

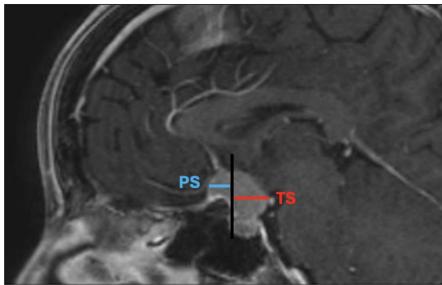
# Refining Surgical Approach Selection for Tuberculum Sellae Meningiomas: A Retrospective Cohort Study

## Background

Tuberculum sellae meningiomas (TSMs) remain a significant surgical challenge due to their proximity to critical neurovascular structures at the anterior skull base, particularly the optic nerves and the supraclinoid carotid arteries. Several grading systems for predicting the morbidity associated with surgical resection of TSMs (especially with regards to visual outcomes) have been well-described. For example, the UCSF score estimates visual outcomes and extent of resection based on tumor size and extent of carotid artery and optic canal involvement.<sup>1</sup> The comparative efficacy of endoscopic endonasal (EEN) versus transcranial approaches remains a subject of ongoing debate, particularly for lesions with high UCSF scores.<sup>2,3</sup>

## Methods

- Retrospective chart review from 2016–2024 of all cases involving surgical resection of a TSM in adult patients by the senior author was performed.
- TSMs were defined as having a **PS/TS ratio  $\leq 0.5$**  as previously described by Henderson et al.: The orthogonal distance along the tumor in the midsagittal plane is measured both anterior (PS) and posterior (TS) to a line drawn through the center of the tuberculum sellae perpendicular to the planum sphenoidale; the **PS/TS ratio [PS/(TS + PS)]** is then calculated.<sup>4</sup> (Figure 1)



- Cases with a PS/TS ratio  $> 0.5$  were considered planum sphenoidale meningiomas and were excluded from further analysis.
- Patient presentation, imaging features, surgical characteristics, pathology, and clinical outcomes data were systematically extracted from patient charts.

Table 1. Imaging features and scores<sup>a</sup>

Parameter	Total N (%) (n=21)	Craniotomy N (%) (n=16)	EEN N (%) (n=5)	p-Value
<b>Largest diameter (cm)</b>	2.9 ± 0.3 (Range: 1.3–5.0)	3.3 ± 0.3	2.0 ± 0.4	<b>0.034*</b>
<b>Multiple meningiomas</b>	3 (14.3%)	2 (12.5%)	1 (20.0%)	-
<b>Imaging features:</b>				
Peri-tumoral edema (on FLAIR)	4 (19.1%)	4 (25.0%)	0 (0%)	-
Optic canal invasion	16 (76.2%)	13 (81.3%)	3 (60.0%)	0.553
ACAs involved	6 (28.6%)	6 (37.5%)	0 (0%)	0.262
ICAs involved	18 (85.7%)	15 (93.8%)	3 (60.0%)	0.128
Sellar extension	19 (90.5%)	14 (87.5%)	5 (100.0%)	1.000
Planum extension	15 (71.4%)	13 (81.3%)	2 (40.0%)	0.115
Sphenoid sinus extension	3 (14.3%)	2 (12.5%)	1 (20.0%)	-
<b>Planum / Tuberculum (PS/TS) Ratio (mean ± SE)</b>	0.40 ± 0.05	0.46 ± 0.01	0.20 ± 0.06	<b>0.024*</b>
<b>UCSF (Magill-McDermott) Score:</b>				
Tumor Score	1.8 ± 0.1	1.9 ± 0.1	1.4 ± 0.2	<b>0.030*</b>
Canal Score	1.1 ± 0.2	1.1 ± 0.2	1.2 ± 0.4	0.846
Artery Score	1.6 ± 0.2	1.8 ± 0.1	1.0 ± 0.4	<b>0.047*</b>
<b>Total Score</b>	4.5 ± 0.3	4.8 ± 0.4	3.6 ± 0.8	0.166

<sup>a</sup> SE indicates standard error; ( ) percentage of cases in each group. A chi-square comparison of distributions was performed for classifier and outcome variables using Fisher's exact test and a t-test comparison of means was performed for continuous variables; \*\*\* = indicates statistical significance for  $\alpha=0.05$ .

## Results

- 21 TSM cases were identified with a mean age of 53.8 years (range 34–82 yrs) with mostly female patients (80.9%). Mean follow-up was 28.2 months.
- A transcranial approach was employed in 16 cases (76.2%) and an EEN approach was used in 5 cases (23.8%). Transcranial approaches most commonly involved a lateral supraorbital craniotomy (81.2%), a bifrontal craniotomy (12.5%), or a cranio-orbitozygomatic approach (6.3%). There were no major differences in patient comorbidities or presenting symptoms between the transcranial and EEN cases, however the majority of the EEN cases (n=3, 60%) were notably re-resections.
- Transcranial cases involved larger tumors (largest diameter 3.3cm vs. 2.0cm,  $p=0.034^*$ ), with a higher PS/TS ratio (0.46 vs. 0.20,  $p=0.024^*$ ), and had a higher UCSF Artery Score (1.8 vs. 1.0,  $p=0.047^*$ ) (Table 1).
- The degree of optic canal invasion, sellar extension, sphenoid sinus extension, ACA involvement, and peritumoral edema were similar between the transcranial and EEN groups.
- Notably, two EEN cases (40.0%) required further interventions for postoperative CSF leaks (Table 2).
- Additionally, two ischemic strokes with only transient focal symptoms were seen only in the transcranial group (12.5%), both involving the artery of Hubner territory.

Table 2. Postoperative outcomes, complications, and follow-up treatments<sup>a</sup>

Parameter	Total N (%) (n=21)	Craniotomy N (%) (n=16)	EEN N (%) (n=5)	p-Value
<b>Visual Outcomes:</b>				
Improved	7 (33.3%)	6 (37.5%)	1 (20.0%)	-
Stable	11 (52.4%)	8 (50.0%)	3 (60.0%)	-
Worse	3 (14.3%)	2 (12.5%)	1 (20.0%)	-
<b>Postoperative complications:</b>				
All complications	9 (42.9%)	6 (37.5%)	3 (60.0%)	0.611
CSF leak (requiring intervention)	2 (9.5%)	0 (0%)	2 (40.0%)	<b>0.048*</b>
Infection	0 (0%)	-	-	-
Hypopituitarism (any axis)	3 (14.3%)	2 (12.5%)	1 (20.0%)	1.000
New/worsened visual deficit	3 (14.3%)	2 (12.5%)	1 (20.0%)	1.000
Other focal neurological deficit	2 (9.5%)	1 (6.3%)	1 (20.0%)	1.000
Ischemic stroke (iatrogenic)	2 (9.5%)	2 (12.5%)	0 (0%)	1.000
<b>Return to OR on index admission</b>	1 (4.8%)	0 (0%)	1 (20.0%)	0.238
<b>Transient DI</b>	1 (4.8%)	0 (0%)	1 (20.0%)	0.238
<b>Permanent DI</b>	2 (9.5%)	2 (12.5%)	0 (0%)	1.000
<b>Recurrence (during follow-up period)</b>	4 (19.1%)	3 (18.8%)	1 (20.0%)	1.000
<b>Re-resection (during follow-up period)</b>	3 (14.3%)	3 (18.8%)	0 (0%)	0.549
<b>Adjuvant RT (SRS)</b>	1 (4.8%)	1 (6.3%)	0 (0%)	-

<sup>a</sup> SE indicates standard error; ( ) percentage of cases in each group. A chi-square comparison of distributions was performed for classifier and outcome variables using Fisher's exact test and a t-test comparison of means was performed for continuous variables; \*\*\* = indicates statistical significance for  $\alpha=0.05$ .

## Conclusions

This retrospective cohort series, while limited by sample size and single-surgeon experience, validates the utility of the existing TSM scoring systems and provides a basis for further exploration of the benefits and limitations of transcranial and EEN approaches for TSMs.

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