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Comparison of some Morphometric Parameters of the Ear on Turkish and African Students

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Abstract

Introduction: Knowledge of distinctness between gender and ethnical groups for face morphometry is significantly important on face reconstruction. For that reason measurements belonging to ear aroused interests of plastic surgeons. In our research, to generate a reference range for Turkish society by measuring some parameters belonging to ear and comparing them with races was aimed.

Method: This research was implemented over 40 (20 males and 20 females) Turkish students and 40 African students who are between 18-25 years of age. Our study was planned in three phases as collection of data, statistical analysis and comparison analysis of results with literature. Measured parameters within the scope of study are; ear length, ear width, tragus-helix, tragus-antihelix, lobular width and lobular height.

Results: Morphometric parameters belonging to both race males and female ears were compared between genders. Right and left tragus-helix and tragus-antihelix distance of Turkish male individuals were founded significantly lower than African male individuals, right and left lobular width and lobular height were founded significantly higher than African male individuals (p<0.05). Left and right ear length of Turkish female individuals, lobular width and left lobular width were founded significantly higher than African Female individuals (p<0.05).

Conclusion: When literature information was considered, anatomic details belonging to external ear are used for identifying persons and genders in forensics. Accordingly we think that the information obtained are important for generating reference range between Turkish and African races, anatomy education, guiding to esthetical surgeons and usage for forensic fields.

Introduction

Human ear is divided into three subsections such as external ear, middle ear and inner ear. Earlap and meatus aucticus externus constitute external ear. Appearance of external ear from lateral is concave and includes irregular indentation and dentations [1]. Earlap is defined for face. Its shape and size varies depending on gender and races [2]. This distinctness is used for authentication by anthropologists and forensic experts [3,4].

Knowing size of ear is important in respect to several congenital and malformations. Dislocated ear is the most common congenital deformity [5,6]. Knowledge of distinctness between gender and ethnical groups for face morphometry is significantly important on face reconstruction [3]. For that reason measurements belonging to ear aroused interests of plastic surgeons [4].

Earlap esthetically contributes to face, additionally it is important for face symmetry and accord [5,7]. Dislocated ear could be object of derision in some societies. These types of situations could cause anxiety and social phobias [5].

Anthropometry is a simple method where components of human body, proportions and type could be revealed, universally applicable, not expensive and non-invasive [8]. In our research, to generate a reference range for Turkish society by measuring some parameters belonging to ear and comparing them with races was aimed.

Materials and Methods

This research was implemented over 40 (20 males and 20 females) Turkish students and 40 African students who are between 18-25 years of age, being educated in Necmettin Erbakan University and Mevlana University. Individuals who had morphological disorders before, major trauma or had plastic or reconstructive surgery excluded.

Our study was planned in three phases as collection of data, statistical analysis and comparison analysis of results with literature. Measured parameters within the scope of study are; length of ear, width of ear, tragus-helix, tragus-antihelix, lobular width and lobular height (Figure 1).
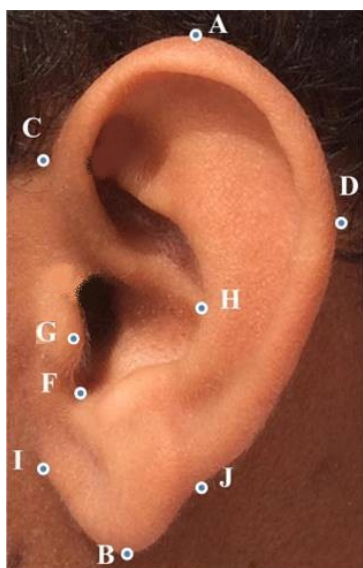

Figure 1. *The landmarks of the ear Ear height (AB), Ear width (CD), Distance from tragus to helix (GD), Distance from tragus to antihelix (DH), Lobular width (IJ), Lobular height (FB).*

In first phase, 80 students were selected among university students. Measurements were made by electronic millimeter caliper in order to minimize error risk by the same researcher.

In the second phase, data was evaluated by using student-t test.

On third and last phase, our data and literature data were compared and study was finalized.

Findings

Parameters of individuals belonging to ear were measured in respect to lateralization and evaluated (Table 1). Statistically significant difference was found among ear lengths and tragus-helix distances of Turkish male individuals ($p < 0.05$). for African female individuals' statistically significant difference for ear length was also found ($p < 0.05$).

Morphometric parameters belonging to same race males and female ears were compared between genders (Table 2).

Left and Right ear width of Turkish male individuals were founded significantly higher than Turkish female individuals ($p < 0.05$). Right and left lobular heights of Turkish female individuals were significantly higher than Turkish male individuals ($p < 0.05$).

Table 1. *Comparison of the obtained data according to lateralization (mean ± SD) (mm).*

		Turkish			African		
		R	L		R	L	
Parameters	Gender	X ± S	X ± S	p	X ± S	X ± S	p
EH	M	60.4 ± 3.7	59.7 ± 4.1	<0.05	58.3 ± 5.1	58.4 ± 5.3	>0.05
	F	59.5 ± 3.6	59.6 ± 3.9	>0.05	55.8 ± 3.8	54.0 ± 4.1	<0.05
EW	M	33.3 ± 2.4	33.2 ± 3.1	>0.05	33.5 ± 4.3	32.8 ± 3.6	>0.05
	F	29.9 ± 3.6	25.9 ± 3.1	>0.05	28.6 ± 3.7	28.8 ± 3.7	>0.05
TH	M	27.0 ± 2.9	25.8 ± 2.2	<0.01	33.8 ± 2.9	34.8 ± 4.1	>0.05
	F	25.9 ± 3.1	26.0 ± 3.5	>0.05	25.2 ± 3.0	25.1 ± 2.6	>0.05
TA	M	16.2 ± 4.3	17.2 ± 2.6	>0.05	19.9 ± 2.4	20.2 ± 2.4	>0.05
	F	16.6 ± 4.1	20.2 ± 3.6	>0.05	17.2 ± 3.1	16.7 ± 3.4	>0.05
LW	M	19.9 ± 3.3	19.4 ± 3.3	>0.05	16.7 ± 3.9	16.4 ± 3.8	>0.05
	F	20.2 ± 3.6	20.2 ± 3.7	>0.05	18.3 ± 3.4	17.5 ± 2.7	>0.05

LH	M	17.0 ± 2.2	17.8 ± 2.3	>0.05	15.2 ± 3.1	15.3 ± 2.7	>0.05
	F	18.9 ± 2.9	19.3 ± 3.0	>0.05	16.3 ± 3.9	16.8 ± 4.1	>0.05

R: Right, L: Left, M: Male, F: Female, EH: Ear height, EW: Ear width, TH: Distance from tragus to helix, TA: Distance from tragus to antihelix, LW: Lobular width, LH: Lobular Height.

Table 2. Comparison of the obtained data according to gender (mean ± SD) (mm)

	Turkish			African		
	M	**F**		**M**	**F**	
Parameters	X ± S	X ± S	p	X ± S	X ± S	p
EH (R)	60.4 ± 3.7	59.5 ± 3.6	>0.05	58.3 ± 5.1	55.8 ± 3.8	>0.05
EH (L)	59.7 ± 4.1	59.6 ± 3.9	>0.05	58.4 ± 5.3	54.0 ± 4.1	<0.01
EW (R)	33.3 ± 2.4	29.9 ± 3.6	<0.01	33.5 ± 4.3	28.6 ± 3.7	<0.01
EW (L)	33.2 ± 3.1	30.5 ± 3.6	<0.05	32.8 ± 3.6	28.8 ± 3.7	<0.01
TH (R)	27.0 ± 2.9	25.9 ± 3.1	>0.05	33.8 ± 2.9	25.2 ± 3.0	<0.01
TH (L)	25.8 ± 2.2	26.0 ± 3.5	>0.05	34.8 ± 4.1	25.1 ± 2.6	<0.01
TA (R)	16.2 ± 4.3	15.9 ± 3.1	>0.05	19.9 ± 2.4	17.2 ± 3.1	<0.01
TA (L)	17.2 ± 2.6	16.6 ± 4.1	>0.05	20.2 ± 2.5	16.7 ± 3.4	<0.01
LW (R)	19.9 ± 3.3	20.2 ± 3.6	>0.05	16.7 ± 3.9	18.3 ± 3.4	>0.05
LW (L)	19.4 ± 3.3	20.2 ± 3.7	>0.05	16.4 ± 3.8	17.5 ± 2.7	>0.05
LH (R)	17.0 ± 2.2	18.9 ± 2.9	<0.05	15.2 ± 3.1	16.3 ± 3.9	>0.05
LH (L)	17.3 ± 2.3	19.3 ± 3.0	<0.05	15.3 ± 2.7	16.8 ± 4.1	>0.05

R: Right, L: Left, M: Male, F: Female, EH: Ear Height, EW: Ear Width, TH: Distance from tragus to helix, TA: Distance from tragus to antihelix, LW: Lobular Width, LH: Lobular Height.

Left ear height of African male individuals, left and right ear length, right and left tragus-helix and right and left tragus-antihelix distance were founded significantly higher than African female individuals ($p<0.05$).

Morphometric parameters belonging to both race males and female ears were compared between genders (Table 3). Right and left tragus-helix and tragus-antihelix distance of Turkish male individuals were founded significantly lower than African male individuals, right and left lobular width and lobular height were founded significantly higher than African male individuals ($p<0.05$).

Table3. Comparison of the obtained data according to race (mean ± SD) (mm)

	M			F		
	Turkish	African		Turkish	African	
Parameters	X ± S	X ± S	p	X ± S	X ± S	p
EH (R)	60.4 ± 3.7	58.3 ± 5.1	>0.05	59.5 ± 3.6	55.8 ± 3.8	<0.01
EH (L)	59.7 ± 4.1	58.4 ± 5.3	>0.05	59.6 ± 3.9	54.0 ± 4.1	<0.01
EW (R)	33.3 ± 2.4	33.5 ± 4.3	>0.05	29.9 ± 3.6	28.6 ± 3.7	>0.05
EW (L)	33.2 ± 3.1	32.8 ± 3.6	>0.05	30.5 ± 3.6	28.8 ± 3.7	>0.05
TH (R)	27.0 ± 2.9	33.8 ± 2.9	<0.01	25.9 ± 3.1	25.2 ± 3.0	>0.05
TH (L)	25.8 ± 2.2	34.8 ± 4.1	<0.01	26.0 ± 3.5	25.1 ± 2.6	>0.05

TA (R)	16.2 ± 4.3	19.9 ± 2.4	<0.01	19.5 ± 3.1	17.2 ± 3.1	>0.05
TA (L)	17.2 ± 2.6	20.2 ± 2.4	<0.01	16.6 ± 4.1	16.7 ± 3.4	>0.05
LW (R)	19.9 ± 3.3	16.7 ± 3.9	<0.01	20.2 ± 3.6	18.3 ± 3.4	>0.05
LW (L)	19.4 ± 3.3	16.4 ± 3.8	<0.01	20.2 ± 3.7	17.5 ± 2.7	<0.05
LH (R)	17.0 ± 2.2	15.2 ± 3.1	<0.05	18.9 ± 2.9	16.3 ± 3.9	<0.05
LH (L)	17.3 ± 2.3	15.3 ± 2.7	<0.05	19.3 ± 3.0	16.8 ± 4.1	<0.05

R: Right, L: Left, M: Male, F: Female, EH: Ear Height, EW: Ear Width, TH: Distance from tragus to helix, TA: Distance from tragus to antihelix, LW: Lobular Width, LH: Lobular Height.

Left and right ear length of Turkish female individuals, lobular width and left lobular width were founded significantly higher than African Female individuals (p<0.05).

Discussion

Anthropometry is an important tool for examining any morphological structure. Structural or topographical auricular deformity is related several congenital syndromes. Early diagnosis is very important to manage prognosis [6]. Ear is identifying part of face. Structure of ear is important to determine age and gender [9]. Measurements for ear could be made on living people or on picture [3]. In a research ear lengths were recorded as, for male right side 6.04 ± 0.36 cm, left side 6.03 ± 0.33 cm, for female on right side 5.74 ± 0.38 cm, and left side 5.77 ± 0.38 cm [1]. In study of Murgod et al. [3] ear lengths were measured as following, male on right side 63.7 ± 0.65 mm, left side 63.8 ± 0.56 mm; female right side 61.1 ± 0.47 cm, left side 62.1 ± 0.44 cm. in our study ear lengths were founded as following; for Turkish males on right side 60.4 ± 3.7 mm, left side 59.7 ± 4.1 mm, Turkish female right side 59.5 ± 3.6 mm, left side 59.6 ± 3.9 mm. our findings are matching with literature findings.

In another study right ear width for males were recorded as 3.02 ± 0.21 cm, left ear width 3.06 ± 0.25 cm. In the same study, ear width for females were recorded 2.88 ± 0.22 cm, left side 2.87 ± 0.25 cm [9]. Taura et al. [10] determined right ear width as 30.46 ± 0.17 cm, left ear width as 29.54 ± 0.16 for university students. In our study ear widths were founded for Turkish males on right side 33.3 ± 2.4 mm, left side 33.2 ± 3.1 mm, Turkish female right side 29.9 ±3.6 mm, left side 25.9 ± 3.1 mm. In African male Right side 33.5 ± 4.3 mm, left side 32.8 ± 3.6 mm, African female right side 28.6 ± 3.7 mm, left side 28.8 ± 3.7 mm, values which we found in our study were higher than values recorded in literature.

Detailed information belonging to face structures of different race, gender and ages of individuals are important for surgical and forensic units [3]. Bozkır et al. [7] determined Tragus - helix distance difference for male on right side as 26.6 ± 1.9 mm, left side 26.3 ± 1.9 mm, for female on right side 25.2 ± 1.9 mm, left side 25.1 ± 2.0 mm. In our study those distances were determined on Turkish male right side as 27.0 ± 2.9 mm,

left side 25.8 ± 2.2 mm, Turkish female on right side 25.9 ± 3.1 mm, left side 26.0 ± 3.5 mm. on African male right side 33.8 ± 2.9 mm, left side 34.8 ± 4.1 mm, African female right side 25.2 ± 3.0 mm, left side 25.1 ± 2.6 mm. Difference between right and left ear for males are statistically significant. This value is statistically significant for African Female and Male students. Difference between Turkish and African students was also found statistically significant.

Distance between tragus-antihelix is quite important for designing hearing aids and early diagnosis of anomalies [7]. Kalcioglu et al. [11] recorded distance between Tragus – Helix on 18 years old males as 17.3 ± 2.5 mm, females 16.7 ± 2.5 mm. Same parameter was recorded as following; for male on right side and left side 17.2 ± 1.8 mm, for female on right side 16.5 ± 1.8 mm, left side 16.6 ± 1.7 mm [7]. In our study distance between tragus-antihelix was founded on Turkish males on right side as 16.2 ± 4.3 mm, left side 17.2 ± 2.6 mm, Turkish female right side 15.9 ± 3.1 mm, left side 16.6 ± 4.1 mm. African males on right side 19.9 ± 2.4 mm, Left side 20.2 ± 2.4 mm, African female on right side 17.2 ± 3.1 mm, left side 16.7 ± 3.4 mm, difference between African male and females are statistically significant in our results. Likewise difference was found statistically significant between Turkish males and African males.

In ear position, having knowledge for measurements and symmetry, increases success significantly for where opposite ear can't be used as template and reconstructive ear surgery. Knowing relative values for face structures belonging to different race, age, ethnical group and gender is significantly important for surgery usage [12]. In a study love width was recorded as 19.6 ± 2.0 mm for right side and 19.6 ± 2.3 for left side [9]. Another study on literature for lobe width was recorded right side 19.6 ± 2.4 mm, left side 20.0 ± 2.9 mm [13]. In our study lobular width was determined as following; Turkish male on right side 19.9 ± 3.3 mm, left side 19.4 ± 3.3 mm, Turkish female right side 19.9 ± 2.4 mm, Left side 20.2 ± 3.7 mm. African male right side 16.7 ± 3.9 mm, left side 16.4 ± 3.8 mm, African female right side 18.3 ± 3.4 mm, left side 17.5 ± 2.7 mm. Our results are statistically significant for right and left sides for Turkish and African males. For Turkish females and African females significant difference was only determined for left side. Our results are compatible with literature.

Kalra et al. [9] recorded lobular height for side as 16.7 ± 2.0 mm, left side 16.9 ± 2.0 mm. Ruma et al. [13]. Recorded same parameter as following; right side 16.9 ± 2.4 mm, left side 16.7 ± 2.7 mm. In our study these values were determined as

following; Turkish male right side 17.0 ± 2.2 mm, left side 17.8 ± 2.3 mm, Turkish female right side 18.9 ± 2.9 mm, left side 19.3 ± 3.0 mm. African male right side 15.2 ± 3.1 mm, left side 15.3 ± 2.7 mm, African female right side 16.3 ± 3.9 mm, left side 16.8 ± 4.1 mm. Result we obtained are statistically significant for Turkish male and females both for right side and left side. For evaluation inter-race; these values belonging to Turkish Female and males were founded statistically significant than Africans either right or left side.

When literature information was considered, anatomic details belonging to external ear are used for identifying persons and genders in forensics. At the same time obtained information are requested on some different fields of medicine for reconstructive surgery and hearing aid designs. Accordingly we think that the information obtained are important for generating reference range between Turkish and African races, anatomy education, guiding to esthetical surgeons and usage for forensic fields.

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