



Significance of the Tentorial Alignment in Protecting the Occipital Lobe with the Poppen Approach for Tentorial or Pineal Area Meningiomas

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■ **OBJECTIVE:** We aimed to identify the factors that can predict the risk of occipital lobe damage preoperatively when resecting tumors located at the tentorial or pineal regions with the occipital-transtentorial approach (Poppen approach).

■ **METHODS:** In 27 consecutive patients who underwent tumor resection with the Poppen approach for tentorial or pineal region meningiomas, the following morphologic parameters were assessed on a preoperative magnetic resonance imaging: (1) tentorial angle, (2) tentorial length, and (3) the shortest distance from the confluence of the sinus to the tumor. These parameters, together with tumor size, texture, and resection extent, were correlated with occipital lobe damage by using the one-way analysis of variance, χ^2 , or Fisher's exact tests.

■ **RESULTS:** The mean value was $55.3^\circ \pm 5.6^\circ$ (range, $45^\circ - 66^\circ$) for the tentorial angle, which was significantly associated with the occipital lobe damage grades ($P = 0.008$), but this was not the case for the tentorial length ($P = 0.802$) and the shortest distance from the confluence of the sinus to the tumor ($P = 0.695$). Interestingly, age was also strongly associated with occipital lobe damage risk ($P = 0.020$). The patients in the subgroup with no occipital damage (grade 4) were the youngest (aged 47.3 years), compared with other grades, with age of 58.0 years for grade 1, 54.3 years for grade 2, and 58.6 years for grade 3. These 2 parameters were also significant after multivariate analysis. No correlation was observed between either tumor nature or the extent of resection and damage grades.

■ **CONCLUSIONS:** The risk of occipital lobe damage increases in the presence of a steep tentorial angle during the Poppen approach for tentorial or pineal area tumors. Awareness of such anatomic features preoperatively is important for minimizing operative complications.

INTRODUCTION

Tentorial meningiomas (TMs) are complex entities that require multiple surgical approaches, according to the tumor position and its relationship with the surrounding structures.^{1,2} Based on the tumor's location and direction of growth, there could be several surgical approaches possible for removing the tumor safely.³ The Poppen approach, or occipital interhemispheric transtentorial approach, is often undertaken if the tumor is located at the posteromedial or anteromedial tentorium, or even along the tentorial notch.^{1,4,5} Similarly, pineal region meningiomas, especially falcotentorial meningiomas, are usually surgically resected with the Poppen approach, which usually causes occipital lobe damage.^{6,7} Occipital lobe damage may cause hematoma, which has to be evacuated by a secondary operation and may lead to vision problems such as hemianopia.⁸⁻¹⁰

Thus far, there has been no research on the factors associated with this severe surgical complication and how to decrease the risk. In resecting tumors with the Poppen approach, one of the most important procedures is lifting up the occipital lobe on the retractor, which can cause local hyperperfusion of the retracted occipital region and even visual field defect without obvious occipital lobe damage seen on a computed tomography (CT) scan.¹¹ In our experience, whether the tentorium is steep or flat can be associated with the difficulty of lifting up the occipital lobe, and this might be the factor that correlates to the extent of occipital

Key words

- Meningiomas
- Poppen
- Tentorial angle
- Tentorium

Abbreviations and Acronyms

- CSF:** Cerebrospinal fluid
- CT:** Computed tomography
- TA:** Tentorial angle
- TM:** Tentorial meningioma

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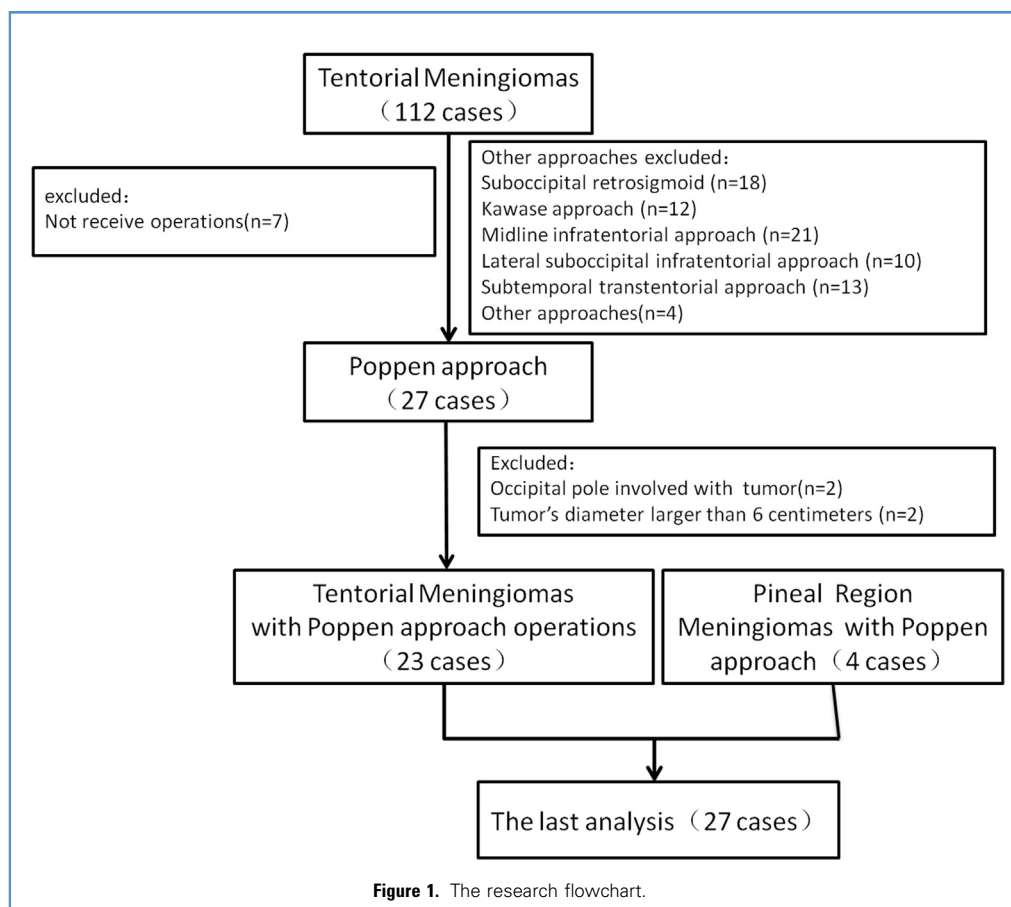
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lobe damage. The tentorial angle (TA) was used to quantify the slope of the tentorium with several calculation methods.¹²⁻¹⁴

In addition to the TA, there might be other factors associated with occipital lobe damage, including tumor characteristics such as the direction of growth (superior or inferior), the texture (soft or hard), and the tumor size, and intraoperative parameters such as blood loss volume, length of operation, and the tumor resection grade. All of these parameters should be analyzed to determine which factors are independent and should be given more attention to decrease the occipital lobe damage complication during surgery.

This research summarizes our retrospectively analyzed data of 27 patients with tentorial or pineal region meningiomas. We aimed to identify the factors that can predict the risk of occipital lobe damage, therefore patients can be informed possible complications with the Poppen approach. Our observations provided the basis for analyzing the relationship between the morphology of the tentorium, especially the TA, and the risk of damage to the occipital lobe in resecting tentorial or falcotentorial meningiomas with the Poppen approach, and provide further insight into how to lower the risk with appropriate surgical skills.

METHODS

By scanning the clinical data available at Beijing Tiantan Hospital, we found 112 cases of TMs admitted to the neurosurgical

department between 2012 and 2015. Only the TM cases treated with the Poppen approach were included in the research. Two patients in whom tumors involved the occipital pole were excluded, and 2 other patients with tumors >6 cm that were accompanied with hydrocephalus were also excluded. The research flowchart is shown in **Figure 1**. The records of all 23 patients with TM, plus another 4 cases with pineal falcotentorial meningiomas on which tumor resection with the Poppen approach was performed, were retrospectively reviewed for clinical presentation, radiologic imaging, surgical record, and outcome. TA was measured as the angle between the tentorium and the line drawn from the hard palate (indicated in **Figure 2E**) according to the criteria by Burak Sade and Joung H. Lee.¹² The extents of occipital lobe damage were divided into 4 categories: hematoma (grade 1), punctate hemorrhage (grade 2), brain edema (grade 3), and normal (grade 4), based on the postoperative CT scan or magnetic resonance imaging (**Figure 2**).

The extent of tumor resection for meningiomas was classified according to the Simpson grading system for tumor removal.¹⁵

Intergroup frequencies among the 4 grades of occipital lobe damage were compared using the one-way analysis of variance for continuous variables such as patient age, maximum diameter of tumor, TA, and tentorial length, and using the χ^2 /Fisher exact test method for categorical variables such as sex, tumor location,

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