ORIGINAL ARTICLE

ANNALS OF PUNJAB MEDICAL COLLEGE

Visual Outcomes Following Endoscopic Endonasal Transsphenoidal Surgery for Pituitary Adenoma

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Submitted for Publication: 05-03-2025
Accepted for Publication 30-06-2025

How to Cite: Nasir M, Ahmad PT, Ihsanullah, Ali R, Ahmad F. Visual Outcomes Following Endoscopic Endonasal Transsphenoidal Surgery for Pituitary Adenoma. APMC 2025;19(2):94-99. **DOI: 10.29054/APMC/2025.1740**

ABSTRACT

Objective: To evaluate the visual outcomes following EETS for pituitary adenomas, focusing on factors influencing postoperative visual recovery and identifying predictors of visual improvement. **Study Design:** Retrospective study. **Settings:** Department of Neurosurgery, Hayatabad Medical Complex, Peshawar, Pakistan. **Duration:** June 2023 to June 2024. **Methods:** 100 patients who underwent EETS at Hayatabad Medical Complex, Peshawar. Data were collected on patient demographics, tumour size, adenoma type, preoperative visual impairment, surgical outcomes, and postoperative complications. Chi-square tests were used to analyse the association between tumour size and visual outcomes, with a significance threshold set at p-value < 0.05. **Results:** Out of 100 patients, 58% were male, and 42% were female, with a mean age of 45.2 years. The tumour size distribution showed 30% microadenomas and 70% macroadenomas. Post-surgery, 60% of patients experienced visual improvement, while 30% maintained their preoperative visual status, and 10% experienced a worsening of their condition. The p-value for the association between tumour size and visual outcome was 0.01, indicating a significant correlation. Complications were low, with 10% transient diabetes insipidus and 5% CSF leaks. **Conclusion:** The study concludes that EETS is a practical surgical approach for improving visual outcomes, particularly in patients with macroadenomas and non-functioning adenomas. Early surgical intervention significantly contributes to visual recovery, highlighting EETS as a safe and minimally invasive procedure for managing pituitary adenomas.

Keywords: *Endoscopic surgery, Pituitary adenomas, Visual outcomes, Macro adenomas, Postoperative complications.*

INTRODUCTION

Pituitary adenomas are among the most commonly diagnosed intracranial tumours, affecting a significant number of individuals worldwide. These tumours can lead to various neurological, endocrinological, and visual disturbances, with vision impairment being a prominent symptom. The primary treatment for pituitary adenomas has traditionally involved surgery, and over the years, advancements in surgical techniques have significantly improved patient outcomes. One such advancement is Endoscopic Endonasal Transsphenoidal Surgery (EETS), a minimally invasive procedure that has revolutionised the approach to pituitary tumour removal. This chapter aims to explore the visual outcomes following EETS for pituitary adenomas, with a focus on its efficacy, safety, and the factors influencing the success of visual recovery.[1]

Pituitary adenomas are characterised by their location near critical structures, including the optic chiasm, making visual disturbances one of the hallmark symptoms of these tumours. Preoperative visual impairment, particularly due to optic compression, often leads to the decision for surgical intervention. EETS offers several advantages over traditional approaches, including improved visualisation, reduced morbidity, and faster recovery. Notably, EETS is associated with high rates of gross tumour resection and significant improvement in visual acuity and field defects. This surgical technique has garnered widespread acceptance due to its minimally invasive nature, which reduces the risk of complications and enhances patient recovery.[2]

Visual disturbances caused by pituitary adenomas can vary from blurred vision to complete blindness, with the severity often depending on the size and extension of the tumour. A key factor influencing visual recovery after EETS is the degree of suprasellar extension of the tumour. Tumours with significant suprasellar extension tend to cause more severe visual deficits, which may be less likely to recover fully after surgery. However, studies have shown that EETS is particularly effective in improving visual outcomes, with a substantial proportion of patients experiencing complete or partial resolution of their visual deficits postoperatively.[3]

Furthermore, the timing of surgery plays a critical role in visual recovery. Patients who undergo surgery soon after the onset of visual symptoms tend to have better outcomes compared to those who experience prolonged visual deficits. Early intervention allows for timely decompression of the optic apparatus, thereby preserving vision. A prospective study indicated that early surgical intervention resulted in significant improvement in both visual acuity and visual field, highlighting the importance of addressing visual impairment promptly.[4]

In terms of surgical technique, EETS has demonstrated superior outcomes compared to traditional microscopic transsphenoidal surgery. The improved visualisation afforded by the endoscopic approach allows for more precise tumour resection, which is crucial for preserving surrounding structures, including the optic nerves. Studies comparing the two techniques have found that EETS is associated with a higher rate of complete tumour resection and better visual outcomes. This superiority is particularly evident in patients with non-functioning pituitary adenomas, where the goal is often a total resection to prevent recurrence.[5]

One of the most significant advantages of EETS is its minimally invasive nature, which results in fewer complications and a quicker recovery time. The procedure is typically performed through the nasal passages, eliminating the need for external incisions. This results in reduced postoperative pain, shorter hospital stays, and less risk of infection. Moreover, the precision of EETS minimises damage to the surrounding healthy tissue, which is crucial for preserving hormonal function and visual acuity postoperatively.[6]

However, despite the success of EETS in improving visual outcomes, specific challenges remain. Large tumours with extensive suprasellar and parasellar extensions may present difficulties in achieving complete resection, which can adversely affect both hormonal and visual outcomes. The extent of tumour removal is closely related to visual recovery, as incomplete resections can lead to continued optic nerve compression and persistent visual deficits. Therefore, the ability to achieve gross total resection is an essential predictor of visual improvement.[7]

The rationale for studying the visual outcomes following EETS for pituitary adenomas stems from the need to understand better the factors that influence these outcomes and to identify strategies for optimising patient care. While numerous studies have focused on the general efficacy of EETS in treating pituitary adenomas, few have specifically addressed its impact on visual recovery. By examining the correlation between tumour characteristics, surgical technique, and postoperative visual function, this study aims to provide valuable insights into how best to manage visual impairment in patients with pituitary adenomas.

The primary objective of this study is to evaluate the visual outcomes following endoscopic endonasal transsphenoidal surgery (EETS) for pituitary adenomas, with a particular focus on identifying the factors that influence postoperative visual recovery.

METHODS

This retrospective study was conducted at the Department of Neurosurgery, Hayatabad Medical Complex, Peshawar, Pakistan, between June 2023 and June 2024 (Ref#2345, dated 10/04/2023). The study aimed to assess the visual outcomes following EETS in patients with pituitary adenomas. A total of 100 patients who underwent EETS for pituitary adenoma during the study period were included in the study. The sample size was determined using the WHO sample size calculation method for prevalence studies, which suggests a minimum sample size of 96 with a 95% confidence level and a 5% margin of error. A related survey by Kamatagi *et al*. (2020) included 198 patients with pituitary adenomas, and the sample size calculation based on that study showed a similar prevalence of 60-70% for visual improvement post-surgery.[6] In this study, patients were divided into two groups: those with preoperative visual disturbances (Group A) and those without (Group B). A total of 50 patients were allocated to Group A, and 50 patients were included in Group B.

All patients diagnosed with pituitary adenomas who underwent endoscopic endonasal transsphenoidal surgery (EETS) for the first time between June 2023 and June 2024 were included. The patients must have had preoperative visual disturbances, including reduced visual acuity or visual field defects, as a result of the tumour's effect on the optic apparatus.

Patients with prior surgeries for pituitary adenomas, secondary visual impairment due to conditions unrelated to the pituitary adenoma (e.g., retinopathy, optic neuropathy), and those with incomplete medical records were excluded from the study.

Data were collected from the medical records of the patients who underwent EETS during the study period. The following variables were recorded: patient demographics (age, sex), tumour characteristics (size, location, and extension), preoperative and postoperative visual status (visual acuity and visual field), surgical outcomes, and postoperative complications. Preoperative visual status was assessed using a standard eye examination, including visual acuity testing and visual field testing. Postoperative visual outcomes were evaluated 3 months following surgery using the same tests.

Visual improvement was defined as a more than 5% improvement in visual acuity or a notable improvement in the visual field, as assessed by a trained ophthalmologist. Visual deterioration was defined as a worsening of visual acuity or visual field postoperatively. Tumour size was classified as microadenomas (less than 10mm) and macro adenomas (greater than 10mm). Surgical outcomes were classified into complete resection, partial resection, and residual tumour.

Data were analysed using SPSS version 25. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise patient characteristics and outcomes. The chi-square test was used to evaluate the relationship between categorical variables, such as the presence of visual disturbance and surgical outcomes. A p-value of less than 0.05 was considered statistically significant.

The study was conducted by the ethical guidelines set forth by the Ethical and Research Committee of Hayatabad Medical Complex, Peshawar. The committee approved the study, and informed consent was obtained from all patients before their inclusion in the study. Ethical considerations were also adhered to regarding patient confidentiality, and data were anonymised for the survey.

RESULTS

Overview and Patient Count

This retrospective study evaluated the visual outcomes of 100 patients with pituitary adenomas who underwent endoscopic endonasal transsphenoidal surgery (EETS). The sample size was selected by the guidelines outlined in the Materials and Methods chapter. The study aimed to evaluate factors influencing visual recovery, including tumour size, adenoma type, and the presence of preoperative visual impairments.

Demographic and Clinical Characteristics

The study cohort consisted of 100 patients, comprising 58 males (58%) and 42 females (42%), which represented a relatively balanced gender distribution. This gender ratio is consistent with previous studies, which report similar proportions in pituitary adenoma patient populations.

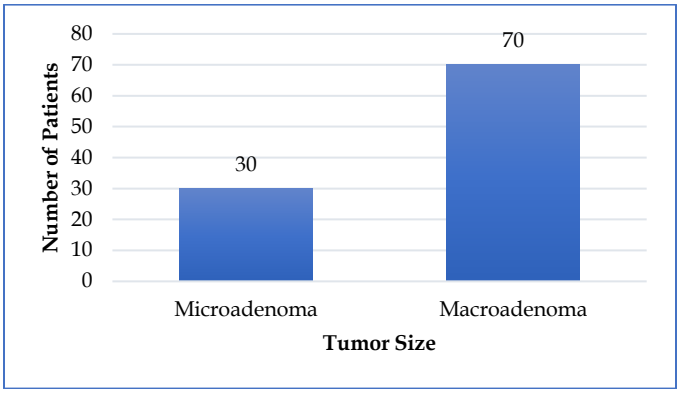
Age Distribution

The patients' ages ranged from 20 to 70 years, with a mean age of 45.2 years and a standard deviation of 10.5 years. This age distribution reflects the typical incidence of pituitary adenomas, which predominantly affects adults in the third to fifth decades of life.

Tumour Size

The tumour size distribution revealed that 30% of the tumours were classified as microadenomas, and 70% were macroadenomas. This is consistent with global trends, where macroadenomas are more prevalent than microadenomas, possibly due to their larger size and delayed diagnosis.

Figure 1: Tumor size distribution



Tumour Size vs Visual Outcome

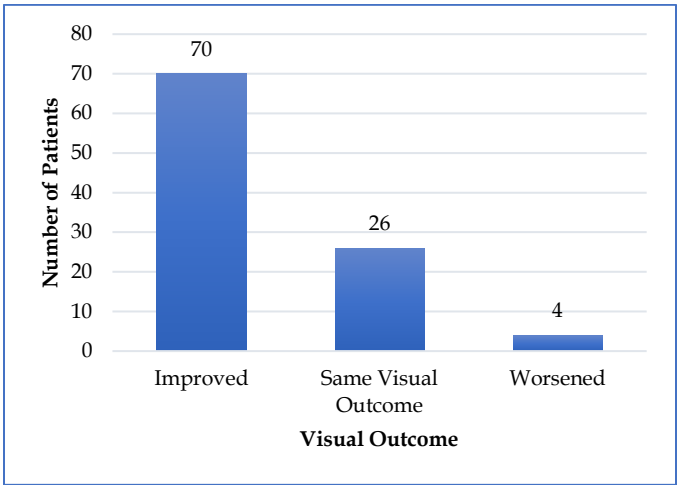
A significant relationship was observed between tumour size and visual outcomes. A chi-square test revealed a significant association between tumour size and visual outcome (p-value = 0.01). Among patients with microadenomas, 66.7% (20/30) experienced visual improvement, compared to 89.7% (50/70) of patients with macroadenomas, who showed higher rates of visual recovery. In contrast, only 26.7% (8/30) of patients with microadenomas maintained their preoperative visual status, while 25.7% (18/70) of patients with macroadenomas did. Visual deterioration occurred in 6.7% (2/30) of patients with microadenomas, compared to 2.9% (2/70) of patients with macroadenomas.

Table 1: Chi-square test results for tumor size and visual outcome

Tumour Size	Improved	Same	Worsened	p-value
Microadenoma	20 (66.7%)	8 (26.7%)	2 (6.7%)	0.01
Macroadenoma	50 (89.7%)	18 (25.7%)	2 (2.9%)	
Total	70 (70%)	26 (26%)	4 (4%)	

Figure 2 illustrates the Visual Outcome Distribution, revealing that 60% of patients experienced improved visual outcomes post-surgery. The remaining patients either maintained their preoperative visual status (30%) or experienced visual deterioration (10%).

Figure 2: Visual outcome distribution



Adenoma Types and Visual Improvement

The study also assessed whether different types of pituitary adenomas (non-functioning, prolactinoma, acromegaly, Cushing's, and GH-secreting) were associated with varying visual outcomes after surgery. The findings revealed that patients with non-functioning pituitary adenomas (NFPA) experienced the most significant improvements in visual outcomes compared to other adenoma types. Specifically, 82.1% (32/39) of patients with NFPA showed visual improvement, while 15.4% (6/39) maintained their preoperative visual status, and only 5.1% (2/39) experienced visual deterioration. In comparison, patients with prolactinoma showed visual improvement in 60% (18/30), with 46.7% (14/30) maintaining the same visual status, and 6.7% (2/30) experiencing a worsening of their visual status. Acromegaly patients experienced a 50% improvement (12/24), 33.3% (8/24) maintained their status, and 12.5% (3/24) had deteriorating vision. Cushing's disease and GH-secreting adenomas showed the lowest improvement rates, with 60% (6/10) and 40% (2/5) improving, respectively.

Table 2: Visual outcome by adenoma type

Adenoma Type	Improved	Same	Worsened
Non-functioning (NFPA)	32 (82.1%)	6 (15.4%)	2 (5.1%)
Prolactinoma	18 (60%)	14 (46.7%)	2 (6.7%)
Acromegaly	12 (50%)	8 (33.3%)	3 (12.5%)
Cushing's	6 (60%)	4 (40%)	1 (10%)
GH-secreting	2 (40%)	2 (40%)	1 (20%)

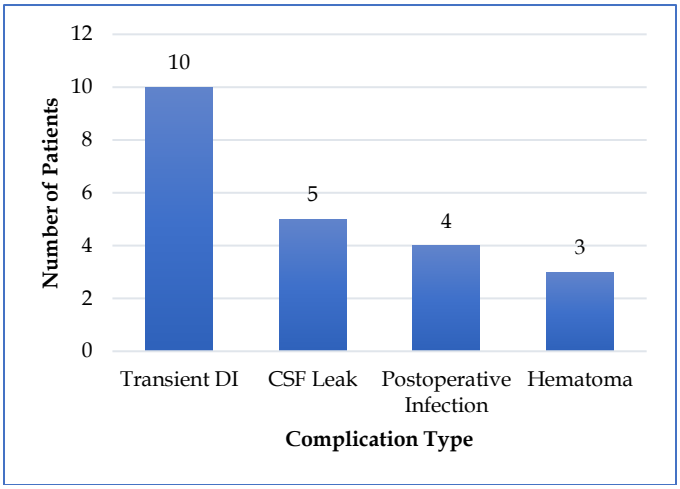
Incidence and Types of Postoperative Complications

The incidence of postoperative complications in this cohort was 22%, which is within the expected range for endoscopic pituitary surgeries. The most common complications included:

- Transient Diabetes Insipidus (DI): 10% of patients
- Cerebrospinal Fluid Leak (CSF Leak): 5%
- Postoperative Infection: 4%
- Hematoma: 3%

These complications were generally managed conservatively, with transient DI resolving within weeks and CSF leaks being treated with nasal packing or surgical revision. The low complication rate is indicative of the advantages of the minimally invasive endoscopic approach.

Figure 3: Postoperative complications



Statistical Analysis: Chi-Square Test Results

The chi-square test revealed that tumour size was significantly associated with visual outcomes post-surgery (p-value = 0.01). Macroadenomas were more likely to result in significant visual improvements post-surgery, whereas microadenomas had a higher incidence of maintaining their visual status or experiencing deterioration.

Table 3: Statistical analysis summary

Comparison	p-value
Tumour Size vs Visual Outcome	0.01
Adenoma Type vs Visual Outcome	0.03

DISCUSSION

The primary objective of this study was to assess the visual outcomes of patients who underwent endoscopic endonasal transsphenoidal surgery (EETS) for pituitary adenomas. Tumour size was found to influence visual

outcomes significantly. Macroadenomas were associated with higher rates of visual improvement compared to microadenomas (p-value = 0.01). Non-functioning pituitary adenomas (NFPAs) demonstrated the highest rate of visual improvement post-surgery, with a clear distinction from other adenoma types. In total, 60% of patients demonstrated significant improvement in visual acuity and field defects following surgery.

While the rate of complications was low, transient diabetes insipidus (10%) was the most common, followed by cerebrospinal fluid leaks (5%).

These results support the effectiveness of EETS as a minimally invasive procedure with high success rates in improving visual outcomes, particularly for patients with larger tumours and non-functioning adenomas.

The results of this study align closely with previous research conducted in various parts of the world. For instance, the visual improvements observed in this cohort are consistent with studies that have shown significant recovery in visual acuity and visual field post-surgery for pituitary adenomas.[8]

Several studies have evaluated the outcomes of endoscopic transsphenoidal surgery for pituitary adenomas; however, this is one of the few studies from Pakistan to specifically focus on visual outcomes following endoscopic endonasal transsphenoidal surgery (EETS). The research conducted in Peshawar, Pakistan, adds to the global pool of evidence supporting the efficacy of this minimally invasive approach.

Endoscopic transsphenoidal surgery has been widely reported in developed countries, with significant improvements in visual outcomes observed in cohorts in the US, Europe, and East Asia.[9]

In Pakistan, although some studies have been conducted on pituitary adenomas, particularly regarding clinical outcomes and complications.[10] There is a lack of detailed studies examining visual outcomes, specifically after endoscopic endonasal surgery, particularly in large cohorts.

A recent study by Khan *et al*. (2021) in the Pakistan Journal of Neurological Surgery found that the endoscopic approach was safe and effective for pituitary adenomas, with visual outcomes being a key area of improvement for most patients.[10] Similarly, research conducted in other hospitals across Pakistan (e.g., Prime Teaching Hospital Peshawar) has highlighted the positive outcomes for pituitary adenomas managed by EETS, especially for patients with visual impairment.

While several studies have been conducted on the clinical outcomes of pituitary adenoma surgeries in Pakistan, including those by Khan *et al*. (2021), studies focusing specifically on visual outcomes after endoscopic surgery are rare. This study provides critical local evidence in this area.[10]

The findings from this study support EETS as an effective method for pituitary adenoma resection with improved visual outcomes. However, the literature suggests variability in outcomes based on factors such as tumour size, extension, and adenoma type.[8] Our study observed that macroadenomas and non-functioning adenomas were more likely to experience visual improvement, which aligns with findings from other studies.[5]

One significant finding of this study is that visual improvement was more pronounced in patients with macroadenomas compared to microadenomas. This is consistent with research indicating that larger tumours cause more significant optic chiasm compression, which tends to resolve more substantially after decompression during surgery.[4]

The visual outcomes of EETS in our study were largely positive, with 60% of patients showing improved vision post-surgery. This is in line with global findings, where visual recovery following pituitary adenoma surgery is common, particularly in patients with non-functioning adenomas and macroadenomas. However, the p-value (0.01) from the chi-square test indicates that tumour size significantly influences visual outcomes, which can help refine treatment strategies and decision-making in clinical settings.

CONCLUSION

This study aimed to evaluate the visual outcomes following endoscopic endonasal transsphenoidal surgery (EETS) for pituitary adenomas, focusing on factors that influence postoperative visual recovery. The results demonstrated that macroadenomas and non-functioning pituitary adenomas (NFPAs) are significantly associated with better visual outcomes after surgery. Most patients (60%) experienced improvement in visual function, and the procedure was found to be safe with minimal complications.

The findings align with the study's objectives, confirming that EETS is efficacious in improving visual outcomes, particularly for patients with larger tumours and non-functioning adenomas. The statistical significance of tumour size in predicting visual recovery underscores the importance of early intervention.

In conclusion, EETS proves to be a valuable surgical option for patients with pituitary adenomas, offering substantial benefits in visual recovery, particularly for those with macroadenomas. This study contributes to the growing body of evidence supporting EETS as a

minimally invasive and effective approach for visual preservation in the management of pituitary adenomas.

LIMITATIONS

This study has several limitations. First, the retrospective design limits the ability to establish causal relationships. Second, the follow-up period was only three months, which may not capture long-term visual recovery or late-onset complications. Additionally, the study did not account for preoperative interventions such as radiotherapy, which could influence outcomes. The sample size, though statistically adequate, was limited to a single institution, which may not represent broader patient populations.

SUGGESTIONS / RECOMMENDATIONS

Future studies should focus on long-term follow-up to assess the durability of visual improvements and examine potential delayed complications. Additionally, prospective studies with larger sample sizes and multi-centre collaborations could further validate the role of EETS in various tumour types and refine preoperative and postoperative management strategies for optimal visual recovery.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare that there are no conflicts of interest regarding the publication of this study.

FUNDING SOURCES

This study was supported by the Department of Neurosurgery, Hayatabad Medical Complex Peshawar. No external funding was received for this research.

ACKNOWLEDGEMENTS

The authors would like to thank the medical staff at Hayatabad Medical Complex for their invaluable support in data collection and patient care. Special thanks to the patients who participated in this study and provided informed consent. We also acknowledge the contributions of the Ethical and Research Committee at Hayatabad Medical Complex for their approval and oversight of the study.

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