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TECHNICAL REPORT

Endoscopic-assisted contralateral interhemispheric transfalcine keyhole approach for falcine meningioma: How I do it

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Abstract

Background Although the ipsilateral craniotomy approach has been used for the removal of falcine meningioma (FM), we report a case of FM that was minimally invasively removed using a contralateral interhemispheric approach assisted with endoscopy.

Methods We used a contralateral approach with a small craniotomy of the FM. The tumor was detached from the surrounding tissue during internal decompression. It was dissected and coagulated endoscopically in a blind spot under a microscope, and a Simpson Grade I resection was achieved.

Conclusion A small craniotomy with a contralateral interhemispheric approach assisted by endoscopy allowed minimally invasive tumor removal without complications.

Keywords Falcine meningioma · Endoscopic-assisted approach · Contralateral approach · Minimally invasive surgery

Relevant surgical anatomy

Meningiomas originating from the falx account for 5–9% of all intracranial meningiomas [1], and the ipsilateral interhemispheric approach has been used for their removal [2]. Complications, such as superficial bridging veins and deep cortical damage have been a problem with this approach [2]. It is also associated with an increased risk of ipsilateral cerebral contusions.

Recently, endoscopic approaches have been reported, and their numbers are increasing because of their good visibility in deep areas and their ability to remove tumors with a small craniotomy [3, 4]. Specifically, one study used an oblique surgical trajectory through the interhemispheric fissure [5], and two other studies used a contralateral interhemispheric approach [3, 6]. Another study used the ipsilateral approach [2]. Of these reports, all but one case of combined microscopic and endoscopic resection [6] was performed endoscopically [2, 3, 5]. The patients underwent gross total resection without serious complications.

Herein, we report a case of complete removal of the FM using an endoscopic approach, mainly the contralateral approach, in combination with the ipsilateral approach.

Description of the technique

Preoperative assessment

A 61-year-old woman with an incidental falcine lesion was diagnosed using head computed tomography (CT) performed at another hospital. Two years later, the lesion showed a gradual increase in size and edematous changes and surgery was indicated.

No other special findings were available for her life history.

Contrast-enhanced MRI and preoperative plain CT, 3D fusion images, and MRI fluid attenuated inversion recovery images at admission are shown in Fig. 1.

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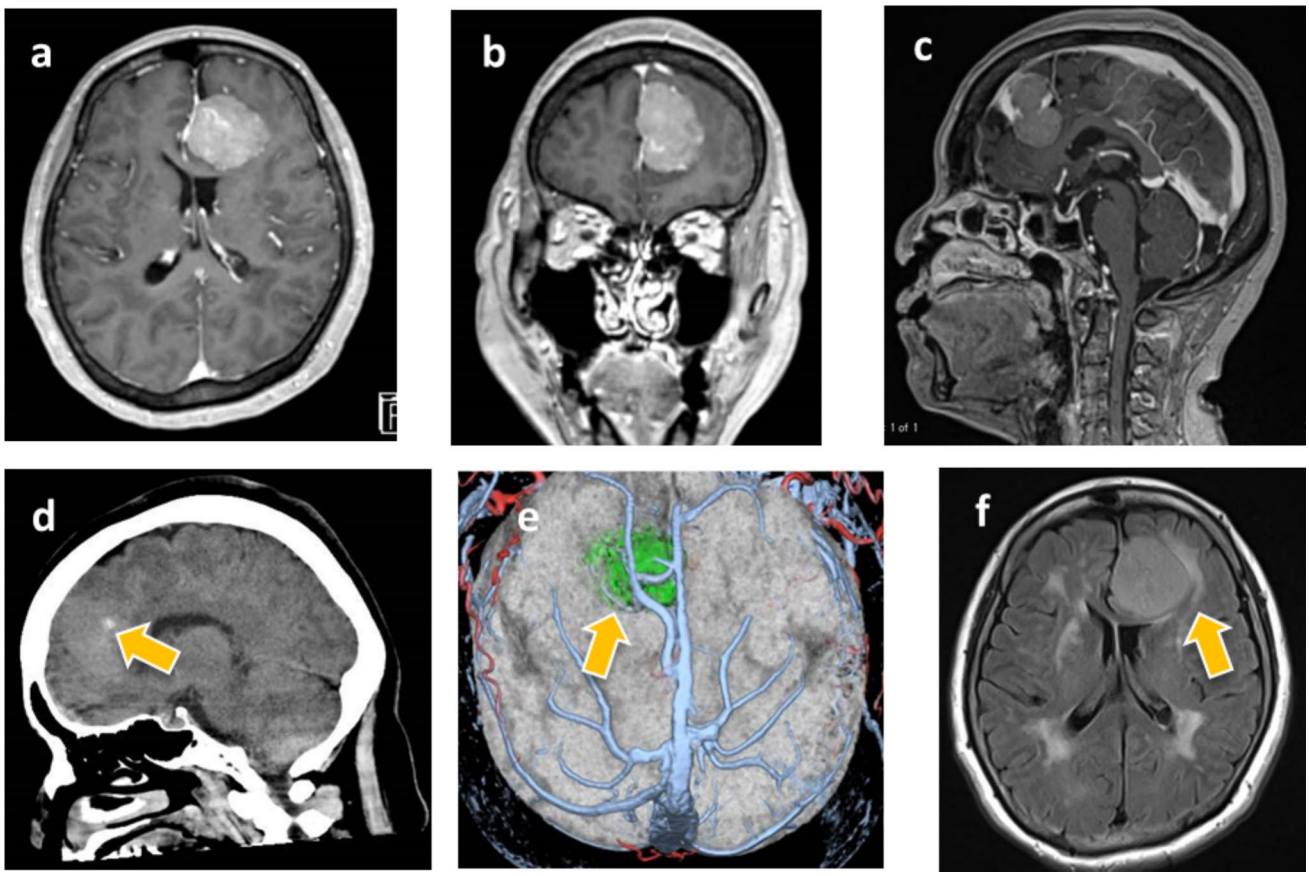

Fig. 1 Contrast-enhanced MRI axial (**a**), coronal (**b**), and sagittal (**c**) images showed a homogeneous enhanced lesion with a maximum diameter of 35 mm attached at anterior part of the ipsilateral falcine Preoperative CT showed calcified lesions (d), 3D fusion image which overlapped CT angiography, CT venography, tumor, and cerebral cortex showed development of ipsilateral bridging veins overlying the tumor lesion (e) , and fluid attenuated inversion recovery image showed peritumoral edema (f).

Description of the technique

We planned preoperative embolization and tumor resection via craniotomy. Preoperative embolization was performed the day before tumor removal. Using an Embosphere, we successfully embolized the feeder from the anterior branch of the middle meningeal artery (MMA), achieving complete occlusion. We selected an endoscope-assisted small craniotomy approach for the tumor resection. Bilateral craniotomies were performed across the superior sagittal sinus (SSS); however, as the bridging veins on the ipsilateral side were positioned directly above the tumor, a larger craniotomy was prioritized on the contralateral side. On the ipsilateral side, a smaller opening was created to facilitate the endoscopic cauterization of the tumor attachment site.

Patient Positioning and Skin Incision: The patient was placed in the supine position with the head slightly vertexed up (Fig. 2a).

A skin incision was formed as a 9 cm straight line vertical to the SSS (Fig. 2b).

Craniotomy 4 × 3 cm with a contralateral predominance of the tumor (Fig. 2c).

Dural opening A U-shaped dural incision was made with the SSS as the base (Fig. 2d), and the falx was incised contralaterally from the dural attachment site (Fig. 2e).

Tumor removal We dissected and internally decompressed the tumor contralaterally at the site of attachment and separated it from the frontal lobe and ACA (Fig. 2f).

Owing to the embolization, we were able to decompress the tumor without hemorrhage (Fig. 2g).

The use of the endoscope was advantageous in the following situations: manipulation of the ISS lining, contralateral confirmation of the ipsilateral ACA (Fig. 2h), contralateral dissection of the upper margin of the tumor from the

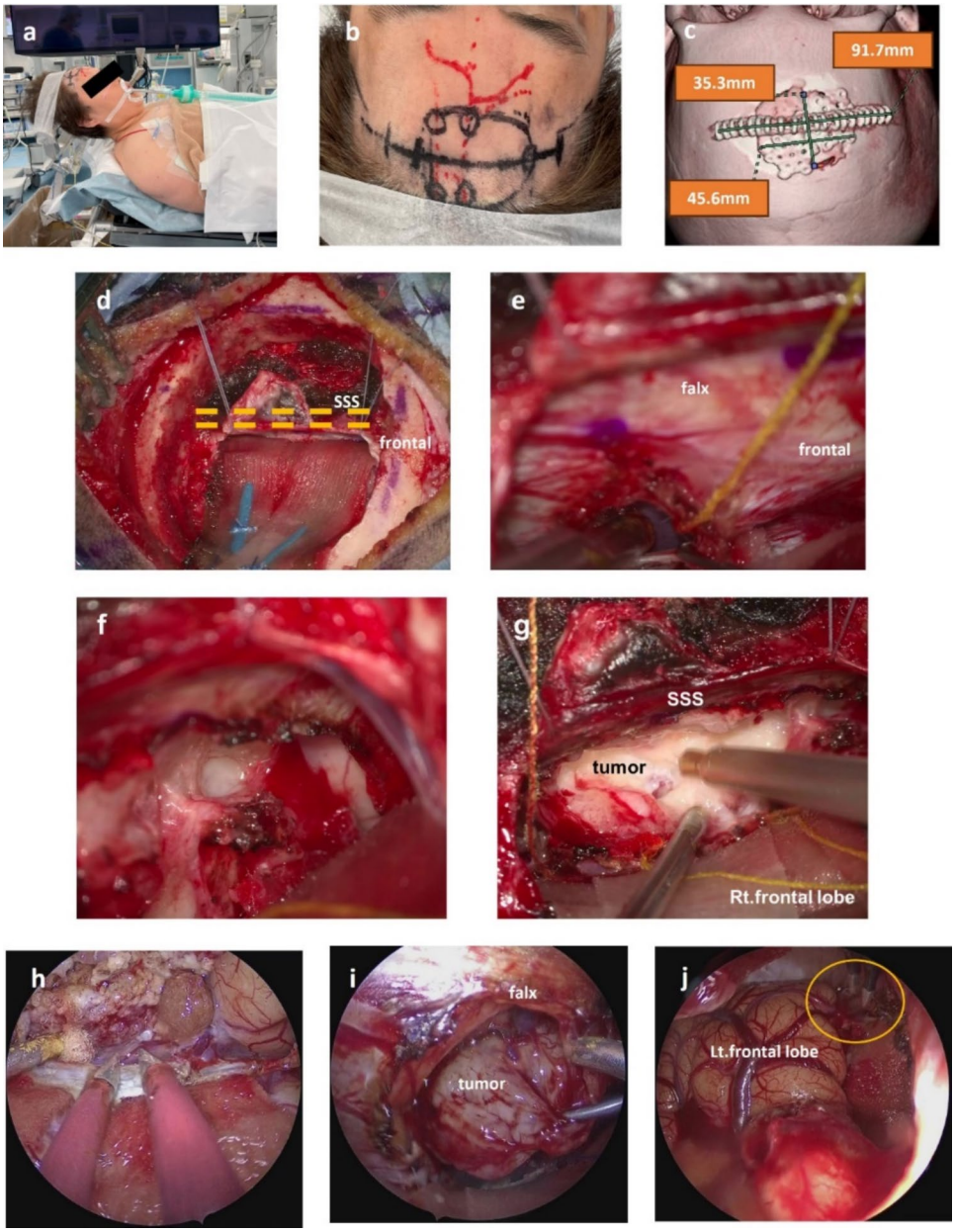

Fig. 2 The patient was placed in the supine position with the head slightly vertexed up (**a**), a linear skin incision of about 9 cm was designed (**b**), and a small craniotomy of about 4×3 cm was made contralaterally dominant to the tumor (**c**). The U-shaped dural incision was made with the SSS (superior sagittal sinus) as the base (**d**), and falx was incised from the dural attachment site contralaterally (**e**). We dissected and internally decompressed the tumor at the site of attachment and dissected the tumor from the surrounding tissue including the frontal lobe (**f**). Bleeding during intratumoral decompression was easily controlled due to preoperative embolization (**g**). Situations in which endoscopy was useful included contralateral tumor dissection along the ISS (**h**), contralateral identification of the ipsilateral anterior cerebral artery, contralateral dissection from the ipsilateral frontal lobe (**i**), and ipsilateral coagulation of the ipsilateral attachment site (**j**)

ipsilateral frontal lobe (Fig. 2i), and handling of the adherent area from the ipsilateral side (Fig. 2j).

The procedures took 6 h and 19 min. Simpson grade 1 resection was achieved without ipsilateral frontal lobe injury (Fig. 3). A head CT performed on the morning following surgery revealed no abnormalities including postoperative hemorrhage and no new neurological findings were observed during the postoperative course. Consequently, the patient

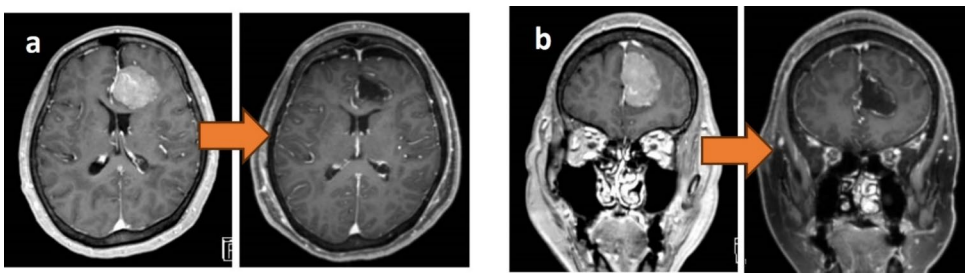

Fig. 3 Pre- and postoperative contrast-enhanced MRI axial (**a**), coronal (**b**), clearly showed that the tumor had been totally removed

was mobilized, and oral intake was initiated. Early rehabilitation intervention was undertaken. The patient was discharged on 10th postoperative day without recurrence.

Indications

In this case, the FM was removed minimally invasively using an endoscopy-assisted contralateral interhemispheric transfalcine approach with a small craniotomy. Although the ipsilateral approach is generally used, some cases have been reported using the contralateral approach, which has the advantage of reducing cortical damage near the tumor surface. The ipsilateral approach is also used for dissection from the same side as the tumor attachment, thus ensuring that the widest possible visual axis is important for tumor removal.

In addition, endoscopes allow close-up observations and good visualization, even in deep areas. In this case, endoscopic manipulation from the contralateral side was useful for treating the lower edge of the deep tumor attachment zone, contralateral dissection from the ipsilateral ACA (Fig. 4a), and contralateral dissection from the shallow ipsilateral supralateral cortex (Fig. 4b). With the drainage of cerebrospinal fluid (CSF), access to deep areas from the ipsilateral approach becomes easier, reducing the need for brain retraction. However, regarding the observation of the dissection plane for the tumor pressing into the frontal lobe, the contralateral approach is considered to have further reduced the need for brain retraction.

On the ipsilateral side, the manipulation near the SSS was equally useful (Fig. 4c). There are some reports on the endoscopic approach for falcine meningioma (FM) [2, 3, 5, 6]; however, it has the advantage of being less invasive because of the small craniotomy size. Roser used a combination of endoscopy and microscopy [6], while Zhang, Sakaeyama, and Spektor used endoscopy alone for tumor removal [3, 5, 2]. In addition, simplification of the blindspot detachment maneuver will help reduce operating time. However, this is difficult to implement unless the facility and the surgeon are familiar with the procedure. All previously reported cases of endoscopic contralateral approach to falcine meningiomas were from high-volume centers specializing in endoscopic surgery. Zhang et al. performed over 1000 endoscopic procedures to remove pituitary neuroendocrine tumors and various skull base tumors [2]. However, as shown in this case, a small craniotomy approach is possible even when used in combination with an endoscope and microscope. Because it is significant in securing the field of view

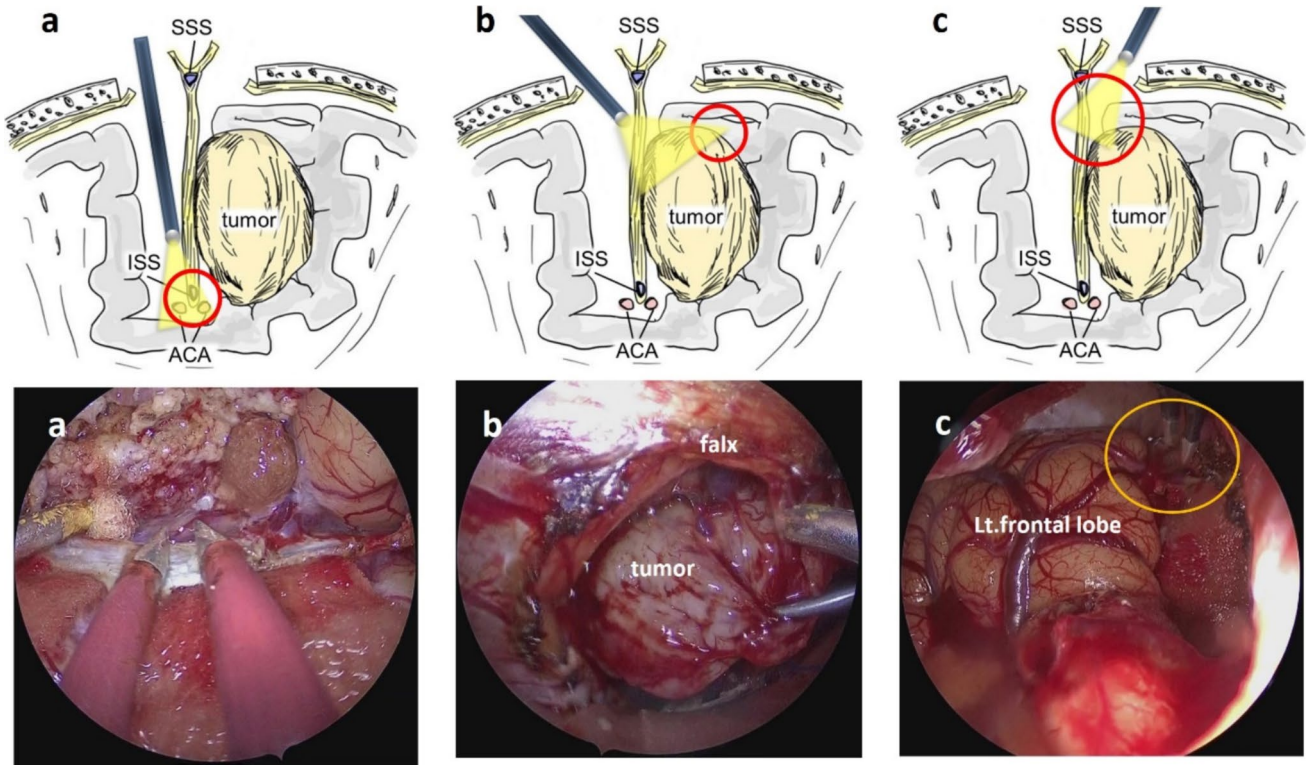

Fig. 4 These illustrations demonstrate instances in this case where endoscopic techniques provided a distinct advantage.: dissection of the ISS lining, confirmation of bilateral ACA (**a**), contralateral dissection of the upper margin of the tumor from the ipsilateral frontal lobe (**b**), and ipsilateral manipulation of the adherent area (**c**)

during tumor removal, and can be easily introduced even at facilities that are not accustomed to endoscopic surgery.

Limitations

An important limitation of the contralateral approach is that the upper margin of the tumor must be at a certain distance from the SSS. Sakaeyama et al. reported that the upper edge of the tumor should be at least 5 mm away from the SSS [3]. If a shallow lesion is too close to the SSS, dissection of the contralateral side becomes difficult. To overcome this problem, we created a small opening on the ipsilateral side and detached it from the attachment near the SSS by using an endoscope.

Additionally, this is a case report with a limited number of cases. Further studies are required to confirm their efficacy and safety. We intend to continue to evaluate the safety and efficacy of the endoscopic ipsilateral interhemispheric approach.

How to avoid complications

Venous complications may occur if a bridging vein runs over the tumor, as in the present case. Careful preoperative imaging is of paramount importance to prevent complications.

Specific information for the patient

The possibility of a wider craniotomy should be explained to patients if a sufficient field of view cannot be obtained during tumor removal. In addition, patients should be warned about the general surgical risks, including intraoperative bleeding, residual tumors, and postoperative infections.

Conclusion

In this case, a FM was minimally invasively removed without neurological or venous complications using an endoscopy-assisted contralateral interhemispheric approach. This method is considered to be useful as a minimally invasive approach for the patient.

10 key points summary

1. The ipsilateral approach is generally used by FM surgeons; however, the contralateral approach has the advantage of reducing ipsilateral cortical damage.
2. Endoscopic surgery alone is difficult to implement unless the facility or team is accustomed to it. However, the combined approach is easy to implement, even for facilities that are not accustomed to it.
3. In this case, bridging veins had developed on the tumor; therefore, the contralateral approach was judged to be more suitable than the ipsilateral approach as the main approach.
4. Preoperative embolization is useful for minimized bleeding.
5. The contralateral endoscopic approach is useful for manipulating the lower edge of the deep tumor attachment zone and dissecting it from the ipsilateral ACA contralaterally.
6. The contralateral endoscopic approach was advantageous for contralateral dissection of the shallow ipsilateral supralateral cortex.
7. An ipsilateral endoscopic approach through a small opening is necessary to process the shallow tumor attachment site from the SSS.
8. The use of both contralateral and ipsilateral endoscopic approaches facilitates the visual field and prevents complications.
9. As a result, we were able to perform a Simpson Grade I removal without complications through a small craniotomy.
10. If this approach is used in many more cases in the future, it is expected to lead to even more innovative and minimally invasive surgeries.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00701-025-06497-5.

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Data availability No datasets were generated or analysed during the current study.

Code availability Not applicable.

Declarations

Ethics approval Not applicable.

Informed consent The participants and identifiable individuals consented to the publication of their images.

Conflict of interest The authors declare no competing interests.

Consent to publish This technical report utilizes only anonymized images, and consent was deemed unnecessary.

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