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

Vidit Pratap Dixit¹, Pratishtha Potdar²*, Jagmohan Singh Dhakar³

¹Senior Demonstrator, Department of Anatomy, Rama Medical College Hospital and Research Centre, Hapur, U.P, India
²Associate Professor, Department of Anatomy, Santosh Medical College, Ghaziabad, U.P, India
³Statistician cum Assistant Professor, Department of Community Medicine, Santosh Medical College, Ghaziabad, U.P, India

*Address for Correspondence: Dr. Pratishtha Potdar, Associate Professor, Department of Anatomy, Santosh Medical College, Ghaziabad, India
E-mail: drpratishthagupta@gmail.com

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, Morphometry

INTRODUCTION

Human ear is a complex, curved interwined 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


Access this article online

https://ijilss.com/
no literature are available on ultra structural age changes in human auricular cartilage \cite{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 \cite{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.

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

Fig. 1: External features of ear

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

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.
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.

![Image of ear lobule measurement](image)

**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>
<thead>
<tr>
<th>Groups</th>
<th>Age (Yrs)</th>
<th>Number of subjects</th>
<th>Mean pinna length (mm)</th>
<th>Mean ear width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>REL</td>
<td>LEL</td>
</tr>
<tr>
<td>A</td>
<td>18-30</td>
<td>114</td>
<td>61.58±3.86</td>
<td>61.47±3.8</td>
</tr>
<tr>
<td>B</td>
<td>31-40</td>
<td>54</td>
<td>63.23±4.68</td>
<td>63.18±4.45</td>
</tr>
<tr>
<td>C</td>
<td>41-50</td>
<td>24</td>
<td>64.15±4.23</td>
<td>64.02±4.31</td>
</tr>
<tr>
<td>D</td>
<td>51-60</td>
<td>8</td>
<td>64.36±2.59</td>
<td>64.36±2.59</td>
</tr>
</tbody>
</table>

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.
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

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

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
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 mm 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

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

P-value (>0.005)= Non-significant

Table 4 shows that right and left ear width was 24.41 mm 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

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

P-value (>0.005)= Non-significant

Table 5 shows that right and left lobular length was 18.79 mm 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

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

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

P-value (>0.005)= Non-significant

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

<table>
<thead>
<tr>
<th></th>
<th>Total ear length (mm)</th>
<th>Total ear width (mm)</th>
<th>Lobular length (mm)</th>
<th>Lobular width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right</td>
<td>Left</td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>Correlation (r)</td>
<td>0.288</td>
<td>0.017</td>
<td>0.088</td>
<td>0.082</td>
</tr>
<tr>
<td>p-value</td>
<td>0.001</td>
<td>0.811</td>
<td>0.214</td>
<td>0.248</td>
</tr>
</tbody>
</table>

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.
effects of earing but due to ageing process. Deopa et al. showed that the increase in lobular length is not due to weight significantly with the age. In our study we also explained ear length and lobular length and width were increased higher with height in right ear width, while in our study study. Taura et al. showed that the total ear length and total lobular length were similar to our 17.2±4.2 mm. There were no significant differences in 15.9±3.6 mm and total ear lobule width 17.2±4.0 mm, lobular length of left and right side was 15.8±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 15–45 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 reported that the correlation is 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 shown in his morphometric study of the external ear on 123 volunteers, 89 women and 34 men with 18 to 65 years. 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 observed that there were differences in anthropometric data of people from different regions in India similarly Jung 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, 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. Vedit Pratap Dixit  
**Supervision-** Dr. Pratishtha Potdar  
**Materials-** Dr. Vedit Pratap Dixit  
**Data collection-** Dr. Vedit 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

REFERENCES

[1] Bozkar MG, Karakas P, Yavuz M, Dere F. Morphometric of External Ear in our Adult


