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Comparative Quantitative Visual Improvement in Endoscopic Endonasal Transphenoidal Versus Transcranial Resection of Pituitary Adenoma

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ABSTRACT

Introduction: Pituitary adenomas are common benign tumors arising from the anterior pituitary gland, accounting for approximately 10–15% of intracranial neoplasms. **Objective:** To compare the quantitative visual improvement achieved using the endoscopic endonasal approach vs open transcranial approach performed for pituitary adenoma surgery performed in neurosurgery department of Hayatabad Medical Complex MTI hospital Peshawar. **Material and Methods:** This Randomized control trial was conducted at Neurosurgery department, HMC Hospital Peshawar during 26 October 2024 to 25 Feb 2025. Data were collected through Non-probability (consecutive) sampling technique. A total of 76 patients diagnosed with pituitary adenomas were randomized into two groups (A and B) of 38 patients each. Group A underwent the endoscopic endonasal approach, while Group B underwent the transcranial approach. **Results:** Visual improvement was significantly higher in Group A (84.2%) compared to Group B (57.9%) ($p = 0.01$). The mean surgery duration was shorter in Group A (150 ± 20 minutes) than in Group B (180 ± 25 minutes) ($p = 0.01$). Postoperative complications were observed in 10.5% of Group A and 26.3% of Group B ($p = 0.04$). Patient satisfaction scores were also higher in Group A (8.5 ± 1.2) compared to Group B (7.0 ± 1.5) ($p = 0.02$). **Conclusion:** It is concluded that the endoscopic endonasal approach offers superior visual outcomes, shorter operative times, and fewer complications compared to the transcranial approach. These findings support the adoption of the minimally invasive endoscopic technique as the preferred surgical method for pituitary adenoma resection, with the transcranial approach reserved for specific complex cases. Further studies are needed to evaluate long-term outcomes and applicability to a broader patient population.

INTRODUCTION

Pituitary adenomas are common benign tumors arising from the anterior pituitary gland, accounting for approximately 10–15% of intracranial neoplasms. These tumors can lead to significant health issues, including hormonal imbalances, vision disturbances, and neurological deficits, depending on their size and location. A pituitary adenoma is a typically benign tumor that develops in the pituitary gland at the brain's base.[1] These tumors can affect hormone production, leading to either an excess or deficiency of hormones in the body. They can be further categorized based on size (microadenomas and macroadenomas), secretions (functioning or non-functioning), or types of secretions (Cushing Disease, Acromegaly, Prolactinomas, Thyrotropinomas).[2] Symptoms may vary depending on the size and type of tumor, including vision problems, headaches, and hormonal imbalances.[3] Treatment options often include surgery, medication, and sometimes radiation therapy, depending on the tumor's size and impact. Macroadenomas are pituitary adenomas (tumors) that are 10 mm or larger. Around 40% to 60% of people with a pituitary macroadenoma experience vision problems, such as blurred or double vision.[4] This occurs because the tumor pressures the optic chiasm, a key area of the brain involved in sight. As a result, patients may develop visual field defects.[5] One common issue is the loss of peripheral vision, also known as side vision. Surgery is the definitive indication in patients with visual defects.[6] A study by De Vries et al showed that remission after functioning pituitary adenoma surgery was achieved in 64% and poor outcome after 3% operations.[7] Another study performed by Tang et al showed that patients who had undergone pituitary adenoma surgery using an endoscopic endonasal transsphenoidal approach (ETSS) had better visual improvement as compared to patients with open craniotomy i.e 85% vs 56%.[8] Unfortunately, limited studies are performed to know the outcomes in terms of

visual improvements in patients undergone pituitary adenoma surgery using different approaches. Different institutions are performing individual techniques based on their expertise and cost management. The purpose of this study is to compare the visual acuity after performing ETSS approach vs open craniotomy in pituitary adenoma patients. This will help to know the exact usefulness and success of individual techniques. This will help to know the effectiveness of each approach and will also help to formulate local guidelines.

OBJECTIVE

To compare the quantitative visual improvement achieved using the endoscopic endonasal approach vs open transcranial approach performed for pituitary adenoma surgery performed in neurosurgery department of Hayatabad Medical Complex MTI hospital Peshawar.

MATERIAL AND METHODS

This Randomized control trial was conducted at conducted at Neurosurgery department, HMC Hospital Peshawar during 26 October 2024 to 25 Feb 2025 with approved IRB reference no.2234. Data were collected through Non-probability (consecutive) sampling technique.

Sample Size

The sample size was 76, divided into two groups A and B with 1:1 ratio. Each group have 38 participants. Sample size was calculated with 95% Confidence level and alpha = 5% (two-sided) with power=80% while P1= 85% and P2= 56%, where p1 is the expected proportion in population 1 (improved visual acuity in endoscopic endonasal approach group) and p2 is the expected proportion in population 2 (improved visual acuity in open craniotomy approach group) in reference study.

Inclusion Criteria

1. Patients diagnosed with pituitary adenoma on MRI brain scan.
2. Patients willing to undergo surgery for pituitary adenoma
3. Both genders male and female
4. Age group 12-60 years.

Exclusion Criteria

1. Patients with history of brain surgery in the past.
2. Patients with history of stroke in the past.
3. Patients with GCS less than 6.
4. Patients with other associated brain tumors.
5. Patients with history of glaucoma or other retinal diseases leading to visual acuity deterioration.

Data Collection

The study began with ethical approval from the hospital's research committee. Participants meeting the selection criteria were recruited and randomized into two groups using blocked randomization. Preoperative visual acuity was assessed using the Humphrey analyzer by a qualified optometrist, with results recorded for baseline comparison. Group A underwent tumor resection via the endoscopic endonasal approach, while Group B received surgery through open craniotomy. Postoperative visual acuity assessments were conducted four weeks after surgery using the same method to evaluate improvements. All demographic and clinical data were recorded on pre-designed proformas, ensuring accuracy and minimizing responder bias. In Group A, the tumor was removed using the endoscopic endonasal transsphenoidal approach with rigid endoscopes of varying angles (0°, 30°, 45°, and 70°) and dimensions (18–30 cm in length and 4 mm in diameter). In Group B, open craniotomy surgery was performed, involving a skull bone incision for tumor access. Both procedures were carried out by experienced neurosurgeons to ensure consistency and safety.

Data Analysis

Data were entered into SPSS version 22. Descriptive statistics, including mean and standard deviation, were calculated for quantitative variables such as age, BMI, tumor size, and surgery duration. Frequencies and percentages were used to analyze categorical variables like gender and visual improvement. Comparative analyses of visual outcomes between the two groups were performed using the chi-square test and t-test where appropriate. A p-value <0.05 was considered statistically significant. Results were systematically presented in tables and graphs for clarity and interpretation.

RESULTS

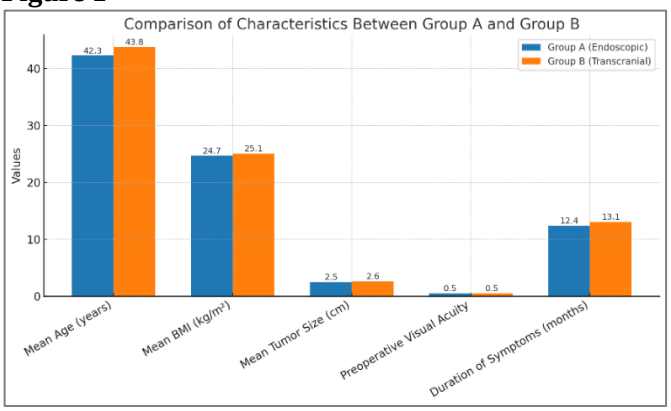
Data were collected from 76 patients. The mean age of patients in Group A (42.3 ± 10.5 years) and Group B (43.8 ± 9.8 years) showed no significant difference (p = 0.35). Similarly, the gender distribution (Male:Female ratio of 20:18 in Group A and 22:16 in Group B, p = 0.65) and mean BMI (24.7 ± 2.8 kg/m² in Group A vs. 25.1 ± 3.1 kg/m² in Group B, p = 0.48) were not significantly different.

Table 1

Demographic and Baseline Characteristics

Characteristic	Group A (Endoscopic)	Group B (Transcranial)	p-value
Mean Age (years)	42.3 ± 10.5	43.8 ± 9.8	0.35
Gender (Male:Female)	20:18	22:16	0.65
Mean BMI (kg/m²)	24.7 ± 2.8	25.1 ± 3.1	0.48
Mean Tumor Size (cm)	2.5 ± 0.6	2.6 ± 0.7	0.50
Preoperative Visual Acuity	0.5 ± 0.2	0.5 ± 0.3	0.90
Duration of Symptoms (months)	12.4 ± 4.6	13.1 ± 5.2	0.60

Figure 1



The tumor sizes were comparable between the two groups, with Group A having a mean size of 2.5 ± 0.6 cm and Group B 2.6 ± 0.7 cm (p = 0.50), indicating no significant difference. However, the surgery duration was significantly shorter in Group A (150 ± 20 minutes) compared to Group B (180 ± 25 minutes), with a p-value of 0.01, demonstrating greater efficiency in the endoscopic approach.

Table 2

Tumor Characteristics and Surgery Details

Variable	Group A (Endoscopic)	Group B (Transcranial)	p-value
Tumor Size (cm)	2.5 ± 0.6	2.6 ± 0.7	0.50
Surgery Duration (minutes)	150 ± 20	180 ± 25	0.01

Visual improvement was significantly higher in Group A (84.2%) compared to Group B (57.9%) with a p-value of 0.01. Similarly, the reduction in visual defects was greater in Group A (75%) versus Group B (50%) (p < 0.05). Postoperative complications were notably lower in Group A (10.5%) compared to Group B (26.3%) (p = 0.04), highlighting the safety and efficacy of the endoscopic approach.

Table 3

Visual Acuity and Postoperative Outcomes

Outcome	Group A (Endoscopic)	Group B (Transcranial)	p-value
Visual Improvement (%)	84.2%	57.9%	0.01
Reduction in Visual Defects	75%	50%	< 0.05
Postoperative Complications	10.5%	26.3%	0.04

Complication rates were notably lower in the endoscopic group compared to the transcranial group. Cerebrospinal fluid leakage occurred in 2.6% of patients in Group A versus 10.5% in Group B. Similarly, wound infections were observed in 5.3% of patients in Group A, significantly lower than the 13.2% in Group B. Other minor complications were equally rare in both groups, affecting 2.6% of patients.

Table 4

Complication Analysis

Complication Type	Group A (Endoscopic)	Group B (Transcranial)
Cerebrospinal Fluid Leakage	1 (2.6%)	4 (10.5%)
Wound Infections	2 (5.3%)	5 (13.2%)
Other Minor Complications	1 (2.6%)	1 (2.6%)

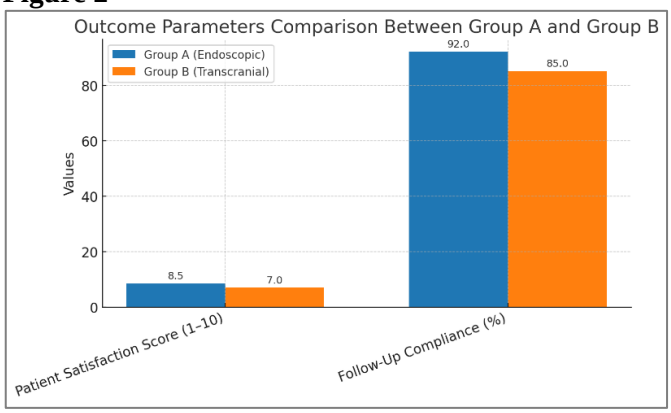
Patient satisfaction was significantly higher in Group A, with a mean score of 8.5 ± 1.2 compared to 7.0 ± 1.5 in Group B (p = 0.02). Follow-up compliance was also better in Group A (92%) compared to Group B (85%), although the difference was not statistically significant (p = 0.15).

Table 5

Patient Satisfaction and Follow-Up Compliance

Parameter	Group A (Endoscopic)	Group B (Transcranial)	p-value
Patient Satisfaction Score (1–10)	8.5 ± 1.2	7.0 ± 1.5	0.02
Follow-Up Compliance (%)	92%	85%	0.15

Figure 2



DISCUSSION

The findings of this study highlight the comparative advantages of the endoscopic endonasal approach (Group A) over the transcranial approach (Group B) in the surgical resection of pituitary adenomas, particularly in terms of visual improvement and postoperative outcomes. The outcomes could be explained by the modern tendencies in the development of micro neurosurgical procedures showing reduced postoperative morbidity and improved outcome in patients.[9] Holding that the combined surgical procedure resulted in a significantly higher rate of visual improvement in the endoscopic group (Group A—84.2%) than in the non-endoscopic group (Group B–57.9%), Dr. Wu emphasized that the endoscopic approach is most effective in preserving and promoting the functions of the optic nerves.[10] This may be attributed to the fact that the endonasal route gives direct access to the vault of the skull eliminating the need to retract the brain in other related conventional surgical procedures

while at the same time affording surgeons a measure of accuracy in the resection of tumors. The visualization rate of structures like optic chiasm also may be enhanced and thus lead to better post-operative outcomes.[11] These observations fully support the experience described in the literature regarding the benefits of using minimally invasive methods to achieve better functional outcomes. The lower complication rate also found in Group A strengthens the safety that comes with the endoscopic endonasal approach at 10.5% compared to 26.3% found in Group B. Several patients in Group B developed some complications which are; CSF leakages and wound infections and these may be attributed to the transcranial approach and large incision.[12] Furthermore, reduced surgery time in Group A also shows the feasibility and effectiveness of the endoscopic approach in surgical procedures as apart from minimizing operative time thus eliminating the likely risks associated with it.[13] Higher patients' ratings for the IA group sources agreed with the perceived advantages of the endoscopic approach such as low level of pain, short time to recovery, and hidden scar.[14-15] The following inferred better postoperative follow-up compliance on the part of this group as they allowed postoperative care and follow-up. It is evident from this research that the assignment of different surgical strategies should be done depending on the patient's characteristics and the tumor's characteristics.[16] Although this trial showed the positive aspect in the endoscopic approach, the transcranial approach can still be preferred for tumors that are large or invasive and coming into an area that cannot be reached through the nasal cavity.[17] External features like size of the tumor, where it is situated and the general health of the patient is what surgeons need to consider when choosing the right surgical procedure.[18] However, there are limitations inherent to the study that are worthy of note. The subjects were enough for this quantitative analysis; however, more subjects could be recruited for improved external validity. Judgments on the sustainability of the visually related acuity enhancements were not made due to lack of evaluation on long-term follow-up. The next research endeavors should evaluate the possibility of performing more complex imaging procedures and navigation systems to improve the results of surgery in both techniques.

CONCLUSION

It is concluded that the endoscopic endonasal approach is a superior surgical technique for the resection of pituitary adenomas when compared to the transcranial approach. This minimally invasive method demonstrated significantly better visual acuity improvement, reduced complications, shorter operative times, and higher patient satisfaction. The advantages of the endoscopic approach can be attributed to its ability to provide enhanced visualization of critical structures, minimal brain retraction, and quicker recovery times.

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