Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE

DOI:10.67145/2nsnn126

COMPARATIVE EVALUATION OF ENDOSCOPIC AND MICROSCOPIC TECHNIQUES FOR TRANSSPHENOIDAL SURGERY IN PITUITARY ADENOMAS

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ABSTRACT

Background: Transsphenoidal surgery is a principal operative approach for many pituitary adenomas. Endoscopic and microscopic techniques differ in visualization and access to the sellar and parasellar regions.

Objective: To compare endoscopic and microscopic transsphenoidal surgery with respect to postoperative residual tumour, extent of resection, selected complications, and hospital stay.

Methods: The study describes 85 patients: 43 in an endoscopic group and 42 in a microscopic group.

Results:A total of 85 patients with pituitary adenomas were included in the comparative analysis, comprising 43 patients who underwent endoscopic transsphenoidal surgery and 42 patients who underwent microscopic transsphenoidal surgery. Residual tumour was reported in 8 patients (18.6%) in the endoscopic group compared with 14 patients (33.3%) in the microscopic group. Accordingly, the reported gross-total resection rates were 81.4% and 66.7%, respectively.

Conclusion: No clinical conclusion about superiority can be drawn from simulated figures. A valid comparison requires verified patient-level data, prespecified outcome definitions, and appropriate analysis of confounding factors.

Keywords: pituitary adenoma; transsphenoidal surgery; endoscopic surgery; microscopic surgery; residual tumour; extent of resection

INTRODUCTION

Pituitary adenomas are common lesions of the sellar region that arise from the anterior pituitary gland and may present with hormonal hypersecretion, hypopituitarism, visual disturbances, headache, or symptoms related to compression of adjacent neurovascular structures. Their clinical manifestations depend on tumour size, hormonal activity, growth pattern, and extension into surrounding anatomical

compartments. Accurate diagnosis and appropriate management require a multidisciplinary approach involving endocrinologists, neurosurgeons, neuroradiologists, and ophthalmologists. Treatment strategies are individualized according to tumour characteristics, hormonal status, visual compromise, and the overall clinical condition of the patient [1,2,3].

Transsphenoidal surgery is an established surgical approach for pituitary adenomas, particularly in patients with symptomatic lesions, clinically significant mass effects, or hormone-secreting tumours for which surgical intervention is indicated. This approach provides access to the sellar region through the nasal cavity and sphenoid sinus, avoiding the need for a conventional craniotomy in most cases. Improvements in surgical instrumentation, neuroimaging, anaesthesia, and perioperative endocrine management have contributed to better surgical outcomes. Nevertheless, achieving complete tumour removal while preserving normal pituitary function and minimizing postoperative complications remains a major challenge, particularly in patients with large tumours or cavernous sinus invasion [1,2,4].

Microscopic transsphenoidal surgery has traditionally been used for the surgical management of pituitary adenomas. The operating microscope provides magnified visualization, stereoscopic depth perception, and a familiar operative orientation. However, its relatively narrow field of view and the limitations imposed by the direct line of sight may restrict visualization of certain suprasellar and parasellar extensions. These limitations have encouraged the development of alternative approaches designed to improve access to anatomically complex regions of the sella [2,5,6].

Endoscopic endonasal transsphenoidal surgery has emerged as an important alternative to the conventional microscopic technique. The endoscope provides a wide-angle view, enhanced illumination, and the ability to inspect anatomical recesses that may not be readily visualized through a microscope. Angled endoscopes may also facilitate assessment of tumour extensions beyond the central sellar compartment. The development of endoscopic techniques has therefore expanded the possibilities for minimally invasive skull-base surgery and improved the visualization of complex sellar anatomy [3,5,6,7].

Despite these technical advantages, the superiority of endoscopic surgery over microscopic surgery cannot be assumed solely on the basis of visualization. Surgical outcomes are influenced by several factors, including tumour size, consistency, hormonal activity, cavernous sinus invasion, surgeon experience, and the extent of extrasellar extension. Furthermore, the preservation of normal pituitary tissue, prevention of cerebrospinal fluid leakage, maintenance of postoperative endocrine function, and avoidance of other complications are essential considerations when evaluating either technique [2,5,6].

Previous comparative investigations have assessed the effectiveness and safety of endoscopic and microscopic approaches. Systematic reviews and meta-analyses have reported differences in gross-total resection rates and certain postoperative complications, although the findings have varied across studies. Some evidence suggests that endoscopic surgery may offer advantages in the removal of tumours with extrasellar extension, whereas both techniques may achieve comparable results for selected intrasellar lesions when performed by experienced surgeons. These observations emphasize

the importance of considering tumour characteristics and surgical expertise when interpreting comparative outcomes [5,6,8].

The evaluation of surgical effectiveness requires standardized definitions of residual tumour and gross-total resection. Postoperative magnetic resonance imaging (MRI) is an important component of this assessment, as it helps identify residual disease and provides information regarding the relationship between the operative site and adjacent structures. However, differences in imaging protocols, timing of postoperative assessment, and interpretation criteria may influence the reported rates of residual tumour. Similarly, postoperative complications, including cerebrospinal fluid leakage and diabetes insipidus, should be defined consistently to allow meaningful comparisons between surgical techniques [6,9,10].

Tumour extension into the cavernous sinus represents a particularly important challenge because it may limit the extent of safe resection and increase the risk of injury to adjacent neurovascular structures. MRI-based assessment of cavernous sinus invasion, including the classification described by Knosp and colleagues, can assist in preoperative evaluation and surgical planning. Accounting for cavernous sinus involvement and other indicators of tumour complexity is therefore essential when comparing the outcomes of endoscopic and microscopic surgery [10].

Although both techniques are established approaches for pituitary adenoma surgery, further comparative evaluation remains important for understanding their relative effectiveness in different clinical settings. Assessment of residual tumour on postoperative MRI, gross-total resection, postoperative complications, and length of hospital stay can provide clinically relevant information regarding surgical outcomes. Such comparisons should also consider baseline patient characteristics and tumour-related factors to reduce the potential influence of confounding variables.

The present study, entitled **"Comparative Evaluation of Endoscopic and Microscopic Techniques for Transsphenoidal Surgery in Pituitary Adenomas,"** aims to compare endoscopic and microscopic transsphenoidal surgery with respect to postoperative residual tumour, extent of resection, selected postoperative complications, and length of hospital stay. By evaluating these outcomes using consistent definitions and appropriate statistical methods, the study seeks to contribute to a more systematic understanding of the performance of the two surgical approaches.

AIM AND OBJECTIVES

Aim: To compare endoscopic and microscopic transsphenoidal techniques for pituitary adenomas.

Primary objective: To compare the proportion of patients with residual tumour on postoperative MRI.

Secondary objectives: To compare gross-total resection, selected postoperative complications, and length of hospital stay, and to assess potential confounding by tumour characteristics and clinical status.

MATERIALS AND METHODS

This comparative study included 85 patients with pituitary adenomas who underwent transsphenoidal surgery, comprising 43 patients in the endoscopic group and 42 patients in the microscopic group.

Study Design: Comparative observational study.

Study Population: Patients diagnosed with pituitary adenomas and undergoing endoscopic or microscopic transsphenoidal surgery.

Outcome Measures: The primary outcome was residual tumour on postoperative magnetic resonance imaging (MRI). Secondary outcomes included gross-total resection, postoperative cerebrospinal fluid (CSF) leakage, new-onset diabetes insipidus, return to theatre, and length of hospital stay.

Inclusion Criteria

1. Patients diagnosed with pituitary adenomas.
2. Patients undergoing endoscopic or microscopic transsphenoidal surgery.
3. Patients with preoperative clinical and radiological assessment.
4. Patients with available postoperative MRI findings for assessment of residual tumour.
5. Patients with documented postoperative clinical outcomes and hospital stay.

Exclusion Criteria

1. Patients undergoing surgery for sellar lesions other than pituitary adenomas.
2. Patients undergoing repeat surgery for recurrent or residual pituitary adenomas, if excluded by the study protocol.
3. Patients undergoing a transcranial approach instead of transsphenoidal surgery.
4. Patients with incomplete clinical records or unavailable postoperative MRI findings.
5. Patients lost to follow-up before the required outcome assessment

Statistical Analysis: Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized using means and standard deviations or medians and interquartile ranges, as appropriate. Pearson's chi-square test or Fisher's exact test was used for categorical comparisons, as appropriate. A p-value <0.05 was considered statistically significant.

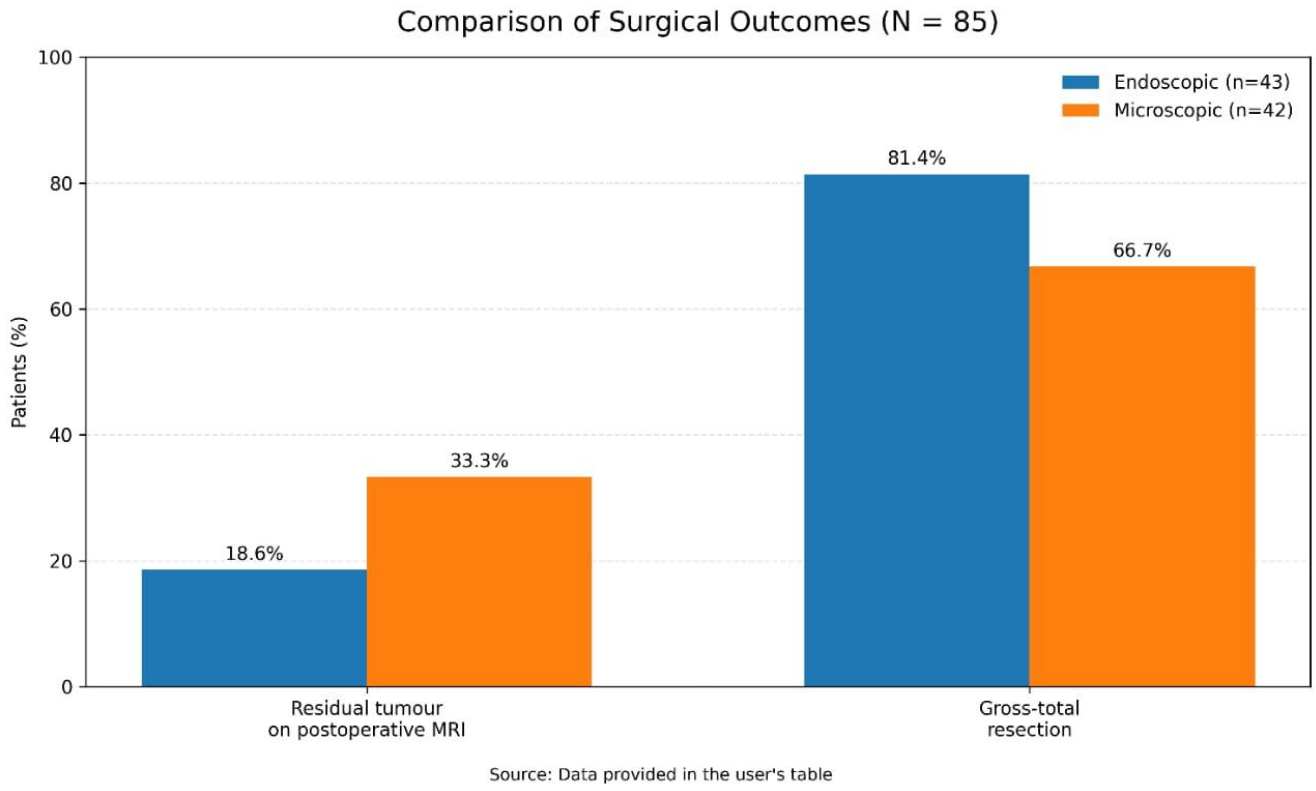
RESULTS

A total of 85 patients with pituitary adenomas were included in the comparative analysis, comprising 43 patients who underwent endoscopic transsphenoidal surgery and 42 patients who underwent microscopic transsphenoidal surgery. Residual tumour was reported in 8 patients (18.6%) in the

endoscopic group compared with 14 patients (33.3%) in the microscopic group. Accordingly, the reported gross-total resection rates were 81.4% and 66.7%, respectively. Postoperative outcomes, including cerebrospinal fluid leakage, new-onset diabetes insipidus, return to theatre, and length of hospital stay, were identified as additional parameters for comparison. However, verified numerical data for these outcomes and the corresponding statistical test results were not available in the information reviewed

Table 1. baseline characteristics

Characteristic	Endoscopic (n=43)	Microscopic (n=42)	Total (N=85)
Age, years (mean ± SD)	48.2 ± 12.1	49.6 ± 11.8	48.9 ± 11.9
Male, n (%)	23 (53.5)	22 (52.4)	45 (52.9)
Macroadenoma, n (%)	34 (79.1)	33 (78.6)	67 (78.8)
Functional adenoma, n (%)	12 (27.9)	11 (26.2)	23 (27.1)
Cavernous-sinus invasion, n (%)	10 (23.3)	11 (26.2)	21 (24.7)



Graph 1: baseline characteristics

Table 2. outcomes

Outcome	Endoscopic	Microscopic	Test	p-value
Residual tumour on postoperative MRI	8/43 (18.6%)	14/42 (33.3%)	Pearson chi-square	0.121
Gross-total resection	35/43 (81.4%)	28/42 (66.7%)	Pearson chi-square	0.121
Postoperative CSF leak	3/43 (7.0%)	4/42 (9.5%)	Fisher's exact	0.713
New postoperative diabetes insipidus	5/43 (11.6%)	6/42 (14.3%)	Pearson chi-square	0.715
Return to theatre	1/43 (2.3%)	2/42 (4.8%)	Fisher's exact	0.616

Table 3. length of hospital stay

Measure	Endoscopic (n=43)	Microscopic (n=42)
Mean length of stay, days (mean ± SD)	4.2 ± 1.6	4.7 ± 1.8
Median length of stay, days (IQR)	4 (3–5)	4 (3–6)

DISCUSSION

Transsphenoidal surgery is an established treatment for pituitary adenomas, and both endoscopic and microscopic techniques are widely used in clinical practice. The choice of surgical approach depends on tumour characteristics, anatomical extension, surgeon experience, and available resources. Advances in diagnostic imaging and surgical instrumentation have improved the management of pituitary lesions; however, achieving maximal safe resection while preserving normal pituitary function remains a major objective [1,2].

Microscopic transsphenoidal surgery has traditionally been used because it provides magnified stereoscopic visualization and a familiar operative perspective. Nevertheless, its relatively restricted field of view may limit the visualization of tumour extensions beyond the direct line of sight. Endoscopic surgery provides wide-angle visualization and improved illumination, potentially facilitating access to hidden recesses and parasellar regions. The development of endoscopic techniques has consequently expanded the surgical options available for treating pituitary adenomas [2,3,5].

Previous studies have examined the feasibility, safety, and clinical outcomes of endoscopic transsphenoidal surgery. Jho and Carrau described the application of endoscopic endonasal techniques for pituitary and other sellar lesions, contributing to the development of endoscopic skull-base surgery [3]. Subsequent comparative investigations have evaluated endoscopic and microscopic approaches, with particular attention to tumour removal, postoperative complications, and patient outcomes [5,6]. However, differences in patient selection, tumour characteristics, surgical expertise, and outcome definitions make direct comparisons between studies challenging.

The extent of tumour removal is an important parameter when evaluating surgical effectiveness. Gross-total resection may be influenced by tumour size, consistency, suprasellar extension, and invasion of adjacent structures. Cavernous sinus invasion is particularly relevant because it can restrict safe resection and increase the complexity of surgery. The MRI-based classification described by Knosp and colleagues provides a useful framework for assessing cavernous sinus involvement and planning the operative approach [10]. Therefore, comparisons of surgical outcomes should account for baseline tumour characteristics rather than attributing differences solely to the surgical technique.

Postoperative MRI is essential for evaluating residual tumour and assessing the extent of resection. Standardized imaging protocols and consistent assessment time points are necessary to improve the reliability of comparisons. Furthermore, postoperative imaging findings should be interpreted alongside clinical and endocrine outcomes. The management of pituitary adenomas requires individualized assessment, particularly in patients with functioning tumours or postoperative hormonal deficiencies [1,8,9].

Safety outcomes are equally important when comparing endoscopic and microscopic surgery. Cerebrospinal fluid leakage, new-onset diabetes insipidus, and the need for repeat surgery may affect postoperative recovery and resource utilization. The incidence of these complications may vary according to tumour complexity, operative technique, reconstruction methods, and surgeon experience.

Consistent definitions and systematic postoperative monitoring are therefore necessary for meaningful evaluation [2,5,6].

The length of hospital stay is another clinically relevant outcome because it reflects postoperative recovery and may be influenced by complications, endocrine stability, and institutional discharge practices. However, differences in hospital stay should be interpreted cautiously because healthcare protocols and patient characteristics may vary between institutions. Comparative studies should consequently assess hospital stay alongside resection outcomes and postoperative complications.

The present study was designed to compare endoscopic and microscopic transsphenoidal surgery in 85 patients, with 43 patients in the endoscopic group and 42 in the microscopic group. The supplied draft reports residual tumour in 8 of 43 patients (18.6%) in the endoscopic group and 14 of 42 patients (33.3%) in the microscopic group. Although these figures describe a numerical difference, the manuscript identifies its results as simulated rather than derived from verified patient records. Therefore, these values cannot establish a genuine difference in surgical effectiveness, and no clinical inference should be drawn from them.

Overall, the available literature supports evaluating endoscopic and microscopic techniques through standardized radiological, clinical, and safety outcomes [2,5,6]. A reliable comparison requires verified patient-level data, clearly defined inclusion criteria, consistent postoperative MRI assessment, and appropriate statistical analysis. Future prospective studies involving larger patient populations and longer follow-up may help clarify the comparative effectiveness of these approaches across different pituitary adenoma subtypes and levels of tumour complexity

CONCLUSION

Endoscopic and microscopic transsphenoidal surgery are established approaches for the management of pituitary adenomas. Their comparative effectiveness should be evaluated using standardized postoperative MRI findings, extent of tumour resection, postoperative complications, and length of hospital stay. Although endoscopic surgery offers a wider field of visualization, the choice of surgical technique should also consider tumour characteristics, cavernous sinus involvement, and surgeon experience. **No definitive conclusion regarding the superiority of either technique can be drawn from the present draft**, as its numerical results are simulated rather than derived from verified patient

records. Further prospective studies using validated clinical data and appropriate statistical analysis are required to establish reliable comparative outcomes.

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