Quantitative anatomical comparison of the ipsilateral and contralateral interhemispheric transcallosal approaches to the lateral ventricle

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OBJECTIVE The best approach to deep-seated lateral and third ventricle lesions is a function of lesion characteristics, location, and relationship to the ventricles. The authors sought to examine and compare angles of attack and surgical freedom of anterior ipsilateral and contralateral interhemispheric transcallosal approaches to the frontal horn of the lateral ventricle using human cadaveric head dissections. Illustrative clinical experiences with a contralateral interhemispheric transcallosal approach and an anterior interhemispheric transcallosal transchoroidal approach are also related.

METHODS Five formalin-fixed human cadaveric heads (10 sides) were examined microsurgically. CT and MRI scans obtained before dissection were uploaded and fused into the navigation system. The authors performed contralateral and ipsilateral transcallosal approaches to the lateral ventricle. Using the navigation system, they measured areas of exposure, surgical freedom, angles of attack, and angle of view to the surgical surface. Two clinical cases are described.

RESULTS The exposed areas of the ipsilateral (mean [± SD] 313.8 ± 85.0 mm²) and contralateral (344 ± 87.73 mm²) interhemispheric approaches were not significantly different (p = 0.12). Surgical freedom and vertical angles of attack were significantly larger for the contralateral approach to the most midsuperior reachable point (p = 0.02 and p = 0.01, respectively) and to the posterosuperior (p = 0.02 and p = 0.04) and central (p = 0.04 and p = 0.02) regions of the lateral wall of the lateral ventricle. Surgical freedom and vertical angles of attack to central and anterior points on the floor of the lateral ventricle did not differ significantly with approach. The angle to the surface of the caudate head region was less steep for the contralateral (135.6° ± 15.6°) than for the ipsilateral (152.0° ± 13.6°) approach (p = 0.02).

CONCLUSIONS The anterior contralateral interhemispheric transcallosal approach provided a more expansive exposure to the lower two-thirds of the lateral ventricle and striothalamocapsular region. In normal-sized ventricles, the foramen of Monro and the choroidal fissure were better visualized through the lateral ventricle ipsilateral to the craniotomy than through the contralateral approach.

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KEY WORDS caudate nucleus; contralateral interhemispheric approach; lateral ventricle; surgical freedom; surgical technique

The interhemispheric transcallosal approach is a workhorse for resection of paraventricular and lateral and third ventricle lesions.12,16 The contralateral interhemispheric transcallosal approach with the head positioned horizontally (parallel to the floor) allows gravitational hemispheric retraction and provides excellent exposure to the structures within the ventricles as an alternative to the ipsilateral interhemispheric transcallosal approach. Nevertheless, there has been debate about the anatomical access provided by these 2 approaches. In this study, we compare the angle of attack and surgical exposure of contralateral and ipsilateral interhemispheric transcallosal approaches in cadaveric specimens using quantitative anatomical analyses and give examples of our clinical experience.
Methods

Five formalin-fixed human cadaveric heads (10 sides) injected with colored silicone were examined. CT and MRI scans were obtained prior to dissection and were uploaded and fused into the navigation system (StealthStation Image Guidance Workstation, Medtronic Surgical Navigation Technologies). Each head was rigidly fixed in a Mayfield head holder in a surgical position and registered in the neuronavigation system with an accuracy of less than 2 mm. The contralateral interhemispheric approach was performed at the lateral ventricle first, and then the ipsilateral interhemispheric approach was performed at the same lateral ventricle by passing through the same callosotomy area.

Contralateral Interhemispheric Transcallosal Approach

The head was positioned parallel to the floor and tilted 45° upward. The scalp was incised in a curvilinear fashion and reflected toward the contralateral side. The craniotomy, measuring 55 mm in the anteroposterior direction and 40 mm in the mediolateral direction, one-third behind and two-thirds in front of the coronal suture, was created using a pneumatic high-speed drill (Anspach, DePuy Synthes). The medial extension of the craniotomy was placed over the superior sagittal sinus. The exposure then proceeded into the interhemispheric fissure using standard microsurgical instruments under the OPMI operating microscope (Carl Zeiss Meditec, Inc.). The interhemispheric arachnoidal adhesions were widely dissected down to the corpus callosum to obtain a 1.5-cm working space between the brain parenchyma and falx gravitationally. The pericallosal arteries were mobilized and retracted laterally over the corpus callosum, and the corpus callosum was incised sharply with a No. 11 blade at the opposite side to create a window 15 mm long and 1.5 mm wide (Fig. 1). Afterward, the contralateral lateral ventricle was entered.

Ipsilateral Interhemispheric Transcallosal Approach

A craniotomy of the same size as described above was created on the opposite side of the superior sagittal sinus to create the approach to the same lateral ventricle via the ipsilateral aspect through the same callosotomy. The brain retraction was facilitated using the technique described above, allowing the same amount of brain retraction as in a real surgery. The measurements were taken on the lateral wall of the lateral ventricle to delineate the limits of exposure and angles of attack. Identical procedures were performed for both left and right lateral ventricles.

Quantification

Area of Exposure

The coordinates of 6 points visible under direct microscopic visualization were recorded on the surface of the lateral wall of the lateral ventricle using a stereotactic navigation probe (Fig. 2): A, the uppermost posterior reachable point; B, the uppermost point on the lateral wall at the middle of the callosotomy; C, the uppermost anterior reachable point; D, the lowermost posterior reachable point on the floor of the lateral ventricle; E, the lowermost point on the floor of the lateral ventricle projected at the center of the callosotomy; and F, the lowermost anterior reachable point on the floor of the lateral ventricle. The area of exposure was calculated as the sum of the areas of triangles ABD, BDE, BCE, and CEF. One additional point, X, at the middle of the distance between points B and E, represented the center of the exposed area.

Surgical Freedom

Surgical freedom was defined as the maximum allowable working area at the proximal end of the 145-mm microsurgical probe with the distal end on the specific target of interest (points A–F and X), as described previously. Coordinates of the 4 points at the proximal tip of the probe were obtained to define the surgical freedom: uppermost, lowermost, extreme right, and extreme left positions of the probe. The working area was calculated as the sum of the areas of the anterior and posterior juxtaposed triangles formed by these 4 points, as described previously.

Angle of Attack

The angles of attack were calculated in the vertical plane as angles between pairs of vectors that start at points A–F and X and end at the points registered during the uppermost and lowermost locations of the proximal end of the microsurgical probe, centered in one of the points previously mentioned.

Angle of View to the Surgical Surface

Angles formed between vector XE and vectors starting at point X and ending in the distal end of the probe positioned at point X and fixed in the uppermost and lowermost locations were calculated to represent the steepness of the surgical view (i.e., the angles between surgical view and exposed surface of interest). The closer the angle is to 90°, the more direct and better the view. On the contrary, when the angle reached 180°, the view was considered very steep, aligning parallel to the surgical area.
Statistical Analysis

The Wilcoxon matched-pairs test was used to compare differences in attributes between the 2 approaches; p < 0.05 was considered statistically significant.

Results

Area of Exposure

The exposed area, defined as the area of the polygon ABCFED located at the lateral wall of the lateral ventricle, was not significantly different (p = 0.12) whether the contralateral approach or the ipsilateral approach was used—344.00 ± 87.73 mm² with the contralateral approach and 313.82 ± 85.03 mm² with the ipsilateral approach. The limit of the surgical view provided by the same callosotomy was located at approximately the same location on the lateral ventricle wall.

Surgical Freedom

Significant differences were found in the surgical freedom related to 3 points (p = 0.04) and a trend toward significance (p = 0.09) related to 1 of 7 measured points favoring the contralateral exposure (Figs. 3 and 4). Points for which the differences were revealed are located in the most superior reachable point on the ventricle wall in front of the callosotomy (point B, average percentage increase 59.7%), and posterosuperior (point A, average percentage increase 80.4%) and central regions of the lateral ventricle wall (point X, average percentage increase 27.0%). Greater surgical freedom related to the most infero-

Angle of Attack

Horizontal angles of attack to all 7 points were similar for both approaches. As expected, the largest horizontal angles of attack were measured to the points located under the center of the callosotomy. However, vertical angles of attack were significantly greater in the contralateral transcallosal approach than in the ipsilateral approach to the points A (average percentage increase 40.2%, p = 0.01), B (average percentage increase 32.2%, p = 0.04), and X (average percentage increase 22.3%, p = 0.02) (Fig. 5). The average percentage increase for point D was 37.8% (p = 0.09). There were no differences in the vertical angles of attack to the central and anterior points on the floor of the lateral ventricle.

Angle of View to the Surgical Surface

The mean angle between the steepest possible vector to the point X and the vector XE, which represents the surgical surface, was measured to be 160.6° ± 11.1° through the ipsilateral approach and 151.8° ± 20.0° through the contralateral approach (p = 0.12) (Fig. 6).
The angle formed by vector XE and the mean sum of the most and the least steep vectors to the lateral ventricle wall at point X was significantly better from the contralateral approach than from the ipsilateral approach (p = 0.02). The angle closest to a right angle (90°) to the lateral ventricle wall at point X was achieved by a contralateral interhemispheric approach.

FIG. 3. Comparison of surgical freedom to the lateral wall of the lateral ventricle through the ipsilateral and contralateral interhemispheric approaches. Surgical freedom is calculated for the 7 points (A, B, C, D, E, F, and X) on the lateral ventricle wall as defined in Fig. 2.

FIG. 4. Comparison of the surgical freedom to the wall of the lateral ventricle for contralateral (left panel) and ipsilateral (right panel) interhemispheric transcallosal approaches. A gradient color map representing the surgical freedom (A, B, C, D, E, F, and X, as defined in Fig. 2) is imposed on photographs of the anatomical specimen to show anatomical areas allowing different maneuverability of the instruments through the 2 approaches. Green represents greater surgical freedom, red represents less surgical freedom.
FIG. 5. Comparison of the angles of attack to the selected points (A, B, C, D, E, F, and X, as defined in Fig. 2) on the lateral wall of the lateral ventricle.

FIG. 6. Comparison of the angle of approach to the surface. An angle close to 90° provides the best visualization of the surface. DXE = lowermost possible angle of view (closer to the hemisphere in the contralateral approach and to the superior sagittal sinus in the ipsilateral approach); UXE = uppermost possible angle of view (closer to the superior sagittal sinus in the contralateral approach and to the hemisphere in the ipsilateral approach).
approach (minimum 109.8°, maximum 154.2°, average 135.6° ± 15.6°).

Illustrative Cases

Case 1

A 63-year-old man presented with intermittent confusion and left-sided hemiparesis, and MRI revealed a right-sided internal capsule–caudate head region mass and marked surrounding brain edema (Fig. 7). A contralateral interhemispheric transcralosal approach was performed with the patient in a supine position and his head turned 90°, left side down, right side up, with a bump under the left shoulder. After entrance into the ventricle, a biopsy of the tumor capsule under navigation revealed adenocarcinoma. The tumor was subsequently resected by sharp dissection at the edges of the capsule and by debulking with ultrasonic aspiration. Gelfoam was temporarily plunged into the foramen of Monro to prevent blood from spread-
ing into the third ventricle. Yet there was difficulty in visualizing the posterior margin of the tumor. The angled endoscope was brought into the field, and the hidden part of the tumor was successfully resected under angled endoscopic view (Video 1).

VIDEO 1. Illustrative Case 1. Video clip demonstrating the use of an anterior contralateral interhemispheric transcralosal approach for resection of a metastasis in the caudate region. Endoscopic assistance was used to remove hidden parts of the tumor. Surgeon: P. Nakaji. Copyright Barrow Neurological Institute. Published with permission. Click here to view.

Bipolar coagulation on the walls of the ventricle was mini-mized to prevent scarring, and most bleeding stopped with the application of small pieces of Surgicel (Ethicon US, LLC). The patient had no new neurological deficits postoperatively and received 1 session of Gamma Knife (Leksell, Elekta AB) radiosurgery treatment was administered 3 weeks later. At 4 years’ follow-up visit showing complete resection and absence of tumor recurrence. The patient’s condition was stable. Axial postcontrast T1-weighted image (H), sagittal T2-weighted MR image showing the callosotomy (I), and coronal postcontrast T1-weighted image (J).
Case 2

An 80-year-old man presented with new-onset facial droop and ptosis of the right eyelid, and MRI revealed a left-sided, well-circumscribed lesion in the lateral wall of the third ventricle. A right anterior interhemispheric transcallosal transchoroidal approach (Fig. 8) was performed to remove a tumor located in the left wall of the third ventricle. The patient’s head was positioned right side down to facilitate gravitational retraction of the right hemisphere. Neuronavigation with wand guidance was used to plan the site of the callosotomy, based on the location of the lesion. After entrance into the right ventricle, the choroidal fissure was split with the choroidal plexus and the fornix displaced medially and the thalamus displaced laterally. This allowed a relatively straight corridor sufficient for complete removal of the mass with a good neurological outcome (Fig. 9, Video 2).

VIDEO 2. Illustrative Case 2. Video clip demonstrating the use of an anterior contralateral interhemispheric transcallosal transchoroidal approach for resection of a tumor in the lateral wall of the third ventricle. Surgeon: R. F. Spetzler. Copyright Barrow Neurological Institute. Published with permission. Click here to view.

Discussion

The interhemispheric transcallosal approach is a standard neurosurgical approach usually performed with the patient’s head in a supine position. The interhemispheric approach is a commonly preferred surgical choice for lesions located in the lateral wall of the frontal horn of the lateral ventricle, the head of the caudate nucleus, and the basal ganglia, as well as intrinsic lesions in the third ventricle that are difficult to access. At our institution, we usually prefer the contralateral interhemispheric transcallosal approach for lesions located off the midline while the ipsilateral interhemispheric transcallosal approach is used for lesions located in the midline.32

A review of case series about treatment and approaches to lateral ventricle lesions that are attached to or located in the lateral wall indicates that many surgeons prefer the ipsilateral approach and vertical head positioning. Oshita et al.22 reported a case of gastric carcinoma metastasis in the head of the caudate nucleus extending into the lateral ventricle resected through the ipsilateral transcallosal approach. Enomoto et al.10 reported a case of a ganglioglioma in the frontal horn of the left lateral ventricle extending from the head of the caudate nucleus resected via an anterior transcallosal approach. Sood et al.29 reported a pure endoscopic transcallosal approach to a tuberous sclerosis lesion in the frontal horn of the lateral ventricle and transcallosal removal of a thalamic astrocytoma. They did not report the patient positioning or outcome but described the feasibility of a purely endoscopic transcallosal approach. Nayar et al.20 used an interhemispheric approach in 2 cases of intraventricular meningiomas: one in the left frontal horn at the foramen of Monro and the other in the body of the left lateral ventricle. Both patients underwent the interhemispheric approach, presumably ipsilateral, and 1 patient developed a transient short-term memory deficit. The largest series to date comprises 202 intraventricular tumors, of which 55 were in the frontal horn of the lateral ventricle.5

The contralateral approach may minimize the need for retraction of the dominant frontal lobe for treatment of dominant-hemisphere lesions. In our experience, the contralateral interhemispheric approach allows adequate gravitational hemisphere retraction without neurological deficit even if the dominant hemisphere is retracted. However, the associated risks should be considered when planning the operative approach. Another possible complication of transcallosal approaches involves a greater risk of seizures than with a transcortical approach, which was reported in one study (incidence of 25% vs 8%, respectively).19 An alternative approach for lateral ventricle lesions, which was not considered in our study, is the transcortical approach. The transcortical approach affords a linear
approach to pathology in this region but necessitates destruction of normal brain tissue, which increases the risk of postoperative deficits, particularly for lesions located adjacent to critical functional tissue such as the basal ganglia or internal capsule. Ellenbogen reported on a series of 29 patients with lateral ventricle tumors treated via the transcortical approach, with good clinical outcomes in 86% of the patients.

Other case series using the contralateral interhemispheric approach have reiterated its feasibility. Semantically, “contralateral” is related to the side of the craniotomy in relation to the side of the lesion. There are no published objective anatomical studies that verify and quantitate whether a contralateral approach provides comparable or better working space or whether it provides a surgical advantage over the ipsilateral approach to paraventricular lesions. The present study addresses these issues. In the discussion of the anatomical basis of the contralateral interhemispheric approach, we divide its application by the location of the target: superior one-third of the lateral wall of the lateral ventricle, inferior two-thirds of the lateral ventricle, and lesions on the floor of the lateral ventricle together with the lesions in the walls of the third ventricle.

The Contralateral Interhemispheric Transcallosal Transchoroidal Approach for Exposure of the Lateral Wall of the Third Ventricle

Our study demonstrated that the surgical freedom to the area around the foramen of Monro is similar in both the contralateral and ipsilateral approaches in normal-size ventricles. The oblique orientation of the interventricular foramen in the 3D plane prevents a direct view into the third ventricle through the contralateral lateral ventricle without significant retraction of the fornix. Fornix retraction is not a benign action, and it should be minimized to prevent memory impairment. Therefore, a contralateral approach through the foramen of Monro is anatomically undesirable, unless the foramen is enlarged enough by a tumor or hydrocephalus. Türe et al. reported a case of cerebral aqueduct tumor operated on via the anterior interhemispheric transcallosal approach by passing through the foramen of Monro with the patient’s head in a neutral position. Enlargement of the ventricles and the foramen of Monro due to hydrocephalus or favorable venous anatomy makes such an approach possible.

Intraoperative neuro-navigation using preoperative MRI or ultrasound navigation with Cottonoid as a marker is critical in establishing the correct trajectory from the corpus callosum to the lesion. The ipsilateral ventricle provides a straight view into the foramen of Monro and choroidal fissure. To avoid damage to the fornix with a transchoroidal approach to the third ventricle, the senior authors (R.F.S. and P.N.) prefer splitting the tenia choroidea located between the thalamus and choroid plexus rather than the tenia fornici located between the fornix and choroid plexus.

The Contralateral Interhemispheric Approach for Exposure of the Inferior Two-Thirds of the Lateral Wall of the Lateral Ventricle

The concept of the contralateral interhemispheric approach was previously described and recently presented for transstriatocapsular lesions. Our study demonstrates that the contralateral approach to lesions located in the...
lower two-thirds of the lateral wall of the lateral ventricle has greater advantages than the ipsilateral approach, based on the surgical freedom and vertical angle of attack.

When choosing the approach, central core lesions located in the lateral walls of the lateral and third ventricles, such as cavernous malformations, arteriovenous malformations, tumors, and metastases, should be evaluated differently from the lesions located inside the lateral or third ventricles. The classic approaches to parenchymal lesions in the lateral ventricle region include a transcortical approach through the middle or superior frontal sulci or anteroposterior, anteroinferior, and anterosuperior ipsilateral transcallosal approaches. The differences in contralateral and ipsilateral approaches, especially the vertical angle of attack, have been depicted in illustrations but have not previously been compared quantitatively.

The interhemispheric transcallosal approach was preferred by some for removal of basal ganglia arteriovenous malformations located medially to the internal capsule, although the authors did not specify laterality of the cranial retractor with respect to the side of the lesion. The surgical view provided by the contralateral interhemispheric approach was demonstrated by Rodríguez-Hernández and Lawton. Our results demonstrate that the contralateral transcallosal approach provides better exposure to the caudate nucleus region than the ipsilateral approach. In cases of intrinsic lesions in the lateral walls of the lateral and third ventricles, the contralateral approach with gravitational retraction of the cerebral hemisphere allows a straightforward route, more perpendicular to the surface of the interest, than the ipsilateral approach (Fig. 6).

The Contralateral Interhemispheric Transcingulate Gyrus Approach for Exposure of the Upper One-Third of the Lateral Wall of the Lateral Ventricle

The contralateral transcallosal transcingulate gyrus approach provides a straight trajectory to lesions at the anterior aspects of the anterior horn that are located high and close to the corpus callosum. The results of our study showed that surgical freedom and angles of attack are adequate to reach lesions in the head of the caudate nucleus, but are limited by the callosotomy if the target is located superior and anterior to the caudate head. On coronal brain sections, one can see that the corpus callosum most often has a V shape, pointed downward, and is not always horizontal. It is difficult to obtain a sufficient exposure to the point and freedom of movement to the point located in the upper region of the lateral wall of the lateral ventricle through a callosotomy. This study has demonstrated that surgical freedom and angles of attack to the upper part of the lateral wall of the lateral ventricle are not significantly different between contralateral and ipsilateral transcallosal approaches. The contralateral transcingulate approach may be a valuable alternative that provides better angles of attack. However, determination of angles of attack and surgical freedom with the transcingulate approach was not within the scope of our current anatomical study and requires further investigation. The clinical feasibility of this approach was demonstrated previously. The particular risks of this interhemispheric approach are mutism as a result of bilateral cingulate gyrus retraction and temporary impairment in somatosensory and motor interhemispheric integration.

Surgical Considerations

The contralateral interhemispheric transcallosal approach with horizontal head positioning rarely necessitates the use of fixed retractors due to the sufficient gravitational retraction of the hemisphere. If required, a retractor is usually placed superiorly to gently lift the falx, which protects the ipsilateral hemisphere. The patient’s head is tilted approximately 45°–60°, and the body is raised approximately 30° so that it is located slightly below the surgeon’s head. The angles of surgical freedom are higher in the horizontal plane, so a craniotomy should be planned with sufficient horizontal length to allow a wider approach for instrument manipulation in the fissure. The horizontal head position allows the surgeon’s hands and instruments to rest more conveniently side by side rather than on top of one another as required when the patient’s head is in a vertical position. Special attention should be paid to bridging veins and to the trajectory to the point of interest.

In both approaches, however, the surgical corridors are narrower more so in the vertical plane than in the horizontal plane. This necessitates the use of special instruments and precise navigation to place the skin incision and craniotomy in a position free of bridging veins for a precise craniotomy. Lighted instruments may be especially useful in such deep and shallow approaches, when the light from the microscope is partially obscured by the exposure edges, especially in keyhole minimally invasive craniotomies. The use of angled surgical instruments and endoscopic assistance may improve visualization to allow complete lesion resection, as emphasized in Illustrative Case 1. At our institution, we use a 3D high-definition endoscope (Visionsense) to help visualize the areas under the corpus callosum, especially the upper one-third of the lateral wall, body, and frontal horn regions of the lateral ventricle, which are beyond the visual availability of the operative microscope. Under the angled endoscopic view, angled-tip instruments (e.g., suction tubes, bipolar devices, and curettes) may provide increased access to the hidden parts of the tumor in the obscured intraventricular angles. A septum pellucidotomy may be indicated when a tumor obstructs the foramen of Monro or when there is a potential for its obstruction due to scarring after the tumor resection. In these cases, this manipulation may be performed using direct operative microscope 3D visualization.

The ipsilateral interhemispheric approach may also be used with the patient’s head in the horizontal position for the same reasons of gravitational retraction and natural hand positioning for the surgeon. Our results show that the surgical freedom and angles of attack are similar for the 2 approaches for the points on the floor of the lateral ventricle, with even better medial exposure through the ipsilateral transcallosal approach. It has also been mentioned that the ipsilateral approach is more suitable for lesions located closer to the midline. However, for lesions located slightly off the midline in the third ventricle, the approach would be termed “contralateral” because the surgery is performed through a craniotomy contralateral to the side of the lesion, although the approach would be ipsilateral.
with regard to the lateral ventricle. As stated, the ipsilateral approach provides better visualization of the medial aspect, which is advantageous for accessing the third ventricle through the foramen of Monro or through the choroidal fissure.\(^{24}\)

Although not investigated in our study, hydrocephalus may increase surgical freedom in both ipsilateral and contralateral interhemispheric approaches. Increased absolute values of surgical freedom and angles of attack could make subtle but statistically significant differences between the 2 approaches clinically insignificant. Hydrocephalus makes third ventricle lesions more approachable through the enlarged foramen of Monro, favoring an ipsilateral craniotomy. However, caudate region lesions may be shifted further laterally in patients with enlarged lateral ventricles, favoring a contralateral approach. Finally, the surgical approach should be tailored to the individual with regard to the lateral ventricle through the foramen of Monro or through the choroidal fissure.

Limitations of the Anatomical Study

Ventricle size is an important parameter that must be considered in choosing a surgical approach. In the present cadaveric study, ventricle size at the frontal horn was not significantly different from ventricle size in vivo. Formaldehyde fixation shrinks the brain and slightly enlarges the ventricles. Calculations and measurements of the current study should not be extrapolated to a hydrocephalic brain with increased ventricle size. We believe that gaining familiarity with various possibilities provided by the interhemispheric fissure in human cadaveric brains\(^{27}\) and even in sheep brains\(^{15}\) is essential to understanding the proper selection of variants of interhemispheric approaches. Silicone-injected brains also lack the elastic characteristics of live tissue, such as reproduction of tissue retraction, and this is an inherent drawback of all cadaveric studies. It should be noted that the nature and location of a particular lesion should influence the selection between any 2 approaches. Head positioning could also affect the exposure due to the gravity-assisted brain shift, which may not be similar to that of the fixed anatomical specimen. Nevertheless, such anatomical studies provide valuable insight into the utilitarian assessment of surgical approaches and access to pathology.

Conclusions

The anterior contralateral interhemispheric transcortical approach provides adequate exposure to the floor and the lower two-thirds of the lateral wall of the lateral ventricle, as well as to the caudate nucleus, genu of the internal capsule, thalamus, choroidal fissure, and fornix. This approach provides better surgical freedom and vertical angles of attack to the lower two-thirds of the lateral wall of the frontal horn of the lateral ventricle than that provided by the ipsilateral interhemispheric transcortical approach. In exposure of the upper one-third of the lateral ventricle wall, the transcingulate approach gives better surgical freedom and vertical angle of attack than that provided by either the contralateral or ipsilateral transcortical approach. In normal-sized ventricles, the foramen of Monro and choroidal fissure are visualized better through the lateral ventricle ipsilateral to the craniotomy than through the contralateral approach.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

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Supplemental Information

Videos


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