ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Dixit *et al*., 2019
DOI:10.21276/SSR-IIJLS.2019.5.5.2

Research Article

open access

Morphometric Study of Pinna in Relation to Age in Uttar Pradesh Population

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Received: 11 Apr 2019/ Revised: 09 Jul 2019/ Accepted: 27 Aug 2019

ABSTRACT

Background: Morphometric dimensions of ear plays a very important role in plastic surgery and prosthetics. This study aimed to determine different morphometric parameters of both ear and to provide information regarding age related changes.
Methods: A study was conducted on 167 subjects including both males and females. The ear was measured using vernier caliper with an accuracy of 0.001 and recorded in millimeters (mm) in a data sheet. The size of pinna and the lobule were measured on both right and left side and were correlated with age of the individual. Readings were statistically analyzed in order to determine the relationship between the size of the pinna and the age of the individual.
Results: In our study of age 18–30 ear length was 6.15 cm, lobule length and width was 1.87 cm and 1.99 cm and in age 31–40 ear length was 6.32 mm, lobular length and width was 1.95 cm and 2.01 cm and in age 41–50 yrs ear length was 6.415 cm, lobular length and width was 1.98 cm and 2.06 cm. This shows that in our study ear length were increasing significantly with age and similarly Rt and Lt lobular length and Lt lobular width were also increasing significantly with the age. There was no significant difference between the size of the right and left pinna.
Conclusion: The present study shows that the expansion of auricle with age was related to structural change in auricular cartilage. The ear morphometry also helps in predicting ear anomalies and to reproduce anatomically corrected ear during its reconstruction.

Key-words: Ear auricle, Ear length, Ear lobule, Ear width, Morphopometry

INTRODUCTION

Human ear is a complex, curved inter wined substructure as compared to rest of human body, its shape is framed in such a way to allow spatial localization of sounds [1]. Human ear convey sign of age and gender that are ill defined [2]. The anatomical structures of the external ear are utilized for personal identification of living subjects in relation to criminal activity.

How to cite this article
Dixit V, Potdar P, Dhakar JS. Morphometric Study of Pinna in Relation to Age in Uttar Pradesh Population. SSR Inst. Int. J. Life Sci., 2019; 5(5): 2379-2386.

Access this article online
https://iijls.com/

There have been claims in recent years that the external ear may be utilized for personal identification of both living and deceased individuals [3]. So knowledge about normal auricular dimensions is important in diagnosis of congenital malformation syndromes and acquired deformities. The size of human auricle continues to enlarge until advanced age and it is well known that this structural changes of auricular cartilage is associated with morphological age changes of elastic fibers, which was one of important cause of expansion of auricle even after adulthood [4,5]. Many studies have been done on expansion of ear auricle by measuring the size of auricle but mechanism of expansion is still not clear [6]. Although various studies on morphological changes of auricular cartilage with age changes and few on fine structure of auricular cartilage have been reported but

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no literature are available on ultra structural age changes in human auricular cartilage [7,8]. The human ear is divided into external, middle and internal parts. The pinna and the external acoustic meatus form the external ear. The lateral surface of the pinna is irregularly concave, faces slightly forward and displays numerous eminences and depressions (Fig. 1). It was of great interest that elastic fibers in auricular cartilage undergoes structural changes with age similar to dermis of skin as this elastic fibers play a fine role in extension of auricular length after puberty [9,10]. In the present study, we measured various parameters of human and also determined the relationship between ear sizes with age of the adult North Indian population.

Fig. 1: External features of ear

MATERIALS AND METHODS

The present study was carried out on the North Indian population, in the age group of 18–60 years including 167 Males and 33 Females. Written consent was obtained from each participant in a prescribed format. Each participant was informed about the nature of the study before obtaining the consent. Healthy individuals in an age group of 18–60 years, without any deformity or abnormality and willingness to participate in the study were included in this study. Age groups below 18 and above 65 years of age, having any type of physical deformity or ear injury were excluded. The subjects were divided into four groups according to their age at intervals of 5 years.

The measurements related to total ear length and ear width and lobule length and width were taken with a digital Vernier Caliper as shown in Fig. 2.

Fig. 2: Digital Vernier Caliper

The observations were made according to the methods of Eboh [11]. Each subject was made to sit in a natural head position in a chair with a backrest and positioned in such a way so that the eyes of the subject looks straight forward with the lower border of the eye sockets in the same horizontal plane as the external auditory meatus.
Total ear length was measured as the distance from the most superior point of the helix (A) to the most inferior point of the ear lobule (B). Total ear width was determined by measuring along the broadest part of the pinna from the (D) to (C) as shown in Fig. 3.

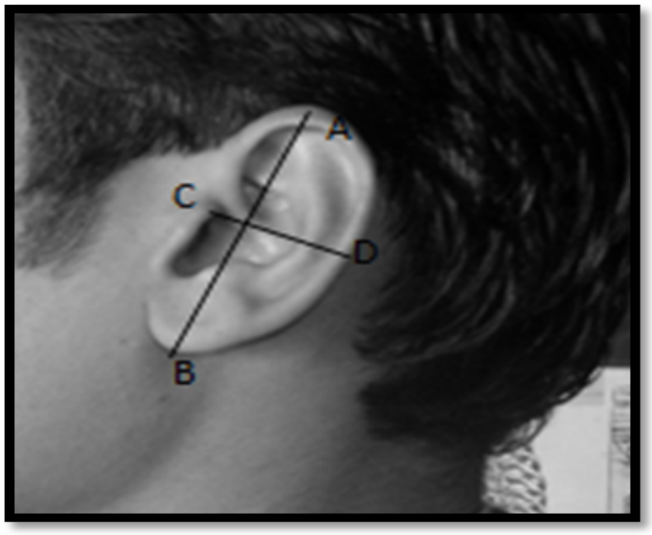

Fig. 3: Left pinna showing the total length A to B and ear width from C to D

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Total lobule length was taken as the distance from the tip of anti-tragus (E) to most inferior point of the lobule (B) and the total lobule width was measured as the horizontal distance of the lobule at the midpoint of the lobule length (EB) as shown in Fig. 4.

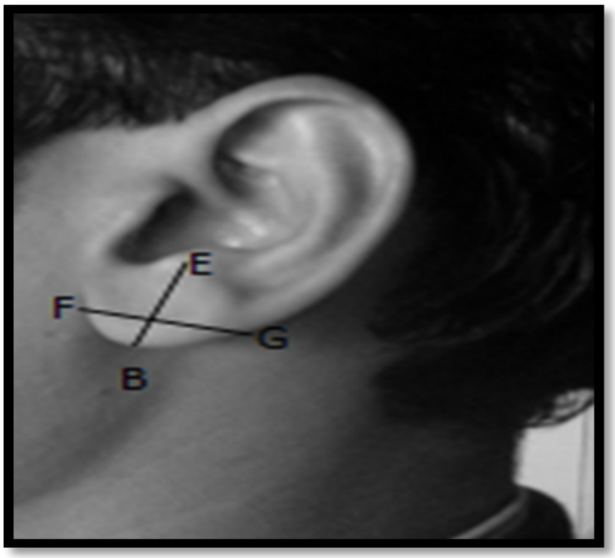

Fig. 4: Left pinna lobule length E to B and lobule width from F to G

Statistical Analysis- All the four parameters of right and left ears were taken by digital venier caliper with an accuracy of 0.001 and recorded in millimeters (mm) in a data sheet. All subjects were divided into four groups according to their age. The Pearson correlation is used to establish the relationship between the size of the pinna and the age of the individual and the data was analyzed using SPSS version 23, $p<0.05$ was significant.

RESULTS

The pinna of 167 subjects were measured in the age group of 18–57 years, which show that there was a gradual increase in length of the pinna with advancing age till 40–50 yrs and thereafter it is non-significant. The results have been summarized as below.

Table 1 shows that there was a gradual increase in the length of the pinna with advancing age till 40–50 yrs and thereafter it was non-significant.

Table 1: Morphometric measurements of pinna in relation to age

Groups	Age (Yrs)	Number of subjects	Mean pinna length (mm)		Mean ear width (mm)	
			REL	LEL	REW	LEW
A	18-30	114	61.58±3.86	61.47±3.8	24.41±2.51	24.53±2.4
B	31-40	54	63.23±4.68	63.18±4.45	24.72±2.36	24.71±2.43
C	41-50	24	64.15±4.23	64.02±4.31	24.63±2.25	24.6±2.60
D	51-60	8	64.36±2.59	64.36±2.59	25.7±1.75	25.7±1.75

REL– Right ear length; LEL- Left ear length; REW- Right ear width; LEW- Left ear width
P-value (>0.005)= Non-significant

Table 2 shows that there was a gradual increase in length and width of lobule from 18.79 and 19.57 mm at the age of 18–30 yrs to 21.24 mm and 21.03 mm at the age of 51–60 with advancing age.

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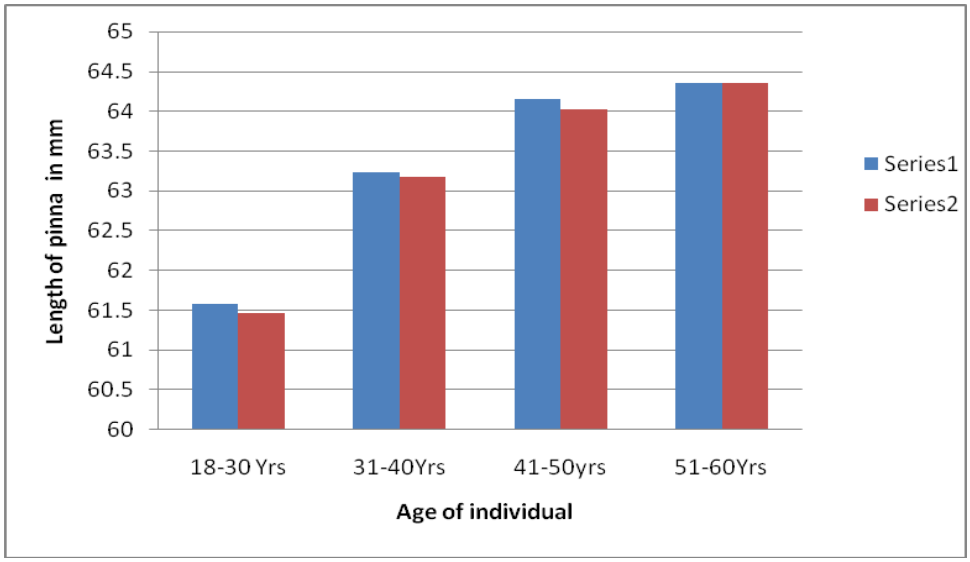

Fig. 5a: Relation between the lengths of pinna with age of individual
Series 1- Average length of right ear**, Series 2-** Average length left ear

Table 2: Morphometric measurements of lobule in relation to age

Groups	Age (Yrs)	Number of subjects	Mean lobule length (mm)		Mean lobule width (mm)	
			RLL	LLL	RLW	LLW
A	18-30	114	18.79±2.86	18.73±2.83	19.98±2.58	19.57±2.1
B	31-40	54	19.53±2.31	19.43±2.34	20.18±2.58	20.17±2.64
C	41-50	24	19.84±2.53	20.62±2.56	20.61±2.55	20.23±2.4
D	51-60	8	20.99±3.45	21.24±3.46	21.03±1.92	21.03±1.92

RLL-Right lobule length, LLL- LEFT lobule width, RLW- Right lobule width, LLW Left lobule width

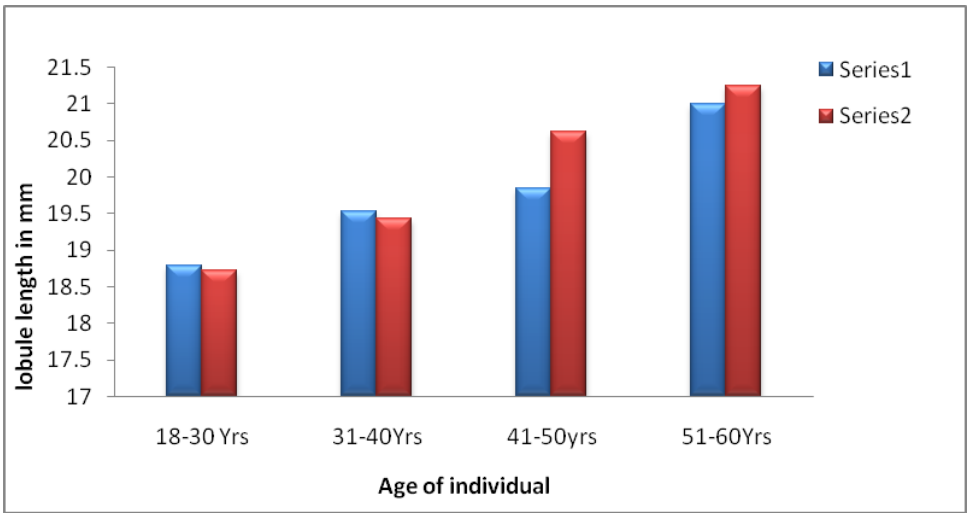

Fig. 5 b: Relation between the lengths of lobule with age of individual
Series 1- Mean length of right lobule**, Series 2-** Mean length of left lobule

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Table 3 shows that the right and left pinna length were the same. Table 3 shows that right and left ear length was 61.58 and 61.47 mm at the age of 18–30 yrs, 64.36 mm and 64.36 mm at the age of 51–60. This shows that there was a non-significant difference between right and left pinna length.

Table 3: Correlation between right and left pinna in relation to age

Groups	Age (Yrs)	Number of subjects	Mean pinna length (mm)		P- value
			REL	REL	
A	18-30	114	61.58±3.86	61.47±3.80	0.82
B	31-40	54	63.23±4.68	63.18±4.45	0.95
C	41-50	24	64.15±4.23	64.02±4.31	0.91
D	51-60	8	64.36±2.59	64.36±2.59	1.00

P-value (>0.005)= Non-significant

Table 4 shows that right and left ear width was 24.41 and 24.53 mm at the age of 18–30 yrs, 25.7 mm and 25.7 mm at the age of 51–60. This shows that there was non-significant difference between right and left pinna width.

Table 4: Correlation of right and left pinna width in relation to age

Groups	Age (Yrs)	Number of subjects	Mean ear width (mm)		P-value
			REW	LEW	
A	18-30	114	24.41±2.51	24.53±2.4	0.71
B	31-40	54	24.72±2.36	24.71±2.43	0.98
C	41-50	24	24.63±2.25	24.6±2.6	0.96
D	51-60	8	25.7±1.75	25.7±1.75	1.00

P-value (>0.005)= Non-significant

Table 5 shows that right and left lobular length was 18.79 and 18.73 mm at the age of 18–30 yrs, 20.99 mm and 21.24 mm at the age of 51–60. This shows P-value (>0.005), which means there was non-significant difference between right and left lobular length.

Table 5: Correlation of right and left lobule length in relation to age

Groups	Age (Yrs)	Number of subjects	Mean lobule width (mm)		P- value
			RLL	LEL	
A	18-30	114	18.79±2.86	18.73±2.83	0.83
B	31-40	54	19.53±2.31	19.43±2.34	0.82

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C	41-50	24	19.84±2.53	20.62±2.56	0.29
D	51-60	8	20.99±3.45	21.24±3.46	0.88

P-value (>0.005)= Non-significant

Table 6 shows that right and left lobule width were 19.98 mm and 19.57 mm at the age of 18–30 yrs which was increasing to 21.03 mm and 21.03 mm at the age of 51–60 yrs, this shows that right and left lobular width have the non-significant difference.

Table 6: Correlation of right and left lobule width in relation to age

Group	Age (Yrs)	Number of subjects	Mean lobule width in mm		P- value
			Right	Left	
A	18-30	114	19.98±2.58	19.57±2.1	0.18
B	31-40	54	20.18±2.58	20.17±2.64	0.98
C	41-50	24	20.61±2.55	20.23±2.4	0.65
D	51-60	8	21.03±1.92	21.03±1.92	1.00

Table 7 shows that the right ear length was increased significantly with age, similarly right and left lobular length and left lobular width were increasing significantly with the age as p-value was <0.001.

Table 7: Correlation of ear dimensions with age

	Total ear length (mm)		Total ear width (mm)		Lobular length (mm)		Lobular width (mm)	
	Right	Left	Right	Left	Right	Left	Right	Left
Correlation (r)	0.288	0.017	0.088	0.082	0.266	0.283	0.130	0.109
p-value	0.001	0.811	0.214	0.248	0.001	0.001	0.067	0.124

DISCUSSION

Morphometric data provides a valuable source of information to ergonomists and designers, who attempted to consider a range of body sizes and abilities in the design of occupational environments and products. Itoh *et al.* [12] studied the morphological age changes in adult human auricular cartilage in 1958 subjects and found that the histological changes of the auricular cartilage containing elastic fibers may be one of the reasons of ear length increases with age. Sharma *et al.* [13] in his morphometric study of ear lobule in 260 northwest Indians between the age of 1 to 80 years observed that maximum length of the lobule increased appreciably between 6–15 years and 41–80 years similarly our study also shows that ear length and lobule length increases from age 18 yrs to 60 yrs as 61.58 mm on right ear and 61.47 on left ear at age of 18-30, which was increased to 64.36 mm on right and 64.36 mm on left ear at the age of 51–60 yrs.

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Liu [14] incorporated anthropometric measurement on 200 hundred subjects with age 20-59 year, found that pinna length was 52.8±8.7 mm in 20 year age group, in 30 year age group pinna length was 56.3±5.8 mm and 40 year age group pinna length was 56.6±6.90 mm, and in 50 year age group pinna length was 59.1±7.1 mm showing increase in pinna length with age. Similarly in our study pinna length was 61.58±3.86 mm at the age 18–30 yrs, 63.23±4.68 mm at the age 31–40 yrs, 64.15±4.32 at the age 41–50 yrs, 64.36±2.59 mm at the age 51-60 yrs showing increase in pinna length with age. Ekanem *et al.* [15] did an anthropometric study of pinna on 217 adult Nigerians in Maiduguri between 18 to 65 years and the subjects were divided into 11 groups showed that the total ear length and total lobular length are increasing significantly as same as our study.

Sullivan *et al.* [16] shown in his morphometric study of the external ear on 123 volunteers, 89 women and 34 men with 18 to 65 years age. They divided all subjects into 3 groups with 15 year age intervals and measured total ear length, lobule length and width. In a group of 15–30 years total ear length was 6.17 cm and lobule length and width 1.78 cm and 2.10 cm similarly in our study of age 18–30 ear length was 6.15 cm, lobule length and width was 1.87 cm and 1.99 cm. In 31–45 year age group, total ear length was 6.27 cm, lobule length and width was 1.85, 1.96 cm respectively, similarly in our study of age 31–40 ear length was 6.32 mm, lobular length and width was 1.95 cm and 2.01 cm. In 46–60 year age group total ear length was 6.45 cm, lobule length and width was, 1.99 cm, 1.97 cm similarly in our study of age 41–50 yrs ear length is 6.415 cm, lobular length and width was 1.98 cm was 2.06 cm this shows that ear length and lobular length are increasing with age. Oludiran and Omotoso [17] shown in the adult of 18 to 30 year, total ear length of the left and the right side were 58.6±5.2 mm, 58.5±4.9 mm and width 33.3±4.8 mm, 34.0±4.9 mm. Total ear lobular length of left and right side was15.8±3.3 mm, 15.9±3.6 mm and total ear lobule width 17.2±4.0 mm, 17.2±4.2 mm. There were no significant differences in ear parameters of right and left side ear similar to our study. Taura *et al.* [18] reported that the correlation is higher with height in right ear width, while in our study ear length and lobular length and width were increased significantly with the age. In our study we also explained that increase in lobular length is not due to weight effects of earing but due to ageing process. Deopa *et al.* [19] observed that there were differences in anthropometric data of people from different regions in India similarly Jung [20] also surveyed the dimensions and characteristic of Korean ears and found that age, gender and different ethnic population were determinants of ear dimensions. According to Kalra and Kalra [21], the breadth of ear lobule increased up to the age of 15 yrs nearest to 0–1 mm and almost static between 16–40 yrs increases again from 41 yrs onwards while in our study ear length and ear width were increasing significantly.

When we compare our study with those of others we find there was a difference in the value of ear measurement and these discrepancies could be result of various factors such as race, genetic variable, individual constitution, environment, age and human error.

CONCLUSIONS

In the present study, we confirmed that the auricular size increased significantly after reaching adulthood until advanced age by morphometric parameters of the ear. It thus appeared that elastic fibers and components of the extracellular matrix in the auricular cartilage changed structurally with ageing. Therefore, it is concluded that further study was required to provide a different formula for different sex with large population size. With these appropriate normative data, it is hoped that better and objective reference material would be provided for the aesthetic plastic surgeon, forensic purpose, in particular, those engaged in ear rejuvenation in the country.

CONTRIBUTION OF AUTHORS

Research concept- Dr. Pratishtha Potdar
Research design- Dr. Vidit Pratap Dixit
Supervision- Dr. Pratishtha Potdar
Materials- Dr. Vidit Pratap Dixit
Data collection- Dr. Vidit Pratap Dixit
Data analysis and Interpretation- Dr. Jagmohan Singh Dhakar
Literature search- Dr. Jagmohan Singh Dhakar
Writing article- Dr. Pratishtha Potdar
Critical review- Dr. Jagmohan Singh Dhakar
Article editing- Dr. Pratishtha Potdar
Final approval- Dr. Pratishtha Potdar

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