

A Preliminary Study on Anthropometric Measurements and Shape Distribution of External Ear in Sriganaganagar District, Rajasthan, India

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ABSTRACT

Introduction: Various parameters have been used to establish the personal identification of individuals and anthropometry of external features of the pinna is one of them.

Materials and Methods: The present longitudinal randomized study is carried on randomly selected total 100 ears (50 individuals). The study samples include subjects aged 01 to 70 years, digital vernier calliper, camera and tripod is used to take anthropometric measurements.

Results: The study results showed that most common ear shape is oval with 56 percent while ear auricle with polygonal shape is least common i.e. 2 percent. Percentage of oval shaped in males (36 %) is higher than females (20 %), while round shaped auricle's percentage in females 16 %, slightly higher than males (14%).

Conclusion: Ears can be used in identification of unknown persons especially in cases of mass disasters, burns, drowning etc., where the face is severely disfigured The identity can be established through methods based on the morphology and

measurements of ears of the victim.

Keywords: Anthropometry, Auricle, Gender, Lobule Attachment.

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INTRODUCTION

Anthropometry is called the study of dimensions of different human body parts which shows variation according to age, sex, and race. Thus, the study of these physical variations plays an important role in establishing the identity of individual as well as it contains importance in plastic surgeries and prosthesis development.¹ The identification of an individual by age and sex possesses difficulty in revealing its identity. Various parameters have been used to establish the personal identification of individuals and anthropometry of external features of the pinna is one of them.² Extensive MEDLINE search revealed that there is limited literature regarding morphometry of the pinna in North India.^{1,3} It was previously reported in a case study that various features of the pinna can be used successfully in the identification of disaster victims.⁴ In India, morphology of ear was used to confirm the identity of Veerappan, the sandal wood smuggler who was killed by Special Task Force in 2004. Veerappan, was identified by several morphological features of his ear, i.e. a flat tragus being contiguous with the curved portion of the helix and an

enlarged and squarish lobule.⁵ Ear piercing, which often occurs on the lobes of females, is also a useful characteristic for forensic identification.⁶ Recent work pertains mainly to the development, quantification, and validation of hereditary variation of ears for utilization in a judicial environment now that it has been illustrated as a viable technique for identification.

Structure of Human Ear

Ear has a definite structure just like the face of an individual. As shown in (Figure 1) the shape of the ear tends to be determined by the outer rim or helix, and also by the shape of the lobe. There is an inner helix or antihelix which runs roughly parallel to the outer helix but diverse into two branches at the upper extremity. The inner helix and the lower of these two branches form the top and left side of the concha, named for its shell-like appearance. The bottom of the concha merges into the very distinctive intertragic notch. The noticeable feature is also the crus of helix where the helix intersects with the lower branch of the antihelix. This is one of the points used by lannarelli as a reference point for

his measurement system, the other point being the antitragus or the little bump on the left of the intertragic notch. The front of the concha opens into the external ear canal or acoustic or auditory meatus. Some ears have well-formed lobes, whereas others have not well-formed lobes.⁷

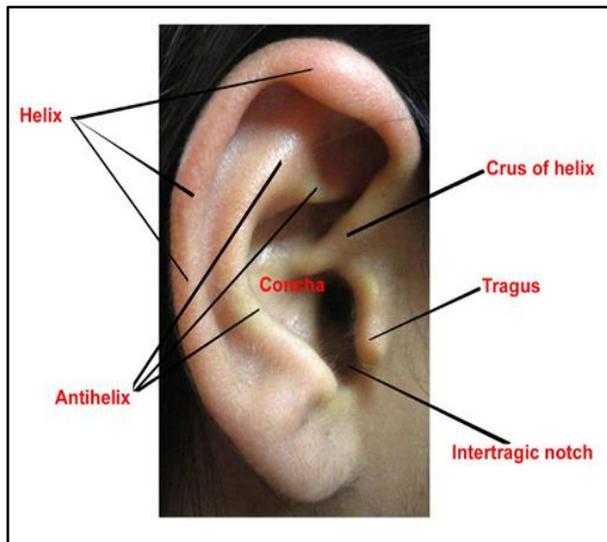


Fig 1: Human Ear

METHODOLOGY

The present longitudinal randomized study is carried on randomly selected total 100 ears (50 individuals), residing in Sriganganagar Rajasthan. The study samples include subjects aged 01 to 70 years, All the subjects are briefed about the purpose of the study and written informed consent is obtained. Thorough clinical examination is done and subjects with history of craniofacial trauma, ear diseases, congenital abnormalities or surgery of the ear, is excluded from the study.

1. **Digital vernier calliper:** It will be used to measure the anthropometric measurements of the ear.
2. **Camera:** This will be used for ear photographs.
3. **Tripod:** It will be used to stabilize the camera for a fixed distance from the subject.

Auricle Shape- Auricle shape is classified depending upon overall shapes with consideration of basic dimensions.

- 1) **Oval Type:** Width of ear measured at tragus level is smaller than ½ ear auricle length and sides of ear are rounded. This is the most common type of auricle shape.
- 2) **Round Type:** Width of ear measured at tragus level exceeds ½ of its length and both side edges of auricle are rounded to relatively equal degree.
- 3) **Triangular Type:** Shape of the ear is similar to a triangular-with an apparently wider part in the upper area of helix and narrowing towards the lobule.
- 4) **Rectangular Type:** Shape of the ear is similar to a rhomb the widths at the level of upper helix and lobule are approximately equal.
- 5) **Polygonal Type:** The outline of the ear has acute angles and a polygonal shape width in the middle part.

Lobule Condition: It is divided into two types on the basis of ear lobule attachment to the cheek

1. Attached- Ear lobule attached to the cheek
2. Detached- Ear lobule hangs freely without any attachment to the cheek



Fig 2: Oval Shaped



Fig 3: Round Shaped



Fig 4: Triangular Shaped



Fig 5: Rectangular Shaped



Fig 6: Polygonal shaped



Fig 7: Attached Lobule



Fig 8: Detached Lobule

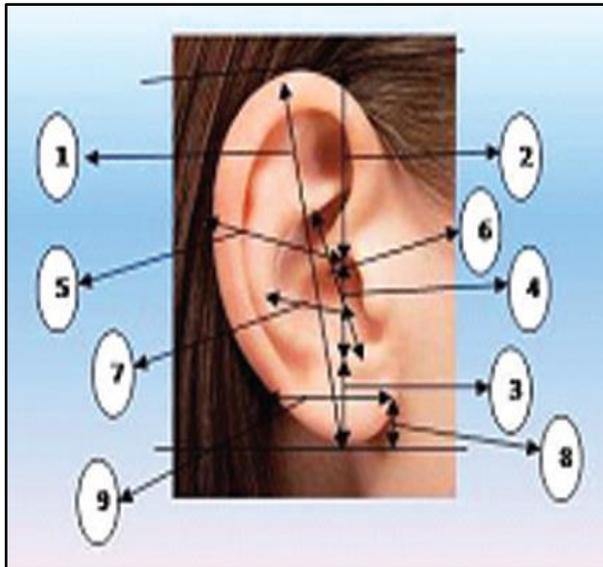


Fig 9: Biometric measurements of external ear. 1 Total ear length 2. Ear length above tragus 3. Ear length below tragus 4. Tragus length 5. Ear breadth 6. Concha length 7. Concha breadth 8. Lobule height 9. Lobule width.

The anatomical landmarks used for ear biometrics of both sides will be

- 1) **Total Ear Length (TEL):** the distance between superior most pinna point to inferior most point of lobule.
- 2) **Ear length above tragus:** distance between superior points of ear to tragus.
- 3) **Ear length below tragus:** distance between intertragic incisure to lower most lobule point.
- 4) **Tragus length:** distance between tragus to intertragic incisures.
- 5) **Ear breadth:** distance between maximum convexity of the helix and the root of ear.
- 6) **Concha length:** distance between intertragic incisures and cymba concha.
- 7) **Concha breadth:** distance between maximum concavity of the antihelix and posterior margin of tragus.
- 8) **Lobule height:** distance between inferior most point of external ear attachment head up to the free margins of ear lobe.

9) **Lobule width:** distance between outermost maximum transverse width of ear lobule and caudal most attachment of ear lobule.

All the measurements will be done on both ears using standard digital Vernier's caliper with measuring capability to the nearest 0.1mm by single investigator. The measurements will be carried out for each subject twice to get accuracy and mean of two measurements will be considered for each dimension.

RESULTS

In the present study male, (54%) outnumbered females (46%). Maximum subjects fall in 11-20 year of age group with 38 percent and minimum of 21-30 & 61-70 year of age group.

Table -3 shows that most common ear shape is oval with 56 percent while ear auricle with polygonal shape is least common i.e. 2 percent.

Percentage of oval shaped in males (36 %) is higher than females (20 %), while round shaped auricle's percentage in females 16 %, slightly higher than males (14%).

Table-4 shows that oval shaped auricle is most common shape among all age groups.

Table- 5 shows that 78% ear lobules are of detached type. Table-6 shows the various anthropometric measurements of the ear with maximum, minimum, range, mean and standard deviation.

Table 1: Gender Frequency

Gender	Frequency	Percent
Male	27	54.0
Female	23	46.0
Total	50	100.0

Table 2: Age Distribution

Age (yr)	Frequency	Percent
1-10	20	20.0
11-20	38	38.0
21-30	4	4.0
31-40	12	12.0
41-50	22	22.0
61-70	4	4.0
Total	100	100.0

Table 3: Distribution of shape of ear

Ear Shape	Frequency	Percent
Oval Shape	56	56.0
Round Shape	30	30.0
Triangular Shape	12	12.0
Polygonal Shape	2	2.0
Total	100	100.0

Table 4: Distribution of shape of ear among gender

Gender	Ear Shape				Total
	Oval Shape	Round Shape	Triangular Shape	Polygonal Shape	
Male	36(36%)	14(14%)	2(2%)	2(2%)	54
Female	20(20 %)	16(16 %)	10(10%)	0(0%)	46
Total	56	30	12	2	100

Table 5: Distribution of shape of ear among age groups

Age (yr)	Shape				Total
	Oval Shape	Round Shape	Triangular Shape	Polygonal Shape	
1-10	12	6	2	0	20
11-20	20	16	2	0	38
21-30	2	2	0	0	4
31-40	8	2	0	2	12
41-50	12	4	6	0	22
61-70	2	0	2	0	4
Total	56	30	12	2	100

Table 6: Frequency of ear Lobule attachment

Ear Lobule Attachment	Frequency	Percent
Attached	22	22.0
Detached	78	78.0
Total	100	100.0

Table 7: Anthropometric measurements of external ear

Anthropometry	Minimum (mm)	Maximum (mm)	Range (mm)	Mean (mm)	Std. Deviation (mm)
Total Ear Length	52.22	78.10	25.88	62.30	5.80
Ear Length Above Tragus	21.27	38.34	17.07	29.67	3.25
Ear Length Below Tragus	12.75	24.60	11.85	18.08	3.13
Tragus Length	12.29	23.82	11.53	17.03	1.88
Ear Breath	20.70	39.68	18.98	30.49	3.64
Concha Length	17.24	28.45	11.12	23.85	2.66
Concha Breath	11.99	23.22	17.23	18.50	2.53
Lobule Height	0.00	14.08	14.08	6.35	3.58
Lobule Width	14.57	27.49	12.92	20.78	3.04
Lobule Thickness	3.20	6.96	3.76	5.47	0.93

DISCUSSION

Results showed that most common type of ear shape is oval shaped and least common shaped auricle is polygonal with more percentage in males (2%). It is seen from all the observations that rectangular shaped auricles are not seen among males and females both.

In ear lobule attachment type, detached ear lobule is most abundant among the sample. In a study conducted in 2017,^{8,9} showed that oval shape of ear auricle is commonest type with 61.33%, with more detached ear lobule type with 65.66%. In our study mean of total ear length is 62.30 ± 5.80 . One study was conducted in 2020 showed mean right ear height (REH) 58.97 ± 3.55 .¹⁰ A similar study has been done in Northern Nigeria, in which all these parameters showed the lower values as compared to the present study. Thus, it proves that ethnic variation exists in the anthropometry of the ear auricle becomes essential among Indians.

CONCLUSION

Ears can be used in identification of unknown persons especially in cases of mass disasters, burns, drowning etc., where the face is severely disfigured. The identity can be established through methods based on the morphology and measurements of ears of the victim. Postmortem photographs of left and right ears taken

are compared with the victim's ante mortem photographs supplied by his family. Among the various parts of the auricle, the ear lobe is more often used in forensic cases. The shape of the lobe can also be used for personal identification. Whether the ear lobe is attached or not is an international standard for identification in disaster victim identification.

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