Rhinology, 39, 160–165, 2001

Nasomaxillary osteotomy in lesions of the central compartment of the middle cranial base*

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SUMMARY

The pituitary fossa, sphenoid rostrum, sphenoid sinus, nasopharynx, pterygopalatine fossa and clivus are the components of the central compartment of the middle cranial base. It is a surgical challenge to gain access to this region. This fact has led to the development of a number of surgical procedures reported in the literature. However, none of these techniques can provide a wide and direct exposure to the middle cranial fossa without morbidity on its own. In this report, nasomaxillary osteotomy is described as a satisfactory alternative to reach the middle cranial fossa.

With the nasomaxillary osteotomy technique, a wide access can be obtained to the central compartment of the skull base, caudally till the inferior clivus and upper cervical vertebrae (C1, C2). Since bilateral, internal carotid arteries are in sight laterally, the technique provides a secure resection of tumors with marked lateral extensions. Repositioning the translocated bone segment, surrounding the apertura piriformis, results in satisfactory cosmesis postoperatively. The technique is discussed on the basis of eight cases with the histopathological diagnosis of squamous cell carcinoma (1 case), olfactory neuroblastoma (2 cases), chordoma (2 cases) and juvenile nasopharyngeal angiofibroma (3 cases). No vascular complication has been encountered. One chordoma patient died of the disease in the follow-up period. All other cases, including one squamous cell carcinoma patient, are alive and disease-free without cosmetic deformity.

In conclusion, nasomaxillary osteotomy provides a wide and direct exposure to the central compartment of the skull base in a relatively short period of time, securing the vascular and neural structures. Besides, it offers the advantage that it can be combined with other techniques in extensive tumors, while cosmesis and nasal functions are preserved.

Key words: skull base, craniofacial surgery, maxillotomy, transfacial

INTRODUCTION

The pituitary fossa, sphenoid rostrum, sphenoid sinus, nasopharynx, pterygopalatine fossa and clivus form the central compartment of the middle cranial base (O'Malley et al., 1998). Because of the complex anatomy of this region and the neighbouring vital structures, surgical access is very difficult. Therefore, a number of surgical techniques have been proposed to resect a tumor in the central compartment safely, such as frontal, frontotemporal, infratemporal, transoral, transnasal, transcervical, transseptal-transsphenoidal, transantral, transpalatal, transbasal, or bilateral le Fort I maxillotomy. However, none of these techniques provide a wide and direct surgical exposure without morbidity, unless used in combination.

This report is designed to emphasize the role of nasomaxillary osteotomy in achieving a satisfactory surgical access to the central compartment of the skull base.

MATERIALS AND METHODS

Eight cases, who had undergone a nasomaxillary osteotomy for a tumor of the central compartment between January 1995–January 2000 at our departments, were included in this study.

Computerized tomography, magnetic resonance imaging and endoscopy were used to determine the localization and extent of the tumor. Preoperatively, selective embolization was performed in 3 cases, who were diagnosed as juvenile nasopharyngeal angiofibroma (Figures 1a, b, and c).

The operations were performed in collaboration of the Otolaryngology and Neurosurgery teams. After induction of general anesthesia, the patient was positioned in a supine position. A lateral rhinotomy incision, starting from approximately 0.5 cm medial to the contralateral epicantus, was performed. For

* Received for publication: December 6, 2000; accepted: April 18, 2001

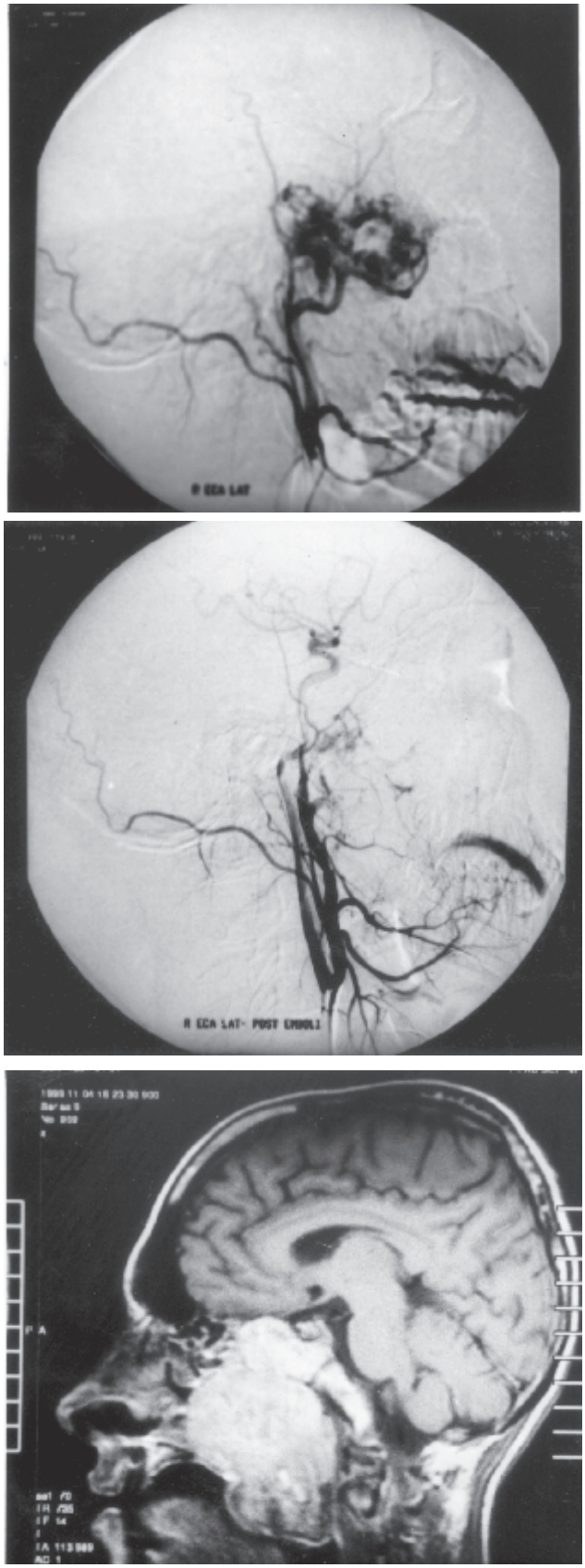

Figure 1. (a) Selective angiography of nasopharyngeal angiofibroma. (b) Angiographic appearance of the tumor after embolization. (c) Sagittal Magnetic Resonance Imaging scan of the tumor with a marked caudal extension.

Figure 2. Modification of Weber-Fergusson skin incision for the nasomaxillary osteotomy technique.

Figure 3. The skin flap is raised subperiostally together with septal cartilage.

tumors with a caudal extension, the incision was extended to the upper lip and the ipsilateral upper oral vestibule, as in the standard Weber-Fergusson incision (Figure 2). To expose the nasion and infraorbital foramens, bilateral facial flaps were raised subperiosteally. In the meantime, cartilage of the septum nasi was detached intranasally, and included in the facial flap together with the upper and lower cartilages (Figure 3).

An osteotomy, parallel to the edges of the apertura piriformis for a distance of 2 cm, was performed (Figure 4). A bone segment, including the anterior maxilla and nasal bones, was translocated and put in a saline solution (Figure 5). For a wider surgical exposure, bilateral inferior concha, middle concha and bony nasal septum were removed (Figure 6). After resection of the anterior wall of the sphenoid sinus and sphenoid septum, the region between the internal carotid arteries, comprising the perisellar region, clivus and upper cervical vertebrae, was exposed.

After the tumor resection, the translocated bone segment was repositioned in its original location and fixed with miniplates (Figure 7). Translocated cartilage of the nasal septum was placed in the nasal cavity and sutured to the nasal cavity floor

Figure 4. Osteotomy line surrounding the piriform apertura forms a bone segment (grey) which will be translocated.

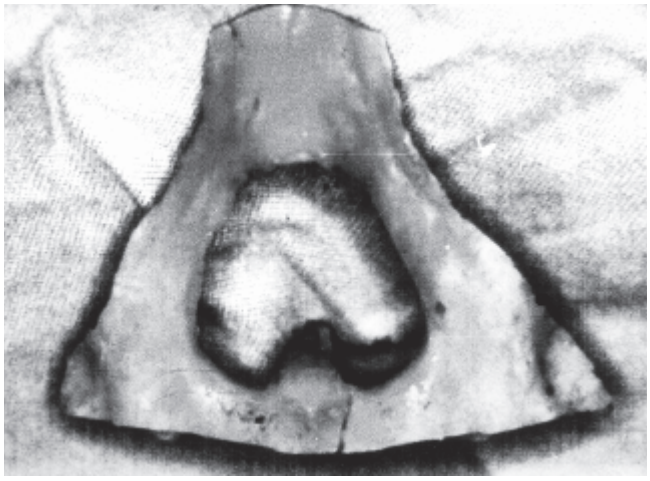

Figure 5. Translocated bone segment.

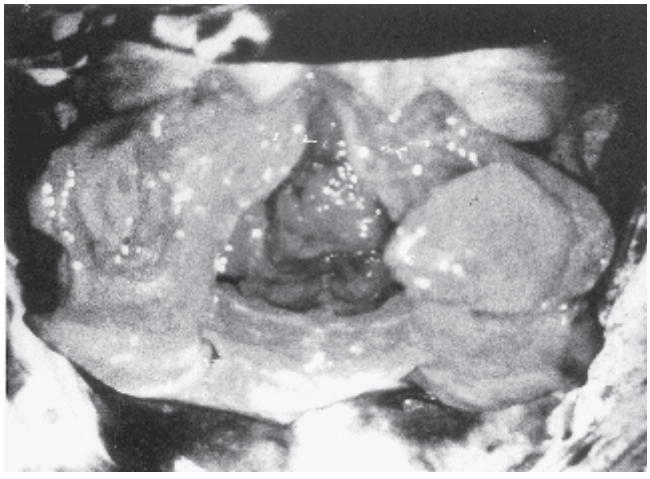

Figure 6. After the bilateral inferior and middle choncha and the bony nasal septum are resected, a wide surgical exposure is obtained.

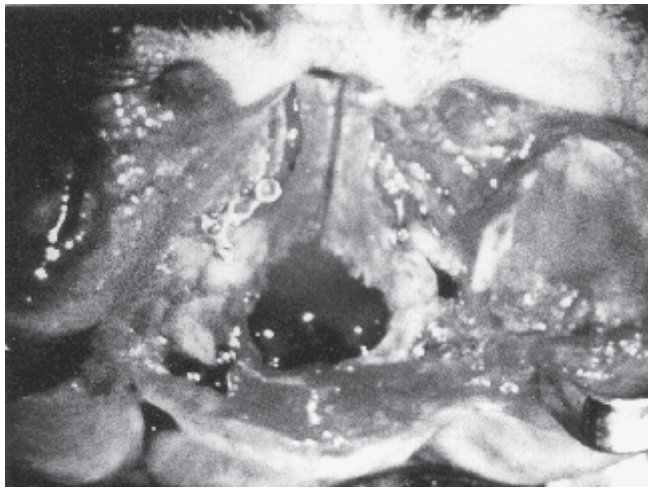

Figure 7. After tumor resection, the translocated bone segment is repositioned and fixed with miniplates.

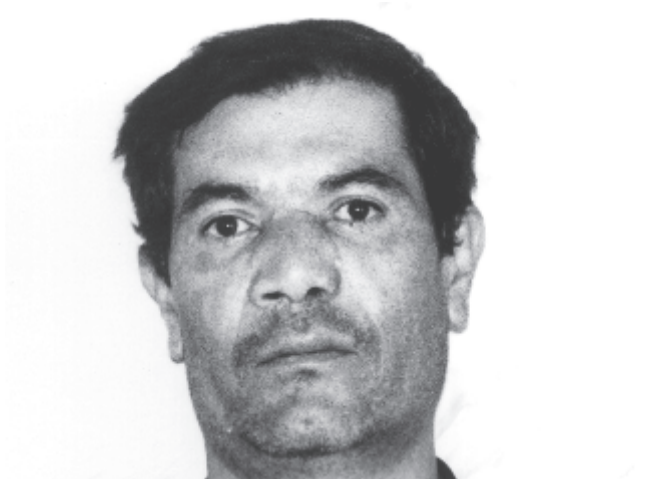

Figure 8. (a) Postoperative front view of the patient. (b) Postoperative oblique view of the patient.

Table 1. Cases according to their diagnosis, tumor extensions and follow-up results.

CASE	AGE	SEX	HISTOPATHOLOY	EXTENSIONS	FOLLOW-UP
1	65	M	Squamous cell carcinoma	Posterior ethmoid cells, nasal cavity, nasopharynx, sphenoid sinus, left pterygopalatine fossa, left cavernous sinus	No evidence of disease; 19 months
2	62	M	Olfactory neuroblastoma	Bilateral ethmoid cells, nasal cavity, nasopharynx, sphenoid sinus, bilateral pterygopalatine fossa, left cavernous sinus, cribriform plate (*T2N0M0*)	No evidence of disease; 21 months
3	42	M	Olfactory neuroblastoma	Bilateral ethmoid cells, nasal cavity, nasopharynx, sphenoid sinus, left pterygopalatine fossa, left cavernous sinus, cribriform plate, anterior cranial fossa (no dural invasion) *(T3N0M0)*	No evidence of disease; 30 months
4	31	M	Chordoma	Superior and middle clivus, nasopharynx, sphenoid sinus, left cavernous sinus	No evidence of disease; 26 months
5	40	M	Chordoma	Superior, middle and inferior clivus, nasopharynx, sphenoid sinus, bilateral cavernous sinus	Died in the 14th month of the follow-up
6	14	M	Juvenile nasopharyngeal angiofibroma	Nasal cavity, nasopharynx, left pterygopalatine fossa, sphenoid sinus, bilateral ethmoid cells, left maxillary sinus, bilateral cavernous sinus *(Stage III)*	No evidence of disease; 31 months
7	15	M	Juvenile nasopharyngeal angiofibroma	Nasal cavity, nasopharynx, right pterygopalatine fossa, sphenoid sinus, bilateral ethmoid cells, right maxillary sinus, right cavernous sinus *(Stage III)*	No evidence of disease; 28 months
8	15	M	Juvenile nasopharyngeal angiofibroma	Nasal cavity, nasopharynx, left pterygopalatine fossa, sphenoid sinus, bilateral ethmoid cells, left maxillary sinus, bilateral cavernous sinus, oropharynx *(Stage III)*	No evidence of disease; 15 months

with absorbable material, while the bilateral facial flaps were released and repositioned. A vermilion line was sutured carefully for a good cosmesis. The sublabial incision was closed tightly in order to avoid oral contamination. The nasal cavity was packed. Postoperative radiotherapy was indicated in case of a malignant diagnosis.

RESULTS

All 8 cases were men with a mean age of 35.5. One squamous cell carcinoma, 2 olfactory neuroblastomas, 2 chordomas and 3 juvenile nasopharyngeal angiofibromas were diagnosed as a result of histopathological examination. As for extension of the lesions, each case with juvenile nasopharyngeal angiofibroma had a stage III tumor, according to the classification of Chandler et al. (Chandler et al., 1984). The tumors of the two olfactory neuroblastoma patients were T2N0M0 and T3N0M0, according to the classification of Dulguerov et al. (Duelgerov et al., 1992). The tumors of the two cases with chordoma and the case with squamous cell carcinoma had marked lateral extensions (Table 1).

There were neither vascular complications preoperatively, nor neural deficits postoperatively. In the postoperative period, all cases complained of crusting and obstruction of the nasal cavity. This problem was managed by means of nasal irrigations with saline solutions. Postoperative cosmetic results were satisfactory with minimal scarring on the incision line (Figures 8a and b). Neither necrosis nor tissue loss of the translocated bone segment was detected in any of the cases. After a follow-up period of 23 months, one patient with the diagnosis of chordoma had died. The other cases, including the patient with squamous cell carcinoma, were alive and free of disease (Table 1).

DISCUSSION

The major goal of the skull base surgery is to resect the tumor totally through a wide and direct exposure with minimum morbidity. For central compartment lesions, frontal, frontotemporal and infratemporal approaches are the techniques requiring craniotomy and brain retraction. Therefore, being less morbid alternatives, anterior transfacial routes, to gain access to the central compartment, are preferred in recent years (Sabit et al., 2000).

In 1897, Giordano was the first performer of the transfacial approach. Following this attempt, modifications, such as subnasal lateral rhinotomy and the subnasal transoral approach were developed. However, the transfacial approach was abandoned soon afterwards, because of the extensive soft tissue dissection, radical osteotomies, insufficient illumination of the cavity and intracranial infections. In the second half of the twentieth century, the anterior transfacial approach has been re-popularized as a result of the introduction of the operating microscope, effective antibiotics therapy and collaborative work of otolaryngology and neurosurgery teams.

Anterior transfacial approaches afford a shorter operative range and a direct access to the hypophysis, clivus and posterior circulating vascular lesions (Sabit et al., 2000). However, for large or

local extensions of various lesions to the parasellar region, petrous bone or cavernous sinus, a limited lateral access and difficulty in attaining proximal control of the internal carotid artery confines the usefulness of these approaches (Sekhar et al., 1986).

There exist numerous transfacial approaches in the literature. The transoral and transcervical approaches are frequently used. However, these approaches expose only the middle and the lower clivus adequately. In addition, there are potential risks of infection from the oral flora when using the transoral approach and damage of the lower cranial nerves with the transcervical approach (Miller et al., 1982; Derome, 1985; Lesoin et al., 1986; Derome et al., 1987; Rabadan et al., 1992). The limitation of the transseptal-transsphenoidal and transantral routes is caused by the frontal process of the maxilla and the lateral nasal walls (Miller et al., 1982; Mann et al., 1985; Derome, 1985; Derome et al., 1987). The transbasal approach for tumors involving the ethmoid and sphenoid sinuses in the midline of the anterior and middle cranial fossa is rarely sufficient, when the tumor grows posteriorly into the upper half of the clivus, below the sella (Derome, 1985; Derome et al., 1987). Although bilateral le Fort I maxillotomy may offer better access, severe complications have been described, including necrosis of the anterior maxilla, necrosis of the alveolar bone, loss of tooth vitality, subcutaneous emphysema, spontaneous pneumomediastinum, perforation or deviation of the nasal septum, sixth nerve palsy and hemorrhage (Parner et al., 1972; Westwood et al., 1975; Stringer et al., 1979; Watts, 1984; Lanigan et al., 1984). Transnasal and transpalatal approaches are not recommended as a single procedure, because the exposure is limited. For the lesions with marked caudal extension, the lateral rhinotomy approach, for instance, provides limited exposure to the clivus and no access to the inferior clivus and cervical spine. Similarly, the midfacial degloving technique offers no access to the inferior and cervical spine (O'Malley et al., 1998). As for the transpalatal approaches, besides the limited exposure to the anterior cranial base, ethmoid cells and pterygopalatine fossa, significant palatal dysfunction caused by palatal shortening and velopharyngeal insufficiency could also result (Decker et al., 1970; Mann et al., 1985; O'Malley et al., 1998).

The described eight cases have presented with tumors having marked lateral extensions, such as cavernous sinus, pterygopalatine fossa, or marked caudal extensions, such as inferior clivus, oropharynx, requiring wide surgical exposure for total resection, and, thus, posing a risk to normal vascular and neural structures. Therefore, these selected cases have been managed through a nasomaxillary osteotomy technique, which is preferred for its wide exposure to the central compartment of the middle cranial base.

In the technique of nasomaxillary osteotomy, emphasized in this report, the frontal process of the maxillary bone and nasal bones are translocated en bloc. Thus, the roof of the nasal cavity and sellar region are exposed superiorly, and a wide exposure downward to the inferior clivus and upper cervical vertebrae (C1-C2) is provided. Additionally, the bilateral internal carotid arteries are in sight laterally. In this series, neither preoperative vascular complications, nor postoperative neural deficits were encountered, while a total tumor resection was achieved in all cases. In advanced cases, this technique can be used in combination with other approaches. For instance, a palatal split for caudal extensions or radical pterygomaxillotomy for lateral extensions is proposed to be combined with nasomaxillary osteotomy (Al-Mefty, 1989; Crumley et al., 1989; Rabadan et al., 1992). A satisfactory cosmesis can be achieved by repositioning the translocated bone segment and septal cartilage, while preservation of the nasal septum prevents the tip ptosis, which causes an alar collapse and nasal obstruction (Günhan et al., 1999). Facial skin incision, the risk of oral and nasopharyngeal contamination and crusting of the nasal cavity are the disadvantages of the technique. The vermilion of the incised upper lip should be carefully sutured for satisfactory cosmesis. The risk of contamination can be avoided by tight closure, effective antibiotics therapy and maintenance of oral hygiene. The problem of postoperative nasal crusting is relieved by forced saline irrigations.

In conclusion, nasomaxillary osteotomy provides a wide and direct exposure to the central compartment of the skull base in a relatively short period of time, securing the vascular and neural structures. Besides, it offers the advantage on that it can be combined with other techniques in case of extensive tumors, while cosmesis and nasal functions are preserved.

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