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Combined Petrosal Intertentorial Approach: A Cadaveric Study of Comparison With the Standard Combined Petrosectomy

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BACKGROUND AND OBJECTIVES: The combined petrosal intertentorial approach (CPIA) has been proposed as an alternative to standard combined petrosal approach (SCPA). CPIA has been designed to maintain integrity of the temporal dura with a view to reduce temporal lobe morbidity and venous complications. This study has been designed to perform a quantitative comparison between these approaches.

METHODS: Five human specimens were used for this study. CPIA was performed on one side and SCPA on the opposite side. The area of exposure (petroclival and brainstem), surgical freedom, and angles of attack to a predefined target were measured and compared.

RESULTS: SCPA provided a significantly larger petroclival area of exposure (6.81 ± 0.60 cm^2) over the CPIA (5.59 ± 0.59 cm^2), P = .012. The area of brainstem exposed with SCPA was greater than with CPIA (7.17 ± 0.84 vs 5.63 ± 0.72, P = .014). The area of surgical freedom was greater in SCPA rather than in CPIA (8.59 ± 0.55 and 7.13 ± 0.96 cm^2, respectively, P = .019). There was no significative difference between CPIA and SCPA in the vertical angles of attack for the Meckel cave, Dorello canal, and root entry zone of cranial nerve VII. Conversely, the horizontal angles of attack permitted by the CPIA were significantly smaller for the Meckel cave (52.36° ± 5.01° vs 64.4° ± 5.3°, P = .006) and root entry zone of cranial nerve VII (30.7° ± 4.4° vs 40.1° ± 6.2°, P = .025).

CONCLUSION: CPIA is associated with a reduction in terms of the area of surgical freedom (22%), skull base (18%), brainstem exposure (17%), and horizontal angles of attack (18%-23%) when compared with SCPA. This loss in terms of exposure is counterbalanced by the advantage of keeping the temporal lobe covered by an extra layer of meningeal tissue, thus possibly reducing the risk of temporal lobe injury and venous infarction. These results need to be validated with adequate clinical experience.

KEY WORDS: Combined petrosal approach, Combined petrosectomy, Tentorial peeling, Petroclival region, Anatomy

Transpetrosal approaches have been developed with the aim to safely access the petroclival region while reducing brain retraction. The standard combined petrosal approach (SCPA), defined as a combination of a posterior (retrolabyrinthine) and anterior petrosectomy, offers many benefits, such as early tumor devascularization, a short working distance,

ABBREVIATIONS: CPIA, combined petrosal intertentorial approach; **FL,** *foramen lacerum*; **FO,** foramen ovale; **FR,** foramen rotundum; **FS,** foramen spinosum; **HC,** hypoglossal canal; **IAC,** internal acoustic canal; **JF,** Jugular foramen; **LCNs,** lower cranial nerves; **MC,** Meckel cave; **OF,** oculomotor foramen; **PA,** petrous apex; **PCJ,** petroclival junction; **PCP,** posterior clinoid process; **PFTL,** posterior fossa tentorial leaf; **REZ,** root entry zone; **RS,** retrosigmoid; **SCPA,** standard combined petrosal approach; **SPS,** superior petrosal sinus; **TFD,** temporal fossa dura; **TTL,** temporal tentorial leaf.

multiple lines of sight to the lesion, and better control of the interface between the brainstem and the tumor.[1] Although the SCPA has been conceived to reduce approach-related morbidity, particularly compared with more aggressive variants (ie, translabyrinthine, transcochlear), it still has some important drawbacks. Notably, the SCPA carries a significant risk of injury to the temporal lobe and the possibility of venous infarction.[2] Vidal et al[3] have recently described the concept of tentorial peeling in transpetrosal approaches with the goal to reduce such complications. This concept has been explored through a previous cadaveric study aiming to describe in detail the combined petrosal intertentorial approach (CPIA).[4] Here, we performed an anatomic investigation to quantitatively compare SCPA with CPIA for area of exposure, surgical freedom, and maneuverability.

METHODS

Specimen Preparation and Surgical Tools

Anatomic dissections were carried out in 5 red and blue colored latex-injected non–formalin-fixed human cadaveric heads (10 sides) at the Neurosurgical Education and Training Laboratory of the Lausanne University Hospital, Switzerland. Appropriate consent was obtained for the publication of cadaveric images. The procedures were performed with standard microsurgical instruments including a high-speed drill (Midax Rex; Medtronic), surgical microscope (Leica Microsystem), and a high-definition camera (Karl Storz GmbH, KG). The dissections were recorded using a 2-dimensional/4K camera (Karl Storz GmbH, KG). Before dissection, specimens were submitted to thin cut (0.5 mm slices), high resolution computed tomography scans, and the images were uploaded to a Cranial Navigation System (Medtronic Stealth) for the collection of stereotactic measurements.

Surgical Approaches

The heads were fixed with a 3-pin Mayfield Clamp and contralateral turned 80°. SCPA was performed on one side following the methodology reported in a previous publication.[5] On the other side of the same head, we performed the CPIA, which followed exactly the same steps for skin incision, craniotomy, and temporal bone drilling as the SCPA (Figure 1) The sole difference between the 2 approaches was the addition of tentorial peeling and consequent adaptation of the dural opening, in agreement with the previously described technique,[4] Figure 2. Briefly, the CPIA enables division of the tentorium into 2 layers: the temporal tentorial leaf (TTL), which is in anatomic continuity with the middle fossa dura, and the posterior fossa tentorial leaf (PFTL), which is in anatomic continuity with the presigmoid dura. This intertentorial plane is developed by staying parallel and superior to the superior petrosal sinus (SPS) (Figure 3A). The SPS stays with the PFTL and is the boundary between the presigmoid dura and PFTL (Figure 3B). Once this dissection has been completed, a small cut in the medial TTL is made, and the fourth cranial nerve (CN) is visualized in the ambient cistern to locate its entrance in the tentorium, to safely extend the peeling till the incisura. The presigmoid dura is then opened around the labyrinth, reaching the dura exposed through the anterior petrosectomy until the inferior petrosal sinus is encountered. Then, the SPS is ligated, and a posterior tentorial cut is performed from the presigmoid dura, through the SPS, and extended across the PFTL until the free edge of the tentorium. The next step is an anterior tentorial cut that similarly starts just inferior to the SPS and is extended across the PFTL until the anterior free edge. The last cut is done over mandibular branch of trigeminal nerve (V3) to open the Meckel cave (MC) (Figure 3C). These cuts remove a rhomboid of dura that then enables access to the petroclival region without exposing the temporal lobe (Figure 4).

Measurements

A neuronavigation system (StealthStation S8, Medtronic) was used to collect the stereotactic data. These data were logged into Excel spreadsheet software (Microsoft Office Excel 2013, Microsoft Corp.), which was then used to calculate the areas of exposure, surgical freedom, and angles of attack.

Areas of Surgical Exposure

Two areas of exposure (petroclival skull base and brainstem) were calculated by obtaining the sum of areas formed by juxtaposed triangles. For the petroclival area, we identified 4 fixed anatomic landmarks (posterior clinoid process, MC, internal acoustic canal, and jugular foramen) and 2 variables (uppermost and lowest medial clivus). Measuring the coordinates of these 6 points created a hexagonal shape. For the brainstem area, we identified 2 fixed points (trigeminal and facial nerve root entry zone [REZ]) and 3 variables (the lowest medial, the uppermost medial, and uppermost lateral brainstem), obtaining a pentagon-shaped area (Figure 5A and 5B drawing). Each polygon was divided along diagonals to create triangles whose area was calculated by the length of each side using Heron's formula. The areas of the 4 triangles of the petroclival skull base and the 3 triangles of the brainstem were then summed to calculate the total area of surgical exposure.

Surgical Freedom

Surgical freedom was defined as the maximal permissible working area allowed by the most superficial surgical opening (dura mater or bone). The 6 extreme most positions in each direction were measured, forming an imaginary hexagonal area (Figure 5C cadaveric picture for CPIA). Similarly to the skull base and brainstem exposure calculations, the coordinates of each of the positions were obtained using neuronavigation, and the area of surgical freedom was calculated by the sum of the areas formed by juxtaposed triangles.

Angles of Attack

The angles of attack were obtained by fixing the distal end of the dissector on each anatomic target. The targets of interest were the oculomotor foramen (OF), MC, Dorello canal, and the REZ of CN VII (Figure 5D).

The angle was calculated using the Law of Cosines applied on the triangle created by the distal point (ie, the anatomic target) and 2 farthest positions of the proximal end of the dissector that were the limiting points of movement in the vertical or horizontal planes.

Statistical Analysis

Data were exported to Stata Statistical Software (release 14, StataCorp). Comparisons of the area of exposure, surgical freedom, and angles of attack were performed using a one-way repeated measure analysis of

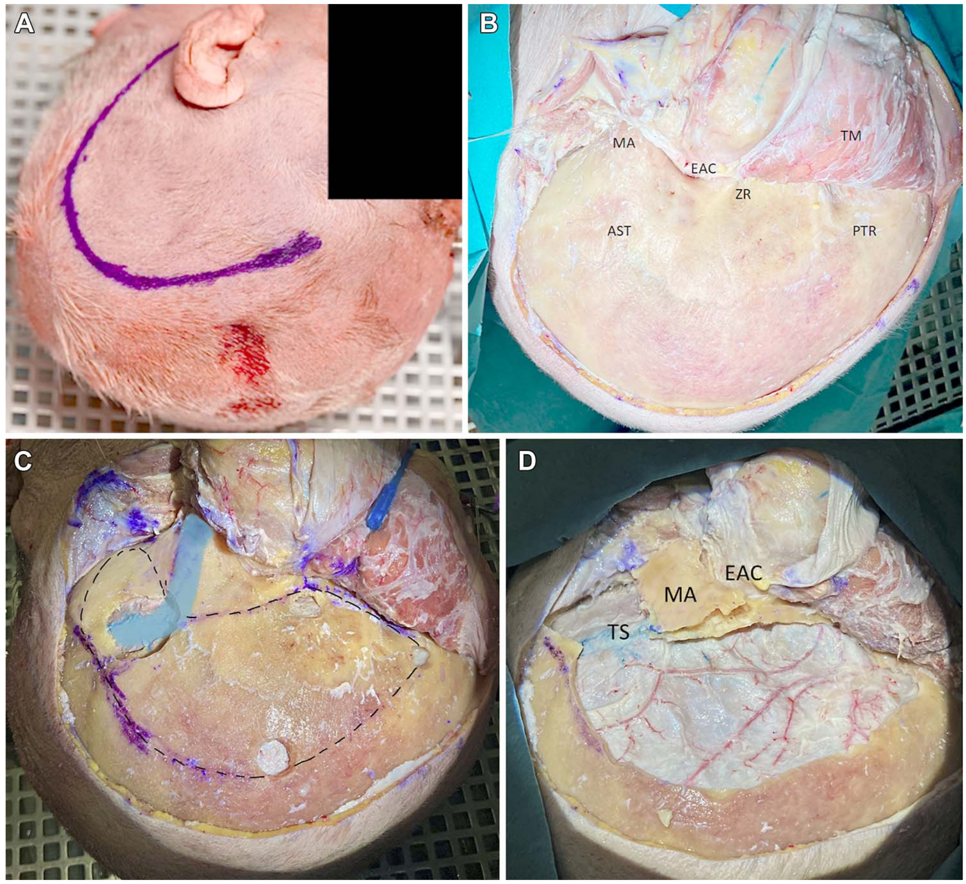

FIGURE 1. *Representation of the initial steps of dissection that are identical for the standard combined petrosal approach and combined petrosal intertentorial approach.* **A**, *Photograph of cadaveric dissection showing the skin incision, starting from the tip of the mastoid and reaching the frontal region.* **B**, *Soft tissues dissection with exposure of the skull.* **C**, *Black dashed lines representing the L-shaped temporo-parieto-occipital craniotomy. The TS and the sigmoid sinus are also represented.* **D**, *The craniotomy has been accomplished. Mastoidectomy and combined petrosectomy will be subsequently performed. AST, asterion; EAC, external auditory canal; MA, mastoid; PTR, pterion; TM, temporal muscle; TS, transverse sinus; ZR, zygomatic root.*

variance with post hoc Holm-Šídák analysis. *P* values <.05 were considered statistically significant.

RESULTS

The SCPA provided a significantly larger petroclival area of exposure (6.81 ± 0.60 cm^2) over the CPIA (5.59 ± 0.59 cm^2), *P* = .012. The area of brainstem exposed with SCPA was greater than with CPIA (7.17 ± 0.84 vs 5.63 ± 0.72, *P* = .014). The area of surgical freedom was greater in SCPA rather than in CPIA (8.59 ± 0.55 and 7.13 ± 0.96 cm^2, respectively, *P* = .019) (Figure 6). Regarding the angles of attack, the OF could not be visualized through CPIA. There was no significative difference between CPIA and SCPA in the vertical angles of attack for MC, Dorello canal, and REZ of CN VII. Conversely, the horizontal angles of attack permitted by the CPIA were significantly smaller for MC (52.36° ± 5.01° vs 64.4° ± 5.3°, *P* = .006) and REZ of CN VII (30.7° ± 4.4° vs 40.1° ± 6.2, *P* = .025) (Figure 7). Data are summarized in Table 1.

DISCUSSION

Compared with SCPA, the intertentorial approach reduces petroclival and brainstem area of exposure by 18% and 17%, respectively, and surgical freedom by 22%. This reduction of exposure is as a result of limiting retraction of temporal lobe and lack of sigmoid sinus transposition. These constraints also reduce the horizontal maneuverability with respect to MC and the facial nerve REZ. Moreover, CPIA also reduces exposure of the most superior part of the upper clivus and posterior wall of the cavernous sinus. However, this may be counterbalanced by a

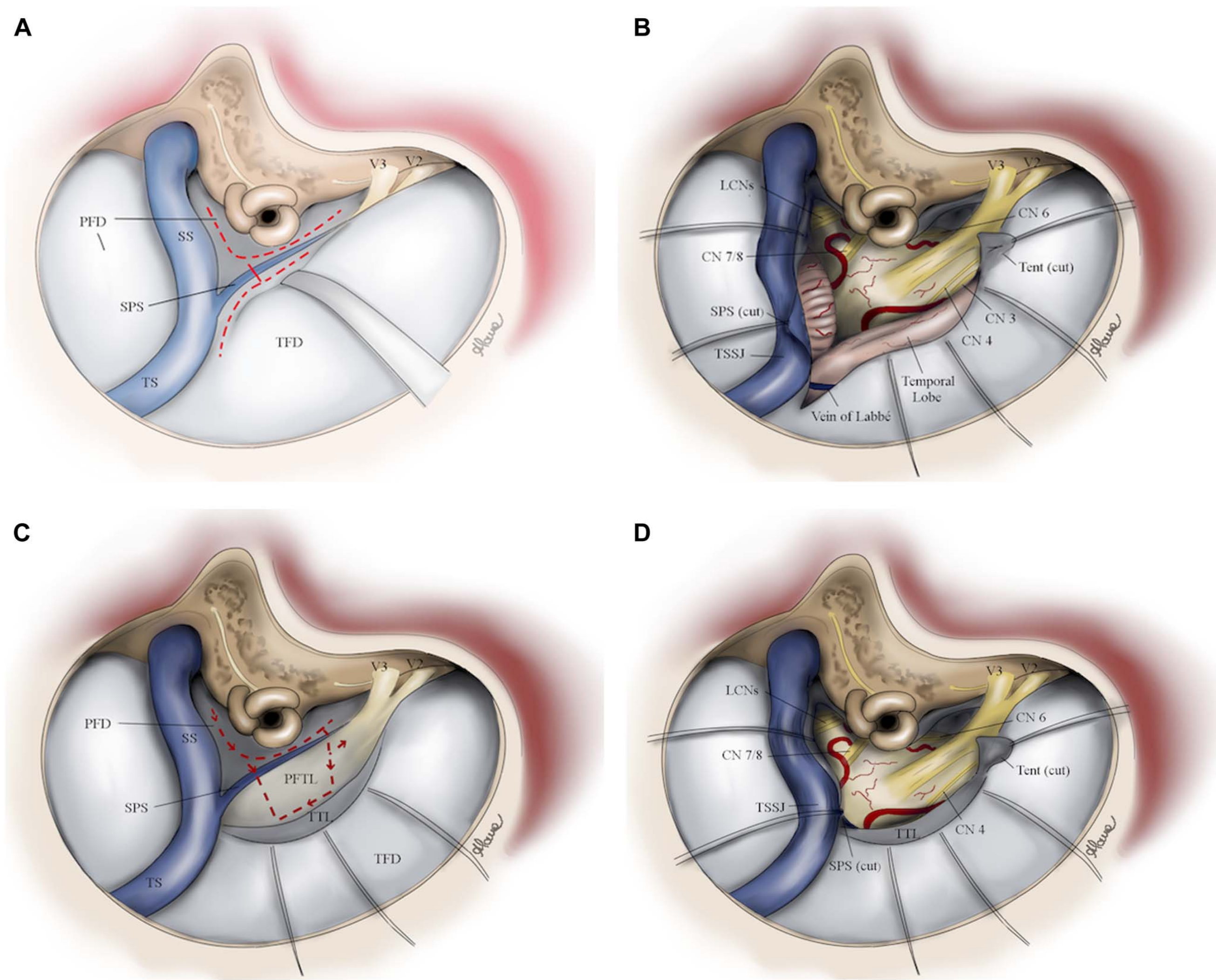

FIGURE 2. **A**, *Illustration of the SCPA with the red dotted lines representing the dural incisions. Note that the temporal dura is opened staying parallel to the SPS and extending posteriorly above the transverse-sigmoid junction.* **B**, *Illustration of the view obtained with SCPA after dural opening. Cranial nerves 3rd to 11th are exposed. Note that the SS has been transposed postero-inferiorly to increase the temporo-cerebellar corridor. The temporal lobe and the vein of Labbé have been exposed, thereby being at risk for iatrogenic injury.* **C**, *Illustration of CPIA. CPIA enables splitting of the tentorium into 2 layers: the TTL, which is in anatomic continuity with the TD, and the PFTL, which is in anatomic continuity with the presigmoid posterior fossa dura. The red dotted lines represent the dural incisions. Tack-up sutures are applied over the TD to extradurally retract the temporal lobe.* **D** *Intradural view obtained with CPIA. Please note that the temporal lobe remains completely covered by the TD and the TTL, thus avoiding possible iatrogenic injuries. Integrity of the TD prevents a posterior transposition of the SS thus limiting the operative exposure; this also explains the lack of visualization of third CN and upper clivus which requires an infero-superior visualization trajectory. CN, cranial nerve; CPIA, combined petrosal intertentorial approach; LCNs, lower cranial nerves; PFD, posterior fossa dura; PFTL, posterior fossa tentorial leaf; SCPA, standard combined petrosal approach; SPS, superior petrosal sinus; SS, sigmoid sinus; Tent, tentorium; TFD, temporal fossa dura; TS, transverse sinus; TSSJ, transverse sigmoid junction; TTL, temporal tentorial leaf; V2, maxillary branch of trigeminal nerve; V3, mandibular branch of trigeminal nerve.*

potential safer extradural retraction of the temporal lobe, which remains completely covered by a meningeal layer of dura.

The SCPA, defined as an anterior and posterior petrosectomy with preservation of the semicircular canals, represents an evolution of the original description by Hakuba.[6] Sekhar et al[7] later described the concept of partial labyrinthectomy and petrous apicectomy, where a partial anterior petrosectomy is performed, taking advantage of the working space created by drilling the semicircular canals. A further anatomic investigation[8] showed that the advantage for exposure was principally provided by the anterior petrosectomy rather than the partial drilling of the semicircular canals. This concept is reflected by the work of Al-Mefty,[1]

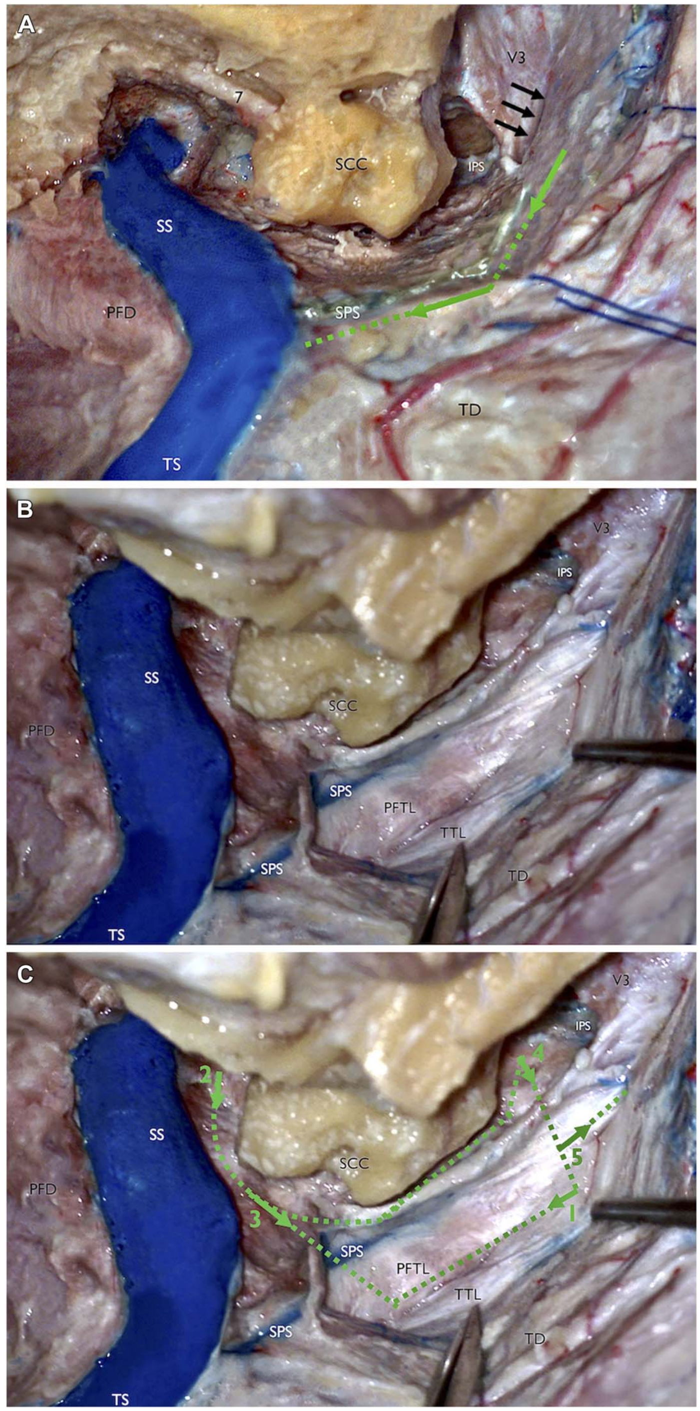

FIGURE 3. **A**, *Photograph of cadaveric dissection showing the methodology of the development of the intertentorial plane. The peeling should start at the level of V3 and then extended in a posterior direction (green arrows) staying just above the SPS. Note that the correct plane of dissection is above the perineurium of V3 (black arrows).* **B**, *Photograph of cadaveric dissection obtained after the tentorial peeling. The tentorium has been split into a TTL, which is in anatomic continuity with the TD, and the PFTL, which is in anatomic*

continuity with the PFD. **C**, *Green dotted lines represent the dural cuts. The first is performed in the TTL to identify the trochlear nerve in the ambient cistern and locate its entrance onto the subtentorial sulcus on the under surface of the tentorium. This will enable to safely continue the peeling till the incisura without damaging the nerve. The second cut is performed at the level of the presigmoid PFD and turns around the labyrinth to end at the dura exposed through the anterior petrosectomy. The third cut (posterior tentorial cut) starts at the level of the SPS and is extended across the PFTL, until the free edge of the tentorium. The fourth cut (anterior tentorial cut) starts at the level of the SPS and is extended across the PFTL until the anterior free edge. The fifth cut is done over V3 to open the Meckel cave. IPS, inferior petrosal sinus; PFD, posterior fossa dura; PFTL, posterior fossa tentorial leaf; SCC, semicircular canals; SPS, superior petrosal sinus; SS, sigmoid sinus; TD, temporal dura; TS, transverse sinus; TTL, temporal tentorial leaf; V3, mandibular branch of trigeminal nerve.*

who largely popularized the technique of SCPA, promoting the philosophy of reducing approach-related morbidity and exposure of this complex anatomic region.

However, SCPA still has an inherent morbidity that has been quantified by a recent meta-analysis.[2] In particular, SCPA may lead to temporal lobe injury secondary to retraction and contusions (4.8% rate) and venous infarction (2.8% rate) with potential catastrophic consequences.[2] Recently, Vidal et al[3] have described the concept of the tentorial peeling. This technique enables the temporal lobe to remain covered by the TTL, potentially avoiding iatrogenic injury to the temporal lobe and vein of Labbé. Previous anatomic studies have already demonstrated that a conservative petrosectomy, such as the retrolabyrinthine version we used here, offered a reduced area of exposure compared with more aggressive variants such as the translabyrinthine or transcoclear versions.[9,10] With this anatomic investigation, we have assessed that the technical modification of tentorial peeling (CPIA) introduces a further reduction for area of exposure. The loss in terms of area exposed and surgical freedom was significant, but one should consider that CPIA still provided 82% of exposure of the petroclival area, 78% of brainstem exposure, and 83% of surgical freedom compared with what is afforded with the SCPA. The loss in terms of exposure is counterbalanced by the advantage of keeping the temporal lobe covered by an extra layer of meningeal

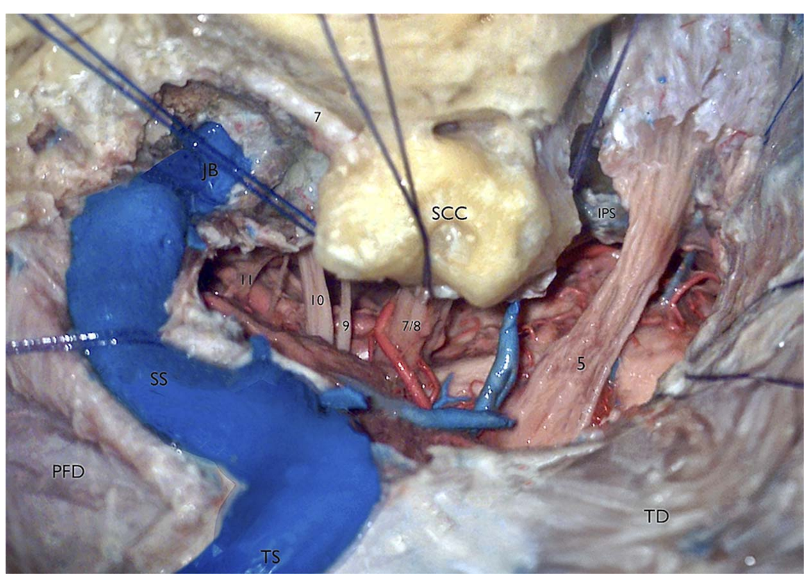

FIGURE 4. *Cadaveric photograph showing the intradural view obtained with CPIA. Note that the exposure of the brainstem and petroclival region has been achieved without any temporal lobe exposure. The lack of transposition of the SS prevents visualization of the upper clivus. The temporal tentorial leaf is not shown in the figure because of the orientation of the image but is present and protecting the basal temporal lobe. CPIA, combined petrosal intertentorial approach; IPS, inferior petrosal sinus; JB, jugular bulb; PFD, posterior fossa dura; SCC, semicircular canals; TD, temporal dura; TS transverse sinus, SS, sigmoid sinus.*

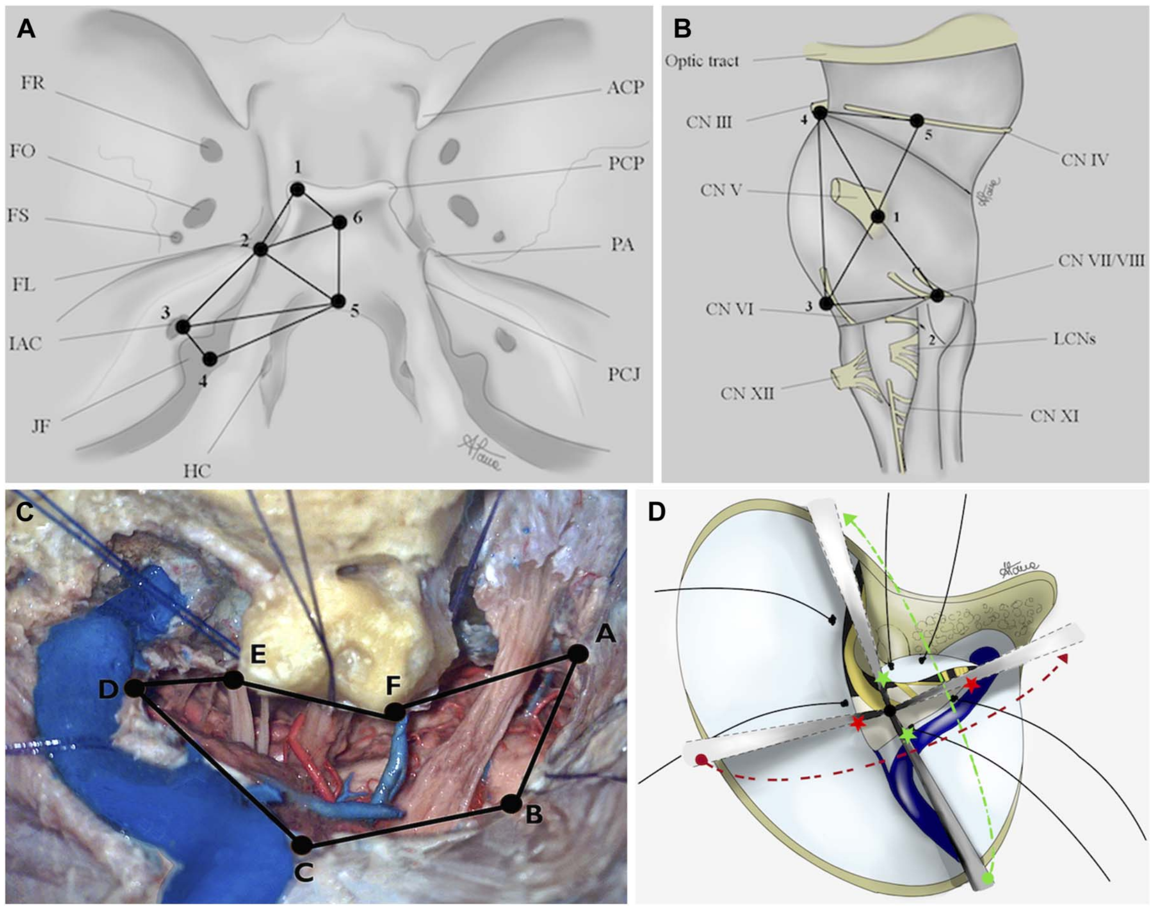

FIGURE 5. *These figures demonstrate the methodology of the study.* **A**, *Schematic representation of the bony skull base indicating the petroclival area of exposure.* **B**, *Schematic representation of the brainstem area of exposure.* **C**, *A, B, C, D, E, and F represent the 6 limits of the surface measurements that form a hexagon (black), bordered by dural and bony structures, whose area describes the surgical freedom.* **D**, *Illustration of the methodology to calculate the angles of attack. The distal point is fixed on the target (ie, right VII REZ), and the dissector is moved in the vertical (cranio-caudal, red dotted lines) and horizontal planes (antero-posterior, green dotted lines) until the limits of the osteo-dural points are encountered (red and green stars). ACP, anterior clinoid process; CN, cranial nerve; FL, foramen lacerum; FO, foramen ovale; FR, foramen rotundum; FS, foramen spinosum; HC, hypoglossal canal; IAC, internal acoustic canal; JF, Jugular foramen; LCNs, lower cranial nerves; PA, petrous apex; PCJ petroclival junction; PCP, posterior clinoid process; REZ, root entry zone.*

tissue and by the fact of virtually eliminating the risk of venous infarction from injury to the vein of Labbé. Despite the reduction, the exposure provided is still very good, and if more exposure is needed, a CPIA could always be converted to an SCPA intraoperatively. Furthermore, the CPIA could be combined with labyrinthectomy if necessary. The choice of approach can be tailored to the pathology of the individual patient.

CPIA also led to a reduced horizontal maneuverability as the horizontal angles of attack for the MC and REZ of CN VII were significantly reduced. The procedure of CPIA has been designed to maintain the integrity of the temporal dura, allowing to keep the temporal lobe covered by convexity dura and the TTL. This, therefore, eliminated the possibility of increasing surgical exposure by sigmoid sinus posterior transposition. A lack of sigmoid sinus transposition explains the reduction in horizontal maneuverability of the CPIA to these targets. This indeed limits the main trajectory of the retro-labyrinthine approach, which is from postero-inferolateral to antero-supero-medial.[11] The reduction of this corridor, together with the limited extradural retraction of the temporal lobe, is also responsible for the lack of visualization of the OF and upper clivus that we observed in this study. This limitation could possibly be partially overcome by drilling the superior semicircular canal as presented in the clinical experience of Vidal et al[3] As an alternative, the surgeon can still perform a very limited dural incision of the TTL at its most anterior part to increase temporal lobe retraction and obtain control of the OF and upper clivus, if

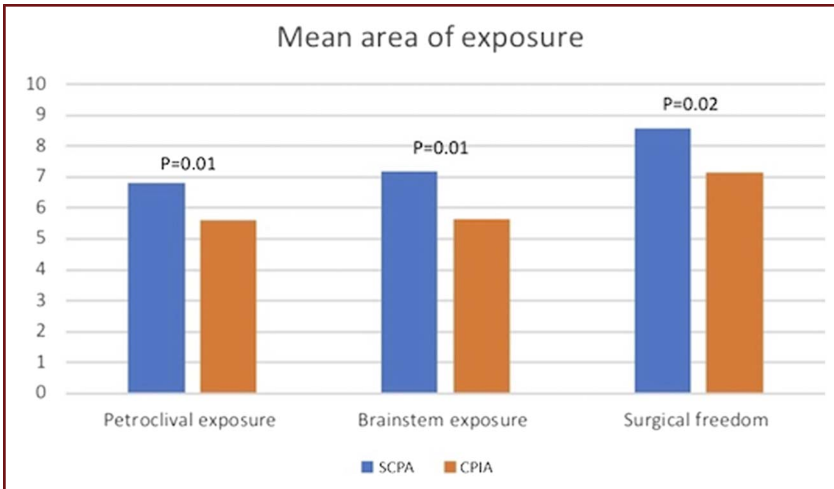

FIGURE 6. *Comparison of the mean petroclival, brainstem, and surgical freedom exposure areas between SCPA and CPIA, which showed a reduction of 17% to 22% for CPIA. CPIA, combined petrosal intertentorial approach; SCPA, standard combined petrosal approach.*

needed. This maneuver would involve a very anterior TTL cut, thus not producing a risk to the vein of Labbé. Finally, in cases of petroclival lesions with major involvement of the upper clivus, the surgeon may eventually consider to use either the SCPA or an alternative strategy such as the pretemporal approach combined with an endoscopic endonasal approach.[12] Although there is a marginal reduction of exposure and maneuverability with the CPIA, we feel that during real surgery, cerebrospinal fluid drainage and tumor debulking may compensate, thus potentially improving applicability of this technical variation.[3] In any case, there is now an accepted trend toward a less aggressive resection of petroclival lesions, with surgery aiming to follow the right balance between tumor resection and function preservation.[13,14] The eventual residual tumor left at the upper clivus or involving the cavernous sinus can be observed or treated with radiosurgery[15] as advocated by many authors.[12] The philosophy of maximal safe resection could help popularize CPIA, as the technique combines the recognized advantages of transpetrosal approaches (early tumor devascularization, a short working distance, multiple lines of sight to the lesion and cranial nerves, better control of the interface between the brainstem and the tumor) with a virtual elimination of the risk to the temporal lobe and vein of Labbé. In the recent literature of petroclival tumors, there is a trend favoring the retrosigmoid (RS) approach, which is simpler and faster to

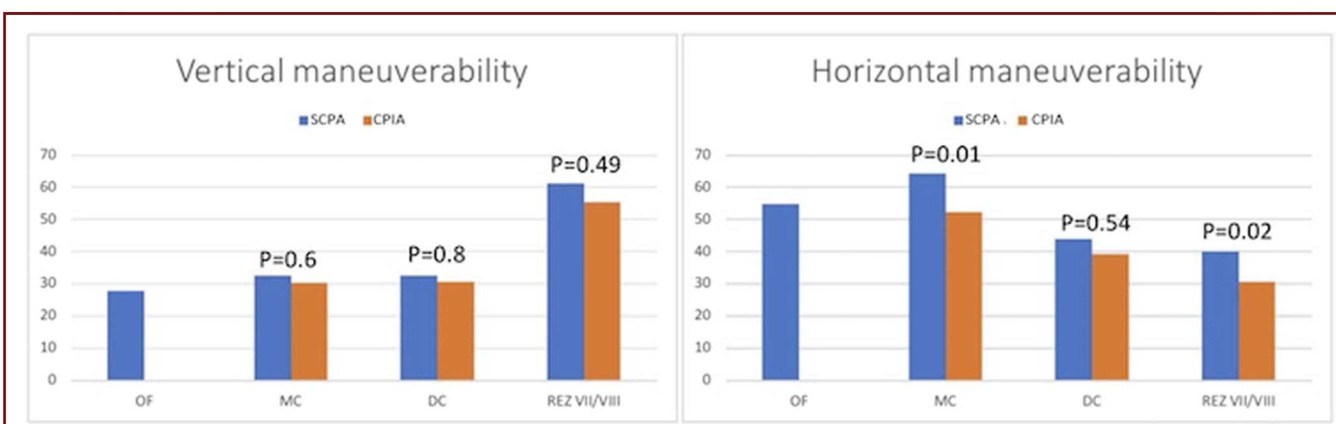

FIGURE 7. *Vertical and horizontal angles of attack (maneuverability) by location for the SCPA and CPIA. The only angles of attacks that were significantly reduced for the CPIA were the horizontal ones for the Meckel cave and REZ VII/VIII nerve, reduced by 18% and 23%, respectively. CPIA, combined petrosal intertentorial approach; REZ VII/VIII, root entry zone of facial and acoustic nerves; SCPA, standard combined petrosal approach.*

TABLE. Summary of Study Measurements

Measurements	SCPA	CPIA	*P* value
Area of exposure (cm^2)			
Petroclival exposure	6.81 ± 0.6	5.59 ± 0.59 (18% less)	.01[a]
Brainstem exposure	7.17 ± 0.84	5.63 ± 0.72 (17% less)	.01[a]
Surgical freedom	8.59 ± 0.55	7.13 ± 0.96 (22% less)	.02[a]
Angles of attack (degree)			
OF vertical angle	27.8 ± 7.1	N/A	N/A
OF horizontal angle	54.9 ± 6.4	N/A	N/A
MC vertical angle	32.5 ± 7.2	30.4 ± 5.1	.6
MC horizontal angle	64.4 ± 5.3	52.36 ± 5.01 (18% less)	.01[a]
DC vertical angle	32.5 ± 13.6	30.7 ± 6.6	.8
DC horizontal angle	44 ± 14.3	39.1 ± 9.6	.54
REZ VII vertical angle	61.3 ± 13.8	55.3 ± 12.3	.49
REZ VII horizontal angle	40.1 ± 6.2	30.7 ± 4.4 (23% less)	.02[a]

CPIA, combined petrosal intertentorial approach; DC, Dorello canal; MC, Meckel cave; N/A, not applicable; OF, oculomotor foramen; REZ, root entry zone; SCPA, standard combined petrosal approach.
[a]Statistically significant ($P < .05$)

perform, over transpetrosal approaches.[16,17] A previous anatomic study has pointed out that petroclival area of exposure and angles of attack did not significantly differ when comparing the SCPA and the RS approach, although SCPA offers a significantly larger brainstem working area compared with RS.[10] These results pushed the authors to suggest RS as the first choice, except for lesions mainly involving the anterolateral brainstem, especially considering the approach-related risks associated with the SCPA, such as temporal lobe and venous injuries and auditory and facial functions. A recent meta-analysis has showed that SCPA does not increase the risk of facial palsy and deafness when compared with RS for petroclival meningiomas[2] and now CPIA offers a potential solution to solve the issue of temporal lobe and venous complications. We believe that CPIA could be considered among the possible alternatives in view of its potential advantages on approach-related morbidity. Further clinical experience is necessary to add evidence on its benefits and reveal potential disadvantages. Of note, CPIA presents some other potential drawbacks. First, the procedure of tentorial peeling demands some (albeit limited) extra time with respect to the SCPA. Second, the presence of tentorial venous lakes can increase the technical difficulty of the tentorial peeling.[18] This does not represent an absolute contraindication as impairment of a tentorial lake is usually well tolerated given the tendency of the venous system to contain collateral pathways.[19] Third, wrong identification of the correct plane of dissection could lead to entering the SPS. Like the SCPA, CPIA requires sacrifice of the SPS. For this reason, CPIA is contraindicated in the cases of anatomic variations such as direct drainage of the vein of Labbé or basal vein of Rosenthal into the SPS.[20] Fourth, in any petrosectomy approach (standard or intertentorial), the trochlear nerve can be put at risk either during an incision near the incisura. In the CPIA, this can be avoided by making a small opening into the medial TTL to trace the cisternal part of the nerve, although this may be distorted in large petroclival tumors.[21] Fifth, moderate invasion of MC does not represent an absolute contraindication as the correct plane of dissection can be found more posteriorly with respect to V3 (usually at the level of the labyrinth) staying just above the SPS and then secondarily extended anteriorly toward V3. This would enable the operator to remain in the intertentorial plane even in cases of tumor invading the MC. Sixth, some tumors may not be amenable to resection through CPIA. In particular for cases of petroclival meningioma with tentorial involvement but extension limited to the posterior fossa, it will not be possible to identify the PFTL but the TTL will still be recognizable, thus maintaining the validity of the intertentorial technique. For cases of petroclival meningiomas spanning the middle and posterior fossa with consistent tentorial involvement (and eventually calcified tentorium), the technique may not be applicable. Seventh, the extradural retraction may induce the surgeon to underestimate the amount of brain retraction. Moreover, a reduced surgical freedom may also prompt the surgeon to increase retraction over the temporal lobe with possible severe consequences. Currently, clinical experience with CPIA is very limited. Further studies will help to better define the cases that are suitable for this technical variation.

Limitations

The limited number of specimens may have influenced the statistical significance for the studied parameters. The effects of draining cerebrospinal fluid through cisternal dissection, the consistency of the brain in cadaveric specimens, and effects of mass lesions cannot be addressed in a cadaveric study of this nature.

CONCLUSION

This study demonstrated that CPIA is associated with a reduction in terms of the area of surgical freedom, skull base and brainstem exposure, and horizontal angles of attack when compared with SCPA. The moderate reduction in operative exposure and maneuverability is the price that we must pay for potentially eliminating iatrogenic injuries to temporal lobe and temporo-basal veins. The results of this cadaveric study need to be validated with adequate clinical experience to precisely define the benefits and downsides of this relatively new approach.

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COMMENTS

The authors found combined petrosal intertentorial approach (CPIA), which could provide wider operative field than standard combined petrosal approach in a short time. Most neurosurgeons might not be familiar with the boundary between the temporal tentorial leaf (TTL) and the posterior fossa tentorial leaf (PFTL). It is easier to find the dissection plane at the posterior site next to the labyrinth staying just above the superior petrosal sinus (SPS) than at the anterior site next to V3. The authors recommend the dissection starting at the posterior site next to the labyrinth and then going anteriorly rather than starting next to V3 and then going posteriorly. This manuscript is quite practical.

I consider this approach the most promising when it applies to the surgery of petrotentorial and petroclival meningioma. Many of them often invade into Meckel's cave (MC) and tentorium and occupy them. I am afraid it would be difficult to find the boundary between TTL and PFTL in which case. However, the authors addressed the various kind of ways to perform this approach in case of the tumor with various kind of extension. Basically, CPIA can still be employed by starting to search for this plane of dissection posteriorly just above the SPS and moving the dissection toward V3 and MC.

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