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Functional Outcomes of the Retromaxillary–Infratemporal Fossa Dissection for Advanced Head and Neck/Skull Base Lesions

ABSTRACT—The retromaxillary–infratemporal fossa (RM-ITF) dissection, using a preauricular incision, was initially popularized for the treatment of temporomandibular joint disorders, facial fractures, and orbital tumors. This approach has been expanded for the treatment of advanced head and neck and skull base tumors extending into the infratemporal fossa. We studied prospectively eight consecutive patients requiring a RM-ITF dissection. Pre- and postoperative functional outcomes measured were mastication, speech, swallowing, cranial nerve function, pain, and cosmesis. A significant reduction in pain was noted postoperatively in all patients studied. Limited changes were identified in mastication, speech, swallowing, vision, hearing, or cosmesis postoperatively. The RM-ITF dissection should be considered when resecting advanced head and neck/skull base lesions that extend into this region. We have found minimal morbidity associated with this dissection. This procedure may have a useful place in palliation of patients with incurable pain caused by tumor invasion into the infratemporal fossa.

Advances in diagnostic imaging and radiation therapy combined with refinements in surgical approaches have improved the outcomes for advanced head and neck/skull base tumors.[1–7] Disease that was previously considered unresectable is now treated aggressively with multimodality therapy. The retromaxillary–infratemporal fossa (RM-ITF) approach has aided in the surgical treatment of these advanced tumors.

Surgery for skull base lesions involving the retromaxillary space and infratemporal fossa space has been well described. Conley first described a transfacial approach in 1956,[8] and other investigators have since published their techniques.[9–14] In 1978, Obwegeser popularized a preauricular approach to the RM-ITF region for temporomandibular joint (TMJ) disorders, orbital tumors, and facial fractures that avoided any anterior facial incisions.[15,16] Wetmore[17] further expanded this approach by extending the incision into the neck for the treatment of advanced head and neck lesions. We have used a similar approach for advanced head and neck/skull base tumors that extend into the infratemporal fossa. This article reviews our functional results in eight

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consecutive patients, using this technique. The benefits and limitations of the procedure are discussed. The clinical value is illustrated by three representative cases.

METHODS

Subjects

All patients who underwent resection for advanced malignant or benign tumors involving the retromaxillary space/infratemporal fossa between April 1998 and March 1999 at the Department of Otolaryngology/Head and Neck Surgery at Wayne State University were included in the study. Patient demographics, tumor variables, and clinical outcomes, as well as patient interviews, were obtained from hospital and office records.

Technique

This dissection includes the following steps:

1. A preauricular incision is performed with superior extension into the scalp and inferior extension into the neck, depending on the extent of the tumor.
2. The coronal dissection is carried inferiorly over the lateral orbital rim and zygomatic arch (Fig. 1A).
3. The dissection is performed deep to the superficial layer of the deep temporalis muscle, to protect the frontal branch of the facial nerve.
4. An osteotomy of the zygomatic arch is performed, with the posterior osteotomy at the zygomatic root and the anterior osteotomy as far forward as necessary (Fig. 1B).
5. The zygomatic arch with masseter muscle attached is retracted inferiorly (Fig. 1C).
6. The coronoid process of the mandible is resected with the temporalis muscle attached and retracted superiorly (Fig. 1D), exposing the ITF.
7. The ITF is now accessed. If the tumor extends into the temporalis muscle, it may be resected and kept attached to the tumor.

Outcome Measures

Clinical outcomes were measured by comparing the preoperative and postoperative function in several clinical areas. Functional levels were determined using a patient survey questionnaire and evaluation by an attending otolaryngologist in nine areas of clinical interest. The following areas were measured, using the scales shown:

1. *Mastication:* normal (regular diet) = 1, mildly impaired (soft diet) = 2, moderately impaired (puréed diet) = 3, severely impaired (nothing per oral [NPO]) = 4.
2. *Speech:* normal = 1, mildly impaired = 2, moderately impaired = 3, severely impaired (aphonic) = 4.
3. *Swallowing:* normal = 1, mildly impaired = 2, moderately impaired = 3, severely impaired (NPO) = 4.
4. *Vision:* normal/no change = 1, impaired (decreased compared with preoperative vision) = 2, absent = 3.
5. *Trigeminal nerve function divisions 2 and 3:* normal/no change = 1, impaired (decrease compared with preoperative sensation) = 2, absent = 3
6. *Facial nerve function:* using House-Brackmann scale (1–6)[18]
7. *Hearing:* normal (speech reception threshold 0 to 20 dB) = 1, mild loss (SRT 20 to 35 dB) = 2, moderated loss (SRT 35 to 55 dB) = 3, severe loss/profound loss (SRT >55 dB) = 4.
8. *Cosmesis:* normal/no change = 1, minimal deformity = 2, moderate deformity = 3, severe deformity = 4.
9. *Pain:* none (no analgesic) = 1, mild (narcotic use weekly to monthly) = 2, moderate (narcotic use 1 to 2 times/day) = 3, severe (narcotic use 4 four to six 6 times/day) = 4.

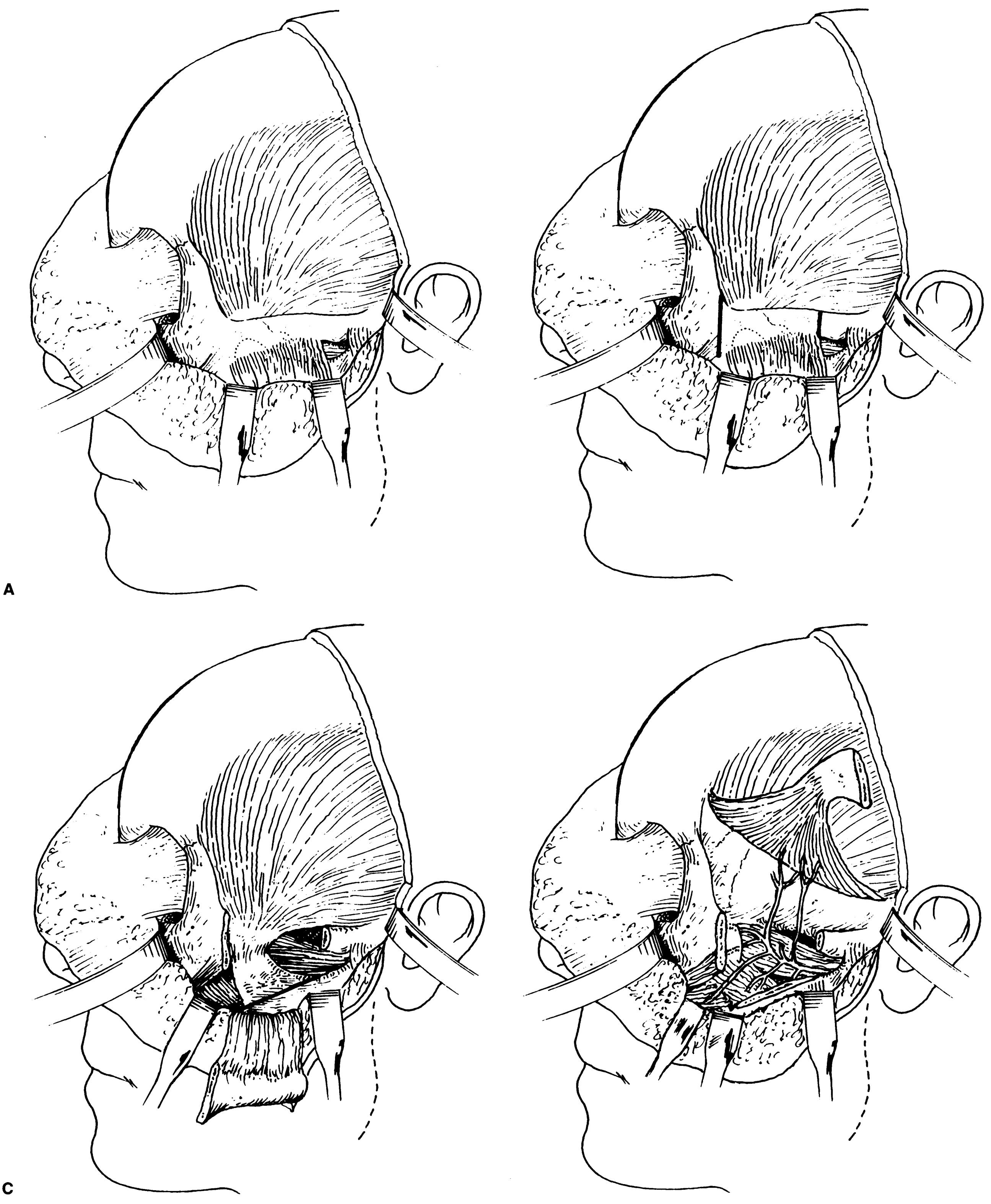
Statistical Analysis

Pre- and postoperative scores were compared using the Wilcoxon signed rank test. Results were considered significant at $P < 0.05$.

RESULTS

The RM-ITF dissection was used to provide improved exposure and direct tumor access during ablative surgery for a variety of malignant and benign head and neck/skull base lesions (Table 1). All tumors extended into this region. The study included 50% (4/8) males and 50% (4/8) females, with a mean age of 65 years (range 50 to 80 years). There were 37.5% (3/8) minor complications (postoperative pneumonia, exposed reconstruction plate, and wound infection) and 12.5% (1/8) major complications (stroke) (Table 1).

Pre- and postoperative function of mastication, speech, and swallowing are quantified in Table 2. No significant morbidity in mastication ($p = 0.86$ Wilcoxon signed rank test), speech ($p = 1.0$ Wilcoxon signed rank test), or swallowing ($p = 0.63$ Wilcoxon signed rank test) were noted postoperatively. In patients 1 and 4, function decreased, whereas in patients 6 and 7, function improved after resection. When assessing postoperative function, it is important to evaluate mastication, speech, and swallowing because the muscles critical for mandibular movement are frequently resected or dissected. The RM-ITF dissection involves dissection of the masseter, temporalis, medial, and lateral pterygoid muscles.



A B C D

Figure 1. **(A)** Retromaxillary–infratemporal fossa (ITF) dissection is performed over the lateral orbital rim and zygomatic arch deep to the superficial layer of the deep temporalis muscle, to protect the frontal branch of the facial nerve. **(B)** Osteotomy of the zygomatic arch is performed, with the posterior osteotomy at the zygomatic root and the anterior osteotomy as far forward as necessary. **(C)** Zygomatic arch with masseter muscle attached is retracted inferiorly. **(D)** Coronoid process of the mandible is resected with the temporalis muscle attached and retracted superiorly, exposing the ITF.

Table 1. Patient Characteristics, Complications, and Disposition

Pt No.	*Primary Site*	*Sex*	*Age (yr)*	*Stage*	*Surgery*	*Complication*	*Disposition*
1	TB	M	74	IV	L TB resect, condylectomy, superficial parotidectomy, L RND, pect flap	Pneumonia	Rehab, NED (10 mo)
2	Oral cavity	M	65	IV	L hemi-mand, resection of cheek, partial glossectomy, L RND, Fib FF, pect flap	Exposed mandibular plate	Home, NED (16 mo)
3	Oropharynx pharynx	F	59	IV	R Partial maxillectomy, R MND, partial mand, pect flap	None	Home, NED (12 mo)
4	TB	F	80	IV	L TB resect, superficial parotidectomy, L MND, pect flap	CVA	DOD (4 mo)
5	V2	M	62	IV	Superficial parotidectomy, neck exploration, resection of V2 neuroma	None	Home, NED (14 mo)
6	Mandible	F	50	IV	Superficial parotidectomy, L hemimand, fib FF	None	Home, NED (15 mo)
7	TMJ	F	60	IV	Superficial parotidectomy, neck exploration, VII decompression, resection of TMJ/tumor	None	Home, NED (13 mo)
8	Max	M	72	IV	L maxillectomy, orbital exenteration, dural resection, ethmoidectomy, sphenoidectomy, frontal sinusectomy, rectus FF	Wound infection	NH, NEC (11 mo)

TB = temporal bone; V2 = trigeminal nerve, second division, TMJ = temporo mandibular joint; Max = maxilla; L = left; R = right; resect = resection; RND = radical neck dissection; MND = modified neck dissection; Pect = pectoralis major myocutaneous; Hemi-mand = hemimandibulectomy; mand = mandibulectomy; Fib FF = fibular free flap; Rectus FF = rectus abdominus free flap; CVA = cerebrovascular injury; NED = no evidence of disease; DOD = dead of disease; NH = nursing home; Rehab = rehabilitation hospital; mo = months.

The function of cranial nerves at risk of injury during the RM-ITF dissection was assessed. Tables 3 and 4 compare the pre- and postoperative function of cranial nerves II, V, VII, and VIII. Vision was unchanged pre- to postoperatively, with the exception of patient 8, in whom a planned orbital exenteration was performed because of tumor invasion. Preoperatively, this patient's eye was fixed in place secondary to tumor invasion. Overall, trigeminal nerve function was lost in 62.5% (5/8) patients because tumor extension necessitated nerve resection. This was not a significant reduction ($p = 0.0625$ Wilcoxon signed rank test) (Table 4). The second and third divisions of the trigeminal nerve was sacrificed in 25% (2/8) and 37.5% (3/8) of cases, respectively (Table 4). In the remaining patients (37.5%), sensation was preserved. Two patients lost ipsilateral facial nerve function because tumor extension necessitated nerve sacrifice, there were not enough patients in this series to determine whether surgery had an effect on facial nerve function. The only instances in which nerve function was completely lost were when the nerve had to be sacrificed secondary to tumor invasion (Table 4). Hearing was not significantly changed ($p = 1.0$) (Table 3). Two patients with temporal bone carcinoma required inner ear sacrifice

Table 2. Mastication, Speech, and Swallowing Function

	Mastication Function[a]		*Speech Function*[a]		*Swallowing Function*[a]	
Pt No.	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
1	1	3	1	3	1	4
2	4	4	4	4	4	4
3	2	2	1	2	1	2
4	1	4	1	2	1	4
5	1	1	1	1	1	1
6	4	2	4	2	4	2
7	4	1	4	1	4	1
8	1	2	1	2	1	2

Pre = preoperative; Post = postoperative.
[a]Graded on a scale of 1–4: 1 = normal; 2 = mildly impaired; 3 = moderately impaired; 4 = severely impaired.

Table 3. Results of Cranial Nerve II, VIII Function, Pain, and Cosmesis

Pt	*Vision*[a]		*Hearing*[b]		*Pain*[c]		*Cosmesis*[d]	
No.	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*[e]	*Pre*	*Post*
1	1	1	4	4	3	1	4	4
2	1	1	1	1	4	2	4	4
3	1	1	1	1	2	1	1	3
4	1	1	4	4	3	1	2	3
5	1	1	1	1	2	1	2	2
6	1	1	1	1	2	1	4	2
7	1	1	2	2	2	1	4	2
8	2	3	1	1	4	1	4	4

Pre = preoperative; Post = postoperative.
[a]Graded on scale of 1–3: 1 = normal/no change; 2 = impaired (decreased compared with preoperative); 3 = absent.
[b]Graded on scale of 1–4: 1 = normal; 2 = mild loss; 3 = moderated loss; 4 = severe/profound loss.
[c]Graded on scale of 1–4: 1 = none; 2 = mild; 3 = moderate; 4 = severe.
[d]Graded on scale of 1–4: 1 = normal/no change; 2 = minimal deformity; 3 = moderate deformity; 4 = severe deformity.
[e]Statistically significant difference ($p = 0.008$, Wilcoxon signed rank test) compared with preoperatively.

Table 4. Results of Cranial Nerve V2, V3, and VII Function

		V2 CN Sensation[a]		V3 CN Sensation[a]		VII CN Function[b]	
Pt No.	*Primary Site*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
1	TB	1	1	1	1	1	2
2	Oral cavity	2	3	2	2	1	6
3	Oropharynx	1	1	1	3	1	2
4	TB	1	1	1	1	1	6
5	V2	1	3	1	1	1	1
6	Mandible	1	1	1	3	1	1
7	TMJ	1	1	1	1	1	3
8	Max	1	3	1	1	1	1

CN = cranial nerve; TB = temporal bone; V2 = trigeminal nerve, second division; TMJ = temporomandibular joint; Max = maxilla.
Pre = preoperative; Post = postoperative.
[a]Graded on scale of 1–3: 1 = normal/no change; 2 = impaired (decreased compared with preoperatively); 3 = absent.
[b]Graded on House-Brackmann scale 1–6.

(patients 1 and 4) but experienced severe hearing loss preoperatively. The loss of cranial nerve function was the result of tumor extension—it was not caused by the surgical approach. The dissection in this region did not cause iatrogenic injury to any cranial nerves.

Subjective assessment of cosmesis was performed by the patients both pre- and postoperatively. Self-image is very important in patient rehabilitation and in return to normal social function. No significant difference in overall pre- and postoperative cosmesis was noted ($p = 0.80$) (Table 3). Two patients (patients 3 and 4) felt that there was a moderate worsening in their physical appearance postoperatively. Two patients (patients 6 and 7) with advanced tumor that had caused a marked deformity preoperatively believed that the tumor resection and reconstruction actually improved their cosmetic appearance.

Postoperative pain was significantly decreased for all patients ($p = 0.008$) (Table 3). This was confirmed objectively by a reduction in the use of analgesics. Resection of the tumor and the corresponding divisions of the involved trigeminal nerve apparently reduced pain. The following three cases illustrate the enhanced surgical exposure provided by the RM-ITF approach.

Case 1

A 74-year-old male who underwent a RM-ITF dissection in conjunction with a temporal bone resection for a recurrent squamous cell carcinoma (SCCA) of the left external auditory canal treated 4 years previously with local resection and radiation therapy. He was referred by an otolaryngologist from another institution; he had recurrent disease extending medially into the middle ear and anteriorly through the wall of the external auditory canal into the glenoid fossa. The RM-ITF dissection permitted wide exposure of the mandibular condyle and neck, as well as the lateral pterygoid muscle. The root of the zygoma, mandibular condyle/neck, lateral pterygoid muscle, and mandibular meniscus were resected en bloc with the temporal bone and parotid gland. A left radical neck dissection was also performed. A pectoralis major myocutaneous flap was used to reconstruct the surgical defect. This case demonstrates improved exposure with the RM-ITF dissection for en bloc resection of the mandibular condyle/ neck, lateral pterygoid muscle, and glenoid fossa. Figure 2 illustrates the pre- and postoperative appearance of this patient.

Case 2

A 65-year-old male had a T4N2BM0 SCCA of the oral cavity that destroyed the mandible and extended through the cheek skin. Resection of tumor required a left hemimandibulectomy, partial glossectomy, cheek

A B

Figure 2. Preoperative **(A)** and postoperative **(B)** appearance after left temporal bone resection, condylectomy, superficial parotidectomy, left radical neck dissection, and pectoralis major myocutaneous flap reconstruction.

excision, total parotidectomy, facial nerve resection, and neck dissection. The RM-ITF dissection was performed for en bloc resection of the tumor, as well as the temporalis, masseter, and medial pterygoid musculature and mandible. Because the facial nerve was also encased by tumor invading the parotid region, it was also resected up to the lateral canthus. Nerve was free of tumor at this point, and all margins were clear of tumor. Reconstruction was performed with a free fibular osseocutaneous flap and a pectoralis major myocutaneous flap. This case demonstrates the use of the RM-ITF dissection for an advanced tumor originating from the oral cavity and mandible. Figure 3 illustrates the pre- and postoperative CT scan findings.

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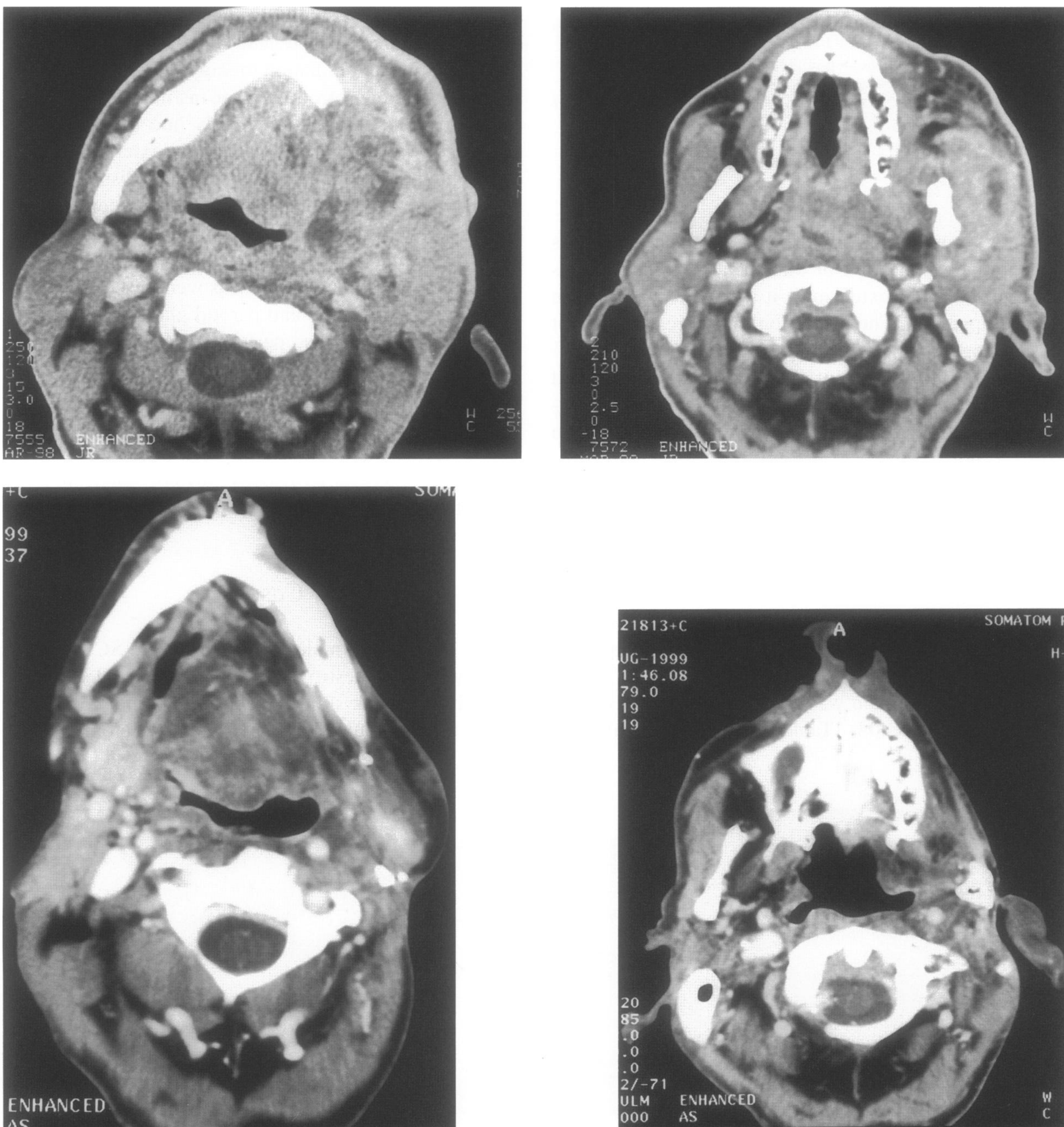

Figure 3. Preoperative CT scan of the mandible **(A)** and pterygoid region **(B)**. Postoperative CT scan **(C,D)** after left hemimandibulectomy, resection of cheek, partial glossectomy, left radical neck dissection, infratemporal fossa resection of medial pterygoid masseter, and temporalis muscle with fibular free flap and pectoralis myocutaneous flap reconstruction.

Case 3

A 72-year-old male had a T4N0M0 SCCA of the left maxillary sinus with extension into the orbit, infratemporal fossa, and questionable dural abutment. Resection entailed a left radical maxillectomy with orbital exenteration, ethmoidectomy, sphenoidectomy, frontal sinusectomy, and a RM-ITF dissection. The RM-ITF dissection was performed in conjunction with a pterional craniotomy both to confirm that the dura was free of cancer and to enhance the exposure of the facial skeleton for maxillectomy and orbital resection. The surgical defect was reconstructed using a rectus abdominus free flap. This case illustrates the enhanced exposure of the sinuses, orbit, and pterional craniotomy site, using the RM-ITF dissection. Figure 4 illustrates the pre- and postoperative appearance of this patient.

DISCUSSION

Advances in surgical approaches, radiographic imaging, radiation therapy, and chemotherapy have all improved treatment of advanced head and neck/skull base tumors.[1–7] Tumors that were previously considered unresectable can now be safely removed with minimal morbidity. This study reviews our recent experience with the RM-ITF dissection. This approach was initially popularized by Obewegeser to enhanced surgical access to this region.[15,16] Previous reports by Wetmore et al.[17] described this exposure with extension of the incision into the neck for removal of tumors involving the lower one-third of the face or neck. Conley[8] initially reported a transfacial approach to this region. Mann et al.[19] made modifications with an anterolateral transfacial procedure that used a lower lip-splitting incision and a Weber-Fergusson incision to access the ITF and nasopharynx. Using this approach, the malar complex osteotomy was performed with a saw and the coronoid process was resected. Unfortunately, the approach required anterior facial incisions. Obewegeser's approach avoided the anterior incision. Fisch[20] also concealed anterior incisions and described an infralabyrinthine approach for accessing the ITF. In this technique, a subtotal petrosectomy was performed through an extended postauricular incision, and the ear canal was closed as a blind sac. The facial nerve was identified and exposed. The zygomatic arch and temporalis muscle were reflected inferiorly. The carotid artery was followed medially to the glenoid fossa, and the mandibular division of the trigeminal nerve was sectioned. The main advantage of this approach is exposure of the carotid artery throughout the skull base. Disadvantages include the length of time needed to dissect the temporal bone and the conductive hearing loss associated with closure of the external auditory canal.

In accessing the skull base, the RM-ITF dissection as performed by our team offers a number of advantages. In general the approach offers a direct route to the


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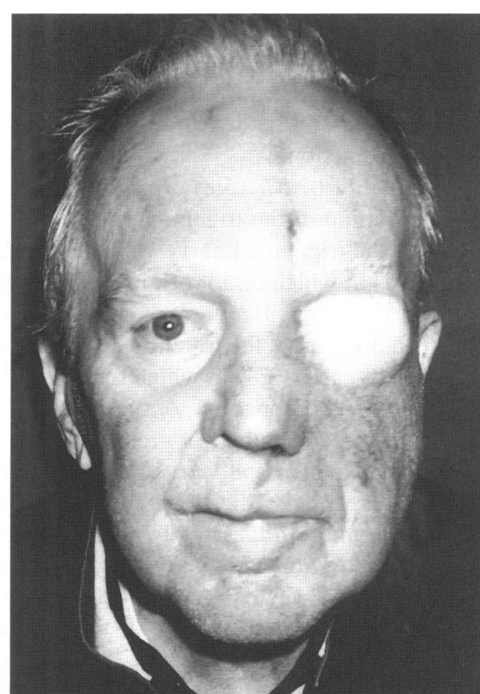
B

Figure 4. Preoperative **(A)** and postoperative **(B)** appearance after left maxillectomy, orbital exenteration, dural resection, ethmoidectomy, sphenoidectomy, frontal sinusectomy, and rectus abdominus free flap reconstruction.

ITF with minimal operating time. The concealed preauricular incision avoids anterior facial scars. If further exposure of the maxilla is necessary, a facial degloving approach may be added. The incision may also be extended into the cervical region for greater exposure of the internal jugular vein, carotid artery, and mandible. When extended into the neck, this approach has provided excellent access to tumors involving the oral cavity, oropharynx, and mandible. A disadvantage of the RM-ITF dissection is the lack of exposure of the carotid artery and jugular vein when the incision does not extend into the neck. If no dissection into the cervical region is planned, the approach described by Fisch et al.[20] is a superior method.

We have also been impressed with the functional outcomes provided by the RM-ITF approach. The dissection permits exposure and protection of the cranial nerves and of the muscles of mastication. This study showed no significant morbidity in mastication (p = 0.86), speech (p = 1.0), or swallowing (p = 0.63) when comparing pre- and postoperative function. Two patients (1 and 4, Table 2) required resection of the condyle and glenoid fossa because of tumor extending from the temporal bone into these regions. For two patients (6 and 7, Table 2) who had severe trismus from tumor extending into the temporal mandibular joint region, surgical resection improved postoperative function in mastication. Unfortunately, this study did not use three-dimensional incisor movements as previously reported to quantify jaw joint function.[21,22] In addition, there was no significant change in hearing (p = 1.0) or vision (p = 1.0). In two patients, malignant neoplasm extension into the nerve necessited sacrifice of the facial nerve. There was almost a statistically significant difference (p = 0.052); however, more patients are needed to clarify whether surgery had any impact on facial nerve function.

A total of 62.5% (5/8) of patients lost sensation in the distribution of the trigeminal nerve. The second division of the trigeminal nerve was sacrificed in 25% of cases (2/8) in which tumor originated from the foramen rotundum and maxillary sinus, respectively (Table 4). The third division of the trigeminal nerve was sacrificed in 37.5% of cases (3/8) in which tumor originated from the oral cavity, oropharynx, or mandible (Table 4). The nerve was resected either for gross disease or for microscopic extension, and all nerve margins were cleared of tumor. Interestingly, these patients had significant reduction in pain postoperatively (p = 0.008), which may be attributed to tumor resection and to loss of sensation in the region. Comparison of pre- and postoperative usage demonstrated a reduction in the amount of analgesics required by the patients. Tumor resection and trigeminal nerve sacrifice may have a useful place in palliating patients with incurable pain, although further outcomes studies are needed to confirm this finding.

CONCLUSIONS

1. The preauricular RM-ITF dissection may be an option when resecting advanced head and neck/ skull base lesions that extend into the infratemporal fossa.
2. A significant reduction in pain was noted postoperatively in all patients studied.
3. Limited postoperative changes were noted in speech, swallowing, mastication, vision, hearing, or cosmesis with this surgical approach.

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