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Original Article

Quantitative Assessment of Visual Field Recovery Following Transspheniodal Pituitary Adenoma Excision and its Time Course

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ABSTRACT

Background: Pituitary adenomas are a significant subset of intracranial tumors, constituting approximately 10-15% of all primary brain tumors. These benign tumors often lead to various clinical symptoms, including hormonal imbalances and visual field defects due to optic chiasm compression. The transsphenoidal approach for pituitary adenoma excision is favored for its minimal invasiveness and favorable outcomes. However, the timeline and extent of visual field recovery post-surgery remain areas of active research.

Objective: This study aimed to quantitatively assess and track visual field recovery in patients following transsphenoidal pituitary adenoma excision and to identify factors influencing the recovery process.

Methods: This descriptive observational study was conducted at the Department of Neurosurgery, Pakistan Institute of Medical Sciences (PIMS), Islamabad, from June 16, 2023, to March 31, 2024. Forty-six consecutive patients, aged 18-70 years, who underwent transsphenoidal pituitary adenoma excision and had documented visual field impairments, were included. Exclusion criteria were previous pituitary surgery, pre-existing visual field abnormalities not attributable to pituitary adenoma, and inability to perform visual field testing. Preoperative visual field measurements were taken within two weeks before surgery using Humphrey visual field testing. Postoperative evaluations were performed immediately after surgery (within 48 hours), and at one month, two months, and three months. Visual field indices, including mean deviation (MD) and pattern standard deviation (PSD), were recorded. Data were analyzed using SPSS version 25, with descriptive statistics for patient demographics and tumor characteristics, and inferential statistics (Student's t-test and chi-square test) for comparing visual field indices.

Results: The study included 23 male and 23 female patients, with a mean age of 52.3 years (SD ± 8.7). Tumor size averaged 2.7 cm (SD ± 0.9). Non-functioning tumors comprised 65.2% of cases. Preoperative hormonal dysfunction was present in 39.1% of patients. Preoperative visual field indices showed a mean MD of -5.2 dB (SD ± 2.1). Visual field improvement was noted postoperatively, with mean MD values of -4.0 dB (SD ± 1.8) at 48 hours, -3.5 dB (SD ± 1.7) at one month, -2.8 dB (SD ± 1.5) at two months, and -2.2 dB (SD ± 1.3) at three months. Endoscopic surgery was performed in 82.6% of cases, with a gross total resection rate of 69.6%. Postoperative complications included CSF leaks (13%) and hypopituitarism (26.1%).

Conclusion: The study demonstrated significant visual field recovery in patients following transsphenoidal pituitary adenoma excision, with notable improvements observed within the first three months post-surgery. These findings support the efficacy of the transsphenoidal approach in improving visual outcomes and highlight the importance of early intervention and comprehensive postoperative monitoring.

Keywords: Pituitary adenoma, transsphenoidal surgery, visual field recovery, Humphrey visual field testing.

INTRODUCTION

Pituitary adenomas account for a substantial fraction of intracranial tumors, representing approximately 10 to 15% of all primary brain tumors (1, 2). These benign neoplasms arise from adenohypophyseal cells in the anterior pituitary gland and manifest a variety of clinical symptoms, including hormonal dysregulation, visual disturbances, and neurological deficits (3, 4). A common and

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potentially debilitating complication of growing adenomas is the visual field defect, which occurs due to compression of the optic chiasm.

Transsphenoidal pituitary adenoma excision has emerged as the preferred surgical approach due to its minimally invasive nature, direct access to the sellar region, and favorable outcomes (6, 7). The primary goals of this surgery are to alleviate symptoms related to the mass effect and to restore endocrine function, but the potential for visual field recovery post-tumor resection is of particular significance to both clinicians and patients (8). The degree and rate of visual field recovery postoperatively are influenced by various factors, including the tumor size, the severity and duration of preoperative visual field impairment, and the extent of surgical resection (9).

Despite the general improvements observed in visual function following surgery, the precise quantification and timeline of visual field recovery remain subjects of ongoing research (10). Quantitative assessments, such as Humphrey visual field testing, provide objective measurements that are essential for tracking changes in visual field deficits over time (11). Understanding the temporal dynamics of visual field recovery post-transsphenoidal pituitary adenoma excision is critical for predicting patient outcomes, guiding clinical decision-making, and refining surgical techniques.

This study aims to quantitatively assess and monitor visual field recovery in 46 patients following transsphenoidal pituitary adenoma excision. By analyzing preoperative and postoperative visual field data at multiple time points, we seek to delineate the pattern and magnitude of visual field improvement and to identify factors that may influence these outcomes. The findings of this research have the potential to enhance patient care by informing clinical decisions, improving prognostic models, and optimizing surgical interventions for individuals undergoing pituitary adenoma excision. Through a comprehensive understanding of visual field recovery, this study strives to contribute valuable insights into the management of pituitary adenomas and their associated visual complications.

MATERIAL AND METHODS

This descriptive observational study was conducted at the Department of Neurosurgery, Pakistan Institute of Medical Sciences (PIMS), Islamabad, from June 16, 2023, to March 31, 2024. The study included 46 consecutive patients, both male and female, aged 18 to 70 years, who underwent transsphenoidal pituitary adenoma excision and had documented visual field impairments. Exclusion criteria were patients who had previously undergone pituitary surgery, those with pre-existing visual field abnormalities not attributable to pituitary adenoma, and patients unable to perform visual field testing.

Preoperative visual field measurements were conducted within two weeks prior to surgery using conventional perimetry procedures, specifically the Humphrey visual field testing. Postoperative visual field evaluations were performed at multiple time intervals, including immediately after surgery (within 48 hours), and subsequently at one month, two months, and three months post-surgery. Visual field examinations were carried out by experienced ophthalmologists or optometrists trained in perimetry procedures, utilizing the Humphrey visual field analyzer. Standardized testing methods such as the 24-2 and 30-2 threshold visual field tests were employed to evaluate visual field abnormalities, with mean deviation (MD) and pattern standard deviation (PSD) recorded for each assessment to determine visual field indices.

The surgical removal of pituitary adenomas was performed by a team of specialized neurosurgeons using a transsphenoidal approach, tailored to the individual anatomical and tumor characteristics of each patient. Both endoscopic and microscopic transsphenoidal techniques were utilized, with the extent of surgical resection determined intraoperatively based on factors such as tumor size, location, and attachment to surrounding structures.

Data collection involved documenting patient demographics, tumor characteristics, and visual field parameters. Ethical approval for the study was obtained from the institutional review board, and all procedures were conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants prior to their inclusion in the study.

Data analysis was performed using SPSS version 25. Descriptive statistics were used to summarize patient demographics, tumor features, and visual field parameters. Inferential statistics included the Student's t-test for comparing continuous data and the chi-square test for categorical data, with a p-value of ≤ 0.05 considered statistically significant.

This comprehensive approach ensured the reliability and validity of the findings, providing valuable insights into the visual field recovery following transsphenoidal pituitary adenoma excision. The study's methodology was designed to facilitate accurate assessment and interpretation of visual field outcomes, contributing to the optimization of surgical and postoperative management for patients with pituitary adenomas (1, 2, 3, 4).

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RESULTS

Table 1: Demographic Characteristics of Study Participants

Characteristic	Number of Patients (n=46)	Frequency (%)
Gender		
Male	23	(50%)
Female	23	(50%)
Age (years), Mean ± SD	52.3 ± 8.7	
18-30	4	(8.7%)
31-40	8	(17.4%)
41-50	12	(26.1%)
51-60	14	(30.4%)
61-70	8	(17.4%)
Comorbidities		
Hypertension	15	(32.6%)
Diabetes Mellitus	10	(21.7%)
Others	8	(17.4%)

Table 2: Tumor Characteristics

Tumor Parameter	Number of Patients (n=46)	Frequency (%)
Tumor Size (cm), Mean ± SD	2.7 ± 0.9	
Range	1.5 - 4.5	
Tumor Type		
Non-functioning	30	(65.2%)
Functioning (Specify)	10	(21.7%)
Mixed	6	(13%)
Preoperative Hormonal Dysfunction		
Yes	18	(39.1%)
No	28	(60.9%)

Table 3: Visual Field Defect Characteristics

Preoperative Visual Field Defect	Number of Patients (n=46)	Frequency (%)
Visual Field Index (e.g., MD, PSD) Mean ± SD	-5.2 ± 2.1 dB	
Range	-9.8 to -1.2 dB	
Severity of Visual Field Defect		
Mild	12	(26.1%)
Moderate	22	(47.8%)
Severe	10	(21.7%)
Blindness	2	(4.4%)

Table 4: Surgical Details and Postoperative Course

Surgical Parameter	Number of Patients (n=46)	Frequency (%)
Surgical Approach		
Endoscopic	38	(82.6%)
Microscopic	8	(17.4%)
Extent of Surgical Resection		
Gross Total	32	(69.6%)
Near Total	10	(21.7%)
Subtotal	4	(8.7%)
Complications		

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CSF Leak	6	(13%)
Hypopituitarism	12	(26.1%)
Others	4	(8.7%)

Table 5: Visual Field Recovery Over Time

Time Point	Visual Field Index (e.g., MD, PSD) Mean ± SD
Preoperative	-5.2 ± 2.1 dB
Immediate Postop (48h)	-4.0 ± 1.8 dB
1 Month	-3.5 ± 1.7 dB
2 Months	-2.8 ± 1.5 dB
3 Months	-2.2 ± 1.3 dB

The demographic characteristics of the study participants revealed an equal distribution of male and female patients, with each gender representing 50% of the total sample (n=23 each). The mean age of the participants was 52.3 years, with a standard deviation of 8.7 years. The age distribution showed that the majority of patients were in the 51-60 year age group, accounting for 30.4% (n=14), followed by those aged 41-50 years at 26.1% (n=12). Younger age groups, specifically 18-30 and 31-40 years, were less represented, comprising 8.7% (n=4) and 17.4% (n=8) of the cohort, respectively. Regarding comorbidities, hypertension was the most prevalent, affecting 32.6% (n=15) of the patients, while diabetes mellitus was present in 21.7% (n=10), and other comorbid conditions were reported by 17.4% (n=8) (Table 1).

Tumor characteristics indicated that the mean tumor size was 2.7 cm, with a standard deviation of 0.9 cm, and the range extended from 1.5 to 4.5 cm. The majority of tumors were non-functioning, constituting 65.2% (n=30) of cases. Functioning tumors, which were further specified, accounted for 21.7% (n=10), while mixed tumors represented 13% (n=6) of the total. Preoperative hormonal dysfunction was noted in 39.1% (n=18) of the patients, whereas 60.9% (n=28) did not exhibit any hormonal abnormalities before surgery (Table 2).

The preoperative visual field defect assessment showed a mean visual field index (MD) of -5.2 dB, with a standard deviation of 2.1 dB, and the range of visual field index values spanned from -9.8 to -1.2 dB. In terms of severity, 26.1% (n=12) of the patients had mild visual field defects, 47.8% (n=22) had moderate defects, and 21.7% (n=10) experienced severe visual field impairments. Notably, blindness was observed in 4.4% (n=2) of the patients (Table 3).

Surgical details indicated that the endoscopic approach was the predominant method, used in 82.6% (n=38) of the cases, while the microscopic approach was employed in 17.4% (n=8). The extent of surgical resection varied, with gross total resection achieved in 69.6% (n=32) of the patients. Near total resection was performed in 21.7% (n=10), and subtotal resection in 8.7% (n=4). Postoperative complications included cerebrospinal fluid (CSF) leaks in 13% (n=6) of patients, hypopituitarism in 26.1% (n=12), and other complications in 8.7% (n=4) (Table 4).

Visual field recovery over time showed a progressive improvement in visual field index values. Preoperatively, the mean visual field index was -5.2 dB. This improved to -4.0 dB within 48 hours postoperatively. Continued improvement was observed at one month (-3.5 dB), two months (-2.8 dB), and three months (-2.2 dB) post-surgery (Table 5). These findings underscore a significant positive trend in visual field recovery following transsphenoidal pituitary adenoma excision, highlighting the efficacy of the surgical intervention and providing valuable insights into the timeline of visual field restoration for affected patients.

DISCUSSION

The demographic characteristics observed in this study, with an equal distribution of gender (23 male [50%] and 23 female [50%] patients), align with previous studies on transsphenoidal pituitary adenoma excision, which also reported an equal representation of male and female patients (12). The average age of participants (52.3 years, SD ± 8.7) is consistent with the age range frequently observed in the literature for patients undergoing surgery for pituitary adenomas, typically falling within the 40 to 60 years range. The majority of participants in this study were within the 41-60 years age range, with 26.1% in the 41-50 years group and 30.4% in the 51-60 years group, mirroring age patterns seen in prior research (13).

Comorbidities, specifically hypertension (32.6%) and diabetes mellitus (21.7%), were commonly observed in patients with pituitary adenomas in this study. These findings align with previous research indicating consistent prevalence rates of these systemic conditions among patients undergoing pituitary adenoma surgery. The significant prevalence of preoperative hormonal dysfunction (39.1%) further corresponds with prior research highlighting the impact of pituitary adenomas on the endocrine system and overall patient well-being (14).

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The majority of tumors in this study (65.2%) were non-functioning, which is consistent with the incidence of non-secreting adenomas in other studies. The comparatively lower percentage of functioning tumors (21.7%) aligns with other research suggesting a higher occurrence of non-functioning adenomas compared to functioning ones (15). Preoperative visual field defects were predominantly moderate (47.8%), with a notable portion categorized as mild (26.1%), severe (21.7%), and blindness (4.4%). These findings align with previous studies on visual outcomes post-pituitary adenoma removal. The high prevalence of endoscopic surgery (82.6%) in this study reflects the growing preference for minimally invasive procedures in pituitary adenoma surgeries, as demonstrated in earlier research (16).

The study generally agreed with previous transsphenoidal pituitary adenoma excision studies regarding patient demographics, tumor characteristics, surgical approaches, and visual outcomes. However, it had several strengths and limitations. One strength was the comprehensive evaluation of visual field recovery at multiple postoperative intervals, providing valuable insights into the timeline of visual field improvement. Additionally, the use of standardized testing methods, such as the Humphrey visual field analyzer, ensured the reliability of visual field measurements.

A limitation of the study was the relatively small sample size, which might have limited the generalizability of the findings. Furthermore, the study did not include long-term follow-up data beyond three months, which could have provided a more comprehensive understanding of the sustained visual outcomes. Another limitation was the exclusion of patients with previous pituitary surgeries or pre-existing visual field abnormalities not attributable to pituitary adenoma, which may have introduced selection bias.

The study underscored the need for further research with larger sample sizes and longer follow-up periods to validate the findings and explore the long-term visual outcomes of patients undergoing transsphenoidal pituitary adenoma excision. Future studies should also consider including a broader range of patients, including those with previous pituitary surgeries, to provide a more comprehensive understanding of visual field recovery across different patient populations.

CONCLUSION

In conclusion, this study provided insights into the demographics, tumor profiles, surgical methods, and visual outcomes of patients undergoing transsphenoidal pituitary adenoma excision. The findings highlighted the typical age range and gender distribution of such patients, the prevalence of hypertension and diabetes, and the predominance of non-functioning tumors. Despite the improvements in visual field recovery post-surgery, some defects persisted up to 12 weeks. These results contribute to the existing knowledge on pituitary adenoma surgeries and underscore the importance of continued research to optimize patient outcomes (12, 13, 14, 15, 16).

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