

Original Research

Surgical Outcomes of Endoscopic Transsphenoidal Pituitary Surgery

Mumtaz Ali¹, Ramzan Hussain¹, Hanif Ur Rahman¹, Sajid Razzaq¹, Abdur Raheem², Muhammad Aneeq¹, Jabir Shah¹, Yasir Ashraf¹

¹Ali Institute of Neurosciences, Irfan General Hospital, Peshawar

²Department of Neurosurgery, Lady Reading Hospital, Peshawar – Pakistan

ABSTRACT

Objective: This study aims to evaluate the surgical outcomes of the endoscopic transsphenoidal approach in terms of safety, effectiveness, intraoperative and postoperative complications, and symptom relief.

Materials & Methods: This study was conducted at Ali Institute of Neurosciences, Irfan General Hospital, Peshawar. Patients diagnosed with pituitary adenomas (confirmed via MRI) and treated with the endoscopic transsphenoidal approach were included. Demographic data was collected, and outcomes were assessed post-surgery and at 6-month follow-up.

Results: The majority of participants were male (65%) with a mean age of 31 years. Most patients presented with headaches (76%) and visual disturbances (60%), while 53% had hormonal imbalances. Post-surgery 100% reported headache relief 87% showed visual improvements measured by Humphrey perimeter and visual acuity tests, and 97% had favorable endocrinological outcomes based on hormonal profile assessments.

Conclusion: When treating pituitary adenoma, the endoscopic transsphenoidal approach is a safe and effective surgical technique associated with improved patient outcomes, symptom relief, and satisfaction. Complications of the procedure include intercavernous sinus hemorrhage, diabetes insipidus, hypopituitarism, and CSF leakage.

Keywords: Adenoma, Endoscopic trans-sphenoidal, Endoscopic Surgery, Pituitary Adenoma.

Corresponding Author: Yasir Ashraf

Ali Institute of Neurosciences

Irfan General Hospital, Peshawar

Email: yasirkhattak099@gmail.com

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INTRODUCTION

Pituitary adenomas are common benign tumors of the brain and cause significant symptoms due to hormonal imbalances (mostly functional pituitary adenomas) and their mass effect on surrounding structures (the majority of nonfunctional pituitary adenomas). Pituitary adenomas are common benign tumors of the human brain, comprising approximately 15% of all intracranial tumors.¹ The peak age of diagnosis for pituitary adenomas is

between 30 and 60 years.² These tumors cause significant symptoms due to hormonal imbalances (functional pituitary adenomas) and their mass effect on surrounding structures (mostly nonfunctional pituitary adenomas). Pituitary macroadenomas tend to grow beyond the sella boundaries, invading the suprasellar, parasellar, infrasellar, and retrosellar compartments.³ Upward tumor growth can compress the optic chiasm, leading to visual field defects and impairments.⁴ Posterior extension may compress the pituitary stalk, disrupting the passage of excitatory hypothalamic factors and resulting in hypopituitarism. Parasellar expansion can lead to cavernous sinus compression, affecting cranial nerves such as the oculomotor (CN III), trochlear (CN IV), trigeminal (V1–V2), and abducens (CN VI) nerves, causing a range of symptoms depending on the nerve involved. Tumor extension into the temporal lobe may also result in seizures.^{5–6} Anteriorly, the tumor can extend to and impact the frontal lobe. In rare cases, pituitary adenomas invade the third ventricle by disrupting the sellar diaphragm, leading to hydrocephalus.⁷ Additionally, these tumors can cause cerebrospinal fluid (CSF) rhinorrhea when they extend into the sphenoid sinus.^{8–9} Functional pituitary adenomas affect the gland's hormonal secretion system and account for 48% to 78% of all pituitary adenomas. They can manifest as various endocrine syndromes, including acromegalic syndrome (GH-secreting tumors), Cushing's syndrome (ACTH-secreting tumors), galactorrhea and amenorrhea (prolactin-secreting tumors), and thyrotoxic hyperthyroidism.¹⁰ A severe clinical condition known as pituitary apoplexy arises due to hemorrhage or infarction and is characterized by sudden, severe headaches, cranial nerve palsies, nausea, vomiting, visual deterioration, and, in some cases, loss of consciousness.¹¹ Several factors contribute to increased morbidity and mortality in pituitary adenomas, including advanced age at onset, tumor cell type, invasive behavior, and the extent of tumor progression. Early diagnosis of

small tumors significantly improves treatment success rates.^{12–13} The diagnosis of pituitary adenomas is based on clinical, radiological, and histological findings. Functional pituitary adenomas causing endocrine syndromes such as Cushing's and acromegaly are primarily treated with noninvasive medications that suppress hormone secretion but do not eradicate the tumor. Surgical resection remains the treatment of choice for most pituitary adenomas.¹⁴ Prolactinomas, which constitute 40% to 66% of all pituitary adenomas, are initially treated with dopamine agonists such as bromocriptine and cabergoline. However, for nonfunctional pituitary adenomas, transsphenoidal surgery is the preferred treatment, followed by medical interventions. Cases resistant to surgery and medication are managed with radiotherapy, including external beam therapy using a linear accelerator (LINAC) and gamma knife radiation. Radiotherapy is also used as a postoperative adjuvant therapy alongside chemotherapy.¹⁵ The transsphenoidal approach for pituitary tumor removal has been performed since the early 1980s. The introduction of the endoscopic transnasal transsphenoidal technique has significantly improved visualization and provides a panoramic view, allowing for a safer and more direct approach to the sella. This advancement has resulted in shorter hospital stays and greater patient comfort.¹⁶ This prospective study included a total of 48 patients who underwent endoscopic transsphenoidal surgery at Ali Institute of Neurosciences, Irfan General Hospital, Peshawar. The study evaluates the surgical outcomes of the endoscopic transsphenoidal approach based on clinical and radiological findings, including tumor resection, postoperative complications, and overall patient recovery.

MATERIALS AND METHODS

Study Setting

A prospective observational study was conducted

at Ali Institute of Neurosciences, Irfan General Hospital, Peshawar, from the records of the past 2 years (January 2019 to December 2021) with the consent of the ethical committee of the Hospital.

Study Design

A total of 48 patients including 31 males and 17 females were included in the study and underwent endoscopic transsphenoidal surgery. The outcomes of endoscopic transsphenoidal surgery were recorded based on clinical, endocrinological, and radiological findings.

Inclusion Criteria

This study included those patients who were diagnosed with pituitary adenomas on MRI and treated via the endoscopic transsphenoidal approach. A comprehensive neurological examination was performed, including assessments of sensory and motor functions, reflexes, and cranial nerves. Preoperative investigations included MRI scans and visual field tests (perimetry). Patients with pituitary macroadenomas (>1 cm) causing compression, pressure symptoms, or hormonal imbalances unresponsive to medical therapy, as well as those with apoplexy, were selected for surgical intervention.

Exclusion Criteria

Patients who declined to share their data or underwent surgical procedures other than the transsphenoidal approach (e.g., the pterional approach) were excluded.

Outcome Measures

The primary outcome measures included radiological and clinical parameters. Clinical outcomes were assessed based on visual and endocrinological recovery, while tumor consistency and method of resection were recorded as factors influencing surgical outcomes.

Radiological and clinical evaluations were conducted at six-month follow-up intervals.

Visual Outcomes

Visual outcomes were evaluated using visual acuity tests and perimetry (visual field tests). Additionally, the fundoscopic examination was performed, as a normal fundus indicates an intact optic nerve and excellent clinical recovery, whereas atrophic changes in the fundus were associated with poor visual outcomes.

Endocrinological Outcomes

Endocrinological outcomes were assessed by measuring hormonal levels, including insulin-like growth factor 1 (IGF-1), growth hormone (GH), glucose tolerance test, thyroid-stimulating hormone (TSH), prolactin, and cortisol levels.

Radiological Outcomes

Radiological evaluation was conducted through preoperative and postoperative imaging. An independent radiologist, blinded to the clinical details, assessed tumor size and calculated the ratio of suprasellar volume to infrasellar volume for objective analysis of tumor resection.

Surgical Procedure

Under general anesthesia with endotracheal intubation, the patient was placed in the supine position. The head and body were positioned in a standard manner, with the neck tilted 10 degrees toward the surgeon's side. Nasal packing was performed using cotton soaked in lignocaine and adrenaline (1:400 dilution). The endoscopic setup was prepared by assembling different segments of the endoscope, ensuring proper zooming and anatomical orientation. All patients initially underwent surgery via the right nostril using a mononostril approach, which was later converted into a binostril approach when required. A small incision (1.5 cm) was made approximately above

the superior border of the nasal conchae at the level of the middle turbinate. The keel of the sphenoid sinus was dissected by elevating the mucosa from the opposite side. Posterior septectomy was performed, followed by sphenoidectomy, in which the anterior wall of the sphenoid sinus was removed. The sinus mucosa was excised, and optic carotid and paraclival impressions were identified between the two optic impressions. A wide exposure of the sella was achieved by removing its anterior wall. A C-shaped durotomy was performed, and an initial tumor biopsy was taken, followed by dissection using ring curettes. Under direct visualization, the tumor was removed using the curettage and suction method until the dura of the medial wall of the cavernous sinus and the arachnoid bulge became visible. The endoscope was introduced into the tumor bed as needed to ensure complete resection. Once total tumor evacuation was achieved, irrigation with saline was performed, followed by packing and reconstruction of the sellar floor. A Foley catheter balloon was placed at the sellar floor to provide a tamponade effect, which was removed on postoperative day one. Postoperatively, the patient was monitored in the intensive care unit (ICU) for 24 to 48 hours under close observation.

Statistical Analysis

Data analysis was performed using SPSS version 26. Mean and standard deviation were used for numerical data, while frequency and percentages were reported for categorical data.

RESULTS

Patient Characteristics

The study included a total of 48 patients, the majority of the participants were males 31 (65%) as compared to females 17 (35%). The mean age was reported to be 31 years. Among 48 patients, all underwent endoscopic transsphenoidal surgery. Postoperative recovery and complications were assessed based on clinical and radiological findings. Postoperative recovery and complications were assessed based on clinical and radiological findings, as shown in Table 1.

Table 1: Comparison of Surgical Outcomes.

Variable	Endoscopic (%)
Surgery for Pituitary Adenoma	48
Headache Relief	100% (48/48)
Visual Improvement	87% (42/48)
Post-op CSF Leak	5% (2/48)
Diabetes Insipidus	5% (2/48)
Intercavernous Sinus Bleeding	2% (1/48)

Clinical Presentations

As shown in Table 2, the majority of patients (76%) presented with headaches, followed by visual disturbances (60%). More than half (53%) experienced symptoms due to hormonal imbalances. Amenorrhea was observed in 19% (9 out of 48) of the total study population and 53% (9 out of 17) of female patients, acromegaly (5%), Cushing disease (14%), and pan-hypopituitarism (8%).

Table 2: Clinical Presentations of patients with pituitary adenoma.

Clinical Presentation	Frequency/Percentages	
Headache	(76%)	
Visual disturbances	(60%)	
Symptoms of hormonal imbalances	Amenorrhea	19% (9 out of 48 total patients), 53% (9 out of 17 female patients)
	Acromegaly	(5%)
	Cushing disease	(14%)
	Pan Hypopituitarism	(8%)

Pre-operative Characteristics

Table 3 shows, the pre-operative maximum size of the tumor was reported to be 14 to 46mm with the mean value of 25.5mm evident by MRI brain. In (24%) of patients the adenoma was limited to the sella, (55%) had extension into the suprasellar area and 21% had intracavernous extension.

Post-Operative and Follow-up Outcomes

Figure 4 demonstrates that headache relief was achieved in 100% of patients. Visual improvement was observed in 87% of patients who underwent endoscopic surgery. Additionally, post-operative complications were minimal, with CSF leakage occurring in 5% of cases and diabetes insipidus reported in 5% of cases.

Post-Operative Complications

The post-operative complications observed in the study were: CSF leak in (5%) of patients, diabetes insipidus (5%), Intercavernous sinus bleeding (2%), and hypopituitarism (2%) with no mortality as shown in Table 5.

DISCUSSION

The endoscopic transsphenoidal approach is widely used for pituitary adenoma surgery. Our study findings suggest that endoscopic transsphenoidal surgery shows efficacy in terms of visual improvement, symptom relief, and lower postoperative complications. In this study, we observed that the endoscopic approach resulted in better endocrinological recovery and higher visual improvement rates. Current advancements in

Table 3: Pre-operative characteristics of pituitary tumor.

Tumor Characteristics	Frequency/Percentages
Preoperative tumor size	Mean (25.5) Range (14-46mm)
Pituitary adenoma limited to the sellar area	24%
Extension into the suprasellar area	55%
Extension into cavernous sinuses	21%

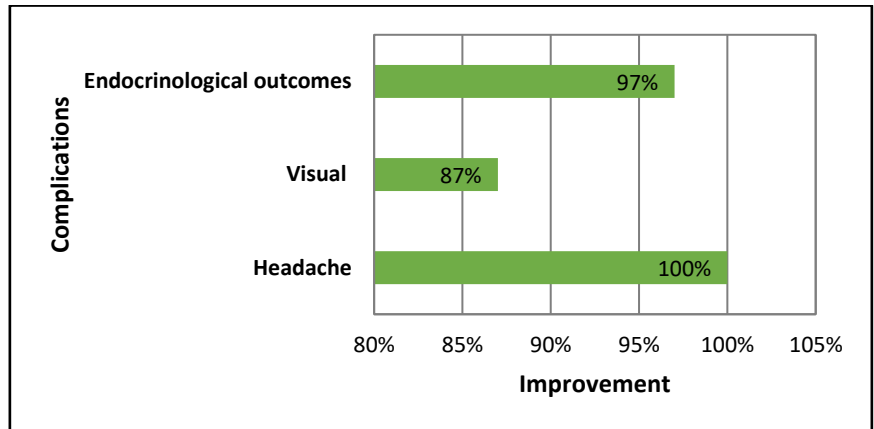


Figure 4: Improvement in Surgical Outcomes.

Table 5: Post-Operative Complications After Endoscopic Transsphenoidal Surgery.

Post-Operative Complications	Frequency/Percentages
CSF Leak	5%
Diabetes Insipidus	5%
Intercavernous sinus bleeding	2%
Hypopituitarism	2%

endoscopic transsphenoidal approaches have significantly reduced the need for transcranial procedures, which are now required in only 5-10% of pituitary adenoma cases.¹⁷ The transsphenoidal approach is the preferred treatment choice for pituitary adenomas it is not without complications. These complications may be classified into local, systemic, neurological, and endocrine categories. Potential risks include damage to the internal carotid artery, leading to stroke or fatal hemorrhage, postoperative cerebrospinal fluid (CSF) leakage, infections such as meningitis, and visual and neurological deficits involving cranial nerves. Anterior pituitary insufficiency is another

long-term complication associated with this approach.¹⁸ The complications reported in our study included CSF leakage in 5% of patients, diabetes insipidus in 5%, intercavernous sinus bleeding in 2%, and hypopituitarism in 2%. No cases of severe complications or mortality were recorded, demonstrating the relative safety of the procedure. For the morphological evaluation of pituitary adenomas magnetic resonance imaging (MRI) with contrast in axial coronal and sagittal planes remains the imaging modality of choice.¹⁹ Hardy-Wilson and Knosp classifications are commonly used in MRI assessments. The Hardy-Wilson classification categorizes tumor extension based on sellar destruction, while the Knosp classification evaluates parasellar invasion by assessing the relationship between the tumor and the cavernous sinus.²⁰ In our study, MRI evaluation using the Knosp classification revealed a higher frequency of Knosp grade 2 (60%) and Knosp grade 3 (40%). The extent of tumor resection (EOR) is influenced by various factors, including tumor consistency, size, extent of invasion, and biological behavior. EOR can range from gross total resection (complete tumor excision) to near-total (>90%), subtotal (80%), or partial resection (<80%).²¹ Tumor consistency plays a crucial role in determining the resection technique. Soft tumors are more amenable to complete resection via suction instruments, whereas fibrous or firm tumors pose greater surgical challenges.²² In our study, the decision regarding the extent of resection was made by the neurosurgical team based on intraoperative tumor consistency, size, and extension. In our study, 53% of female patients presented with amenorrhea, accounting for 19% of the total study population. Prolactinomas constitute 40-66% of all pituitary adenomas, and the first-line treatment for these tumors is dopamine agonist therapy. For nonfunctional pituitary adenomas, transsphenoidal surgery remains the preferred treatment, followed by medical management when necessary. Cases resistant to surgery and medication are managed

with radiotherapy, including external beam therapy using a linear accelerator (LINAC) and gamma knife radiation. Radiotherapy is also utilized as an adjuvant postoperative treatment alongside chemotherapy.¹⁵ Our study included patients with functional adenomas resistant to medical management, demonstrating excellent endocrinological outcomes, with 97% of patients experiencing symptom resolution post-surgery. Temozolomide has also been reported as an effective treatment for aggressive pituitary adenomas and pituitary carcinomas.²³ Although the transsphenoidal approach is highly effective for pituitary adenoma resection, there are specific cases where a transcranial approach is preferred. Indications for a transcranial approach include lateral tumor extensions beyond the cavernous sinus, giant tumors, failed previous transsphenoidal surgeries, multilobulated tumors, asymmetric invasion into the anterior fossa, and fibrous tumors.¹⁴ Our study focused on the surgical outcomes of the endoscopic transsphenoidal approach. While our study evaluates the effectiveness of endoscopic transsphenoidal surgery, future larger randomized controlled trials are needed to validate these findings.

LIMITATION

The limitation of this study is the small sample size (n=48). Future studies with larger sample sizes are recommended to further validate these findings.

CONCLUSION

When treating pituitary adenoma, the endoscopic transsphenoidal approach is a safe and effective surgical technique associated with improved patient outcomes, symptom relief, and satisfaction. Complications of the procedure include intercavernous sinus hemorrhage, diabetes insipidus, hypopituitarism, and CSF leakage.

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Additional Information

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Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Data Availability: Data will be made available upon an adequate request by the principal author (yasirkhattak099@gmail.com)

AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Mumtaz Ali, Ramzan Hussain & Yasir Ashraf	1. Study design and methodology.
2.	Mumtaz Ali & Yasir Ashraf	2. Paper writing.
3.	Muhammad Aneeq & Jabir Shah	3. Data collection and calculations.
4.	Yasir Ashraf, Hanif Ur Rahman & Ramzan Hussain	4. Analysis of data and interpretation of results.
5.	Hanif Ur Rahman, Yasir Ashraf & Jabir Shah	5. Literature review and referencing.
6.	Abdur Raheem & Hanif Ur Rehman	6. Editing and quality insurer.