



Original Article

Middle fossa triangles – A step-by-step dissection

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Received : 14 March 2023

Accepted : 05 April 2023

Published : 28 April 2023

DOI

10.25259/SNI_232_2023

Quick Response Code:



ABSTRACT

Background: The anatomy and surgical approach to the cavernous sinus and the middle fossa can constitute a considerable challenge, specially for young surgeons. Although their surgical explorations have gone through a popular phase in the past, to this date, they remain an uncomfortable subject for many neurosurgeons. The aim of this paper is to systematically review its anatomy and multiple corridors through a step-by-step dissection of the middle fossa triangles, providing a roadmap for surgeons.

Methods: A step-by-step dissection of the cavernous sinus was performed in two fresh-frozen cadavers aiming to describe the anatomy of ten different middle fossa triangles, demonstrating the feasibility of the use of their spaces while surgically approaching this area.

Results: The intradural opening of the roof of the cavernous sinus was obtained by dissection of clinoidal, carotid-oculomotor, supratrochlear, optic-carotid, and oculomotor triangles, allowing an expanded superior view. On the counterpart, the extradural exploration of the lateral wall through the middle fossa floor peeling exposed the infratrochlear, anteromedial, and anterolateral triangles. The middle fossa floor itself was the door to approaching posterior fossa through anterior petrosectomy. The dissection of each individual triangle can be amplified exponentially with exploration of its adjacents, providing broader surgical corridors.

Conclusion: The cavernous sinus still remains far from an “every man’s land,” but its systematic study based on direct approaches can ease the challenges of its surgical exploration, allowing surgeons to feel more comfortable with its navigation, with consequently benefit in the treatment of patients.

Keywords: Cavernous sinus, Microneuroanatomy, Middle fossa, Skull base, Triangles

INTRODUCTION

The groundbreaking works of Dolenc^[2] and other pioneers represented a true revolution in the knowledge and surgical interest regarding the approaches to the cavernous sinus. Before then, it was considered to be impenetrable due its intricate anatomy and potential risk for patients, a surgical “no-man’s land.” After the pace was set by these authors, the exploration of the cavernous sinus gained an increasing look while its approach became more popular and systematized.

The description of the middle fossa and cavernous sinus triangles by the groups of Parkinson,^[9] Kanzaki *et al.*,^[7] Glasscock *et al.*,^[4] Mullan,^[8] Hakuba,^[5] and Dolenc^[1,2] were paramount in order to establish a logical thinking regarding that anatomy and safe pathways to explore, leading to better approaches and surgical results. Since they are based on constant anatomical key-references, they

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represent both a study guidance for these structures and their approach and an intraoperative cornerstone for localization.

As these triangles are carefully dissected, one can note that their initially rigid limits and narrow corridors, seen with skepticism, become progressively more flexible, and their content become significantly more extensive. Furthermore, since these structures are adjacent to one another, the exploration of one triangle can exponentially increase the avenue of the next, creating an unforeseen working space for the surgeon.

MATERIALS AND METHODS

The study of the middle fossa was performed in a fresh-frozen injected cadaver specimen and was approved by the institutional research board.

RESULTS

The dissection was photographically registered step-by-step to demonstrate the approach to ten different middle fossa triangles, with documentation of the limits that compose them and their exploration regarding its contents and navigation. Different angles were included aiming to ease the anatomical study of the structures and the surgical corridors allowed by them. Initially, anterior clinoidectomy was performed intradurally and the triangles of the roof of cavernous sinus were dissected in a sequential manner. The middle fossa floor was then peeled away extradurally to demonstrate the lateral wall of cavernous sinus and progress with the corresponding triangles. Afterward, the middle fossa floor was explored and drilled in a way to address the structures present in the posterolateral and the posteromedial triangles.

The approaches to the middle fossa triangles were divided in those related to the roof of the cavernous sinus, its lateral wall and the middle fossa floor itself, aiming to allow a systematic review of the exploration, contents, and corridors they provide.

DISCUSSION

Roof of the cavernous sinus

The following triangles [Figures 1 and 2] are adjacent and constitute corridors to the contents of the cavernous sinus from a superior perspective, through its roof. Therefore, although the initial steps can be performed completely extradurally, eventually the opening of dura-mater will be paramount to allow visualization of the superior wall of cavernous sinus and its adjacent structures.

Dolenc's or clinoidal triangle

Described as "the anteromedial triangle" by Dolenc in 1989,^[2] the clinoidal triangle is formed by the union of the lateral border of optic nerve and medial border of oculomotor nerve

(CN III), posteriorly limited by the dura between the two at the point of entrance of the CN III into the roof of cavernous sinus. Since CN III penetrates dura-mater through the oculomotor triangle, therefore limiting its visualization at the level of anterior clinoid process, the triangle can only be fully exposed by an anterior clinoidectomy, which also removes its anterior content – the anterior clinoid process itself and the optic strut. Once exposed, the triangle allows direct visualization of both dural rings: The distal, which constitutes the most external, apparent, superior wall of cavernous sinus; and the proximal, attached to the medial wall of CN III and considered to be the real superior wall of cavernous sinus – the carotid-oculomotor membrane. It is also possible to identify the clinoidal segment of the internal carotid artery (ICA) and its transition to the supraclinoid counterpart.^[10]

The opening of cavernous sinus can then be performed by dissection of the carotid-oculomotor membrane, medial to CN III, and the cavernous segment of carotid artery in its distal horizontal and anterior loop is made evident. Therefore, the approach to this triangle is the only that allows exposure of three different segments of ICA – distal cavernous, clinoidal and ophthalmic segment of supraclinoid –, or, in other words, the entire paraclinoid carotid artery [Figures 3a-e].

The dissection allowed by this triangle, if associated with removal of the dura-mater and bone that constitutes the roof of optic canal, also allows medial and superior mobilization of optic nerve and removal of its dura propria on its inferolateral side, with ophthalmic artery becoming evident from its origin – regardless if it ascends from supraclinoid, clinoidal, or cavernous segment of ICA – to its entrance in the optic canal, with an expansion of the opticocarotid triangle.^[6] On the other hand, lateral mobilization of CN III also allows increasing of the triangular space, with better visualization of the horizontal segment of the cavernous carotid and the emergence of the inferolateral trunk (ILT).^[11]

The exploration of the clinoidal triangle, therefore, constitutes a versatile and frequently useful strategy, allowing better manipulation of the carotid artery, CN, and optic nerve and the treatment of a range of pathologies involving these structures.

The removal of anterior clinoidal process also improves the surgeon's angle of vision, facilitating other surgical maneuvers, such as posterior clinoidectomy (by ampliation of carotid-oculomotor triangle) and middle fossa peeling. Hence, it constitutes a keystone in approaching the cavernous sinus by both its superior and lateral walls as far as posterior fossa.

Supratrochlear or paramedial triangle

The supratrochlear triangle, as the name suggests, is formed by the union of the superomedial border of the trochlear

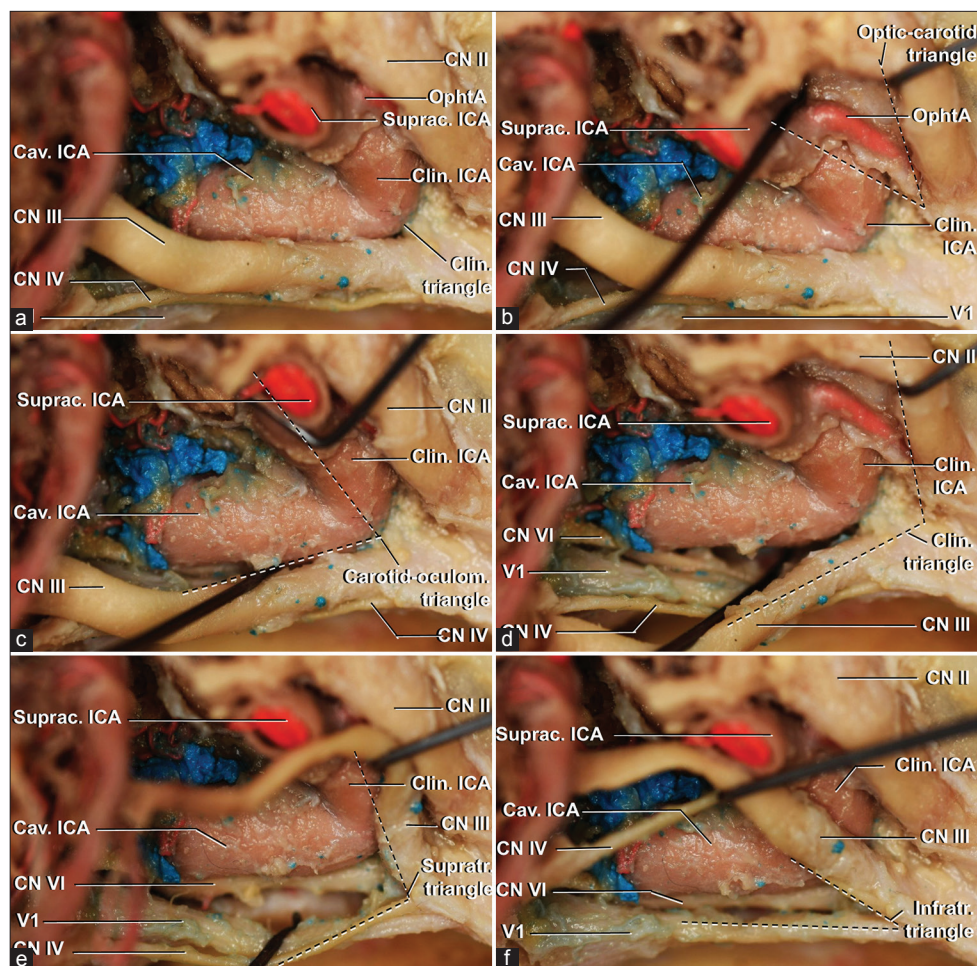


Figure 1: A superior view of a right cavernous sinus with a 30° clockwise rotation. (a) An overview of the roof of the cavernous sinus after complete clinoidectomy. (b) optic-carotid triangle, limited medially by the lateral border of CN II and laterally by the supraclinoid ICA. The emergence of the ophthalmic branch of ICA can be noted within the limits of the triangle. (c) the carotid-oculomotor triangle, formed by the junction of the lateral margin of supraclinoid ICA and medial margin of CN III. Within its limits, after opening the roof of the cavernous sinus, cavernous ICA can be demonstrated. (d) clinoidal triangle, marked by the lateral border of CN II and medial border of CN III, demonstrates the three segments composing the paraclinoid internal carotid artery – cavernous, clinoidal and ophthalmic segment of supraclinoid ICA. (e) the supratrochlear triangle is a narrow corridor located between the infero-lateral border of CN III and superomedial border of CN IV and can be used for exposition of the proximal horizontal portion of the cavernous segment of ICA. (f) infratrochlear or Parkinson's triangle, composed by the junction of the inferior margin of CN IV and superior margin of V1 was dissected, demonstrating the posterior loop of cavernous ICA and the abducens nerve. Cav: Cavernous, Clin: Clinoidal, CN II: Optic nerve, CN III: Oculomotor nerve, CN IV: Trochlear nerve, ICA: Internal carotid artery, Infratr: Infratrochlear, OphthA: Ophthalmic artery, Suprac: Supraclinoid, Supratr: Supratrochlear, V1: Ophthalmic division of trigeminal nerve.

nerve (CN IV) and inferolateral border of the CN III, limited posteriorly by a line connecting the point of piercing of both nerves into dura-mater.^[1] It was also described first by Dolenc in 1989, as the paramedial triangle.^[2] The contact between the nerves occurs at the level of the lateral margin

of optic strut, when CN III, that runs superiorly to CN IV from its entrance at the superior wall of cavernous sinus until this point, descends and becomes inferior to the latter while approaching the entrance of the orbita in the superior orbital fissure.

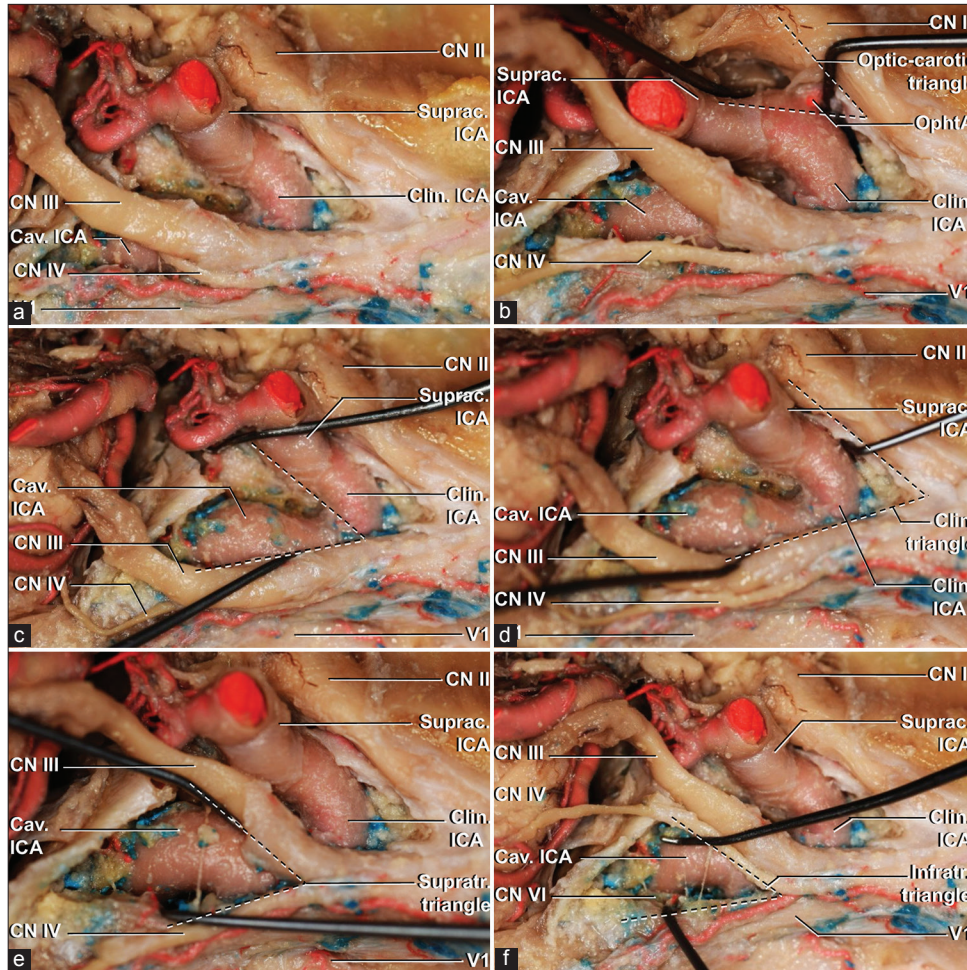


Figure 2: A superolateral view of a right cavernous sinus with a 45° clockwise rotation. (a) an overview of the roof of the cavernous sinus after complete clinoidectomy. (b) optic-carotid triangle, limited medially by the lateral border of CN II and laterally by the medial border of supraclinoid ICA. The emergence of the ophthalmic branch of ICA can be noted within the limits of the triangle. (c) the carotid-oculomotor triangle, formed by the junction of the lateral margin of supraclinoid ICA and medial margin of CN III. Within its limits, after opening the roof of the cavernous sinus, cavernous ICA can be demonstrated. (d) clinoidal triangle, marked by the lateral border of CN II and medial border of CN III, demonstrates the three segments composing the paraclinoid internal carotid artery – cavernous, clinoidal, and ophthalmic segment of supraclinoid ICA. (e) the supratrochlear triangle is located between the infero-lateral border of CN III and superomedial border of CN IV and can be used for exposition of the proximal horizontal portion of the cavernous segment of ICA. (f), infratrochlear or Parkinson's triangle, composed by the junction of the inferior margin of CN IV and superior margin of V1 was dissected, demonstrating the posterior loop of cavernous ICA and the abducens nerve. Cav: Cavernous, Clin: Clinoidal, CN II: Optic nerve, CN III: Oculomotor nerve, CN IV: Trochlear nerve, ICA: Internal carotid artery, Infratr: Infratrochlear, OphthA: Ophthalmic artery, Suprac: Supraclinoid, Supratr: Supratrochlear, V1: Ophthalmic division of trigeminal nerve.

This narrow triangle, therefore, is located within the superolateral wall of the cavernous sinus, which needs to be opened for exposure of its content. Once the CN III is dissected from its dural piercing to the inferior clinoidal pillar – which can be eased with the opening of clinoidal triangle, the cavernous segment of ICA can be visualized

from the posterior to the anterior bends, including the most common point of emergence of the ILT [Figure 3f].^[6] With lateral retraction of CN IV or dissection of the infratrochlear triangle, its adjacent, the meningo-hypophyseal trunk (MHT) and proximal segment of abducens nerve (CN VI) can also be explored.^[1]

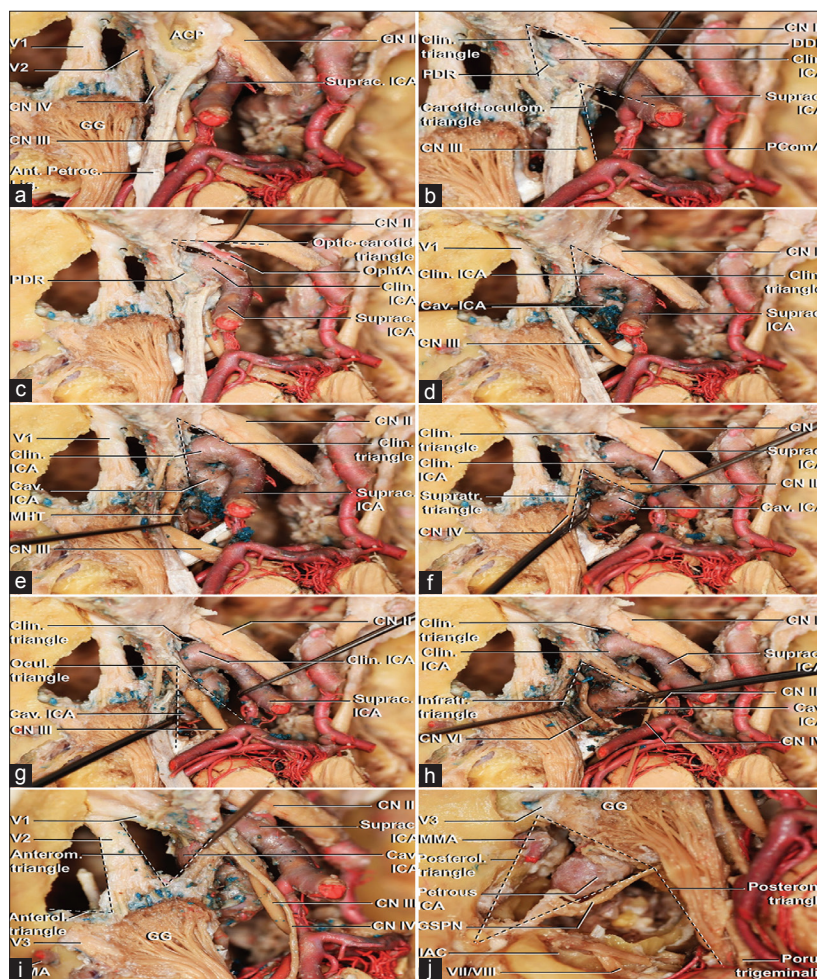


Figure 3: A supero-lateral view of a left cavernous sinus with a 15° counter clockwise rotation through a step-by-step dissection. (a) An overview of the roof and lateral wall of the cavernous sinus after the middle fossa peeling was conducted and an anterior clinoidectomy was partially performed. (b) The anterior clinoid process removal was completed along with the opening of the dura propria covering the optic nerve. It is possible to visualize the proximal dural ring, also known as the carotid-oculomotor membrane, and the distal dural ring. Proximal to the PDR, the cavernous segment of ICA is present. Between PDR and DDR, the carotid is adjacent to the anterior clinoid process – the clinoidal segment. Distal to the DDR, the supraclinoid segment of ICA. The carotid-oculomotor triangle exposes the emergence of the posterior communicating artery. (c) Dissection of the optic-carotid triangle after section of the DDR demonstrated the initial course of the ophthalmic artery, inferior to the optic nerve. (d) With sectioning of the PDR, the cavernous sinus is opened medially to the oculomotor nerve. The anterior loop and distal horizontal portions of cavernous ICA are exposed. (e) Further dissection demonstrates the meningo-hypophyseal trunk emerging from cavernous ICA. (f) The supratrochlear triangle allows approaching the proximal horizontal portion of the cavernous segment of ICA. (g) The complete opening of the oculomotor or Hakuba's triangle exposes the distal ascending and posterior loop of the cavernous ICA. (h) The dissection of the infratrochlear or Parkinson's triangle, conversely, exposes the posterior loop of cavernous ICA, the origin of the meningo-hypophyseal trunk, and the abducens nerve through most of its intracavernous course. (i) The anteromedial triangle exposes the distal horizontal portion of the cavernous ICA. Bone drilling in both anteromedial or anterolateral triangles allows approaching sphenoid sinus. (j) Bone drilling adjacent to the posterolateral and posteromedial triangles expose the course of the petrous carotid artery from its entrance in the carotid canal to the passage under the petro-lingual ligament and penetration of the cavernous sinus. Under the posterolateral triangle, formed by the junction of the GSPN and the lateral border of the gasserian ganglion and V3 until its entrance in the foramen ovale, Eustachian tube and tensor tympani are present. The posteromedial triangle relies adjacent to Glasscock's area and it is limited by the gasserian ganglion and V3 anteromedially, GSPN anterolaterally and a line connecting the geniculate ganglion and petrous apex on the counterpart. Bone drilling within its limits, medial to the IAC, and lateral to the porus trigeminus, over the petrous apex, exposes the posterior fossa dura-mater. ACP: Anterior clinoid process, Ant: Anterior, Anterol: Anterolateral, Anterom: Anteromedial, Cav: Cavernous, Clin: Clinoidal, CN II: Optic nerve, CN III: Oculomotor nerve, CN IV, trochlear nerve, CN VII: Facial nerve, CN VIII: Vestibulocochlear nerve, GG: Gasserian ganglion, GSPN: Great superficial petrous nerve, IAC, Internal acoustic canal, ICA: Internal carotid artery, Infratr: Infratrochlear, Lat: Lateral, Lig: Ligament, MMA: Middle meningeal artery, OphtA: Ophthalmic artery, PComA: Posterior communicating artery, PDR: Proximal dural ring, Petroclin: Petroclinoid, Posterol: Posterolateral, Posterom: Posteromedial, Suprac: Supraclinoid, Supratr: Supratrochlear, V1: Ophthalmic division of trigeminal nerve, V2: Maxillary division of trigeminal nerve, V3: Mandibular division of trigeminal nerve.

Optic-carotid triangle

The optic-carotid triangle is formed by the union of the lateral border of the optic nerve, medial border of the supraclinoid segment of ICA and fist segment of anterior cerebral artery (pre-communicating segment of anterior cerebral artery).^[6] This triangle can be considered to be a content of the clinoidal triangle and can be amplified by the exposure of the latter, specially if accompanied by unroofing of the optic canal and opening of the optic nerve's dura propria [Figure 3c].

Exploring this triangle can be useful in order to approach sella turcica and pituitary stalk. Also, in a lateral to medial view, the contralateral CN III can be exposed. In an anterior to posterior transcavernous view, the basilar apex and both superior cerebellar artery (SCA), first segment of both posterior cerebral (pre-communicating segment of posterior cerebral artery, P1), the ipsilateral posterior communicating (PCoM), and thalamoperforating arteries can be explored.^[11] Since it comprises the medial aspect of the supraclinoid ICA, the ophthalmic artery, the superior hypophyseal artery and perforating branches that irrigate the third ventricle, hypothalamus, pituitary gland, optic nerve, and chiasm must be handled carefully while dealing with this area to prevent ischemic events in this territory and bleeding from the rupture of such delicate vessels.

Carotid-oculomotor triangle

Lateral to the optic-carotid triangle, the carotid-oculomotor triangle is marked by the lateral border of supraclinoid segment of ICA, medial border of CN III, and first segment of middle cerebral artery (pre-bifurcation segment of middle cerebral artery). It can also be included within the clinoidal triangle.^[3]

The loosening of third nerve and ICA by opening of this triangle, that constituted the superior wall of cavernous sinus – which can be maximized by opening of the clinoidal triangle, – allows medial mobilization of ICA and lateralization of CN III, exposing the posterior clinoid process, which can be removed especially in the context of exposing both SCA and P1 origins, the anterior portion of the second segment of posterior cerebral artery, the basilar artery, and its apex and ipsilateral PCoM, and its perforating branches,^[11] but also in approaching other pathologies in the high clivus through the cavernous sinus, with less risk to perforating branches in comparison to its adjacent, the optic-carotid triangle [Figure 3b].^[6] Furthermore, the liberation of CN III before its lateralization reduces the risk of postoperative palsy secondary to manipulation injury.

Hakuba's or oculomotor triangle

The oculomotor triangle was initially described by Hakuba in 1986^[5] and is currently considered to consist in the area

between anterior and posterior petroclinoid ligaments and interclinoid ligaments,^[2,5] although these limits have been described differently within the past.^[6] The CN III pierces the roof and penetrates the cavernous sinus through this triangle. Its exploration allows superior approach to cavernous sinus, being useful in approaching cavernous ICA and CN VI, and expanding its adjacent triangles – carotid-oculomotor and supratrochlear. Therefore, it is dissected frequently as an adjuvant maneuver to the opening of these triangles [Figure 3g]. Since CN IV penetrated the cavernous sinus at the posterior limit of this triangle, the dissection must be careful to preserve the nerve.^[6]

Lateral wall of the cavernous sinus

The lateral wall of the cavernous sinus is divided in two layers – an internal and an external. The external layer is continuous with the dura covering the floor of middle fossa, and can be approached intradurally. On the other hand, the dissection of its inner layer, partially constituted by the cranial nerves IV and ophthalmic (V1), maxillary (V2), and mandibular (V3) divisions of trigeminal nerve (CN V), depends on the removal of its external layer, what is more easily performed extradurally, with a peeling that detaches the dura-mater from the floor of middle fossa up until the cavernous sinus, being limited by the tentorial incisura medially, marking the end of lateral wall and beginning of superior wall.

Such as in the cases of the above-mentioned triangles, since they are adjacent to one another [Figures 3h-j, 4 and 5], the opening of one of the following and the mobilization of its walls allows a better exposure in the next, contributing for a progressive expansion of the surgical corridor between their walls.^[2]

Parkinson's or infratrochlear triangle

Described by Parkinson in 1964,^[9] this triangle is composed by the superior margin of V1 and inferior border of CN IV, and a line that connects the entrance of both nerves into the dura-mater covering the cavernous sinus, relying entirely on the lateral wall of the cavernous sinus.^[3] If the extradural approach is chosen, initially a middle fossa peeling is performed, removing the outer layer of the lateral wall of cavernous sinus and exposing the reticular layer that constitutes its inner part. That allows the direct visualization of both nerves and their exploration. An incision is performed under direct vision inferior to the lower margin of the trochlear nerve and it continues until both nerves merge in the lateral border of the optic strut at the entrance of superior orbital fissure.

The opening of the Parkinson triangle is used for the direct approach of the posterior bend and proximal horizontal segment of the cavernous ICA and the origin of the MHT.

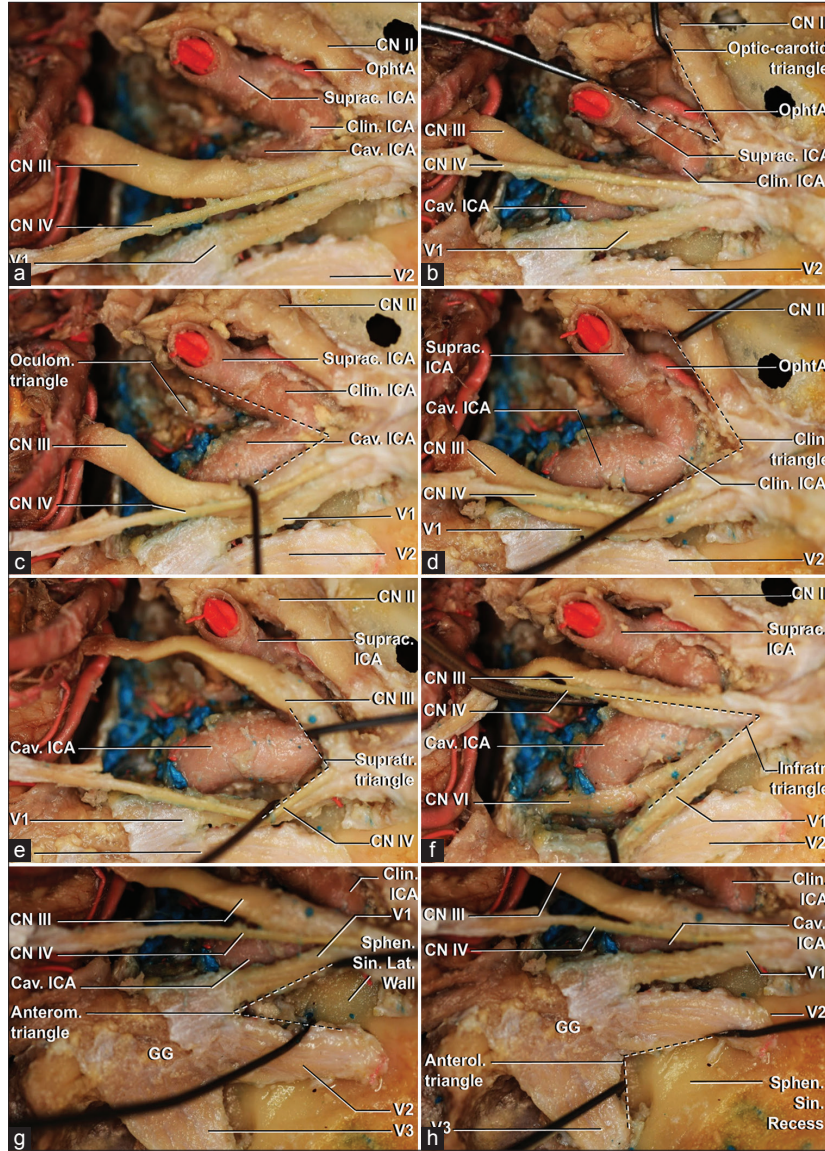


Figure 4: A super-lateral view of a right cavernous sinus with a 60° clockwise rotation. (a) The overview of the roof and lateral wall of the cavernous sinus. (b) Exploration of the optic-carotid triangle demonstrates the emergence of the ophthalmic artery from the supraclinoid portion of the internal carotid artery, distal from the distal dural ring. (c) Exposition of the carotid-oculomotor triangle above the roof of the cavernous sinus. (d) Dissection of the clinoidal triangle demonstrates the distal cavernous (horizontal and anterior loop portions), clinoidal and supraclinoid segment of the internal carotid artery. (e) The opening of the supratrochlear triangle exposes the horizontal portion of the cavernous segment. (f) Demonstration of the infratrochlear triangle exposes the posterior loop and proximal horizontal portions of cavernous ICA and the abducens nerve, lateral to the artery and medial to ophthalmic division of the trigeminal nerve. Cavernous sinus is filled with venous blood. (g) The anteromedial triangle, limited medially by the inferior margin of V1 and laterally by the superior margin of V2, allows approaching the lateral wall of the sphenoid sinus. (h) The wall to the lateral recess of the sphenoid sinus is located in the anterolateral triangle, located between the inferior border of V2 and superior border of V3. Anterol: Anterolateral, Anterom: Anteromedial, Cav: Cavernous, Clin: Clinoidal, CN II: Optic nerve, CN III: Oculomotor nerve, CN IV: Trochlear nerve, ICA: Internal carotid artery, Infratr: Infratrochlear, Lat: Lateral, OphthA: Ophthalmic artery, Sin: sinus, Sphen: sphenoid, Suprac: Supraclinoid, Supratr: Supratrochlear, V1: Ophthalmic division of trigeminal nerve, V2: Maxillary division of trigeminal nerve, V3: Mandibular division of trigeminal nerve.

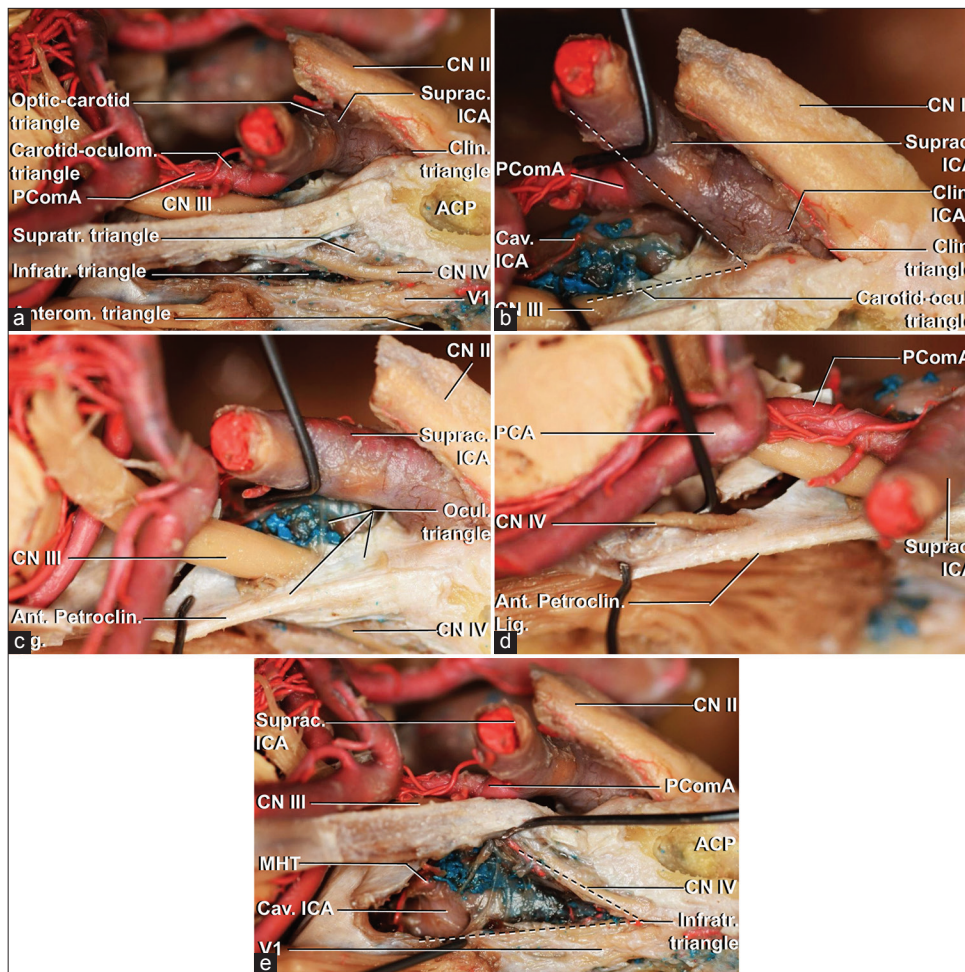


Figure 5: A lateral view of a right cavernous sinus with a 90° clockwise rotation. (a) Overview of transition between the roof and lateral wall of the cavernous sinus. (b) The carotid-oculomotor triangle can be visualized with emergence of the posterior communicating artery. (c) Oculomotor triangle, on the roof of the cavernous sinus, laterally limited by the anterior petroclinoid ligament, medially by the interclinoid ligament and posteriorly by the posterior petroclinoid ligament. (d) The point of entrance of the trochlear nerve in the dura-mater and lateral wall of the cavernous sinus. (e) Infratrochlear triangle opening with exposure of the posterior loop and horizontal portions of cavernous internal carotid artery. Also, the emergence of the meningohipophyseal trunk is noted. ACP: Anterior clinoid process, Ant: Anterior, Anterom: Anteromedial, Cav: Cavernous, Clin: Clinoidal, CN II, optic nerve, CN III: Oculomotor nerve, CN IV: Trochlear nerve, ICA: Internal carotid artery, Infratr: Infratrochlear, Lig: Ligament, PComA, Posterior communicating artery, Petroclin: Petroclinoid, Suprac: Supraclinoid, Supratr: Supratrochlear, V1: Ophthalmic division of trigeminal nerve.

Furthermore, it allows visualization of the entire intradural course of abducens nerve, which follows the carotid lateral wall, internally to the lateral wall of the cavernous sinus, which can be eased with lateral retraction of V1.^[6] If associated with the opening of the supratrochlear or oculomotor triangle, the exposure can be increased significantly, bringing the more distal segment of horizontal cavernous ICA and ILT to the view.^[2]

Mullan's or anteromedial triangle

The anteromedial triangle is located between nerves V1 and V2, from its origin in the gasserian ganglion, until the nerves follow their course, entering the superior orbital fissure and foramen rotundum, respectively. It was first described by Mullan, in 1979.^[8] It provides a narrow corridor that allows visualization of the final portion of the horizontal segment

and the anterior bend of the cavernous ICA and CN VI as it assumes a more inferolateral position toward V1, that can be medially retracted for better exposure.^[1] Furthermore, by drilling the bone between superior orbital fissure and foramen rotundum, the sphenoid sinus is open.^[3]

Anterolateral or lateral triangle

This narrow triangle, described by Dolenc in 1989,^[2] is marked by the inferior margin of V2 and superior margin of V3, from their origin to the entrance in the foramen rotundum and ovale, respectively. It is possible to expose ICA from its horizontal petrous portion and lateral loop to the ascending cavernous segment. This corridor can be improved with drilling of bone lateral to this triangle, to allow lateral mobilization of V3, expanding the field. Furthermore, drilling the floor of the triangle allows access to the lateral recess of sphenoid sinus and infratemporal fossa^[6] and allows superior mobilization of V3, expanding both Glasscock and Kawase triangles.

Middle fossa floor

Glasscock's and Kawase's triangles [Figure 3] rely on a bony surface and, therefore, can be exposed by the middle fossa floor peeling and extradural exposition of the lateral wall of the cavernous sinus. Both can be better explored with the opening of the anterolateral triangle and superior mobilization of both V3 and the gasserian ganglion.

Glasscock's or posterolateral triangle

Glasscock's triangle, described in 1979,^[4] is formed by the junction of the great superficial petrosal nerve (GSPN) and the lateral border of the gasserian ganglion and V3 until its entrance in the foramen ovale.^[10] The hypotenuse of this triangle consists in an imaginary line between the foramen and the arcuate eminence.^[6] This triangle includes the foramen spinosum and emergence of the middle meningeal artery and its labyrinthine branch and the greater (GSPN) and lesser superficial petrosal nerve (LPN). Drilling of its floor between Glasscock's and Kawase's triangles – commonly under GSPN – exposes the posterior loop and horizontal segment of petrous ICA up to its entrance into the foramen lacerum and the cavernous sinus, after passing the petrolingual ligament and ascending to its lateral loop. Furthermore, the aperture of the Eustachian tube and tensor tympani muscle can be visualized lateral to ICA^[2] and the infratemporal fossa can be reached.

Kawase's or posteromedial triangle

The posteromedial triangle, first described in 1977,^[7] relies adjacent to Glasscock's area, being limited by the gasserian

ganglion and V3 anteromedially, GSPN anterolaterally and a line connecting the geniculate ganglion and petrous apex. It can also be amplified to a quadrangular area that includes all the petrous apex, from the internal acoustic canal (IAC) to porus trigeminus.^[6,10]

The anterior face of the triangle consists of an interface with Glasscock's and can be approached to expose ICA similarly.

The importance of this triangle is paramount in skull base surgery, since it allows, through the anterior petrosectomy, the communication between middle and posterior fossa. By drilling the petrous apex and the triangular and quadrangular areas medial and superior to the IAC and GSPN, the clivus posterior to porus trigeminus and the inferior petrous sinus can be exposed, so as cochlea and IAC, laterally, and, in between, the dura-mater of posterior fossa. The approach then proceeds to an intradural phase, in which the superior petrosal sinus and tentorium are divided and the anterolateral portion of pons, the vertebrobasilar junction and anteroinferior cerebellar artery can be visualized.^[6]

CONCLUSION

Although time has allowed immense evolution of the knowledge regarding the cavernous sinus, once known as a surgical “no man's land,” it still remains an indigestible subject for a great deal of neurosurgeons, including skull base surgeons. Its intricate tridimensional anatomy, though inviting, can be seen as excessively difficult to comprehend, especially for beginners. The systematic revision of these constant anatomic references for approaching this space is, therefore, keen, for those who seek for a better understanding and management of its related pathologies and, consequently, improvement in patient care.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: Rosa MR, Nigri F, Zimpel VM, Reghin Neto M. Middle fossa triangles – A step-by-step dissection. *Surg Neurol Int* 2023;14:150.

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