Tuberculum sellae meningioma treatment

The treatment of choice for Tuberculum sellae meningioma is surgical removal with the goal of improving vision and achieving complete tumor removal.

Options

Two options exist to remove these tumors: the transcranial approach (TCA) and the endonasal endoscopic approach (EEA). Significant controversy exists regarding which approach provides the best results and whether there is a subset of patients for whom an EEA may be more suitable. Comparisons using a similar cohort of patients, namely, those suitable for gross-total resection with EEA, are lacking from the literature.

Endoscopic endonasal approach has several advantages for meningiomas in the medial optic canal and associated with progressive visual disturbance. In surgery of tuberculum sellae meningiomas, optic canal decompression and exploration inside the optic canal are important procedures to avoid symptomatic recurrence, which may be facilitated by the endoscopic endonasal approach. optic atrophy and duration of visual deterioration are predictive factors for postoperative visual outcomes.

The results of a study of Kong et al., support EEA over TCA, at least with respect to visual improvement with acceptable complications, although TCA is still an effective approach for TS meningioma.

History

In the early 20th century, the first successful surgical removal of a tuberculum sellae meningioma (TSM) was performed and described by Harvey Williams Cushing.

It soon became recognized that TSM pose a formidable challenge for skull base surgeons because of their deep and sensitive location, proximity to critical neurovascular elements, and often dense and fibrous nature. Because of this, over the next several decades controversy transpired regarding their optimal method of resection. Early attempts involved utilization of open transcranial routes. This included classic bilateral and unilateral frontal approaches, followed by pterional approach or frontotemporal approaches, which have evolved to incorporate skull base modifications, such as the supraorbital, orbitozygomatic, and orbitopterional approaches. Minimally invasive supraorbital keyhole approaches through eyebrow incisions have also been adopted. Over the past 25 years, the microsurgical transsphenoidal approach, classically used for pituitary and parasellar tumors, was modified to resect suprassellar TSM via the extended transsphenoidal approach. More recently, with the evolution of endoscopic techniques, resection of TSM has been achieved using purely endoscopic endonasal transplanum transtuberculum approaches. Although each of these techniques has been successfully described for the treatment of TSM, the question still remains: is it better to access and operate on these lesions via a traditional, transcranial avenue, or are they better treated via endoscopic endonasal techniques?

Management ideally consists of gross-total resection without injury to neighboring vital structure. The difficulty in surgically excising a Tuberculum sellae meningioma stems from its relationship to the optic nerves and chiasma and to the anterior cerebral and internal carotid arteries and their
perforators, which are frequently encased and/or displaced.

The visual outcome is a matter of concern in surgical treatment. Because the inferior surface of the optic nerve and chiasm receives its blood supply from superior hypophyseal arteries that arise from the supraclinoid segment of the internal carotid artery, surgical dissection of the tumor from the inferior side of the optic apparatus is a more formidable procedure than removal of tumors above the optic apparatus.

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Complete tumor resection with preservation or improvement of visual function is the goal of tuberculum sellae meningioma (TSM) treatment.

ICA. Internal Carotid Artery
ON. Optic Nerve
Oa. Ophtalmic Artery
rICA. Right Internal Carotid Artery

**Lateral subfrontal approach**

In 51 patients treated surgically for TSM between 2003 and 2010, with special attention to surgical
Technique, visual outcomes, and prognostic factors for treatment outcome. All patients were operated via the lateral subfrontal approach. The cohort mean age and Karnofsky performance status \( (\text{KPS}) \) on admission was \( 57.1 \pm 13.6 \) and \( 84.3 \pm 11.7 \), respectively. The most common presenting sign was visual impairment. The mean tumor size was \( 29.4 \pm 10.7 \) mm. In 45 of the patients \( (88.2\%) \), gross total resection was achieved. Improvement and/or preservation of visual acuity and visual field were achieved in 95.9\% and 85.3\%, respectively. Visual functions on admission were found to be the strongest predictors for postoperative improvement in visual outcome, followed by better KPS on admission, smaller tumor size, and young age. Postoperative neurological complications included cerebrospinal fluid \( (\text{CSF}) \) leak, meningitis, and postoperative seizures. TSM can be safely operated on through the lateral subfrontal approach. A high percentage of complete tumor resection and excellent visual outcomes are achieved using this technique \( ^6 \).

**Lateral supraorbital approach**

Can be removed with relatively low morbidity and mortality. Surgical results with this fast and simple approach are similar to those obtained with more extensive, complex, and time-consuming approaches \( ^7 \).

**Transsphenoidal approach**

Surgical treatment in the early stage of the disease may result in a better visual outcome. The literature supports transsphenoidal approach for the resection of TSMs with significant optic nerve compromise and limited lateral extension.

Endoscopic transnasal resection may have an equivalent if not superior outcome over transcranial surgery in visual outcome. CSF leaks are still a challenge but may improve with the use of vascularized nasoseptal flaps \( ^8 \).

**Endoscope assistance during transcranial surgery**

All surgical procedures for TSM performed between 2003 and 2015 in the Department of Neurosurgery, University Medicine Greifswald, were retrospectively analyzed. Special attention was paid to the postoperative visual outcome. RESULTS During the study period, 15 patients \( (12 \text{ female and 3 male}) \) underwent surgery for TSM. Gross-total resection was achieved in 14 cases \( (93.3\%) \) and near-total resection in 1. One patient suffered from a major stroke during surgery and had to be excluded from further analyses. No other complications occurred. Preoperatively, visual acuity was disturbed in 12 patients \( (80\%) \) and visual field deficits were present in 11 patients \( (73.3\%). \) In 3 patients \( (20\%) \), the TSM was an incidental finding. Postoperatively, ophthalmological examination revealed an improvement of visual acuity in 10 \( (90.9\%) \) of 11 patients and improvement of visual field deficits in 9 \( (90\%) \) of 10 patients; no deterioration of visual acuity or visual field was seen in any patient. Visual acuity and visual field improvement was observed in all patients who had surgery within 3 years after the onset of visual disturbances. No tumor recurrence was observed during follow-up \( (\text{mean 32 months, range 3-134 months}) \). TSMs were approached via a frontolateral craniotomy in 7 patients and via a supraorbital craniotomy in 8. The use of the endoscope as an assistive device led to improved tumor visualization and consequent removal in areas that were hidden in the microscopic view in 6 patients \( (40\%) \). CONCLUSIONS The present series confirms a favorable visual outcome after TSM surgery via supraorbital or frontolateral endoscope-assisted approaches. With endoscopic visualization, major manipulation of the optic apparatus could be avoided, perhaps affecting the favorable visual outcome \( ^9 \).
Endoscopic endonasal approach (EEA)

see endoscopic endonasal approach.

Fernandez-Miranda et al present the technical and anatomical nuances needed to perform an endoscopic endonasal removal of a tuberculum sellae meningioma. The patient is a 47-year-old female with headaches and an incidental finding of a small tuberculum sellae meningioma with no vascular encasement, no optic canal invasion, but mild inferior to superior compression of the cisternal segment of the left optic nerve. Neuroophthalmology assessment revealed no visual defects. Treatment options included clinical observation with imaging follow-up studies, radiosurgery, and resection. The patient elected to undergo surgical removal and an endonasal endoscopic approach was the preferred surgical option. Preoperative radiological studies showed the presence of an osseous ring between the left middle and anterior clinoids, the so-called carotico-clinoidal ring. The surgical implications of this finding and its management are illustrated. The surgical anatomy of the suprasellar region is reviewed, including concepts such as the chiasmatic sulcus and limbus sphenoidale, medial and lateral optico-carotid recesses, and the paraclinoidal and supraclinoidal segments of the internal carotid artery. Emphasis is made in the importance of exposing the distal dural ring of the internal carotid artery and the precanalicular segment of the optic nerve for adequate intradural dissection. The endonasal route allows for early coagulation of the tumor meningeal supply and extensive resection of dural attachments, and importantly, provides an inferior to superior access to the infrachiasmatic region that facilitates complete tumor removal without any manipulation of the optic nerve. The lateral limit of dural removal is formed by the distal dural ring, which is gently coagulated after the tumor is resected. A 45° scope is used to inspect for any residual tumor, in particular at the entrance of the optic nerve into the optic canal and at the most anterior margin of the exposure (limbus sphenoidale). The steps for reconstruction are detailed and include intradural placement of dural substitute and extradural placement of the nasoseptal flap. The nuances for proper harvesting, positioning, and reinforcement of the flap are described. No lumbar drain was used. The patient had an uneventful recovery with no CSF leak or any other complications. Imaging follow-up at 6 months showed complete removal of the tumor. The patient had no sinonasal or neurological symptoms, and olfaction was fully preserved. The video can be found here: http://youtu.be/kkuV-yEHMg.

Recent reports of surgical resection of tuberculum sellae meningiomas through an endoscopic endonasal approach (EEA) have provided an alternative to transcranial approaches in selected cases. However, these published reports have been limited by small sample size from single institutions.

A systematic review of the literature and analyzed pooled data for descriptive statistics on short-term morbidity and outcomes, compared EEA to transcranial approaches reported during the same time-frame. Six studies (49 patients) met inclusion criteria for EEA. A pooled analysis of transcranial results reported during a similar time period yielded 11 studies (412 patients). There were no differences in rate of gross total resection or peri-operative complications between the two groups. Although the EEA group was associated with higher rates of CSF leak (p < 0.05; OR 3.9; 95 % CI 1.15, 15.75), EEA were also associated with significantly higher rates of post-operative visual improvement compared to transcranial approaches (p < 0.05; OR 1.5; 95 % CI 1.18, 1.82). A systematic review of the small series of EEA for tuberculum sellae meningiomas published to date revealed similar extent of resection and morbidity, but increased post-operative visual improvement compared to transcranial approaches during a similar time period. Long-term follow-up will be needed to define recurrence rates of EEA as compared to transcranial approaches. Cautious use of EEA for the removal of smaller tuberculum sellae meningiomas after formal endoscopic training may be warranted.
The **internal carotid artery** (ICA) and the **patent cavernous sinus** were detected with the **indocyanine green** (ICG) endoscope in real time and at high resolution. The ICG endoscope is very useful. Hide et al. suggest that the real-time observation of the blood supply to the **optic nerves** and pituitary helps to predict the preservation of their function.\(^{1[2]}\)


