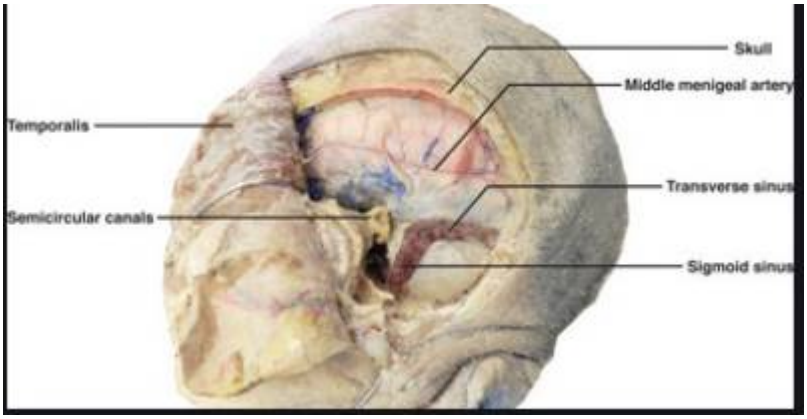
Transverse sigmoid sinus junction



The transverse-sigmoid sinus junction refers to the point at which the transverse sinus and the sigmoid sinus merge. The transverse sinus and sigmoid sinus are two dural venous sinuses or large blood vessels that drain blood from the brain. The transverse-sigmoid sinus junction is located in the posterior cranial fossa and is an important anatomic landmark for neurosurgeons.

Damage or injury to this junction can result in a number of medical conditions, including sinus thrombosis, intracranial hypertension, and subdural hematoma. Neurosurgical procedures that involve this area, such as craniotomy or embolization, require a thorough understanding of the anatomy and potential risks to minimize the risk of complications.

A reference coordinate system may be an accurate and practical method for identifying the ASTS during presigmoid craniotomy. The squamosal-parietomastoid suture junction (SP) might be difficult to find during presigmoid craniotomy and, therefore, it is not always a reliable landmark for defining the ASTS [1)]

Anatomical localization remains integral to neurosurgery, particularly in the posterior fossa where neuronavigation is less reliable. There have been many attempts to define the location of the transverse- sigmoid sinus junction (TSSJ) using anatomical landmarks, to aid in the placement of the “strategic burr hole” during a retrosigmoid approach. There is a paucity of research allowing direct comparison of such techniques.

The asterion is not a strictly reliable landmark in terms of locating the underlying posterior fossa dura. Its location is very often directly over the transverse sigmoid sinus junction complex. Burr holes placed at the asterion may often open the bone directly over the sinus, leading to potential damage [2)].

The asterion was located over the posterior fossa dura in 32% on the right and 25% on the left. Its position was over the transverse sinus or sigmoid sinus complex in 61% on the right and 66% on the left. The landmark was located above the transverse sigmoid sinus junction complex in 7% on the

right and 9% on the left [3].

The top of the mastoid notch (TMN) is close to the transverse sigmoid sinus junction. The spatial position relationship between the TMN and the key points (the anterosuperior and inferomedial points of the transverse-sigmoid sinus junction, ASTS and IMTS) can be used as a novel method to precisely locate the sinus junction during lateral skull base craniotomy.

Forty-three dried adult skull samples (21 from males and 22 from females) were included in the study. A rectangular coordinate system on the lateral surface of the skull was defined to assist the analysis. According to sex and skull side, the data were divided into 4 groups: male&left, male&right, female&left and female&right. The distances from the ASTS and IMTS to the TMN were evaluated on the X-axis and Y-axis, symbolized as ASTS&TMN_x, ASTS&TMN_y, IMTS&TMN_x and IMTS&TMN_y.

Among the four groups, there was no significant difference in ASTS&TMN_x ($p = 0.05$) and ASTS&TMN_y ($p = 0.3059$), but there were significant differences in IMTS&TMN_x ($p < 0.001$) and IMTS&TMN_y ($p = 0.01$), and multiple comparisons indicated that there were significant differences between male&left and female&left both in IMTS&TMN_x ($p = 0.0006$) and in IMTS&TMN_y ($p = 0.0081$). In general, the ASTS was located 1.92 mm anterior to the TMN on the X-axis and 27.01 mm superior to the TMN on the Y-axis. For the male skulls, the IMTS was located 3.60 mm posterior to the TMN on the X-axis and 14.40 mm superior to the TMN on the Y-axis; for the female skulls, the IMTS was located 7.84 mm posterior to the TMN on the X-axis and 19.70 mm superior to the TMN on the Y-axis.

The TMN is a useful landmark for accurately locating the ASTS and IMTS [4].

Using high-resolution contrast-enhanced cranial computed tomography images, we constructed three-dimensional virtual cranial models. Fifty models (100 sides) were created from a retrospective sample of images performed in a New Zealand population. Ten methods of anatomical localization were applied to each model allowing qualitative and quantitative comparisons. The “key point” was defined as the point on the outer surface of the skull that directly overlaid the junction of the posterior fossa dura, transverse sinus (TS), and sigmoid sinus (SS). The proximity of each method to this “key point” was compared quantitatively, in addition to other descriptive observations. TSSJ localization methods analyzed included: (1) asterion; (2) emissary foramen; (3) Lang and Samii; (4) Day; (5) Rhoton; (6) Avci; (7) Ribas; (8) Tubbs; (9) Li; and (10) Teranishi.

Mean distance to the “key point” showed two tiers of accuracy, those <10 mm, and those >10 mm: Li (6.3 mm), Ribas (6.6 mm), Tubbs (6.8 mm), Teranishi (7.8 mm), Day (8.4 mm), emissary foramen (12.0 mm), Avci (13.0 mm), asterion (13.9 mm), Lang and Samii (15.6 mm), and Rhoton (17.4 mm). The asterion would most frequently overlie the TS (63%) and was often supratentorial (14%).

Each method has a unique profile of dura or sinus exposure. There are significant differences in the accuracy of localization of the TSSJ among anatomical localization methods [5].

Sixty-three patients, 29 male and 34 female, who would undergo retrosigmoid craniotomy admitted to Department of Neurosurgery, the First Affiliated Hospital of Xinjiang Medical Universityfrom March to

October 2019 were enrolled in the study and were divided into trial group and control group according to the computer-generated random numbers. Preoperative venous computed tomographic angiography (CTA) combined with 3-dimensional computed tomography computed tomography (3D CT) was randomly given to the patients(n=32). Asterion was used for identification of the TSSJ in the controls (n=31). The main outcome measures as postoperative complications and relevant intraoperative indicators were compared.

Incision length, craniotomy time, bone window size in trial group were shorter or smaller than those of the controls, as(6.8±0.5) cm vs (8.0±1.5) cm, (37±8) min vs (45±15) min, (8.7±1.2) cm(2) vs (10.2±2.4) cm(2) respectively, with statistical significance (all P<0.05). No statistical significance was found in bleeding amount, incidence of sinus injury and Cerebrospinal fluid fistula. While incidence of neck pain was lower in case group (15.63% vs 38.71%; P=0.04) and the remission time of incisional pain in case group was shorter [(6±1) d vs (9±2) d; P=0.01].

While the technique is used, the center of the keyhole should be located at transitional place of the lateral part of the occipitomastoid suture, the retromastoid ridge and the superior nuchal line. Compared with the traditional craniotomy method marked by asterion, it has great advantages in reducing incidence of postoperative complications, craniotomy time, and the remission time of incisional pain [6].

References

1)
Li RC, Liu JF, Li K, Qi L, Yan SY, Wang MD, Xie WF. Localization of Anterosuperior Point of Transverse-sigmoid Sinus Junction Using a Reference Coordinate System on Lateral Skull Surface. Chin Med J (Engl). 2016 Aug 5;129(15):1845-9. doi: 10.4103/0366-6999.186633. PMID: 27453235; PMCID: PMC4976574.

2) , 3)
Day JD, Tschabitscher M. Anatomic position of the asterion. Neurosurgery. 1998 Jan;42(1):198-9. PubMed PMID: 9442525.

4)
Li R, Qi L, Yu X, Li K, Bao G. Mastoid notch as a landmark for localization of the transverse-sigmoid sinus junction. BMC Neurol. 2020 Mar 27;20(1):111. doi: 10.1186/s12883-020-01688-2. PMID: 32220232; PMCID: PMC7099776.

5)
Hall S, Peter Gan YC. Anatomical localization of the transverse-sigmoid sinus junction: Comparison of existing techniques. Surg Neurol Int. 2019 Sep 27;10:186. doi: 10.25259/SNI_366_2019. PMID: 31637087; PMCID: PMC6778333.

6)
Wu H, Li YL, Maimaitili M, Chen LX, Mamutijiang M, Bate G, Shen YS, Lyu MY, Zhu GH. [Assessment of computed tomographic angiographysinus development combined with occipitalbone marks for the location of transverse sigmoid sinus junction]. Zhonghua Yi Xue Za Zhi. 2020 Sep 8;100(33):2618-2621. Chinese. doi: 10.3760/cma.j.cn112137-20191210-02695. PMID: 32892609.