Maxillary Removal and Reinsertion for Anterior Cranial Base Tumors

Long-term Results

Pramod K. Sharma, MD; David E. Schuller, MD; Joseph H. Goodman, MD; Stephen P. Smith; Fedrico P. Goldman, MS; Sonia Raj; Roy E. Nicholson, MB, ChB; Donn C. Young, PhD

Objective: To evaluate complications and sequelae of maxillary removal and reinsertion for anterior cranial base tumors.

Design: A retrospective review of patients who underwent maxillary removal and reinsertion from 1990 to 1996.

Setting: The Arthur G. James Cancer Hospital and Research Institute at The Ohio State University, Columbus.

Patients: A consecutive sample of 46 patients who underwent maxillary removal and reinsertion. The patients ranged in age from 11 to 77 years and were followed up for as long as 6 years after surgery. There were 16 benign and 30 malignant lesions.

Main Outcome Measures: Intraoperative, postoperative (1-10 days), short-term (11 days through 3 months), and long-term (>3 months) complications; survival status of patients; and adjuvant therapy.

Results: Four patients (9%) had undergone previous radiotherapy; 9 (20%) received intraoperative radiation therapy; and 23 (50%) received planned postoperative radiotherapy. No intraoperative complications were noted. The most common short-term complication found was transient diplopia, affecting 9 patients (20%). Diplopia resolved within 3 months in all but 2 patients, in whom the condition was permanent. There were 4 patients (9%) who required removal of the nasal dorsum plate, and 4 (9%) who required removal of maxillary plates that were exposed intranasally. Midface asymmetry as reported by the patient or noted on the physical examination was documented in only 2 patients. The most common long-term complication was nasal asymmetry, affecting 13 patients (28%).

Conclusions: Maxillary removal allows improved visualization and access to anterior skull base lesions, while reinsertion of the maxillary fragment provides functional preservation and excellent cosmesis with few short- or long-term complications, even when adjuvant radiotherapy is used.


A VARIETY of benign and malignant lesions are found at the anterior skull base. These lesions are often difficult to visualize owing to their location. This difficulty in visualization contributes to delayed diagnosis and to the presence of extensive disease at the time of treatment. Advances in cranial base surgical techniques have improved access and provide for potentially complete resection of clinically detectable lesions.1-4 However, these surgical procedures can create functional and/or cosmetic deformities. The challenge of creating adequate surgical access, while minimizing postoperative morbidity, remains. Approaches to the anterior skull base can involve resection of a portion of the midface, primarily to provide access to a lesion.5 Those anatomic structures directly involved with malignant neoplasms need to be resected. However, some surgical approaches to the anterior skull base include resecting noninvolved midfacial bone solely to provide access. An alternative approach involving maxillary removal to allow resection of the lesion with immediate reinsertion of the maxillary bone graft has been previously described by Schuller et al6 and has been used for a variety of lesions since 1990. Short-term sequelae and complications associated with this approach were discussed, and provided the rationale for expanding the clinical experience. It is the purpose of this report to assess an expanded population with the primary objective of evaluating the results after a more extended follow-up period.

RESULTS

There were 9 patients (20%) who had received therapy for their lesions before undergoing maxillary removal and reinsertion. Four patients (9%) had previously undergone surgical resection; 4 patients (9%) had previously undergone radiotherapy; and 1 patient (2%) had previously undergone chemotherapy. No patients received planned preoperative radiation therapy or chemotherapy. Intraoperative radiation therapy was adminis-
PATIENTS AND METHODS

PATIENT POPULATION

We performed a retrospective analysis of a consecutive series of 46 patients who underwent maxillary removal and reinsertion from February 1990 through June 1996 at the Arthur G. James Cancer Hospital and Research Institute, The Ohio State University, Columbus. The patients ranged in age from 11 to 77 years (mean age, 47 years). Thirty-three patients were male, and 13 were female. The surgical procedure was used to treat 16 benign and 30 malignant lesions (Table).

Our analysis included a description of the types of adjunctive treatment modalities. The primary emphasis was to assess perioperative (0-10 days after surgery), short-term (11 days through 3 months), and long-term (>3 months) complications. Nasal crusting was evaluated during the first 6 months after surgery and again more than 6 months after surgery. The extent of nasal crusting was determined by physical examination during outpatient visits, and severity was subjectively graded as follows: 0, minimal; 1, moderate; and 2, severe.

CURRENT SURGICAL TECHNIQUE

Maxillary removal and reinsertion for anterior cranial base tumors is performed by an otolaryngology–head and neck surgeon in conjunction with a neurosurgical team. The details of the extracranial component of the procedure have been previously published. Initially, a tracheotomy tube is placed to allow improved exposure to the surgical field and better control of the airway after surgery and to prevent positive pressure–induced pneumocephalus. The neurosurgical team then performs a frontal craniotomy to determine the resectability of any intracranial disease. The otolaryngology–head and neck surgeon subsequently performs an extended facial degloving to allow exposure of the midface.

We have used a variety of approaches to try to decrease postoperative nasal crusting. The extracranial approaches to seal the defect have included pericranial flaps with split-thickness skin grafts, split-thickness skin grafts alone, dermal grafts alone, and pericranial flaps alone. None of these approaches has resulted in a substantial decrease in the crusting.

<table>
<thead>
<tr>
<th>Lesion</th>
<th>No. (%)</th>
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<tbody>
<tr>
<td>Squamous cell carcinoma</td>
<td>11 (24%)</td>
</tr>
<tr>
<td>Angioblastoma</td>
<td>7 (15%)</td>
</tr>
<tr>
<td>Esthesioneuroblastoma</td>
<td>5 (11%)</td>
</tr>
<tr>
<td>Adenoid cystic carcinoma</td>
<td>5 (11%)</td>
</tr>
<tr>
<td>Meningioma</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Hemangioendoctoma</td>
<td>2 (4%)</td>
</tr>
<tr>
<td>Melanoma</td>
<td>2 (4%)</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Chondrosarcoma</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Chordoma</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Giant cell tumor</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Malignant histiocytoma</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Mixed tumor</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Osteoma</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Plasmacytoma</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Schwannoma</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Neurofibroma</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Neuroblastoma</td>
<td>1 (2%)</td>
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</tbody>
</table>

The short-term complications occurring between 11 days and 3 months after surgery were diplopia (3 patients [7%]), midfacial asymmetry (1 patient [2%]), frontal cranial osteomyelitis (1 patient [2%]), trismus (1 patient [2%]), and toxic effects caused by dilantin use (1 patient [2%]). Thirty-nine patients (85%) had no short-term complications. Diplopia remained the most common complication during this period. Long-term complications were those that lasted longer than 3 months after surgery. Nasal asymmetry (13 patients [28%]) and plate-associated problems (8 patients [17%]) were the most common, while midface asymmetry persisted in 3 patients (7%) and diplopia persisted in only 2 (4%).

Postoperative nasal crusting was evaluated in all patients. In the immediate postoperative period, all patients had severe nasal crusting. Evaluations of the patients 6 months after the surgical procedure revealed that...
23 (55%) had minimal crusting, 15 (35%) had mild crusting, and 7 (15%) had severe crusting.

All patients with benign lesions were alive at the completion of the review. Recurrence of benign lesions were noted in 2 patients with meningiomas. There was a heterogeneous group of malignant neoplasms, with a variety of high- and low-grade lesions treated with a variety of approaches; however, 28 (93%) of the patients were treated with surgery and radiotherapy. The overall 5-year survival rate in this group was 56% (Figure 2).

**COMMENT**

The ability of surgeons to resect lesions of the anterior skull base continues to improve owing to better imaging and surgical techniques. There is a reasonable opportunity for complete resection with curative potential. The challenge faced by the interdisciplinary surgical teams is to limit the morbidity created by the extirpation of the primary lesion. With some techniques, obtaining surgical access to the anterior skull base oftentimes involves resecting portions of the bony midface, which provides exposure to the lesion, but may also create permanent functional and cosmetic deformities. Maxillary removal and reinsertion is an alternative surgical technique that provides adequate exposure to the extracranial component of the disease. It limits the potential for postoperative morbidity by preserving the maxillary fragment that provides the functional support to the orbital contents and the aesthetic benefit of preserving the entire orbital rim and malar bone (Figure 3).

This surgical procedure provides excellent exposure to the skull base, but reinsertion of the maxillary segment essentially represents a free bone graft. This is a possible source of complications, since there is concern regarding the long-term survival of such a large bone graft, especially if the patient receives external beam radiation therapy to this field, further compromising the blood supply to the reinserted maxillary fragment. Our series of patients included 4 who had previously undergone radiation therapy, 9 who received intraoperative radiation therapy, and 23 who received postoperative radiation therapy, or approximately 61% of the entire series. There were only 2 (4%) of the 46 who had permanent midfacial asymmetry suggestive of some resorption of the reinserted maxillary fragment (Figure 4).

Evaluation of the patients who underwent maxillary removal and reinsertion revealed few complications. In the immediate postoperative period, diplopia was the most common complication. This was thought to be secondary to edema resulting from the surgical procedure. Complaints of diplopia resolved in all but 2 patients within 3 months after surgery. Both patients underwent surgical resection of meningiomas that had previously undergone attempted surgical removal. The diplopia was thought to be due to the structural changes and scarring resulting from the multiple surgical procedures. Permanent visual problems are uncommon after maxillary removal and reinsertion.

Cerebrospinal fluid leaks were encountered in 4 patients (9%). All CSF leaks were diagnosed in the immediate postoperative period. A conservative treatment approach included placement of a lumbar CSF drain, bed rest, and elevation of the head of bed. The CSF drain was removed when there was no further clinical evidence of CSF leak. Surgical exploration was not necessary, since conservative management was successful in all patients.

The most common long-term complication was nasal asymmetry. A variety of nasal deformities, including caudal septal deflection andalar and bony pyramid asymmetry, were noted. In this surgical approach, a completely mobile external nose is created by means of lateral nasal osteotomies, nasal root osteotomy, and release of the nasal septum from the nasal spine and maxillary crest. Postoperative nasal appearance is enhanced, and cosmetic deformities are minimized, by accurate placement of a craniofacial plate at the nasal root, securing the system in the midline on the maxillary crest and nasal spine, and by application of an external nasal splint.

![Figure 1. Osteotomies along the malar bone, orbital floor, nasofrontal process of the maxilla, and inferior and lateral aspects of the maxilla allow removal of the anterior maxillary fragment.](image1)

![Figure 2. Survival curve of patients with malignant tumors.](image2)
Problems with the craniofacial fixation plates were noted in 8 patients (17%). Some patients required removal of plates from the nasal root (4 patients [10%]) and the maxilla (4 patients [10%]). Initially, miniplates were used at all osteotomy sites. Patients with thin nasal skin and those who wore glasses reported discomfort caused by the plate at the nasal root. The surgical technique was modified, and microplates were substituted at the nasal root. We have not needed to remove a nasal plate since this alteration was made.

Midfacial asymmetry was noted in only 2 patients. These patients had firm bone palpable in the midface. However, both were noted to have decreased malar prominence. There was no evidence of maxillary bone fragment resorption on clinical evaluation. In a patient who required a second operation for a recurrent lesion, the bony fragment was found to be viable and stabilized with new bone growth fusing it to the remaining maxilla. It appears that the bony fragment does not undergo significant resorption. Appropriate attention to surgical technique in performing osteotomies, in conforming plates to the facial skeleton, in drilling accurate pilot holes for the screws, and in mobilizing the maxillary fragment is necessary to obtain a good result.

All patients are given instructions on maintaining nasal cavity hygiene using frequent irrigation and lubricating ointments. Postoperative nasal crusting, which occurred in all our patients, is an expected sequela of surgical manipulation of the nasal and paranasal anatomy. The amount of crusting decreased as the nasal cavity healed and remucosalized. The majority of patients did not have clinically relevant nasal crusting 6 months after surgery. However, most patients require some cleaning of their nasal cavities during the regular follow-up ambulatory examinations. The amount of crusting appears to be a function of the extensiveness of the skull base surgery and the aggressiveness of the patient in nasal irrigation. Nasal crusting has been managed with variable effectiveness by the patients. There were no cases of nasal crusting related to severe complications, such as infection or airway obstruction, in this group of patients.

Maxillary removal and reinsertion provides excellent visualization and access to the anterior skull base. The majority of complications appear to be short term. Evolution of the technique has decreased the long-term complications. This procedure represents a method to decrease operative morbidity by preserving function and aesthetics, while allowing excellent surgical access to skull base lesions.

Accepted for publication July 14, 1997.

This study was supported in part by grant 2P30CA16058 from the National Cancer Institute, Bethesda, Md. The authors acknowledge support for this project from The Ohio State University Comprehensive Cancer Center Head and Neck Oncology Program and the Arthur G. James Cancer Hospital and Research Institute, Columbus.


The authors thank Debra Parker, whose technical excellence was invaluable to the success of this research.

Reprints: David E. Schuller, MD, Comprehensive Cancer Center Head and Neck Oncology Program, Arthur G. James Cancer Hospital and Research Institute, Room 519, 300 W 10th Ave, Columbus, OH 43210.

REFERENCES


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