ORIGINAL ARTICLE
KLİNİK ARAŞTIRMA

Analysis of external ear morphometry in university students

Üniversite öğrencilerinde dış kulak morfometrisinin analizi

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SUMMARY

Aim: We aim to obtain data for our society by comparing the auricula's right and left morphometric measurements according to sex and side.

Material and Methods: Our study was conducted with the voluntary participation of 60 healthy individuals (30 female, 30 male) between the ages of 18 and 26 studying at Amasya University Health Services Vocational School. Ear measurements of individuals with no anomalies related to the outer ear and who had not undergone surgery or trauma were made using a digital carbon fiber caliper. The measurement results were stated in mm.

Results: The right PAL, PAW, and MAL measurement results and the left PAL and PAW measurement results of males were statistically higher than those of females. Other parameters were not statistically different in males and females. The variables' right and left side values were not statistically different in the whole group, in males and females.

Conclusion: We believe that knowing the dimensions of the auricula will be important in surgical procedures and in determining sex and identity.

Keywords: Auricula, sex, morphometry

ÖZET

Amaç: Auricula'nın sağ ve sol morfometrik ölçümlerini cinsiyete ve tarafa göre karşılaştırarak kendi toplumumuza ait veriler elde etmeyi amaçlamaktayız.

Materyal ve Metodlar: Çalışmamız Amasya Üniversitesi Sağlık Hizmetleri Meslek Yüksekokulu'nda öğrenim gören 18-26 yaş arası 60 sağlıklı bireyin (30 kadın, 30 erkek) gönüllü katılımı ile gerçekleşmiştir. Dış kulak ile ilgili herhangi bir anomalisi olmayan, cerrahi ya da travma geçirmemiş bireylerin kulak ölçümleri digital karbon fiber kaliper kullanılarak yapıldı. Ölçüm sonuçları mm cinsinden belirtildi.

Bulgular: Erkeklerin sağ FAU, FAG, MAU ölçüm sonuçları ile sol FAU ve FAG ölçüm sonuçları kadınlara göre istatistiksel olarak yüksekti. Diğer parametreler kadın ve erkeklerde istatistiksel olarak farklı değildi. Tüm grupta, erkeklerde ve kadınlarda değişkenlerin sağ ve sol taraf değerleri istatistiksel olarak farklı değildi.

Sonuç: Auricula'nın boyutlarının bilinmesi cerrahi işlemelerde, cinsiyet ve kimlik tayininde önemli olacağı kanaatindeyiz.

Anahtar kelimeler: Auricula, cinsiyet, morfometri

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INTRODUCTION

The ear, called organum vestibulocochlear, is known as the organ of hearing and balance. It has three sections: auris externa (external ear), auris media (middle ear) and auris interna (auris interna). The auris externa is formed by the auricle (auricula) and the external auditory canal (external acoustic meatus) (1,2). The auricle has an elastic cartilage structure and originates from six buds that develop from the first and second pharyngeal arches in the embryonic period (3-5). With the development of these buds, the external ear first forms and then the earlobe (6,7). The auricle transfers the sound from the external environment to the external auditory canal (1). In a study on ear development, it was reported that vertical ear growth was completed at the age of 11 in girls and 12 in boys. It was stated that the distance between the tragus and the antihelix reached its full size in 6 months in girls and 12 months in boys (8). On the other hand, there is information in the literature that the ear continues to grow with age (9,10). When ear sizes were evaluated according to sex, it was stated that males were taller than females (10).
Morphometric and morphological information about the ear is important for the symmetrical appearance of the face, as well as being as specific to the person as biometric data such as fingerprints, iris, and voice (11). Ear structure can vary according to age (9), sex (12), and ethnicity (13). In addition, it is stated in the literature that chromosomal diseases (14) and psychiatric diseases (15) can affect ear structure. In light of all this information, studies on ear structure are important in plastic and reconstructive surgery, anthropologists, forensic scientists, and genetic counselling, as well as in producing medical products such as ear microphones and hearing aids. In our study, in which university students participated voluntarily, we aim to obtain data related to our society by comparing the right and left morphometric measurements of the auricle of both sexes according to sex and side.

MATERIAL AND METHODS

Our study was carried out with the voluntary participation of 60 healthy individuals (30 female, 30 male) between the ages of 18 and 26. The sample size was calculated with the G power package program, significance level (alpha) = 0.05, power (power) = 0.80, effect size (d) = 0.74, and the total sample number was calculated as a minimum of 60.

Permission was obtained from the Amasya University Non-Interventional Clinical Research Ethics Committee, with the decision numbered 2024/82. The research was conducted according to the Helsinki Declaration 1975, as revised in 2013.

Our study included healthy individuals aged 18 and over who were studying at Amasya University Health Services Vocational School, had no anomalies related to the outer ear, and had not undergone surgery/trauma. After the students were informed about the purpose of the study and the ear measurement, volunteers who wanted to participate signed the informed consent form. A digital carbon fiber caliper with ±0.1 mm precision was used in our morphometric measurements. Our measurement results were expressed in mm. The measurement parameter definitions and references we used in our study are below (Figure 1).

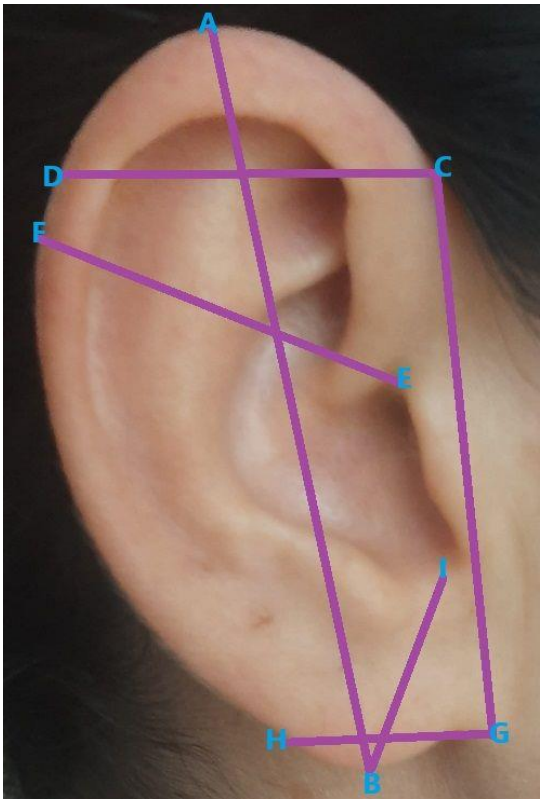

Figure 1. Measurement Parameters of External Ear. A-B: Physiognomic auricula length (PAL), C-D: Physiognomic auricula width (PAW), C-G: Morphological auricula width (MAW), E-F: Morphological auricula length (MAL), G-H: Lobular width (LAW), B-I: Lobular length (LAL)

Morphological and physiognomic measurement parameters in external ear morphometry were determined according to studies by Zhao et al. (16);

- The distance between supraauricular and infraauricular is physiognomic auricula length (PAL),
- The distance between the Darwin tubercle and the deepest point on the tragus is morphological auricula length (MAL),
- The distance between otobasion superius and otobasion inferius is morphological auricula width (MAW),
- The distance between preauricular and postauricular is physiognomic auricula width (PAW),

The measurement parameters of lobule auricula length and width in external ear morphometry were determined according to the studies of Kapil et al. (17);

- The distance between the intertragic incisureand the lowest free edge of the lobule of the auricle is the length of the auriculae lobule (LAL),
- The distance between the otobasion inferior and the widest edge of the lobule of the auricle on the transverse axis is the width of the auriculae lobule (LAW).

Statistical Analysis

Data were evaluated using the IBM SPSS Statistics Standard Concurrent User V 30 (IBM Corp., Armonk, New York, USA) statistical package program. Descriptive statistics were given as units (n), percentage (%), mean ± standard deviation, and minimum and maximum values. The normal distribution of data belonging to numerical variables was evaluated with the Shapiro-Wilk normality test. The variance homogeneity of the groups was analyzed using the Levene test. Numerical variables were compared to sex using the t-test in independent samples. Right and left side values were compared using the paired t-test. The $p<0.05$ value was considered statistically significant.

RESULTS

Our study included 60 patients, 30 (50.0%) male and 30 (50.0%) female. Patients' ages ranged from 18 to 26, and the mean age was 19.3±1.9 years (Table 1).

Table 1. Descriptive Statistics

Variables	Values
Sex. n (%)	
Female	30 (50.0)
Male	30 (50.0)
Age (year)	19.3±1.9 (17.0-26.0)
Right PAL	59.45±4.99 (48.40-70.50)
Left PAL	59.35±5.10 (46.40-69.30)
Right PAW	33.00±3.41 (22.30-40.10)
Left PAW	33.31±3.19 (23.80-39.70)
Right MAW	42.84±5.24 (32.20-52.90)
Left MAW	42.76±7.50 (30.30-79.40)
Right MAL	29.88±2.20 (25.30-36.40)
Left MAL	29.77±2.57 (24.60-38.10)
Right LAL	17.30±2.49 (11.10-22.50)
Left LAL	17.61±2.85 (11.80-23.30)
Right LAW	16.96±3.16 (10.40-24.70)
Left LAW	17.43±3.20 (10.00-27.20)

n: The number of patients. %: The percentage value. Numerical variables are summarized as mean±standard deviation (minimum-maximum) values.

According to Table 2, the right PAL, right PAW, left PAW, and right MAL values of males were statistically higher than those of females. Other variables values were not statistically higher than those of females. Other variables values were not statistically different between females and males.

Table 2. Comparison of Lengths by Sex

Variables	Sex		*t*	*p*
	Female	Male		
Age (year)	19.2±2.1	19.5±1.7	0.532	0.597
Right PAL	57.12±3.80	61.79±5.00	4.073	<0.001
Left PAL	56.75±4.54	61.95±4.28	4.564	<0.001
Right PAW	31.05±2.55	34.96±3.04	5.392	<0.001
Left PAW	31.68±2.87	34.94±2.64	4.575	<0.001
Right MAW	42.92±4.59	42.76±5.89	0.120	0.905
Left MAW	44.24±8.25	41.28±6.48	1.548	0.127
Right MAL	28.99±1.98	30.77±2.08	3.404	0.001
Left MAL	29.35±2.20	30.19±2.88	1.266	0.211
Right LAL	17.19±2.61	17.40±2.40	0.324	0.747
Left LAL	17.45±3.02	17.77±2.71	0.432	0.668
Right LAW	16.90±2.96	17.01±3.40	0.134	0.894
Left LAW	17.38±3.03	17.47±3.41	0.108	0.914

Numerical variables are summarized as mean±standard deviation. t: Independent samples t test

According to Table 3, the values of the right and left sides of the variables were not statistically different in the entire group, in males and females.

Table 3. Comparison of right and left values

Groups		Side		*t**	*p*
		Right	Left		
All Group	PAL	59.45±4.99	59.35±5.10	0.281	0.780
	PAW	33.00±3.41	33.31±3.19	0.827	0.412
	MAW	42.84±5.24	42.76±7.50	0.100	0.921
	MAL	29.88±2.20	29.77±2.57	0.302	0.764
	LAL	17.30±2.49	17.61±2.85	1.363	0.178
	LAW	16.96±3.16	17.43±3.20	1.548	0.127
Female	PAL	57.12±3.80	56.75±4.54	0.712	0.482
	PAW	31.05±2.55	31.68±2.87	1.044	0.305
	MAW	42.92±4.59	44.24±8.25	1.069	0.294
	MAL	28.99±1.98	29.35±2.20	0.861	0.396
	LAL	17.19±2.61	17.45±3.02	0.764	0.451
	LAW	16.90±2.96	17.38±3.03	0.961	0.345
Male	PAL	61.79±5.00	61.95±4.28	0.345	0.733
	PAW	34.96±3.04	34.94±2.64	0.047	0.963
	MAW	42.76±5.89	41.28±6.48	1.530	0.137
	MAL	30.77±2.08	30.19±2.88	0.992	0.329
	LAL	17.40±2.40	17.77±2.71	1.161	0.255
	LAW	17.01±3.40	17.47±3.41	1.298	0.204

Numerical variables are summarized as mean±standard deviation. t: Paired t test*

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DISCUSSION

The ear, which is expressed as the determinant of the face, varies depending on many factors. Knowing ear morphometry is essential for many disciplines. Based on this, we aim to compare the right and left auricular measurements of healthy individuals aged 18-26 in our society according to sex and side.

In the study conducted by Erdem et al. (18) in the neonatal group, PAL, MAL, LAL and LAW values on both sides and PAW and MAW values on the right side were statistically higher in males than in females.

Özkoçak and Özdemir (19) made ear measurements of 40 male individuals between the ages of 20 and 40, constituting a part of their study. PAL values were reported as 75.23±8.16 mm on the right and 74.30±8.41 mm on the left, while PAW values were reported as 37.85±5.32 mm on the right and 36.23±5.43 mm on the left. In the same study, MAW values were reported as 55.58 mm on the right and 56.30 mm on the left, while LAW values were reported as 16.73 mm on the right and 17.28 mm on the left. Except for the LAW values, the measurement results were higher than those of our study. The LAW values are consistent with our study. We think the reason for the differences may be the average age. In another study, ear measurements were made on the Malaysian and Indian populations. It was reported that the measurement results of the Malaysian participants were higher than those of the Indians (20). In another study conducted in the North Indian population, it was reported that PAL and PAW values on both sides differed significantly according to sex (21).

Açar (22) performed external ear measurements using digital photo analysis on 246 (110 male, 136 female) medical faculty students aged 22-25. Her study reported that males and females had higher PAL and MAW values. LAL measurement results were reported as 1.41 ±0.27 cm in females and 1.48 ±0.30 cm in males; LAW values were reported as 1.59 ±0.43 cm in females and 1.57 ±0.41 cm in males. Similarly, in our study, PAL values were higher in males than females. LAL and LAW values were found to be lower than in our study. We believe that the reason for the differences may be related to body mass index or height.

In their study, Sforza et al. (23) presented results regarding PAL and PAW values in different age groups. The closest age group to our study was found to be between 18 and 30 years old, and comparisons were made according to the values of this age group. In this direction, PAL values were expressed as 56.11±4.31 mm on the right and 56.36±4.05 mm on the left; PAW values were expressed as 34.51±2.96 mm on the right and 34.42±3.05 mm on the left. The findings are consistent with our results.

Demir et al. (15) performed many morphometric measurements in their study with schizophrenia patients (n=35) and control (n=35) groups. Our study included Comparing the PAL, PAW, LAL and LAW parameters. According to the study by Demir et al. (2017), right and left PAL values were 6.34±0.71 cm, 6.36±0.50 cm in the patient group, 6.04±0.49 cm, 6.07±0.47 cm in the control group, respectively. Right and left PAW values were 3.37±0.56 cm and 3.20±0.34 cm in the patient group and 3.24±0.30 cm and 3.21±0.28 cm in the control group, respectively. Right LAL values were 1.96±0.29 cm in the patient group and 1.80±0.23 cm in the control group. Right and left LAW values were reported as 2.09±0.24 cm and 2.15±0.28 cm in the patient group and 1.91±0.26 cm and 1.91±0.22 cm in the control group, respectively. The PAL and LAL values of the control group and the PAW values of both groups are consistent with our study. The LAW value results of both groups were higher than our study's. It has been reported in the literature that nasion-stomion lengths may be longer in schizophrenia patients (24). Therefore, we consider this situation to be the reason for the differences in the findings.

In another study conducted in South India, PAL, PAW, LAL, and LAW values of 100 students (70 females, 30 males) aged 18-22 were measured by digital photo analysis. PAL values were reported as 43.94 ± 3.97 mm, 45.25 ± 3.92 mm; PAW values as 20.79 ± 3.20 mm, 21.29 ± 2.08 mm; LAL values as 16.71 ± 3.00 mm, 17.22 ± 2.24 mm, LAW values as 11.49 ± 1.77 mm, 13.21 ± 1.88 mm in females and males, respectively (25). PAL, PAW, and LAW values were lower than in our study. Only the LAL value was consistent with our study. We think the reason for the differences in the findings may be related to the different methodologies and populations.

The outer ear morphometry of 60 university students between the ages of 18-26 was analysed in our study. While some measurement parameters were found to be higher in males in our study, it was seen that there was no difference according to sex when evaluated in terms of right and left sides. As far as we have researched from the literature, morphometric measurements were made using different methodologies. It has been reported that outer ear measurements differ according to sex and ethnic origins. The measurement results of our study will be meaningful for many disciplines and will contribute to the medical industry.

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