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A study on Morphological and Morphometric Features of Asterion in Adult Dry Skulls and its Clinical Importance.

T. Sarada[1], G. Manoj Kumar Reddy[2], Hariharan J K[3], Shaik Hussain Saheb[4]

1.Professor & HOD, 2. Associate Professor, 3. Postgraduate Student, Department of Anatomy, Govt Medical College, Kadapa, Andhrapradesh, India.
4.Assistant Professor of Anatomy, Govt Medical College, Kadapa and Post doctoral research scholar, Manipur International University, Impal, Manipur.

Corresponding Author:Dr. Shaik Hussain Saheb,

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Abstract

Background: Asterion is the meeting point of lower end of lambdoid suture, parietomastoid suture and the occipitomastoid suture. In infants, asterion is a site of mastoid fontanels or posterolateral fontanels. It is triangular is shape. On the basis of presence or absence of suture, asterion can be classified as type I and type II. During surgical approaches asterion should be given consideration to the superficial anatomic reference points of the posterior cranial fossa. Important reference points of asterion are of great importance in surgical procedures to locate the site where the initial trepanning will be carried out. The study of asterion morphology and morphometry may be helpful to Neuro and ENT surgeon.

Materials and Methods: The present study conducted with 96 adult dry skull. All the skulls were examined carefully and identified the gender and separated, we found 52(104 sides) skulls as male and sides 44(88 sides) skulls as female. We have observed sutural bone at asterion, if sutural bone present it was classified as Type I, if no sutural bone present it was classified as type II. The morphometric measuremnets were taken with digital vernier callipers and recorded & expressed in Mean±SD.

Results: We found 42(40.35%) sides in males as type I and 62(59.5%) sides in female as type II. In females 33(37.5%) sides as type I and 62(59.5%) sides as type II.We found right side type I asterion in 39(37.35%) sides and type II asterion 52(54.15%) sides. On left side side type I asterion in 36(40.65%) sides and type II asterion 65(67.85%) sides. Morphometric parameters were tabulated and expressed in form of Mean±SD.

Conclusion: The morphometrc measurements may be helpful to neurosurgeons, ENT surgeons and forensic practice. The type I and type II asterions knowlede may be helpful in surgeries in mastoid and asterion regions.

Keywords: Asterion, Sutural bones, Skull, Mastoid Process.

Introduction

Asterion is the junction of lambdoid, parietomastoid and occipitomastoid sutures and it corresponds to the location of the posterolateral fontanelle which closes at the end of the first year of the life. It is close related to the location of junction of transverse and sigmoid sinuses. Asterion is a surgical landmark for lateral approach to posterior cranial fossa. Vascular, inflammatory, neoplastic or traumatic lesions in the posterior cranial fossa are common issues which require surgery. Surgeons dealing with deep anatomical structures must have detailed anatomical knowledge about superficial projections of these deep structures. Asterion provides a reliable surface point to indicate underlying structures. Asterion is the articulation site of occipital, parietal and temporal bones. It is a common center of interest for anatomists, neurosurgeons, radiologists, anthropologists and forensic experts[1].

The transverse-sigmoid sinus junction is predominantly found at the asterion. The incidence of Wormian bones tend to be population specific. Understanding the morphology of the asterion may assist surgeons and radiologists. As the Type I asterion can lead to complications during surgery and may also result in misdiagnosis as Wormian bones may appear as fractured. Asterion morphometry may allow surgeons to safely approach the skull without lacerating the dural venous sinuses. It has been considered a reliable anatomical landmark used by neurosurgeons due to its close relation to the transverse-sigmoid sinus junction. It is also clinically significant for treating inflammation, lesions and tumours located in the posterior cranial fossa. The asterion is a vital point for the initial burr hole in a retro-sigmoid approach used for initializing neuro-surgery, as well as, for hearing implant surgery[2]. The anatomic points of reference to analyse the topography of the posterolateral surface of the skull are asterion, external occipital protuberance, suprameatal crest, apex of the mastoid process, root of the zygomatic arch, Frankfurt horizontal plane, and the mastoid foramen. These reference points are of great importance in surgical procedures to locate the site where the initial trepanning will be carried out. The surgical importance of the posterior cranial fossa lies in its dense collection of neurovascular structures housed in a small, rigid space, which makes the invasive approach very delicate and prone to accidents or medical errors in surgery [3,4,5]. The present study aimed to determine the anatomical position of the asterion in relation to selected external landmarks and determine its morphology in the adult dry skulls.

Materials and Methods

The present study conducted with 96(192 sides) adult dry skull, which were collected from departments of Anatomy of multiple medical and dental inistitutions. All the skulls were examined carefully and identified the gender and separated, we found 52(104 sides) skulls as male and sides 44(88 sides) skulls as female[6]. We have observed right and left sides of all the skulls to observe asterion. The type of asterion was determined as type I or type II depending on the presence or absence of sutural bone respectively. The following measurements were taken bilaterally using digital vernier calipers with an accuracy of 0.01 mm. 1) AMP: Distance from the centre of the asterion to tip of the mastoid process 2) AI : Distance from the centre of the asterion to inion 3) ASC: Distance from the centre of the asterion to supramastoid crest 4) ASS: Nearest distance from the centre of the asterion to sigmoid sinus internally 5) ATS: Nearest distance from the centre of the asterion to transverse sinus internally 6) T: Thickness of asterion at its centre. The thickness, ASS and ATS were measured after removal of the vault of the skull. The centre of a circle with smallest radius connecting the corners of sutural bone was considered the centre in case of type II asterion. The measurements were carried out by Digital Vernier calipers with a precision of 0.1 mm. Each dimension was measured thrice and the mean figure recorded. The data collected was checked for errors prior to analysis[7].

Results

The present study conducted with 96(192 sides) adult dry skull, out of 96 skulls 52 were male and 44 skulls were female. In males type I asterion with presence sutural bone were found 42 sides (40.5%) and 62 sides(59.5%) were found as type II with normal asterion. In females type I asterion with presence sutural bone were found 33 sides (37.5%) and 55 sides(62.5%) were found as type II with normal asterion. On right side type I asterion with presence sutural bone were found 39 sides (40.65%) and 57 sides(59.35%) were found as type II with normal asterion. On left side type I asterion with presence sutural bone were found 36 sides (37.5%) and 60 sides(62.5%) were found as type II with normal asterion.

Table 1. Incidence of Types of Astreion

	Type I (Presence of Sutural Bone)	**Type II (absence of Sutural Bone)**
Male (n=104)	**42(40.5%)**	**62(59.5%)**
Female (n=88)	**33(37.5%)**	**55(62.5%)**

Table 2. Incidence of Types of Astreion on Right and Left side

	Type I (Presence of Sutural Bone)	**Type II (absence of Sutural Bone)**
Right (n=96)	**39(40.65%)**	**57(59.35%)**
Left (n=96)	**36(37.5%)**	**60(62.5%)**

Table 3. Micrometric measurements of Asterion from different landmarks

Sl.No	**Parameter**	**Male (n=104)**	**Female (n=88)**	**P-value**
1	**AMP -R**	**5.18±0.32**	**4.72±0.52**	**0.001***
	AMP -L	**4.92±0.65**	**4.67±0.71**	**0.03***
2	**AI -R**	**5.76±0.78**	**5.62±0.64**	**0.41**
	AI -L	**5.54±0.92**	**5.45±0.82**	**0.57**
3	**ASC -R**	**4.12±0.74**	**4.34±0.64**	**0.006***
	ASC -L	**4.36±0.92**	**4.22±0.76**	**0.242**
4	**ASS -R**	**1.42±0.12**	**1.57±0.31**	**0.92**
	ASS -L	**1.52±0.24**	**1.34±0.16**	**0.33**
5	**ATS -R**	**0.92±0.13**	**0.63±0.17**	**0.24**
	ATS -L	**0.86±0.26**	**0.59±0.13**	**0.36**
6	**T-R(n=10)**	**0.76±0.18**	**0.86±0.09**	**-----**

	T-L(n=10)	**0.82±0.26**	**0.72±0.17**	**-----**

AMP: Distance from the centre of the asterion to tip of the mastoid process, on right sides, in males it was 5.18±0.32cm and in females 4.72±0.52cm, on left sides, in males it was 4.92±0.65cm and in females 4.67±0.71cm. AI : Distance from the centre of the asterion to inion, on right sides, in males it was 5.76±0.78cm and in females 5.62±0.64cm, on left sides, in males it was 5.54±0.92cm and in females 5.45±0.82cm. ASC: Distance from the centre of the asterion to supramastoid crest in males it was 4.12±0.74cm and in females 4.32±0.64cm, on left sides, in males it was 4.36±0.92cm and in females 4.22±0.22cm. ASS: Nearest distance from the centre of the asterion to sigmoid sinus internally, in males it was 1.42±0.12cm and in females1.57±0.31cm, on left sides, in males it was 1.52±0.24cm and in females 1.34±0.16cm. ATS: Nearest distance from the centre of the asterion to transverse sinus internally, in males it was 0.92±0.13cm and in females0.63±0.17cm, on left sides, in males it was 0.86±0.26cm and in females 0.59±0.13cm. T: Thickness of asterion at its centre. The thickness, ASS and ATS were measured after removal of the vault of the skull, in males it was 0.76±0.18cm and in females 0.86±0.09cm, on left sides, in males it was 0.82±0.26cm and in females 0.72±0.17cm.

Figure 1. Showing type II Asterion without sutural bone and Type I with sutural bone.

Discussion

The asterion is located at the posterior aspect at the base of the skull, and is the meeting point of the lambdoid, parieto-mastoid and occipito-mastoid suture. Embryologically, this point corresponds to the posterolateral mastoid fontanelle, which closes by the second year of infant development. The morphology of the asterion can be classified as being either Type I, which has Wormian bones within the sutures that make up the asterion, or Type II, which has no Wormian bones present[2]. In present study we observed the types of asterion type-I with sutural bone and type II asterion without sutural bone, in males and female, on right and left side. In males and females type II asterion was more compared to type I. We have observed the distance of center point of asterion from multiple landmarks, al the data were tabulated(Table 1).

In study of Yasmin Khan[2] in 36 skulls, Type I asterion was observed in 18 (25.0%) of the cases and Type II presented in the majority of the cases with a prevalence of 75.0%. The distances from the asterion to the respective external bony landmarks were found to have no differences with regard to laterality ($p > 0.05$). The South African sample of KwaZulu-Natal was found to have majority of Type II present. In present study Indian population also shown similar results. Muche A[8] study with sixty-one dry and intact adult human skulls of unknown sex. In this study, type II was found to be the predominant asterion type. There was statistically significant difference in measurements of central thickness of right and left sides of asterion ($P = 0.04$, Eta squared = 0.025).

Galindo-de Leon S etal[9] study observed the thickness and types of asterion, With a 1.3 mm drill drilled both sides of 88 dry skulls (176 hemicranias). The anatomical landmarks studied were the asterion, the apex of the mastoid process, spina suprameatal, the Frankfurt horizontal plane, the posterior root of the zygomatic arch, the external occipital protuberance and its relationship with the sinus transversus.The asterion type I prevails in 74.4% of the pieces. In 82.4% of the skulls asterion level is, sinus transversus in less than 12.5% and above this at 5.1%. Ucerler H and Govsa F[10] study on 100 skull halves a 2mm drill bit was externally placed over the asterion and was drilled through the bone perpendicular to the skull surface. The position of the asterion has been found to be located superficial to the transverse-sigmoid sinus junction in 87% of all samples, inferior to the transverse-sigmoid sinus junction in 11% and superior to the transverse-sigmoid sinus junction in 2%. The distance from the asterion to the root of the zygoma has been determined to be 54.6$\pm$5.5mm. The distance

between asterion and Henle's spine was 45.2±5.2, and from asterion to Frankfurt Horizontal Plane 15±7.5mm. The study involved 40 human dry skulls in Indians (n= 27 male (10.8%), n= 13 female (5.2%)) of unknown age, by Sharma R[11] evaluating morphometric characteristics of 80 pterions and asterions. Two sutural patterns were observed in the asterion: type 1 (presence of sutural bone) in 17.9% of skulls and type 2 (absence of sutural bone) in 82.1%.

Sinem Akkaşoglu[12] study in twenty human dry skulls, distance between asterion and mastoid process was 43.65 ± 6.75 mm on the left side and 45.01± 6.04mm on the right side. Distance between asterion and posterior end of zygomatic arch was 43.97 ± 7.37 mm on the left side and 43.95± 7.02 mm on the right side. Distance between asterion and external occipital protuberance was 62.59 ± 8.83 mm on the left side and 54.75 ±5.57mm on the right side. Distance between asterion and lambda was 81.40 ± 7.36 mm on the left side and 82 ± 4.96 mm on the right side. In 84 % of the cases asterion was at the junction of transverse and sigmoid sinuses. In 12% of the cases asterion was below the junction of transverse and sigmoid sinuses. In 4 % of the cases asterion was above the junction of transverse and sigmoid sinuses. Saheb H S[13] study in 125 human skulls of known gender (83 male, 42 female) were examined on both sides. Four types of pterion were observed – sphenoparietal 69.25%, frontotemporal 17.35%, stellate 9.7% and epipteric 3.7%. Two types of asterion were also observed – type I in 23.15% cases and type II 76.85% cases.

Gharehdaghi, J et al[14] examined the morphology of the asterion, its association with deep vein elements, the mastoid apex and inion in 105 adult cadavas (210 hemicraniums) including 146 males and 64 females. Two types of asterion were observed. Type I was found in 14.7%, and type II in 85.3% of cases. In 70% of cases, the asterion was at or above the venous sinus. The distance between the asterion and the mastoid appendage on the right side was 47.03 mm and on the left side was 46.5 mm. The distance between the asterion and the inion at the right side was 70.55 mm and on the left side was 70.2 mm. Godswill, Okoro Ogheneyebrorue et al[15] observed that type II (absence of sutural bones) was commoner than type I (presence of sutural bones)asterion. The asterion was 55.72±2.60 mm from tip of the mastoid process on the right side and 51.07±1.43 mm on the left, p value being statistically significant (P=0.001). The distance of asterionfrom supramastoid crest was 47.16±1.47 mm on the right and 43.80±1.97 mm on the left. P value 0.002 was statistically significant.

Deepak S and Dakshayani KR[7] study in 50 (27 male & 23 female) adult skulls observed that type II (absence of sutural bones) was commoner than type I (presence of sutural bones) asterion. The asterion was 4.82 ± 0.58 cm from tip of the mastoid process on the right side and 4.70 ± 0.70 cm on the left. It was greater in males than in females, p value being statistically significant. The distance of asterion from supramastoid crest was 4.22 ± 0.73 cm on the right and 4.23±0.58 cm on the left. The distance in males was more than in females. The P value 0.00 was statistically significant on the right side. Regarding the position of the asterion in relation to transverse sinus, it was on the transverse sinus in 62% cases, below it in 32% and above in 6%. Usha Verma et al[16] study in 120 human adult dry skulls consisting of 80 male and 40 female skulls were analyzed for Type-I and Type-II asterions. out of 120 skulls, (n=240) Type-I asterion was observed in 36 (15%) skulls, and Type-II was observed in 204 (85%) skulls. Type-I was 28 (17.5%) in males, 8 (10.0%) in females and 36 (15.0%) in total skulls. Type-II was 132 (82.5%) in males, 72 (90.00%) in females and 204 (85.0%) in total skulls. In this study, the incidence of Type-I asterion was found more in males than females. The present study concludes the finding may be helpful to neurosurgeons to assist in posterior cranial fossa surgeries. This may also helpful radiologists, anthropologists, anatomists, and forensic medicine practicians.

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