

A STUDY OF MORPHOLOGICAL VARIATIONS OF THE HUMAN EAR

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Abstract: Background: External human ear is considered to be a highly variable structure showing different morphological and individualistic features in The uniqueness of the ear may be useful in establishing the identity of individuals by direct examination, during the examination of CCTV footage or analysis of the ear prints. Considering the forensic significance of the human ear and ear prints encountered at the scene of the crime, the present study is an attempt to evaluate various morphological characteristics of the ear .

Methodology: The sample for the present study comprises of 90 males and 87 females aged of the 19 years. characteristics such as overall shape of the ear, size and shape of the tragus.

Results: The oval-shaped ear was present among 40% of the males and 44.8% of the females in the study sample. The other types of the ear such as oblique, rectangular, round, and triangular were also found in both sexes.

Bilateral asymmetry was observed in the shape of the ear. The shape of the tragus also varied with respect to the left and right sides as well as sexes.

Conclusion: The present study shows that the individualistic characteristics of the ear can provide very useful information for personal identification in forensic examinations. The shape of the ear and tragus, show a variety of structures and individuality. The importance and variability of the human ear may encourage the researchers in conducting further studies and solving the forensic cases pertaining to the investigation of CCTV footage and in examination of dead in airplane crashes, intentional mutilation and dismemberment, explosions, or other mass disasters.

Keywords: Forensic science, Forensic anthropology, Personal identification, Human ear, Morphological variations .

1. INTRODUCTION

The human ear is another organ of the body which is unique to an individual. Like fingerprints and other characteristics of the human body, the ear retains certain individualistic characteristics which are unique due to variations in the anatomical structure of the external ear (Iannarelli 1989). In certain situations, where the dead body is recovered in dismembered or mutilated conditions, the shape, size, and individualistic features of his ears may be useful in identifying the deceased along with other identification characteristics of the human body. In the recent past, it has also been shown that like the ear, the prints left by the human ear are also individualistic to an individual (Krishan and Kanchan 2016; Meijerman 2006). The earprints can be left by the criminals/burglars while listening at the doors or windows of the target house. In the present scenario when the crimes are recorded by CCTV cameras, an expert may be asked to identify the individual/suspect on the basis of CCTV footage where the ear of the suspect is clearly visible. Many studies have been conducted worldwide to show variations in human ears morphologically and morphometrically. Some recent studies (Rubio et al. 2017; Cameriere et al. 2011; Purkait 2016; Verma et al. 2016; Vanezis et al. 1996) have shown that every part of the external ear is morphologically unique and shows reasonable variations in individuals and population groups. These studies have described different types and shapes of the ear and various forms of the tragus.

2. MATERIALS AND METHODS

The study was conducted in department of anatomy in Faculty of Medical Sciences, University "Goce Delcev" - Stip. The sample for the present study comprises of 90 males and 87 females aged of the 19 years characteristics such as overall shape of the ear, size and shape of the tragus.

The photographs of the ears were taken with the help of Dig. Camera Sony DSC-W810 Cyber-Shot at the same distance in all the subjects

Table 2 shows the frequency distribution of the shape of the tragus (Fig. 2) among both sexes in the studied subjects. Single knob tragus was found to be common (66.3% males and 95.3% females for the left ear; 72.2% males and 94.3% females for the right ear) among both

sexes in the studied population. The results indicate that the significant sex differences exist as far as the single knob tragus is concerned with predominance in females. The frequency of the double knob tragus was very low, 2.3% and

3.4% in the left and right ears of females, respectively; however, the trait is totally absent in males. Long-type tragus was absent in females; however, the trait was found among 4.4% and 5.6% of males on the left and right sides, respectively. Round-type tragus was observed in 22.2% and 2.3% on the left and right sides, respectively, in both sexes. The shape of the tragus also varies with respect to the left and right sides as well as sexes.

3. METHODOLOGY

Morphological characteristics of the study were evaluated in order to develop standards for the unique morphology of the ear in the population. The ears of the subjects were photographed, and some peculiar characteristics were noted in the studied population. The photographs of the ears were taken with the help of Dig. Camera Sony DSC-W810 Cyber-Shot at the same distance in all the subjects

4. RESULTS

The results of the present study show that every ear is unique in shape and size and with respect to various other morphological features. The uniqueness/ individuality of the ear can be judged from the variable structure of the ear in every individual. Table 1 shows the frequency of the overall shape of the left and right ears in the both sexes. Oval shape (Fig. 1) of the ear was common (40% males and 44.8% females for the left ear; 40.2% males and 46% females for the right ear) among the overall sample of the study in both sexes. The rectangular (8.9% males 9.2% females for the left ear; 2.2% males and 8% females for the right ear) and triangular types (8.9% males and 12.6 females for the left ear; 6.7% males and 11.5% females for the right ear) of the ears were the rare variants reported in the study. The other types of the ear such as the oblique and round were also found in both sexes. Slight sex differences were observed as regards the overall shape of the ears in the subjects. Bilateral asymmetry exists as regards the shape of the ear, however, not significant.

Table 1 Shape of the ear in males (N = 90) and females (N = 87)bilaterally

Shape of the ear	Male		Female	
	Right (N , %)	Left (N , %)	Right (N , %)	Left (N , %)
Oval	38, 42.2%	36, 40.0%	40, 46.0%	39, 44.8%
Oblique	26, 28.9%	20, 22.2%	14, 16.1%	14, 16.1%
Rectangular	2, 2.2%	8, 8.9%	7, 8.0%	8, 9.2%
Round	18, 20.0%	18, 20%	16, 18.4%	15, 17.2%
Triangular	6, 6.7%	8, 8.9%	10, 11.5%	11, 12.7%
Total	90, 100%	90, 100%	87, 100%	87, 100%



Fig. 1 Photographs showing the shape of the ear. a Oval. b Triangular. c Rectangular. d Round

Table 2 shows the frequency distribution of the shape of the tragus (Fig. 2) among both sexes in the studied subjects. Single knob tragus was found to be common (66.3% males and 95.3% females for the left ear; 72.2% males and 94.3% females for the right ear) among both sexes in the studied population. The results indicate that

the significant sex differences exist as far as the single knob tragus is concerned with predominance in females. The frequency of the double knob tragus was very low, 2.3% and 3.4% in the left and right ears of females, respectively; however, the trait is totally absent in males. Long-type tragus was absent in females; however, the trait was found among 4.4% and 5.6% of males on the left and right sides, respectively. Round-type tragus was observed in 22.2% and 2.3% on the left and right sides, respectively, in both sexes. The shape of the tragus also varies with respect to the left and right sides as well as sexes.

Table 2 Shape of the ear tragus in males (N = 90) and females (N = 87) bilaterally

Shape of the ear tragus	Male		Female	
	Right (N , %)	Left (N , %)	Right (N , %)	Left (N , %)
Double knob	0, 0%	0, 0%	3, 3.4%	2, 2.3%
Single knob	65, 72.2%	66, 73.3%	82, 94.3%	83, 95.4%
Long	5, 5.6%	4, 4.5%	0, 0%	0, 0%
Round	20, 22.2%	20, 22.2%	2, 2.3%	2, 2.3%
Total	90, 100%	90, 100%	87, 100%	87, 100%

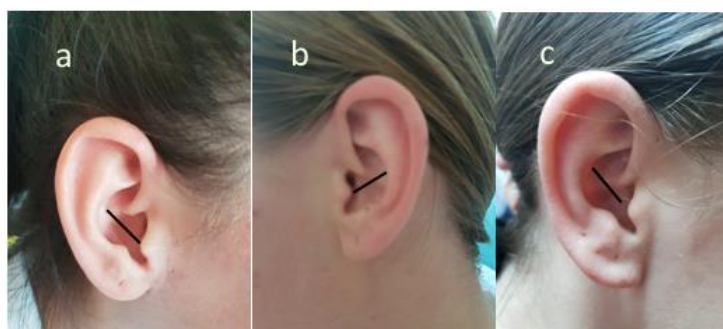


Fig. 2 Photographs showing the different shapes of the ear tragus. a Knob. b Round. c Long

5. DISCUSSION

The results of the study indicate that the oval-shaped ear was present among about 40% of the males and 44.8% of the females in the study sample. The other types of ear such as oblique, rectangular, round, and tri-angular were also found in both the sexes. Bilateral asymmetry exists as regards the shape of the ear. The size and shape of the tragus also vary with respect to the left and right sides as well as sexes.

A few studies are available in the literature (Rubio et al. 2017; Cameriere et al. 2011; Purkait 2016; Verma et al. 2016; Vanezis et al. 1996; Purkait and Singh 2008; Alexander et al. 2011; Kearney 2003) regarding the morphological characteristics of the ear which enhance the anthropological and forensic knowledge about the ear and its variability in different populations

6. CONCLUSION

The study concludes that the oval-shaped ear was present among 40% of the males and 44.8% of the females in the study sample. The studied population also showed other types of the ear such as oblique, rectangular, round, and triangular in both sexes. The shape of the tragus also varied with respect to the left and right sides as well as sexes.

REFERENCES

- Ahmed AA, Omer N (2015) Estimation of sex from the anthropometric ear measurements of a Sudanese population. *Leg Med (Tokyo)* 17(5):313 – 319
- Alexander KS, Stott DJ, Sivakumar B, Kang N (2011) A morphometric study of the human ear. *J Plast Reconstr Aesthet Surg* 64(1):41 – 47
- Cameriere R, DeAngelis D, Ferrante L (2011) Ear identification: a pilot study. *J Forensic Sci* 56(4):1010 – 1014
- Emersic Z, Struc V, Peer P (2017) Ear recognition: more than a survey. *Neurocomputing* 255(13):26 – 39
- Guyomarc'h P, Stephan CN (2012) The validity of ear prediction guidelines used in facial approximation. *J Forensic Sci* 57(6):1427 – 1441
- Kumar A, Chan TS (2013) Robust ear identification using sparse representation of local texture descriptors. *Pattern Recogn* 46(1):73 – 85
- Purkait R (2016) External ear: an analysis of its uniqueness. *Egypt J Forensic Sci* 6(2):99 – 107

- Rubio O, Galera V, Alonso MC (2017) Morphological variability of the earlobe in a Spanish population sample. *Homo* 68(3):222 – 235
- Rubio O, Galera V, Alonso MC (2015) Anthropological study of ear tubercles in a Spanish sample. *Homo* 66(4):343 – 356
- Yuan L, Chun Mu Z (2012) Ear recognition based on local information fusion. *Pattern Recogn Lett* 33(2):182 – 190