The Transglabellar/Subcranial Approach to the Anterior Skull Base

A Review of 72 Cases

Robert M. Kellman, MD; Lawrence Marentette, MD

Objectives: To describe the transglabellar/subcranial approach to the anterior skull base and to compare it with more traditional approaches to craniofacial resection.

Design: A retrospective analysis of 72 cases at 2 academic medical centers. The main parameters analyzed were the disease entities treated, the average operating room time, the average amount of blood loss, the number of transfusions, the length of intensive care unit and hospital stays, and complication rates. These were compared with published data for traditional craniofacial approaches.

Setting: All patients were operated on by the authors in collaboration with neurosurgical teams at the State University of New York Upstate Medical University, Syracuse, and the University of Michigan Hospital, Ann Arbor.

Patients: The transglabellar/subcranial approach was performed 72 times in 69 patients in this series. Forty-two procedures in 40 patients were performed for malignant disease and 30 procedures in 29 patients were performed for benign entities. Patients' ages ranged from 2 to 78 years. Follow-up ranged from 6 months to 4 years, with a minimum follow-up of 1 year for survivors.

Results: There were no operative mortalities. Operating time, average amount of blood loss, length of hospital and intensive care unit stays, and complication rates compared favorably with published results of traditional craniofacial resections.

Conclusions: The transglabellar/subcranial approach to the anterior skull base may be a reasonable technique for the surgical management of lesions in the region of the anterior skull base. It provides excellent exposure of the nasal cavity, the orbits, and the ethmoid and sphenoid sinuses, while allowing wide access to the anterior fossa with a minimum amount of frontal lobe retraction.


Lesions of the nose and paranasal sinuses that extend into the anterior cranial fossa pose a technical challenge from the standpoint of both resection and the avoidance of complications. During the last 3 decades, the techniques of craniofacial resection for these lesions have gained acceptance, and numerous reports have detailed their effectiveness; complications, though not trivial, have been minimized to acceptable levels.

The standard (traditional) approach combines a lateral rhinotomy, with or without a Weber-Ferguson facial flap, with a bifrontal craniotomy. First introduced by Smith et al in 1954, in this technique, the junctional area of the skull base between the nose, sinuses, and anterior fossae is approached from above by the neurosurgical team and from below by the head and neck surgical team, with the 2 teams meeting in the middle. While certainly successful, the approach requires significant retraction of the frontal lobes, which makes en bloc resection of the entire lesion difficult. Nonetheless, excellent results have been reported by many experienced teams.

The transglabellar/subcranial approach was developed by Raveh et al as a natural offshoot of their experience with frontobasal trauma, in which fractures that involved the nasal root/glabellar region, the ethmoid sinuses, and the anterior fossae were dismantled prior to reconstruction. It is an extension of the work of Janecka and Sekhar combined with the advances introduced by Tessier for craniofacial surgery. By directly approaching the base of the anterior skull by disarticulating the nasal root with the frontal bone flap, more direct access to the anterior fossa floor can be obtained.

In 1997, Jung et al reported a retrospective comparison between their first 10 cases using this approach and 10 cases using the traditional lateral rhinotomy, bifrontal craniotomy approach. The current report details a retrospective analysis of our combined experience of using the subcranial approach in 69 patients and compares it with the classic approach.
PATIENTS AND METHODS

PATIENTS

The transtubercular/subcranial approach was performed 72 times in 69 patients in this series at the hospitals of the University of Michigan, Ann Arbor, and the State University of New York Upstate Medical University, Syracuse. Forty-two procedures in 40 patients were performed for malignant disease, and 30 procedures in 29 patients were performed for benign entities. Ages ranged from 2 to 78 years. Follow-up ranged from 6 months to 4 years, with a minimum follow-up of 1 year for survivors.

METHODS

Surgical Technique

The surgical technique for the transtubercular/subcranial approach has been described by Raveh et al.20,21 It basically involves a coronal incision taken down to the bone. The flap is elevated using great care to preserve the pericranium, so that it can be used for later lining of the skull base defect. The bone flap is outlined to include the nasal bones and nasal root and a portion of the frontal bone. The size of the frontal bone and the amount of the orbital rims included in the flap is determined by the amount of exposure that will be needed. It can vary from a limited frontal bone flap (Figure 1) to an extended frontal flap (Figure 2). Rigid fixation microplates may be applied to the frontal bones and removed prior to making the osteotomies to ensure the exact repositioning of the bone flap during closure.

If the tumor extends anteriorly in the ethmoid sinuses, the bone cut will generally need to be anterior to the anterior lacrimal crest(s). If the lesion is more posterior, the lacrimal crests may be preserved in the flap, and, occasionally, for a tumor that does not involve the ethmoid sinuses, an anterior position of the lateral nasal bone cuts will allow preservation of the medial canthal attachments. In most cases, the medial canthal ligaments are articulated. If the posterior wall of the frontal sinus is to be excised, then an osteoplastic anterior frontal wall excision may be combined with the glabellar/nasal cuts. Otherwise, the entire frontal sinus may be included in the bone flap. Unlike Raveh et al.20 who separated the distal nasal bones from the upper lateral cartilages of the nose, we left 3 to 5 mm of distal nasal bone intact to preserve the internal nasal valves.

Before the frontal bone cuts are completed (so that the bone flap is still stable), an osteotome is placed horizontally behind the glabella to fracture the flap from the crista galli, making every effort to stay as anterior as possible to avoid penetration of the anterior fossa dura. Similarly, the bony nasal septum must be fractured behind the nasal bone portion of the flap. The flap is then elevated, revealing a direct view of the nose, the ethmoid sinuses, and the anterior fossa dura. The resection is then performed as appropriate for the lesion being treated. Whenever possible, one or both sides of the cribiform plate and olfactory elements are preserved. The direct view makes unilateral preservation of olfaction easy without jeopardizing the en bloc resection. Exposure posteriorly to the posterior sphenoid and pituitary fossa and inferiorly to the palate and nasopharynx is possible.

After the resection of the lesion has been completed, the anterior fossa may be separated from the nose and sinuses using the previously preserved pericranium either as a thin pericranial flap or as a thicker galeal/pericranial flap. Note that a hole must be created in the center of the pericranial flap for replacement of the bone flap. Care should be taken to avoid injury to the bilateral supraorbital vessels. Before the bone flap is fixed in place, the medial canthal ligaments are sutured independently to the opposite frontal bone, with the sutures passing behind the nasal bones (centripetal suspension) (Figure 3). The frontal sinuses are generally obliterated (although Raveh et al23 stent them into the nose).

Review

Patient data were analyzed for the nature of the disease process and the results of surgery. The number of major complications, average operating room (OR) time, average blood loss, number of transfusions, and average volume of blood transfused were included, as well as the average time of hospitalization and average length of time spent in the intensive care unit (ICU). Surgical outcomes were noted, although the follow-up was too short to assess long-term success rates.

RESULTS

A total of 72 transtubercular/subcranial approaches were performed in 69 patients. Forty-two procedures were performed in 40 patients for malignant disease, including 6 esthesioneuroblastomas, 6 adenocarcinomas, 5 squamous cell carcinomas, 4 sinonasal undifferentiated carcinomas, 4 adenoid cystic carcinomas, and 15 miscellaneous lesions. Thirty procedures were performed in 29 patients for benign disease ranging from inverting papillomas to dermoids and encephaloceles. The average OR time was 8 hours for malignant diseases and 5 hours for benign diseases (6.75 hours overall). Average blood loss was 1100 mL for malignant disease and 504 mL for benign disease (849 mL overall), and 21 patients with malignant disease received an average transfusion of 3 U of blood each, while 3 patients with benign disease received 1 U each. The duration of hospitalization and ICU stays averaged 11 days and 4 days, respectively, for malignant disease, and 7 days and 2 days for benign disease.

Major complications (including tension pneumocephalus, persistent leak of cerebrospinal fluid, meningitis, loss of the bone flap, and subdural hematoma) occurred in 12 (29%) of 42 procedures for malignant disease and 4 (13%) of 30 procedures for benign disease. There were no operative mortalities. The major predictor of complications was dural involvement by malignant disease, with 6 of 9 suffering major complications and 8 of 9 dying of their disease. Eleven (28%) of 40 patients with malignant disease had positive margins, 6 of whom suffered complications and 5 of whom died of disease. Of 29 patients with negative margins, 9 (31%) had compli-
cations and 6 (21%) died of disease. Twenty-two (55%) of 40 patients with malignant disease had radiation therapy, including 4 (10%) who had radiation failure and 18 (45%) who were given planned postoperative treatment. There was no measurable correlation between radiation and occurrence of complications.

To the extent that data were available, a meta-analysis of similar results from other reports is presented in Tables 1, 2, and 3.

**COMMENT**

Simultaneous combined craniofacial resection has evolved over the past 40 years from an extremely high-risk procedure with a high risk of meningitis and death to an accepted treatment for lesions of the anterior skull base and sinuses. Although such procedures were originally performed only as staged procedures, the increased cooperation between neurosurgeons and head and neck surgeons has led to many recent advances. The transglabellar/subcranial approach is such an advance, since the osteotomies and flap elevation require simultaneous effort and complete cooperation between the neurosurgical and head and neck teams. Rather than a revolutionary concept, this approach is a logical step in the progression of osteotomies available. It builds upon the pioneering work of Frazier,22 Smith et al,10 and Ketcham et al,23 who demonstrated the possibilities for transfacial approaches, and the developments of Tessier13 and Derome,24 who advocated the transbasal approach. The more recent advances of Lawton et al,25 Fukuta et al,26 and Janecka and Sekhar12 paved the way for the subcranial approach.

The transglabellar/subcranial approach as advocated by Raveh et al20,21 was a logical development of their experience with severe frontobasal trauma. Initially, they used transetmoidal approaches in these severely traumatized cases,27 noting over time that completely disarticulating the fractured nasal-ethmoid complex led to better access to the floor of the frontal fossa for dural repair without frontal lobe retraction and ultimately more controlled repair of the medial canthal tendons, the anterior skull base, and the nasal roots.20,21,27,28

While several authors have published experience with the transglabellar/subcranial approach,24-29 the inclusion of the nasal root and nasal bones in the craniotomy flap still seems either aggressive or unnecessary to some. While it

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**Table 1. Major Complications Reported Using the Transglabellar/Subcranial Approach**

<table>
<thead>
<tr>
<th></th>
<th>Shah et al7</th>
<th>Richtsmeier et al2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average OR time, h</td>
<td>6-8</td>
<td>...</td>
</tr>
<tr>
<td>Average blood loss, mL</td>
<td>1500-2500</td>
<td>...</td>
</tr>
<tr>
<td>Average hospitalization time (range), d</td>
<td>24 (8-89)</td>
<td>13 (6-35)</td>
</tr>
<tr>
<td>Average amount of blood transfused, U</td>
<td>...</td>
<td>3.9</td>
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</tbody>
</table>

*OR indicates operating room; ellipses indicate data are unavailable.
increases some cosmetic deformity by avoiding all facial incisions (unlike the lateral rhinotomy incision of the traditional approach), it does increase the risk of cosmetic deformity when there is loss of some or all of the bone flap (as in one of our patients).

In this series, the complication rates were similar to or better than those reported in most series of craniofacial resections. As noted in the retrospective comparison of this technique with the classic approach, overall surgical times, ICU stays, transfusion rates, complication rates, and hospital stays compared favorably in our series as well. Success and failure rates are similar for malignant disease, and, as in previously reported series, dural involvement with malignant disease is the single greatest predictor of complications and failures. The perioperative mortality for this procedure as seen in the meta-analysis is significantly lower than that reported using the traditional craniofacial resection.

The results in this series of patients operated on using the transglabellar/subcranial approach to the anterior skull base suggest that it is a reasonable technique for surgical management of lesions in the region of the anterior skull base. It provides excellent exposure of the nasal cavity, orbits, and ethmoid and sphenoid sinuses while allowing wide access to the anterior fossa with a minimum amount of frontal lobe retraction.

### CONCLUSIONS

The results in this series of patients operated on using the transglabellar/subcranial approach to the anterior skull base suggest that it is a reasonable technique for surgical management of lesions in the region of the anterior skull base. It provides excellent exposure of the nasal cavity, orbits, and ethmoid and sphenoid sinuses while allowing wide access to the anterior fossa with a minimum amount of frontal lobe retraction.

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**Table 2. Major Complications Reported Using the Classic Craniofacial Approach**

<table>
<thead>
<tr>
<th>Site of Study</th>
<th>Year</th>
<th>Complications/Total Cases, No. (%)</th>
<th>Deaths, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Virginia, Charlottesville</td>
<td>1989</td>
<td>10/25 (40)</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Johns Hopkins University, Baltimore, MD</td>
<td>1992</td>
<td>10/32 (31)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>University of Pittsburgh, Pittsburgh, PA</td>
<td>1992</td>
<td>15/94 (16)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Mayo Clinic, Rochester, Minn</td>
<td>1994</td>
<td>16/54 (30)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>University of California, San Francisco</td>
<td>1996</td>
<td>21/52 (40)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>M. D. Anderson Cancer Center, Houston, Tex</td>
<td>1996</td>
<td>27/76 (36)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Memorial Sloan-Kettering Cancer Center, New York, NY</td>
<td>1997</td>
<td>36/115 (31)</td>
<td>4 (3)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>133/448 (30)</td>
<td></td>
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*There were no deaths.

### REFERENCES


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Corresponding author and reprints: Robert M. Kellman, MD, Department of Otolaryngology, Upstate Medical University, 750 E Adams St, Syracuse, NY 13210.