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Original Article

Minimally invasive presigmoid retrolabyrinthine suprameatal approach (PRSA): A cadaveric study for accessing premeatal anterior inferior cerebellar artery (AICA) aneurysms

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ABSTRACT

Background: The surgical management of aneurysms involving the proximal third of the anterior inferior cerebellar artery (AICA) usually necessitates complex and invasive approaches, thus posing major challenges. We aimed to investigate the infratentorial presigmoid retrolabyrinthine suprameatal approach (PRSA) as a surgical corridor for premeatal AICA aneurysms.

Methods: We performed 10 PRSA dissections in five cadaveric heads. Twelve morphometric parameters were measured, analyzed, and categorized into pre-procedural, intra-procedural, and additional parameters. The typical anatomic-radiological characteristics and variations were evaluated, and the related anatomical and radiological parameters were analyzed to predict surgical accessibility.

Results: Preoperative anatomic-radiological parameters provide valuable information to select patients with favorable anatomy that may offer appropriate surgical accessibility to the premeatal AICA through a PRSA corridor. The position of the basilar artery from the midline determines the degree of accessibility to the origin of AICA through the infratentorial PRSA. The PRSA for targeting proximal AICA aneurysms was also compared to other surgical approaches based on the available current literature.

Conclusion: Premeatal AICA aneurysms can be accessed and clipped through the infratentorial PRSA corridor. This would allow surgeons to avoid the sacrifice of hearing and balance as compared to other available invasive alternative approaches. The selection of the appropriate patients should be based on the individualized preoperative radiological characteristics for both the vascular and bony anatomy.

Keywords: Aneurysm, Anterior inferior cerebellar artery, Clipping, Posterior skull base, Presigmoid, Retrolabyrinthine, Sigmoid sinus

INTRODUCTION

Aneurysms involving the proximal third of the anterior inferior cerebellar artery (AICA) may arise from the basilar artery (BA)-AICA origin or from the AICA segments proximal to the internal auditory canal (IAC). The surgical management of these aneurysms is particularly challenging due to their location posterior to the middle of the clivus and the petrous apex, anterior to the cranial nerve (CN)-VII/VIII complex, and inferior to CN-V.[3] Available surgical corridors often involve extensive lateral skull base approaches that may lead to severe cerebrovascular and neurological complications.

In this anatomical study, we evaluated the feasibility of a minimally invasive presigmoid retrolabyrinthine suprameatal approach (PRSA) to expose the proximal AICA segments at the level of the lateral prepontine and cerebellopontine angle (CPA) cisterns.

MATERIALS AND METHODS

Five adults, formalin-fixed, triple-injected[29] cadaveric heads were utilized, adhering to our institution's ethical standards and regulations. No Institutional Review Board approval was required for this cadaveric study. Pre-procedural thin-cut head computed tomography (CT) scans (1.0 mm/slice) were obtained. Dissections were performed on both sides, for a total of 10 sides operated under ×3–×40 magnifications using an operating microscope (Haag-Streit®, Germany). Rigid Storz (El Segundo, CA) 0° and 30° endoscopes (4 mm diameter, 18 cm length) were also utilized for appraising the endoscopic anatomy. Post-procedural thin-cut head CT scans were obtained, and OsiriX (opensource software; www.osirixviewer.com) was used for all the radiographic analyses. The frameless navigation system (Curve Image Guided Surgery; Brainlab AG) was used to calculate in-situ measurements using the iPlan Cranial 3.0 software (Brainlab AG).

Surgical technique

A mastoidectomy followed by a classic retrolabyrinthine approach characterized the initial stage of the surgery. The next stage included the drilling of the posterior part of the petrous apex superior to the IAC through the presigmoid mastoidectomy, thus creating the retrolabyrinthine suprameatal corridor. This provided a multiangled exposure contemplated with effective micro-surgical maneuverability, exposing the AICA from its origin to the IAC.

Morphometric measurements

Twelve morphometric parameters were measured, analyzed, and categorized into pre-procedural, intra-procedural, and additional parameters.

The pre-procedural parameters were analyzed on pre-procedural head CT scans and used for surgical planning: (I) sigmoid sinus (SS) position,[27] which is graded into Grade 1 (favorable): the SS was not hindering the view of the presigmoid bony plate and of the posterior semicircular canal (PSC). The Trautmann triangle (TT) is wide. Grade 2 (intermediate): Anterior placement of the SS obscures the view of the presigmoid bony plate but not of the PSC. The TT became narrower compared with grade I. Grade 3 (unfavorable): The SS was situated so far anterior to impede the visualization of the presigmoid bony plate and the PSC. The TT was severely narrowed; (II) SS dominance; (III) petroclival angle;[2] (IV) BA position within clival zone II,[2] which extends from the IAC to the jugular tubercle into grade-0 midline, grade-1 right paramedian, grade-2 left paramedian, grade-3 right petro-clival junction, and grade-4 left petro-clival junction) [Figure 1]; and (V) petrous apex pneumatization (PAP).[8]

The intra-procedural parameters were assessed within the surgical field during the cadaveric dissection: (VI) BA depth (if the BA was not exposed, this distance was measured using the midline as a reference); (VII) arterial exposure (i.e., AICA and BA); (VIII) clipping feasibility, which classified the ease of

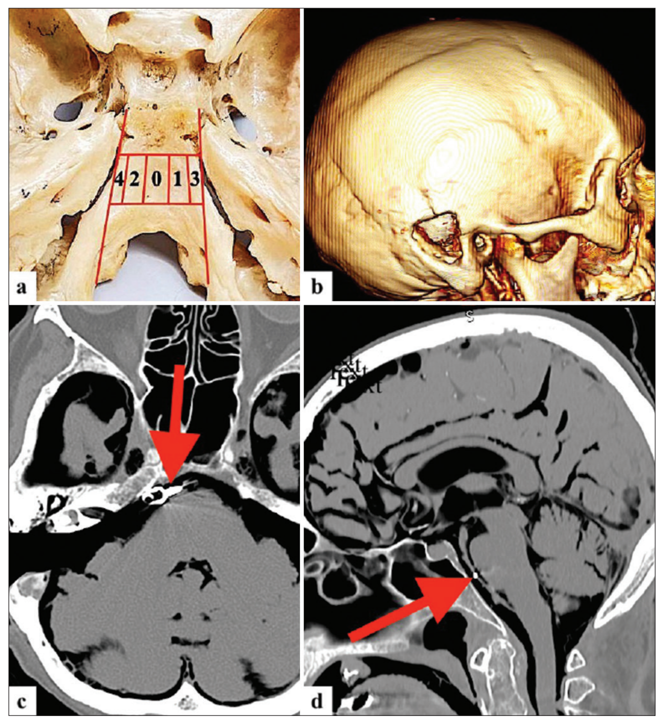

Figure 1: (a) Depiction of the clival zone II with the longitudinal classification of the basilar artery (BA) position in relation to the midline. The red bar indicates the BA position within clival zone, which extends from the internal auditory canal (IAC) to the jugular tubercle into: grade-0, midline; grade-1, right paramedian; grade-2; left paramedian; grade-3, right petro-clival junction, and grade-4, left petro-clival junction. (b-d) Post-procedural cranial computed tomography scans showing the anterior inferior cerebellar artery (AICA) clipping using the presigmoid retrolabyrinthine suprameatal approach (PRSA) approach. (b) 3D reconstruction of right side PRSA craniotomy, (c) axial, and (d) sagittal sections showing the final position of the aneurysmal clip (red arrow) on the AICA origin from BA.

aneurysmal clips application on the exposed BA and premeatal AICA segment into grade-1 if clipping was feasible, grade-2 if clipping was feasible with some difficulty, and grade-3 if clipping was not feasible; (IX) exposure area of the pons in cm^2, measured by multiplying the longest posterosuperior-anteroinferior and posteroinferior-anterosuperior diameters; and (X) exposure score,[4] based on the exposure of the target structure (AICA/BA) coupled with the feasibility to perform the surgical clipping.

The additional parameters included (XI) the need for PSC drilling and (XII) the presence of a high jugular bulb.

RESULTS

The pre-procedural anatomic-radiological parameters proved to be able to provide valuable information to select patients with favorable anatomy that may offer appropriate surgical accessibility to the premeatal AICA through a PRSA corridor [Table 1]. The position of the BA from the midline may determine the degree of accessibility to the origin of AICA through the infratentorial PRSA. Comparisons with other available approaches discussed in the literature are provided in Table 2. The SS position was favorable in seven specimens. The petro-clival angle varied from 129° to 150° with a median (interquartile range [IQR]) of 143° (9°). In clival zone II, the BA position was grade-0 midline in two specimens and grade-1 right paramedian in four specimens.

The median (IQR) BA depth was 7.04 cm (0.47 cm). The AICA was exposed on all ten sides, and the BA was exposed on eight sides. The median (IQR) of the exposure area of the pons was 94.4 cm^2 (49 cm^2). The exposure score was four in all specimens (three sides required PSC drilling), and clipping was feasible in all specimens (grade-2 on two sides) [Figures 2 and 3].

On post-procedure CT scans, an absent superior petrosal sinus (SPS) was noted on two sides and a high jugular bulb on the other two sides. The endoscope was utilized to confirm the course of the exposed BA and bilateral AICAs by following them to their origin with the parent arteries and also to inspect the surrounding critical perforators after the placement of the aneurysm clip.

DISCUSSION

The presigmoid approach per se has been extensively analyzed and recently classified in the literature.[15-17] According to the most extensive series in the literature, AICA aneurysms comprise ≤1% of all intracranial aneurysms.[10,11,19] Typically, those aneurysms arise at the origin of AICA from BA or arise throughout the AICA distally. However, some relatively older series included the aneurysms arising from the basilar trunk at the vicinity of AICA as well.[10] The classic AICA

Table 1: Measurements of morphometric parameters for BA/AICA through PRSA.

Cadaver ID	Side of approach	SS position	SS dominance	Petro clival angle (degrees)	Clival zone II BA position (degrees)	PAP	BA depth (cm)	Exposure area of the pons (cm^2)**	Exposure AICA	Exposure BA	Exposure score	Clipping feasibility	Need PSC drilling	SPS drainage	High jugular bulb
1	R	2	Co	135	0	2	7.09	126.36	+	–	4*	2	+	2	–
1	L	2	Co	129	0	2	6.75	68.53	+	–	4*	2	+	3	+
2	R	2	R	136	4	1	6.69	70.35	+	–	4*	2	+	2	–
2	L	1	R	139	4	1	7.3	123.75	+	+	4*	2	+	3	–
3	R	1	L	149	2	1	6.68	112.64	+	+	4	1	–	1	–
3	L	1	L	150	2	1	6.98	88.335	+	+	4	1	–	3	–
4	R	1	R	144	1	1	7.88	175.925	+	+	4	1	–	3	–
4	L	1	R	142	1	2	7.95	104.52	+	–	4*	2	+	2	–
5	R	1	L	145	1	4	6.97	42.245	+	+	4	1	–	1	–
5	L	1	L	146	1	4	7.21	76.8	+	+	4	1	–	4	+

SS: Sigmoid Sinus, BA: Basilar artery, PAP: Petrous apex pneumatization, AICA: Anterior inferior cerebellar artery, CN: Cranial nerve, REZ: Root entry zone, PSC: Posterior semicircular canal, SPS: Superior petrosal sinus, R: Right, L: Left, Co: Codominance. The grading of the SS position: Grade 1 (favorable): The SS was not hindering the view of the presigmoid bony plate and of the PSC. With a wide Trautmann triangle. Grade 2 (intermediate): Anterior placement of the SS, obscures the view of the presigmoid bony plate but not of the PSC. The Trautmann triangle became narrower compared with grade I. Grade 3 (unfavorable): The SS was situated so far anterior to impede the visualization of the presigmoid bony plate and the PSC. The Trautmann triangle was severely narrowed. Clival zone II BA position: 0: Midline, 1: R paramedian, 2: L paramedian, 3: Touch R PCJ (petro-clival junction), 4: Touch L PCJ. (Clival zone of AICA origin according to Aziz zones: (1) From dorsum sellae to upper border of IAC (2) from IAC to Jugular tubercle (3) below jugular tubercle). The degree of PAP using the labyrinth as the reference structure: (1) no air cells were present in the vicinity of the petrous apex medial to the labyrinth; (2) less than half of the petrous apex medial to the labyrinth was pneumatized; (3) more than half of the petrous apex medial to the labyrinth showed pneumatization, and group (4) most of the petrous apex area medial to the labyrinth was composed of air cells. The exposure score is for AICA/BA clipping. The exposure score is 4* only after PSC drilling. The exposure area** is measured by multiplying the posterosuperior-anteroinferior and posteroinferior-anterosuperior diameters. SPS drainage type: (1) Medial, (2) lateral, (3) complete, and (4) absent, PRSA: Presigmoid retrolabyrinthine suprameatal approach

Table 2: Comparison of PRSA with other potential approaches targeting BA/AICA aneurysms.

Approach/parameter	AICA origin exposure score	Brain traction	Affection of hearing	Risk of venous thrombosis/ injury (exposure or manipulation)	Cranial nerves at risk	AICA exposure via direct trajectory from origin to IAC	BA-proximal control	Applied on patients/Rupture or non-ruptured aneurysm
Pre-Sigmoid Trans-Labyrinthine/ Cochlear[16,17]	4	–	+++	+ (SS)	VI, VII, VIII	+	+	+/Both
Combined Supra-infra-tentorial pre-sigmoid[18-21]	4	+	+	+ (SS+vein of Labe)	IV, VI, VII, VIII	+	+	+/Both
Combined petrosal approach[22,23]	4	–	+	+ (SS+vein of Labe)	IV, V, VI, VII, VIII	+	+	+/Both
Endonasal transclival[24,25]	4	–	–	+ (clival venous plexus)	VI, VII, VIII	+/–	+	–
Anterior petrosal/Middle fossa[26]	3	+	+++	+ (vein of Labbe)	VI, VII, VIII	+/–	–	–
Retro-Sigmoid[27,28]	1	++	–	+ (SS)	V, VI, VII, VIII	–	–	–
PRSA	4	–	–	– (minimal)	VI	+	+	–

AICA: Anterior inferior cerebellar artery, IAC: Internal auditory canal, BA: Basilar artery, PRSA: Presigmoid retrolabyrinthine suprameatal approach, SS: Sigmoid sinus

aneurysms discussed under the microsurgical treatment option were saccular in shape.[11]

AICA aneurysms are classified according to the four AICA segments: anterior pontine, lateral pontine, flocculonodular, and cortical. The first 2 segments are considered the premeatal AICA segments. Endovascular strategies are preferred for aneurysms arising from the BA-AICA origin up to the IAC segment, and surgery is favored for more distal aneurysms. Operative strategies for proximal AICA aneurysms may include direct clipping, wrapping, or trapping with direct bypass.[14,31] Endoscopic transclival and PRSA routes can also be considered for some surgically treatable unruptured aneurysms.[1,12,33] For the surgical management of ruptured proximal AICA aneurysms, several different approaches have been reported across the literature, such as retrosigmoid, trans-labyrinthine, trans-cochlear, and combined supra-infratentorial presigmoid approaches, which require extensive drilling with significant brain traction.[3] In our anatomical study, we proved that the PRSA corridor is feasible to access the premeatal AICA and can be used to treat complex aneurysms involving the AICA origin.

Anatomy and landmarks of the PRSA

While performing the PRSA, we primarily tracked the course of the premeatal AICA up to the midline in the retroclival area. We found that multiple preoperative anatomic-radiological parameters can impact patient selection. The main parameters of interest include (1) BA position at the level of the clival zone II; (2) obtuse petro-clival angle (≥144°); and (3) SS position and the volume of the mastoid cavity. Among our specimens, 5 sides (50%) showed a ≥144° angle, achieving an optimal operative trajectory that exposed the full course of the pre-meatal AICA with the feasible and straightforward dissection and clip application. In addition, more posterior SS positions provide a more feasible approach through working in a relatively wide mastoid cavity. These grades should be assessed through a CT scan in the preoperative planning phase. Other parameters with moderate planning value are the type of SPS drainage and the degree of PAP. AICA contains several sets of perforators distributed along its segments. The first segment represents the premeatal segment, containing 2–8 perforators supplying the brainstem around the entry zone of the trigeminal, facial, and vestibulocochlear nerves; middle cerebellar peduncle and the adjacent part of the pons; and the choroid plexus of the CPA, the superolateral medulla, and the glossopharyngeal and vagus nerves.[21] During our clipping simulation, all the surrounding AICA perforators are safely avoided; however, this should be considered with caution as compared to real life surgery due to the absence of cerebrospinal fluid pulsation in the cadavers in addition to the relatively larger subarachnoid space surrounding the vessels as compared to real operative field.

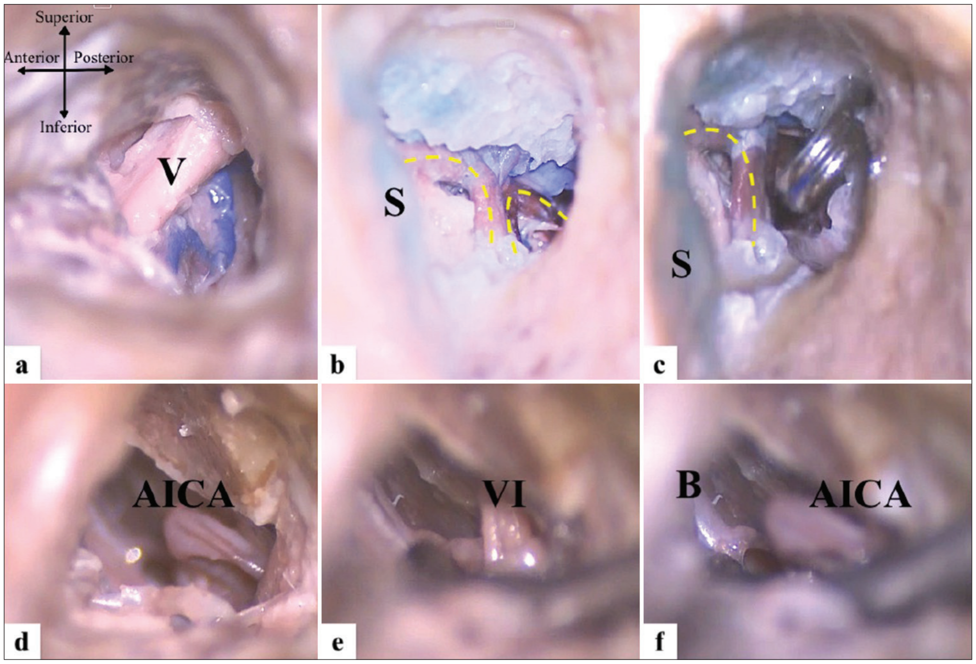

Figure 2: Operative steps on injected cadaver head showing the extent of the minimally invasive bone cavity of left side presigmoid retrolabyrinthine suprameatal approach: (a-c) Microscopic views exposing the cranial nerve (CN)-V, and then exposing and clipping the premeatal anterior inferior cerebellar artery (AICA); (d-f) endoscopic views of the operative field for the same cadaver, using 0° and 30° scopes showing the relation of the AICA to the surrounding structures. V: Trigeminal nerve, VI: Abducent nerve, B: Basilar artery, S: Sigmoid sinus, AICA: Anterior inferior cerebellar artery.

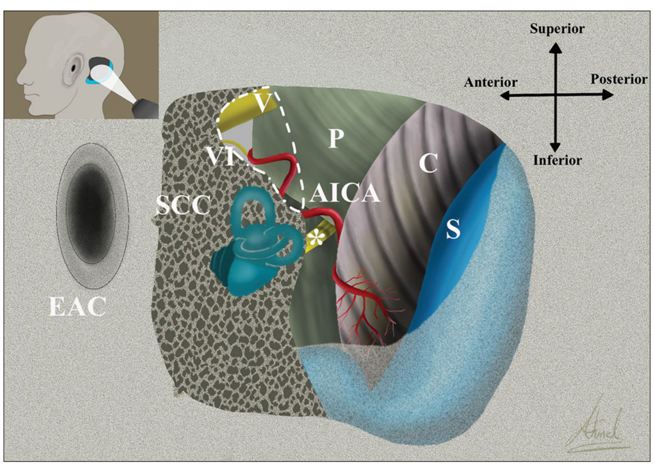

Figure 3: Artistic depiction of the presigmoid retrolabyrinthine suprameatal approach with the exposed anterior inferior cerebellar artery (AICA) and related operative anatomy. The dashed line indicates the drilled bone of the posterior petrous apex above the IAC. AICA: Anterior inferior cerebellar artery, C: Cerebellum, EAC: External auditory canal, P: Pons, S: Sigmoid sinus, SCC: Semicircular canals, V: Trigeminal nerve, VI: Abducent nerve, *:Facial nerve complex. Illustration prepared by Ahmed Muthana and courtesy of Samer Hoz. Asterix is defined in blue highlight. the red line is part of the illustration, and it depicts the anterior inferior cerebellar artery (AICA).

The BA position from the midline determines the accessibility of the origin of AICA from the BA through a PRSA corridor, and it should be measured at the level of any surgical approach due to the common variations and tortuosity of the BA course. For this reason, we analyzed the BA position at the middle clival area (also called Aziz's clival zone II[2]), which extends between the level of IAC and the jugular tubercle. We suggested a longitudinal partition of clival zone II in relation to the midline [Figure 1]. These complex approaches can be tackled only through a multidisciplinary team of skull base specialized neurosurgeons and neuro-otologists. This setting offers the experience of both specialties in planning, intraoperatively acting, and dealing with complications such as cerebrospinal fluid leaks and partial breaching of the semicircular canal. Using this technique, the PSC needs to be drilled to gain maximum exposure to the AICA origin. Based on our clinical experience, in the case of implementing this technique in real operative scenarios, immediate obliteration of the semicircular canal defect with bone wax and dust under high magnification may be of critical importance to preserve the auditory function. This technique may be performed as previously described by Horgan *et al*. during the transcrusal approach.[13]

Based on our anatomic study, we found that the full course of premeatal AICA can be exposed with the PRSA, which allows to treat of aneurysms located in the premeatal segment of AICA at the AICA origin and proximal to IAC. The exposed area comprises a trapezoid that connects the IAC, the CN-VI, the CN-V, and the BA groove. Clipping was feasible in most of the specimens with some difficulty in certain specimens. The grading of clipping feasibility was based on the expertise of our trainees and surgeons. The results should be interpreted with caution, and larger clinical trials are recommended to achieve a more standardized consensus following Delphi guidelines.[18] Variable angled optics and adapted endoscopic instruments may allow optimal visualization of previous inaccessible corners in the retroclival area, offering feasible corridors for BA clip application. It would be important to highlight that the PRSA visualization in our dissection was achieved with a microscopic view. This is because the use of exoscope has been recently introduced to the field and might benefit newer minimally invasive approaches by providing a 3D-expanded view.[5]

Comparison of PRSA with other approaches for BA/AICA aneurysms

When comparing different skull base approaches for AICA origin aneurysms, the variables that need to be considered include the extent of bone resection, brain retraction, and technical feasibility. For the posterolateral approaches to the petro-clival region, the retrosigmoid approach offers minimal bone resection with significant brain retraction to approach this region. However, since the retrosigmoid region is routinely used in clinical practice, most neurosurgeons are well-versed in this approach, resulting in technical expertise and minimizing morbidity. The transcochlear approach is associated with maximal bone resection and minimal brain retraction but requires neurotology expertise for the approach and results in hearing and vestibular loss. As regards the PRSA, moderate bone resection and minimal brain retraction are needed while providing reasonable surgical exposure.

When performing a comprehensive search of the literature, different approaches to the BA/AICA aneurysms have been described, each with its limitations and opportunities. To better define the possible advantages in terms of exposures and risks of our proposed PRSA, we provided a detailed description of the other approaches for accessing BA/AICA aneurysms [Table 2].[6,7,9,20,22-26,28,30,32,34] The scores on anatomical target exposure and intraoperative risks are listed as reported by the authors of each publication, offering potential comparisons with our approach, which may offer maximal and direct exposure of the AICA origin and BA-proximal, with clear visualization of the ipsilateral CNs, minimal/absent brain retraction, and potential hearing preservation.

The most common standard lateral skull base approaches may carry low morbidity when properly executed but are often unable to provide proper exposure of the AICA origin, thus necessitating larger exposures and increasing the chances of intraoperative complications. The presigmoid window may be offered as an addition to the subtemporal approach. However, we noted that temporal lobe exposure, retraction, and tentorial resection are often not necessary. We have consistently observed the presence of the proximal AICA in our surgical field when employing our proposed approach. These findings prompted us to explore the presigmoid window as a viable access point for these difficult lesions, which occasionally lack suitable surgical or endovascular alternatives.

There are numerous advantages of the PRSA over the classic transcochlear, presigmoid supra-infra-tentorial, and combined transpetrosal, trans-sigmoid, and endoscopic trans-clival approaches. The most important comprises the limited mastoid drilling, the avoidance of exposure and traction of the SS, and the preservation of the SPS, labyrinthine, cochlea, and CN-VII functions. In addition, the avoidance of the retraction of the temporal lobe and cerebellum, coupled with the preservation of the vein of Labbe, characterize critical differences in the PRSA as compared to other lateral and posterolateral approaches targeting the area of the petro-clival region between the IAC and the upper border of the jugular tubercle (clival zone II).[2,6,7,9,20,22-26,28,30,32,34]

Limitations

The PRSA corridor has some limitations. The proximal AICA can be exposed and manipulated through the minimally invasive PRSA. However, large lesions that require wide exposure, ruptured aneurysms with considerable hematoma, and unfavorable anatomy may pose some difficulties. Real surgical nuances and complications cannot be assessed fully through cadaveric studies. Thus further clinical implication seems to represent a mandatory step in advocating where and when to use such minimally invasive approaches. As the primary aim of this study was to propose our minimally invasive technique to tackle BA/AICA aneurysms, we did not perform cadaveric dissections to compare different approaches, but we searched the literature to identify the potential benefits and limitations of our approach in comparison to others. Future work is warranted to complete further comparative cadaveric dissections.

CONCLUSION

The premeatal AICA aneurysms can be accessed and clipped through the infratentorial PRSA corridor. This approach allows the preservation of hearing and balance as compared to other available invasive alternative approaches. The selection of the appropriate patients should be based on the individualized preoperative radiological characteristics for both the vascular and bony anatomy.

Acknowledgments

We acknowledge Ahmed Muthana for providing the graphical illustration [Figure 3].

Ethical approval

The Institutional Review Board approval is not required, as it is cadaveric study.

Declaration of patient consent

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

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. Aljuboori Z, Hoz SS, Al-Sharshahi ZF, Ding D, Andaluz N. Surgical clipping of a ruptured distal anterior inferior cerebellar artery aneurysm: A technical note. Cureus 2021;13:e18688.
2. Abdel Aziz KM, Sanan A, van Loveren HR, Tew JM Jr., Keller JT, Pensak ML. Petroclival meningiomas: Predictive parameters for transpetrosal approaches. Neurosurgery 2000;47:139-50.
3. Bambakidis NC, Manjila S, Dashti S, Tarr R, Megerian CA. Management of anterior inferior cerebellar artery aneurysms: An illustrative case and review of literature. Neurosurg Focus 2009;26:E6.
4. Bernardo A, Evins AI, Visca A, Stieg PE. The intracranial facial nerve as seen through different surgical windows: An extensive anatomosurgical study. Neurosurgery 2013;72:ons194-207.
5. Bocanegra-Becerra JE, Acha Sánchez JL, Contreras Montenegro L, Cueva M, Bellido A, Contreras S, *et al.* Exoscopic clipping of a ruptured posterior communicating artery aneurysm through a minipterional approach: 2-dimensional operative video. Oper Neurosurg 2022;p. 10.1227
6. Chanda A, Nanda A. Partial labyrinthectomy petrous apicectomy approach to the petroclival region: An anatomic and technical study. Neurosurgery 2002;51:147-60.
7. Day JD, Fukushima T, Giannotta SL. Cranial base approaches to posterior circulation aneurysms. J Neurosurg 1997;87:544-54.
8. Dexian Tan A, Ng JH, Lim SA, Low DY, Yuen HW. Classification of temporal bone pneumatization on high-resolution computed tomography: Prevalence patterns and implications. Otolaryngol Head Neck Surg 2018;159:743-9.
9. Doan V, Lemos-Rodriguez AM, Sreenath SB, Unnithan A, Recinos PF, Zanation AM, *et al.* Using the endoscopic endonasal transclival approach to access aneurysms arising from AICA, PICA, and vertebral artery: An anatomical study. J Neurol Surg B Skull Base 2016;77:207-11.
10. Drake CG, Peerless SJ, Hernesniemi JA. Surgery of vertebrobasilar aneurysms: London, Ontario experience on 1767 patients. New York: Springer Science and Business Media; 2012.
11. Gonzalez LF, Alexander MJ, McDougall CG, Spetzler RF. Anteroinferior cerebellar artery aneurysms: Surgical approaches and outcomes--a review of 34 cases. Neurosurgery 2004;55:1025-35.
12. Gross BA, Tavanaiepour D, Du R, Al-Mefty O, Dunn IF. Petrosal approaches to posterior circulation aneurysms. Neurosurg Focus 2012;33:E9.
13. Horgan MA, Delashaw JB, Schwartz MS, Kellogg JX, Spektor S, McMenomey SO. Transcrusal approach to the petroclival region with hearing preservation. Technical note and illustrative cases. J Neurosurg 2001;94:660-6.
14. Hou K, Xu K, Yu J. Endovascular treatment of anterior inferior cerebellar artery trunk aneurysms. Interv Neuroradiol 2022;28:604-12.
15. Hoz SS, Palmisciano P, Albairmani SS, Kaye J, Muthana A, Johnson MD, *et al.* A proposed classification system for presigmoid approaches: A scoping review. J Neurosurg 2023;139:965-71.
16. Hoz SS, Palmisciano P, Ismail M, Sharma M, Muthana A, Forbes J, *et al.* Anatomical study of the supratentorial extension for the retrolabyrinthine presigmoid approaches. World Neurosurg 2024;188:e120-7.
17. Hoz SS, Sharma M, Palmisciano P, Johnson MD, Ismail M, Muthana A, *et al.* Peritrigeminal safe entry zone access to anterolateral pons using the presigmoid retrolabyrinthine suprameatal approach: A Cadaveric morphometric study. Oper Neurosurg (Hagerstown) 2023;25:e303-7.
18. Humphrey-Murto S, Varpio L, Wood TJ, Gonsalves C, Ufholz LA, Mascioli K, *et al.* The use of the Delphi and other consensus group methods in medical education research: A review. Acad Med 2017;92:1491-8.
19. Locksley HB, Sahs AL, Knowler L. Report on the cooperative study of intracranial aneurysms and subarachnoid hemorrhage. Section II. General survey of cases in the central registry and characteristics of the sample population. J Neurosurg 1966;24:922-32.
20. Quiñones-Hinojosa A, Chang EF, Lawton MT. The extended retrosigmoid approach: An alternative to radical cranial base approaches for posterior fossa lesions. Oper Neurosurg 2006;58:Ons-208-14.
21. Rhoton AL Jr. Microsurgical anatomy of the posterior fossa cranial nerves. Neurosurgery 1979;26:398-462.
22. Samii M, Ammirati M. The combined supra-infratentorial pre-sigmoid sinus avenue to the petro-clival region. Surgical technique and clinical applications. Acta Neurochir

1988;95:6-12.
23. Sanmillan JL, Lawton MT, Rincon-Torroella J, El-Sayed IH, Zhang X, Meybodi AT, *et al.* Assessment of the endoscopic endonasal transclival approach for surgical clipping of anterior pontine anterior-inferior cerebellar artery aneurysms. World Neurosurg 2016;89:368-75.
24. Seifert V. Direct surgery of basilar trunk and vertebrobasilar junction aneurysms via the combined transpetrosal approach. Neurol Med Chir (Tokyo) 1998;38:86-92.
25. Sekhar LN, Schessel DA, Bucur SD, Raso JL, Wright DC. Partial labyrinthectomy petrous apicectomy approach to neoplastic and vascular lesions of the petroclival area. Neurosurgery 1999;44:537-50.
26. Sincoff EH, McMenomey SO, Delashaw JB Jr. Posterior transpetrosal approach: Less is more. Oper Neurosurg 2007;60:53-9.
27. Singh A, Irugu DV, Sikka K, Verma H, Thakar A. Study of sigmoid sinus variations in the temporal bone by micro dissection and its classification - a cadaveric study. Int Arch Otorhinolaryngol 2019;23:e311-6.
28. Siwanuwatn R, Deshmukh P, Figueiredo EG, Crawford NR, Spetzler RF, Preul MC. Quantitative analysis of the working area and angle of attack for the retrosigmoid, combined petrosal, and transcochlear approaches to the petroclival region. J Neurosurg 2006;104:137-42.
29. Smith K, Ventre GJ, Palmisciano P, Hussein AE, Hoz SS, Forbes JA, *et al.* Brain vasculature color-labeling using the triple-injection method in cadaveric heads: A technical note for improved teaching and research in neurovascular anatomy. Oper Neurosurg (Hagerstown) 2023;24:291-300.
30. Spetzler RF, Daspit CP, Pappas CT. The combined supra-and infratentorial approach for lesions of the petrous and clival regions; experience with 46 cases. J Neurosurg 1992;76:588-99.
31. Suh SH, Kim DJ, Kim DI, Kim BM, Chung TS, Hong CK, *et al.* Management of anterior inferior cerebellar artery aneurysms: Endovascular treatment and clinical outcome. AJNR Am J Neuroradiol 2011;32:159-64.
32. Thomas N, Maratos E, Barazi S. Combined supra-and infra-tentorial retro-labyrinthine pre-sigmoid approach. Curr Otorhinolaryngol Rep 2019;7:195-9.
33. Tjahjadi M, Niemelä M, Kivelev J, Serrone J, Maekawa H, Jahromi BR, *et al.* Presigmoid approach to vertebrobasilar artery aneurysms: A series of 31 patients and review of the literature. World Neurosurg 2016;92:313-22.
34. Tomio R, Horiguchi T, Borghei-Razavi H, Tamura R, Yoshida K, Kawase T. Anterior transpetrosal approach: Experiences in 274 cases over 33 years. Technical variations, operated patients, and approach-related complications. J Neurosurg 2022;136:413-21.

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