

# Surgical Outcomes of the Petroclival Meningiomas Related to Tumor Type: Classic Tumor Classification and Recent Updated Surgical Approaches

Dong-Won Shin, MD<sup>1</sup>; Joonho Byun, MD<sup>2</sup>; Hyun Seok Lee, MD<sup>3</sup>, Heejun Yoo<sup>4</sup>, and Chang-Ki Hong<sup>5</sup>

<sup>1</sup>Department of Neurosurgery, Gachon University Gil Medical Center, Gachon University College of Medicine, Incheon, Republic of Korea; <sup>2</sup>Department of Neurosurgery, Korea University Guro Hospital, Korea University College of Medicine, Seoul, Republic of Korea; <sup>3</sup>Department of Neurosurgery, Konkuk University Medical Center, Seoul, Republic of Korea; <sup>4</sup>Department of Neurosurgery, Chung-Ang University Gwangmyeong Hospital, Gyeong-Gi, Republic of Korea; <sup>5</sup>Department of Neurological Surgery, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Republic of Korea

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## Abstract

**Purpose:** To evaluate surgical outcomes of petroclival meningiomas based on tumor types and approaches, including the endoscopic transorbital approach (eTOA).

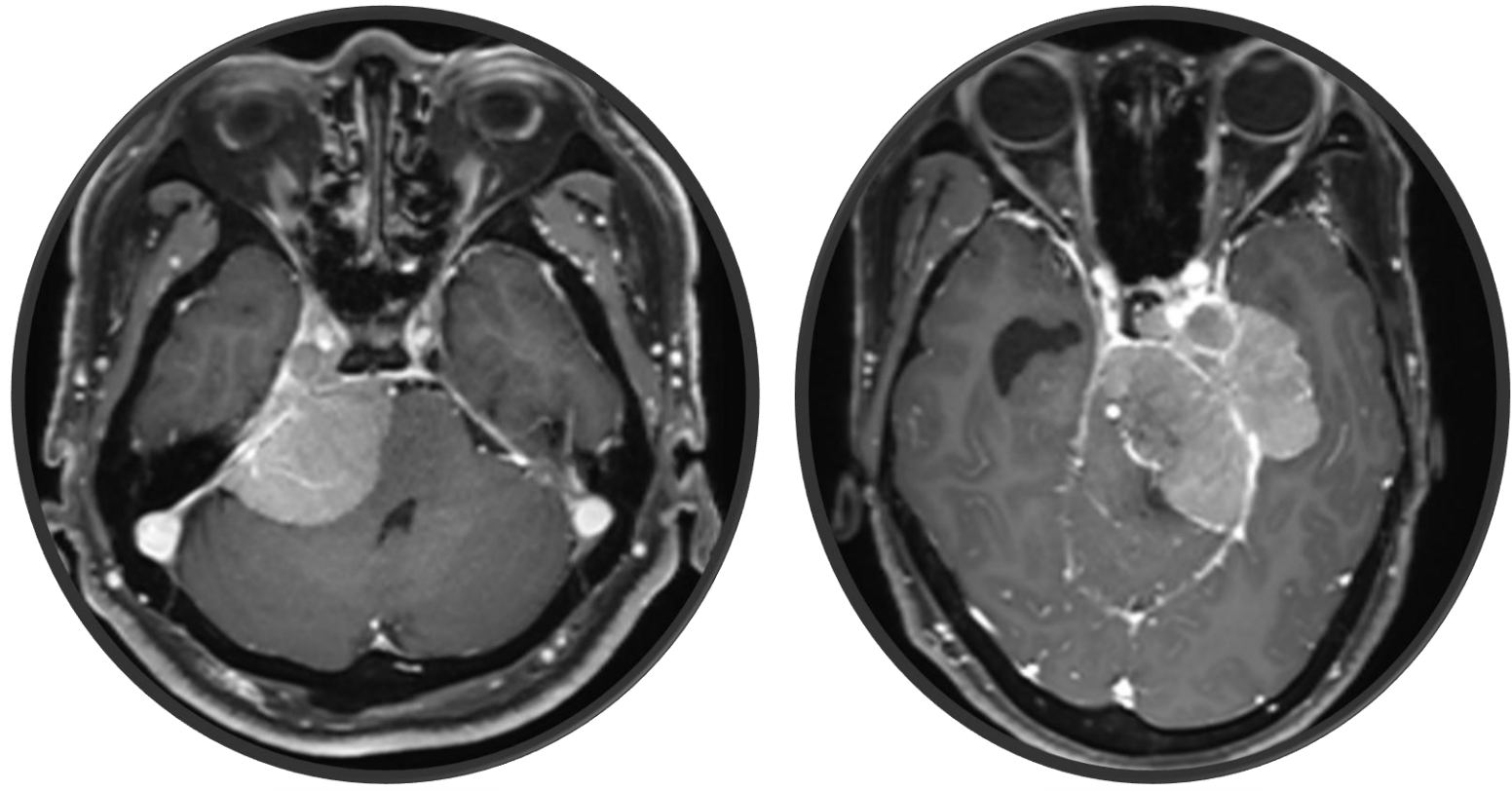
**Methods:** This retrospective study reviewed 47 patients who underwent surgery for petroclival meningiomas from March 2021 to December 2022.

**Results:** Patients' median follow-up was 13.6 months. The mean tumor size was 3.2 cm. The most common surgical approach was anterior petrosal approach (63.8%). Gross total resection (GTR) was achieved more frequently in smaller tumors (mean size 3.1 cm,  $p = 0.038$ ) and those with high T2WI signal intensity ( $p = 0.013$ ). Postoperative complications included abducens nerve palsy in 11 patients (23.4%), followed by oculomotor and trochlear nerve palsies in 6 patients (12.8%). Surgery-related complications also included cerebrospinal fluid leakage in 4 patients (8.7%) and temporal lobe injury in 5 patients (10.6%).

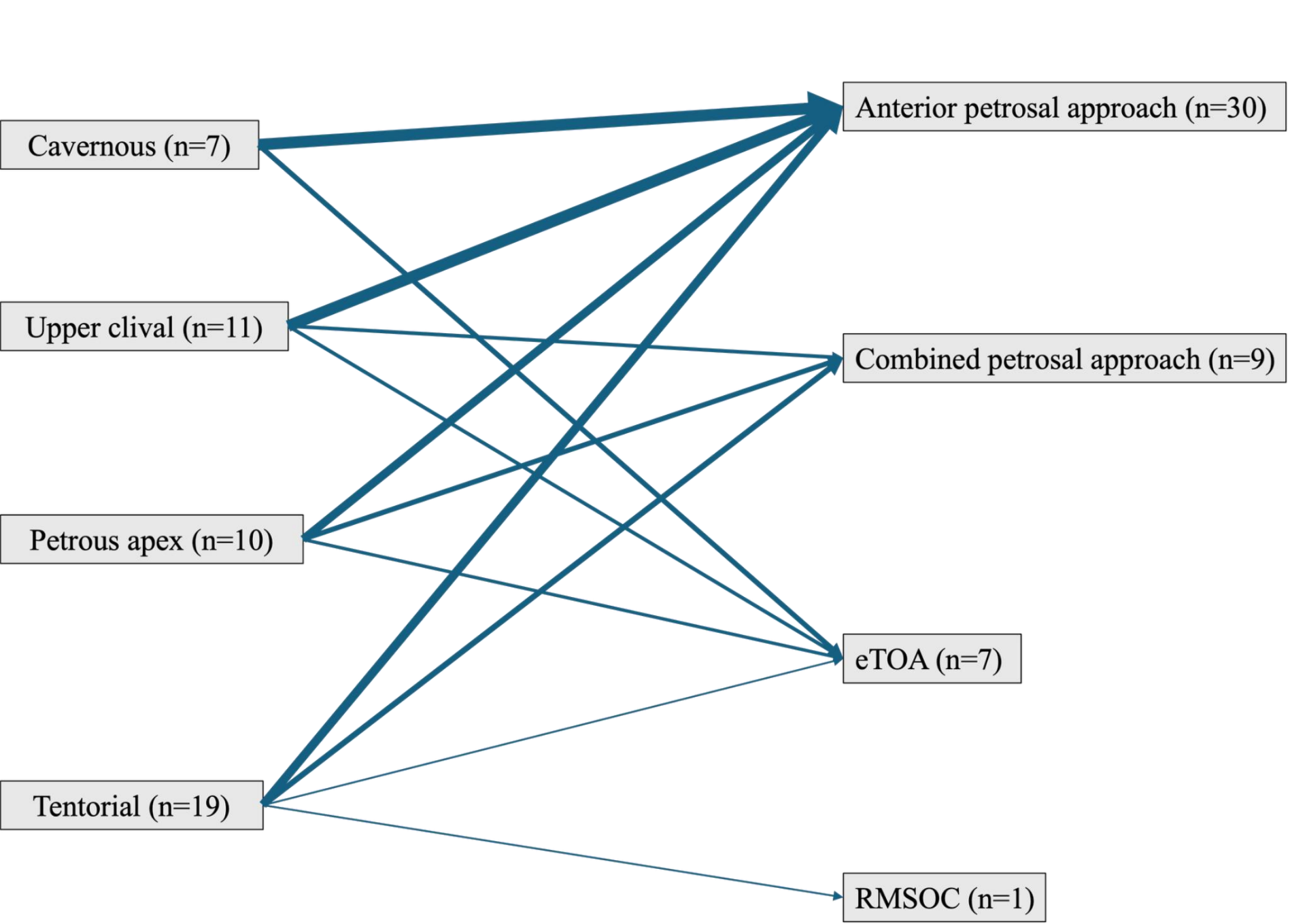
**Conclusion:** Surgical outcomes of petroclival meningiomas are influenced by tumor type and approach. GTR is associated with smaller tumor size and specific imaging characteristics. While the eTOA shows promise, it cannot fully replace open craniotomy.



## Which approach?



**Figure 1.**  
**a:** upper eyelid incisions for transorbital approach  
**b:** U-shape skin incision for combined petrosal approach  
**c:** Curvilinear incision for anterior petrosal approach



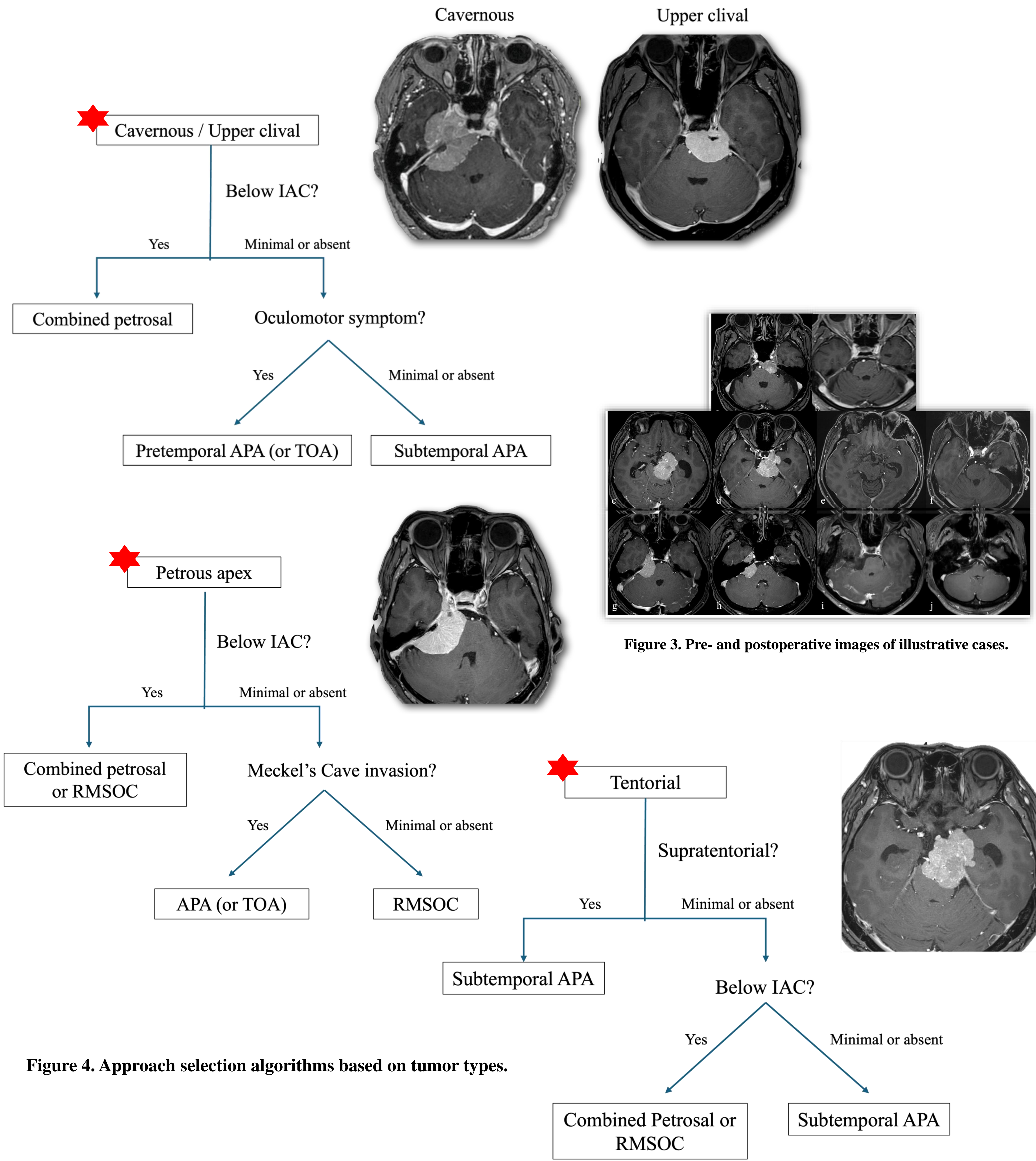
**Figure 2. Tumor types and selected approaches in the present study.**

	GTR (n=32)	STR (n=15)	p value
Male	6 (18.8%)	3 (20.0%)	1
Age	52	52	0.568
Size (2SD)	3.1 [2.5; 4.0]	3.6 [3.0; 5.2]	0.038*
Type			0.108
- cavernous	2 ( 6.2%)	5 (33.3%)	
- upper-clival	8 (25.0%)	3 (20.0%)	
- petrous apex	8 (25.0%)	2 (13.3%)	
- tentorial	14 (43.8%)	5 (33.3%)	
T2-WI			0.013*
- high	12 (37.5%)	0 ( 0.0%)	
- intermediate	14 (43.8%)	8 (53.3%)	
- low	6 (18.8%)	7 (46.7%)	
Approach			0.005*
- anterior petrosal	25 (78.1%)	5 (33.3%)	
- combined petrosal	2 (6.2%)	7 (46.7%)	
- eTOA	4 (12.5%)	3 (20.0%)	
- RMSOC	1 ( 3.1%)	0 (0.0%)	
Consistency			0.137
- soft	13 (40.6%)	2 (13.3%)	
- intermediate	11 (34.4%)	6 (40.0%)	
- hard	8 (25.0%)	7 (46.7%)	
WHO gradeI	26 (81.2%)	11 (73.3%)	0.814
CS invasion	9 (28.1%)	10 (66.7%)	0.028*
Brainstem edema	3 ( 9.4%)	6 (40.0%)	0.037*
Vessel encasement	6 (18.8%)	7 (46.7%)	0.1
Endoscope assist	5 (15.6%)	3 (20.0%)	1
RT/SRS prior to surgery	5 (15.6%)	3 (20.0%)	1

**Table 3. Comparison of clinical features between GTR and STR.**

Complications	No. (%)	improved	no change	worsened
New CN deficits				
III	6 (13)	4	2	
IV	6 (13)	2	4	
V	5 (11)	2	3	
VI	11 (23)	5	6	
VII	2 (4)	1	1	
Lower CN	1 (2)	1		
Temporal lobe injury	5 (11)	3		
Brainstem infarction	1 (2)		1	
Hemorrhage	1 (2)		1	
CSF leakage	4 (9)	4		

**Table 4. Surgery-related complications**



**Figure 4. Approach selection algorithms based on tumor types.**

Type	cavernous (7)	upper-clival (11)	petrous apex (10)	tentorial (19)	Total (47)	p value
CN IV	1	2	0	0	3	0.153
CN V	6	3	8	11	28	0.037*
CN VI	4	1	0	0	5	0*
CN VII-VIII	0	2	4	5	11	0.269
Lower CN	0	0	1	1	2	0.646
Long Tract Sign	0	2	1	1	4	0.521

**Table 2. Preoperative cranial nerve deficits**