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A Preliminary Study on Frequency Distribution & Inheritance Pattern of Different Characteristics of Ear among Population of Moth Region of Jhansi District

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Abstract: To establish the identity of a person is quite important in field of forensic science. There are many techniques are used for the identification purpose. Identification from ear is quite a new and innovative technique. In this paper preliminary study of ear is conducted in Moth region of Jhansi district. Frequency distribution of basic characteristics of ear i.e. auricle shape, lobule shape and lobule condition is studied in 300 subjects and inheritance pattern of ear lobe attachment is also seen in 51 families of the area. Distribution of basic features of ear will be beneficial to further studies of identification from ear and inheritance pattern of ear lobe attachment will prove to be helpful in paternity dispute cases.
*Key Words: Moth region, auricle shape, lobule shape, ear lobe attachment, inheritance pattern*

I. INTRODUCTION

External ear is one of the most defining feature of the face and it extends from skull. The auricle consists of a network of yellow elastic fibro cartilage covered by a very thin layer of skin, which tightly adheres directly to the perichondrium[1]. There are many traditional as well as latest techniques like signature verification, facial features, finger printing, iris scanning etc. Use of external ear for the purpose of personal identification is quite an innovative and emerging technique. There are many cases found in recent years that external eamay be used for personal identification in living subjects as well as in dead bodies[2, 3].

II. MORPHOLOGY OF EXTERNAL EAR

The lateral surface of the pinna is irregularly concave, faces slightly forward and displays numerous eminences and depressions[4]. Fig 1 shows the predetermined landmarks of the ear.
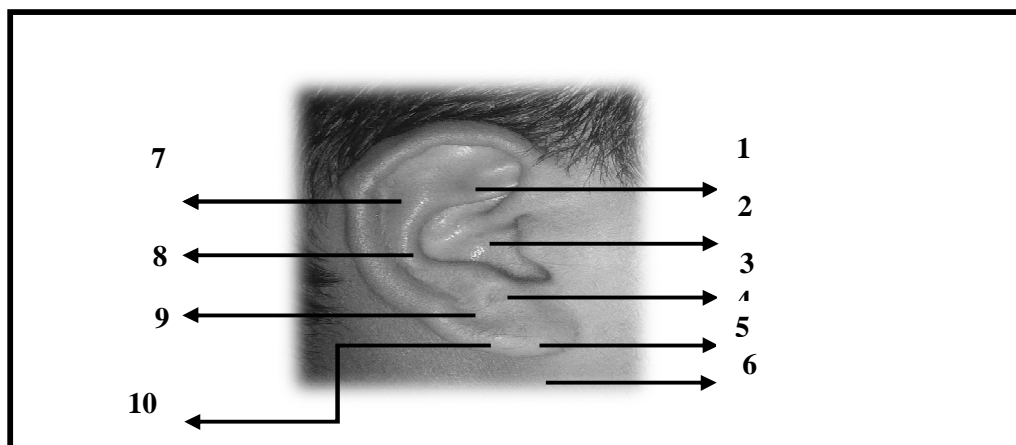
1-Helix; 2- Triangular fossa; 3- Crux of helix; 4- Tragus; 5- IncisuraIntertragica; 6- Lobule; 7- Darwin's Tubercle; 8- Antihelix; 9- Concha; 10- Anti tragus.

A. *Auricle Shape*

Auricle shape is classified depending upon overall shapes with consideration of basic dimensions[5].

1) *Oval Type:*Width of impression measured at tragus level is smaller than ½ ear auricle length and sides of prints are rounded. This is the most common type of auricle shape.

2) *Round Type:*Widt

3) of impression measured at tragus level exceeds ½ of its length and both side edges of auricle are rounded to relatively equal degree.

4) *Triangular Type:*Shape of the impression is similar to a triangular- with an apparently wider part in the upper area of helix and narrowing towards the lobule.

5) *Rectangular Type:*Shape of the impression is similar to a rhomb the widths at the level of upper helix and lobule are approximately equal.

6) *Polygonal Type:*The outline of the impression has acute angles and a polygonal shape width in the middle part.

Oval Shaped   **Round Shaped**   **Triangular Shaped**

Rectangular Shaped   **Polygonal Shaped**

Fig 2. Various Auricle Shapes

B. *Lobule Shape*

A soft, fleshy part hanging from the lower margin of ear is called lobule. Lobule is the only part of external ear which is not supported by cartilage[6]. On the basis of shape, lobule is divided in four types:-

1) *Round:*Lobule has round shape.

2) *Arched:*Lobule making an arch like structure.

3) *Triangular:*Narrowing down towards below portion.
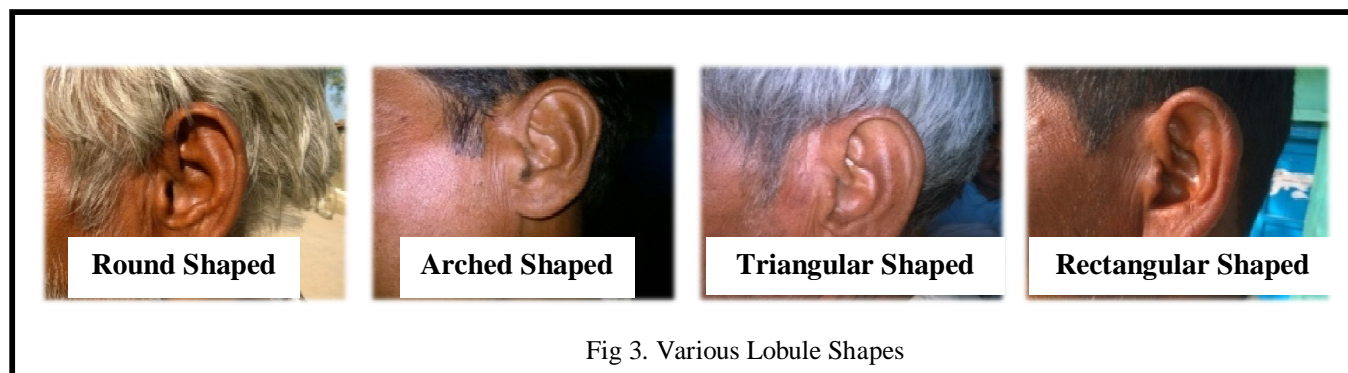
4) *Rectangular:* Lobule making a rectangular shape.

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Fig 3. Various Lobule Shapes

C. Lobule Condition

On the basis of attachment to the cheek lobule is divided into two types.

*1) Attached:*Lobule is attached to the cheek.

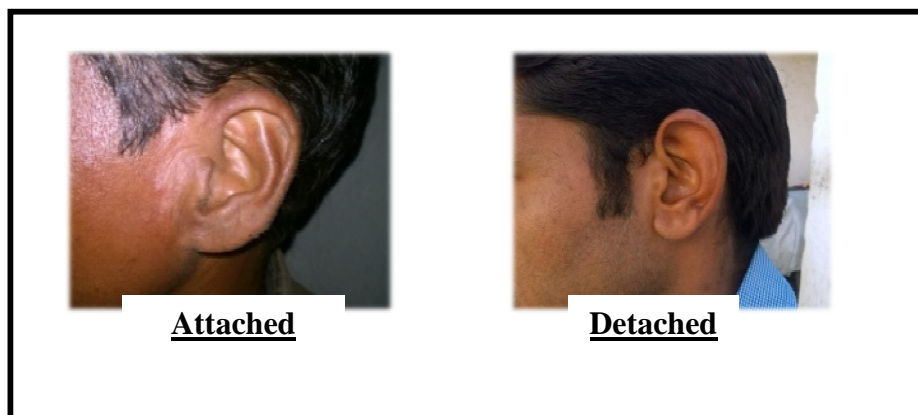*2) Detached:*Lobule hanging freely without attachment to the cheek.

Fig 4. Lobule Conditions

Both ears do not show 100% similarity. There is 93.66% accuracy between both ear's dimensions[7].

III.   MATERIALS

51 families consisting of 102 parents (51 males & 51 females) and their 63 offspring (43 males & 20 females) were analyzed for inheritance pattern of ear lobe without any boundation of caste and religion. After this 56 males and 79 females (total 135 persons) were selected randomly. So that a total of 300 (150 males & 150 females) persons were could be analyzed for the study of frequency distribution of characteristics of external ear. All the subjects were between age group of 2 to 70 years. Persons who had torn ears or any abnormality were excluded.

IV.   METHODOLOGY

A. Image Acquisition

Direct photography was done for acquisition of image. The head of subject was held in stable anatomical position and photography was done. Images were captured by Microsoft Lumia 540 mobile phone HD camera. Following precautions were applied during the photography:- Hairs and clothes like saree covering the ear were shifted away.

B.   Image Analysis

After capturing the photographs of ears, images were transferred into laptop and then categorized. Categorization was done on the basis of ratio of height and width of auricle. A transparent graph sheet was placed on the screen of laptop and height and width ratio of ear was observed without any changes in the image.

C.   Feature Extraction

After categorization of image, features under consideration were extracted from auricle. Data for auricle shape, lobule shape and lobule condition was written in sample form.

D.   Data Interpretation

For determination of frequency distribution, the percentage of auricle shape, lobule shape and lobule condition was calculated manually in all subjects as well as in males and females separately. For determining the level of significance of inheritance of ear lobe attachment, chi square test was used. Four possible parental combinations were made of ear lobe attachment i.e. mother attached & father detached; mother detached & father attached; both attached and both detached. Chi test was applied for offspring of each combination.

V.   RESULTS

Following results are gained:

Shape	Overall		Male		Female	
	No. of Persons	Percent	No. of Persons	Percent	No. of Persons	Percent
Oval	184	61.33%	86	57.33%	98	65.33%
Round	44	14.66%	28	18.66%	16	10.66%
Triangular	25	8.33%	8	5.33%	17	11.33%
Rectangular	38	12.66%	24	16%	14	9.33%
Polygonal	9	3%	4	2.66%	5	3.33%
Total	300	99.98%	150	99.98%s	150	99.98%

Table 1.Shows the Auricle shape ditribution.

Table 1. Reveals that oval shaped auricle is most common (61.33%) while polygonal shaped auricle is least common i.e. 3% (9 persons out of 300). Percentage of oval shaped in males 57.33% (86 persons out of 150) is slightly lesser than females 65.33% (98 persons out of 150). Round shaped auricle's percentage in males is 18.66% (28 persons out of 150) and in females is 10.66% (16 persons out of 150). Triangular shaped auricle's percentage in males is found to be 5.33% (8 persons out of 150) and in females 11.33% (17 persons out of 150). Percentage for rectangular shape in males is 16% (24 persons out of 150) and in females is 9.33% (14 persons out of 150). Polygonal shaped auricle is found to be least common in both males 2.66% (4 persons out of 150) and in females 3.33% (5 persons out of 150).

Table 2.Shows the Lobule Shape Distribution.

Shape	Overall		Male		Female	
	No. of Persons	Percent	No. of Persons	Percent	No. of Persons	Percent
Round	129	43%	63	42%	66	44%
Arched	119	39.66%	63	42%	56	37.33%
Triangular	13	4.33%	11	7.33%	2	1.33%
Rectangular	39	13%	13	8.66%	26	17.33%
Total	300	99.99%	150	99.99%	150	99.99%

Table 2. Reveals that round (43%) and arched (39.66%) shaped lobules are most common while triangular shaped (4.33%) lobule is least common. Round and arched shaped lobules in males are found in equal percentage i.e. 42% (63 persons out of 150) while in females round shaped lobule 44% (66 persons out of 150) is found slightly more than in males. Percentage for arched shape in females is found 37.33% (56 persons out of 150). Triangular shaped lobule is found to be least common in both males 7.33% (11 persons out of 150) and females 1.33% (2 persons out of 150). Percentage for rectangular shape in males is 8.66% (13 persons out of 150) and 17.33% (26 persons out of 150).

Table3 Shows the Lobule Condition's Distribution.

Shape	Overall		Male		Female	
	No. of Persons	Percent	No. of Persons	Percent	No. of Persons	Percent
Detached	197	65.66%	92	61.33%	105	70%
Attached	103	34.33%	58	38.66%	45	30%
Total	300	99.99%	150	99.99%	150	100%

Table 3.Reveals that detached ear lobe (65.66%) is most common while attached ear lobe (34.33%) is least common. Table also reveals that detached ear lobe is found to most abundant in both males 61.33% (92 persons out 150) and females 70% (105 persons out of 150). Percentage for attached ear lobe is found 38.66% (58 persons out of 150) in males and 30% (45 persons out of 150) in females.

Table 4. Shows Possible Parental Combination of Ear Lobe Attachment and Their Offspring Frequency With Attached and Detached Ear Lobe.

Parental Combination of Ear lobe Attachment	No. of Fami--lies	Total No. of Offspring		Total	Male offspring		Female offspring	
		Detached	Attached		Detached	Attached	Detached	Attached
Mother Attached; Father Detached	8	4	7	11	2	5	2	2
Mother Detached; Father Attached	19	9	13	22	6	9	3	4
Both Detached	20	20	6	26	13	4	7	2
Both Attached	4	0	4	4	0	4	0	0
Total	51	33	30	63	21	22	12	8

Table4.Revealsthat out of 63 offsprings, 33 were with detached ear lobe and 30 with attached ear lobe. The ratio of detached and attached ear lobe in male offspring is almost similar while in female off springs, the ratio for detached ear lobe is higher than attached ear lobe. Table also reveal that parental combination of both parent detached and mother detached and father attached were found in abundance and it is found that both parents with detached ear lobe had 20 offspring with detached ear lobe and 6 with attached ear lobe. Parental combination with attached ear lobe of both parents had all offspring with attached ear lobe.

Table. Chi value for ear lobes in offspring with inference.

Parental Combination of Ear lobe Attachment	No. of Fami--lies	Total No. of Offspring		Total	Chi Value	Critical value	Inference
		Detached	Attached				
Mother Attached; Father Detached	8	4	7	11	5.99	3.84	Significant
Mother Detached; Father Attached	19	9	13	22	6.11	3.84	Significant
Both Detached	20	20	6	26	283.82	3.84	Significant
Both Attached	4	0	4	4	2.32	3.84	Not Significant
Total	51	33	30	63			

Table 5.Reveals that for parental combinations- mother attached & father detached; mother detached & father attached and both parents detached, significant results are found while for parental combination of both parents attached, result were not significant.

VI. DISCUSSION

Results showed that oval shaped auricle is found in most abundance. Polygonal shaped auricle among population of Moth region of Jhansi district is found to be least common (3%) and almost similar percentage in males (2.66%) and females (3.33%). Out of four shapes of lobules, round shape is present in most abundance among 300 persons (43%) while percentage for arched shaped lobule is 39.66% means Arched shaped is present in second most abundance shape of lobule. It is concluded from all the observations that triangular shaped lobule is least common shape in males and females both. Detached ear lobe is commonly found amongst the population under study while attached ear lobe is present in 38.66% in males and 30% in females. Ordu*et al* (2014)[8] have also worked on inheritance pattern of ear lobe attachment. They did their research on 200 Nigerians families. Chi square test was applied by them for determining the level of significance. Following table shows the results for Ordu*et al*'s study and this study:

For parental combination of mother attached & father detached and both detached, results were significant in both present and Ordu*et al*'s study. For parental combination of both attached, results were not significant in both studies. In parental combination of mother detached and father attached, results were found significant in this study and not significant for their study. This difference may occur due to region and sample size variance.

VII. CONCLUSION

There are many class and individual characteristics present in ear on basis of which identification can be done. Before studying the individual features, study of class characteristics is needed. Present study belongs to preliminary study of ear so it may provide help for further studies about ear. Using ear as identification feature is quite a new and emerging field. In the present study frequency distribution of auricle shape, lobule shape and lobule condition had observed for identification purpose. These three are the basic features of ear. Like other characteristics of body ear lobe is also inherited. This type of study will be helpful in predicting the offspring with certain traits. Ears are visible and do not changes with facial expressions. The images of the ears can taken easily even without the knowledge off the suspect. All these parameters and advantages make the ear a perfect option in field of personal identification. Ears can be used in following cases as identification parameter: new born babies identification, prisoner's identification, identification from side range photos, identification from CCTV footages, excluding the false accused.

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