Section: ENT

Original Research Article

RETROSPECTIVE STUDY ON ENDOSCOPIC TRANSSPHENOIDAL RESECTION OF PITUITARY TUMORS

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Received *: 20/06/2025*
Received in revised form *: 04/08/2025*
Accepted *: 28/08/2025*

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DOI: 10.70034/ijmedph.2025.4.314

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (4); 1749-1754

ABSTRACT

Background: Pituitary adenomas constitute a frequently encountered category of intracranial tumors which may result in debilitating visual problems, cephalgia, and endocrine dysfunctions. The traditional microscopic approach has now been replaced by the endoscopic transsphenoidal approach because of its better clinical outcomes and reduced complications. This new technique provides both better panoramic visualization and a less invasive approach to the sella. **Objectives:** 1. Assess the degree of tumor resection through endoscopic transsphenoidal surgery. 2. Evaluate postoperative complications like cerebrospinal fluid leak and diabetes insipidus. 3. Analyze change in visual and hormonal status after surgery.

Materials and Methods: This study was carried out in a tertiary care teaching hospital in India from April 2021 to March 2025, covering a retrospective observational period. The study population included adults aged 18 and over who underwent endoscopic transsphenoidal resection of pituitary adenomas and who had comprehensive clinical, radiological, and follow up records. Those with records of treatment by microscopic or transcranial approaches were excluded as well as those with incomplete records. Symptoms pre and post- surgery, tumor features, radiology results, complications, and surgical results were documented. All patients had a lumbar drain placed prior to surgery (removed postoperatively on day 6), nasal packing (removed on post operative day 5) and reconstruction which included fat and fascia lata graft, Hadad flap or middle turbinate flap with adhesive tissue glue.

Results: A total of twenty-five patients were enrolled reporting an average tumor size of 28.1 mm. 40% showed some form of cavernous sinus invasion, and 48% had functioning tumors. Gross total resection was attained in 88% of the participants. Visual improvement was noted in 76% of the participants who were previously visually impaired. Hormonal improvements were seen in 40% of patients, however, 16% of patients showed a decline in these markers. Most strikingly, no patients demonstrated a CSF leak postoperatively. 8% of patients developed permanent DI. Patients with a tumor >30 mm frequently experienced complications such as residual disease, incomplete tumor resection, and worse hormonal and radiological outcomes compared to patients with smaller tumors.

Conclusion: Pituitary tumor resection using endoscopic transsphenoidal technique is associated with high rates of resection and minimal risk. Tumor invasiveness particularly with involvement of the cavernous sinus significantly impacts the rate of surgical success. In majority of patients favorable outcomes were reported when operated upon by a well-coordinated multidisciplinary team using the appropriate technique.

Keywords: Diabetes Insipidus, Endoscopy, Pituitary Neoplasms, Transsphenoidal Surgery.

INTRODUCTION

Pituitary adenomas represent the commonest form of intracranial neoplasms that present with symptoms like visual impairment, headaches and hormonal imbalances. Symptomatic or hormonally active tumors typically require surgical resection, with the transsphenoidal approach being the preferred method due to its minimally invasive access to the sellar region.[1]

The twenty-first century has witnessed a replacement of the traditional microscopic approach with an endonasal endoscopic transsphenoidal approach. Guided by the endoscope's unparalleled panoramic visualization and angled optics, it also provides easier access to the parasellar and suprasellar extensions which facilitates safer and more complete tumor resections while minimizing tissue trauma to surrounding structures.[2]

From the perspective of otorhinolaryngology, the approach improves reach through the nasal corridor while better preserving nasal structures. This is associated with significantly reduced sinonasal morbidity. Several studies comparing the use of endoscopy versus conventional microscopy reported at least equal, if not better, outcomes in visual recovery and tumor resection using endoscopic techniques.[3]

Further development of endoscopic techniques for pituitary surgery with the evolution of the binostril technique has enhanced control and manoeuvrability over surgical instruments by expanding the working space within the nasal cavity. Enhanced ergonomics such as these facilitate precise tumor excision and reconstruction within very narrow corridors.[4]

While initial reports raised concerns regarding complications such as cerebrospinal fluid (CSF) leaks and diabetes insipidus (DI) recent studies show that skilled multidisciplinary teams having experience in endoscopic techniques incur far less complications than those associated with more traditional methods.[5] Significantly, this technique has been shown to work for even large and giant adenomas. Cavernous sinus and suprasellar regions can also be accessed more thoroughly with endoscopy, thereby enhancing the surgical potential for the more difficult cases while maintaining safety.[6]

The improvement of preoperative visual deficits with the endoscopic technique has been stronger than with the microscopic approach which is most likely due to better optic chiasma decompression.[7] This further proves the effectiveness of transsphenoidal approach particularly for patients with tumors situated around critical visual structures.

It is well-known fact that the learning curve for endoscopic transsphenoidal surgery is more demanding than that for the microscopic approaches. However, there is a growing body of literature demonstrating that surgical finesse improves with a higher number of cases and a well-defined training framework leading to lower complication rates and better outcomes supported by temporal evidence.[9] Castaño-Leon et al. (2020),[10] reinforced this approach with a propensity score-matched comparison to microsurgery and showed better results with endoscopic surgery even in higher-risk patient groups.

This retrospective study seeks to analyze the institutional experience related to the endoscopic transsphenoidal approach for pituitary adenoma surgery. The outcome measures included the degree of resection achieved, the visual and hormonal outcomes, complications and reconstruction considerations.

Objectives

1. To evaluate the extent of tumor resection achieved through endoscopic transsphenoidal surgery for pituitary tumors.
2. To assess postoperative complications such as cerebrospinal fluid (CSF) leak and diabetes insipidus.
3. To analyze changes in visual and hormonal status following surgery.

MATERIALS AND METHODS

The goal of this retrospective observational study was to assess the surgical outcomes and complications associated with endoscopic transsphenoidal surgery for pituitary adenomas performed at a tertiary care teaching hospital. The patient cohort for this study comprised individuals who had surgery between April 2021 and March 2025.

Being an observational study, there were no randomization or sample size calculation processes undertaken. All adult patients (aged 18 years and above) diagnosed with pituitary adenomas, whether functioning or non-functioning and who had undergone endoscopic transsphenoidal resection during the study period were included in this study. Only cases with full documentation, including preoperative and postoperative hormone levels and imaging data were included in the study.

Exclusion criteria included patients with a history of undergoing pituitary surgery whether by microscopic or transcranially, those classified as biopsy only, recurrent tumors or cases with incomplete medical records and follow up data.

Following Institutional Ethics Committee approval, detailed review of medical records was performed. The information retrieved included age and sex, presenting symptoms, hormonal profile, pertinent imaging (especially MRI), intraoperative findings, extent of resection and complications such as CSF leak, diabetes insipidus, and hypopituitarism.

Postoperative CT was evaluated for gross total, subtotal or partial resection. Collectively, the visual and hormonal outcomes were assessed based on follow-up data.

In all cases, preoperative lumbar drains were inserted and removed on postoperative day 6. Nasal packing

was removed on postoperative day 5. Sellar reconstruction was performed by employing fat, fascia lata and Hadad flap in 22 patients, a middle turbinate flap was used in 3 patients and lastly tissue glue was applied as part of the surgical closure.

All clinical and surgical information was entered into proformas for analysis. Outcomes were assessed based on the degree of resection, symptom relief, and complication rates.

RESULTS

In the cohort of 25 patients, headaches were the most frequent presenting symptom, noted in 80% of cases. Headache was major complaint in 92.3% of females and 66.7% of males suggesting females predominate in this subset. Visual symptoms were noted in 68% of all patients and showed almost equal gender distribution with females at 69.2% and males at 66.7%. In striking contrast, hormonal symptoms exhibited a pronounced sexual dimorphism and was recorded in 92.3% of females and only 16.7% of males. Examined by age group, headaches were least common in the younger than 35 years (0%) and most common among those aged 55-64 as well as 65 years and over, where both groups reported headache in all cases (100%). This trend suggests that the likelihood of headache increases with age. The same trend was noted for visual disturbances, which included the 55-64 age group (83.3%), 35-44 (75%) as well as the youngest group (<35) who showed no cases.

The youngest age cohort displayed no hormonal symptoms, but these symptoms increased progressively with age, impacting 100% of patients over 55 and only 25% of those between 35-44. As a whole, older patients tend to present with greater symptomatology, particularly females who were more likely to exhibit hormonal changes, headaches, and visual disturbances. (Table 1)

Table 1: Symptoms by Gender and Age Group (n = 25)

Variable	Category	Headache		Visual Disturbances		Hormonal Symptoms	
		Yes	No	Yes	No	Yes	No
Sex	Female (n=13)	12	1	9	4	12	1
	Male (n=12)	8	4	8	4	2	10
Age Group	<35 (n=1)	0	1	0	1	0	1
	35–44 (n=8)	7	1	6	2	2	6
	45–54 (n=9)	6	3	5	4	5	4
	55–64 (n=6)	6	0	5	1	6	0
	≥65 (n=1)	1	0	1	0	1	0
Total (n=25)		**20**	**5**	**17**	**8**	**14**	**11**

The average tumor size among the 25 patients was 28.1 mm (SD ±8.5 mm), ranging from 14 mm to 41 mm, indicating considerable variability. Cavernous sinus invasion was observed in 10 cases (40%) suggesting aggressive parasellar extension. Functioning pituitary adenomas were seen in 48% of patients (n=12), while 52% (n=13) had non-functioning tumors. Visual disturbances were reported in 68% (n=17), likely due to suprasellar extension affecting the optic chiasma. (Table 2, Figure 1).

Table 2: Tumor and Radiological Characteristics (n = 25)

Parameter	Value
Tumor size	**28.1 ± 8.5 mm** (range 14–41 mm)
Cavernous-sinus invasion	Yes 10 (40 %) · No 15 (60 %)
Functioning tumor	Yes 12 (48 %) · No 13 (52 %)
Visual disturbance	Yes 17 (68 %) · No 8 (32 %)

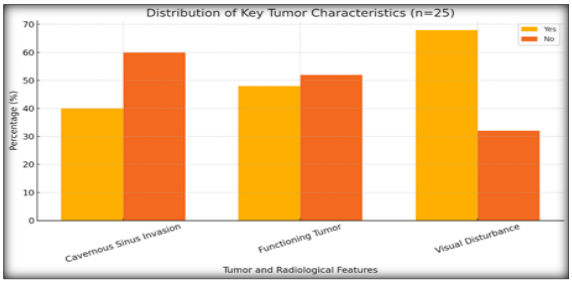

Figure 1: Distribution of tumor characteristics in studied cases

Patients experienced headaches in 80% of all cases, which exacerbated in older cohorts, becoming pervasive among patients 55 years and older. Visual disturbances, which are seen in 68% of cases, followed a parallel trend where people less than 35 years of age did not have any of these issues, but those 65 years and older did have them. Hormonal symptoms were noted in 56% of the subjects, all of the patients greater than or equal to 55 years of age had endocrine symptoms while only 25% of the 35 to 44-year age group had them. It can thereby be concluded that older patients tend to come forth with multiple symptoms perhaps owing to considerable, aggressive, or functional tumors. (Table 3)

Table 3: Age Group vs Clinical Features

Age Group	Headache (Yes)	Visual Disturbance (Yes)	Hormonal Symptoms (Yes)	Total Patients
<35	0	0	0	1
35–44	7	6	2	8
45–54	6	5	5	9
55–64	6	5	6	6
≥65	1	1	1	1
Total	20	17	14	25

Younger patients also did not have a macroadenoma exceeding 20 mm if they were under 35 years old. Patients in the 35-44 and 45-54 age brackets included some small (10-20 mm) and medium (21-30 mm) adenomas with three cases each. The 45-54 group also showed four tumors in the 31-40 mm range, indicating some level of advancement. The 55-64 age group had a marked increase in mean tumor diameter in five out of six tumors in the 31-40 mm range. This indicates a trend leading to larger lesions as patients age. The lone giant adenoma (>40 mm) was only seen in the ≥65 age group (Table 4).

Table 4: Age Group vs Tumor Size Group

Age Group	>40 mm	10–20 mm	21–30 mm	31–40 mm	Total Patients
<35	0	1	0	0	1
35–44	0	3	4	1	8
45–54	0	3	2	4	9
55–64	0	0	1	5	6
≥65	1	0	0	0	1
Total	1	7	7	10	25

As tumors increase in size, more advanced clinical features tend to be present. The single patient who had a tumor exceeding 40 mm possessed a hormonally active tumor with invasion into the cavernous sinus and underwent subtotal resection. Postoperatively this patient suffered from permanent diabetes insipidus (DI) as well as hypopituitarism indicating a surgically complicated and multifaceted postoperative course. Within the group of 31–40 mm tumors (n=10), 7 patients showed signs of cavernous sinus invasion, and of the 10, 8 had functioning tumors demonstrating increasingly higher biological aggressiveness. Even with difficult tumor characteristics, gross total resection was accomplished in 8 of these 10 patients, with only 2 requiring subtotal resection. There were no CSF leaks in any patient suggesting that meticulous reconstruction techniques were utilized. Compared to this, tumors ≤30 mm were more likely to be completely resected, were associated with fewer complications (Table 5).

Table 5: Tumor Size Group vs Key Clinical and Surgical Variables

Variable	Category	>40 mm	10–20 mm	21–30 mm	31–40 mm	Total
Cavernous Invasion	Yes	1	0	2	7	10
	No	0	7	5	3	15
Functioning Tumor	Yes	1	1	2	8	12
	No	0	6	5	2	13
Resection Extent	Gross Total	0	7	7	8	22
	Subtotal	1	0	0	2	3
	Partial	0	0	0	0	0
CSF Leak	Yes	0	0	0	0	0
	No	1	7	7	10	25
DI	Permanent	1	0	0	1	2
	Transient	0	0	2	4	6
	No	0	7	5	5	17
Hypopituitarism	Yes	1	0	2	7	10
	No	0	7	5	3	15

Results were strikingly different in relation to the size of the tumors. Within the >40 mm group, the sole patient showed no improvement in vision, had a worse hormonal profile, displayed a CT consistent with residual tumor, and ultimately passed away—indicative of poor prognosis. Within the 31–40 mm tumors, although most patients (6/10) demonstrated some visual improvement alongside better or stable hormonal outcomes, 3 had tumor recurrence while 4 had residual tumors; overall, this reflected rather mixed outcomes irrespective of the size. In contrast to the 10-30 mm, these small tumors seemed to be associated with better prognosis; the majority showed no MRI evidence of tumor residue (12/14), had stable clinical status at follow-up (14/14), and 8 out of 14 patients demonstrated improvement in hormonal levels (Table 6).

Table 6: Tumor Size Group vs Outcomes

Variable	Category	>40 mm	10–20 mm	21–30 mm	31–40 mm	Total
Visual Gain	Yes	0	1	6	6	13
	No	1	0	0	3	4
	NA	0	6	1	1	8
Hormonal Outcome	Improved	0	2	5	3	10
	No Change	0	0	2	4	6
	Worsened	1	0	0	3	4
	NA	0	5	0	0	5
MRI Outcome	No Residue	0	7	5	1	13
	Minimal	0	0	2	5	7
	Residual	1	0	0	4	5
Final Status	Stable	0	7	7	6	20
	Recurrence	0	0	0	3	3
	Deceased	1	0	0	0	1
	Lost to FU	0	0	0	1	1

DISCUSSION

The current investigation demonstrates that complete resection was achieved in 88% of patients, with the rest undergoing subtotal or partial resection. This is in agreement with Guvenc et al [11] who reported similar resection rates for endoscopic and retro-auricular microscopic approaches, although he pointed out that endoscopic visualization helped greatly with anatomical orientation and thus allowed for safer maximal resection in cases of invasive or large tumors.

With regards to the patients' visual disturbances, our results are comparable with those from Sheehan et al [12] as they reported that 76% of their participants who suffered from visual issues, improved postoperatively. Sheehan's observations of greater visual recovery in patients who underwent endoscopic trans-nasal as opposed to sublabial transseptal transverse were likely due to better optic chiasma decompression owing to improved access to the optic chiasma.

In our sample, the overall hormonal results were unique because 40% of the cohort marked an improvement while 16% marked a worsening of their condition. This is similar to the observations made by Iwai et al [13] who reported that while surgical resection is sometimes beneficial for disturbing hormonal balance, there often exists a long-standing pressure—whether from outside the patient or from overactive hormonal function within—tends to greatly limit the potential for endocrine recovery following surgery.

Our patients experienced NO cerebrospinal fluid leak. Permanent diabetes insipidus was seen in 8% of cases. These rates reinforce the conclusions drawn by Zhu et al [14] in a systematic review that endocrine controlled complications preferred and performed endoscopic approaches over microscope surgery due to the less damages and better hormonal balance achieved with fewer complications.

Moreover, preservation of patient comfort and recovery factors alongside limited nasal morbidity or reoperation aligns with the work of Li et al [15] who highlighted the swift recovery and discharge of patients attributed to the minimally invasive nature of the approach, thus reducing overall discomfort.

These observations aligned with those reported by Phogat et al [16] who noted the significant association of cavernous sinus invasion on incomplete resection attributed to the anatomical constraints and risk to neurovascular structures.

During the four-year study period, the improvement in complication rates and completeness of resection correlated with the learning curve. This has been documented by Uren et al [17] who emphasized the surgical learning curve noting that the outcomes of endoscopic surgery are better with more time and experience from the institution and surgeon.

12% of patients were noted to have tumor residue or recurrence predominantly in patients with tumors less than 30 mm. This supports the systematic review done by Strychowsky et al [18] wherein it was concluded that endoscopic approaches tend to provide better radial clearance and lower rates of residual tumors compared to the traditional microscopic techniques.

In terms of visual outcomes, 76% of patients improved their vision and none were found to have worsening deficits, which parallels the findings by Charalampaki et al [19] who reported the postoperative vision restoration was excellent and morbidity was minimal after endoscopic endonasal removal.

Ultimately, the cumulative shape of the tumor greatly contributed towards defining the overall results. One mortality occurred in a patient with a tumor larger than forty millimeters while patients with smaller lesions, less than thirty millimeters, had improved radiological and hormonal outcomes. This reinforces the results put forth in Castaño-Leon et al. (2020),[20] which demonstrated that with appropriate planning, and technique, endoscopic approaches performed superiorly even in large tumor riskier groups.

CONCLUSION

Pituitary adenomas could be effectively and safely managed through endoscopic transsphenoidal surgery. Nearly all patients had a significant improvement in their vision and in their hormonal profiles. No patient had CSF leak post-operatively. The degree of resection was influenced by the size of the tumor and its invasion into the cavernous sinus. With smaller tumors, hormonal recovery, the rate of

residual lesions, and visual outcomes all improved. These findings support the previously claimed benefits of endoscopic surgery, especially by skilled surgeons which further justifies the technique in properly chosen cases.

Conflict of Interest: None

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