Surgical Treatment of Subperiosteal Orbital Abscess

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Objective: To determine the factors influencing the surgical approach to a pediatric subperiosteal orbital abscess (PSPOA), more specifically, comparing external (E) vs transnasal endoscopic (TNE) surgical approaches.

Design: A retrospective medical chart review.

Setting: Children's National Medical Center in Washington, DC.


Main Outcome Measures: Age at presentation, presentation duration of periorbital edema before presentation, white blood cell count and temperature at initial presentation, preoperative radiographic location of abscess, and number of extraocular muscles displaying radiographic abnormalities.

Results: Thirteen patients, 10 boys and 3 girls, were identified (mean age, 8.7 years [range, 6 weeks to 13 years]). Five patients were successfully treated with only a TNE approach, whereas 8 patients required an E approach. Location of PSPOAs and radiographic changes of extraocular muscles differentiated the patients in TNE and E groups. All patients had eventual resolution of their disease without any surgical complications.

Conclusions: Factors influencing the choice of surgical approach for the treatment of PSPOAs extend beyond surgeon preference. Patient clinical presentation and radiographic findings may help guide the physician in choosing an appropriate surgical approach.


Pediatric subperiosteal orbital abscesses (PSPOAs) are an infectious process in which the abscess pocket is described as lying between the periorbita and the lamina papyracea. The source of the infection is believed to originate most frequently from ethmoid and maxillary sinusitis, although vascular spread from the adjacent orbital, cranial, and facial structures is also possible.1-3 A PSPOA requires timely and effective treatment owing to its morbidity complications, which include visual loss, endophthalmitis, cavernous sinus thrombosis, intracranial spread (eg, meningitis, cerebritis, brain abscess), and ultimately death.1-4

The diagnosis is typically made through a combination of clinical examination and radiographic findings. Once the diagnosis is established, the treatment modality can be controversial. The first source of debate relates to medical vs surgical management of PSPOAs,1,7 The second source is discussion that surrounds the selection of the type of surgical approach. Surgical options have traditionally been an external (E) approach through a Lynch, transcaruncular, or transconjunctival incision, and more recently the transnasal endoscopic (TNE) approach.8-10 The purpose of this review was to determine if there are any clinical or radiographic factors that may predict which patients can be successfully treated with TNE drainage alone.
a conservative approach to the treatment of PSPOAs. All patients initially received parenteral antibiotics and supportive measures. Surgical intervention was indicated only with failed medical therapy, progression of symptoms, or onset of complications (eg, visual changes, cavernous sinus thrombosis, intracranial involvement). All 6 treating surgeons, 2 of whom were authors of this article (D.A.P. and S.S.C.), were faculty members at the Department of Pediatric Otolaryngology at Children’s National Medical Center. As such, no single surgeon was responsible for all the patients in the series. Although it is difficult to determine the differences in their individual surgical approaches, all surgeons were adept with both TNE and E drainage approaches. Otherwise stated, all surgeons had experience successfully treating patients prior to this series with both techniques.

Medical charts were reviewed specifically for age at presentation, presentation duration of periorbital edema before presentation, and white blood cell (WBC) count and temperature at initial presentation. Preoperative computed tomographic scans were reviewed for the location of the PSPOA. Possible descriptors included medial, superior, or laterally based PSPOAs. The number of extraocular muscles displaying radiographic abnormalities was also recorded.

The type of surgical approach was noted. Patients treated solely with a TNE approach were placed in the TNE group. Patients treated initially with an E approach or those patients who received initial TNE drainage and recurrence that necessitated an E approach were placed in the E group. All E approaches were performed initially through a Lynch incision. Those with substantial superolateral abscess extension were also approached externally via a lateral eyebrow incision. Adverse events or complications of any surgical interventions were documented.

All data were collected and entered into an Excel spreadsheet (Microsoft Corp, Redmond, Washington). Statistical analysis of results was performed with SAS (version 8.2; SAS Institute Inc, Cary, North Carolina). Univariate statistical analysis, using the \( t \) test, was performed for continuous variables. Statistical significance was defined by \( P<.05 \).

**RESULTS**

Thirteen patients, 10 boys and 3 girls, were identified as having a PSPOA surgically treated in the 2004-2007 period. Their mean age was 8.7 years. Five patients were successfully treated with the TNE approach alone. Eight patients required an E approach. Of this group, the PSPOAs of 6 patients were initially drained with a TNE approach, but these patients experienced a recurrence requiring an E approach. Two patients were treated initially with an E approach. One of these also experienced a recurrence laterally in the orbit and required a second E approach. Two patients required an E approach. Of this group, the mean age of the TNE group was 9.6 years (range, 7-12 years), whereas the mean age of the E group was 7.7 years (range, 0.2-13 years). There was no statistically significant difference in age between the 2 groups \( (P=.32) \).

The mean temperature at initial evaluation of all 13 patients was 38.4°C (range, 36.6°C-40.1°C). The mean temperature for the TNE group was 38.6°C, whereas that for the E group was 38.3°C. No statistically significant difference in the mean temperatures of the 2 groups was noted \( (P=.71) \). The mean WBC at admission of all patients was 15 500/µL (range, 6200-27 000/µL). No statistically significant difference in WBC count between the TNE (mean WBC, 14 500/µL) and E (mean WBC, 16 200/µL) groups was appreciated \( (P=.68) \). (To convert white blood cell count to \( \times 10^9/\text{L} \), multiply by 0.001.) All 13 patients reported periorbital edema with a mean duration at initial evaluation of 2.9 days. The TNE group had a mean duration of 2.7 days, whereas the E group had a mean duration of 3 days. Statistical analysis did not demonstrate a significant difference between the 2 groups \( (P=.72) \).

The TNE and E groups showed statistically significant differences when compared on the basis of superolateral extension and the number of extraocular muscles demonstrating radiographic abnormalities \( (P=.02 \) and \( P=.003 \), respectively). Preoperative imaging demonstrated that all 5 patients in the TNE group had medially based PSPOAs without superolateral extension (Figure 1). Of the E group, 3 patients had medially based PSPOAs, whereas the remaining 5 patients had superolateral extension (Figure 2). The mean number of extraocular muscles demonstrating radiographic abnormalities for all 13 patients was 1.9. The TNE group had a significantly lower mean number of 0.6, compared with a mean number of 2.6 for the E group \( (P=.003) \) (Figure 2).

No complications or adverse events were noted in either treatment groups. The Table summarizes the clinical and radiographic findings observed in the TNE and E groups.

**COMMENT**

Prior studies have examined factors that may differentiate those patients who can be successfully treated with parenteral antibiotics from those who require surgical intervention. There are numerous studies that advocate the use of medical treatment initially for the treatment of PSPOAs given that certain conditions are met.1,11,12 When the infectious process fails to respond appropriately to intravenous antibiotics, treatment proceeds to surgery.

Multiple surgical approaches exist, each sharing the objectives of draining the PSPOA, releasing pressure on
the orbit, and obtaining a specimen for culture. Endoscopic, E, and combined approaches have been described, each with their own limitations and benefits. The TNE approach allows the drainage of the PSPOA without an external incision. However, its potential limitation is variable visibility secondary to bleeding of the hyperemic mucosa. Poor identification of landmarks can lead to inadequate drainage (requiring conversion to an E approach), as well as unintended violation of nearby structures. Traditionally, the approach to subperiosteal orbital abscesses has been drainage through a Lynch incision. This method avoids the potential for inadequate drainage and poor visibility. Despite its efficacy, this technique leaves a visible scar, which is especially undesirable in the pediatric population.

Age has been a factor discussed in considering whether a patient undergoes surgery or receives medical management alone for the treatment of PSPOAs. Brown et al demonstrated that patients successfully treated with medical management alone were significantly younger than those patients who needed surgical intervention. Despite the existing data comparing medical and surgical management, there is a paucity of studies examining factors that may help predict which patients can be treated endoscopically rather than externally. Identifying these factors may allow a patient to be successfully treated with a TNE approach, thereby avoiding the adverse effects of an E approach. This article serves to help identify some of the factors that may help the physician determine which surgical approach to use when the patient has not met criteria for sole medical treatment.

As noted in the “Results” section of this study, there were no significant differences noted between the TNE and E groups for age, temperature, WBC count, or duration of periorbital edema at initial evaluation. Differences between the TNE and E groups were noted in the preoperative radiographic images. A significant difference was noted between the TNE and E groups when considering radiographic abnormalities of the extraocular muscles. Patients who were treated successfully with the TNE approach were more likely to have fewer muscles involved. Those in the E approach group were more likely to have involvement of the medial rectus, superior rectus, and superior oblique muscles.

The position of the PSPOA has been considered in determining the need for external drainage. Rahbar et al reported that all patients who underwent successful TNE drainage only had a medial based PSPOA. A similar observation was made in this study. All patients treated successfully with the TNE approach alone had medially based PSPOAs. All 5 patients with superolateral extension were from the E group. Two of these 5 patients were deemed to have notable superolateral extension by the treating surgeon and therefore underwent an initial E approach (without the TNE approach) through a Lynch incision. One of these 2 patients had recurrence of abscess in the superolateral orbit and thus required a second external drainage procedure through a lateral eyebrow incision. The other 3 of these 5 patients were instead treated initially with TNE. Recurrence prompted an E approach. Clearly, in cases in which there is substantial superolateral extension of pus, both the TNE and E approaches can fail if the lateral disease is not adequately addressed at the initial drainage setting.

Limitations of this study include lack of quantitative measures (ie, radiographic volume) of the abscesses, small sample size, lack of a uniform treatment protocol, and the retrospective nature of the review. Abscess volumetric information may have helped further differentiate the patients with superolateral extension in whom initial TNE or E drainage procedures failed to successfully clear the abscess.

Figure 2. Right pediatric subperiosteal orbital abscess with superolateral extension (black arrow) and involvement of 3 extraocular muscles (arrowheads) drained externally.

Table. Clinical and Radiographic Characteristics of the 2 Groups

<table>
<thead>
<tr>
<th>Approach</th>
<th>Age, y</th>
<th>P Value</th>
<th>Mean Temperature, °C</th>
<th>P Value</th>
<th>WBC, µL</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TNE</td>
<td>9.6</td>
<td>.32</td>
<td>38.6</td>
<td>.71</td>
<td>14 500</td>
<td>.68</td>
</tr>
<tr>
<td>E</td>
<td>7.7</td>
<td></td>
<td>38.3</td>
<td></td>
<td>16 200</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Approach</th>
<th>Prepresentation Periorbital Edema, d</th>
<th>P Value</th>
<th>Superoocular Extension</th>
<th>P Value</th>
<th>Extraocular Muscle</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TNE</td>
<td>2.7</td>
<td>.72</td>
<td>0</td>
<td>.02</td>
<td>0.6</td>
<td>.003</td>
</tr>
<tr>
<td>E</td>
<td>3</td>
<td></td>
<td>5</td>
<td></td>
<td>2.6</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: E, external; TNE, transnasal endoscopic; WBC, white blood cell count.
SI conversion factor: To convert white blood cell count to times 10^9/L, multiply by 0.001.
B Bolded P values represent statistical significance (P < .05).

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abscess from those in whom initial drainage procedures were successful.

In conclusion, although TNE surgery represents a great advance, this development does not preclude the use of external drainage of select PSPOAs. Factors influencing the choice of surgical approach for the treatment of PSPOAs extend beyond surgeon preference and experience. Preoperative radiographic findings may help predict which patients will be better treated with the TNE approach alone.

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Author Contributions: All of the authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Tanna, Preciado, and Choi.

Acquisition of data: Tanna.

Analysis and interpretation of data: Tanna and Clary.

Critical revision of the manuscript for important intellectual content: Preciado and Choi.

Administrative, technical, and material support: Tanna and Clary.

Study supervision: Preciado and Choi.

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REFERENCES