ORIGINAL ARTICLE

Indian Journal of Forensic Medicine and Pathology
Volume 16, Number 2, April-June 2023
DOI: https://dx.doi.org/10.21088/ijfmp.0974.3383.16223.1

Morphometric Study of Supra-meatal Triangle and Mastoid process in the Adult dry Skulls

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How to cite this article:

Anuja Sinha, Abhilasha Priya, Ashim Mishra, *et al.*/Morphometric Study of Supra-meatal Triangle and Mastoid process in the Adult dry Skulls. Indian J Forensic Med Pathol.2023;16(2):95-99.

ABSTRACT

Introduction: This study was done with an objective to do a craniometric study of supra meatal triangle and mastoid process to explore the variations as a determinant to sex.

Methodology: A total of 47 skull bones formed our study sample which comprised of 31 males and 16 females Six landmarks were identified on each side of the skulland measurements were taken using Digital Vernier caliper with precision of 0.01.

Observations and Results: The area of supra-meatal triangle in male was 134.68± 21.69 mm^3 on the right side and 134.17± 16.98 mm^3 on the left side. In females the area of supra-meatal triangle was 114.82± 21.99 mm^3 on right side and 122.46± 24.05 mm^3 on the left side.

In male skulls, the length, breadth and width of the mastoid process on the right side was 23.56 ± 2.88, 19.81 ± 2.49 and 11.46 ± 2.51 mm and the left side measurements were 23.33 ± 2.17, 18.93 ± 1.91 and 10.84 ± 2.39mm respectively.

In females the length, breath and width of mastoid were 23.03 ± 2.94, 18.87 ± 2.42 and 10.03 ± 2.32 mm on right side and 22.06 ± 1.99, 17.85± 2.22 and 9.43 ± 1.89 mm in left side respectively.

Conclusion: In this present study the supra meatal triangle and all measurements of mastoid process were greater in males with the mastoid breadth and width showed statistically significant values.

The findings can be applied to unknown skull samples or bone fragmentsand can provide insight to future studies of forensic anthropologists and ENT surgeons.

Keywords: Suprameatal triangle; Mastoid; Sexual dimorphism; Anthropology.

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Received on: *13.01.2023* ***Accepted on:*** *09.05.2023*

INTRODUCTION

The supra-meatal triangle is the area between the posterior wall of the external acoustic meatus and the posterior root of the zygomatic process.[1] In living individuals, the suprameatal triangle forms an important landmark for ENT surgeons to explore lateral wall of mastoid air systems in the squamous part of temporal bone.

This approach considered relatively safer since it has minimum chance of injury to facial nerve or chorda tympani as pointed by earlier studies.[2] The mastoid notch because of its proximity to transverse sigmoid sinus assumes greater significance during lateral skull base craniotomy.[3] Authors have reported thatthese landmarks have high variability owing to individual variation and varying degrees of pneumatization of the mastoid bone.[4] These anatomical variations are utilized to determine sex of individuals from bone fragments in mass disaster victims while performing a morphological assessment. Earlierstudies were done on mastoid triangle taking porion, asterion and mastoidale as three points of reference.[5]

While some authors established the credibility of mastoid process in establishing sexual dimorphism, an Indian study had concluded mastoid triangle as a poor indicator of sex without population reference.[6,7]

Since very few studies were done with supra meatal triangle, this study was done with an objective to do a craniometric study of supra meatal triangle and mastoid process to explore the variations as a determinant to sex. The secondary objective was to determine whether any anatomical variations occurs between two sides.

MATERIAL AND METHODS

The study was initiated after due approval by Institutional Ethics Committee at Department of Anatomy and Forensic Medicine at Manipal Tata Medical College, Jamshedpur.

Samples: Only dried intact skulls were included in this study. The skulls were observed for fusion of posterior 1/3rd of Anterior Sagittal suture to ensure all of it belonged to individuals were more than 30 years. The broken skull and damaged skull were excluded from the study.

A total of 47 skull bones formed our study sample which comprised of 31 males and 16 females based on the criteria for determination of sex.[8]

Six landmarks were identified on each side of the skulland measurements were taken using Digital Vernier caliper with precision of 0.01. Each measurement was taken two times for precision.

Fig. 1 A: D1 Fig. 1 B: D2 Fig. 1 C: D3

Fig. 2 A: length of mastoid process Fig. 2 B: breadth of mastoid process Fig. 2 C: width of mastoid process

- All three sides of supra-meatal triangle were recorded for both the sides. The three sides of supra-meatal triangle were measured as D1, which is supra-mastoid crest, D2-Posterosuperior margin of external auditory meatus, D3-Vertical tangent drawn from posterior margin of external auditory meatal orifice.
- They were entered in excel sheet as RD1, RD2, RD3 for right side and LD1, LD2 and LD3 for left side.
- The area of the supra-meatal triangle was calculated by Heron's formula by A= √s(s-a) (s-b) (s-c); peri-circumference(s)=(a+b+c) /2.
- Length (RL, LL), breadth (RB, LB), and

width (RW, LW) of the mastoid process were recorded for both the sides. Length was calculated as straight distance from mastoidale (inferior point of mastoid process) to the upper rim of root of zygomatic process of temporal bone. Breadth was calculated as straight distance from posterior end of digastric notch to the nearest point of posterior border of external auditory meatus. Width was calculated as straight distance from medial surface to lateral surface.

Statistical Analysis

Data was collected in a tabulated form and statistical analysis was done using SPSS version 20.0. Comparison of the values of all measurements were made between sides of each subject and comparisons between genders were made.

OBSERVATIONS AND RESULTS

The area of supra-meatal triangle in male was 134.68± 21.69 mm3 on the right side and 134.17± 16.98 mm3 on the left side. In females the area of supra-meatal triangle was 114.82± 21.99 mm3 on right side and 122.46± 24.05 mm3 on the left side. (Table 1& 2)

In male skulls, the length, breadth and width of the mastoid process on the right side was 23.56 ± 2.88, 19.81 ± 2.49 and 11.46 ± 2.51 mm and the left side measurements were 23.33 ± 2.17, 18.93 ± 1.91 and 10.84 ± 2.39 mm respectively.

In females the length, breath and width of mastoid were 23.03 ± 2.94, 18.87 ± 2.42 and 10.03 ± 2.32 mm on right side and 22.06 ± 1.99, 17.85± 2.22 and 9.43 ± 1.89 mm in left side respectively. (Table 1 & 2)

Asymmetry index (Al) was calculated from the formula AI = [(R-L)/R+L)] x 100% in which R and L stand for the values on the right and left sides. (Table 1) The discriminant functions were found to be statistically significant (Wilks's = .81, (2) = 9.16693, p = 0.01022 for discriminant function Suprameatal triangle area of right side. (Table 3)

Table 1: Suprameatal triangle areaand Mastoid measurement of right and left sides in both genders

Parameters	Males (n=31)			Females (n=16)			
	Mean ± SD	Min	Max	Mean ± SD	Min	Max	Z, P
RD 1	19.41 ± 1.87	15.08	22.39	16.96 ± 1.65	13.73	20.07	-3.772, <.001
RD 2	15.68 ± 2.01	12.49	19.45	14.72 ± 1.57	11.81	18.14	-1.538, 0.124
RD 3	18.81 ± 2.09	15.43	23.25	17.54 ± 2.09	13.91	22.34	-1.931, 0.053
Area-Right	134.68 ± 21.69	103.08	187.27	114.82 ± 21.99	77.32	161.72	-2.919, 0.004
LD1	19.25 ± 1.65	15.9	22.97	18.23 ± 1.82	15.13	21.6	-1.830, 0.067
LD2	15.62 ± 1.53	12.94	19.44	14.68 ± 2.27	10.73	20	-1.864 , 0.062
LD3	18.92 ± 2.17	15.57	24.07	18.28 ± 1.61	16.04	21.03	-.629, 0.530
Area-Left	134.17 ± 16.98	108.18	191.32	122.46 ± 24.05	79.07	166.21	-1.639, 0.101
Length (RL)	23.56 ± 2.88	16.96	29	23.03 ± 2.94	19.45	28.5	-0.831, 0.406
Breadth (RB)	19.81 ± 2.49	15.55	26.76	18.87 ± 2.42	16.09	25.38	-1.605, 0.108
Width (RW)	11.46 ± 2.51	6.95	17.93	10.03 ± 2.32	6.8	15.4	-1.875, 0.061
Length (LL)	23.33 ± 2.17	20.11	28.07	22.06 ± 1.99	18.62	25.52	-1.785, 0.074
Breadth (LB)	18.93 ± 1.91	15.52	22.42	17.85 ± 2.22	14.47	22.41	-1.751, 0.080
Width (LW)	10.84 ± 2.39	6.44	15.27	9.43 ± 1.89	6.44	13.13	-1.953, 0.051
Asymmetry indexs	0.0020 (-5.9 - 5.5)			-1.7 (-8.9 - 6.2)			-0.808, .419

Note: $ values are Median and IQR

Table 2: Comparison between the Each side in both the genders

Parameters	Males (n=31)			Females (n=16)		
	Right	Left	p	Right	Left	p
Suprameatal triangle Area	134.68 ± 21.69	134.17 ± 16.98	0.903	114.82 ± 21.99	122.46 ± 24.05	0.324
Mastoid Length	23.56 ± 2.88	23.33 ± 2.17	0.577	23.03 ± 2.94	22.06 ± 1.99	0.138
Mastoid Breadth	19.81 ± 2.49	18.93 ± 1.91	0.013	18.87 ± 2.42	17.85 ± 2.22	0.005
Mastoid Width	11.46 ± 2.51	10.84 ± 2.39	0.023	10.03 ± 2.32	9.43 ± 1.89	0.037

Table 3: Univariate discriminant function analysis from each sex

Parameter	Unstandardized coefficient	Constant	Average accuracy	
			Correctly classified	Cross validated group correctly classified
Area right (males)	0.284	-19.528	83.9	83.9
Area right (females)	0.242	-14.967	31.3	31.3

DISCUSSION

In this present study the supra meatal triangle and all measurements of mastoid process were greater in males with the mastoid breadth and width showed statistically significant values. The discriminant function explains 16.3% of variance. Canonical correlations were 0.431 for the discriminant functions, indicating that Discriminant function 1 has the largest relationship with right side area. Our study findings were in line with a study done in North Indian Population where discriminant function analysis was done and it was found mastoid process pointed the gender with 76.7% accuracy and mastoid length was best determinant.[9]

Another study done in India revealed that the three sides of mastoid triangles were greater in males was asterion-mastoidale and mastoid breadth best parameter with 87% accuracy.[10]

Our study had pointed significant difference between right and left side thus establishing the fact that both sides of skull were not perfectly symmetrical. However, several authors had pointed to regard population specificity as an important factor while performing anthropometric measurements.[11]

CONCLUSION

The present study attempted to reaffirm suprameatal triangle along with mastoid process measurements to differentiate sex inan skull sample. The findings can be applied to unknown skull samples or bone fragments and this method is quite feasible and economical requiring only vernier callipers. This study can provide insight to future studies of forensic anthropologists and ENT surgeons. However, population characteristics should be kept in mind before proceeding further.

Conflict of Interest: *Nil*

Source of Funding: *Nil*

Acknowledgement: *The authors are indebted to Manipal Tata Medical College, MAHE for providing the logistic support.*

Ethical clearance: *Obtained prior to study vide no.KMC and KH IEC1-327*

REFERENCES

1. *Gray's Anatomy the anatomical basis of clinical practice 40th edition. Susan Standering. Elsevier Churchill Livingstone. London; 2008: p1223*
2. ***Kronenberg J, Baumgartner W, Migirov L, Dagan T, Hildesheimer M.*** *The suprameatal approach: an alternative surgical approach to cochlear implantation. OtolNeurotol, 2004 Jan; 25(1): 41-4*
3. ***Van Osch K, Allen D, Gare B, Hudson TJ, Ladak H, Agrawal SK.*** *Morphological analysis of sigmoid sinus anatomy: clinical applications to neurotological surgery. J Otolaryngol Head Neck Surg. 2019;48:2*
4. ***A.Aslan,C. Mutlu, O.Celik, F.Govsa, T.Ozgur, M.Egrilmez.*** *Surgical implications of anatomical landmarks on the lateral surface of the mastoid bone.SurgRadiolAnat (2004) 26: 263–267*
5. **Chayanit Manoonpo, Vasana Plakornkul**. *Sex determination using*

mastoid process measurement in Thais. J Med Assoc Thai. 2012 Mar; 95(3):423-9

6. ***Rogers T.L.***
Determining the sex of human remains through cranial morphology. 2005. J Forensic Sci. 50:493–500.

7. ***Kanchan T, Gupta A, Krishan K.***
Estimation of sex from mastoid triangle - a craniometric analysis. J Forensic Leg Med 2013; 20:855-60.

8. ***Mukerjee JB.***
Forensic Medicine and Toxicology.Edited: R.N. Karmakar. 5th Edition.Kolkata. Academic Publisher. 2018:167-168

9. ***Patnaik VV, Phatak A.***
Determination of sex from mastoid process by discriminant function analysis. J Anat Soc India 2010; 59(2): 222-228.

10. ***Saini V, Srivastava R, Rai RK, Shamal SN, Singh TB, Tripathi SK.***
Sex estimation from the mastoid process among North Indians.J Forensic Sci 2012;57:434-9

11. ***Kemkes A, Gobel T.***
Metric assessment of the mastoid triangle for sex determination: a validation study. J Forensic Sci 2006; 51: 985-9.