

Surgical modalities other than ethmoidectomy

Rodney P. Lusk, MD St. Louis, Mo.

When medical management fails to control the symptoms of chronic sinusitis, surgical intervention is frequently considered. The more commonly recommended procedures include tonsillectomy and adenoidectomy, adenoidectomy alone, maxillary sinus irrigation, and nasal antral windows. These procedures have not undergone meticulous prospective evaluation or documentation of chronic sinusitis. It has only recently become known that plain sinus x-ray films are frequently misleading, and there has been a tendency to completely ignore ethmoid disease. Adenoidectomy has been frequently recommended; however, these studies have not documented the duration of symptoms or the extent of disease. Approximately 20% of the patients treated with tonsillectomy and adenoidectomy do not have resolution of symptoms of chronic sinusitis. It is prudent, however, to remove an enlarged obstructive adenoid pad as a first course of therapy. Irrigation has been proposed, but it treats only the maxillary sinus, and the ethmoid sinuses are involved approximately 70% of the time. One irrigation rarely clears the symptoms. Nasal antral windows in children require well-developed maxillary sinuses and do not maintain their patency. Therefore they are not an effective mechanism for treating chronic sinusitis. Other surgical modalities must therefore be sought. (J ALLERGY CLIN IMMUNOL 1992;90:538-42.)

Our current state of knowledge is lacking critical pieces of information that would allow us to critically assess our surgical modalities. We are currently unable to determine the prevalence or natural history of chronic pediatric sinusitis. We do not have an accurate staging mechanism for pediatric sinusitis, and we have just started to understand how the disease vacillates. The following surgical modalities have been used to treat chronic sinusitis.

ADENOTONSILLECTOMY

Previous investigations have shown an association between children with "diseased" tonsils and adenoids and sinusitis. The incidence, however, varies widely with the methods of detection and the investigators. Almost all of these studies are retrospective, with poor follow-up, and unclear indications for the tonsillectomy and adenoidectomy.

A correlation may exist between the size of the adenoid and the frequency of sinusitis.¹⁻³ Merck¹ found that the size of the adenoid pad was related to the incidence of sinusitis. Abnormal maxillary sinuses were noted in 13% of children with small adenoid pads, 24% with medium-sized adenoid pads, and 34% with large adenoid pads. Birrell³ found that 27% of children undergoing tonsillectomy and adenoidectomy had maxillary sinus infections as manifested by a "pos-

itive antral puncture" through the middle meatus. Preston⁴ found that purulent rhinorrhea was associated with tonsil and adenoid hypertrophy in 65% of children. Carmack⁵ attempted to rule out all patients with sinusitis or allergy and still found that 14.2% of the children undergoing "routine tonsillectomy and adenoidectomy" had positive findings on antral lavage. There appears to be an association between sinusitis and tonsil or adenoid disease, but the causal relationship remains unclear.

The role of tonsillectomy and adenoidectomy in the treatment of sinusitis is unclear, and most studies do not define the indications for tonsillectomy and have not documented the presence of sinusitis. In 1937 Griffiths⁶ stated that the indications for many tonsillectomies and adenoidectomies were ill-founded. Most of the papers seem to incriminate the adenoid pad as the source of the problem and have relied on plain radiographs to diagnose maxillary sinus disease. Virtually all the authors who have addressed sinusitis equate sinus disease with maxillary sinus disease, and the ethmoid sinuses were not or could not be evaluated with existing technology. We now know that 23% of the patients who have clear maxillary sinuses will have ethmoid disease not detected on plain films.⁷ It is likely that maxillary sinus disease is more dependent on concomitant ethmoid disease than on adenoid hypertrophy.

Tonsillectomy and adenoidectomy have not cured all cases of sinusitis.^{5, 8-12} When sinusitis was treated with antibiotics alone, Paul⁹ found that 11 of 50 patients had resolution, 38 of 50 required antral lavage, and 1 required antrostomy. Tonsillectomy and ade-

From St. Louis Children's Hospital at Washington University School of Medicine, St. Louis, Mo.

Reprint requests: Rodney P. Lusk, MD, St. Louis Children's Hospital, 400 S. Kingshighway, 3S-35, St. Louis, MO 63110.

1/0/38517



FIG. 1. Large obstructive adenoid pad causes symptoms compatible with sinusitis.

noidectomy alone were successful in only 18 of 50 patients and 29 of 50 patients progressed to antral lavage. Fujita¹³ evaluated the effect of adenoidectomy on sinusitis and eustachian tube function in 78 children, ages 4 to 7 years. He found that adenoidectomy "improved" nasal sinusitis in 56% of children, whereas 24% of the children in the nonadenoidectomy group improved.

The causal relationship between adenoid hypertrophy and sinusitis is not at all clear, but it would seem logical that if the adenoids were so large that there was stasis of secretions, then symptoms of sinusitis could be mimicked. The secretions could also cause inflammation of the sinus ostia to cause sinusitis. As Birrell stated more than 40 years ago,³ "No sinus can remain free from secretion when the nasal cavity, with which it communicates, contains a plentiful supply of secretion."

Our current state of knowledge does not allow us to predict whose sinusitis will resolve with adenoidectomy alone. It would seem prudent to examine the nasopharynx of the child to see if the adenoid pad are so large that they cause stasis of secretions. If they are (Fig. 1), then performing an adenoidectomy or tonsillectomy with adenoidectomy may be a prudent first step. How large the adenoid must be before obstruction is present is a matter of judgment (Fig. 2). If they are not obstructive, our experience indicates that the adenoidectomy does not effectively alter the course of the sinusitis; however, this issue has not been studied with prospective studies staging sinusitis with computed tomographic scans.

ANTRAL LAVAGE

On physical examination the middle meatus is not well visualized. If no edema or secretions are noted

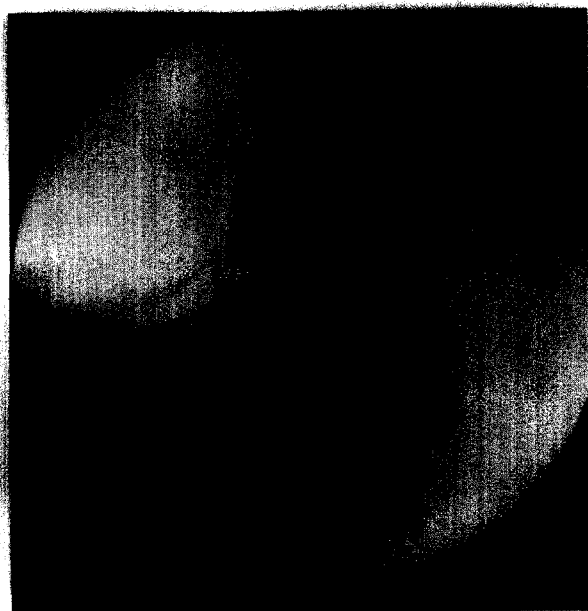


FIG. 2. Moderately large adenoid pad that could cause intermittent nasal obstruction and have symptoms similar to sinusitis.

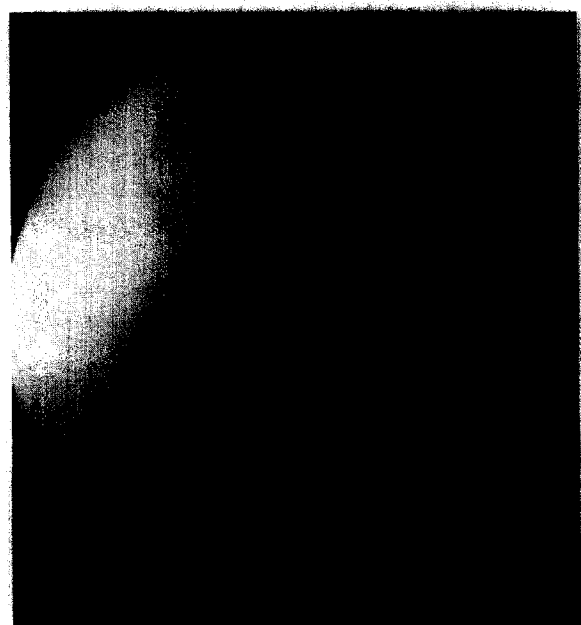


FIG. 3. Normal entrance to the middle meatus without edema or purulence.

lateral to the middle turbinate, one can be encouraged but not assured that the osteomeatal complex is free of disease (Fig. 3). If purulence is seen in this region (Fig. 4), one cannot infer from the physical examination that the infection is isolated to the osteomeatal complex, anterior ethmoid, or frontal or maxillary sinuses.

Sinus infections are thought to originate in the nose.¹⁴⁻¹⁶ The epithelium of the nose and the sinuses

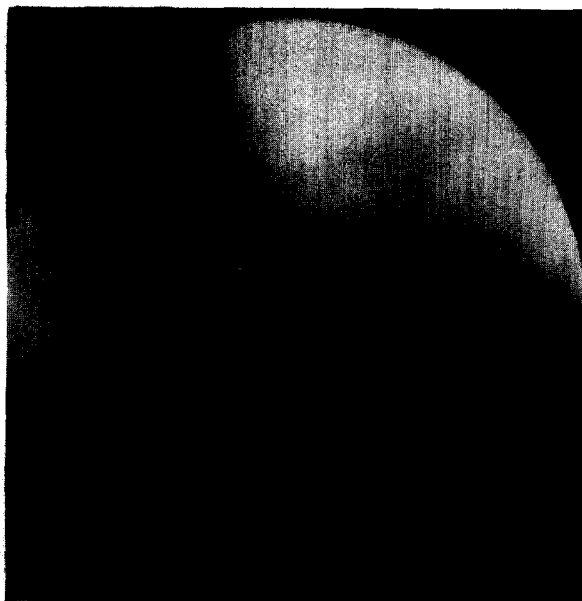


FIG. 4. Purulence in the superior middle meatus.

is similar, and they are connected through the natural ostium of the sinus. During an acute infection, there may be stasis of secretions because of ciliary dyskinesia. Irrigation of the sinus is not thought to hasten recovery from acute maxillary sinusitis, and in fact, the instrumentation may spread the infection into surrounding tissues.¹⁷ If the products of the infection are too thick to be transported out of the sinus, a persistent infection may permanently alter the mucosa of the sinus and result in irreversible disease.¹⁸ The rationale for irrigation or lavage of the maxillary sinus is to suction or force debris out of the sinus through the natural ostium to prevent chronic sinusitis.

Both irrigation and sinusotomy are directed only to the maxillary sinus, and it is not possible to irrigate the ethmoid or sphenoid sinuses. The frontal recess or duct is not easily cannulated, so only the external approach is practical. For these reasons, the rather large body of literature involving lavage is directed only toward the maxillary sinus.

The three methods of irrigating the maxillary sinus are as follows: (1) through the natural ostium, (2) through the inferior meatus, and (3) through the canine fossa (anterior) puncture (Fig. 5).

Natural ostium

Perhaps the oldest way to irrigate is through the natural ostium of the maxillary sinus. A curved cannula is inserted into the middle meatus along the posterior half of the middle turbinate. The cannula is rotated laterally and pulled anteriorly to position it behind the uncinate process. With gentle lateral pres-

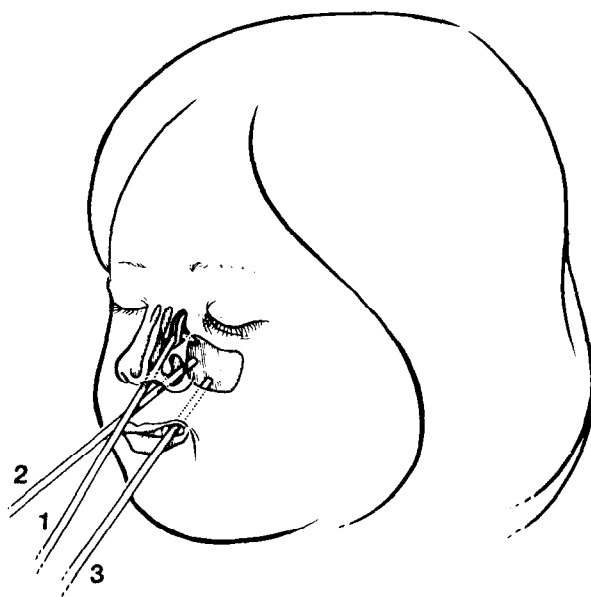


FIG. 5. Diagram depicting the three possible routes for maxillary sinus irrigation: (1) through the natural ostium of the maxillary sinus: a curved suction irrigator must be placed behind the uncinate process and engage the natural ostium; (2) through the inferior meatus: this is limited by how well the floor of the maxillary sinus is developed; and (3) through the anterior wall of the maxillary sinus by going under the lip and through the gingival sulcus.

sure, the cannula will engage the natural ostium, and once in the ostium, the cannula is rotated laterally, inferiorly, and anteriorly. The maxillary sinus can then be aspirated or lavaged with warm saline solution until clear. The procedure can only be performed in children under general anesthesia. The cannula cannot be introduced easily in patients who have a horizontal canal.¹⁹ The natural ostium is adjacent to the inferior and medial orbit, and the orbit could be entered accidentally if the surgeon is disoriented and forces the cannula through the lateral wall. It has been our experience that this is the region most likely to be penetrated during an ethmoidectomy.

Inferior meatus

The inferior meatal puncture was popularized by Lichtwitz,¹⁹ Krause,²⁰ and Mikulicz.²¹ It was preferred because (1) the middle meatal approach was not always anatomically possible, (2) there was a large blood vessel (sphenopalatine) behind the middle turbinate that could result in troublesome bleeding, and (3) the natural ostium is in close proximity to the orbit. There was also concern about damage to the ostium of the maxillary sinus.²²

The procedure is difficult to perform in children without the use of a general anesthetic. This approach

has been combined with the use of cannulas of different types for irrigating the maxillary sinus. Alden,²³ Asherson,²⁴ Carmack,⁵ and Archer¹¹ have recommended that the antrum be left to irrigate the sinus several times a day. Hugill²⁵ performed lavage and left a size 2 polyethylene cannula in place for irrigation with a solution of 500 U/ml of penicillin. Over time these methods of treatment have proved unsuccessful and are now rarely used.

Canine fossa

Canine fossa puncture is performed by going through the bone of the anterior antral wall. It is the most direct route to the sinus; it was originally introduced in 1743, and was repopularized in the early 1970s.²⁶ Petersen thought this procedure was easier and safer to perform under local anesthesia. In children the antrostomy for irrigation or sinuscopy can be difficult. Stammberger does not recommend the canine fossa approach in children less than 9 years old. This is probably the safest approach in children¹⁷ but may be compromised by a high floor of the maxillary sinus (small sinus), by trauma to the roots of the teeth, and by a thick anterior antral wall. The examination of the ostium is significantly better through the canine approach, and bleeding is usually significantly less than with the inferior meatal approach.

The effectiveness of antral lavage in the treatment of sinusitis has had mixed reviews. Carmack⁵ recommended that lavage be performed as early as possible and inferred that it should be used as a primary mode of therapy. Lavage will rarely be successful with one intervention.^{11, 27-29} Crooks²⁸ recommended weekly lavage until the patient was clear and reported as high as 10 lavage procedures before this mode of therapy was abandoned. Alden²³ mentions that Dean administered general anesthesia between 6 and 20 times to children in performing lavage for maxillary sinusitis. Stammberger does not feel multiple lavages are necessary if the adequate local decongestant is applied to the osteomeatal complex.

Antral lavage continues to be practiced today and has merit in selected patients. However no good prospective studies have allowed us to make recommendations about which patients will respond to antral lavage. Inferior meatal lavage is traumatic, and it is not without potential complications. The canine fossa approach is perhaps easier, but adult patients frequently complain about the pain that sometimes persists. There is no reason to suspect that the pediatric patient is not equally predisposed to persistent pain. Most previous studies were performed before the use of prolonged antibiotic therapy. In today's medical environment it is unlikely that parents, pediatricians,

or otolaryngologists will tolerate local lavage of this frequency, and multiple general anesthesia would likely meet with equal resistance. Antral lavage, however, may be appropriate at the time of another procedure such as a tonsillectomy or adenoidectomy. Its overall efficacy requires further delineation.

INFERIOR MEATAL ANTROSTOMY

It is a natural progression to treat failures of maxillary sinus lavage or irrigation by creating a larger hole in the sinus to allow better ventilation and drainage of the purulence. The inferior meatal antrostomy became a popular surgical technique in the management of maxillary sinusitis³⁰ and therefore in the management of chronic sinusitis. In spite of its many advocates, there has been little prospective investigation regarding its efficacy. As with the lavage technique, the inferior meatal antrostomy was felt to be safer and technically easier than the middle meatal antrostomy.²¹ This procedure gained in popularity until the introduction of the Caldwell-Luc procedure. The Caldwell-Luc procedure was preferred for several years in adults, but once again has become less popular. Lund³⁰ reports a steady decline in the incidence of inferior meatal antrostomy and Caldwell-Luc procedures at the Royal National, Throat, Nose and Ear Hospital from 1950 to 1985. There was a resurgence in the Caldwell-Luc procedure from 1979 to 1981, but a marked decrease has occurred since then. The dependent position of the inferior meatal antrostomy was thought to improve drainage of the maxillary sinus, and this rationale has been a cornerstone for its use.³¹ It is now known that even though the sinus is ventilated, the mucociliary clearance patterns continue to transport the secretions to the natural ostium of the sinus.^{15, 18, 32} If there is obstruction at the ostium, secretions will accumulate and promote chronic infection. Indeed, the secretions can circulate from the nose through the inferior meatal antrostomy and into the maxillary sinus.

A crucial factor in the success of the inferior meatal antrostomy is the patency of the "window" over time. Lund³⁰ did both a retrospective and prospective evaluation of inferior meatal antrostomy patency. In a retrospective evaluation of 216 patients, she found that 45% were closed, 50% were patent, and 5% could not be assessed. Of the 15 patients who were younger than 16 years old, 13 had closed antrostomies. The patent antrostomies were in 14- and 15-year-old patients. A possible reason for the antrostomy closure is the surgical technique, but the experience of the surgeon has not proved to be a significant factor.³⁰ In a prospective study, Lund³⁰ created inferior meatal antrostomies from 0.5 to 2.5 cm in length and from

0.5 to 1 cm in height. She found an average initial loss of 27% of the lumen over a 5-week period. She concluded that the antrostomy had to be greater than 1 cm to remain patent. She also performed six antrostomies in four patients younger than 16 years; all closed.

The inferior meatus is smaller in children than in adults, and therefore it is not possible to create an adequate sized antrostomy. Patency in children appears to be difficult to achieve, and if patency is required for resolution of the sinusitis, one would expect a correspondingly low success rate in children. Muntz and Lusk³³ performed a retrospective evaluation of 39 children (mean age, 6.3 years) who had chronic sinusitis and had undergone bilateral inferior meatal antrostomies. They found a failure rate of 60% at 1 month and 73% 6 months after surgery. Seven of the patients had repeated inferior meatal antrostomies: two improved and five did not.

As with antral lavage, some children will benefit from inferior meatal windows, but no prospective data are available to assist us in patient selection. We have abandoned the use of inferior meatal antrostomies in the treatment of chronic sinusitis in children with the possible exception of children with ciliary dyskinesia. These children do not have normal ciliary function, and the inferior meatal antrostomies make more sense, because gravity would be the primary means of evacuating secretions from the sinus. The problem of window patency, however, remains.

REFERENCES

- Merck W. Relationship between adenoidal enlargement and maxillary sinusitis. *HNO* 1974;6:198-9.
- Nickman NJ. Sinusitis, otitis and adenotonsillitis in children: a retrospective study. *Laryngoscope* 1978;88:117-21.
- Birrell JF. Chronic maxillary sinusitis in children. *Arch Dis Child* 1952;27:1-9.
- Preston HG. Maxillary sinusitis in children, its relation to coryza, tonsillectomy and adenoidectomy. *Va Med Mon* 1955;82:229-32.
- Carmack JW. Sinusitis in children. *Ann Otol Rhinol Laryngol* 1931;40:515-21.
- Griffiths I. Functions of tonsils and their relations to aetiology and treatment to nasal catarrh. *Lancet* 1937;2:723-9.
- McAlister WH, Lusk RP, Muntz HR. Comparison of plain radiographs and coronal CT scans in infants and children with recurrent sinusitis. *Am J Roentgenol* 1989;153:1259-64.
- Walker FM. Tonsillectomy and adenoidectomy: unsatisfactory results due to chronic maxillary sinusitis. *Br Med J* 1947;908-10.
- Paul D. Sinus infection and adenotonsillitis in pediatric patients. *Laryngoscope* 1981;91:997-1000.
- Hoshaw TC, Nickman NJ. Sinusitis and otitis in children. *Arch Otolaryngol* 1974;100:194-5.
- Stevenson RS. The treatment of subacute maxillary sinusitis especially in children. *Proc R Soc Med* 1947;40:854-8.
- Cleminson FJ. Nasal sinusitis in children. *J Laryngol Otol* 1921;36:505-13.
- Fujita A, Takahashi H, Honjo I. Etiological role of adenoids upon otitis media with effusion. *Acta Otolaryngol Suppl* (Stockh) 1988;454:210-3.
- Stammberger H. Nasal and paranasal sinus endoscopy: a diagnostic and surgical approach to recurrent sinusitis. *Endoscopy* 1986;18:213-8.
- Stammberger H. Endoscopic endonasal surgery—concepts in treatment of recurring rhinosinusitis: part I. Anatomic and pathophysiologic considerations. *Otolaryngol Head Neck Surg* 1986;94:143-7.
- Kennedy DW, Zinreich SJ, Rosenbaum AE, Johns ME. Functional endoscopic sinus surgery: theory and diagnostic evaluation. *Arch Otolaryngol* 1985;111:576-82.
- Ritter FN. A clinical and anatomical study of the various techniques of irrigation of the maxillary sinus. *Laryngoscope* 1977;87:215-23.
- Kennedy DW, Zinreich SJ, Shaalan H, Kuhn F, Naclerio R, Loch E. Endoscopic middle meatal antrostomy: theory, technique, and patency. *Laryngoscope* 1987;97:1-9.
- Myerson MC. The natural orifice of the maxillary sinus. *Arch Otolaryngol* 1932;15.
- Krause H. Instrumente nach Dr. Krause. *Monatsschrift für Ohrenheilkunde* 1887;21:70.
- Mikulicz J. Zur operativen Behandlung des KEmpyens der Highmorshohle. *Lagenbeck's Arch für Klinische Chir* 1887;34:626-34.
- Proetz AW. Essays on the applied physiology of the nose. St. Louis: Annals Publishing Co, 1941:356.
- Alden AM. A new procedure in the treatment of chronic maxillary sinus suppuration in children. *Arch Otolaryngol* 1926;4:521-5.
- Asherson N. Intubation of the maxillary antrum for acute empyema. *Lancet* 1937;1399-400.
- Huggill PH, Ballantyne JC. An investigation into the relationship between adenoids and sinusitis in children. *J Otolaryngol* 1952;66:84-91.
- Peterson RJ. Canine fossa puncture. *Laryngoscope* 1973;83:369-71.
- StClair T, Negus VE. Diseases of the nose and throat. London, 1937:232.
- Crooks J, Signy AG. Accessory nasal sinusitis in childhood. *Arch Dis Child* 1936;11:281-306.
- Maes JJ, Clement PA. The usefulness of irrigation of the maxillary sinus in children with maxillary sinusitis on the basis of the Water's x-ray. *Rhinology* 1987;25:259-64.
- Lund VJ. Inferior meatal antrostomy. Fundamental considerations of design and function. *J Laryngol Otol Suppl* 1988;15:1-18.
- Hajek M. Pathology and treatment of the inflammatory diseases of the nasal accessory sinuses. St. Louis: The CV Mosby Co, 1926.
- Hilding AC. Role of ciliary action in production of pulmonary atelectasis, vacuum in paranasal sinuses and in otitis media. *Ann Otol Rhinol Laryngol* 1943;52:816-33.
- Muntz HR, Lusk RP. Nasal antral windows in children: a retrospective study. *Laryngoscope* 1990;100:643-6.