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Technical Note

Modified Trans-Middle Temporal Gyrus Approach for Trigonal Tumor to Preserve Visual Field

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Objective : We evaluated a modified trans-middle temporal gyrus (MTG) approach with good postoperative visual preservation for patients with trigonal tumors.
Methods : Three patients with a trigonal tumor were treated via the modified trans-MTG approach guided by a neuro-navigator. Modified trans-MTG approach involve the incision at the MTG within 5 mm to the superior temporal sulcus. This approach makes a proper trajectory to the trigone but also reduces the retraction injury of MTG as little as possible to prevent postoperative visual field defect. Preoperative and postoperative visual field examination using perimetry was performed to evaluate the visual field.
Results : Three patients underwent surgery for lymphoma in the right trigone, meningioma in the left trigone, and focal enhancing nodule in the right paratrigonal area, respectively. In case of lymphoma, preoperative examination showed a left homonymous hemianopsia : one week later after surgery, a visual field examination was performed and revealed improvement of the visual field defect. In case of the meningioma, the preoperative examination showed no visual field defect : one month later, the visual field had no defect. In case of the enhancing nodule, preoperative visual field testing revealed a partial left homonymous hemianopsia. Visual examination within one month after surgery showed no visual field defect. All three patients treated with the modified trans-MTG approach showed no visual deterioration after surgery.
Conclusion : The modified trans-MTG approach provides a safe and useful technique for trigonal tumors without postoperative visual field deterioration and affords adequate exposure of the trigonal tumor with a short trajectory.

Key Words : Trigonal tumor · Visual field · Preservation.

INTRODUCTION

The occurrence of tumors arising at the trigone of the lateral ventricle is comparatively infrequent[1,13]. Lateral ventricular tumors including the trigone are divided into true intraventricular and paraventricular tumors according to the Koos and Laubichler[9] classification. The former include meningiomas, choroid plexus papillomas, ependymomas, colloid cysts, or metastatic tumors, and the latter include astrocytomas, oligodendrogliomas, or glioblastomas[1,13]. A variety of surgical approaches have been introduced for the management of these tumors, such as the middle temporal gyrus (MTG), lateral temporoparietal, occipital lobe, superior parieto-occipital, and transcallosal approches[12,13]. Among them, the MTG approach is the most widely used procedure for trigonal tumors because of its short trajectory, early identification of the anterior choroidal artery[4,8,12], and wide operative field[1-3,12]. However, the MTG incision may result in serious neurological deficits such as visual field defects, language impairment in the dominant hemisphere, or memory disturbance[1,8]. Because the MTG incision is performed parallel to the optic radiation, optic radiation injury may be theoretically minimized[10-12]. However, the postoperative occurrence of visual field defects after MTG incision is still reported in the literature[5,8,10-12]. Possible mechanism of the postoperative visual field defect is due to the retraction injury of the optic radiation by the standard MTG approach.

In this article, the definition used for the trans-middle temporal gyrus (trans-MTG) approach was a transcortical approach through the MTG not including transsulcal approach. This approach had been reported for the removal of the trigonal tumors and explained the procedure as the incision of MTG[1,7]. Modified trans-MTG approach involved the incision at the MTG within 5 mm to the superior temporal sulcus. During operation, MTG was gently retracted toward the superior temporal sulcus and the retraction injury of MTG could be minimal. The goal of this report is to introduce the modified trans-MTG

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approach and report on good postoperative visual preservation when used for the trigonal tumor removal.

MATERIALS AND METHODS

Three patients with a trigonal tumor were treated with a modified trans-MTG approach guided by the neuro-navigator. Preoperative and postoperative visual field examination with perimetry was performed to evaluate the visual field. Serial neurological changes were closely observed to detect other postoperative complications.

Surgical technique

A small craniotomy was performed under general anesthesia. After dural opening, we could make a shortest trajectory to reach trigonal or paratrigonal tumor under the neuronavigation guidance. A transverse cortical incision of approximately 15-20 mm was made at the MTG within 5 mm to the superior temporal sulcus (Fig. 1). The gray and white matter were divided carefully with suction and bipolar cutting toward the entry point of the trigone by use of a neuronavigation system and then gently retracted toward the superior temporal sulcus with or without brain retractor. When trigone was reached, cerebrospinal fluid (CSF) was drained through the trigonal opening and the glomus of the choroid plexus was identified. After drainage of ventricular CSF, trigonal tumor was exposed and removed by use of gentle retraction.

RESULTS

This approach made a proper trajectory to the trigone but also minimized the retraction injury of middle temporal gyrus as little as possible, which might result in postoperative visual field defect.

Case 1 : A patient with a right trigonal tumor

A 63-year-old man with left hemiparesis was transferred to our department with a history of seizure. Brain computerized tomography (CT) showed a high attenuated mass with strong enhancement at the right trigone. Brain magnetic resonance images (MRI) revealed iso-signal intensity on both T1-weighted (T1W) and T2-weighted (T2W) images with perilesional edema, and strong enhancement on T1W images with gadolinium (Fig. 2A, B). Preoperative visual field examination showed bitemporal hemianopsia (Fig. 3A). Tumor removal was done with the modified trans-MTG incision and histopathological examination confirmed the diagnosis of lymphoma. One week later after surgery, visual field examination was performed and showed improvement of the visual field defect (Fig. 3B). There were no postoperative complications or additional neurological deficits. Follow-up MRI showed minimal encephalomalatic change around the trigone and the surgical trajectory (Fig. 2C, D).

Case 2 : A patient with a left trigonal tumor

A previously healthy 40-year-old woman visited a community hospital suffering from headache, nausea, and vomiting. A brain CT showed a slightly high attenuated mass with strong enhancement in the left trigone. A brain MRI was low on T1W, iso-signal on T2W, and strong enhancement on T1W image with gadolinium (Fig. 4A, B). Preoperative examination showed no field defect. The enhancing mass was totally removed with

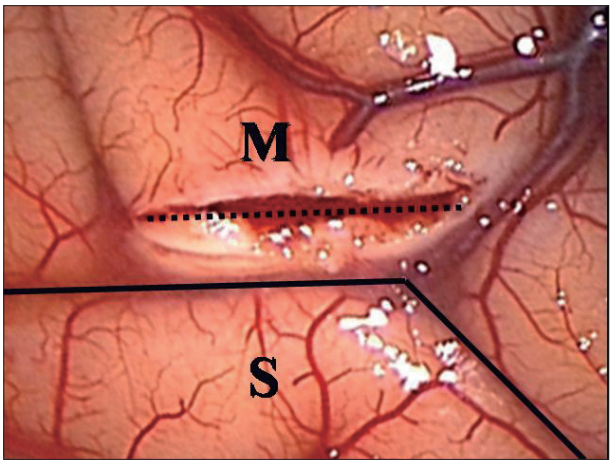

Fig. 1. Modified trans-MTG approach. A shortest trajectory to reach trigonal or paratrigonal tumor was made under the neuronavigation guidance. Photographic image shows modified trans-MTG incision within 5 mm to the STS. M : MTG S : superior temporal gyrus, Dotted line : modified trans-MTG incision, Solid line : superior temporal sulcus, MTG : middle temporal gyrus STS : superior temporal sulcus.

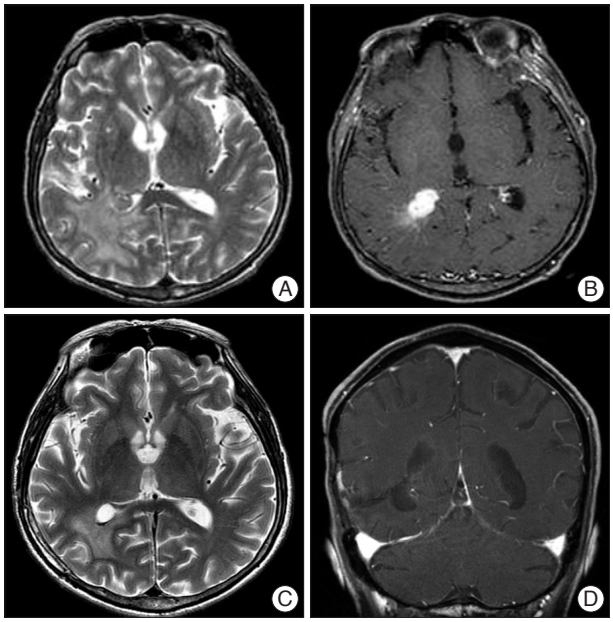

Fig. 2. Case 1: Preoperative and postoperative magnetic resonance (MR) images. A : Preoperative axial MR image showing iso-signal intensity on T2-weighted image with perilesional edema. B : Strong enhancement on T1 weighted gadolinium enhanced image. C : Postoperative follow-up axial MR image showing minimal encephalomalatic change around the trigone. D : Postoperative follow-up coronal MR image showing the surgical trajectory.

the modified trans-MTG approach. The tumor had the characteristics of a well-capsulated hard mass. Histopathological examination confirmed the diagnosis of a meningioma. One month later, postoperative visual field examination revealed no visual field defect. The postoperative clinical course was uneventful without any complication.

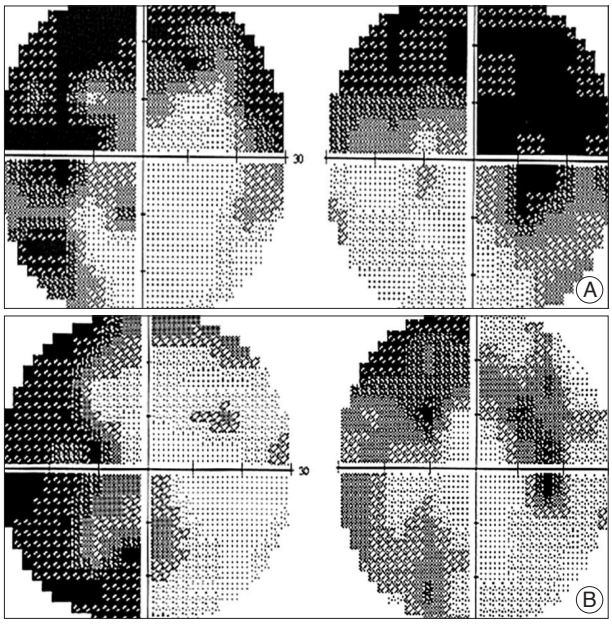

Fig. 3. Case 1 : Preoperative and postoperative visual field examination. A : Preoperative visual field examination showing left homonymous hemianopsia. B : Postoperative visual field examination showing the improvement of visual field defect.

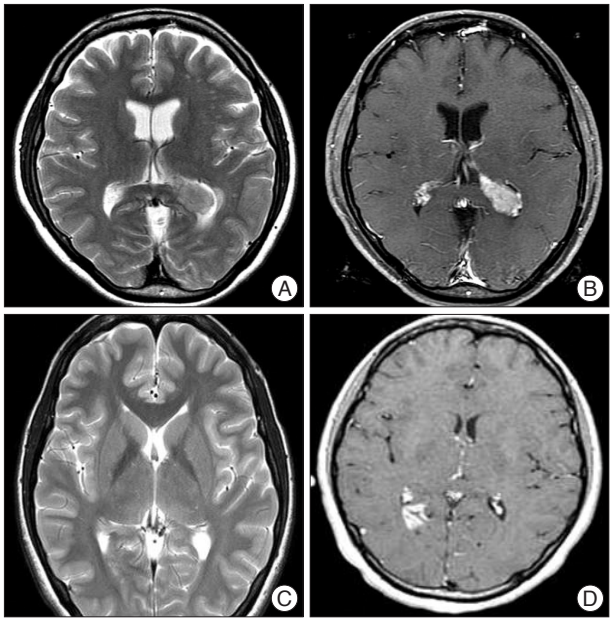

Fig. 4. Case 2 and 3 : Preoperative magnetic resonance (MR) images. A : Preoperative axial MR image showing iso-signal intensity on T2-weighted (T2W) scan. B : Strong enhancement on T1-weighted (T1W) scan with gadolinium. C : Preoperative axial MR image showing no mass lesion on T2W scan. D : Strong enhancement on T1W image with gadolinium at the paratrigonal occipital area.

Case 3 : A patient with a right paratrigonal lesion

A 21-year-old woman visited our department with a history of a visual field defect. She had no neurological symptoms or signs except for a visual problem. The brain CT with enhancement showed no mass lesion. A brain MRI was performed immediately. Both T1W and T2W images failed to visualize a definite mass (Fig. 4C). However, the T1W scan with gadolinium revealed a strong enhancing mass at the paratrigonal occipital area (Fig. 4D). Preoperative visual field examination showed a left homonymous upper quadrantanopsia. The patient underwent an open biopsy through the modified trans-MTG incision. Histopathological examination confirmed the diagnosis of focal infarction. The postoperative clinical course was uneventful without any complication. One month later after surgery, visual field examination was performed and revealed no visual field defect.

DISCUSSION

The advantages of both the MTG and the modified MTG approach include a short trajectory, early identification of the anterior choroidal artery[4,8,12], as well as a wide operative field[1-3,12]. Because a cortical incision is performed directly over the trigone, the depth into the brain is minimized[8]. Most tumors arising from the region of the trigone receive their arterial supply from the anterior or posterior choroid artery[4]. The early identification of these arteries facilitates ligation of feeding vessels and a good operative field[4]. Fornari et al.[6] reported that the MTG approach provided the only possible method to reach the intraventricular segment of the anterior choroidal artery. A horizontal transcortical incision, along the posterior portion of the MTG, would permit the surgeon to elevate the tumor and to clip the feeding vessels before removal[4]. By debulking the tumor at the trigone after devascularization from the choroid plexus, sufficient decompression is possible and a wide operative field is obtainable[12]. Through only a 15-20 mm cortical incision, a remarkably wide exposure is accomplished once the ependyma is opened[3]. Furthermore, the dilatation of the inferior horn of the lateral ventricle plays an important role in provision of a wide operative field[1].

The optic radiations run inferolaterally to the ventricle[1]. The anterior bundle of the optic radiation initially pass over the roof of the temporal horn, then turns backward, forming Meyer's loop around the tip of the temporal horn. Then it passes posteriorly along the lateral wall of the temporal horn, the roof of the trigone, and finally back to the occipital visual center[10,11,14]. Theoretically, the horizontal incision, parallel to the optic radiation, will not damage the optic radiation[10-12]. However, most of the patients that had undergone MTG technique suffered from a postoperative visual field defect. We performed retrospective review of 25 patients with trigonal or paratrigonal tumors treated by the MTG approach from 1994 to 2005 in our hospital to evaluate the frequency of postoperative visual field defects.

Among them, 10 patients were excluded because of loss to follow-up. The review revealed that seven of 15 patients (46.7%) had postoperative visual deterioration. We postulated that the possibility of optic radiation damage resulted from a retraction injury. During the trans-MTG procedure, the cranial portion of MTG was retracted superiorly toward the superior temporal sulcus. In order to reduce the retracted portion of the MTG, the incision was performed at the MTG adjacent to the superior temporal sulcus. Furthermore, because the superior temporal sulcus had a buffering effect against retraction, a retraction injury to the superior temporal gyrus could be minimized.

Lateral transsulcal approaches have been reported for treatment of trigonal or paratrigonal tumors. In 1931, van Wagenen[15] first described the lateral approach for pineal tumor surgery. Although the technique was not accepted for treatment of pineal tumors, the approach has been adopted for treatment of trigonal or paratrigonal tumors by several surgeons. Nagata and Sasaki[12] applied the superior temporal sulcus (STS) approach to treat trigonal meningiomas. They suggested that the STS approach was applicable to small trigonal tumors with an acceptable risk of morbidity. However, this approach has several potential risks of postoperative morbidity caused by retraction injury of the superior temporal gyrus or parietal lobe. The possible morbidities associated with the STS approach include damage to : association fibers, the optic radiation, the auditory radiation, the transverse gyri of Heschl, and the parietal lobe[12]. In the dominant hemisphere, language impairment can occur due to injury to the Wernicke's area. The inferior temporal sulcus (ITS) approach was first introduced by Miyagi[10,11]. This approach was developed for patients with medically intractable mesial temporal lobe epilepsy; patients underwent amygdalohippocampectomy with the ITS approach. The investigators suggested that the ITS approach provided the least invasive amygdalohippocampectomy while preserving the optic radiation. However, this approach has not yet been applied to trigonal tumors, and requires more retraction than MTG to obtain a wide operative field for the trigone. Retraction may result in injury of associated fibers and the optic radiation of the MTG. Therefore, currently the modified trans-MTG is the good approach with preservation of the visual field and no other complications.

CONCLUSION

The modified trans-MTG approach involving transcortical incision that was made within 5 mm to superior temporal sulcus, was used for treatment of trigonal tumors. The advantage of the modified tran-MTG approach over the trans-MTG approach includes preservation of the postoperative visual field and proper surgical trajectory for the trigonal region. A cortical incision adjacent to the superior temporal sulcus could result in a reduced retraction of the middle temporal gyrus.

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