International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

The Morphometric Variations of External Ear between Asian and African Population

Lakshmi Sai Sneha Nedunuri[1], Dhwani Patel[2]

[1]PG Student MSc. Forensic Odontology, Gujarat Forensic Sciences University

[2]Assistant Professor, Forensic Odontology Gujarat Forensic Sciences University

Abstract: ***The morphometric characteristics of the external ear is different for every individual. This unique characteristic of the external ear morphometry can be used for identification of an individual in various circumstances where ear is considered as an evidence. Aim and Objectives: To compare the morphometric variations of external ear between Asian and African population. Material and Methods: The study was conducted on a total of 36 people with 20 male and 16 female which includes 16 subjects from African population and 20 from the Asian population. A total of nine ear parameters including two indices were recorded using a digital Vernier's calliper and two indices were calculated for both the ears. Independent t-test was performed to evaluate significant relationship between different variables. Results: After the analysis of the independent t–test results, few parameter showed significant difference (p<0.05) between the Asian and African groups. The details of the results are discussed below.***

Keywords: *ear morphology, morphometric analysis, otoscopy*

1. Introduction

Since late 19th century ear has been used as a tool for human identification when it has been utilized as one of the anthropometric measurements by Alphonse Bertillon for individual identification. The fetal development of the ear starts by the 38th day with some of the features recognizable, the ear moves to its definitive position on the 56th day and the shape is recognized by 70th day. Ear has a fixed shape and never changes throughout life [1]. The most defining feature of the face is the pinna of the ear the shape and size varies according to the ethnic origin, sex and age.The morphometry of the ear is as unique as fingerprints but can be considered generally based on the ethnicity, age, and sex of the individuals [2]. The appearance of the external ear differs from every individual and also between ethnic races. The morphometry of the ear and its biometrics can be used for the identification and the database can be created which can be used for both inclusion and exclusion of the perpetrators in criminal cases. The morphology of the external ear is important to detect the racial variability and any genetic abnormalities during the early stages of life [3]. The superior border of the ear is at the level lower end of the eyebrow and the inferior border is at the level equal to the upper lip in both males and females [4]. The feature that makes ear an important tool for biometrics is that the ear shape does not change with the change in the facial expressions. As ear is large when compared to the other biometric parameters (like iris, retina and fingerprints) it can be recorded or captured at a distance. According to the study done by Yan et al. recognition of 97.8% has been achieved by using a range scanner and Iterative Closest Point (ICP) [5].

2. Aim and Objectives

To compare the morphometric variations of external ear between Asian and African population.

Objectives

1) To observe if there is any significant difference between the morphometric analysis between Asian and African population.
2) To observe if there is any significant difference between male and female of the same population group.
3) To compare and observe the significant difference between males of both the population groups.
4) To compare and observe the significant difference between females of both the population groups.

3. Material and Methods

The present pilot study was conducted on a total of 36 subjects including male and female. The study sample included subjects aged from 20 to 35 years, of which 20 subjects were males and 16 were females which includes 16 from African population and 20 from Asian population . The purpose of the study was explained to all the subjects and a written informed consent was obtained. Subjects were evaluated thoroughly and the subjects with craniofacial abnormalities or any other deformities (trauma, any history of surgery) were excluded. The parameters and the anatomical landmarks used for measurements are taken from the study done by Dr. Pradhuman Verma in 2016.The lobule attachment whether free or attached is also considered.

1) Total Ear Length (TEL): the distance between superior most pinna point to inferior most point of lobule.
2) Ear length above tragus (ELAT): distance between superior point of ear to tragion.
3) Ear length below tragus (ELBT): distance between intertragic incisure to lower most lobule point.
4) Tragus length (TL): distance between tragion to intertragic incisures.
5) Ear breadth (EB): distance between maximum convexity of the helix and the root of ear. 6) Concha length (CL): distance between intertragic incisures and cymba concha.
6) Concha breadth (CB): distance between maximum concavity of the antihelix and posterior margin of tragus.

7) Lobule height (LH): distance between inferior most point of external ear attachment head up to the free margins of ear lobe.
8) Lobule width (LW): distance between outermost maximum transverse width of ear lobule and caudal most attachment of ear lobule.

All the measurements were recorded on both ears using standard digital Vernier's calliper with measuring capability to the nearest 0.1mm. The ear index and lobule index are calculated from the recorded measurements.
Ear index = (ear width/ ear length x 100)
Lobule index = (lobule width / lobule height x 100).

4. Results

The percentage of attached (22%) and free (78%) was noted in both the population groups with equal gender and racial distribution.The parameters TEL, ELBT, EB, LH and LW of both the sides and CB of the left side are greater in Asian population. The other parameters RELAT, RTL, RCL, RLI, LCL, LEI and LLIare greater in African population. The parameter RCB, REI, LELAT, LTL show no significant difference in the mean difference between Asian and African population.These parameters ELBT, LH, LW of both the sides show significant difference ($p< 0.05$) between both the population groups. These parameters TL, EB CL of both the ears, CB of the right side and TEL, ELATof the left side of the ears show significant difference between male and female of both the populations together.

No parameter shows a significant difference between females of two population groups.The parameters ELBT, LH, LW of both the sides and TEL, ELAT of the left side of the ear show significant difference between males of both the population groups.

Parameters	*P-Value*	*Mean Difference*
RELBT	.018	AFRICAN 15.86 ASIAN 17.83
RLH	.018	AFRICAN 15.86 ASIAN 17.83
RLW	.033	AFRICAN 16.94 ASIAN 18.91
LELBT	.005	AFRICAN 15.80 ASIAN 18.27
LLH	.005	AFRICAN 15.80 ASIAN 18.27
LLW	.009	AFRICAN 15.95 ASIAN 18.28

These are the parameters that show significant difference between the African and Asian population groups.

Parameters	*p- value*	*Mean difference*
RTL	.008	F 16.20 M 17.66
REB	.022	F 28.99 M 31.34
RCL	.000	F 23.15 M 26.04
RCB	.017	F 15.44 M 16.84
LTEL	.004	F 57.04 M 61.82
LEAT	.004	F 25.6 M 28.68
LTL	.000	F 15.12 M 17.63
LEB	.011	F 29.4 M 32.4
LCL	.001	F 23.4 M 26.02

These are the parameters that show significant difference in both African and Asian population groups between males and females

parameters	*P value*	*Mean difference*
RELBT	.003	AFRICAN 15.74 ASIAN 18.88
RLH	.003	AFRICAN 15.74 ASIAN 18.88
RLW	.011	AFRICAN 16.41 ASIAN 19.54
LTEL	.018	AFRCAN 58.88 ASIAN 64.76
LELAT	.026	AFRICAN 27.15 ASIAN 30.21
LELBT	.002	AFRICAN 15.55 ASIAN 19.56
LLH	.002	AFRICAN 15.55 ASIAN 19.56
LLW	.029	AFRICAN 15.86 ASIAN 18.62

These parameters in the above table show significant difference amongst males in both Asian and African population groups. P value < 0.05 is significant and < 0.01 is highly significant.

5. Discussion

This study uses all the parameters from the study done by Dr. Pradhuman Verma in 2016 with a change in the lobule height parameter for more accuracy. In this study the lobule height measured was from the same points used for ear length below the tragus, this is done to avoid theintra observer errors while recording the distance between inferior most point of external ear attachment head up to the free margins of ear lobe.In the present study, from the overall measurements seen the length of the ears in males of Asian population is more than that of the African population. All the parameters except lobule index are more in males than in females in both the population groups. In our study the percentage of free lobule is more than the percentage of attached lobule.This current study is in accordance withto the Verma.K et al., study among the rickshaw drivers of central India were 66.46% ears lobe is free and 33.53% is attached [1, 6].Gates observed that the attached ear lobule is possibly an African character with recessive inheritance pattern [1, 7]. Azaria also noticed that the lobule is smaller amongst black Africans compared with other ethnic groups [2, 8].The ear width of males in Indian > Caucasian > Afro-Caribbean is greater than in females which is in accordance with this study where the ear width is more in males in both the Asian and African population groups. This study is in contrast with a study done by Kalciolglu where they found no significant difference of the ear width between males and females [2, 9].In cases with different ethnicity and individual

identification amongst same population the morphometry of the external ear is useful. The cases where ear can be used are in forensic identification and ear reconstruction cases. People from the Indian subcontinent hadthe longest ears, followed by Caucasians, with Afro-Caribbeanshaving the smallest ears, according to a study done by K. Skaria Alexander, David J. Stott, Branavan Siva Kumar, and Norbert Kang [2].The total ear length is important in cases of congenital anomalies like Down's syndrome and also in forensic cases of facial reconstruction. The age of maturity is 12 years in females and 13 years in males to reach the maximum height. The total ear length is more in males than in females in a study done in north eastern (60.03mm left side mm; 61.58mm right side) and the north western (61.11mm left side and 63.74mm on the right side) population groups. The TEL of left ear in men was found to be 62.4mm, 63.1mm and 61.4mm respectively according to the studies done by Purkait R., Bozkir et al., and Asai Y et al. [1, 10, 11, 12]. This is justified as there is more release of growth hormone in males than in females at this age which is in accordance to this study where the ear length is more in males than in females. In this study all the measurements recorded were more in males than in females (excluding the indices) which is accordance to the study conducted by Ekanem et al., Eboh DEO and Deopa D et al., [1, 13, 14, 15].

6. Limitations

- The sample size is very small.
- The age related changes in the morphometry of the ear are not recorded.
- The possibilities for inter and intra observer error should be considered.

7. Conclusion

Through this study the morphometry of the ear can be differentiated between the Asian and the African population groups which can be used to identify individuals based on the ethnicity. If the study could be extended to a larger population groups then two different database can be created for two different population groups like a fingerprint database which makes the identification process much easier and convenient in criminal and disaster cases.

Acknowledgements

I sincerely thanks Dr. Kalgi Shah, Dr. Dhruv Patel and all my classmates for their help and constant support.

References

[1] Verma P. Morphological Variations and Biometrics of Ear: An Aid to Personal Identification. JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH. 2016;
[2] [2] Alexander K, Stott D, Sivakumar B, Kang N. A morphometric study of the human ear. Journal of Plastic, Reconstructive & Aesthetic Surgery. 2011; 64(1):41-47.
[3] [3] Vijay Laxmi, Palak, Sharma Nidhi, JS Kullar, RK Sharma. EXTERNALEAR: MORPHOLOGICAL AND MORPHOMETRIC STUDY INNORTH INDIAN MALES AND FEMALES. Int J Anat Res 2017; 5(2.2):3866-3869. DOI: 10.16965/ijar.2017.206
[4] Singh P, Purkait R. Observations of external ear—An Indian study. HOMO. 2009; 60(5):461-472.
[5] Hurley D, Arbab-Zavar B, Nixon M. The Ear as a Biometric. Handbook of Biometrics. :131-150
[6] Verma K, Bhawana J, Kumar V. Morphological variations of ear for individual identification in forensic cases: a study of an Indian population. *Res. J. Forensic Sci.* 2014; 2(1):1-8
[7] Gates RR. Etudes sur le croissement de races (III Nouvelles observations concernant les Oreilles, en particulier les lobes.). *J Genet Hum*. 1954; 3:95-112.
[8] Azaria R, Adler N, Silfen R, et al. Morphometry of the adult human earlobe: a study of 547 subjects and clinical application. Plast Reconstr Surg 2003 Jun; 111:2398e402.
[9] Kalcioglu MT, Miman MC, Toplu Y, et al. Anthropometric growth study of normal human auricle. Int J Pediatr Otorhinolaryngol 2003 Nov; 67:1169e77.
[10] Purkait R. Ear biometrics: an aid to personal identification. *Anthropologist Spl*. 2007; 3:215-18.
[11] Bozkir MG, Karakas P, Yavuz M, Dere F. Morphology of the external ear in our adult population. *Aesthetic Plast Surg*. 2006; 30:255-59.
[12] Asai Y, Yoshimura M, Nago N, T Yamada, et al. Why do old men have big ears? Correlation of ear length with age in Japan. *BMJ*. 1996; 312:582.
[13] Ekanem A.U., Garba SH, Musa TS, Dare ND. Anthropometric study of the pinna (auricle) among adult Nigerians resident in Maiduguri metropolis. *J Med Sci*. 2010; 10(6):176-80
[14] Eboh D. Morphological changes of the human pinna in relation to age and gender of Urhobo people in Southern Nigeria. *J Cli Exp Anat*. 2013; 12:68-74.
[15] Deopa D, Thakkar HK, Prakash C, Niranjan R, Barura MP. Anthropometric measurements of external ear of medical students in Uttarakhand. *J Ana Soci India*. 2013; 62:79-83