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Technical Notes

Minimally invasive craniotomy for putaminal hemorrhage using a tubular retractor: A technical note

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ABSTRACT

Background: Minimally invasive endoscopic and stereotactic surgery have been established as surgical treatments for putaminal hemorrhage. However, facilities that do not have equipment for endoscopic or stereotactic surgery will likely have to perform conventional craniotomy. Using a tubular retractor, we were able to perform minimally invasive surgery, such as endoscopic surgery.

Methods: A craniotomy was performed for left putaminal hemorrhage after cerebral infarction treatment. A 3–4 cm craniotomy centered at Kocher's point was performed under general anesthesia. A 2 cm incision was made in the cortex, and a tubular retractor was inserted under a microscope. The hematoma was reached at a position 4–5 cm from the cortex.

Results: Thanks to the tubular retractor, it was relatively easy to observe the hematoma, and it was possible to remove it and confirm hemostasis without difficulty. Brain injury caused by the retractor insertion cavity was small, and no hemostasis was required. The surgery was completed by dura mater closure, bone flap fixation, and wound closure as per the standard. Most of the putaminal hemorrhage could be removed, and there was no rebleeding after the operation. The patient is still undergoing rehabilitation because of aphasia and muscle weakness. Manual Muscle Testing was at three points in the upper limb, and four points in the lower limb remained.

Conclusion: For putaminal hemorrhage, microscopic craniotomy was performed using a tubular retractor and an approach such as endoscopic surgery. Craniotomy, hematoma removal, and hemostasis operations are also considered to be minimally invasive surgeries.

Keywords: Craniotomy surgery, Minimally invasive surgery, Putaminal hemorrhage, Removal of hematoma, Tubular retractor, Craniotomy

INTRODUCTION

Minimally invasive endoscopic surgery and stereotactic surgery have been established as surgical treatments for putaminal hemorrhage.[4,8,10,15,16] However, facilities that do not have equipment for endoscopic or stereotactic surgery will have to perform a conventional craniotomy. In craniotomy for putaminal hemorrhage, the transsylvian approach or transcortical approach is selected depending on the amount of hematoma and direction of growth.[13] At our facility, we perform craniotomy in all cases because the environment does not permit endoscopic or stereotactic surgery, but using a tubular retractor, minimally invasive surgery such as endoscopic surgery was possible. We will report on the surgical method.

ILLUSTRATIVE CASE

A 73-year-old man underwent tissue plasminogen activator intravenous therapy and thrombectomy for the left middle cerebral artery (MCA) occlusion due to cardiogenic embolism, resulting in total recanalization. There was no postoperative bleeding [Figure 1a], and recurrence was prevented with apixaban 10 mg. Before treatment, the patient had right hemiparesis and total aphasia; the National Institutes of Health Stroke Scale score was 30, which improved to 0 after treatment. However, 4 days later, he presented with a sudden loss of consciousness; Glasgow Coma Scale (GCS) was E3V1M5, left putaminal hemorrhage, and subarachnoid hemorrhage (SAH) were confirmed on head computed tomography (CT) [Figure 1b]. After administering andexanet alfa, a direct-acting factor Xa inhibitor, a craniotomy was performed to remove the hematoma.

METHODS

We usually perform craniotomy and removal of hematoma using a transsylvian approach for putaminal hemorrhage. In this case, it was thought that the Sylvian fissure would be difficult to remove due to SAH. In addition, although the bleeding was counterbalanced, he was taking anticoagulants and wanted to keep the bleeding as small as possible. Therefore, we devised craniotomy with an endoscopic approach in mind and planned to perform the surgery by inserting a tubular retractor through Kocher's point [Figure 2 and Video 1].

A 3–4 cm craniotomy centered at Kocher's point [Figure 3a] was performed under general anesthesia. A 2 cm incision was made in the cortex [Figure 3a], and a tubular retractor, ViewSite (Vycor MEDICAL, Boca Raton, Florida, USA), was advanced approximately vertically under the microscope. The hematoma could be reached at a position 4–5 cm from the brain surface [Figure 3b and Video 1].

RESULTS

Thanks to the tubular retractor, it was simple to observe the hematoma cavity, and it was possible to remove the hematoma and confirm hemostasis without difficulty [Figure 3b and Video 1]. Brain injury caused by the retractor insertion cavity was small, and no hemostasis was required [Figure 3b and Video 1]. The surgery was completed by dura mater closure, bone flap fixation, and wound closure as per the standard. The surgical time was 91 min. SAH remained because it was not touched during surgery, but the putaminal hemorrhage was generally removed [Figure 4]. In addition, there was no rebleeding after the surgery. His consciousness improved (GCS E4V4M6), and he continued to undergo rehabilitation because moderate hemiparesis and aphasia remained.

DISCUSSION

Endoscopic surgery and stereotactic surgery have been established as minimally invasive surgery for putaminal

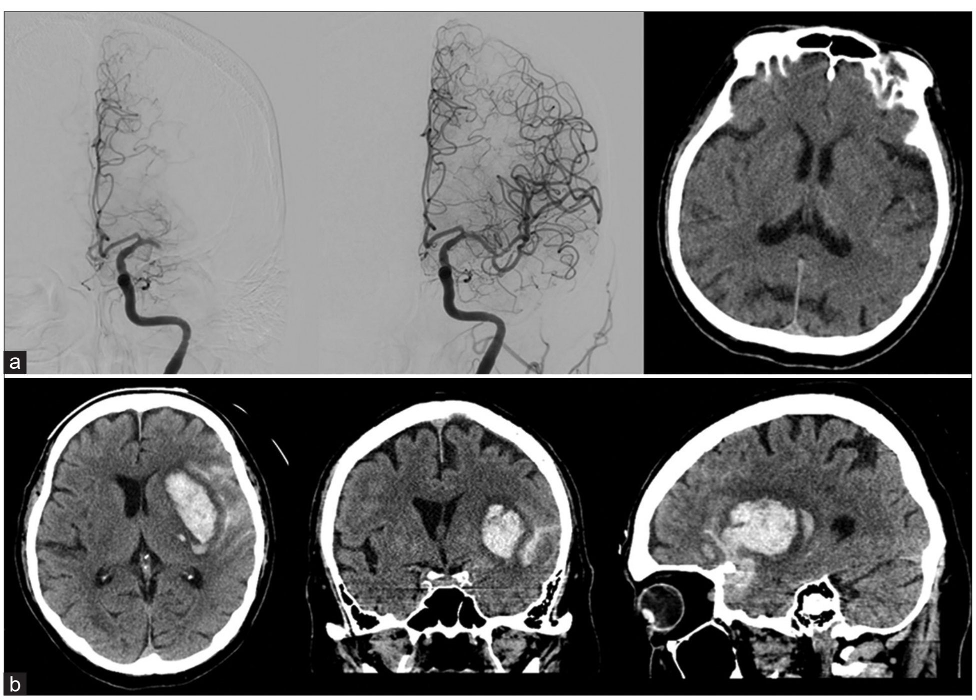


Figure 1: Angiography and head CT (a). The patient received a thrombectomy for left middle cerebral artery occlusion. Just after treatment, there was no hemorrhage. Head CT (b). 4 days later, he presented with a sudden loss of consciousness, and putaminal hemorrhage was confirmed.

hemorrhage.[4,8,10,15,16] At our facility, we do not have these instruments, so we have no choice but to use craniotomy. This surgical method allows treatment using an approach such as endoscopic surgery and is thought to be less invasive. In craniotomy for putaminal hemorrhage, a transsylvian approach is usually performed, but if the hematoma is located very shallowly from the cortex, a transcortical approach is also an option.[13] In the transsylvian approach, it is necessary to pay attention to the running of the superficial temporal artery and facial nerve and treatment of the temporal muscle. Moreover, there are individual differences in the anatomy of the superficial middle cerebral vein, MCA, and variation of perforators.[2,13,17] It sometimes takes a long time to reach the hematoma. In addition, putamen hemorrhage may extend to the caudate nucleus, thalamus, and corona radiata, and in the transsylvian approach, hematomas in the anteroposterior and cranial directions tend to become blind spots, making complete removal difficult. If we try to observe the entire hematoma cavity, there is a risk of retracting the brain too hard.

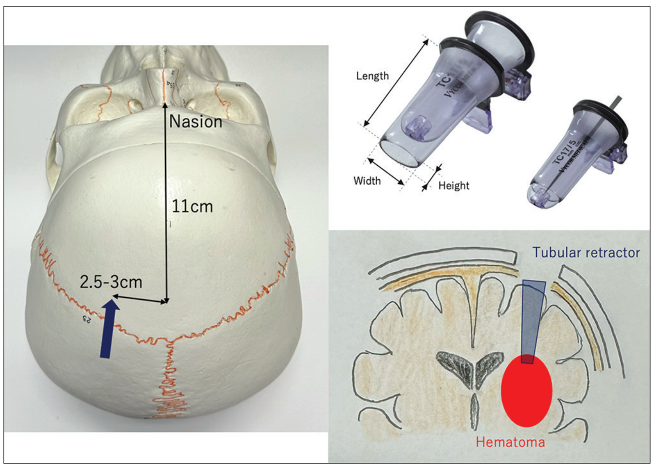
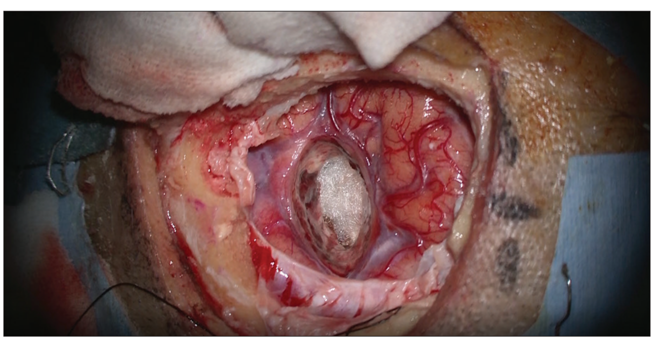


Figure 2: A tubular retractor was inserted from Kocher's point (arrow) such as the schema.



Video 1: The patient was in supine position under general anesthesia. A skin incision and 3–4 cm craniotomy centered at Kocher's point were made. A 2 cm incision was made in the cortex, and a tubular retractor was advanced approximately vertically under the microscope. The hematoma could be reached at a position 4–5 cm from the brain surface. The hematoma was removed by a suction tube. Thanks to the tubular retractor, it was simple to observe the hematoma cavity, and it was possible to confirm the bleeding points clearly. After hemostasis was confirmed, the retractor was removed. Brain injury caused by the retractor insertion cavity was small, and no hemostasis was required. Moreover, the operation was finished.

Since this approach imitates the approach of endoscopic removal of hematoma, it is extremely mini-invasive, even though it is a craniotomy. Normally, craniotomy can be performed centered on Kocher's point (11 cm behind the nasion, 2.5–3 cm lateral to the midline), but this may vary depending on the location and direction of the hematoma, so measurements using preoperative images are required. In this case, surgery was performed after confirming the location of the hematoma directly below the Kocher's point using preoperative CT.

There are many reports of surgeries using tubular retractors, such as ViewSite, for intraventricular approaches and deep brain tumors.[1,3,7,9,11,12,14] Although it is also used for cerebral hemorrhage,[5] there is no report of craniotomy for putaminal hemorrhage performed with the approach used in this case. Considering ViewSite's advantages as described below, we believe that it is a very useful surgery.

ViewSite has an oval cavity that reduces the injury by insertion. The transparent design allows for clear visibility and makes it easy to check for bleeding within the tract. There are variations in size (12 mm × 8 mm, 17 mm × 11 mm, 21 mm × 15 mm, 28 mm × 20 mm) and length (3, 5, 7 cm), and in this case, 21 mm × 15 mm × 7 cm was selected. The distance from the brain surface to the hematoma was about 5 cm, but since it is necessary to thoroughly observe the depths of the hematoma cavity, especially when stopping bleeding, we think that it is better to choose a longer retractor. Because the field of view is wider than that of an endoscope, the inside of the hematoma cavity can be observed very clearly, and hemostasis can be performed without difficulty.

Points to note are that a corticotomy large enough to insert this retractor is required, and the cortical incision and tract width are larger than in endoscopic or stereotactic surgery. After the hematoma was removed, no active bleeding was observed within the tract, but some contusion was still observed. Therefore, it appears that the injury to the cavity was minimal. There should be no problem if the retractor is inserted directly below the hematoma, but if it becomes displaced, complications due to injury to anatomically important fibers may occur. These fibers include the coronal radiata, internal capsule, arcuate fasciculus, superior longitudinal fasciculus, superior occipitofrontal fasciculus, and projection fibers. Since the surgical field is deep, longer bipolar forceps and suction tubes may be required, which may make it more difficult for surgeons who are not accustomed to operating in deep fields. In addition, this

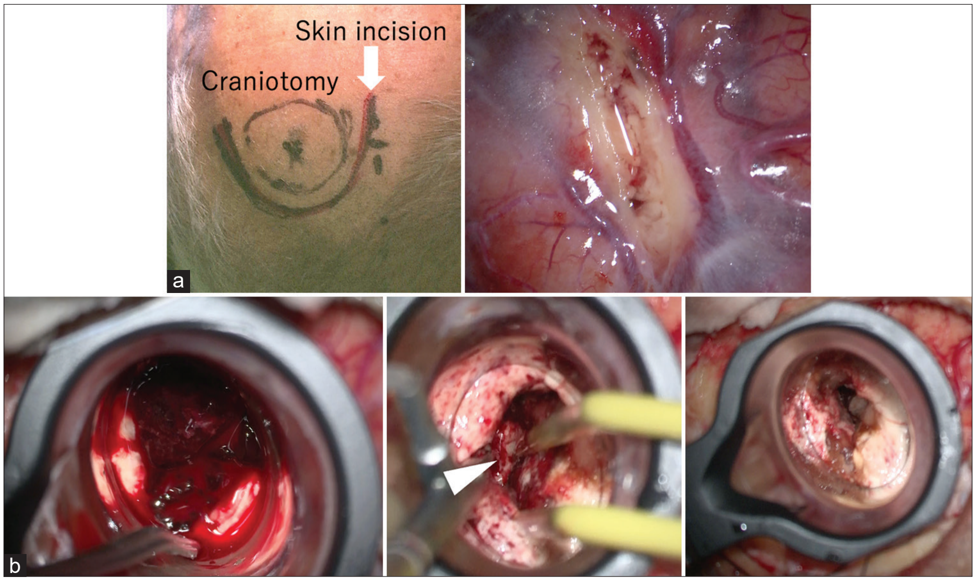


Figure 3: Operative images. Skin incision and craniotomy (a) A 2 cm corticotomy was made. (b) The retractor reached to hematoma, the bleeding point (arrowhead) was observed clearly, and the injury caused by the retractor insertion cavity was small.

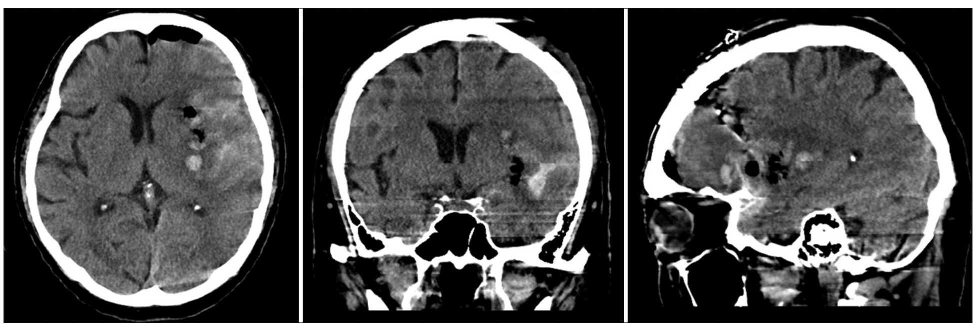


Figure 4: Postoperative head CT showed that the hematoma was almost removed.

approach is considered unsuitable when the hematoma is in a posterior position, such as when it extends to the thalamus.

In previous reports, the operating times for endoscopic surgery and craniotomy for intracerebral hemorrhage were 1.6 ± 0.7 h and 5.2 ± 1.8 h,[16] respectively, or the respective averages were 63 min and 105 min.[6] The operative time in this case was 91 min, which is comparable to endoscopic surgery. Furthermore, depending on future experience, it will be possible to reduce further the size of skin incision, craniotomy, and cortical incision, and aim to reduce surgical invasiveness, including shortening the operative time.

Limitation

This is the author's first attempt at this surgical method, and it is necessary to accumulate more cases in the future to examine the surgical outcomes. Furthermore, although the hematoma in this case was associated with SAH, its shape was not complicated, and removal was not difficult. Future studies will also be needed to determine whether it is effective against large or complex hematoma.

CONCLUSION

For putaminal hemorrhage, craniotomy was performed using a tubular retractor and an approach such as endoscopic surgery. This method is considered to be extremely minimally invasive in terms of craniotomy, removal of hematoma, and hemostasis.

Ethical approval

Institutional Review Board approval is not required.

Declaration of patient consent

Patient's consent is 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. Capitanio JF, Donofrio CA, Panni P, Barzaghi LR, Bailo M, Gagliardi F, *et al*. Microsurgical endoportal MRI/US-navigated approach for the resection of large intraventricular tumours: A 20-consecutive patients case series. Br J Neurosurg 2021;35:570-7.
2. Coscarella E, Vishteh AG, Spetzler RF, Seoane E, Zabramski JM. Subfascial and submuscular methods of temporal muscle dissection and their relationship to the frontal branch of the facial nerve. Technical note. J Neurosurg 2000;92:877-80.
3. Cuellar-Hernandez JJ, Lopez-Gonzalez MA, Olivas-Campos JR, Tabera-Tarello PM, Seanez-Prieto C, Eastin TM, *et al*. The use of exoscope combined with tubular retractor system for minimally invasive transsulcal resection of an ventricular atrium atypical choroid plexus papilloma: Three-dimensional operative video. Surg Neurol Int 2021;12:444.
4. Fayad PB, Awad IA. Surgery for intracerebral hemorrhage. Neurology 1998;51(3 Suppl 3):S69-73.
5. Ibrahim N, Scullen T, Tucci M, Delashaw J, Khan P, Dumont A, *et al*. Minimally invasive hematoma evacuation using the mindseye expandable tubular retractor: A technical note. World Neurosurg 2023;176:162-7.
6. Katsuki M, Kakizawa Y, Nishikawa A, Yamamoto Y, Uchiyama T. Endoscopic hematoma removal of supratentorial intracerebral hemorrhage under local anesthesia reduces operative time compared to craniotomy. Sci Rep 2020;10:10389.
7. Li B, Kim MG, Dominguez J, Feldstein E, Kleinman G, Hanft S. Intraventricular choroid plexus cavernoma resection using tubular retractor system and exoscope visualization: A technical case report. Oper Neurosurg (Hagerstown) 2022;22:e134-7.
8. Li Y, Yang R, Li Z, Yang Y, Tian B, Zhang X, *et al*. Surgical evacuation of spontaneous supratentorial lobar intracerebral hemorrhage: Comparison of safety and efficacy of stereotactic aspiration, endoscopic surgery, and craniotomy. World Neurosurg 2017;105:332-40.
9. Marenco-Hillembrand L, Prevatt C, Suarez-Meade P, Ruiz-Garcia H, Quinones-Hinojosa A, Chaichana KL. Minimally invasive surgical outcomes for deep-seated brain lesions treated with different tubular retraction systems: A systematic review and meta-analysis. World Neurosurg 2020; 143:537-45.e3.
10. Nishihara T, Teraoka A, Morita A, Ueki K, Takai K, Kirino T. A transparent sheath for endoscopic surgery and its application in surgical evacuation of spontaneous intracerebral hematomas. Technical note. J Neurosurg 2000;92:1053-5.
11. Okasha M, Ineson G, Pesic-Smith J, Surash S. Transcortical approach to deep-seated intraventricular and intra-axial tumors using a tubular retractor system: A technical note and review of the literature. J Neurol Surg A Cent Eur Neurosurg 2021;82:270-7.
12. Piloni M, Gagliardi F, Bailo M, Barzaghi LR, Caputy AJ, Mortini P. Endoscope-assisted neuroportal transcerebellar approach to the fourth ventricle: An anatomical study. J Neurol Surg A Cent Eur Neurosurg 2021;82:248-56.
13. Tanriover N, Rhoton AL Jr., Kawashima M, Ulm AJ, Yasuda A. Microsurgical anatomy of the insula and the sylvian fissure. J Neurosurg 2004;100:891-922.
14. Valarezo-Chuchuca A, Morejón-Hasing L, Wong-Achi X, Egas M. Minimally invasive surgery with tubular retractor system for deep-seated or intraventricular brain tumors: Report of 13 cases and technique description. Interdisciplin Neurosurg 2021;25:101260.
15. Wang WH, Hung YC, Hsu SP, Lin CF, Chen HH, Shih YH, *et al*. Endoscopic hematoma evacuation in patients with spontaneous supratentorial intracerebral hemorrhage. J Chin Med Assoc 2015;78:101-7.
16. Xu X, Chen X, Li F, Zheng X, Wang Q, Sun G, *et al*. Effectiveness of endoscopic surgery for supratentorial hypertensive intracerebral hemorrhage: A comparison with craniotomy. J Neurosurg 2018;128:553-9.
17. Zabramski JM, Kiris T, Sankhla SK, Cabiol J, Spetzler RF. Orbitozygomatic craniotomy. Technical note. J Neurosurg 1998; 89:336-41.

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