Frontozygomatic Approach to Intraorbital Tumors

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ABSTRACT

We removed 12 intraorbital tumors (5 schwannomas, 3 meningiomas, 2 cavernomas, 1 pleomorphic adenoma, and 1 neuroblastoma) using the frontozygomatic approach. No patients died. Postoperatively, 1 patient developed transient ptosis, and 3 patients had mild enophthalmos. Two patients with a meningioma developed transient worsening of their visual acuity and visual field. The frontozygomatic approach for surgical treatment of intraorbital tumors provides a wide visual field exposing the entire optic nerve. This approach is indicated for large intraorbital tumors, tumors affecting the optic nerve or orbital apex, intraorbital tumors that have extended into the intracranial cavity, and intracranial tumors that have extended into the orbit. The operative procedure for intraorbital tumor is determined by the location of the lesion and by the direction of its growth. The procedure is applicable to all intraorbital tumors. It reduces discomfort for surgeons while providing a relatively wide surgical field.

KEYWORDS: Intraorbital tumors, frontozygomatic approach, skull base surgery

OBJECTIVES

When intraorbital tumors are treated surgically, it is essential to remove the tumor, to improve or preserve visual function without inducing complications, and to resolve aesthetic problems.

Over a 7-year period, 12 patients underwent surgical resection of intraorbital tumors using a frontozygomatic (FZ) approach at our facility. We analyzed their clinical outcomes and the advantages and disadvantages of the FZ approach.

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SUBJECTS

From 1995 to 2002, 12 patients (5 males, 7 females; mean age, 43.5 years; age range, 22 to 63 years) with intraorbital tumors underwent an FZ approach at the Department of Neurosurgery of the Kansai Medical University Hospital (Table 1).

OPERATIVE PROCEDURE

Before the scalp was incised, a control suture (4-0 silk) was applied to the superior rectus and the lateral rectus muscles. After the scalp was incised, the temporalis muscle was divided into a deeper layer and a superficial layer at a point anterior to the zygomatic arch. The muscle flap was pushed posteriorly to expose the base of the temporal bone. After a frontotemporal craniotomy was performed, an osteotomy of the superior and lateral walls of the orbit (frontal process of the zygomatic arch) was performed. Both superior and lateral walls were resected as bone flaps as far as possible and were repaired later.

The dura mater of the anterior cranial fossa was freed along the edge of the sphenoid bone. When necessary, the anterior clinoid process was cut to release the optic canal. To avoid postoperative enophthalmos, the osteotomy of the superior and lateral walls of the orbit was performed en bloc and to reduce a pressure of orbit in this area. The periorbita was incised to enter the orbit. The optic canal was released from the spreading tumor, and the tumor was completely removed.

Available approaches to the muscle spindle included a medial approach (via the space between the superior oblique muscle and levator palpebrae muscle or superior rectus muscle); a median approach (via the space between the levator palpebrae muscle and superior rectus muscle), and a lateral approach (via the space between the levator palpebrae muscle or superior rectus muscle and lateral rectus muscle). For all 12 patients, the median approach was adopted. The tumor was slightly

tensioned with a cryoprobe, and its periphery was freed. In cases of malignant tumors, en bloc resection was performed as much as possible. Small benign tumors were resected en bloc. En bloc resection was not attempted for large benign tumors if it was not easy. Instead, internal decompression was performed before the tumor was resected. Compression of normal structures by large tumors provided a wide working space. Intraorbital fat was left unresected, and the periorbita was sutured as much as possible. The orbital wall and cranial flap were subjected to plate fixation.

RESULTS

The tumor affected the left side in five cases and the right side in seven cases. The site of the tumor was within the muscular cone in seven cases and outside it in four cases. The length of time from onset of symptoms to surgery ranged from 2 months to 15 years. All patients had exophthalmos.

In four cases, the tumor had spread from the orbit into the intracranial cavity. In one case, the tumor had spread from the intracranial cavity into the orbit. There were five schwannomas, three meningiomas, two cavernomas in two cases, one pleomorphic adenoma, and one olfactory neuroblastoma.

Visual acuity ranged from normal level to hand motion level. Preoperative visual acuity was often low in patients who had been ill for a long while and in patients with a meningioma. When the visual field was evaluated, five patients had a concentric constriction. Eye movement was abnormal in seven patients (disturbed supraduction in five cases, oculomotor palsy in one case, and abducens palsy in one case) and normal in five patients.

When the tumor had spread into the intracranial cavity or from the intracranial cavity into the orbit, we cut the anterior clinoid process and released the optic canal. In four patients with a meningioma that had spread into the intracranial cavity, resection was subtotal. Total resection of the tumor was attained in the other eight patients.

Table 1 Clinical Summary of 12 Patients with Intraorbital Tumors

Patient No.	Sex	Age (Years)	Histology	Symptom Term	Tumor Side	Tumor Location	Intracranial Extension	Operation Intraorbital Extension	Opening of Optic Canal	Removal of Anterior Clinoid	Opening of Supraorbital Fissure	Degree of Resection
1	M	63	Schwannoma	8 years	R	O	-	-	-	-	-	Total
2	F	58	Meningioma	2 years	R	I	+	+	+	+	+	Subtotal
3	F	34	Cavernoma	10 years	R	I	-	-	-	-	-	Total
4	F	42	Cavernoma	2 months	L	I	+	+	+	+	+	Total
5	F	46	Schwannoma	3 years	R	I	+	+	+	+	+	Subtotal
6	F	60	Meningioma	2 years	L	I	+	+	+	+	+	Total
7	M	25	Schwannoma	15 years	R	O	-	-	-	-	-	Total
8	M	40	Schwannoma	10 years	R	O	-	-	-	-	-	Total
9	F	22	Schwannoma	3 years	L	O	-	-	-	-	-	Total
10	F	45	Meningioma	4 years	R	I	+	+	+	+	+	Subtotal
11	M	67	Pleomorphic adenoma	5 months	L	I	-	-	-	-	-	Total
12	M	23	Neuroblastoma	2 years	L	I	+	+	+	+	+	Total

O, outside muscle cone; I, inside muscle cone; M, male; F, female; R, right; L, left.

Postoperatively, exophthalmos was alleviated in all cases. Visual acuity and visual fields improved or remained unchanged after surgery, except for two patients whose function deteriorated transiently after surgery. Both of these patients had a meningioma. Mild enophthalmos (causing only slight laterality) occurred in three cases. Blepharoptosis, observed in one case, was the only new neurological symptom that developed after surgery. No patients died.

CASE PRESENTATION

Case 1

A 63-year-old man (Fig. 1) had exophthalmos, reduced visual acuity (1/20), a concentric con-

striction, and disturbed supraduction of the right eye, which had gradually progressed over the previous 8 years. Visual acuity of his tumor-free left eye was at the level of light perception. The tumor appeared as an isodensity area on T1-weighted magnetic resonance (MR) imaging, as high- and low-density areas on T2-weighted MR imaging, and as heterogeneously enhancing on Gd-MR imaging. The muscle spindle in the upper part of the eyeball was injured. After craniotomy, incision of the periorbital exposed a firm, elastic, yellow tumor immediately below the periorbital. The tumor, histologically diagnosed as a neurilemmoma, was resected en bloc. Postoperatively, the patient's visual acuity improved from his preoperative level of 1/20 to 10/20. His abnormal eye movement and exophthalmos were alleviated after surgery.

Figure 1 (Left) T1-weighted and (right) T2-weighted magnetic resonance images showing tumor at the medial side of the optic nerve. The patient had exophthalmos on the right.

Figure 2 Enhanced computed tomography scans show well-enhanced round tumor in the retrobulbar space on the optic nerve.

Case 2

A 34-year-old woman (Fig. 2) had noticed mild exophthalmos of the right eye over the past 10 years, but had left it untreated. During the 3 months before her presentation, the abnormality had become worse and she had consulted an ophthalmologist. Computed tomography (CT) revealed a circular retro-orbital tumor within the muscle spindle above the optic nerve. Surgery was performed using a median approach. After the craniotomy was performed, the periorbital was incised. The tumor was approached via the space between the levator palpebrae muscle and superior rectus muscle. A tumor with a thin dark-red membrane and numerous dilated blood vessels was resected en bloc by coagulating and cutting blood vessels. Histologically, the tumor was diagnosed as a cavernous angioma. After surgery, the patient was discharged with no problems associated with her visual acuity, visual field, or eye movements.

DISCUSSION

The prevalence of intraorbital tumors among ophthalmological patients has ranged from 0.3 to

0.56%.¹⁰ With advances in diagnostic imaging such as MR imaging and 3D-CT, the number of patients diagnosed with intraorbital tumors has increased. Neurosurgeons now encounter such patients more frequently than before.

Approaches for the surgical treatment of intraorbital tumors include anterior, lateral, and transcranial approaches. An anterior approach is used to treat superficial tumors affecting the medial side of the orbit. A lateral approach is used to treat tumors affecting the lateral side of the orbit. These two approaches are primarily used by ophthalmologists.¹¹ A transcranial approach is indicated to treat large intraorbital tumors, tumors affecting the deeper area of the orbit or the medial part of the optic nerve, or tumor that extends intracranially. When used to treat intracranial tumors, the transcranial approach provides a wide surgical field that includes the entire optic nerve.

Depending on the extent of the osteotomy, it is either an FZ approach (sometimes called the fronto-orbital approach) or an FZ-orbital approach (used when the zygomatic arch is also freed).^{1-9,11-16} We use the FZ approach, which involves osteotomy of the superior wall of the orbit and frontal process of the zygomatic arch

(lateral wall) when resecting intraorbital tumors. Both approaches provide a good visual field while the brain is only slightly compressed. In the past, we used an FZ-orbital approach. However, we found that it was possible to ensure an adequate operative field that extended to the orbital apex, even when the zygomatic arch was not freed. If the zygomatic arch is freed, the temporalis muscle also must be manipulated.

The resection of intraorbital tumors involves restoration and preservation of visual and oculomotor function (the functional prognosis) and cosmetic concerns. Before performing a craniotomy, we therefore make it a rule to apply a control suture to the superior rectus and lateral rectus muscles. This suture helps identify the location of the eyeball and the muscles during an intraorbital approach.

Regarding histological differences in intraorbital tumors, we found that schwannomas were relatively well demarcated and not very hard. These features made them relatively easy to resect. However, schwannomas rich in fibrous components were sometimes hard to resect. A problem that we encountered when treating intraorbital tumors was how to deal with the nerves from which the tumor had developed. When intraorbital tumors originate from peripheral nerves, there may be no problem in resecting the affected nerves. Cavernomas are well demarcated like schwannomas. Sometimes, however, it is difficult to manipulate the arteries supplying and the veins exiting the tumor. When these manipulations were performed satisfactorily, no patient developed a problem with optic nerve function.

Meningiomas formed a clear border with surrounding muscles and connective tissue, but they were very difficult to free from the optic nerve sheath without causing postoperative visual dysfunction. All our patients who had postoperative visual dysfunction had a meningioma. A meningioma within the orbit often spreads into the intracranial cavity, making its resection difficult. The operative procedure for intraorbital

tumor is determined by the location of the lesion and by the direction of its growth. The procedure that we used is applicable to all cases and causes less operative difficulties, while providing a relatively wide operative field.

CONCLUSION

The FZ approach for surgical treatment of intraorbital tumors provides a wide surgical field that covers the entire optic nerve. This approach is indicated for large intraorbital tumors, for tumors affecting the optic nerve or orbital apex, for intraorbital tumors that have spread into the intracranial cavity, and for intracranial tumors that have spread into the orbit. The choice of operative procedure for an intraorbital tumor is determined by the location of the lesion and the direction of its growth. The procedure that we used provides a relatively wide operative field and is applicable to all cases.

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Commentary

Yoshihiro Numa described his experience using the frontozygomatic approach to treat orbital tumors. He obtained excellent results. As the author notes, this approach provides excellent exposure of intraorbital tumors affecting the medial or posterior half of the orbit and for those that extend intracranially. The frontozygomatic approach minimizes mobilization of the temporalis muscle and improves cosmetic outcomes. When the tumor extends into the middle fossa, the approach needs to be converted to a full orbitozygomatic approach¹ or combined with division of the zygomatic arch and greater mobi-

lization of the temporalis muscle.² Atrophy of the temporalis muscle can be minimized by avoiding use of unipolar cauterization for dissection and by leaving the muscle attached to the zygomatic arch.

At my institution these tumors are managed using a team approach with an experienced ophthalmologic surgeon and neurological surgeon. A team approach ensures the best opportunity to obtain complete resection of the tumor while preserving or restoring visual function.

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Commentary

Numa reports 12 patients with large intraorbital lesions that became symptomatic with exophthalmos. I agree that a procedure with orbital osteotomy is required for the treatment of these lesions. A few neurosurgeons will attempt to resect these lesions alone, but many will request the presence of an oculoplastic-trained ophthalmologist. Numa shows that resection of these lesions can be difficult. Meningiomas can often be attached to the optic nerve causing transient visual difficulties. Widened exposure of

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the entire optic nerve can help limit this complication and control the surgeon's desire to obtain complete resection. We have found that debulking in the absence of a good surgical plane

between tumor and nerve is sometimes the best option.

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