curvature           | ac            | The sharpest point of the antihelical inclination      |

Table II. The parameters and their explanations of the auricle.

| Parameters                           | Definitions                                                                 |
|--------------------------------------|-----------------------------------------------------------------------------|
| Auricular length                     | The distance between the most superior part of the helix and the most inferior part of the lobule |
| Auricular width                      | The distance between the most anterior point and the most posterior point of the auricle |
| Lobular length                       | The distance from the most inferior part to the tragal notch base           |
| Lobular width                        | Transvers measurement at the midpoint level of the lobule                   |
| Conchal length                       | The distance from the highest point of the antihelix and the deepest point of the intertragic notch |
| Conchal width                        | The distance between incisura anterior auris posterior and strongest antihelical curvature |
| Protrusion at the tragal level       | The horizontal distance between the posterior borders of the helix at the tragal level |
| Protrusion at the supraurale level   | The transvers straight line from the superior point of the helix to the mastoid area at the supraurale level |
Additionally, the auricular, lobular and conchal indices were calculated by using following formulas:

Auricular index: Auricular width*100/ Auricular length  
Lobular index: Lobular width*100/ Lobular length  
Conchal index: Conchal width*100/ Conchal length

One digital caliper (0-150mm x 0.05mm), one double sliding caliper (Holtain Ltd. UK), a depth gauge (Model 01140, Lafeyetta, USA; 2 cm, 0-60 cm), a leather measuring instrument (Model 01128, Lafeyetta, USA; 0.5 mm, 0-100 mm), an angle measurement set, a tape measure, a height measuring instrument (Model of Seca 220, Hamburg, Germany; 0.1 cm) and a scale (Model of Seca 220, Hamburg, Germany; 0.1 kg Maximum: 200 kg) were used for measurements.

The data were analyzed by Statistical Package for Social Sciences (SPSS) statistical software (version 15.0; SPSS, Inc., Chicago, IL, USA). The mean values of the auricular measurements were calculated and analyzed to show statistical differences between the sexes. Independent sample t test was used for comparing the values of sexes. The Wilcoxon test was used to compare the right and left auricle measurements in the same participants. The mean, the standard deviation, the maximum and minimum values of the skin of the male and female participants were determined. The statistical significance level was accepted as p < 0.05.

RESULTS

The anthropometric data and comparison of results for the right and left auricles of the participants are described in Table III. All sex-related changes of the auricular measurements were found to be statistically significant in males compared to females. The length and width of the right and left auricle, the right lobular width, the conchal width and length of the left auricle, protrusion at the tragal level of left auricle, protrusion at the supra-aural level of right and left auricle showed a statistically significant difference (p<0.05). Lobular length of right and left auricle, lobular width of left auricle and the conchal length, the conchal width and the protrusion at the tragal level of the right auricle were larger in males than in females but did not have a significant difference (p>0.05).

The findings according to sex, all of the auricular indices apart from right lobular index had a statistically significant difference (p<0.05). Except for right lobular index, all of the indices were longer in males than in females (Table IV).

Table III. Mean auricular measurements (mm) of males and females.

| Variables               | Male       | Female      |
|-------------------------|------------|-------------|
| Right                   | Left       | Right       | Left       |
| Auricular length        | 6.23±0.36  | 6.20±0.54   | 5.83±0.42  | 5.85±0.38  |
| Auricular width         | 3.41±0.56  | 3.40±0.90   | 3.04±0.33  | 2.97±0.27  |
| Lobular length          | 1.85±0.62  | 1.81±0.62   | 1.61±0.22  | 1.65±0.21  |
| Lobular width           | 1.92±0.28  | 2.05±0.59   | 1.76±0.26  | 1.88±0.21  |
| Conchal length          | 2.64±0.33  | 2.65±0.33   | 2.51±0.26  | 2.51±0.26  |
| Conchal width           | 2.03±0.36  | 2.09±0.39   | 1.89±0.18  | 1.87±0.19  |
| Protrusion at the tragal level | 1.67±0.36 | 1.69±0.33   | 1.51±0.28  | 1.51±0.28  |
| Protrusion at the supraaural level | 1.27±0.46 | 1.26±0.48   | 0.77±0.21  | 0.88±0.42  |

Table IV. Mean auricular indices of males and females.

| Variables          | Male          | Female       |
|--------------------|---------------|--------------|
| Right auricular index | 54.10±6.84   | 52.42±6.53  |
| Left auricular index | 54.27±13.32  | 50.93±4.88  |
| Right lobular index | 110.44±26.37 | 111.37±20.23|
| Left lobular index  | 120.70±47.11 | 115.32±15.60|
| Right conchal index | 78.01±15.30  | 76.18±12.08 |
| Left conchal index  | 79.52±14.07  | 75.27±10.41 |

DISCUSSION

Auricular morphometry is important for cosmetic compliance of the face. Auricle and earlobe are an element of beauty in many cultures and ethnic groups and also the earlobe is decorated with earrings and similar objects (Yotsuyanagi et al., 2002). Auricular symmetry is very important for the smoothness of the aesthetic appearance of the face. As previously provided, there is no standard for the ear (Rubin et al., 1962). Even within the same ethnic group, the shape and size of the auricle may vary. Knowledge of the anthropometric measurements of the auricle is very useful to analyze morphological differences, to determine the appropriate time for surgical corrections, and to establish standards for the designing of hearing aids and applications (Farkas et al., 1992).

A number of reference points can be used to define the size, location and level of the auricle. Although visual...
In our study, the length of the right auricle was 62.33 ± 3.4 mm, the left auricle width was 33.00 mm (Purkait & Singh, 2007) found that the right auricle length was 58.20 mm, the left auricle was 33.60 mm and the left auricle was 33.96 mm. According to these results, the auricle of the young males in our study is longer than Purkait’s study while they have the same auricular width. Ferrario et al., evaluated ear measurements of 314 adolescents and adults and the measurements of the males were statistically greater than the females (Ferrario et al.). Similar results were also obtained in our study.

Mean values obtained in our study will be clinically beneficial in the facial aesthetics and the facial transplantation. In case of damage to the auricle formation, the average values of the ear in the relevant age and sex group are crucial in auricle surgical procedures. We live in the century of technology and information. The researchers should benefit from the technological developments. We recommend the use of a new reference point and different measurement technique in the auricle measurement using the opportunities provided by the technology.

In a study conducted in the north of Italy with the age of participants between 31-40 it was found that auricle lengths were 62.40 mm and 35.30 mm in the ears (Gualdi-Russo, 1998), length was 62.92 mm; left auricle length was 63.16 mm; right auricle width was 38.80 mm; the width of the left auricle was 38.17 mm (Ferrario et al., 1999). In our study, we found that the right auricle length was 60.28 mm and the length of the left auricle was 60.46 mm. According to these results, it can be said that the auricle of the northern people of Italy are longer and wider than the ear of the young participants in our study. Another group studied on Sephardic Jewish individuals aged between 20-40 years old found that the length of the right ear lobe was 17.50 mm and the length of the left earlobe was 17.30 mm (Azaria et al.). In our study, we found that the length of the right ear lobe was 17.23 mm and the left earlobe length was 17.26 mm. The ear lobe length of the Sephardic Jewish individuals is higher than the ear lobe length of the participants in our study. Also, another study reported that the right auricle inclination angle of 18-40 year old male in China was 14.80 ± 6.1 mm, while it was 25.31 ± 1.01 mm in our study (Wang et al., 2011). According to these results, it was determined that the inclination angle of the male participants in China is narrower than that of the young males in our study. The same study showed that the right conchal width of the male subjects was 17.80 ± 2.0 mm, while the right conchal width of the male subjects in our study was 20.29 ± 0.36 mm (Wang et al.). According to these results, it was found that the male population in China has narrower right conchal width than the young males of our study. A study conducted in the Indian population (Purkait & Singh, 2007) found that the protrusion at the level of left tragus was 24.80 mm. In our study, the protrusion of male individuals at the level of left tragus was 17.00 mm. The protrusion of the auricle of the individuals in India is quite higher when compared to the measurements taken from the individuals in our study. The same researcher group reported that the right auricle length was 58.20 mm, the left auricle length was 57.70 mm, the right auricle width was 34.10 mm, the left auricle width was 33.00 mm (Purkait & Singh). In our study, the length of the right auricle was 62.33 mm, the left auricle length was 62.49 mm, the right auricle was 33.60 mm and the left auricle was 33.96 mm. According to these results, the auricle of the young males in our study is longer than Purkait’s study while they have the same auricular width. Ferrario et al., evaluated ear measurements of 314 adolescents and adults and the measurements of the males were statistically greater than the females (Ferrario et al.). Similar results were also obtained in our study.

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Corresponding author
Emrah Altunsoy, M.D.
Department of Anatomy
Ondokuz Mayis University
Samsun
55100
TURKEY

E-mail: emrah.altunsoy@omu.edu.tr

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