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Technical Note

Limited vertical dural opening for lesions of the vermis, 4th ventricle, and distal PICA segments

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Abstract

Background: Lesions of the vermis and 4th ventricle are commonly addressed through a midline suboccipital approach. Most neurosurgeons use either a Y-shaped or a curvilinear dural opening in this setting. Although these approaches offer a wide intraoperative surgical exposure, in occasion, the dural opening is difficult to repair primarily, often necessitating the use of a patch, which may increase the risk for development of CSF fistula. We are describing our experience with a limited, vertical, midline, dural opening for approaches to the vermis, tentorium, 4th ventricle, and distal posterior-inferior cerebellar artery (PICA) segments as an alternative to the classic Y-shaped or curvilinear incision.

Methods: We report our experience with a limited vertical midline durotomy in five patients with posterior fossa lesions. The lesions treated included a PICA dissecting aneurysm, three metastatic lesions (located in the vermian, floor of the 4th ventricle, and undersurface of the tentorium cerebelli), and one intra-axial tumor (ependymoma). All patients were positioned prone, and the lesions were accessed without difficulty through a limited, vertical, midline durotomy.

Results: Mass lesions and vascular abnormalities located from the midline as far lateral as the outlet foramina of the 4th ventricle can be accessed comfortably via a limited midline dural opening when combined with microsurgical techniques, and the use of a frameless Stealth Station Neuronavigation System (SSNS) [Medtronic Sofamor Danek, Inc., Memphis, TN]. By doing this, simple primary dural closure was achieved with a single running absorbable suture without tension in each case.

Conclusion: In our experience, a suboccipital linear dural opening appears to be as effective as the more traditional Y-shaped incision, yet allows for quicker and easier primary dural repair.

Key Words: Dural opening, median suboccipital approach, posterior fossa

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INTRODUCTION

Surgical approaches to the posterior fossa are designed to achieve adequate intraoperative exposure with minimal brain retraction and manipulation. The combination of intraoperative microsurgical techniques with the SSNS allows surgeons to precisely navigate and dissect within the posterior fossa corridors and subarachnoid

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spaces. Traditionally, neurosurgeons have used either a "Y"-shaped or a curvilinear dural opening to access the posterior fossa.[1-5] In this report, we describe the usefulness of a simple vertical, linear durotomy to access the midline cerebellar regions, facilitating dural repair. With this technique, exposure of the vermian, tentorial, 4th ventricle structures and distal PICA segments was achieved without undue brain retraction or manipulation. Dural repair was simpler and quicker than with the more traditional Y-shaped dural opening.

MATERIALS AND METHODS

We report our experience with a limited vertical midline durotomy in five patients with post-fossa lesions. The lesions treated included a PICA dissecting aneurysm, three metastatic lesions (located in the vermian, floor of the 4th ventricle, and undersurface of the tentorium cerebelli), and one intra-axial tumor (ependymoma). All patients were positioned prone, and the lesions were accessed without difficulty through a limited, vertical, midline durotomy.

RESULTS

Illustrative cases

Case 1

A 72-year-old female with previously diagnosed metastatic lung cancer presented with a newly found, enlarging, vermian lesion that failed stereotactic radiosurgical treatment. A decision was made to proceed with surgical resection, and a midline suboccipital approach was planned. A limited linear durotomy was performed and the SSNS was utilized to localize the tumor. The vermis was entered via a paramedian approach, sparing the vertically oriented vermian veins. Following gross total resection of the lesion, the dura was closed without difficulty. The postoperative course was uneventful, and there was no evidence of cerebrospinal fluid (CSF) leak or accumulation.

Case 2

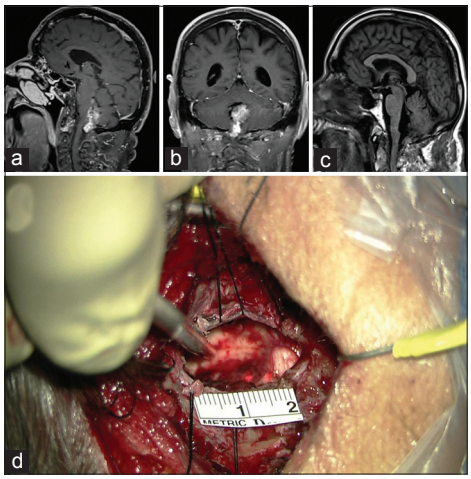
A 24-year-old male was found to have a large 4th ventricular tumor, requiring surgical resection. Following a midline suboccipital exposure, the dura was opened using a limited, midline incision. The cerebellar tonsils were separated from the tumor region inferiorly, and PICA segments were mobilized and dissected away laterally. The floor of the 4th ventricle was entered. The tumor, which was fairly vascular in nature, was dissected using its natural cleavage plane and removed as a single specimen. Primary dural repair was performed, and the postoperative course was without incident [Figure 1a-d].

Case 3

A 66-year-old male presented with a coma producing subarachnoid hemorrhage due to a ruptured dissecting aneurysm of the right PICA. He underwent microsurgical wrapping and remote distal outflow occlusion of the aneurysm. Surgically, the aneurysm was accessed via a midline suboccipital craniotomy, with bone work involving exposure and removal of the C1 arch. Dural opening was performed in the midline, using a linear incision, followed by the lifting or "tenting" of the dural edges superiorly. The right PICA in the 4th ventricular region was identified and followed proximally. The aneurysm was extremely friable in nature, which prompted the decision to wrap it. The distal outflow occlusion was carried out beyond the PICA tonsillar point, just after the last evident brainstem perforators. There were no postoperative complications.

Technique description

The patient positioning on the operation table is crucial. We prefer the prone position for exposing the posterior fossa via a median suboccipital approach, because the cerebellum falls away from the brainstem surface, opening the subvermial surgical corridor. A midline skin lineal incision is made using the external occipital protuberance and the spinous process of C2 as a landmark [Figure 2]. The paraspinal muscles and the avascular plane of the ligamentum nuchae are divided in the midline with diathermy coagulation. Separating the fascia in this manner is of paramount importance, since this creates a fascial plane, which is easily approachable to closure, preventing future CSF leakage. The occipital bone is exposed from the superior nuchal line to the region of the foramen magnum. Partial removal of the arch of C1 is not often needed, but may allow additional exposure to the cervicomedullary junction after dural opening. During the bone work, it is crucial to avoid injuring the vertebral arteries and dura mater. After performing the craniotomy, a midline, vertical durotomy is made extending from the



Figrue 1: (a and b) Pre-operative sagittal and coronal MRI views demonstrating a heterogeneous, nodular mass that fills the 4th ventricle and extends through the foramen magnum into the upper cervical canal. (c) Postoperative sagittal MRI showing gross total resection of the lesion. (d) Intraoperative photomicrograph shows the minimally invasive durotomy, with sutures "tenting" the dural edges

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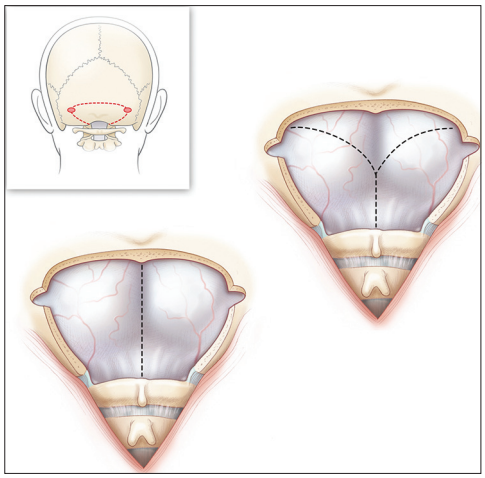

Figure 2: Illustration demonstrating the traditionally "Y"-shaped versus the straight incision. A midline, vertical, dural opening is made extending from the region of the foramen magnum to below the bony margin superiorly

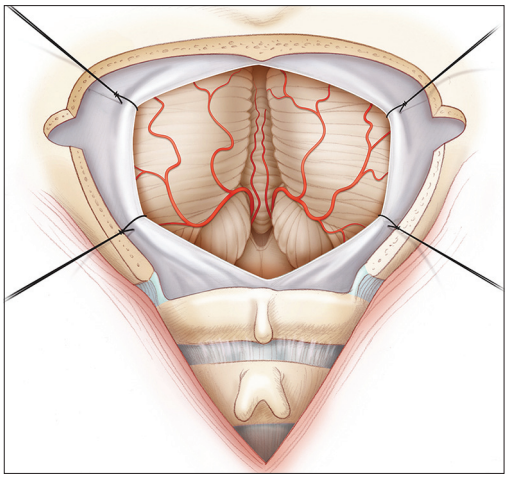

Figure 3: Graphic picture showing the lifting or "tenting: of the free dural edges with sutures, and exposure of the vermian, tentorial, 4th ventricle structures, and distal PICA

region of the foramen magnum to below the bony margin superiorly. The free dural edges are "tented" with sutures [Figure 3]. At this point, the microscope is brought into the field, allowing us to open the cervicomedullary cistern.

DISCUSSION

There are several benefits of Y-shaped dural opening when performing a medial suboccipital approach, which consist of wide surgical field exposure, avoidance of injury to the occipital sinus, good control of the sinusoid vessels around the foramen magnum and easy access to the cerebellomedullary cistern for CSF drainage.[1,3,4]

Our description demonstrates that a lineal dural opening may provide the same intraoperative benefits as the Y-shaped incision. Surgical dissection of the posterior fossa corridors and CSF space can be achieved without significant brain manipulation and retraction.

Our indications for this kind of practice include elective lesions located in the vicinity of the cerebellar vermis, floor of the 4th ventricle, cortical, telovelo, tonsilomedullary and lateral medullary segments of the PICA.[1-5]

Although the amount of exposure may be slightly diminished by a midline vertical dural opening, in our experience, this exposure has been more than sufficient for lesions as far lateral as the foramina of Luschka.

When choosing a linear durotomy, we have used intraoperative navigation techniques to carefully guide our opening as well as the surgical trajectory. By working through the natural arachnoid planes and releasing CSF as needed, adequate exposure can be achieved without significant brain manipulation and retraction. The vermian, tentorial, 4th ventricle structures, and distal PICA segments, can be accessed without difficulty [Figure 3].

CONCLUSION

In our experience, a suboccipital linear dural opening appears to be as effective as the more traditional Y-shaped incision, yet allows for quicker and easier primary dural repair.

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