ORIGINAL RESEARCH

A prospective observational study of benefits and limitations of endoscopy assisted microneurosurgery in brain tumours in a tertiary care centre of Eastern India

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ABSTRACT

Aim: To evaluate benefits and limitations of endoscopy assisted microneurosurgery in brain tumours in a tertiary care centre of Eastern India. **Materials And Methods:** This was a descriptive and observational study with prospective design conducted in the department of Neurosurgery, Bangur Institute of Neurosciences, IPGMER and SSKM Hospital, Kolkata during July 2021- December 2022. 45 patients with radiologically confirmed brain tumours admitted at Department of Neurosurgery during the study period were recruited. A detailed clinical history was elucidated, followed by careful clinical examination along with the radiological reports was recorded. Clinical outcomes and complications were assessed at the time of discharge, 1 month and 3 months post-operatively along with the immediate post-operative complications. **Results**: The most common tumour among the study subjects was Pituitary Adenoma (35.56%). Complete and partial removal of lesion among the study subjects was reported in 51.11% and 48.89% of the subjects respectively. In all the surgical cases; endoscope helps in 100% more visualization. Endoscope showed residual tumor in 14 cases (31.11%) & removal of the intracanalicular part under endoscopic vision in 4 cases (8.89%). **Conclusion**: Through our experience, we confirmed that the endoscope is a useful tool to be used in the routine microsurgery, not only in the specific small craniotomy approaches. Simultaneous or tandem endoscopic and microscopic approaches may have the potential for better functional outcomes through better visualization and preservation of vital structures in corners that are hidden from the microscope.

Keywords: Tumours, Neurourgery, Endoscope, Advantage

INTRODUCTION

Primary brain tumors are a heterogeneous group of benign and malignant tumors arising from the brain parenchyma and its surrounding structures[1]. The nervous system tumors are a kind of neoplasms, which form several morphological subgroups with different behavior patterns; Nervous system cancers account for about 3% of all cancers in the world and are more common among men than women[2]. Although CNS tumors are rare, they are a significant cause of cancer morbidity and mortality, especially in children and young adults where they respectively account for approximately 30% and 20% of cancer deaths. They are also a cause of excessive mortality relative to other cancers. CNS tumors are predicted to represent 1.4% of new cancer diagnoses in 2015 and will cause 2.6% of cancer deaths. The commonest CNS tumors in children are pilocytic astrocytoma, embryonal tumors, and malignant gliomas whereas meningiomas, pituitary tumors, and malignant gliomas are most common adult brain tumor types[3].

The majority of primary brain tumors fall under the WHO classification scheme of tumors of neuroepithelial tissue. Malignant gliomas are the most common primary brain tumor, comprising more than 80 percent of all primary brain neoplasms. Gliomas

can be divided into astrocytomas, oligodendrogliomas, ependymomas, and oligo-astrocytomas (mixed gliomas). These neuroglial tumors can be further divided based on grade. Astrocytomas are subdivided into grades I-IV as follows: pilocytic, grade I; diffuse, grade II; anaplastic, grade III; and Glioblastoma Multiforme (GBM), grade IV. Ependymomas are subdivided into grades I-III. Oligodendrogliomas are typically grade II and oligoastrocytomas are usually grade III[4].

The clinical features of brain tumors can be as diverse as the spectrum of the disease itself. **Most brain tumors present with:**

- Progressive neurological deficit: usually motor weakness
- Headache: was a presenting symptom in 54%
- Seizures: often focal in onset (due to cortical irritation in the area of the tumor), may generalize secondarily.

Recently, endoscopes have been introduced in multiple surgical fields to minimize surgical invasiveness or to provide new visual dimensions. The earliest neuroendoscopic procedures were performed and published by L'Espinasse, who coagulated the choroid plexus endoscopically, and by Doyen, who utilized an endoscope in posterior fossa surgery in 1917. Those were followed by further endoscopic procedures by Dandy, Fukushima, and Prott. Hopf and Perneczky introduced the concept of "endoscope-assisted microsurgery" (EAMS) in which the surgery is primarily performed under the operative microscope in addition to the endoscope, which serves as an adjunct to the microscopic manipulations, in contrast to "endoscope-controlled neurosurgery," in which the endoscope is utilized as the primary operative tool[5].

Endoscopes can be used through a narrow corridor and provide clear and close-up views of objects. Endoscopes also provide angled views where no view would otherwise be possible. In the field of neurosurgery, endoscopic procedures have established their role in specialized applications for spinal and peripheral nerve lesions and ventricular pathological features or intraparenchymal mass lesions[6].

But in routine cranial microneurosurgery, the endoscope has not become an essential addition, because the endoscope cannot provide information about the surrounding structures and there is no expandable space in the cranium to create working space for the endoscope[7]. Endoscopy assisted techniques allows for improved illumination, magnification and closer inspection of the neurovascular elements. However, using an endoscope leads to a false sense of 3D image with a lack of stereopsis[8-10].

In the above context, the purpose of this study was to evaluate the advantages of endoscopic assisted microsurgery in management of patients of brain tumour in relation to location, histopathology and clinical presentation of the tumours besides finding out the complications of such procedures which might help in fine tuning one of the newest modalities of minimally invasive neuro-oncosurgery.

MATERIALS AND METHODS

This was a descriptive and observational study with prospective design conducted in the department of Neurosurgery, Bangur Institute of Neurosciences, IPGMER and SSKM Hospital, Kolkata during July 2021- December 2022. All patients of radiologically confirmed brain tumours admitted at Department of Neurosurgery, Bangur Institute of Neurosciences, IPGMER and SSKM Hospital, Kolkata undergoing an endoscopy assisted microsurgery within the specified study period. During the study period, 45 patients were recruited.

INCLUSION CRITERIA

All patients willing to participate of all ages and either sex undergoing an endoscopy assisted microsurgery for brain tumours with at least 3 months of follow up.

EXCLUSION CRITERIA

- A surgical procedure of biopsy or removal of a recurrent brain tumour.
- Residual brain tumour after previous surgery.
- Patients unfit for anaesthesia.
- Patients lost to follow up.

METHODOLOGY

This particular study descriptive, observational and prospective study was conducted over one and half years among 45 patients with brain tumours getting admitted at the Department of Neurosurgery, Bangur Institute of Neurosciences, IPGMER and SSKM Hospital, Kolkata undergoing endoscopy assisted microneurosurgery considering the inclusion and exclusion criteria were included. A detailed clinical history was elucidated, followed by careful clinical examination along with the radiological reports which were recorded as per the proforma. Clinical outcomes and complications were assessed at the time of discharge, 1 month and 3 months post-operatively along with the immediate post-operative complications. All the observed data was then analyzed by appropriate statistical methods.

POST OPERATIVE COMPLICATIONS

a. CSF Leakage
b. ICH
c. Wound infection
d. New cognitive deficit
e. New vision deficit
f. Post-operative seizures
g. ICU stay
h. Others

DURATION OF POST-OPERATIVE COMPLICATIONS

a. Early

b. Late.
c. Prolonged.
d. Residual.

PERIOD OF FOLLOW-UP

a. Post-operative
b. 1-month
c. 3-months

STATISTICAL ANALYSIS

It was done using SPSS software version 24.

RESULTS

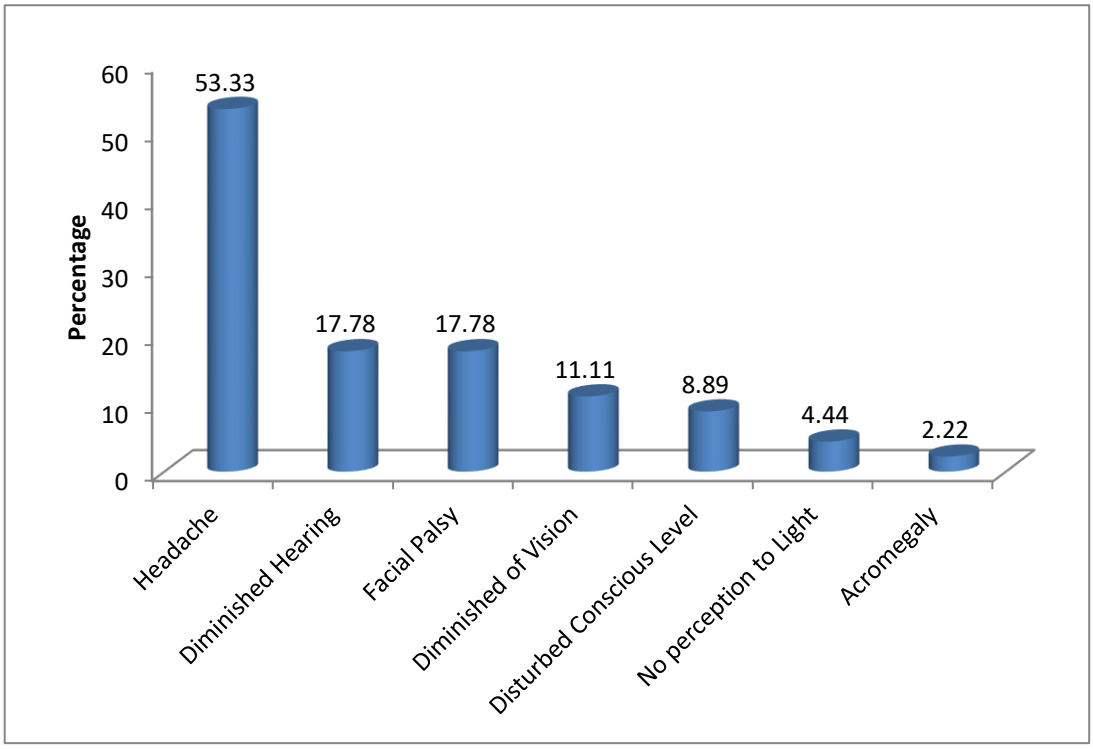
Out of 45 subjects, males were comparatively more as compared to females in this study. Mean age among the subjects was 41.29±14.82 years with range of 7-66 years. The most common tumour among the study subjects was Pituitary Adenoma (35.56%) followed by CPA Schwannoma (22.22%) and Foramen Magnum Meningioma (15.56%). The least common tumour was Sellar Abscess along with Supra Sellar Meningioma (table 1).

Table 1: Gender, age and tumour type among the study subjects

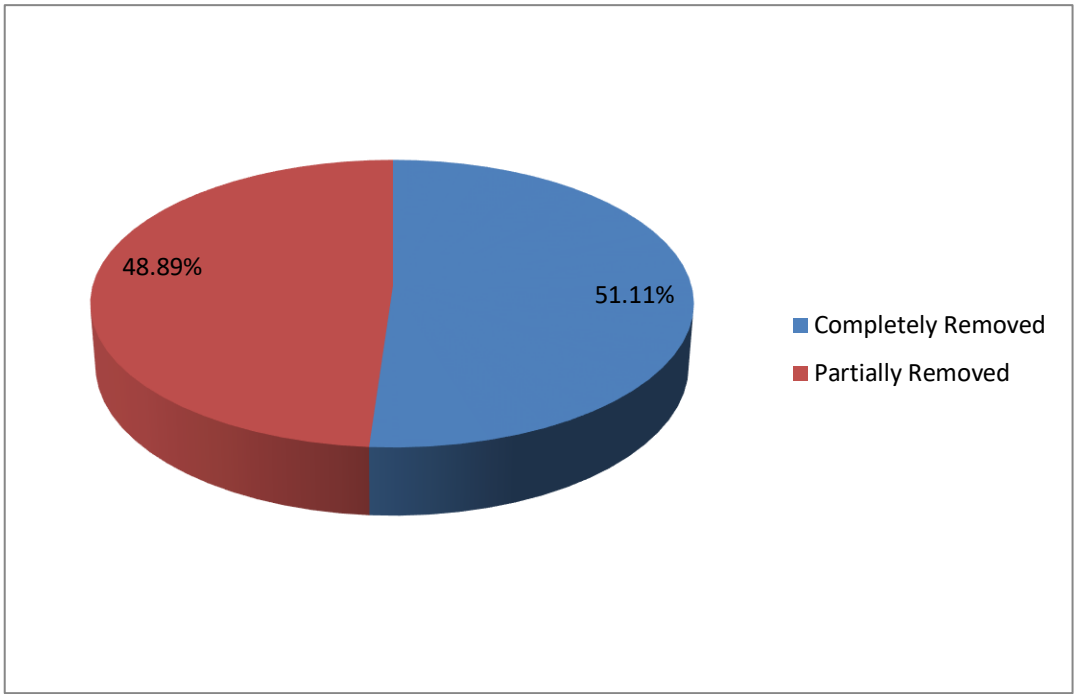
Gender	**N=45**	**%**
Male	29	64.44
Female	16	35.56
Age in years (Mean±SD)	41.29±14.82	
Tumour		
Pituitary Adenoma	16	35.56
CPA Schwannoma	10	22.22
Foramen Magnum Meningioma	7	15.56
Craniopharyngioma	5	11.11
Fontal Lymphoma	3	6.67
Sellar Abscess	2	4.44
Supra Sellar Meningioma	2	4.44

In our study, headache was found in 53.33% of the subjects. Diminished hearing, facial palsy, diminished of vision, disturbed conscious level, no perception to light and acromegaly was revealed in 17.78%, 17.78%, 11.11%, 8.89%, 4.44% and 2.22% of the subjects respectively (graph 1).

Complete and partial removal of lesion among the study subjects was reported in 51.11% and 48.89% of the subjects respectively (graph 2).



Graph 1: Clinical presentation among the study subjects



Graph 2: Removal of lesion among the study subjects

Table 2 shows the benefits and disadvantages of endoscope among the studied group. In all the surgical cases; endoscope helps in 100% more visualization. Endoscope showed residual tumor in 14 cases (31.11%) & removal of the intracanalicular part under endoscopic vision in 4 cases (8.89%). Average time of the endoscopic-assisted procedure was 19 minutes.

Table 2: Benefits and disadvantages of endoscope among the studied group

Benefits	N	%
More Visualize	45	100.00
Residual Tumour	14	31.11
Removal of the Intracanalicular Part Under Endoscopic Vision	4	8.89
Average time of the endoscopic-assisted procedure	19 minutes	

Most common complication was 3rd nerve palsy (8.89%) among the study subjects. Cerebrospinal fluid leak, delay of auditory brainstem response and intratumoral hematoma was found in one subject each. Mortality was reported among 6.67% of the subjects after the final followup (table 3).

Table 3: Complications among the study subjects

Complications	N	%
3rd Nerve Palsy	4	8.89
Cerebrospinal fluid leak	1	2.22
Delay of auditory brainstem response	1	2.22
Intratumoral hematoma	1	2.22
Mortality	3	6.67

DISCUSSION

The development of endoscopic and endoscope-assisted approaches has played a key role in treating and improving the outcomes of brain tumours. The endoscopic endonasal transsphenoidal approach, for instance, may decrease the incidence of surgical complications when compared with traditional microsurgical cases in treating pituitary adenomas, likely a direct result of the improved visualisation of anatomy this approach provides[11]. Utilisation of endoscopic approaches in treating patients with sinonasal and ventral skull base cancers has also been found to significantly improve patient quality of life scores within the first postoperative year[12]. However, despite the great strides made in endoscopy, it is the use of surgical instruments in endoscopic approaches that has remained the greatest technical barrier to their adoption[13].

Presently, many of the instruments used in endoscopic and endoscope-assisted neurosurgical approaches have been adopted from the armamentarium of neighbouring specialties such as rhinology and urology. But due to its limited literature in neurosurgery, this prospective study was conducted over one and half years among 45 patients with brain tumours getting admitted at the Department of

Neurosurgery, Bangur Institute of Neurosciences, IPGMER and SSKM Hospital, Kolkata undergoing endoscopy assisted microneurosurgery considering the inclusion and exclusion criteria were included. The aim of the study was to evaluate the outcome of endoscopy assisted microneurosurgery in brain tumours in a tertiary care centre of Eastern India.

Out of 45 subjects, males were comparatively more as compared to females in this study. In this study, the mean age among the subjects was 41.29±14.82 years with range of 7-66 years. Similarly Karl-Michael Schebesch et al[14] in their study reported male dominance. They revealed mean age of 37.6 years among the study subjects which is approximately similar to this study. According to Walid Ali et al[15], there were 60% males while there were 40% females. The age ranged from 8 to 63 years old with a mean of 39.30 years. These findings are similar to the present study.

In our study, headache was found in 53.33% of the subjects. Diminished hearing, facial palsy, diminished of vision, disturbed conscious level, no perception to light and acromegaly was revealed in 17.78%, 17.78%, 11.11%, 8.89%, 4.44% and 2.22% of the subjects respectively. Walid Ali et al[15] in their study too showed that headache was the most common presentation and it was found in 50 % of the patients.

Complete and partial removal of lesion among the study subjects was reported in 51.11% and 48.89% of the subjects respectively. Total removal of the lesion was confirmed in 50 % of cases by the follow up MRI postoperative as mentioned by Walid Ali et al[15] in their study. Mohamed A. El Beltagy et al[16] in their study showed that craniopharyngiomas treated using EAMS techniques, gross-total resection (GTR) was achieved in 51 (78.5%). Near-total resection (NTR) with residual tumors less than 1 cm and subtotal resection (STR) with residual tumors more than 1 cm were performed in 11 and 3 patients, respectively.

In all the surgical cases; endoscope helps in 100% more visualization. Endoscope showed residual tumor in 14 cases (31.11%) & removal of the intracanalicular part under endoscopic vision in 4 cases (8.89%). Average time of the endoscopic-assisted procedure was 19 minutes. Fries and Perneczky[17] pioneered the use of the endoscope as an assisting device in specifically designed microsurgery techniques. They advocated the use of the endoscope with a small keyhole approach to provide additional vision, which was not provided through the microscopic view partly because of the narrow surgical approach.

Jho[18] pioneered the application of the endoscope as a primary optical device, especially in pituitary or spinal procedures, and advocated the usefulness of the endoscope to minimize surgical invasiveness. According to Akio Morita et al[19], in the cisternal pathological features, the scopes were used only for visual assistance in most patients (82%). However, in most of the air sinus or extradural cranial base pathological features, especially for pituitary procedures, endoscopes were used as the primary optical device (63%; Class III). The benefits scored as Class IV can be categorized into two types: 1) complication avoidance and 2) increased visualization.

Mohamed A. El Beltagy et al[16] in their study also revealed that endoscopic assistance enabled a more detailed appreciation of the tumor's relationship to the undersurface of the optic apparatus, hypothalamus, pituitary stalk, perforators, tumor–pituitary stalk interface, and Liliequist membrane. More visualize in 20 cases (100%), showing residual tumor in 6 cases (30%) & removal of the intracanalicular part under endoscopic vision in 2 cases (10%) Endoscopes provided more information to evaluate the tumor and neurovascular relationship than what was possible with microscope alone se mentioned by Mohamed A. El Beltagy et al[16] in their study.

Most common complication was 3rd nerve palsy (8.89%) among the study subjects. Cerebrospinal fluid leak, delay of auditory brainstem response and intratumoral hematoma was found in one subject each. Mortality was reported among 6.67% of the subjects after the final followup. Neurovascular injuries have been reported during endoscope-assisted procedures. For example, the oculomotor nerve within the free edge of the tentorium can be touched by the shaft of the endoscope, especially when placed through the carotid-oculomotor triangle. The facial nerve should also be well monitored in CPA approaches to avoid injuries that may even require nerve suturing[20].

In a study by Akio Morita et al[19], they encountered cerebrospinal fluid leaks in three patients. Walid Ali et al[15] in their study reported 3rd nerve palsy in 2 cases (10 %). 2 case died (one case Lt vestibular schwannoma old age died due to chest infection & the second case craniopharyngioma young age died two days after surgery perhaps due to thalamic insult). These findings are approximately similar to the present study.

There are still a number of difficulties in using endoscopes during microneurosurgery, including:

1) Neurosurgeons are not used to using endoscopes or video-guided surgery,
2) Bimanual surgical procedures cannot be achieved when holding a scope with one hand,
3) No information immediately around the endoscope is available,
4) Clouding vision by bloody body fluid, and
5) Insufficient development of endoscopic equipment.

To overcome such technical barriers, the endoscope should be used as frequently as possible in the initial phase of the procedure by the surgical team so that they become familiar with the preparation and use of endoscopes. Also, an endoscopic procedure should be practiced with cadaveric or virtual models. To perform sophisticated bimanual procedures under

endoscopic view, there needs to be an easily maneuverable endoscopic holding device that can be quickly fixed and released. When the endoscope is used to assist routine microsurgery, the microscope should be equipped with a picture-in-picture device so that the surrounding neurovascular structures are not damaged when the instruments under the endoscope are inserted or manipulated. Also, irrigating suction can solve the problem of cloudy vision simply.

CONCLUSION

Although, the endoscope as a visual tool had solved many of the disadvantages of the microscope, it still can see only from its tip with lack of backward or sideways vision which makes it risky to move the endoscope in the operative field. From here came the idea to combine the characteristics of both tools in one procedure to complement each other through the application of the endoscope into the field under direct vision of microscope "endoscope-assisted technique".

Through our experience, we confirmed that the endoscope is a useful tool to be used in the routine microsurgery, not only in the specific small craniotomy approaches. Simultaneous or tandem endoscopic and microscopic approaches may have the potential for better functional outcomes through better visualization and preservation of vital structures in corners that are hidden from the microscope.

To gain the most benefit from endoscopes, we should use endoscopes further in precisely selected approaches and develop more efficient surgical instruments and safer surgical approaches to manipulate instruments freely.

REFERENCES

1. Landis SH, Murray T, Bolden S, Wingo PA. Cancer statistics. CA Cancer J Clin 1998;8:6–29.
2. Nelson DJ, McDonald JV, Lapham LW, Qazi R, Rubin P. Central nervous system tumors. In: Rubin P, eds. Clinical Oncology. A Multidisciplinary Approach for Physicians and Students. 7th ed. Philadelphia: WB Saunders Company; 1993.
3. Black P, Wen P. Clinical, imaging and laboratory diagnosis of brain tumors. In: Kaye A, Laws E, eds. Brain Tumors. New York: Churchill Livingstone; 1995.
4. Louis DN, Oghaki H, Wiestler OD, et al. WHO classification of tumors of the CNS. Lyon 2007: 12-18.
5. Röntgen WC. On a new kind of rays. Sci 1896;3(59):227–231.
6. Matson GB, Weiner MW. MR spectroscopy in vivo: principles, animal studies and clinical applications. In: Stark DD, Bradley WG, eds. MagnReson Imaging St. Louis: Mosby;1988:201–228.
7. Arle JE, Morriss C, Wang ZJ, Zimmerman RA, Phillips PG, Sutton LN. Prediction of posterior fossa tumor type in children by means of magnetic resonance image properties, spectroscopy, and neural networks. J Neurosurg 1997;86:755–761.
8. Arnold D, Shoubridge E, Villemure J, Feindel W. Proton and phosphorus magnetic resonance spectroscopy of human astrocytomas in vivo. Preliminary observations on tumor grading. NMR Biomed 1990;3:184–189.
9. Barany M, Langer BG, Glick RP, Venkatasubramanian PN, Wilbur AC, Spigos DG. In vivo H-1 spectroscopy in humans at 1.5 T. Radiol 1988;167:839–844.
10. Bruhn H, Frahm J, Gyngell M, et al. Noninvasive differentiation of tumors with use of localized H-1 MR spectroscopy in vivo: initial experience in patients with cerebral tumors. Radiol 1989;172:541–548.
11. Cappabianca P, Cavallo LM, Colao A, De Divitiis E. Surgical complications associated with the endoscopic endonasal transsphenoidal approach for pituitary adenomas. J. Neurosurg. 2002, 97, 293–298.
12. Castelnuovo P, Lepera D, Turri-Zanoni M, Battaglia P, Villaret A.B, Bignami M, Nicolai P, Dallan I. Quality of life following endoscopic endonasal resection of anterior skull base cancers: Clinical article. J. Neurosurg. JNS 2013, 119, 1401–1409.
13. Marcus HJ, Cundy TP, Hughes-Hallett A, Yang GZ, Darzi A, Nandi, D. Endoscopic and keyhole endoscope-assisted neurosurgical approaches: A qualitative survey on technical challenges and technological solutions. Br. J. Neurosurg. 2014, 28, 606–610.
14. Schebesch K-M, Doenitz C, Höhne J, Haj A, Schmidt NO. Endoscopic Assistance in the Deep and Narrow Spaces of the Brain—Microscopic Tumor Surgery Supported by the New Micro-Inspection Tool QEVO®.Front. Surg.2021; 8:648853.
15. Ali W, Alaghory I, Ghannam OE. Endoscopic Assisted Microscopic Skull Base Surgery. The Egyptian Journal of Hospital Medicine 2018;72 (8):5034-5038.
16. El Beltagy MA, Atteya MM. Benefits of endoscope-assisted microsurgery in the management of pediatric brain tumors. Neurosurgical Focus. 2021;50(1):E7.
17. Fries G, Perneczky A. Endoscope-assisted brain surgery: Part 2. Analysis of 380 procedures. Neurosurgery 1998;42:226–231.
18. Jho HD. Endoscopic microscopic transpedicular thoracic discectomy. Technical note. J Neurosurg 1997;87:125–129.
19. Morita A, Shin M, Sekhar LN, Kirino T. Endoscopic microneurosurgery: usefulness and cost-effectiveness in the consecutive experience of 210 patients. Neurosurgery. 2006;58(2):315-21.
20. Hori T, Okada Y, Maruyama T, et al. Endoscope-controlled removal of intrameatal vestibular schwannomas. Minim Invasive Neurosurg. 2006;49(1):25–29.