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A Morphometric Study of the External Ear Morphology among Adult Male Libyan Population

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ABSTRACT

The aim of our study is to have an idea about morphology and morphometric characteristics of external ear among Libyan adults, and to generate anthropometric normative cross-sectional data for Libyan population. Total (191) male volunteers were randomly selected for this study. The cohort consisted of ages 19 to 23. The average total ear height across the entire cohort for both left and right ears was (60.760 ± 5.31 mm), the average ear breadth was (31.15±3.025), lobular height was (13.697 ± 4.24), and average lobular width was (9.210 ± 4.21mm). Between individuals such parameters showed a high percentage of differences, and when analyzed the differences were statistically significant.

Keywords *– Morphometric; Morphology; Lobule; Tripoli, Libya.*

INTRODUCTION

Anthropometry is a series of measuring procedures of different parts of human body or his skeleton before or after death, and the results is expressing quantitatively the form of the human body.[1-2] Forensic scientists introduced system that uses various parts of body measurements which the size remains constant throughout the life after attaining its full growth, such as head, finger, and ear which is so unique that any individual could be identified if that part of the body was properly measured and compared what is known today as forensic anthropology which is one of the sub disciplines in forensic biology which usually applied in identification of human remains.[3]

Human ear, as it influence the one face appearanceand malformed auricle may have negative affect on face appearanc, as its appearance and symmetry contribute to facial aesthetics and otoplasty.[4-6]

Surgery increases in popularity with each successive year and plastic surgeons should have data available to define the limits of normal ear shape, size and orientation when treating congenital abnormalities of the pinna.[7]

The results of morphometric studies plays role in many fields of medicine such as prosthetics, personal identification[8], beside other roles in industrial and clothing design[9], and the possibility of using ear characteristics for assessing familial relationships, because the morphology of ears tends to be hereditary.[10-11]

Symmetry between both sides have studied over years, Ferkas noted asymmetry between left and right ears in a pediatric population[3,12], this is well documented in many parts of the world[13,14], but such variations not documented yet among Libyan and this study is the first of its kind.

The main aim of the current study is to examine the morphometries of different anatomical componints of libyan adult male external ears, to see If there is a significannt morphological variations between adult libyan male ears, and to compare our findings with the findings of others, so this study presents the first insight to general main features of adult male libyan ear external morphology.

MATERIALS AND METHODS

This study was conductes on randomaly selected 191 male adult volunteers from University of Tripoli in the capital of Libya, with age 19 to 23, any one with evidence of congenital anomalies or previous history of ear surgery were excluded from this study.

All basic information such as age, sex, wieght and hight were recorded against each volunteer.

Farkas presented his method of measuring ear parameters.[2] We used many of Farkas' measurements for this study, and adapted some to improve precision and reproducibility, objective measurements were made in the sitting position with the head in the Frankfort horizontalplane.[15]

The standardized measurements of the following parameters were taken carefully, by the same person every time in order to minimize bias and the investigator suspected to intensive and detailed study of normal anatomy of external ear in order to minimize error of identification of ear landmarks, mark points distance was calculated in mm using digital caliper with the resolution 0.01mm.

Standardized measurments of the pinna were taken according to the landmark points defined by De Carlo et al., and the metodologey was adopted from Mckinney et

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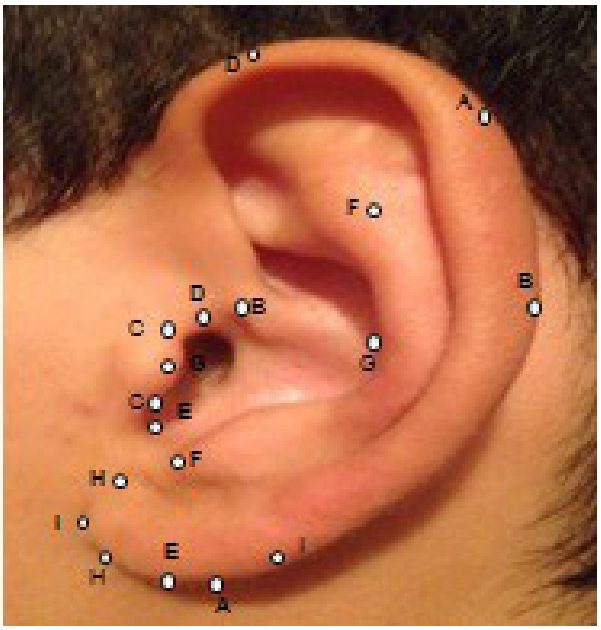

Figure 1: Shows location of different anatomical landmarks of ear

Total Ear Length (AA), Ear Breadth (BB), Tragus Length (CC), Ear length above tragus (DD), Ear length below tragus (EE), Concha Length (FF), Concha Breadth (GG), Lobule Length (HH), Lobule Breadth (II).

al., and Brucker et al.[16,17]

The anatomical landmarks (Figure 1) used for this research study were;

1. Total Ear Length (TEL): distance from the most inferior projection of ear lobule to the uppermost of the pinna.
2. Ear Width (EW): distance from root of the ear to maximum convexity of the helix.
3. Lobule Hight: distance from lower point of attachment of the external ear to the head to the distal extension of the ear lobe free margin.
4. Lobule Width (LW): the transverse width of the lobule at the midoint of the lobular height.
5. Tragus length: distance between tragion to intertregic incisures.
6. Ear length above tragus: distance between superior points of ear to tragion.
7. Ear length below tragus: distance between intertragic incisure to lower most lobule point.
8. Concha length: distance between intertragic incisures and cymba concha.
9. Concha breadth: distance between maximum concavity of the antihelix and posterior margin of tragus.

Data analysis:

The data collected was recorded and subjected to statistical analysis like Mean, Standard Deviation (S.D.) and Student t-test used to show significant difference. They were analyzed using Statistical Package for Social Sciences

Table 1: The mean ear parameters in mm from Libyan medical students.

Parameter mm	Right	Left	Combined
Total Ear Length	60.42 ± 4.71	61.10 ± 5.86	60.760 ± 5.310
Lobule Height	13.63 ± 3.94	14.06 ± 4.12	13.697 ± 4.240
Lobule Width	9.98 ± 3.94	8.64 ± 4.20	9.210 ± 4.210
Ear Breadth	31.02 ± 3.10	31.28 ± 2.95	31.150 ± 3.025

Table 2: Shows the mean SD correlation between the mean anatomical landmarks of right ear length (REL), Left ear length (LEL), right ear breadth (REB), left ear breadth (LEB) right lobule width (RLH), left lobule width (LLW), right lobule height (RLH) and left lobule height (LLH).

	REL	LEL	REB	LEB	RLW	LLW	RLH	LLH
Mean	60.42	61.10	31.02	31.28	13.63	14.06	9.980	8.64
SD	4.71	5.86	3.10	2.95	3.94	4.12	3.945	4.20
T, test	0.10			0.20		0.15		0.001

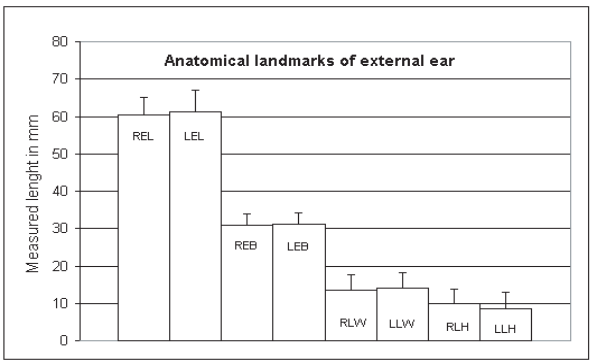

Figure 2: Shows the comparison of anatomical landmarks of external right and left ear from Libyan Medical Students.

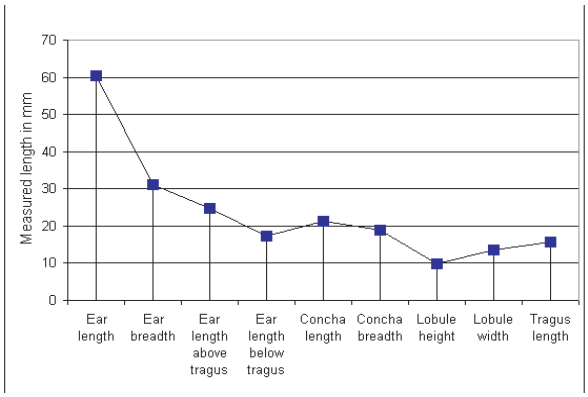

Figure 3: Shows the values of anatomical landmarks of the external ear. All values are expressed the mean vale in mm.

Table 3: Summary of various studies of external ear biometrics comparing with current study.

Source	Year	Population	Ear length / mm	Ear width / mm
Dreyfus	1967	American	63.05	35.5
Alexander	1968	American	76.0	34.5
Burkhard	1975	American	68.5	
Algazi	2001	American	64.1	29.2
Purkait	2007	Central India	57.7	33.1
Chattopadhay	2009	Eastern India	62.5	33.5
D.E.O. Eboh	2013	Nigeria	56.6	30.5
Vermak	2014	Greater Noida	64.2	35.3
P. Verma	2016	North West India	63.7	32.2
Current study	2017	Libya (Tripoli)	60.7	31.1

(SPSS) for Windows XP-Professional.

RESULTS

The data was divided into groups representing the right and left ears. The mean and standard deviations were also calculated. A two-tailed t test at the 95% confidence interval was used to check for statistical significance. A P-value of less than 0.05 was considered to be statistically significant.

The total 191 male medical students were examined, both right and left ear parameters have been calculated, the mean ear length of the right ear was 60.42±u.71, and that for the left was 61.10±5.86, and as is shown the differences between the right and left ear length was not significant, with the combined mean is 60.760±5.31 (Table 1).

Regarding TEL and on both right and left sides, the range was 54.21-74.19mm ($P \leq 0.001$). In present study the mean TEL was found among adult libyan male (60.40 right side mm; 61.10 mm left side among adult Libyan populations (Figure 2; Table 1).

The results of our study show a higer reading in comparative with the studies done by Ekanem at al.[18], but it shows close similarity with other studies[19,20], also we have a lower reading compairing with study done others.[13,21,22]

We found that ear width showed a significant trend for males these data concur with the observations of most other studies (Figure 3; Table 3).[23,24]

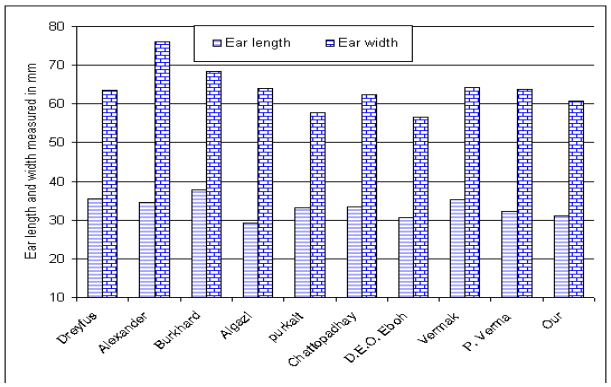

Figure 4: Shows the values of anatomical landmarks of the external ear in different studies comparing with current study. All values are expressed the mean value in mm.

DISCUSSION

Regarding the ear width the mean ear width of Libyan adult is 31.1 mm, which is very similar to the finding of Eboh D8, but the external ear width among adult male Libyan is higher than the finding of Algazi et al.,[25] at the same time our reading is lower comparing with the finding of, Alexander et al, Burkhard et al and Dreyfus et al (Figure 3).[21,25,26]

The mean lobule height of both right and left ear calculated the readings are 13.63±3.94 and 14.06±u.12 respectively, the lobule width was also calculated and the mean was 9.98±3.94 for right and 8.64±u.20 for the left (Table 2).

In most of the parameters which were statistically significant when subjected to determination of Identification, they showed a high percentage of differences between Libyan adult males, for TEL on both right and left sides, the range was 54.21-74.19mm ($P \leq 0.001$) which is statistically significant.

All the above provide strong evidence that ear paramaters are related to racial and genetic background of the individials, and can provide good tool for individual identification.

Asymmetry between left and right ears in a pediatric population is common but by adulthood, the discrepancies diminished.[3,9]

Ear symmetry have been studied, and tested among male adult Libyan, our data are mainly from an adult population and show generally good symmetry between left and right ears which concurs with previous studies (Table 2; Figure 2), concurring with Ferrario's findings and others.[26-28]

CONCLUSION

This study is the first of its kind in Libya population, it provides the first insight on ear external morphologey among adult male libyan, it demonstrated a significannt morphometric variation among libyan adult male external ear morphologey, which can be used as a basis for personal individulization, and to provide data for inclusion or exclusion of persons for identification,also it shows the

close similarity and symmetry of right and left sides of external ear morphologey among adult male libyan.

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