Original Article

Anthropometric assessment of human auricle in North Indian population

ABSTRACT

Introduction: Morphometric studies of the auricle find its place in many areas, such as esthetics, forensic medicine, biology, anthropology, mythology, arts, and acupuncture.

Aims and Objective: This study aims at establishing the anatomical variations in the auricular dimensions in North Indian population. The objectives of this study were to measure auricle height in males and females, to measure auricle width in both sexes, to measure lobular height (LH) in both sexes, to measure lobular width (LW) in both sexes, to calculate the auricle index in both sexes, and to calculate lobular index in both sexes.

Materials and Methods: This study was conducted on 130 subjects (78 males and 52 females), in the age group of 18–25 years, without history of genetic disorders, injuries, or any disease of the auricle.

Results: The average length of the auricle was 6.28 cm (right) and 6.23 cm (left), and the average width was 3.21 cm (right) and 3.28 cm (left). The average height of the lobule was 1.76 cm and 1.77 cm on the right and left sides, respectively, while the lobule width was 1.90 cm on the right side and 2.01 cm on the left side.

Conclusion: Total right auricle height and total auricle width of both the right and left ears are more in males as compared to females, and the difference between both the sides was significant. Both right- and left-side LH and LW were higher in males as compared to females.

Keywords: Auricle, external ear, lobule, morphometry, types of the auricle

INTRODUCTION

The appearance of an individual or facial esthesis is determined by the size, shape, position, symmetry, and projection of the auricle of the external ear.[1] Many congenital and acquired defects occur in the auricle. Congenital anomalies occurring are microtia, macrotia, malposed ear, accessory auricle, lop ear, and protruding ear which may be associated with various syndromes such as Down's, Turner's, and Potter's syndromes.[2] Traumatic injuries like burns and pathological condition such as carcinoma of the pinna account for acquired defect in the external ear. Dimensions of the normal auricle are thus required to correct these deformities.

A lot of variations exist in the dimensions of the pinna in different age, sex, and ethnic groups in different parts of the world. It has also been seen that a lot of difference in morphometry exists between the right and left ears in the same individual.[3] Parameters of the ear lobule are important for plastic surgeons, and reconstructive surgeries of the ear, and for facial rejuvenation. Knowledge of the ear pinna is used

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for manufacturing ear microphones and for designing ear prosthesis.[4] The forensic expert also needs the dimensions of the ear pinna in making the identity of an individual.[5]

Since the morphometric measurements of the auricle differ in various ethnic groups, and India is a country with diverse races, this study is being done in North Indian population to further substantiate the available data for morphometry of the external ear.

MATERIALS AND METHODS

This was a prospective study, conducted in the Department of E. N. T, King George Medical University, Lucknow, and Department of Anatomy, Integral Institute of Medical Sciences, Lucknow, in 130 medical students, in which 78 were males and 52 were females in the age group of 18–25 years. Institutional ethical clearance and written consent were taken from the subjects after informing them about the study. Ethical Clearance was Obtained from Institutional Ethical Committee vide letter no IRC/IIMSR/2021/03 dated 17.03.2021.

Subjects with history of craniofacial trauma and congenital ear anomalies were excluded from the study. The linear measurements of the human auricle were done with the help of digital Vernier caliper. All the measurements of the auricle were based on international standards.[6-9]

The following parameters were measured keeping the subject's head in Frankfurt horizontal plane [Figure 1]:

1. Total auricle height (TAH) = Distance between the inferior projection of the ear lobule and the superior projection of the helix
2. Total auricle width (TAW) = From the root of the auricle to the maximum convexity of the auricle helix
3. Auricle index (AI) = TAW/TAH ×100
4. Lobular height (LH) = Distance between the inferior end of the lobule and the base of the tragal notch
5. Lobular width (LW) = Horizontal width of the ear lobule
6. Lobular index (LI) = LW/LH ×100.

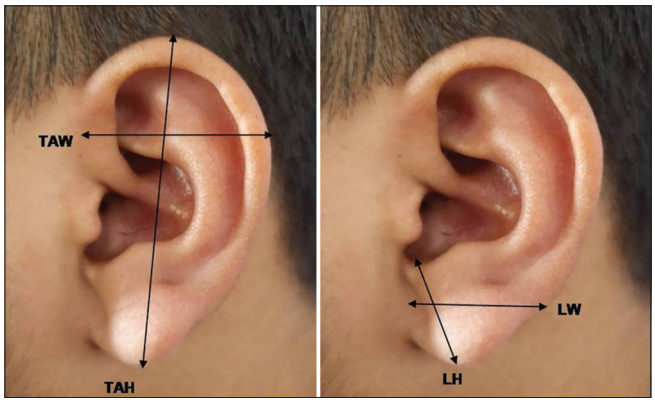

Figure 1: Dimensions of ears (auricle and lobule height and width)

All the data were tabulated and analyzed statistically using simple *t*-test and paired *t*-test.

RESULTS

The readings of all parameters of both the right and left ears of all the subjects are shown in Tables 1-3.

According to Table 1, TAH is higher in the right ear, whereas LH, LW, AI, and LI were higher in the left ear.

According to Table 2, TAH and TAW measurements were higher in the right ear, whereas LH, LW, AI, and LI were higher in the left ear.

According to Table 3, TAH measurements were higher in the right ear, whereas TAW, LH, LW, AI, and LI were higher in the left ear.

According to Table 4, all the parameters of both right and left were more in males as compared to females, except right and left lobular indexes, which was higher in females as compared to males.

DISCUSSION

TAH helps in the evaluation of congenital anomalies (Down's syndrome).[10,11] In a study on North American whites, it was observed that the total height of the left ear was 62.4 mm in men and 58.5 mm in women. In a study done by Asai *et al*. in Japanese population, the measurement of the left ear height was found to be 70.1 mm.[12] In Bozkir *et al*.'s study, the height of the left ear was 63.1 mm in men and 59.7 mm in women.[13] In Praveen *et al*.'s study, the total ear height of the left ear in males was 6.06 cm and 5.88 cm in females.[14] In the present study, the TAH of the left ear in males is 6.23 cm and 5.91 cm in females, whereas the TAH of the right ear in males is 6.29 cm and 5.99 cm in females. Similar results were also found in a study done by Barut and Aktunc. It was thus concluded by many studies and also the present study that the mean height of the ears on both the sides was higher in males as compared to females.[15]

In the study of Bozkir *et al*., the ear width in males was 33.3 mm on the left side and 33.1 mm on the right side, whereas in females, it was 31.3 mm in the left ear and 31.2 mm in the right ear.[13] According to Balogh and

Table 1: Comparison of right and left ear measurements of all subjects

Parameters	Mean±SD		*P*	Conclusion	Inference
	Right (cm)	Left (cm)			
Auricle height	6.28±0.48	6.23±0.48	0.019	<0.05	Significant
Auricle width	3.31±0.44	3.28±0.39	0.29	>0.05	Not significant
Auricle index	52.66±6.07	52.66±5.93	1.00	>0.05	Not significant
Lobular height	1.76±0.31	1.77±0.29	0.68	>0.05	Not significant
Lobular width	1.90±0.34	2.01±0.36	0.00	<0.05	Significant
Lobular index	109.59±20.28	115.15±20.05	0.01	<0.05	Significant

SD: Standard deviation

Table 2: Comparison of right and left ear measurements of male

Parameters	Mean±SD		*P*	Conclusion	Inference
	Right (cm)	Left (cm)			
Auricle height	6.29±0.48	6.23±0.48	0.011	<0.05	Significant
Auricle width	3.31±0.45	3.28±0.39	0.35	>0.05	Not significant
Auricle index	52.69±6.12	52.79±5.87	0.85	>0.05	Not significant
Lobular height	1.76±0.31	1.77±0.30	0.68	>0.05	Not significant
Lobular width	1.90±0.34	2.02±0.36	0.30	>0.05	Not significant
Lobular index	109.55±20.42	115.34±22.16	0.005	<0.05	Significant

SD: Standard deviation

Table 3: Comparison of right and left ear measurements of female

Parameters	Right (cm)	Left (cm)	*P*	Conclusion	Inference
Auricle height	5.99±0.40	5.91±0.39	0.007	<0.05	Significant
Auricle width	3.04±0.34	3.05±0.38	0.97	>0.05	Not significant
Auricle index	50.91±5.51	51.70±6.21	0.41	>0.05	Not significant
Lobular height	1.67±0.29	1.75±0.31	0.03	<0.05	Significant
Lobular width	1.82±0.35	1.98±0.35	0.20	>0.05	Not significant
Lobular index	110.24±20.87	115.39±21.86	0.10	>0.05	Not significant

Table 4: Comparison of male and female ear measurements

Parameters	Male	Female	*P*	Conclusion	Inference
Right auricle height	6.29±0.48	5.99±0.40	0.002	<0.05	Significant
Right auricle width	3.31±0.45	3.04±0.34	0.001	>0.05	Not significant
Right auricle index	52.69±6.12	50.91±5.51	0.006	<0.05	Significant
Right lobular height	1.76±0.31	1.67±0.29	0.006	<0.05	Significant
Right lobular width	1.90±0.34	1.82±0.35	0.012	<0.05	Significant
Right lobular index	109.55±20.42	110.24±20.87	0.398	>0.05	Not significant
Left auricle height	6.23±0.48	5.91±0.39	2.24	>0.05	Not significant
Left auricle width	3.28±0.39	3.05±0.38	5.74	>0.05	Not significant
Left auricle index	52.79±5.87	51.70±6.21	0.18	>0.05	Not significant
Left lobular height	1.77±0.30	1.75±0.31	0.39	>0.05	Not significant
Left lobular width	2.02±0.36	1.98±0.35	0.40	>0.05	Not significant
Left lobular index	115.34±22.16	115.39±21.86	0.93	>0.05	Not significant

Millesi, the ear width in males was 32.4 mm in the left ear and 33 mm in the right ear, whereas in females, it was 31.9 mm in the left ear and 32.4 mm in the right ear.[16] In the study of Praveen *et al*., the ear width in males for the right ear was 3.07 cm, and for the left ear, it was 3.06 cm. In females, the ear width for the right ear was 2.89 cm, and for the left ear, it was 2.87 cm.[14] In the present study, the auricle width of the right ear in males is 3.31 cm, and for the left ear, it is 3.28 cm. In females, it is 3.04 cm in the right ear and 3.05 cm in the left ear. The result of the present study is almost similar to the previous studies wherein the auricle width of both the sides is more in males as compared to females.

According to Praveen *et al*.,[14] right LH and right LW are more in males as compared to females, but left LH and left LW are

more in females as compared to males.[12] According to the present study, both right- and left-side LH and LW are higher in males as compared to females. The dimensions of the ear lobule reported in studies done by Brucker *et al*. and Azaria *et al*.[6,17] vary from 13 mm to 25 mm. In the present study, the length of the ear lobule on the right side was found to be around 1.76 cm in males and 1.67 cm in females and the width of the ear lobule on the right side was found to be around 1.90 cm in males and 1.82 cm in females. The length of the ear lobule on the left side was found to be around 1.77 cm in males and 1.75 cm in females, and the width of the ear lobule on the left side was found to be around 2.02 cm in males and 1.98 cm in females.

CONCLUSION

The present study provides normal human auricle dimensions, which is important for the diagnosis of congenital malformations, acquired deformities, and various syndromes. These data are also helpful for plastic surgeons in reconstruction of the pinna. The morphometric parameter of the auricle gives information about sex of the person which plays an important role in the forensic investigation. These data also provide the mean values of the different morphometric parameters of the right and left auricles of the medical students in North Indian population.

Right TAH and TAW of both the right and left ears are more in males as compared to females, and the difference between both the sides was significant. Both right- and left-side LH and LW were higher in males as compared to females.

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Conflicts of interest

There are no conflicts of interest.

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