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Original Research Article

STUDY ON MORPHOMETRY OF MASTOID PROCESS IN ADULT DRIED HUMAN SKULLS AND ITS IMPORTANCE IN OTOLARYNGOLOGY

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Abstract

Background: The mastoid process is a conical projection lying in the posterior region of the temporal bone. The petro mastoid part of temporal bone is further divided into the petrous and mastoid parts. The mastoid process has an outer surface roughened by attachments of the occipitofrontalis and auricularis posterior and a lateral surface where the sternocleidomastoid, splenius capitis, and longissimus capitis are attached. The degree of mastoid pneumatization is variable, which may be categorized as pneumatic, sclerotic (solid bone), diploic (marrow), or mixed (air cells and marrow). Mastoidectomy is the surgical procedure performed to evacuate pathology involving the mastoid, such as cholesteatoma, granulation tissue, or infection. **Materials and Methods:** Total 92 skulls were used in present study, out of 92 dried adult skulls 62 were male and 30 were female. The mastoid measurements were taken on the skull by using sliding vernier caliper to the nearest millimeter (mm). All the measurements were done by single observer to avoid inter-observer error. We have measured Mastoid length, Medio-lateral diameter, Antero-posterior diameter, Mastoid process index, Asterion to Mastoidale. Asterion to Porion. Porion to Mastoidale. The data obtained was tabulated and analyzed with SPSS software and P vale <0.05 set as significant. **Result:** The mastoid process mean length in male was 27.36+1.52mm and in female it was 22.82 +1.36mm, mean value of Medio-lateral diameter was 11.92+0.76mm in males and in female sit was 9.56 +0.82mm. The mean value of Antero-posterior diameter in male was 11.92+0.76mm and in females it was 9.56 +0.82mm. The mean value of mastoid index was 89.70+19.62mm and 88.32 +22.44mm. Asterion-Mastoidale mean value in males was 56.70+1.68mm and females was 51.30 +2.28mm. Asterion-Porion mean value was in male 49.66 +1.66mm and in female it was 51.30 +2.28. The mean value of Asterion-Porion in males it was 49.66 +1.66 and females it was 27.62 +1.88. There was statistically significance difference(P<0.05) between parameters of males and females. **Conclusion:** The study concludes that the present results may be helpful in anthropological and otolaryngology practice.

INTRODUCTION

Mastoid process is the downward projection from the mastoid part of the temporal bone located posteroinferior to external auditory meatus. It is the least prone site to be damaged due to its inferolateral location on the skull. It is the most dimorphic bony feature of the skull. Due to its dimorphism, it is a favorable point for sex discrimination. It is larger in males than in females, not only the size of mastoid process but also shape is a statistically significant gender indicator. Many muscles attach to it it is the attachment site for posterior belly of digastric muscle, clavicular head of sternocleidomastoid muscle, splenius capitis muscle and longissimus capitis muscle. Location and dimensions of the mastoid process are of great importance because of surrounding anatomical structure for anatomists, neurosurgeons, neurotologists and otolaryngologist. Asterion is the junction of lambdoid, parietomastoid and the occipitomastoid sutures on the lateral aspect of the skull. It overlies the junction of transverse and sigmoid sinuses. Asterion is a landmark commonly used by neurosurgeons in cerebellopontine trigone surgery, transmastoid cisternoscopy, mastoid antrum surgery and venous sinus surgery. Mastoid process is

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a palpable bony structure which enables to determine the location of asterion.[1-8]

The gross features includes an irregular cavity within the anterosuperior aspect of the bone is called the mastoid tympanic antrum, which communicates with the attic of the tympanic cavity 1. Pneumatization extends from the antrum as the mastoid air cells. The roof of the mastoid antrum is called the tegmen mastoideum, which is a posterior extension of the tegmen tympani. The tegmen mastoideum forms part of the floor of the middle cranial fossa, separating the mastoid from the cranial cavity. The lateral extracranial surface of the mastoid is sometimes called the mastoid cortex. The anterior landmark is the MacEwen triangle including the spine of Henle. The posterior landmark is the asterion. The medial extracranial surface of the mastoid process contains a deep groove called the digastric fossa (mastoid notch), which originates the digastric muscle. Medial to that is the occipital groove, which is traversed by the occipital artery. At the posterior intracranial surface of the mastoid, the sigmoid sulcus lodges the sigmoid sinus and partially the transverse sinus. The sigmoid plate is the thin lamina of bone that separates mastoid air cells from the dural venous sinuses. Around this area is the inconstant mastoid foramen, which transmits an emissary vein and occipital artery branch. The mastoid contains the mastoid segment of the facial nerve canal as well as the mastoid canaliculus, which transmits the Arnold nerve. The mastoid part of the temporal bone articulates with the following bones, superiorly: mastoid angle of the parietal bone via the parietomastoid suture, posteriorly: squamous part of the occipital bone via the occipitomastoid suture, anteriorly: tympanic part of the temporal bone via the tympanomastoid suture. Medially posterior belly of digastric muscle, laterally from superior to inferior includes, occipitalis muscle (occipital belly of occipito-frontalis, posterior auricular muscle, sternocleidomastoid muscle, splenius capitis muscle, longissimus capitis muscle. The relations of mastoid process includes anteroinferiorly, the mastoid contributes to the posterior bony wall of the external auditory canal and tympanic cavity. The anterior margin is partly defined by the tympanic part of the temporal bone at the plane of the tympanomastoid suture. The mastoid part is fused anterosuperiorly with the descending process of the squamous temporal bone and medially with the petrous temporal bone. The boundaries of the mastoid part at these sites are imprecisely defined based on the semicircular canals medially and the external auditory canal anteriorly. The degree of mastoid pneumatization is variable, which may be categorized afull air cell development: pneumatic, Solid bone: sclerotic, diploic (marrow) or mixed contains air cells and marrow. The Development facts of mastoid process includes it is absent at birth. Starting in infancy and continuing into puberty, the mastoid develops from the squamous and petrous parts of the temporal portion. The anterolateral third belongs to the squamous part and the posteromedial two-thirds belongs to the petrous part. The dividing walls are largely resorbed in development by 5 years of age. However, the margin of fusion often remains discernable in adults at some sites as the Koerner septum internally and petrosquamous fissure externally. Pneumatization/ creation of mastoid air cells occurs in 80% of people by age 4 years. Mastoid pneumatization can in some cases proceed into other areas of the squamosa and petrosa. The clinical aspects of mastoid process, that is mastoidectomy is the surgical procedure performed to evacuate pathology involving the mastoid, such as cholesteatoma, granulation tissue, or infection.[9,10]

The present study was conducted to find morphometric analysis of foramen magnum, this results may be helpful for anthropologist and otolaryngologists.

MATERIALS AND METHODS

Total 92 skulls were used in present study, which were collected from multiple medical institution. Out of 92 dried adult skulls 62 were male and 30 were female. The skulls were studied to determine the validity of the mastoid process variables in sexual dimorphism. Skulls with no apparent deformity, intact mastoid process and already synostosed spheno-occipital junction were included in the study. The damaged skulls were excluded from study and skull not intact with mastoid process also excluded. The mastoid measurements were taken on the skull by using sliding vernier caliper to the nearest millimeter (mm). All the measurements were done by single observer to avoid inter-observer error.

We have marked Frankfort plane on the skull. It is a horizontal plane passing through upper margin of external acoustic meatus and the lower margin of the orbital opening. The following measurements were taken on the mastoid process of skull.

Mastoid length: It was measured from a point on the Frankfort plane vertically downward to the tip of the mastoid process. The skull was placed on one side facing towards the observer; the fixed arm of the vernier caliper was positioned tangentially on the upper border of auditory meatus.

Medio-lateral diameter: The measurement was taken from the highest part of medial surface within digastric fossa to the most lateral point of the mastoid process at same level.

Antero-posterior diameter: It was measured as a straight distance from the posterior end of incisura mastoidea to the nearest point on the posterior border of the external acoustic meatus.

Mastoid process index. Mastoid process index = Maximum Mastoid breadth / Maximum Mastoid length X 100.

For further mastoid measurements following points were used. Asterion: is the meeting point of lambdoid, occipitomastoid and parietomastoid sutures. Porion: Superior point of external acoustic meatus. Mastoidale: is the tip of mastoid process. The

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points were located and marked. The following readings were measured in millimeter. Asterion to Mastoidale. Asterion to Porion. Porion to Mastoidale. The data obtained was tabulated and analysed with SPSS software and P vale <0.05 set as significant.

RESULTS

In present study we have studies 92 dried adult human skulls, out of that 62 were and 30 were male. We have chosen the study which are with intact and measurable mastoid process. The mastoid process mean length in male was 27.36+1.52mm and in female it was 22.82 +1.36mm, mean value of Medio-lateral diameter was 11.92+0.76mm in males and in female sit was 9.56 +0.82mm. The mean value of Antero-posterior diameter in male was 11.92+0.76mm and in females it was 9.56 +0.82mm. The mean value of mastoid index was 89.70+19.62mm and 88.32 +22.44mm. Asterion-Mastoidale mean value in males was 56.70+1.68mm and females was 51.30 +2.28mm. Asterion-Porion mean value was in male 49.66 +1.66mm and in female it was 51.30 +2.28. The mean value of Asterion-Porion in males it was 49.66 +1.66 and females it was 27.62 +1.88.

Table 1: Showing the various parameters of mastoid process.

Sl.no	Parameter	Male Mean+SD(62)(mm)	Female Mean+SD(30)(mm)	P value
1	Mastoid length	27.36+1.52	22.82 +1.36	The P value is for all variables is P<0.05, which shows statistically significant
2	Medio-lateral diameter	11.92+0.76	9.56 +0.82	
3	Antero-posterior diameter	23.18+0.92	19.98 +1.76	
4	Mastoid index	89.70+19.62	88.32 +22.44	
5	Asterion-Mastoidale	56.70+1.68	51.30 +2.28	
6	Asterion-Porion	49.66 +1.66	44.82 +1.66	
7	Porion-Mastodale	32.57 +0.82	27.62 +1.88	

DISCUSSION

Mastoid process is of great interest for scientists because of its location and relations. Its location carries it to a critical point in posterolateral cranial surgery and its relations are crucial to prevent complications. Initial key hole formation before craniotomy is the first step for proper surgery. Reference point for key hole formation is the asterion. Underlying in proximity of asterion is the junction of transverse and sigmoid sinuses. Close relation of asterion and venous sinuses lead to complications such as lacerations. Asterion is the unique reference point in these types of operations but unfortunately it can not be palpated. Bony landmarks on lateral aspect of skull help to indicate position of asterion. In our opinion the most reliable landmark is the mastoid process because of its palpable mass. That's why mastoid process is one of the most commonly studied points by researchers. There are studies in the literature presenting distance between apex of mastoid process and asterion.[1,11-14] Secretory otitis media is the most common middle ear disease of childhood. It heals spontaneously, by medical therapy or by minor surgical procedures in most of the cases. Sequelae such as retraction pockets and adhesive otitis that lead to cholesteatoma rarely occur, but initialy it is hard to diagnose which patient will acquire a sequela. It is well known that mastoid pneumatization is poor in the patients who had complications like retraction pocket, adhesive otitis and cholesterol granuloma.[15]

The present study results in accordance with study of Sukre SB et al,[2] in their study also they conducted similar morphometric parameters, in study of Hoshi H,[16] studied the mastoid length and he divided the mastoid process into 3 categories viz. male, neutral and female categories. His study stated that, when the skulls were kept on flat surface, it lies on mastoid process in males and on occipital condyles in females. This observation indirectly confirms that the male skulls have more mastoid length. In study of Giles and Elliot,[17] conducted in Negroes and Caucasian people for studying mastoid length in Caucasian population and Negroes. They found in their study that mean mastoid length was more in males and in Negroes than in Caucasians. The present study also in correlation with same study lesser mean value of mastoid length among females than males. In study of Sukre SB et al,[2] the mastoid process index has been studied, in present study also we have studied mastoid index. In study of Ghule SB,[18] studied separately on right and left side, they concluded that the mastoid process index was significantly more in females than in males. In study of Sukre SB et al,[2] the mastoid process index was more in females than in males. In this point of view there are very few works done on mastoid process index, thus mastoid index help to sex the skull.

Present study showed a statistically significant difference asterion to mastoidale distance, the studies of Sukre SB et al,[2] Vineeta S et al,[19] and Nidugala H et al,[20] coincides to present study. However in study of Kemes and Gobel,[21] found that the asterion to mastoidale distance insignificant and stated the cause, may be the asterion position which varies with progression of age in a population-specific manner.

In study of Yılmaz et al.[22] presented distance between mastoid apex and asterion and compared the difference between right and left sides. They found no statistically significant difference. In the Selma Caliskani study,[1] distance between asterion and mastoid apex of right side was greater than of left side and the difference between sides was statistically significant. In same study, they measured vertical

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length of mastoid process and found that it is greater on the right sight. Surgical resection of the advanced parotid cancer requires detailed anatomical knowledge of mastoid process and neighboring structures. Mastoidectomy is an important part of parotid cancer surgery which leads to clear exposure of facial nerve to prevent facial paralysis. Muscles attaching to mastoid process are detached from the mastoid process before resection.[23]

Rahne et al,[24] concluded that mastoid volume reaches the size of adult mastoid by the age of 19 in females and 18.9 years in males. Chronic otitis media, mastoiditis and cholesteatoma history result in smaller mastoid volume. Mastoid pneumatization accompanies expansion of mastoid size by age. Patients suffering from conductive hearing loss can be treated with transdermal hearing implants. Mastoid size may be a limiting factor when fitting implant into mastoid. In nanother study studied about mastoid groves and canals.[25] The present study concludes that the mastoid process morphology and its anatomical relations are important for anatomists, neurosurgeons, anthropologists and forensic experts.

CONCLUSION

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