Vision Outcomes Following Endoscopic and Microscopic Transsphenoidal Resection of Sellar/Parasellar Lesions – A Systematic Review of the Literature

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Key words
- Endoscopic endonasal approach
- Pituitary adenoma
- Sellar lesions
- Transsphenoidal surgery
- Visual acuity
- Visual field defects
- Visual outcomes

Abbreviations and Acronyms
CI: Confidence interval
cm^3: Cubic centimeters
GTR: Gross total resection
IQR: Interquartile range
MRI: Magnetic resonance imaging
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
pVI: Post-operative visual improvement
SD: Standard deviation
SPSS: Statistical package for the social sciences
VI: Visual impairment

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Supplementary digital content available online.

Citation: World Neurosurg. (2026) 211:125044.
http://doi.org/10.1016/j.wneu.2026.125044
*Journal homepage: **www.journals.elsevier.com/world-neurosurgery***

*Available online: **www.sciencedirect.com***

OBJECTIVES: **Transsphenoidal surgery for the resection of pituitary neoplasms has evolved over the years. The current study sought to summarize visual outcomes following transsphenoidal surgery for sellar and parasellar lesions and evaluate how these outcomes are reported across the literature.**

METHODS: **A systematic review was conducted in accordance with PRISMA guidelines. PubMed, EMBASE, Scopus and Cochrane Library database were searched from inception through October 2023. Studies were included if they reported pre- and post-operative visual outcomes for patients undergoing transsphenoidal resection of sellar or parasellar lesions. Reviews, abstracts, and non-English studies were excluded. Rates of pre- and postoperative visual loss, visual field defects, and visual acuity impairment were collected. Post-operative outcomes were categorized as improved, normalized, unchanged, or worsened.**

RESULTS: **Of 3828 studies identified, 236 met inclusion criteria and were included in the analysis. Pituitary adenomas accounted for 80% of cases, followed by craniopharyngiomas (14%) and meningiomas (4%). Preoperative visual loss, visual field defects, and visual acuity impairment were present in 55%, 51%, and 37% of patients, respectively. Postoperative improvement occurred in 76% of patients with visual loss, 73% with visual field defects, and 64% with visual acuity impairment, while 2%–11% experienced worsening of symptoms. Reporting completeness varied across studies, with fewer than half of studies reporting both pre- and post-operative outcomes.**

CONCLUSIONS: **Across all studies, approximately 76% of patients with preoperative visual impairment experienced postoperative improvement following transsphenoidal surgery. Reporting of visual outcomes remains highly variable, underscoring the need or standardized definitions and outcome measures in future research.**

INTRODUCTION

Transsphenoidal surgery for the resection of pituitary neoplasms has evolved over the years. The traditional microscopic approach was first described in 1907 by Schloffer[1] and was later refined by Cushing[2] and Hardy[3,4] in the mid-20th century. After that, microscopic transsphenoidal surgery became the primary surgical procedure for sellar and parasellar lesions.[5] Although the microscopic approach has proven relatively safe and carries a mortality rate of less than 1%,[5-8] endoscopic approaches to pituitary surgery started to gain traction after being first described by Jankowski et al.[9] in 1992. Over time, these surgical techniques have continued to develop and have expanded the ability to access and resect a broad range of sellar and parasellar lesions while minimizing the risk of postoperative morbidity.

Vision changes are one of the predominant symptoms of sellar lesions due to mass effect upon the optic nerve and surrounding structures.[10,11] These symptoms commonly manifest as visual field defects such as bitemporal hemianopsia, declines in visual acuity, and/or acute vision loss.[12-15] Surgical intervention has been shown to improve the visual symptoms of most patients.[16-18] While the overall benefits of surgery for these lesions have been demonstrated throughout the current

body of literature, published data on vision outcomes following transsphenoidal surgery remain inconsistent, and few studies have systematically analyzed how visual outcomes are reported across different studies. The current study aimed to summarize visual outcomes following transsphenoidal surgery for sellar and parasellar lesions and assess how visual recovery and reporting patterns have been characterized in published studies to date.

METHODS

Literature Search

In accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, we conducted a systemic review of the literature. PubMed, EMBASE, Scopus, and Cochrane Library were searched for publications from database inception until December 31st, 2022, using Boolean operators "OR" and "AND" and a combination of search terms "transsphenoidal", "endonasal", "endoscopic", "microscopic", "visual", "vision".

Study Selection

Inclusion and exclusion criteria were predetermined for the literature search. Included studies were those with patients' sellar pathologies that were surgically treated via a microscopic or endoscopic approach. To be included in our analysis, each study had to have reported clinical features, treatments, and outcomes. All studies included in our search were written in English. Exclusion criteria for the search included reviews, conference abstracts, animal studies, and autopsy reports. Studies were also excluded if they omitted data on clinical characteristics, treatments, and/or outcomes. Two independent investigators completed an assessment of study eligibility.

Data Extraction

Extracted data from each included article included title, author, year of publication, country of origin, approach, number of patients, sex, age, pathology, tumor diameter (mm), tumor size (cm3), gross total resection (GTR), and follow-up period. The number of patients with preoperative visual loss, visual field defects, and visual acuity impairment was collected. The primary outcome that was collected was postoperative visual status, specifically whether visual loss, visual field defects, and visual acuity impairments were reported as improved, normalized, unchanged, or worsened from a patient's preoperative status. The number of patients whose postoperative visual status was not reported was also collected.

Since the impairment of vision was reported variably between studies, including vision loss, visual acuity impairment, and or visual field defect, to better appreciate visual impairment, we created a variable entitled "visual impairment" (VI). For each study that reported a combination of both visual loss and/or visual acuity impairment and visual field defects, the variable that was reported most consistently across that study was included as VI. Similarly, a variable entitled "postoperative visual improvement" (pVI) was created by taking the largest variable for visual loss improvement, visual loss normalized, visual acuity improvement, normalized visual acuity, improved visual field defect, or normalized visual field defect across each study. Additionally, due to the heterogeneity of reporting these variables across the literature, loss of vision, loss of visual acuity and visual field defects were recorded as non-quantifiable variables, thus any loss of vision or visual acuity or visual field defect regardless of its severity.

Additionally, a sub-analysis was performed using studies that met a predetermined higher quality level. For this study, studies were considered higher quality if they included 20 or more patients and reported both visual field defects and visual acuity impairment outcomes.

Statistical Analysis

All analyses were performed at the study level. Given substantial heterogeneity in visual outcome definitions and non-normal distributions, continuous variables are summarized as medians with interquartile ranges (IQR), and categorical variables are summarized as frequencies and proportions. Composite variables for preoperative visual impairment (VI) and postoperative visual improvement (pVI) were constructed as described above, and study-level postoperative visual improvement rates were calculated as the proportion of patients with improvement relative to those with preoperative impairment (pVI/VI). Comparisons of study-level postoperative visual improvement rates between higher-quality and lower-quality studies were performed using the Mann—Whitney U test, and differences across pathology subgroups among higher-quality studies were assessed using the Kruskal—Wallis test. When studies reported outcomes separately for microscopic and endoscopic approaches, each approach-specific cohort was treated as an independent analytic entry for statistical comparisons, while summary tables reflect the number of unique studies. Statistical significance was defined a priori at < 0.05. All analyses were performed using SPSS 27 (IBM, Armonk, NY). Percentage values were rounded to the nearest whole integer in accordance with journal reporting guidelines.

RESULTS

Study Selection

The study selection process is illustrated in Figure 1. The initial literature search yielded 3828 articles. After duplicates were removed (N = 710), 3118 records remained for preliminary screening. Four hundred ninety-four full-text articles remained after non-relevant book chapters, review articles, non-English articles, case reports, small case series, non-oncologic studies, and pediatric studies were removed (N = 2624). After applying our predetermined inclusion and exclusion criteria on the remaining full-text articles (N = 494), 236 were ultimately included for our review.[19-30,31-55,56-70,71-85,86-100,101-120,121-130,131-145,146-160,161-180,181-200,201-220,221-235,235-254] Of these 236 articles, 183 (78%) used an endoscopic approach, and 64 (27%) used a microscopic approach. Eleven (5%) of the 236 articles used both approaches and reported data for each approach separately, allowing statistical analysis.

Publication Characteristics

While 236 articles were included for final review, 494 articles were included in the

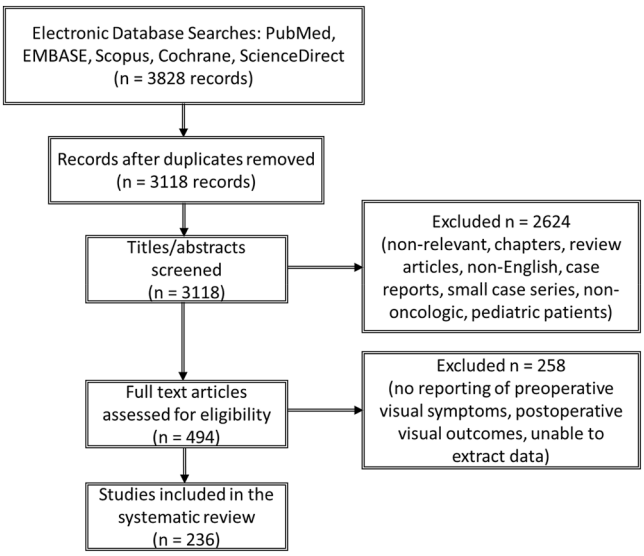

Figure 1. PRISMA flowchart of the methodology of systematic review.

prior review stage as they reported outcomes following transsphenoidal resection of sellar/parasellar lesions, whether endoscopic or microscopic. Of those studies, 83% reported pre-operative visual outcomes; however, only 68% reported pre-operative and post-operative visual outcomes. Additionally, 30% of these studies did not report their outcomes in a manner that could be quantifiable for studies, leading to only 48% of the 494 articles being included for final review. Finally, 16% of articles did not report pre-operative or post-operative visual outcomes.

Of the final articles included for review, 67% of the articles reported vision loss as a measure of visual impairment, while 42% reported visual field defects, and only 20% reported visual acuity. Only 6% of the articles reported both vision loss, visual acuity loss and visual field defects, 13% reported both vision loss and visual field defects, and 11% reported both visual field defects and visual acuity loss. Interestingly, 54% of the articles reported visual loss only, 20% reported visual field defects only, and 3% reported visual acuity loss only. The majority of the articles were published in Asia (N = 102, 43%), followed by North America (N = 62, 26%), Europe (N = 52, 22%), South America (N = 9, 4%), Australia (N = 7, 3%), and Africa (N = 4, 2%) (Figure 2 and 3). As expected, the number of publications in this topic has steadily increased, with 26% published between 2020 and 2022 (Figure 4). Overall, there are more publications on the endoscopic approach than the microsurgical approach.

Patient Demographics, Pathology, and Visual Outcomes

There was a total of 24,453 patients (median [IQR] age = 50.3 [43.2–54.8]) across the 236 included studies. Of these, 10,485 (43%) and 10,596 (43%) were male and female, respectively. Gender was unspecified in 3372 (14%) patients. Pituitary adenoma was the most common pathology (N = 19,528, 80%), followed by craniopharyngioma (N = 3,317, 14%), meningioma (N = 979, 4%), Rathke's cleft cyst (N = 559, 2%), and other (N = 70, 0%). Figure 5 illustrates the proportion of pathologies by surgical approach. For studies where tumor size was reported, the median maximum tumor diameter was 27.0 (24.0–34.0) mm, and the median tumor size was 8.6 (5.9–16.9) cm^3. Gross total resection was achieved in 68% of the studies that reported the extent of resection. The median follow-up period was 32.8 (20.4–51.0) months. The mean duration of preoperative symptoms in studies that reported (n = 19) was 284.5 days.

Visual outcomes were reported differently between studies, with studies reporting overall vision loss, loss of visual acuity, or visual field defects. In those studies, reporting vision loss, 55% of patients presented with vision loss pre-operatively, of which 76% improved post-operatively (10% normalized), 17% were unchanged, 4% worsened, and the

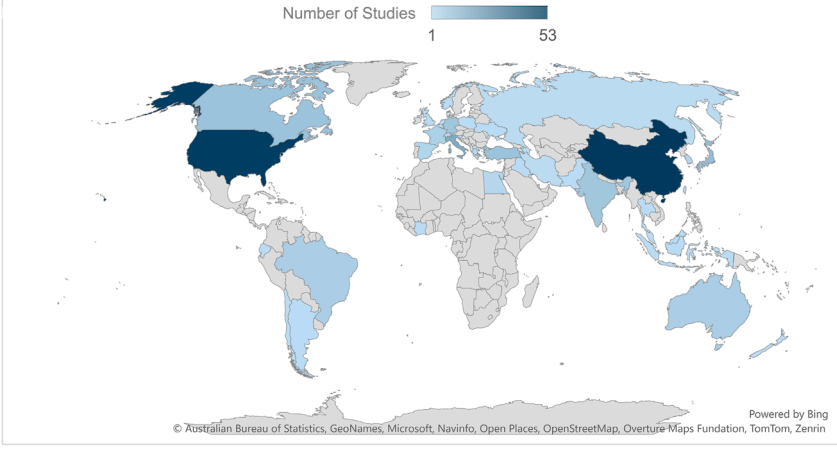

Figure 2. Distribution of Studies by Country of Origin.

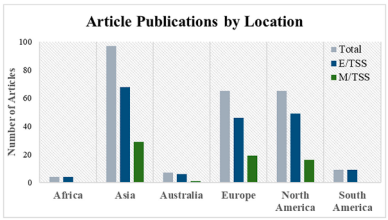

Figure 3. Breakdown of article publications by location: E/TSS indicates articles utilizing endoscopic approaches, M/TSS for microsurgical approaches.

remainder (3%) were not reported. In studies reporting visual fields, 51% of patients presented with visual field defects pre-operatively, of which 73% improved (11% normalized), 10% were unchanged, 2% worsened, and the remainder (15%) were not reported. In studies reporting visual acuity, 37% of the patients presented with visual acuity impairment pre-operatively, of which 64% improved (4% normalized), 16% were unchanged, 5% worsened, and the remainder 15% were not reported.

Microscopic Studies. In all, 64 articles utilized the microscopic approach with a total of 8548 (median age = 49.5 [42.9–53.9]) patients, 42% and 43% of which were male and female, respectively. Gender was not specified in the remainder (15%) of patients. The most common pathology was pituitary adenoma (74%), followed by craniopharyngioma (19%), meningioma (5%), Rathke's cleft cyst (2%), and other (0%). The median max tumor diameter was 28.5 (23.8–35.1) mm, and the median tumor size was 8.0 (5.8–11.9) cm^3. GTR was achieved in 64% of patients where the extent of resection was reported. The median follow-up period was 34.9 (20.4–59.1) months post-operatively.

In studies reporting vision loss, 58% of patients presented with visual loss pre-operatively, of which 70% improved (12% normalized), 18% were unchanged, 5% worsened, and the remainder (7%) were not reported. In studies reporting visual fields, 56% of the patients presented with visual field defects pre-operatively, of which 65% improved (12% normalized), 17% were unchanged, 4% worsened, and the remainder (14%) were not reported. In studies reporting visual acuity, 34% presented with visual acuity impairment pre-operatively, of which 35% (0% normalized) improved, 28% were unchanged, 11% worsened, and the remainder (26%) were not reported.

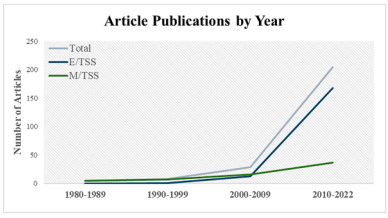

Figure 4. Breakdown of article publications by year. E/TSS indicates articles utilizing endoscopic approaches, M/TSS for microsurgical approaches.

Endoscopic Studies. In all, 183 studies utilized the endoscopic approach, with a total of 15,905 (median age=50.8 [43.6–54.8]) patients, 43% and 44% of which were male and female, respectively. Gender was not specified in the remainder (13%) of patients. The most common pathology was pituitary adenoma (83%), followed by craniopharyngioma (11%), meningioma (3%), Rathke's cleft cyst (3%), and other (0%). The median maximum tumor diameter was 27.0 (24.0–34.0) mm, and the median tumor size was 8.6 (6.0–18.0) cm^3. In 69% of the studies where the extent of resection was reported, gross total resection was achieved. The median follow-up period was 32.8 (19.6–48.0) months (Table 1). Percentages are rounded to the nearest whole number; therefore, totals may not equal 100% due to rounding.

In studies reporting vision loss, 54% of patients presented with visual loss pre-operatively, of which 80% (8% normalized) improved, 17% were unchanged, 3% worsened, and the remainder (0%) were not reported. In studies reporting visual fields, 52% of the patients presented with visual field defects pre-operatively, of which 79% (11% normalized) improved, 4% were unchanged, 1% worsened, and the remainder (16%) were not reported. In studies reporting visual acuity, 39% presented with visual acuity impairment pre-operatively, of which 62% (7% normalized) improved, 5% were unchanged, 0% worsened, and the remainder (33%) were not reported (Tables 2 and 3).

Analysis of High-Quality Studies

There were 31 (12 microsurgical, 19 endoscopic) studies meeting our criteria of a higher quality study, with a total of 5107 (median age=51.4 [43.1–54.9]) patients, 42% and 39% of which were male and female, respectively. Gender was not specified in the remainder (19%) of patients. The most common pathology was pituitary adenoma (71%), followed by craniopharyngioma (27%) and meningioma (1%). The median maximum tumor diameter was 36.6 (29.5–43.3) mm, and the median tumor size was 8.6 (5.8–21.6) cm^3. In 69% of the studies where the extent of resection was reported, gross total resection was achieved. The median follow-up period was 42.8 (29.1–63.0) months. Patient and pathology characteristics are summarized in Table 4.

Across these studies, postoperative visual improvement was reported in the majority of patients with preoperative impairment, with overall improvement rates generally consistent with those seen in the larger cohort. Detailed patient, tumor, and outcome characteristics are summarized in Table 4 and 5. Median rates of postoperative visual improvement relative to preoperative visual impairment (pVI/VI) did not differ between high-quality studies and lower-quality studies (0.77 vs. 0.77, $P = 0.595$). Within the high-quality cohort, study-level postoperative visual improvement rates varied by pathology but did not reach statistical significance ($P = 0.159$) (Table 6).

DISCUSSION

Approximately 41% of patients with sellar/parasellar lesions first present with visual disturbances.[255] While the classic presentation is bitemporal hemianopsia, visual impairment due to these lesions can present as unilateral or mixed hemianopsia, visual acuity changes, alterations in color vision, and blurry vision due to cranial nerve defects. Formal ophthalmologic examination is recommended, not only because the visual impairment may sometimes be subtle but also because this is essential information for surgical planning.

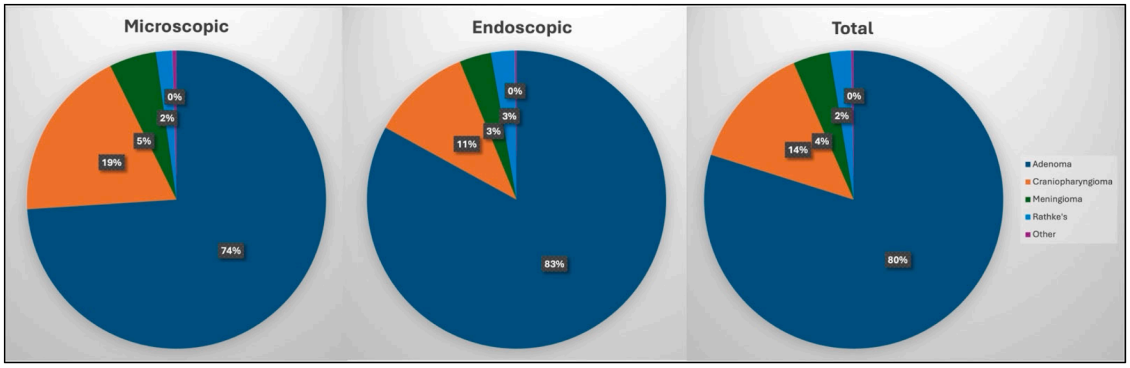

Figure 5. Breakdown of Pathology by Surgical Approach.

Improvement of visual symptoms post-operatively has been characterized as occurring in 3 stages by Uy et al.[17] rapid recovery occurring minutes to day, delayed recovery occurring weeks to months, and late recovery occurring months to years. While improvement can be seen as far as 5 years after surgery, most of the improvement occurs within 3–6 months post-operatively.[256] Postoperatively, rates of visual improvement for pituitary adenomas are 79%–95% for visual field defects and 45%–86% for visual acuity.[17,257,258] The extent of resection, tumor size, and duration of visual symptoms are some pre-operative factors that predict visual recovery post-operatively.[257,259] From our systematic review of the entire literature, we found that following transsphenoidal resection, improvement of visual loss, visual acuity and visual field defects to be 76%, 64%, and 73%, respectively.

Over recent decades, the techniques for transsphenoidal resection of sellar and parasellar lesions have undergone substantial refinement, driven by improvements in visualization and access to deep-seated skull base structures. Both endoscopic and microscopic methods have contributed to expanding surgical corridors and improving exposure of

Table 1. Patient and Sample Characteristics

	Entire Sample (n = 24,453)	Microscopic (n = 8548)	Endoscopic (n = 15,905)
Age, Md (IQR)	50.3 (43.2–54.8)	49.5 (42.9–53.9)	50.8 (43.6–54.8)
Gender			
Male, n (%)	10,485 (43)	3624 (42)	6861 (43)
Female, n (%)	10,596 (43)	3672 (43)	6924 (44)
Unspecified, n (%)	3372 (14)	1252 (15)	2120 (13)
Pathology n (%)			
Adenoma	19,528 (80)	6323 (74)	13,205 (83)
Craniopharyngioma	3317 (14)	1601 (19)	1716 (11)
Meningioma	979 (4)	434 (5)	545 (3)
Rathke's	559 (2)	152 (2)	407 (3)
Other	70 (0)	38 (0)	32 (0)
Max Tumor Diameter (mm), Md (IQR)	27.0 (24.0–34.0)	28.5 (23.8–35.1)	27.0 (24.0–34.0)
Tumor Size (cm^3), Md (IQR)	8.6 (5.9–16.9)	8.0 (5.8–11.9)	8.6 (6.0–18.0)
Gross Total Resection, n/total (%)	11,922/17,533 (68)	3313/5138 (64)	8609/12,395 (69)
Follow-up Period (months), Md (IQR)	32.8 (20.4–51.0)	34.9 (20.4–59.1)	32.8 (19.6–48.0)

Note: Md: median; IQR: interquartile range.

Table 2. Visual Outcomes by Surgical Approach

Visual Status	Entire Sample (N = 24,453)	Microscopic (N = 8548)	Endoscopic (N = 15,905)
Preoperative			
Total Visual Impairment (VI), n/Total Patients (%)	13,429/24,453 (55)	4871/8548 (57)	8558/15,905 (54)
Visual Loss, n/total (%)	7640/13,873 (55)	2640/4560 (58)	5000/9313 (54)
Visual Field Defects, n/total (%)	6388/12,586 (51)	2652/4696 (56)	3736/7171 (52)
Visual Acuity Impairment, n/total (%)	1970/5361 (37)	959/2752 (39)	1011/2609 (39)
Postoperative			
Total Visual Improvement (pVI), n/Total Visual Impairment (%)	9680/13,429 (72)	3108/4871 (64)	6572/8558 (77)
Visual Loss			
Any Visual Loss Improvement	5836 (76)	1835 (70)	4001 (80)
Improved, n (%)	5106 (67)	1517 (57)	3589 (72)
Normalized, n (%)	730 (10)	318 (12)	412 (8)
Unchanged, n (%)	1326 (17)	486 (18)	840 (17)
Worsened, n (%)	273 (4)	125 (5)	148 (3)
Not Reported, n (%)	205 (3)	194 (7)	11 (0)
Visual Field Defects			
Any Visual Field Improvement	4681 (73)	1722 (65)	2959 (79)
Improved, n (%)	3947 (62)	1394 (53)	2553 (68)
Normalized, n (%)	734 (11)	328 (12)	406 (11)
Unchanged, n (%)	617 (10)	451 (17)	166 (4)
Worsened, n (%)	121 (2)	96 (4)	25 (1)
Not Reported, n (%)	969 (15)	383 (14)	586 (16)
Visual Acuity Impairment			
Any Visual Acuity Improvement	1258 (64)	335 (35)	624 (62)
Improved, n (%)	1185 (60)	334 (35)	552 (55)
Normalized, n (%)	73 (4)	1 (0)	72 (7)
Unchanged, n (%)	316 (16)	267 (28)	45 (5)
Worsened, n (%)	109 (5)	105 (11)	4 (0)
Not Reported, n (%)	287 (15)	252 (26)	338 (33)

critical anatomy such as the parasellar and suprasellar regions.[260,261] Innovations in angled visualization, illumination, and instrument design have enhanced the surgeon's ability to achieve safe, effective resections with minimal morbidity. However, despite these technical advancements, the documentation and reporting of visual outcomes have not evolved in parallel. Many studies prioritize technical descriptions or complication rates but provide incomplete or inconsistent reporting of postoperative visual data.

Across the published literature, there remains considerable heterogeneity in how visual outcomes are defined, measured, and reported. Some studies rely on qualitative descriptions of "improvement" or "stability," whereas others use objective testing such as formal perimetry or visual acuity measurement. The timing of postoperative evaluation also varies widely—from early inpatient assessments to delayed follow-up years later—limiting meaningful comparison across series. As demonstrated in our review, fewer than half of studies quantified visual outcomes, and 16% did not report visual outcomes at all, highlighting a major gap in the evidence base. Additionally, vision impairment was not only scarcely reported in the literature, even when reported it was done so inconsistently amongst publications—67% of the articles reported vision loss as a measure of visual impairment, and only 42% and 20% reported visual field defects and visual acuity loss, respectively. In fact, 54% of the articles reported visual loss only as a measure of visual impairment. Standardization of ophthalmologic assessment and consistent postoperative time points are needed to enable accurate synthesis of outcomes and to guide future work evaluating visual recovery following transsphenoidal surgery. Makarenko et al., for instance, described a new scale for describing visual outcomes in patients

Table 3. Visual Outcomes by Tumor Pathology

Pathology	Entire Sample (N = 24,453)	Microscopic (N = 8548)	Endoscopic (N = 15,905)
Adenoma			
Total Visual Impairment (VI), n/Total Patients (%)	10,372 (53)	3791 (60)	6581 (50)
Total Visual Improvement (pVI), n/Total Visual Impairment (%)	7528 (73)	2400 (63)	5128 (78)
Craniopharyngioma			
Total Visual Impairment (VI), n/Total Patients (%)	1952 (59)	627 (39)	1325 (77)
Total Visual Improvement (pVI), n/Total Visual Impairment (%)	1313 (67)	374 (60)	939 (71)
Meningioma			
Total Visual Impairment (VI), n/Total Patients (%)	845 (86)	374 (86)	471 (86)
Total Visual Improvement (pVI), n/Total Visual Impairment (%)	626 (74)	259 (69)	367 (78)
Rathke's			
Total Visual Impairment (VI), n/Total Patients (%)	223 (40)	64 (42)	159 (39)
Total Visual Improvement (pVI), n/Total Visual Impairment (%)	185 (83)	62 (97)	123 (77)
Other			
Total Visual Impairment (VI), n/Total Patients (%)	33 (47)	15 (39)	18 (56)
Total Visual Improvement (pVI), n/Total Visual Impairment (%)	27 (82)	13 (87)	14 (78)

following resection of lesions affecting the optic apparatus, combining visual field with visual acuity examination scores into a single grading system, namely Grade A to C.[262] Utilization of such visual assessment scores needs to be considered to better understand visual outcomes following resection of sellar/parasellar lesions.

The current study found that patients with pre-operative visual impairment undergoing transsphenoidal resection of sellar/parasellar lesions have a 76% cumulative rate of improvement post-operatively. Ultimately, the findings of our review emphasize that visual recovery following transsphenoidal surgery is both common and clinically significant for sellar and parasellar pathologies, across endoscopic and microsurgical techniques. However, while the overall efficacy of surgery in treating visual deficits secondary to these lesions has been demonstrated through the literature, the wide variation in how visual outcomes are defined and recorded across studies highlights a persistent gap. Interestingly,

Table 4. Characteristics of High-Quality Studies

	Entire Sample (n = 5107)	Microscopic (n = 2736)	Endoscopic (n = 2371)
Age, Md (IQR)	51.4 (43.1—54.9)	48.8 (37.5—52.4)	52.2 (48.5—56.3)
Gender			
Male, n (%)	2142 (42)	1312 (48)	830 (35)
Female, n (%)	2008 (39)	1296 (47)	712 (30)
Unspecified, n (%)	957 (19)	128 (5)	829 (35)
Pathology n (%)			
Adenoma	3645 (71)	1422 (52)	2223 (94)
Craniopharyngioma	1392 (27)	1271 (46)	121 (5)
Meningioma	70 (1)	43 (2)	27 (1)
Max Tumor Diameter (mm), Md (IQR)	36.6 (29.5—43.3)	34.3 (28.3—43.4)	40.6 (29.2—43.8)
Tumor Size (cm^3), Md (IQR)	8.6 (5.8—21.6)	5.8 (5.8—5.8)	13.3 (5.8—24.4)
Gross Total Resection, n/total (%)	1993/2870 (69)	1306/1797 (73)	687/1073 (64)
Follow-up Period (months), Md (IQR)	42.8 (29.1—63.0)	54.7 (40.1—74.2)	39.6 (21.2—54.2)

Note: Md: median; IQR: interquartile range.

Table 5. Visual Outcomes Among Higher Quality Studies

Visual Status	Entire Sample (n = 5107)	Microscopic (n = 2736)	Endoscopic (n = 2371)
Preoperative			
Total Visual Impairment (VI), n/Total Patients (%)	2694/5107 (53)	1560/2736 (57)	1134/2371 (48)
Visual Field Defects, n/total (%)	2461 (48)	1443 (53)	1018 (43)
Visual Acuity Impairment, n/total (%)	1824 (36)	952 (35)	872 (37)
Postoperative			
Total Visual Improvement (pVI), n/Total Visual Impairment (%)	1939/2694 (72)	1046/1560 (67)	893/1134 (79)
Visual Field Defects			
Any Visual Field Improvement	1488 (60)	744 (52)	744 (73)
Improved, n (%)	1387 (56)	736 (51)	651 (64)
Normalized, n (%)	101 (4)	8 (1)	93 (9)
Unchanged, n (%)	418 (17)	396 (27)	22 (2)
Worsened, n (%)	89 (4)	88 (6)	1 (0)
Not Reported, n (%)	466 (19)	215 (15)	251 (25)
Visual Acuity Impairment			
Any Visual Acuity Improvement	852 (47)	334 (35)	501 (58)
Improved, n (%)	787 (43)	334 (35)	435 (50)
Normalized, n (%)	66 (4)	0	66 (8)
Unchanged, n (%)	303 (17)	267 (28)	36 (4)
Worsened, n (%)	108 (6)	105 (11)	3 (0)
Not Reported, n (%)	560 (31)	246 (26)	332 (38)

restriction of analyses to higher quality studies did not meaningfully alter observed rates of postoperative visual improvement, supporting the robustness of the overall findings despite heterogeneity in reporting quality. However, standardization of ophthalmologic assessment and consistent postoperative time points are needed to enable accurate synthesis of outcomes and to guide future work evaluating visual recovery following transsphenoidal surgery. Future research should prioritize consistent reporting of pre- and postoperative visual acuity and field defects, perhaps with the inclusion of standardized scoring criteria and ophthalmologic testing. Furthermore, the stratification of outcomes by key variables such as symptom duration, tumor subtype, and degree of optic apparatus compression may be prudent. In sum, establishing uniform metrics and reporting protocol would not only strengthen interstudy comparability but also improve prognostication and patient counselling/education. As transsphenoidal surgery continues to evolve and improve, a unified framework for visual outcome assessment, particularly in the context of reporting for research purposes, will be essential to accurately measure and compare surgical efficacy and guide evidence-based refinement of practice.

Table 6. Study-level postoperative visual improvement rates Stratified by Study Quality and Pathology

	Group (No. Of Studies)	Median pVI/VI (IQR)	*P* Value
Study Quality	High-quality (31)	0.77 (0.61—0.90)	0.595
	Low-quality (205)	0.77 (0.60—0.90)	
Pathology (HQ only)	Adenoma (23)	0.86 (0.69—0.90)	0.159
	Craniopharyngioma (6)	0.66 (0.46—0.94)	
	Meningioma (2)	0.58 (—)	

Note: IQR not reported for groups with fewer than 3 studies.

Limitations

The main limitations of the study are the retrospective nature of the data, and the objective reporting of visual outcomes data from each paper by the respective authors. The overall reporting of visual outcomes throughout the literature was limited, and the majority of publications did not report duration of visual symptoms pre-operatively, which may be important in determining improvement of vision after surgery.

CONCLUSION

The current systematic review found that patients with preoperative visual impairment undergoing transsphenoidal resection of sellar and parasellar lesions experienced a 76% rate of postoperative visual improvement. Overall trends of visual improvement were comparable across microsurgical and endoscopic techniques. While these findings underscore the overall effectiveness of transsphenoidal surgery in restoring visual function, the reporting of visual outcomes across the literature remains highly variable and often incomplete, with fewer than half of included studies documenting both pre- and postoperative visual outcomes. Future investigations should prioritize standardized definitions, uniform reporting criteria, and consistent ophthalmologic assessment to enable meaningful comparison and ultimately evidence-based recommendations.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Emal Lesha: Writing — original draft, Validation, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **John E. Dugan:** Writing — original draft, Methodology, Investigation, Formal analysis, Data curation. **Camille Milton:** Writing — original draft, Methodology, Investigation, Formal analysis, Data curation. **Elsa Nico:** Writing — original draft, Methodology, Investigation, Formal analysis, Data curation. **Logan Eskin:** Methodology, Investigation, Formal analysis, Data curation. **Kaan Yagmurlu:** Writing — original draft, Investigation, Data curation. **Emir Begagic:** Writing — review & editing, Methodology, Investigation, Data curation. **Mirza Pojskic:** Writing — review & editing, Validation, Supervision, Conceptualization. **Kenan Arnautovic:** Writing — review & editing, Validation, Supervision, Resources, Project administration, Methodology, Conceptualization.

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Conflicts of interest statement: The authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received 5 April 2026; accepted 5 May 2026

Citation: World Neurosurg. (2026) 211:125044.
http://doi.org/10.1016/j.wneu.2026.125044

Journal homepage: ***www.journals.elsevier.com/world-neurosurgery***

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