

MORPHOMETRIC STUDY OF ASTERION AND ITS RELATION TO TRANSVERSE SIGMOID JUNCTION FOR POSTEROLATERAL CRANIAL SURGERIES.

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ABSTRACT

Asterion is the craniometric point at the junction of the lambdoid suture, occipitomastoid suture and the parietomastoid suture, it is closely related to the junction of transverse and sigmoid sinus.

Aim of the present study was to identify the safe zone in relation to asterion for initial burr hole placed before craniotomy in posterolateral cranial surgeries in order to prevent larger craniotomies and sinus injuries. As the position of asterion displays population specific variability its anatomic location was studied in adult human dry skulls of Telangana region.

Material and methods: 100 Sides of 50 human adult dry skulls of unknown sex and age from bone banks of medical colleges of Telangana region were studied. Measurements of the asterion from tip of the mastoid, root of zygoma and external occipital protuberance on both right and left sides were taken using digital vernier calipers. Surface projection of transverse sigmoid junction in relation to asterion was noted using transillumination.

Result: The mean distance between the tip of mastoid process and asterion was 49.87 ± 2.09 mm on right side and 51.02 ± 2.01 mm on left side and P value was found to be significant. The mean distance from root of zygoma to asterion was 55.8 ± 1.91 mm on right side and 56.5 ± 1.89 mm on left side. The mean distance between external occipital protuberance and asterion was 62.4 ± 2.23 mm on right side and 62.9 ± 2.02 mm on left side. In majority of skulls (84%) transverse sigmoid junction was at the asterion, in 14% the transverse sigmoid junction was above the asterion and in 2% cases it was below the asterion.

Conclusion: Knowledge of the anatomical position of asterion using palpable bony landmarks, and its relation to the underlying venous sinuses plays an important role in performing safer posterolateral cranial surgeries.

Key words: Asterion, Transverse- sigmoid junction, Posterolateral cranial surgeries.

INTRODUCTION

Asterion which means “starry” in Greek is an important anatomical landmark visible on the human skull following the removal of soft tissue from the bony surfaces and is closely related to transverse and sigmoid sinus internally (1). It is the joining of lambdoid, parietomastoid and occipitomastoid sutures which lies at the posterior end of parietotemporal suture and represents the site of closed mastoid fontanelle (2,3). Retrosigmoid approach is commonly used by neurosurgeons to perform posterior cranial fossa craniotomies and craniectomies for

the resection of Infratentorial lesions and cerebellopontine angle tumors(2,4,5). This approach needs to be accurately localised in order to prevent laceration of underlying transverse sinus, transverse sigmoid junction and sigmoid sinus. Skin incisions can be mapped using traditionally used landmarks like the asterion, superior nuchal line and the line joininginion to the posterior root of zygoma. Each of these surface landmarks is associated with a specific underlying sinus of which asterion approximates the transverse sigmoid junction(2,4–6). Thorough knowledge of surface anatomy of deep internal structures is essential for a surgeon. Asterion is a reliable craniometric point to localise underlying structures(7). Variable location of asterion and its linear distance from tip of mastoid process, root of zygoma and external occipital protuberance are important parameters useful during posterolateral cranial surgeries.

AIM

As the asterion is variable in its location its linear distance from known palpable surface anatomical landmarks like tip of mastoid, root of zygoma and external occipital protuberance was measured and its relationship to underlying transverse sigmoid junction was noted in order to determine the safe zone for initial burr hole placed before craniotomy to prevent larger craniotomy and sinus injury.

MATERIAL AND METHODS

A total of 50 adult human dry skull (100 sides) of unknown sex and age from bone bank of medical colleges of Telangana region were used for the study. Skulls with erupted 3rd molar were considered as adult skulls and included in the study. Pathological, damaged and skulls with previous surgical procedures were excluded from the study. Measurements were taken on the right and left side of the skull using digital vernier callipers with an accuracy of 0.01mm. Three Parameters were noted 1) Linear distance from tip of mastoid to asterion 2) Linear distance from root of zygoma to asterion 3) Linear distance from external occipital protuberance to Asterion.(Fig.1,2) Each measurement was taken thrice and then averaged in order to minimise the bias. Results were analysed and mean and standard deviation was recorded. Location of transverse sigmoid junction at, above or below the asterion was evaluated using transillumination method by placing a laser pointer at the transverse sigmoid junction in the interior of the skull and noting its surface projection.

RESULTS

A total of 50 skulls (100 sides) were studied. The mean distance between the tip of mastoid process and asterion was 49.87 ± 2.09 mm on right side and 51.02 ± 2.01 mm on left side and P value was found to be significant. The mean distance from root of zygoma to asterion was 55.8 ± 1.91 mm on right side and 56.5 ± 1.89 mm on left side. The mean distance between external occipital protuberance and asterion was 62.4 ± 2.23 mm on right side and 62.9 ± 2.02 mm on left side. (Table 1)

In majority of skulls (84%) transverse sigmoid junction was at the asterion, in 14% the transverse sigmoid junction was above the asterion and in 2% cases it was below the asterion.(Fig.3)

DISCUSSION

Knowledge of the topographical anatomy of the sinuses plays a key role in successful surgical outcome. The single most factor determining further success of the procedure is

starting the craniotomy at the right place(4,8).This study was targeted at providing information about the anatomical location of asterion for initial burr hole over the posterior cranial fossa. This will help in avoiding unnecessary serious complications such as bleeding from laceration to sigmoid transverse sinus. According to Cirpan et al, zone 10mm superior and 10mm inferior to asterion is a danger zone for surgical approach prone to lacerations of sigmoid and transverse sinus (9).Urculu et al suggested that a burr hole 2cm below the asterion is a better alternative (10). Leon et al localised the safety zone by utilising Frankfurt horizontal plane and four points, root of zygoma, suprameatal spine,apex of mastoid process and external occipital protuberance (11). The present study does not include suprameatal spine and Frankfurt horizontal plane. Various authors have localised the asterion using the distance from palpable bony land mark as shown in table 2. Present study shows a significant p-value for the distance between asterion and tip of the mastoid on right and left side which is a valuable point to be kept in mind by surgeons while placing a burr hole.

Asterion is a surgical landmark for transverse sinus surgeries and underlying it is the junction of transverse and sigmoid sinus. Tubbs RS et al found that in 74.4% the asterion was located superficial to Transverse sigmoid junction (16), according to the study by Gharabaghi et al. transverse sigmoid junction was at the asterion in 61% of the cases on the right side and 66% on the left, it was below the asterion in 7% on right and 9% on the left (17). Study by Leon et al. showed that in 84% of the cases transverse sigmoid junction was located at the asterion , above the asterion in 12.5% of the cases and below it in 5.1% of the cases (11). Mwachaka et al. reported that majority of the cases ,80% transverse sigmoid junction was at the asterion and only 1 case it was below the asterion (13). Our data was in accordance with the above studies with maximum,84% transverse sigmoid junction located at the asterion and 14% above the asterion and 2% below the asterion. According to Akkasoglu asterion is an essential point to indicate safety zone for surgical approach (7).

CONCLUSION

Asterion is an important craniometric point knowledge of which is essential for anatomists, forensic experts, radiologists, anthropologists and neurosurgeons. It acts as a guide to localise the site for initial burr hole and reduce the risk of injury to the sinuses as it is a reliable landmark indicating the surface projection of transverse sigmoid sinus junction. Though recent advanced techniques like CT scan can accurately determine the bony landmarks and underlying dural sinuses , localisation of asterion to delineate the safety zone for posterolateral cranial surgeries by means of morphometric measurements from palpable bony landmarks is useful in areas where such facilities are not available.

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Table 1. Position of asterion from palpable surface landmarks

PARAMETER	RIGHT (mm)	LEFT (mm)	P-VALUE
Distance of the asterion to the tip of mastoid process	49.87 ± 2.09	51.02 ± 2.01	0.005
Distance of the asterion to root of zygoma.	55.8 ± 1.91	56.5 ± 1.89	0.06
Distance of the asterion to External Occipital protuberance	62.4 ± 2.23	62.9 ± 2.02	0.26

Table 2. Distance of asterion from various palpable bony landmarks as studied by different authors.

Authors	Asterion to tip of Mastoid (mm)	Asterion to root of Zygoma (mm)	Asterion to external occipital protuberance
Martinez et al.(2000) (12)	49.70	55.42	64.40
Bozbuga et al.(2006) (4)	Right: 49.9 Left:50.1	Right:55 Left : 55.9	—
Mwachaka et al. (2010) (13)	Right-47.89 ± 3.72 Left-47.62 ± 2.87	Right-58.85 ± 2.5 Left-58.44 ± 2.12	—
Galindo-de Leon et al.(2012) (11)	51.33 ± 4.97	54.74 ± 4.46	61.51 ± 7.44
Ahad et al.(2015) (14)	50.84	53.83	61.41
Patil et al.(2019) (15)	Right – 48.77 ± 2.23 Left – 47.45 ± 2.62	Right – 56.15 ± 2.4 Left - 57.48 ± 2.68	—
Akkasoglu et al. (2019) (7)	Right – 45.01 ± 6.04 Left – 43.65 ± 6.75	Right – 43.95 ± 7.02 Left –43.97 ± 7.37	Right- 54.75 ± 5.57 Left – 62.59 ± 8.83
Present study	Right –49.87 ± 2.09 Left - 51.02 ± 2.01	Right – 55.81 ± 1.91 Left –56.51 ± 1.89	Right –62.45 ± 2.23 Left - 62.92 ± 2.02



Fig.1 Measurements using vernier calipers

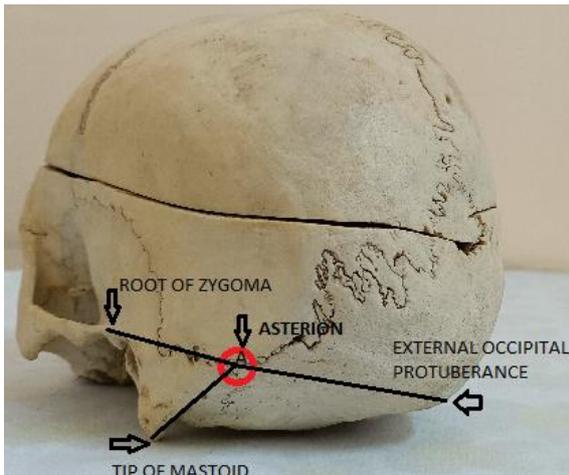


Fig.2 Position of asterion from palpable bony landmarks.



Fig.3 Transverse sigmoid junction A)Above the asterion B) At the asterion C) Below the asterion