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Oncologic Safety of Endoscopic Removal of Infiltrated Tumor Onto the Periorbita Using Bipolar Cauterization Technique in Sinonasal Malignancy

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－ ABSTRACT －

Background：The periorbita has been regarded as the crucial structure in decision of orbital exenteration in the patients with sinonasal malignancies. The purpose of this study is to evaluate the oncological safety of endoscopic removal using bipolar cauterization in tumor encroaching on the periorbita without orbital sacrifice through analysis of long-term follow-up results of 5 cases. **Methods**：Retrospective review including demographic data, follow-up results, and local recurrence were performed on the 5 patients of advanced sinonasal cancer who showed bony orbital wall destruction and infiltration onto the periorbita but not transgressing into the orbital fat. Partial or total maxillectomy with orbital preservation was conducted in each patient. The tumor was dissected along the periorbita using bipolar nasal coagulation forceps by one senior surgeon under the endoscope. Preoperative CT and MRI scan were performed in all cases and retrospectively compared with intraoperative and permanent pathologic reports. **Results**：The mean age of tumor onset was 51.8 (39－74) years. Histopathology included four squamous cell carcinomas and one adenoid cystic carcinoma. Follow-up period ranged from 31 to 219 months (mean 112.6 months). All cases showed no local recurrence in the orbit but one patient had local recurrence in the pterygopalatine fossa and the other had local recurrence in the neck. **Conclusions**：Endoscopic removal of infiltrated tumor onto the periorbita using bipolar cauterization technique might be oncologically safe technique in advanced maxillary cancer infiltrated onto the periorbita which is not invading the orbital fat. **(J Clinical Otolaryngol 2017;28:67-75)**

KEY WORDS：Endoscope · Orbit · Periorbita · Nasal cavity · Paranasal sinus · Neoplasms.

Introduction

In the management of advanced carcinoma (T3-T4) of the sinonasal tract, the extension of the tumor into the orbit is very important for oncological safety and quality of life. Before the 1970s, the size and extent of the cancer could not be adequately judged using the earliest sinus tomogram. Therefore, radical excision with orbital exenteration was the main stream of treatment in sinonasal malignancy close to the orbit.[1,2] Increased sensitivity of recognizing tumor with high-resolution computed tomography (CT) scan, magnetic resonance imaging (MRI) and proven outcomes of combined surgery with radiotherapy have resulted in orbital preservation surgery possible since the 1970s.[3,4] As a yardstick of actual orbital invasion, a variety of indication of exenteration have been proposed based on involvement of bone, periorbita, orbital fat, extraocular muscles, orbital apex, or eyelid. Most of all, periorbita has been considered to be an effective barrier to tumor extension into the orbit and has been regarded as the critical structure in decision of preservation of the eye in patients with sinonasal malignancy,[5-7] but actual in-

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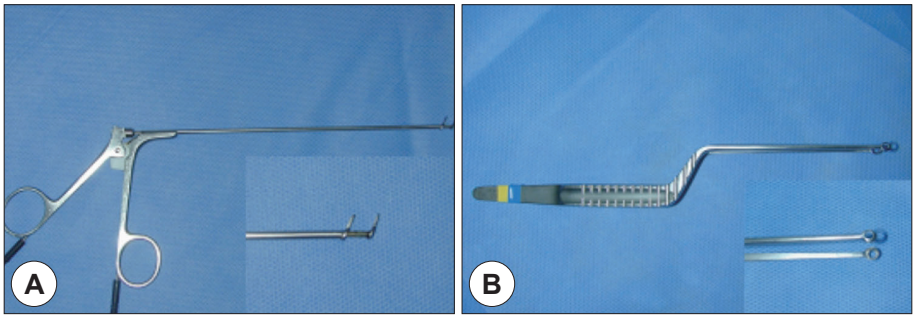

Fig. 1. 120° Bipolar coagulation nasal forcep (A) and tumor forcep (B). During surgery, infiltrated tumor onto the periorbita was removed by stripping the tumor and periorbita with an adequate margin after coagulation using bipolar coagulation nasal forceps.

volvement of the periorbita cannot be determined until surgical exploration.

Still, there were several reports opposing the concept of conservative surgery in the aspect of local tumor control.[5,8-12] Few studies have been reported the surgical outcomes in terms of endoscopic orbital preservation surgery for sinonasal malignancy.

The purpose of this study was to analyze our experience on sinonasal malignancy which is encroaching the orbit and to appraise the oncological safety of endoscopic orbital preservation surgery using bipolar cauterization technique.

Methods

A retrospective study was performed on the patients with sinonasal malignancies who were surgically treated in between 1997 and 2004. Of these, 5 patients who were suspected of periorbital invasion without transgression into the orbital fat were included in this study. Preoperative clinical data, imaging studies including CT and MRI, TNM stage, operative notes, operative video, permanent pathologic reports, adjuvant chemotherapy or radiotherapy and follow-up medical records were reviewed for each patient. All patients underwent partial or total maxillectomy via external approach combined with endoscopic technique for periorbital area.

The suspicious lesions on the periorbita were cauterized with bipolar coagulation nasal forceps (Fig. 1A) and removed with tumor forceps (Fig. 1B) under direct endoscopic view. Using this technique, the outer layer of periorbita could be stripped away from the inner layer (Fig. 2). Preoperative CT and MRI scan were performed in all cases and retrospectively compared with intraoperative and permanent pathologic reports.

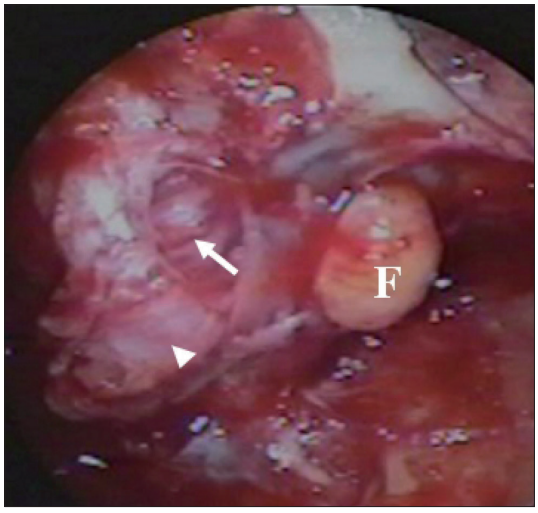

Fig. 2. Intraoperative findings. The periorbita (arrow head) has been partially sacrificed. The periorbital fat is kept in place by a thin "periorbital fascia" (arrow). At one point, there is a minuscule defect of continuity of this fascia, and a single blob of fat (F) is visible.

Results

Two patients were male and 3 patients were female.

Histologic findings included 4 squamous cell carcinomas (SCCs) and 1 adenoid cystic carcinoma (ACC). Follow-up period ranged from 31 to 219 months (mean 112.6 months). All cases showed no local recurrence on the orbit after endoscopic removal. One patient had local recurrence in pterygopalatine fossa (case 2) and the other had regional recurrence in the neck (case 3) (Table 1).

Case 1

A 53-year-old woman presented with 5-month history of left nasal obstruction and cheek swelling. Nasal endoscopy revealed a huge mass filling entire left nasal cavity with biopsy confirming SCC. Preoperative paranasal CT and MRI revealed a soft-tissue mass filling the left maxillary sinus with extension to left middle and inferior turbinate. CT images showed partial bony destruction of the inferior wall of the orbit, but periorbita was distinct from the tumor mass on T2 weighted image (WI). The tumor was judged not to transgress the periorbita based on these radiologic findings. Intra-arterial infusion chemotheraphy via left superficial temporal artery was performed but changed into systemic chemotherapy due to blockage of the infusion line on day 2. After 4-week systemic chemotherapy, partial maxillectomy via Caldwell-Luc approach assisted with endoscopy was performed. Suspicious lesion on the outer layer of the periorbita was cauterized and easily separated from the inner layer under endoscopic view. The patient received postoperative radiotherapy (total 5,940 cGy). During 175 months follow-up, no signs of local recurrence or metastasis have been observed.

Case 2

A 42-year-old woman complaining of right toothache and ocular pain for 2 months was diagnosed as SCC of right maxillary sinus by dentist. She had undergone right medial maxillectomy for right sinonasal inverted papilloma 18 months ago. Despite three cycle of systemic chemotherapy at other university hospital, the tumor resisted the chemotherapy and the patient was transferred to our clinic. Nasal endoscopy, paranasal CT and MRI showed a huge mass filling right maxillary sinus and extending to right hard palate, pterygoid plate, pterygoid muscles and orbit. Periorbita, showing the signal intensity slightly lower than tumor on T2-WI and equal to that of muscle on Gadolinium enhanced T1-WI, was clearly distinct from tumor mass (Fig. 3A and 3B). CT Images revealed bony destruction of the inferior orbital wall (Fig. 3C). Even after the intensity modulated radiation therapy (IMRT) (total 6,200 cGy), tumor size was not decreased and the total maxillectomy was performed. Though there was focal (0.5×0.5 cm) periorbital invasion of tumor, the inner layer was not invaded and the outer layer could be stripped from the inner layer without difficulty (Fig. 3D). The tumor was recurred in pterygoid fossa 1 month after the surgery and wide excision of the tumor using endoscopy was followed by radiosurgery (cyberknife). During the follow-up period, no recurrence was observed on the orbit (Fig. 3D). However, the

Table 1. Summary of cases: clinical and radiological findings of five patients

Case	Sex/Age	Pathology	Site	stage	Tx. modality	S name	PMP	BD	F/U (mo)	Recur	State
1	F/53	SCC	Lt. Max.	T4aN0M0	CTx→S→RT	PM	M+, I-	+	175	−	NED
2	F/42	SCC	Rt. Max.	T4aN0M0	CTx→RT→S	TM	M+, I+	+	31	PPF, DM	DWD
3	F/39	SCC	Lt. Max.	T3N0M0	S→RT	PM	M-, I+	+	94	Neck node	NED
4	M/51	SCC	Lt. Max.	T3N0M0	S→RT	PM	M+, I-	+	106	−	NED
5	M/74	ACC	Lt. Max.	T3N0M0	S→RT	PM	M+, I+	+	54	DM	DWD

ACC : adenoid cystic carcinoma, AWD : alive with disease, BD : bone defect on CT image, CTx : chemotherapy, DM : distant metastasis, DWD : death with disease, I : inferior wall of the periorbita, Lt. : left, M : medial wall of the periorbita, Max. : maxillary sinus, MM : medial maxillectomy, NED : no evidence of disease, PM : partial maxillectomy, PMP : final pathologic margin of the periorbita, PPF : pterygopalatine fossa, Rt. : right, RT : radiotherapy, S : surgery, SCC : squamous cell carcinoma, TM : total maxillectomy, Tx. : treatment

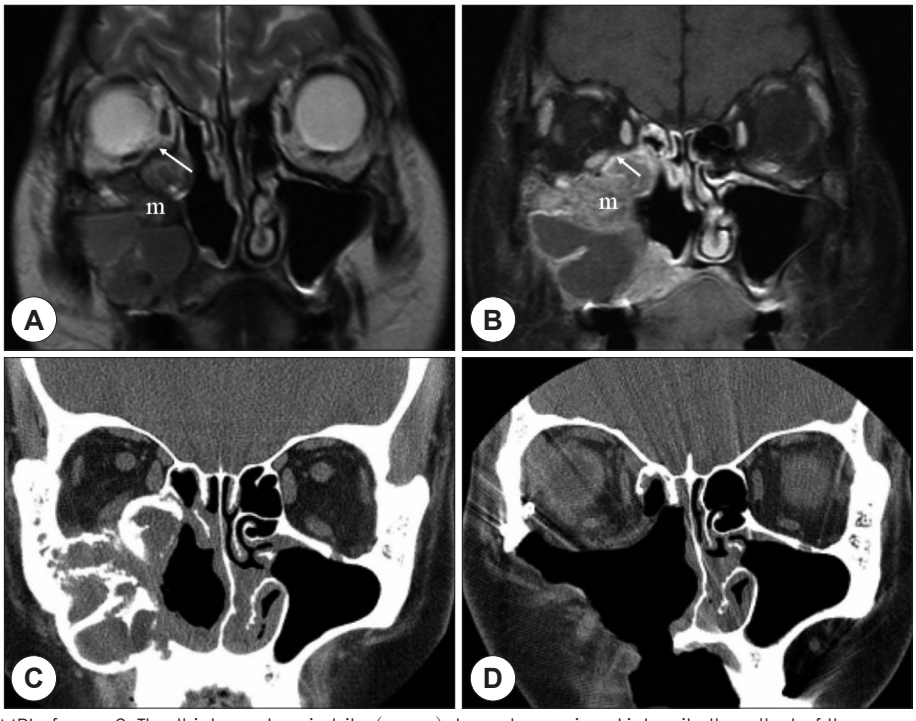

Fig. 3. CT/MRI of case 2. The thickened periorbita (arrow) shows lower signal intensity than that of the mass (m) on T2-weighted MR coronal image (A). Gadolinium-enhanced T1-weighted MR coronal image reveals the thickened periorbita (arrow) is enhanced as the extraocular muscles or the mass (B). The periorbita is not able to be discerned on coronal CT images (C). There is no evidence of residual or recurrent tumor on follow-up coronal CT images after 8 months (D).

patient died for distant metastasis after 30 months of reoperation.

Case 3

A 39-year-old woman complaining left orbital pain and frontal headache for several years presented to our clinic. Nasal endoscopy showed a huge mass filling entire left nasal cavity and the biopsy was confirmed as SCC. Preoperative CT scan revealed a soft tissue density filling left maxillary sinus and displacing the left middle and inferior turbinate medially. Periorbita was clearly identified showing slightly lower intensity compared to tumor on T2WI (Fig. 4A, B). Bony destruction of superior and posterior wall of the sinus was observed on CT scan (Fig. 4C). Partial maxillectomy using Denker's approach was performed. A 4×4 cm sized perforation was found on the superior wall of the left maxillary sinus and tumor infiltrated periorbita around the perforation. Under endoscopic view, the outer layer of the periorbita was peeled off easily using bipolar coagulation nasal forceps and tumor forceps and inner layer was preserved (Fig. 4D). Adjuvant radiotherapy was followed (total 5,400 cGy). Four months after surgery, cervical metastasis was observed on right level II and the patient had undergone neck dissection. After 2nd operation, no signs of local recurrence or metastasis has been observed for 94 months.

Case 4

A 51-year-old man complaining 1-month of left bloody rhinorrhea had been diagnosed as sinonasal SCC and transferred to our clinic. Nasal endoscopy showed a mass in the nasal cavity originated in the left middle meatus. Posteriorly, the tumor invaded pterygoid plate and pterygoid muscles on MRI. Bony destruction of superior and posterior wall of the sinus was observed

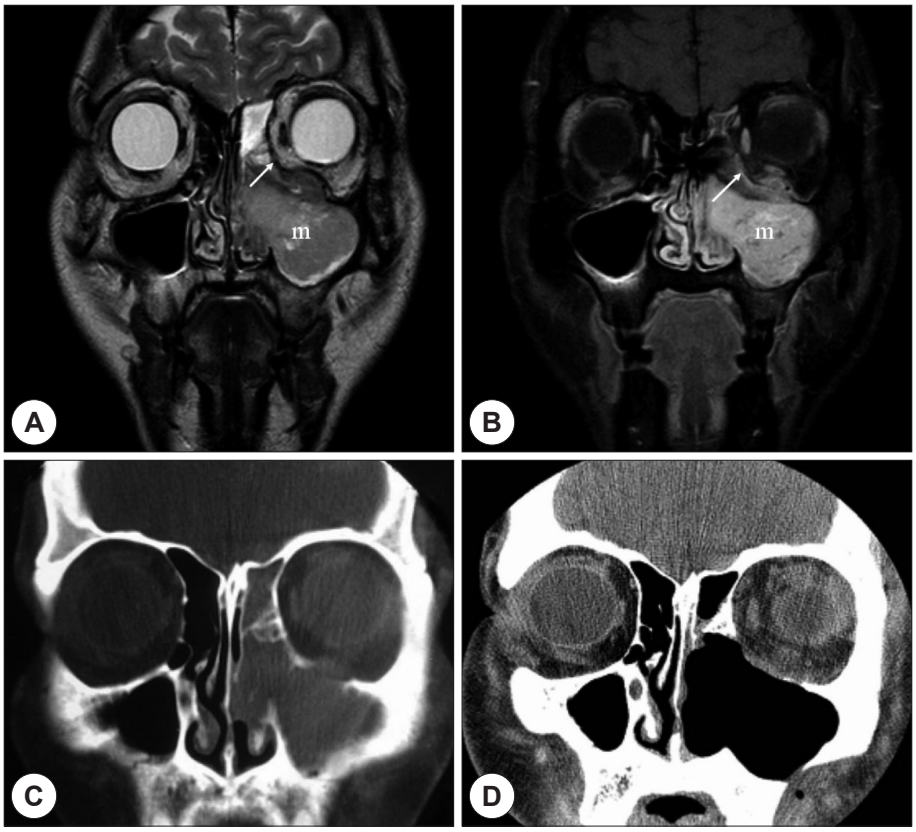

Fig. 4. CT/MRI of case 3. The thickened periorbita (arrow) shows lower signal intensity than that of the mass (m) and left frontal and ethmoidal sinus shows high signal intensity on T2-weighted MR coronal image (A). Gadolinium-enhanced T1-weighted MR coronal image reveals that the thickened periorbita (arrow) is less enhanced than the extraocular muscles or the mass (B). The periorbita is not able to be discerned on coronal CT images (C), and the mass seems to invade the orbital fat beyond the orbital bone defect. There is no evidence of residual or recurrent tumor on follow-up coronal CT images after 12 months (D).

on CT scan, but periorbita was clearly identified showing slight lower intensity compared to tumor mass on T2-WI and equal intensity to that of muscle on the Gadolinium enhanced T1-WI (Fig. 5A, B). CT scan revealed a soft tissue density filling left maxillary sinus and destructing posterior and superior wall of the sinus (Fig. 5C). Partial maxillectomy via Caldwell-Luc approach assisted with endoscope was performed. The tumor was found to invade the periorbita through the bone defect. The outer layer of the periorbita was stripped from the inner layer under endoscopic view (Fig. 5D). Adjuvant radiotherapy was followed (total 5,400 cGy). During 106 months follow-up, there was no signs of local recurrence or metastasis.

Case 5

A 74-year-old man presented with 2-month history of left nasal obstruction. Nasal endoscopy revealed a huge mass in left nasal cavity originated in the middle meatus. The biopsy was confirmed as ACC. Preoperative CT showed a soft tissue density, filling the left maxillary and anterior ethmoid sinus and destructing superior wall of the maxillary sinus extending to common cavity. On MRI, periorbital was clearly identified showing slightly lower intensity compared to the tumor on T2-WI (Fig. 6A, B). Intraoperatively, the tumor was found to invade the periorbita through the bone defect, but the outer layer of the periorbita was peeled off easily using bipolar electrocautery and tu-

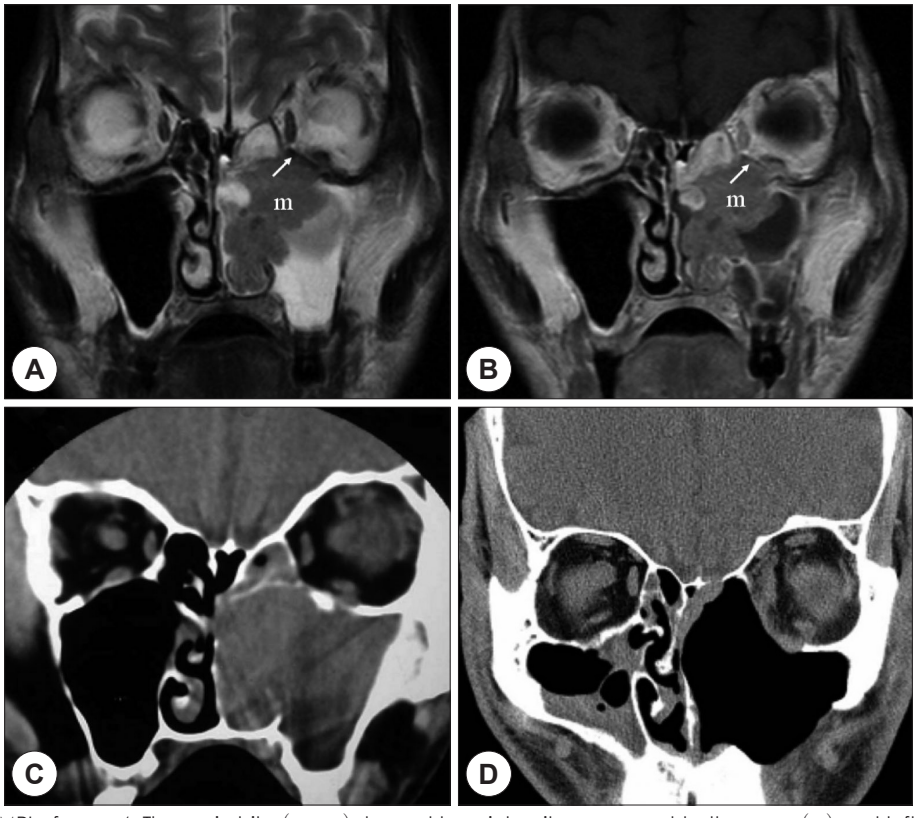

Fig. 5. CT/MRI of case 4. The periorbita (arrow) showed hypointensity compared to the mass (m) and left maxillary and ethmoidal sinusitis showed high signal intensity on T2-weighted MR coronal image (A). On Gadolinium-enhanced T1-weighted MR coronal image the periorbita (arrow) showed less enhancement than extraocular muscles or the mass (B). The periorbita is not able to be discerned on coronal CT images (C). There is no evidence of residual or recurrent tumor on follow-up coronal CT images after 24 months (D).

mor forceps, and inner layer was preserved. Adjuvant radiotherapy was followed (total 6,000 cGy). There was no evidence of residual or recurrent tumor until 15 month follow-up images (Fig. 6C, D). At the 34-month of follow-up, multiple systemic metastases were diagnosed, and the patient died from multiple systemic metastases at the 54-month of follow-up.

Discussion

In general, the primary goal of treatment for sinonasal cancer is to cure the disease. For most, the next consideration is local control of the disease because local recurrence is the most common cause of treatment failure. In the sinonasal passageways, normal neurologic function, preservation of vision, and physical appearance are important in patient's standpoint. In the management of advanced carcinoma of the maxillary sinus, if orbital invasion is suspected, the patient and surgeon face with the difficult decision of orbital exenteration.

Over the past 30 years, a variety of indication of exenteration has been proposed based on involvement of bone, periorbita, orbital fat, extraocular muscles, orbital apex, or eyelid.[13] Harrison removed the eye if there was evidence of bone erosion preoperatively, although tumor was not seen on radiologic findings after neoadjuvant radiotherapy. Because he thought that it was impossible to be sure that tumor cell did not remain in the periosteum.[2] Perry et al, suggested that the

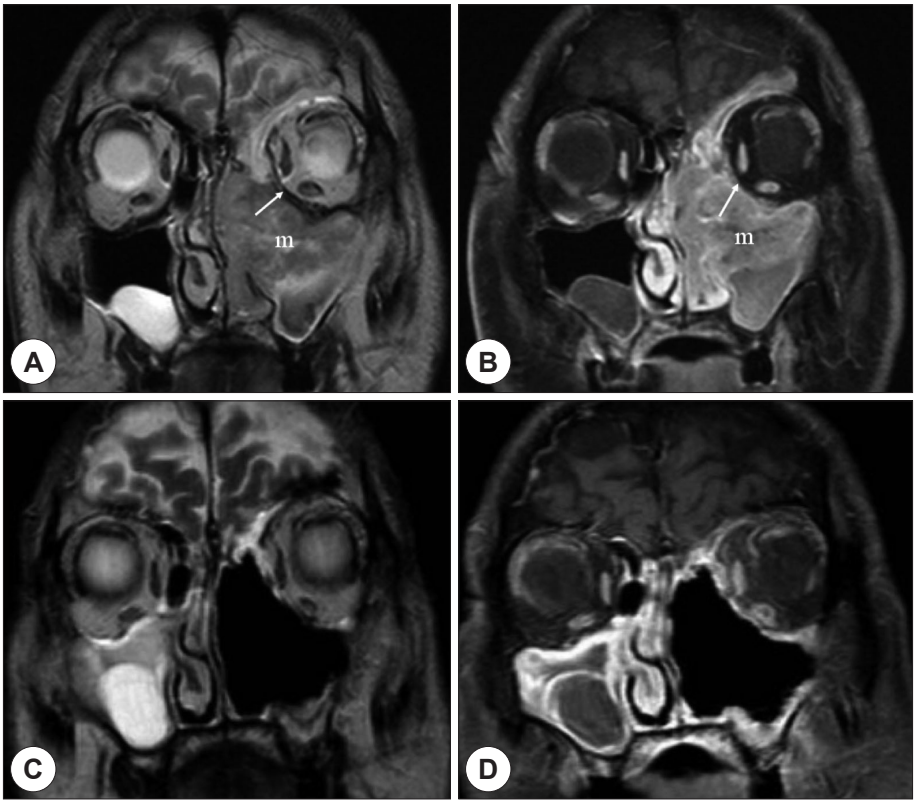

Fig. 6. CT/MRI of case 5. The periorbita (arrow) showed hypointensity compared with the mass (m) and left frontal sinusitis and right maxillary retention cyst showed high signal intensity on T2-weighted MR coronal image (A). On Gadolinium-enhanced T1-weighted MR coronal image, the periorbita (arrow) showed less enhancement than extraocular muscles or the mass (B). There is no evidence of residual or recurrent tumor on follow-up T2-weighted MR coronal image (C) and Gadolinium-enhanced T1-weighted MR coronal image (D) after 15 months.

critical structure in decision of preservation of the eye was not a bone but a periorbita. If the tumor mass could be peeled from the periorbita, the eye was able to save. Minimally involved periorbita was locally resected. If the invasion of periorbita was extensive, an orbital exentration was performed achieving the local control in the orbit.[12] Imola and Schramm[13] attempted to preserve the orbit by stripping the tumor from the periorbita or by limited resection of the periorbita except when the tumor extended into retrobulbar fat, extraocular muscles and orbital apex, or invaded the bulbar conjunctiva, sclera and eyelid. No statistical difference in 5-year survival rate was seen between the orbital preservation group and orbital exenteration group. Now, there seems to be no doubt that selective orbital preservation based on periorbital invasion does not adversely affect survival or local control.

Orbital exenteration can be an intense psychological trauma to the patient even though it may be required for complete resection. Therefore, a more accurate preoperative assessment to predict the presence of actual orbital invasion of tumor would benefit both the patient and surgeon. Periorbita consists of 3 layers which include an outer fibrous layer (periosteum proper) that resembles dense connective tissues, a middle adipose layer and an inner, more cellular layer (periorbital fascia) that contains the osteoprogenitor cells.[14,15] Tiwari et al also showed the presence of the thin, distinct fascial layer which surrounds the periocular fat and is separated from the periorbita.[7] It is thought

that tumors invading the bony orbital wall and infiltrated onto the periorbita could be dissected from periorbita because of these anatomic characteristics of the periorbita and periorbital fascial layer. In the presence of the infiltration of the periorbita, wherever possible, the eye was preserved by peeling the periorbita and preserving this fascial layer. During the follow-up of our patients, there was no evidence of local recurrence which suggested that this fascial layer is a last frontier to tumor extension into the orbit. However, the thinness of this fascia and its close proximity to the periorbita make it difficult to distinguish true infiltration of tumor to the orbit by CT or MRI preoperatively and intraoperative inspection is essential to make decision with respect to preservation of the eye.

Recently, Roh et al have reported that periorbita was conspicuous on MRI and that the tumor was distinct from the periorbita on T2-WI. In their study, tumor mass showed a slight hyperintensity than those of the bone and periorbita on T2-WI. They suggested that the mass beyond the thickened periorbita on T2-WI was considered to be a positive finding of orbital invasion. But, if there is no mass beyond the periorbita, orbital invasion seemed to have a low possibility.16 In all our cases, periorbita was clearly identified showing slight lower intensity compared to tumor mass on T2-WI. The outer layer of the periorbita was easily separated from the inner layer under endoscopic view in every case. Furthermore, local recurrence was not occurred. Our results suggested the possibility that the surgeon could predict the orbital invasion more accurately using T2-WI based on the presence of distinct periorbita showing slight lower intensity compared with tumor mass.

Nasal endoscope delivers brilliant illumination which permits excellent magnified visualization of orbital boundary especially the periorbita. Endoscope has great advantage to distinguish outer layer from inner layer, and the middle layer of periorbital could be a good surgical plane. Even when the tumor invaded bony orbital wall and periorbita, the tumor could be successfully stripped from the inner layer of the periorbita using bipolar coagulation nasal forceps and tumor forceps under endoscopic view. It is believed that the bipolar cauterization technique under endoscope helps to destroy the viable tumor cells on the periorbital plane although microscopic studies are further needed.

Although limited in its number, endoscopic removal of using bipolar cauterization technique in our 5 cases of advanced sinonasal malignancy which suspected infiltrated tumor onto the periorbital showed fair results in local control. Moreover, sterotactic and three-dimensional radiation delivery systems as well as effective neoadjuvant chemotherapy have demonstrated increasing benefit.[17-19)]

Conclusion

Endoscopic removal of infiltrated tumor onto the periorbita using bipolar cauterization technique might be oncologically safe technique in advanced maxillary cancer infiltrated onto the periorbital which is not invading the orbital fat.

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