Sinus Balloon Catheter Dilation After Adenoidectomy Failure for Children With Chronic Rhinosinusitis

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Objective: To assess surgical outcomes in children undergoing sinus balloon catheter dilation for whom previous adenoidectomy has failed. Adenoidectomy is the first line of surgical management for children with chronic rhinosinusitis (CRS). This procedure is successful in about 50 percent of patients.

Design: Prospective review of children who had surgery for CRS.

Setting: A referral tertiary health care system.

Patients: Children with persistent symptoms after adenoidectomy, despite medical treatment, as documented by the sinonasal 5 (SN-5) score and the Lund-Mackay computed tomography (CT) score.

Main Outcome Measure: The SN-5 score at 1 year post procedure.

Results: Twenty-six children met the inclusion criteria. The age range was 4 to 12 years (mean [SD] age, 9.0 [2.5] years). The mean (SD) CT score was 7.3 (2.9). The minimum preoperative SN-5 score was 3.0 (mean [SD], 4.6 [0.9]). The mean (SD) time of postoperative follow-up was 13 (3.0) months. The mean (SD) SN-5 score at 1 year was 3.0 (1.2). This was a significant change from preoperative scores (P < .001). Surgical success, measured by a decrease of more than 0.5 on the postoperative SN-5 score, was achieved in 21 children (81%).

Conclusions: Sinus balloon catheter dilation has previously been shown to be safe and effective in children. This current study demonstrates that balloon dilation is effective in children for whom previous adenoidectomy has failed. Balloon catheter dilation may be considered prior to proceeding to functional endoscopic sinus surgery in children with CRS.


CHRONIC RHINOSINUSITIS (CRS) affects approximately 30 million Americans annually.¹ The vast majority of children with CRS will improve with medical management, including antibiotics, saline irrigations, nasal steroids, antihistamines, allergy therapy, and asthma control. Some children, however, have persistent symptoms despite maximum medical management, and surgical intervention may be indicated.²

Surgery for children with CRS refractory to medical management continues to evolve. Adenoidectomy is currently the mainstay of treatment for most children with CRS.³ It has the advantage of being a simple procedure with low complication rates. Adenoidectomy, however, is effective in about 50% of cases.⁴ Functional endoscopic sinus surgery (FESS) can be effective for children with recurrent symptoms after adenoidectomy, but it can be technically difficult and has the potential for serious complications.⁵

Balloon catheter sinusplasty has been shown to be safe and effective in children.⁶ Not only does it have a good safety profile, but it increases the effectiveness of surgery from 50% with adenoidectomy alone to 80% when balloon sinusplasty is performed.⁷ The goal of the current study was to determine if balloon catheter sinusplasty is a successful surgical treatment in children with persistent symptoms after adenoidectomy.

METHODS

A nonrandomized prospective evaluation was performed of patients seen by the pediatric otolaryngology service at a tertiary referral hospital between August 2006 and February 2010. Institutional review board approval was obtained from West Virginia University. Included were pediatric patients for whom adenoidectomy had failed at a mean follow-up of 12 months despite continued medical treatment that included oral and sometimes intravenous antibiotics, nasal steroids, decongestants, systemic steroids, and allergy management. Children un-
derwent an allergy evaluation, an immunoglobulin deficiency workup, and a sweat chloride test when indicated. Inclusion criteria included longstanding sinusitis after adenoidectomy as defined by more than 3 months of symptoms OR 6 episodes per year AND a positive computed tomography (CT) scan at the end of a 20-day course of oral antibiotics. Staging was reported according to the Lund-Mackay system. A sinonasal 5 (SN-5) questionnaire was also filled out by the child’s guardian at the same time as the preoperative CT scan.

Children were excluded from this analysis if they had previous sinus surgery, cystic fibrosis, extensive sinonasal osteoneogenesis, sinonasal tumors or obstructive lesions, a history of facial trauma that distorted the sinus anatomy and precluded access to the sinus ostium, or ciliary dysfunction.

Balloon catheter sinusoplasty has been described elsewhere, but, in brief, the procedure was performed in the following manner. All patients were placed under general anesthesia. The nose was appropriately decongested with pledgets and local anesthetic. The sinus guide catheter was inserted behind the uncinate process using a rigid endoscope for visualization, and then the flexible guide wire was passed through the catheter. That the guide wire was in the maxillary sinus was confirmed by wire transillumination. Once the guide wire was in place, the sinus balloon catheter was passed over the guide wire into the sinus and placed across the ostium. After positioning was confirmed, the balloon was inflated. After inflation, the balloon dilating system was removed. Nasal packing was used as necessary.

Postoperatively, all children were evaluated at 3, 12, 24, and 52 weeks. An SN-5 questionnaire was administered at baseline for all children and again at least at 12-month follow up. A postoperative CT scan was not performed because this represented added radiation exposure, and we have shown previously that SN-5 scores correlate with CT scores.10

Outcomes were based on the 12-month SN-5 score compared with the preoperative SN-5 score. As originally described by Kay and Rosenfeld,1 a decrease of 0.5 to 1.0 is a small change, 1.0 to 1.5 is a moderate change, and greater than 1.5 is a large change. Any case with a decrease in SN-5 score greater than or equal to 0.5 was considered a success. Cases with scores that decreased less than 0.5 were considered failures. Any case with a worse score and any case in which the child needed more surgery were considered surgical failures. Statistical analysis was performed using a paired t test of preoperative and postoperative SN-5 scores.

RESULTS

Twenty-six children met the inclusion criteria and completed 12 months of follow-up. The age range was 4 to 12 years old; average age, 7.7 years. Twenty of the 26 children were boys (77%). Seven children had asthma (27%), and 10 children had allergies (38%). Their mean (SD) preoperative SN-5 and CT scores were 4.6 (0.9) and 7.3 (2.9), respectively. The mean (SD) time between adenoinecody and balloon dilation was 36 (18) months. Average time of follow up was 13 months. Patient characteristics are summarized in Table 1.

A total of 33 maxillary sinuses were targeted for balloon dilation. One sinus for which adenoidectomy had failed was opened up with traditional instruments. Confirmation of balloon placement was performed with radiography or transillumination. Currently, our surgical team uses only transillumination. There were no surgical complications in this study group.

The importance of using a stepwise approach to the management of pediatric CRS cannot be overemphasized. Long-term, appropriate antibiotic therapy is a necessity; in some cases intravenous antibiotics may also be necessary.11 Investigation and treatment of comorbid conditions such as asthma and allergic rhinitis can vastly im-

### Table 1. Patient Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Patients</th>
<th>Total success</th>
<th>Same (0 to −0.4)</th>
<th>Marked improvement (−1.5 or better)</th>
<th>Total failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male sex</td>
<td>20 (77%)</td>
<td>19 (95)</td>
<td>2 (10)</td>
<td>2 (10)</td>
<td>5 (25)</td>
</tr>
<tr>
<td>Age, mean, y</td>
<td>7.7</td>
<td>7.4 (0.6)</td>
<td>4.9 (1.0)</td>
<td>7.7 (0.9)</td>
<td>7.6 (0.8)</td>
</tr>
<tr>
<td>Allergy</td>
<td>10 (38%)</td>
<td>10 (50)</td>
<td>2 (10)</td>
<td>5 (25)</td>
<td>5 (25)</td>
</tr>
<tr>
<td>Asthma</td>
<td>7 (27%)</td>
<td>6 (30)</td>
<td>1 (5)</td>
<td>5 (25)</td>
<td>3 (15)</td>
</tr>
<tr>
<td>CT score, mean</td>
<td>7.3</td>
<td>6.8 (1.1)</td>
<td>4.6 (1.2)</td>
<td>7.1 (1.4)</td>
<td>6.5 (1.2)</td>
</tr>
<tr>
<td>SN-5 score, mean</td>
<td>4.6</td>
<td>4.5 (0.7)</td>
<td>3.8 (1.0)</td>
<td>5.0 (1.5)</td>
<td>4.2 (0.8)</td>
</tr>
</tbody>
</table>

Abbreviations: CT score, computed tomography findings as evaluated by the Lund-Mackay score; SN-5 score, findings from the sinonasal 5 questionnaire.

*Unless otherwise noted, data are reported as number (percentage) of patients.*

### Table 2. Percentage of Children According to Their SN-5 Score Change After the Balloon Procedure

<table>
<thead>
<tr>
<th>SN-5 Score Change</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total success</td>
<td>21 (81)</td>
</tr>
<tr>
<td>Marked improvement (−1.5 or better)</td>
<td>11 (42)</td>
</tr>
<tr>
<td>Moderate improvement (−1.0 to −1.4)</td>
<td>5 (19)</td>
</tr>
<tr>
<td>Mild improvement (−0.5 to −0.9)</td>
<td>5 (19)</td>
</tr>
<tr>
<td>Total failure</td>
<td>5 (19)</td>
</tr>
<tr>
<td>Same (0 to −0.4)</td>
<td>3 (12)</td>
</tr>
<tr>
<td>Worse (≥0.1)</td>
<td>2 (8)</td>
</tr>
</tbody>
</table>

Abbreviation: SN-5 score, findings from the sinonasal 5 questionnaire.

*Data are reported as number (percentage) of patients.*
prove symptoms in some children. Only a minority of children will have continued symptoms and warrant consideration for surgical intervention.

Adenoidectomy is the primary surgical treatment for most children with CRS owing to its excellent safety profile and technical ease. Adenoidectomy serves to eradicate a reservoir for bacteria and open the nose to enhance drainage.12 Studies have demonstrated that adenoidectomy is effective in about half of children with CRS.3,4 In particular, children with asthma and children younger than 7 years require more surgery sooner after an adenoidectomy.5

Children who have persistent rhinosinusitis after adenoidectomy are often treated with functional endoscopic sinus surgery. Functional endoscopic sinus surgery has a reliable profile in children, having a low complication rate and a success rate of 75% to 88%.3 It is, however, an invasive procedure, and serious complications include hemorrhage, cerebrospinal fluid leak, and orbital complications.13 Also, concerns regarding facial growth persist despite negative findings in photographic and radiographic studies in humans.14,15

Balloon dilation may play a unique role in the management of pediatric CRS. It is less invasive than FESS because no sinonasal tissue is removed; therefore, the possibility of affecting facial growth is extremely low, although no prospective studies have been done. Balloon dilation has an excellent safety profile.5,7 We have not had any major complications in children, although admitted pediatric numbers are still small. Our researchers have previously shown that it can be used with adenoidectomy to improve the success rate to 80%.7

Our current study demonstrates that balloon dilation can be effective in children with persistent symptoms after adenoidectomy. The success rate is 81% in this study, which makes it similar to the success rates of FESS. This success rate was similar for children who had balloon dilation only and for children who had a hybrid procedure. The fact that some children needed a hybrid procedure emphasizes that each case must be evaluated individually. Balloon dilation alone may be ineffective for children with a hypoplastic sinus or older children with significant ethical disease.

A significant limitation of this study is the fact that it was a retrospective, 1-arm study with small number of cases. In this specific group of children, balloon sinusplasty worked, but short of prospective controlled studies, management of these children should be addressed accordingly.

In conclusion, balloon catheter sinus dilation can significantly improve the quality of life of children with CRS. We have shown in this study that it can be effective in children who continue to have rhinosinusitis after adenoidectomy. It is less invasive than FESS and may be similar in efficacy, but a prospective randomized trial would be ideal to evaluate the outcomes between these two surgical modalities.

Submitted for Publication: February 13, 2012; final revision received April 27, 2012; accepted May 3, 2012.

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Author Contributions: Dr Ramadan had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Ramadan. Acquisition of data: Bueller, Hester, and Terrell. Analysis and interpretation of data: Ramadan, Bueller, and Hester. Drafting of the manuscript: Ramadan, Bueller, and Terrell. Critical revision of the manuscript for important intellectual content: Ramadan, Bueller, and Hester. Statistical analysis: Ramadan, Bueller, and Hester. Administrative, technical, and material support: Ramadan and Hester. Study supervision: Ramadan.

Financial Disclosure: None reported.

Previous Presentation: This article was presented at the Annual American Academy of Otolaryngology Meeting; September 12, 2011; San Francisco, California.

REFERENCES