TRANSGLABELLAR SUBCRANIAL APPROACH FOR THE MANAGEMENT OF NASAL MASSES WITH INTRACRANIAL EXTENSION IN PEDIATRIC PATIENTS

Parul Goyal, MD; Robert M. Kellman, MD; Sherard A. Tatum III, MD

Objective: To describe the use of the transglabellar subcranial approach for the management of congenital nasal masses in the pediatric population.

Methods: Case series. Medical records of 5 patients who underwent resection of congenital nasal lesions via the subcranial approach were reviewed.

Results: Five children underwent successful resection of congenital nasal lesions with intracranial extension via the subcranial approach. Lesions resected included nasal dermoids with intracranial extension (n=3) and encephaloceles (n=2). Patient age at the time of operation ranged from 13 months to 15 years. All lesions were resected successfully, and there have not been any recurrences. Follow-up has ranged from 1 to 12 years. There has been no apparent negative effect on facial growth in any of these patients.

Conclusions: The subcranial approach is an effective technique for the resection of nasal masses with intracranial extension. These lesions have traditionally been managed with lateral rhinotomy, midface degloving, or external rhinoplasty approaches combined with a frontal craniotomy. The subcranial approach offers several advantages over a traditional frontal craniotomy. It provides excellent exposure, minimizes frontal lobe retraction, reduces the likelihood of cerebrospinal fluid leakage, and provides for an excellent cosmetic result. Long-term follow-up in 5 pediatric patients has shown no recurrence or negative effect on craniofacial growth. These factors make the transglabellar subcranial approach a useful and safe technique for the management of nasal lesions with intracranial extension in very young patients.

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Various congenital nasal masses have been described. Among the most common of these lesions are nasal dermoids, gliomas, and encephaloceles. Many different surgical approaches have been described to manage these lesions, but selecting the ideal approach remains a challenge. Dermoids, gliomas, and encephaloceles can have intracranial extension, and this adds to the difficulty in treating these patients. The intracranial portion of these lesions has most often been resected by means of a frontal craniotomy.¹

The subcranial approach was initially described for the management of craniofacial trauma.² Its role has been extended to the management of skull base lesions,³ but the experience with the subcranial approach in children is limited. The subcranial approach has been used extensively at our institution for the management of anterior skull base lesions.⁴ This case report describes the use of the transglabellar subcranial approach in 5 pediatric patients with congenital nasal lesions. The experience confirms that the transglabellar subcranial approach provides excellent exposure and can be performed safely in pediatric patients. Findings in the medical literature support the hypothesis that the subcranial approach is associated with lower morbidity than a frontal craniotomy approach,⁴ making it the procedure of choice even in very young patients.

Methods:
The exposure for the subcranial approach begins with a coronal incision that is made and carried down to bone. The flap is elevated in a subperiosteal plane, taking care to preserve the pericranium in case it is needed for later reconstruction. Laterally, care is taken to avoid injury to the frontal branch of the facial nerve by elevating deep to the superficial layer of the deep temporal fascia below the temporal line of fusion. The supraorbital neurovascular bundles are identified and preserved. The central portion of the flap is elevated down to the level of the upper lateral cartilages of the nose. The proposed bone flap is then outlined. Rigid fixation microplates are applied across the proposed osteotomy sites to allow for accurate repositioning of the bone flap at the end of the procedure (Figure 1). After removal of the plates, burr holes are made in the frontal bone, and the dura is separated from the frontal bones and ethmoid roof. The upper osteotomy lies horizontally across the frontal bones, and the lateral osteotomies extend vertically through the supraorbital rims. Alternatively, the entire fron-
talar osteotomy can be semicircular. Because intracranial exposure is needed, the osteotomies are made beyond the limits of the frontal sinus when it is present. The bone flap will contain both the anterior and posterior walls of the frontal sinus. Frontal sinus pneumatization is absent or limited in many young patients, and the bone flap can be fashioned without being affected by the frontal sinus. Inferiorly, the osteotomies lie laterally along the nasal or lacrimal bones and horizontally across the distal nasal bones. If the inferolateral osteotomies are made posterior to attachment of the medial canthal tendons, the tendons must be resuspended at the end of the procedure.

Before completion of the frontal bone osteotomies, an osteotome is passed posterior to the glabella to carefully fracture the flap from the crista galli and the nasal septum. After the bone flap is free (Figure 2), the intranasal portion of the lesion is removed. Resection of the intracranial portion is then performed by the neurosurgical team. In the case of encephaloceles and gliomas, no other incisions are necessary because the extracranial portion of the lesions can be dissected through the exposure provided. In the case of nasal dermoids, an incision along the nasal dorsum may be necessary to excise the cutaneous punctum and tract often associated with these lesions.

A pericranial flap may be used for reconstruction. If a nasal dorsum incision was necessary, it can be closed primarily. The underside bone flap must be inspected closely to remove any adherent portions of the lesion. Burring of this surface may be necessary. The bone flap is replaced and secured using the microplates applied earlier, and the coronal incision is closed.

**REPORT OF CASES**

**CASE 1**

A 14-month-old boy was referred for evaluation of a left nasal cavity mass noted on examination by the child’s pediatrician. Computed tomography (CT) demonstrated a bony defect in the left cribriform area with associated soft tissue extending into the nasal cavity. The diagnosis of a meningoencephalocele was made, and the patient’s family was counseled on the treatment options. A subcranial approach was used for resection of the encephalocele. During surgery, the encephalocele was reduced, and temporalis fascia was used to reconstruct the skull base defect. The patient had no postoperative complications and was able to be discharged from the hospital on the sixth postoperative day. Follow-up during 12 years has shown an excellent functional and cosmetic outcome (Figure 3).

**CASE 2**

A 13-month-old boy was evaluated for an enlarging mass along the nasal dorsum. Examination findings also revealed a small punctum inferior to the mass. Magnetic resonance imaging confirmed the presence of the nasal dorsum mass and showed a small intracranial component. A diagnosis of a nasal dermoid with intracranial extension was made. The patient underwent resection of the lesion via a subcranial approach without any complications. A tract extended from the nasal dorsum mass to the intracranial portion of the lesion. The patient has been followed up for 8 years and has had an excellent cosmetic outcome.

**CASE 3**

A 9-year-old boy developed drainage from a small nasal dorsum cutaneous ostium after sustaining trauma to the area. There was a suggestion of a nasal dermoid, and computed tomographic and magnetic resonance imaging studies were obtained. Magnetic resonance imaging confirmed a mass that extended intracranially, and the patient was taken to surgery for subcranial resection of the suspected nasal dermoid. An incision over the nasal dorsum was necessary to resect the sinus ostium associated with the dermoid. The cyst was exposed along its entire tract and was resected. The patient had no intraoperative or postoperative complications. He has not had any complications for 2 years.
operative photographs. Our subjective evaluations of patients’ preoperative and postoperative follow-up in all these patients has shown excellent cosmetic results without any intraoperative or postoperative complications. Five pediatric patients underwent successful resection of the lesion without complications.

Five pediatric patients underwent resection of nasal encephaloceles or dermoids via the transglabellar subcranial approach. Data from 2 of these patients were presented previously. Patient data are summarized in the Table. Follow-up in the patients ranged from 1 to 12 years. All patients underwent successful resection of the lesion without any intraoperative or postoperative complications. Follow-up in all these patients has shown excellent cosmetic outcome without any growth disturbance. Assessment of cosmetic outcomes and growth disturbances was based on our subjective evaluations of patients’ preoperative and postoperative photographs.

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age When the Procedure Was Performed</th>
<th>Diagnosis</th>
<th>Duration of Follow-up, y</th>
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<tr>
<td>1</td>
<td>14 mo</td>
<td>Meningoencephalocele</td>
<td>12</td>
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<tr>
<td>2</td>
<td>13 mo</td>
<td>Dermoid</td>
<td>8</td>
</tr>
<tr>
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<td>Dermoid</td>
<td>7</td>
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<tr>
<td>5</td>
<td>15 y</td>
<td>Encephalocele</td>
<td>1</td>
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</table>

*a Described previously by Kellman et al.*

**RESULTS**

Congenital nasal masses are rare anomalies, occurring in 1 of every 20 000 to 40 000 births. These lesions usually manifest as nasal masses but often have intracranial extension. Intracranial communication is always present with encephaloceles and is often found with dermoids and gliomas. Infections resulting from these masses place these patients at risk of life-threatening intracranial complications. Therefore, early diagnosis and surgical resection is recommended to minimize the risk of these complications.

Various surgical approaches have been used to resect these nasal lesions. In cases of intracranial extension, combined craniofacial approaches have been used to allow for complete resection of the extracranial and intracranial portions of the lesions. Generally, this has meant addressing the intracranial portion of the lesion using a frontal craniotomy. Although these approaches have been used successfully, the transglabellar subcranial approach is advantageous because it provides superior exposure with less morbidity.

Traditional craniofacial approaches to the anterior skull base involve 2 separate approaches performed by 2 separate teams. The neurosurgical team performs the frontal craniotomy and approaches the lesion from above, while the head and neck surgical team approaches the lesion from below. The 2 teams ultimately meet in the middle to resect the portion of the lesion at the skull base. The transglabellar subcranial technique is advantageous because it allows the lesion to be visualized in continuity and approached in a single field. Because the surgical teams work jointly in a common field, the subcranial approach requires a high level of cooperation between the neurosurgeons and the head and neck surgeons.

Several advantages of the subcranial approach lead to a lower morbidity than the traditional approaches. These advantages include minimal risk of anosmia, decreased frontal lobe retraction, and lower likelihood of cerebrospinal fluid leakage. These advantages are a result of the unique exposure provided by the subcranial approach. A traditional frontal craniotomy necessitates frontal lobe retraction for access to the anterior skull base. This retraction can lead to brain edema and contusions. Because substantial brain edema can lead to short-term and long-term neurological deficits, it is important to use surgical techniques that decrease the likelihood of brain edema by minimizing brain retraction. The subcranial approach is ideal for this purpose because it provides exposure from below, eliminating the need for frontal lobe retraction.

The osteotomy size can be tailored to the size and course of the lesion. For midline lesions such as dermoids, the osteotomy is smaller than the traditional frontal craniotomy. The smaller osteotomy reduces the risk of dural tears and resultant cerebrospinal fluid leaks. Finally, depending on the degree of involvement of the cribiform, the olfactory elements can be preserved in many cases. The cribriform can even be osteotomized and retracted superiorly for exposure of the posterior central portion of the anterior cranial fossa.

Published reports have shown complication rates to be lower with the transglabellar subcranial approach than with traditional craniofacial approaches. A meta-analysis compared the rates of major complications between the 2 techniques. Considering the major complications of tension pneumocephalus, cerebrospinal fluid leakage, loss of the bone flap, and subdural hematoma, Kellman and Marentette found the rate of complications to be 30% with the classic craniofacial approaches and 16% with the subcranial approach. The rate of complications was even lower in patients in whom the subcranial approach was used for benign lesions.

The less invasive nature of the subcranial approach compared with the classic craniofacial approach is supported by other data. In comparing patients with anterior skull base neoplasms, Moore et al found shorter operative time, intensive care unit stay, and overall hospital stay in the group undergoing a subcranial approach compared with the group undergoing a standard frontal craniotomy and lateral rhinotomy. The complication rate was also lower in the group undergoing a subcranial approach. Similarly, Jung et al found less blood loss, a lower transfusion requirement, and shorter intensive care unit stays and hospital stays in patients undergoing the subcranial approach compared with patients undergoing the traditional craniotomy approach.

The risk of postsurgical growth disturbances mandates careful selection of surgical approaches when treating young patients. In patients having nasal lesions with intracranial extension, untreated masses carry the risk of intracranial infection. Furthermore, the lesions themselves may lead to altered craniofacial growth. Therefore, surgical resection should be carried out soon after diagnosis. The patients treated in this series ranged in age from 13 months to 15 years at the time of resection.

**COMMENT**

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All have had an excellent cosmetic outcome without any notable adverse effects on craniofacial growth. Based on this experience, it seems that the transglabellar subcranial approach can be used safely in young patients without substantial alteration of future growth.

Endoscopic techniques have increasingly been used for the resection of nasal lesions. Authors have described the management of dermoids, gliomas, and encephaloceles using endoscopic techniques. However, certain lesions with a substantial amount of intracranial extension remain difficult to approach endoscopically. For these lesions requiring open procedures, the transglabellar subcranial approach is preferable to traditional craniootomy approaches. As the role of endoscopic approaches expands, it is possible that they may be used even for lesions with a large intracranial component.

Patients with midline nasal masses must undergo preoperative imaging to assess for intracranial extension. Computed tomography is often the initial imaging study obtained. Computed tomography is not optimal for definition of soft-tissue masses, but it provides good visualization of the bony landmarks of the skull base. The path of nasal masses that extend intracranially can cause deformity of the foramen cecum and the crista galli. Authors have advocated relying on bony deformities of these structures on CT as indirect signs of intracranial extension. Others have found these signs to be unreliable. These differences in experience likely originate from the fact that there is substantial variability in the ossification of the skull base in infants and young children. The anterior skull base consists primarily of unossified cartilage at birth. There is progressive ossification during the first few years of life, with approximately 50% of the skull base undergoing ossification by 6 months of age and 84% undergoing ossification by 2 years of age. Because unossified cartilage is of the same signal intensity as the surrounding soft tissue, a bony defect seen on CT may simply represent normal skull base development. This fact makes it difficult to define strict criteria that indicate intracranial extension on CT. Consequently, some authors have concluded that magnetic resonance imaging should be obtained when CT shows bony deformity or when the results of CT are indeterminate.

Because patients with midline nasal masses often are seen early in life, general anesthesia may be needed when an imaging study is performed in these patients. We agree with Bloom et al that magnetic resonance imaging may be the best initial study to obtain in these patients to avoid potential morbidity from multiple anesthetics. In the absence of an obvious intracranial mass, it is important to interpret any imaging studies with caution to avoid unnecessary procedures. Conversely, the absence of intracranial extension in the presence of questionable skull base findings on imaging should be viewed with caution for the possibility of intracranial extension.

CONCLUSIONS

Management of congenital nasal masses is challenging, especially in patients who have lesions with intracranial extension. When surgical resection is planned, the subcranial approach is an effective technique even in the youngest of patients. It provides excellent exposure, minimizes frontal lobe retraction, reduces the likelihood of cerebrospinal fluid leak, and provides for an excellent cosmetic result. Long-term follow-up in 5 pediatric patients has shown no recurrence or negative effect on craniofacial growth. These factors make it preferable to use the transglabellar subcranial approach over traditional frontal craniotomy approaches described in the medical literature.

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Correspondence: Robert M. Kellman, MD, Department of Otolaryngology–Head and Neck Surgery, Upstate Medical University, 750 E Adams St, Syracuse, NY 13210 (kellmanr@upstate.edu).

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REFERENCES