Supramastoid Crest, Safety Landmark for Craniotomy?

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Background: *Bony landmarks are important in identifying and avoiding various structures, and thus, decreasing surgical morbidity. Knowledge of frontal bone was studied to help surgeons with safe craniotomy as temporooccipital region study was rare.*
Objective: *To identify usefulness of supramastoid crest and relationship to venous and Labbe's vein.*
Material and Method: *Twenty fresh cadaveric heads, the vessels were injected with colorized silicone, were studied on both sides, yielded 40 sides. The relationship of the supramastoid crest to the transverse, sigmoid sinus, Labbe's vein was also determined and measured. The following distances were measured utilizing the digital caliper for all measurements.*
Results: *Supramastoid crest was found in all cadavers (100%) and skull opened along supramastoid crest 100% safe from injury to venous sinus. Anterior border of supramastoid crest was close in relation to middle cranial fossa floor, 85% on right side and 90% on left side and the same level of middle cranial. The authors defined supramastoid point with turning of supramastoid crest and found distance from supramastoid point to nearest venous sinuse (always transverse sinus) 1.0-22.41 mm in range and average 12.94 mm on right side and 11.87 mm on left side. The last distance, from supramastoid point to nearest Labbe's vein, was measured and found to be 5.94-24.97 mm in range and average 17.23 mm on both sides.*
Conclusion: *Supramastoid crest is bony landmark and easy to identify in the adult cadaver and craniotomy along supramastoid crest and always safe from injuring the venous sinus and Labbe's vein. 87.5% anterior border of supramastoid crest is the same level for middle cranial fossa floor.*

Keywords: *Supramastoid crest, Safty landmark*

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Anatomical localization of internal cranial anatomy based on superficial landmarks is important in identifying and avoiding various structures, and thus, decreasing surgical morbidity. Knowledge of frontal bone was studied to help surgeons in safe craniotomy, as temporooccipital region study was rare. Supramastoid crest is bone ridge in the posterior part of temporal fossa than runs backward and upward across at the posterior part of temporal fossa; it serves for the attachment of the temporal fascia and limits the origin of the temporalis muscle. In the past, the supramastoid crest was not verifiable, recognized and studied relative to beneath the venous structure.

The purpose of this present study was to identify usefulness of the supramastoid crest and measure the distance from supramastoid crest to middle fossa floor, Labbe's vein, the transverse and sigmoid sinus. Accurate information of supramastoid crest can guide a surgeon to a safe craniotomy in temporooccipital operation example, hemicraniectomy or temporal craniotomy for subtemporal approach. For practical information, we studied the supramastoid crest in fresh cadavers and dissected the cadavers with techniques similar to a real operation.

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Material and Method

Twenty fresh cadaveric heads, the vessels injected with colored and silicone, were studied. Studies of both sides yielded 40 sides. The temporalis muscle and soft tissues were removed to expose the temporal fossa and posterior cranium-identified zygomatic root and followed to supramastoid crest. The following supramastoid crest were identified in each specimen and defined the anterior border of the supramastoid crest, supramastoid point (turning curve of the supramastoid crest) and the posterior border of the supramastoid crest in Fig. 1, 2. Posterior cranial bone was cut to expose the dural sinus.

Supramastoid point was identified, drilled with

a small drill 1.5 mm and marked at underlying dura with methylene blue first then the supramastoid crest was cut and marked at the dura. Temporal fossa and posterior fossa bone were removed with high speed craniotome. The distance from the supramastoid point to the nearest margin of the transverse or sigmoid sinus was measured. The relationship of the anterior border of supramastoid crest and middle cranial fossa floor was checked and measured. Dura was opened and distance from supramastoid point to nearest Labbe's vein was measured. The following distances were measured utilizing the Marathon 8 inch/200 mm Electronic Digital Caliper for all measurements. Descriptive statistics was used to report the reslts. Design and study protocol was approved by Khon Kaen University Ethics Committee for Human research.

Fig. 1 Supramastoid crest was identified after scalp and temporalis muscle was dissected.

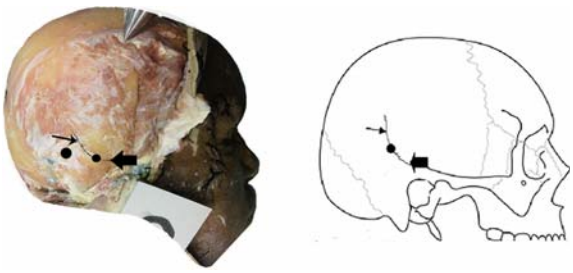

Fig. 2 Identifed supramastoid point (circle), anterior border of supramastoid crest (dark arrow) and posterior boder of supramastoid crest (thin arrow).

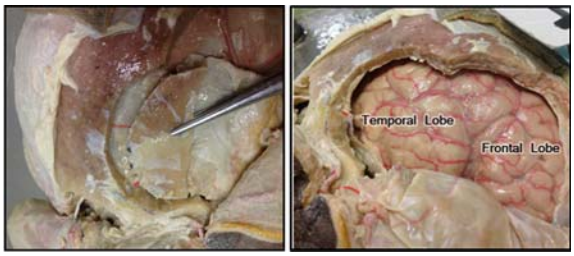

Fig. 3 Skull was opened along supramastoid crest and and dura was opened and relationship between supramastoid crest with middle cranial fossa, venous sinus, Labbe's vein was studied.

Results

Of our 20 cadavers, there were 9 female cadavers and 11 male. All cadavers were older than 18 years; the supramastoid crest was found in all cadavers (100%) and easy to view all cadavers. When the skull was opened along supramastoid crest, the authors found that the venous sinus to be far from the supramastoid crest in all specimens and were (100% safe from injury to venous sinus). The authors defined anterior border of the supramastoid crest and found it close relation to middle cranial fossa floor, 85% on right side and 90% on left side as with level of the middle cranial fossa and above the middle cranial fossa 15% on right side with average distance 5.88 mm and 10% on left side with an average distance 5.33 mm.

The authors defined the supramastoid point with turning of the supramastoid crest and found distance from the supramastoid point to the nearest venous sinuse (always transverse sinus) 1.0-22.41 mm in range and average 12.94 mm on right side and 11.87 mm on left side. The last distance from the supramastoid point to the nearest Labbe's vein was measured and found to be 5.94-24.97 mm, in range, and the average 17.23 mm on both sides (Table 1).

Discussion

Middle fossa surgery for brain tumor, trauma and vascular operation always needs adequate temporal craniotomy for excellent exposure to lesions with minimal brain retraction; however, study about the landmark to guide temporal craniotomy was rare. On the other hand, the squamaous part and mastoid part of temporal bone lay on transverse and sigmoid sinus and the temporal craniotomy may injure the venous sinus and lead to intra-operative complications as well as significant postoperative neurologic morbidity or mortality. In the past, many studies about bony the landmark and venous sinus example asterion superior nuchal line but not usefulless for temporal

Table 1. Relationship of supramastoid crest and others structure

Distance	Mean (mm) ± SD		
	Right	Left	Mean (mm)
Supramastoid point-transverie sinus (1.0-22.41 mm)	12.94	11.87	12.40
Supramastoid point-labbe's vein (5.94-24.97 mm)	17.23	17.06	17.14
Supramastoid crest save to injury sinus	20 (100%)	20 (100%)	40 (100%)
Anterior border supramastiod crest = middle cranial fossa (Y/N)	17 (85%)	18 (90%)	35 (87.50%)
Anterior border supramastiod crest higher than middle cranial fossa	5.88 mm	5.33 mm	5.60 mm
	3 (15%)	2 (10%)	5 (12.50%)

craniotomy because previous the landmark was not exposed in middle fossa surgery.

The supramastoid crest is the bone ridge that runs backward and upward across its posterior part; it serves for the attachment of the temporal fascia, and limits the origin of the temporalis muscle and is the boundary between the squama and the mastoid portion of the bone. This structure was designated by Broca (1875) as supramastoid crest, and also called retrotemporal crest by Rossa (1896) and temporal ridge by Leidy (1883). Turgut HB et al reported suprameatal crests were observed commonly as a trace type on the male dry skulls (51.2%), though no such crest was seen on most of the female skulls (54.4%). In the present study, 20 adult cadavers at Khon Kaen University it was found that it could identify the supramastoid crest easily in 100% of the cadavers and height at least 2 mm; no gender difference was observed. The authors defined the anterior part of the supramastoid crest and found 85% on right, 90% on left side the same level in of the middle cranial fossa and 15% in right and 10% on the left superior to middle cranial fossa 5 mm in average. When the craniotomy along the supramastoid crest had not exposed the venous sinus, the distance from the supramastoid point to the nearest venous sinus was (always transverse sinus) 1.0-22.41 mm in range and 12.4 mm in average.

Labbe's vein travels on the brain surface and is susceptible to injury during maneuver. In our study after durotomy, the nearest Labbe's vein (inferior anastomosis vein) was identified and was always far from the supramastoid crest and from the supramastoid point, 5.94-24.97 mm in range and 17.14 mm on average.

Conclusion

The supramastoid crest is the bony landmark that is easy to identify in adult Thai cadaver which makes the craniotomy along the supramastoid crest always safe from injury to the venous sinus and Labbe's vein, and 87.5% of the anterior border of the supramastoid crest is the same at the level of the middle cranial fossa floor. The supramastoid point can provide guidance to the position of venous sinus and Labbe's vein.

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Potential conflicts of interest

None.

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การศึกษาความสัมพันธ์ของรอยนูนกะโหลกศีรษะ supramastoid crest และตำแหน่งของโพรงหลอดเลือดดำบริเวณ posterior cranial fossa, Labbe's vein ในผู้บริจาคร่างกายที่โรงพยาบาลศรีนครินทร์ มหาวิทยาลัยขอนแก่น

พิชเยนทร์ ดวงทองพล, ไชยวิทย์ ธนไพศาล, อำนาจ กิจควรดี, โกวิท ไชยศิวามงคล, วิไลวรรณ หม้อทอง

ภูมิหลัง: เนื่องจากการผ่าตัดกะโหลกศีรษะบริเวณ temporo occipital เป็นหัตถการทำบ่อยในทางประสาทศัลยศาสตร์ เช่น การผ่าตัด decompressive craniectomy เพื่อลดความดันในกะโหลกศีรษะแต่การศึกษา anatomical landmark บริเวณนี้ยังมีอยู่น้อย

วัตถุประสงค์: เพื่อทำการศึกษาประโยชน์ของจุดอ้างบนกะโหลกศีรษะ supramastoid crest ว่าสามารถสังเกตุได้ง่ายจริงและมีความสัมพันธ์กับโพรงเส้นเลือดดำบริเวณ Posterior fossa และ Labbe's vein อย่างไร

วัสดุและวิธีการ: การศึกษาพรรณนา (descriptive study) โดยนำศพอาจารย์ใหญ่ที่เสียชีวิตเมื่ออายุมากกว่า 18 ปี จำนวน 12 ศพ (24 ข้าง) ซึ่งได้จากการบริจาคร่างกายให้แก่ภาควิชากายวิภาคศาสตร์ จากนั้นทำการฉีดสีน้ำเงินผสมซิลิโคนเพื่อให้เห็นโพรงเส้นเลือดดำชัดเจนและลงมือผ่าตัดเปิดกะโหลก ถ่ายภาพพร้อมสังเกตจุดอ้างอิงที่ผิวกะโหลกศีรษะและวัดระยะกับโพรงเส้นเลือดดำที่ศึกษาห่างดังกล่าวด้วยเครื่องมือวัด digital caliper ใช้หน่วยเป็นมิลลิเมตร ทศนิยมสองตำแหน่งและรายงานเป็นค่าเฉลี่ย

ผลการศึกษา: พบว่า supramastoid crest สามารถสังเกตได้ 100% ของอาจารย์ใหญ่ที่ทำการศึกษาและเมื่อเปิดกะโหลกศีรษะตามแนว supramastoid crest ปลอดภัยต่อโพรงเส้นเลือดดำและเส้นเลือด Labbe's vein แม้จะมีการฉีกขาดต่อชั้นดูราและพบว่าเมื่อวัดระยะจากขอบหน้าของ supramastoid crest พบว่าอยู่ในระดับเดียวกับ middle cranial floor 85% ในข้างขวาและ 90% ในข้างซ้าย เราเรียกจุดเปลี่ยนความโค้งของ supramastoid crest ว่า supramastoid point with และพบว่าระยะจากจุดอ้างอิงดังกล่าวมาถึง โพรงเส้นเลือดดำ transverse sinus ได้ระยะ 1.0-22.4 มิลลิเมตร และเฉลี่ย 12.94 มิลลิเมตร ในข้างขวา และ 11.87 มิลลิเมตร ในข้างซ้ายส่วนระยะจาก supramastoid point ถึง Labbe's vein เป็น 5.94-24.97 มิลลิเมตร และเฉลี่ย 17.23 มิลลิเมตร

สรุป: supramastoid crest เป็นรอยนูนกะโหลกศีรษะที่สังเกตได้ง่าย และสามารถใช้เป็นจุดอ้างอิงในการเปิดกะโหลกศีรษะโดยไม่เกิดอันตรายต่อโพรงเลือดดำและเส้นเลือด Labbe's vein และแนวขอบหน้าของ supramastoid crest ร้อยละ 87.5 อยู่ระดับเดียวกับ middle cranial fossa floor