The Histologic Relationship of Preauricular Sinuses to Auricular Cartilage

Brian Dunham, MD; Martha Guttenberg, MD; Wynne Morrison, MD; Lawrence Tom, MD

Objective: To determine the histologic relationship and distance between excised preauricular epithelial sinus tract and the adjacent auricular cartilage (sinocartilaginous distance) in a series of patients. The excision of preauricular sinuses is a common surgical procedure. Recurrences are frequent and can be technically challenging. While advocated by several authors, the surgical removal of adjacent auricular cartilage is not universally performed.

Design: Retrospective case series.

Setting: Children’s Hospital of Philadelphia.

Patients: Fifty-two pediatric patients who underwent surgical excision of preauricular sinus tracts and adjacent auricular cartilage.

Interventions: Between September 1, 2005, and July 31, 2007, the preauricular sinus tracts and adjacent auricular cartilage were excised from 52 pediatric patients. A pathologist reviewed a total of 58 specimens to determine the relationship between epithelial tract and cartilage.

Main Outcome Measure: The sinocartilaginous distance in microns.

Results: Patient ages ranged from 8 months to 17 years (mean age, 4 years). In all but 1 case, the tracts were in close proximity to the cartilage. The average sinocartilaginous distance was 472 µm (median distance, 400 µm); the 25th percentile was 250 µm. In over 50% of the specimens, the sinocartilaginous distance was less than 0.5 mm, and in nearly all of the these, the epithelial tract was in continuity with stromal tissue histologically indistinguishable from perichondrium.

Conclusions: The observed sinocartilaginous distances suggest that it may be difficult to dissect most sinus tracts from the cartilage. The routine removal of a small portion of auricular cartilage along with the sinus tract may yield a more thorough excision and help to prevent recurrence.


Preauricular sinuses are the most common of all periauricular cysts, sinuses, and fistulas. A preauricular sinus is most often noted on physical examination as an inconspicuous cutaneous pit on the ascending limb of the helix; the vast majority are asymptomatic and do not require treatment. However, once they become infected, surgical excision is recommended because the likelihood of recurrent infections is high. These epithelial tracts commonly arborize; they have narrow, tortuous paths and are often grossly rooted on or near the perichondrium of the helical root of the pinna.

Surgical removal is the mainstay of treatment. However, simple sinectomy is plagued by recurrence, with literature-reported rates often near 20% and ranging as high as 42%. Current theories attribute recurrence to an incomplete removal of epithelial cells. Several authors advocate the routine excision of abutting cartilage, a maneuver that appears to be associated with a lower rate of recurrence. From the literature, it is impossible to ascertain whether the decrease is attributable to removal of cartilage because no study has directly addressed this issue. The removal of cartilage is often done in conjunction with a more thorough excision of the tract. While recommended by some, excision of cartilage has not yet become universally accepted. To our knowledge, no study to date has investigated the histologic relationship of sinus tracts to cartilage. The present
study represents an early step in assembling evidence to develop consistently effective approaches to address these malformations.

### METHODS

This retrospective, single-center study was approved by our institutional review board at The Children’s Hospital of Pennsylvania. We evaluated the histologic characteristics of specimens from pediatric patients who underwent primary preauricular sinusectomy between September 1, 2005, and July 31, 2007, at The Children’s Hospital of Philadelphia. At our institution, cartilage is typically removed during preauricular sinuectomy, but the attending surgeon makes the final decision based on the clinical circumstances. The primary measure of interest was the sinocartilaginous distance measured in microns. Patient medical charts were reviewed for demographic information.

Routine 4-µm-thick hematoxylin–eosin–stained slides were studied. The closest distance between the squamous tract and the excised auricular cartilage was measured using a slide micrometer. Descriptive data are presented as medians (interquartile ranges [IQRs]) or means (SDs), as indicated. The relationships of demographic variables with sinocartilaginous distances was analyzed using the Wilcoxon rank sum or Spearman correlation test, as appropriate. Adjusted analysis was performed using linear regression. All analyses were performed using Stata software, version 10 (StataCorp LP, College Station, Texas).

### RESULTS

During the 2-year period of analysis, 74 operations were performed on 65 patients, 9 of whom underwent bilateral sinuectomy. Only 1 patient was diagnosed as having branchio-oto-renal syndrome (BOR). No other patients were known to have syndromes associated with preauricular sinuses. The patient with BOR underwent the same surgical treatment as the others, and his specimen was included in the histologic review. Sixteen specimens were eventually excluded from histologic review: 7 of these specimens were too disrupted to allow measurement of the sinocartilaginous distance; 5 had not been submitted for pathologic review; 3 had no discernible cartilage; and 1 had no identifiable epithelial tract. The 58 remaining specimens are included in the analysis. All 58 specimens had anteriorly positioned pits; there were no posterior variants in this series.

### Table. Patient Demographic and Surgical Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Patients, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>23 (44)</td>
</tr>
<tr>
<td>Female</td>
<td>29 (56)</td>
</tr>
<tr>
<td>Side of operation</td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>22 (42)</td>
</tr>
<tr>
<td>Right</td>
<td>24 (46)</td>
</tr>
<tr>
<td>Bilateral</td>
<td>6 (12)</td>
</tr>
</tbody>
</table>

*The mean (SD) age of the patients was 5.9 (4.6) years (age range, 8 months to 17 years).*

### Figure 1. Embryologic origins of the auricle. A 42-day-old human embryo shows 6 hillocks of His evenly distributed between the first (green tint) and second branchial arches (purple tint). The second arch is thought to have a larger eventual relative contribution to the formation of the pinna.

Patients of a wide age range and both sexes were included in the sample (Table). Six of the 52 patients underwent bilateral operations (12%). Nine surgeons performed the procedures (4-10 procedures per surgeon).

The mean (SD) sinocartilaginous distance was 473 (535) µm, and the median (IQR) distance was 400 (250-500) µm. The closest distance was 5 µm, and the farthest was 4000 µm. Patient age was not significantly correlated with sinocartilaginous distance (Spearman ρ=0.22) (P=.10). Mean sinocartilaginous distance did not differ by sex (boys, 560 µm; girls, 397 µm; 95% confidence interval, −44 to 117 µm) (P=.24) or side of surgery (left side, 349 µm; right side, 588 µm; 95% confidence interval, −515 to 38 µm) (P=.09). Adjusted analysis using linear regression for all 3 predictive variables (age, sex, and side of operation) showed no associations with sinocartilaginous distance (P=.40, P=.50, and P=.10, respectively).

In over 50% of the specimens reviewed, the sinocartilaginous distance was less than 0.5 mm, and in nearly all of these cases, the epithelial tract was in continuity with stromal tissue histologically indistinguishable from the perichondrium.

### EMBRYOLOGY AND MORPHOLOGY

Six paired branchial arches composed of ectoderm, mesoderm, and endoderm appear in the fourth week of fetal life. Each arch is separated by a 2-layered closing membrane, which demarcates the inner, endothelially lined pharyngeal pouch from the outer, ectodermally lined branchial cleft. Each arch gives rise to muscle, skin, and cartilage, which are innervated primarily by 1 cranial nerve. The first pharyngeal pouch gives rise to the middle ear, mastoid antrum, and eustachian tube. The closing membrane becomes the tympanic membrane. Only the first
branchial cleft persists as the external ear canal. All other clefts are resorbed.\(^8\)

The pinna is formed by mesoderm and ectoderm from the first and second branchial arches and first branchial cleft. During the sixth week of embryonic development, mesenchymal proliferation produces the 6 hillocks of His. Three hillocks gather on the caudal aspect of the first branchial arch, and another 3 on the cephalic aspect of the second branchial arch. The hillocks eventually enlarge and fuse to form the pinna. With growth of the auricle, the contribution of the first branchial arch becomes relatively reduced (Figure 1).\(^9\)

The exact embryologic basis of preauricular sinuses is uncertain. They may be related to an incomplete fusion of the first arch hillocks, an entrapment of ectodermal folds during auricular formation, or a defective closure of the dorsal portion of the first branchial cleft.\(^9\)\(^-\)\(^11\)

**INCIDENCE**

Preauricular sinuses can be both sporadic and inherited. They are bilateral in approximately 25% to 50% of patients. When bilateral, the sinuses are more likely to be inherited. Their inheritance shows an autosomal dominant pattern with reduced penetrance and variable expression.\(^12\) Recent research has mapped a potential locus for congenital preauricular fistula to chromosome 8q11.1-q13.3.\(^13\) Although the true prevalence is not well established, preauricular sinuses are thought to occur most commonly in black populations. The incidence of preauricular sinuses has been estimated to be 0.1% to 0.9% in the United States, 0.9% in England, 1.6% to 2.5% in Taiwan, and 4% to 10% in some areas of Africa.\(^14\)\(^-\)\(^16\)

**ANATOMIC LOCATION**

Preauricular sinuses are the most common variant of all the periauricular cysts, fistulas, and sinuses. The cutaneous pit of the preauricular pit is most often located on or near the ascending limb of the helical rim but can also open along the superior posterior margin of the helix as well as the tragus.\(^17\) While both cutaneous opening and fistulous tracts are classically located anterior to the external auditory canal, a reported variant form has its opening behind an imaginary vertical line drawn at the posterior most aspect of the tragus and the posterior aspect of the ascending limb of the helix (Figure 2). This variant typically presents with postauricular swelling and requires both postauricular and preauricular incisions for its removal.\(^18\)

**SINECTOMY, WIDE LOCAL EXCISION, AND THE “INSIDE-OUT TECHNIQUE”**

Classically, the surgical approach consists of a simple sinectomy with an elliptical island of skin removed around the opening of the sinus and excision of the epithelial sinus tract. Various authors have advocated the use of either methylene blue or gentle probing of the tract to carefully delineate the tract.\(^1\)\(^-\)\(^3\)\(^13\) However, neither approach guarantees full removal of the tracts: reported recurrence rates are quite high, typically near 20%.\(^1\)\(^-\)\(^3\)\(^13\)

In 1981, Emery and Salama\(^12\) described a wide local excision approach that added a supra-auricular limb to the incision and carried the dissection down to the level of the temporalis fascia. They noted adherence of the tracts to auricular perichondrium in 10 of 10 of these approaches, and they reported no recurrences using this approach over an average follow-up time of 2.7 years. In 1990, Prasad et al\(^6\) compared the simple sinectomy with the supra-auricular approach (which involved removal of a portion of the auricular perichondrium); they noted recurrences of 42% (n=12) and 5% (n=21), respectively, with no mention of follow-up duration. In 2001, Lam et al\(^6\) compared these 2 techniques and again noted a favorable recurrence rate for the supra-auricular approach of 3.7% (n=27) vs 32% (n=25) for the simple sinectomy approach. Follow-up ranged from 36 months to 13 years. They noted recurrences at 3 months to 5 years after removal (mean, 6 months), which supports the importance of a long period of observation postoperatively to obtain an accurate sense of the true rates of recurrence. The supra-auricular approach includes a wide and deep removal of the tract, but it was not made clear in the cited studies whether auricular perichondrium or cartilage was removed in the simple sinectomy groups.

More recently, Baatenburg de Jong\(^4\) reported a study of the “inside-out technique,” a procedure first used by Jensma in the 1970s, although he never published a description. In this approach, the use of magnification is mandatory. An ellipse of skin is incised around the opening as in the simple sinectomy, but the tract is purposely opened and dissected with its branches by following the differences of the appearance of epithelium under magnification. Smaller branches and tracts are pursued to their end. Baatenburg de Jong\(^4\) also mentions removing a segment of perichondrium as well as its underlying cartilage. Using this technique, he noted no recurrence in 23 patients in a follow-up period ranging from 1 to 25 months.
CONCLUSIONS

Since recurrences are attributed to incomplete excision, it follows that both depth and breadth of excision are important. While an understanding of the embryology will reinforce the surgeon’s understanding of the location of these tracts, it is the recognition of their often branching, tortuous structures as well as their proximity to perichondrium that is essential in developing a thorough technique.

Because the present study is not a randomized controlled trial, our findings cannot be used to determine whether excision of cartilage or perichondrium prevents recurrence of preauricular sinuses. This present descriptive effort was designed to help understand the histologic relationship between preauricular sinuses and the underlying cartilage of the helical rim. Histologic sectioning always introduces an element of uncertainty in that it represents a fairly random sampling of the tissue that could unintentionally skew results. Nonetheless, the evidence reported herein suggests that it may be difficult to dissect the tract completely from the cartilage without removing cartilage itself or at least a piece of perichondrium. In over 50% of the specimens reviewed, the sinocartilaginous distance was less than 0.5 mm, and in nearly all of these cases, the epithelial tract was in continuity with stromal tissue histologically indistinguishable from the perichondrium. The removal of a small piece of cartilage or perichondrium does not produce a visible cosmetic deformity or add any significant morbidity. Therefore, the routine removal of a small portion of perichondrium and/or auricular cartilage along with the sinus tract may yield a more thorough excision and help to prevent recurrence.

Submitted for Publication: March 11, 2009; final revision received June 16, 2009; accepted July 1, 2009.

Correspondence: Brian Dunham, MD, Division of Pediatric Otolaryngology, The Children’s Hospital of Philadelphia, First floor, Richard D. Wood Center, 34th Street and Civic Center Boulevard, Philadelphia, PA 19104 (dunhamb@email.chop.edu).

Author Contributions: Dr Dunham 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: Dunham and Tom. Acquisition of data: Dunham. Analysis and interpretation of data: Dunham, Guttenberg, and Morrison. Drafting of the manuscript: Dunham and Guttenberg. Critical revision of the manuscript for important intellectual content: Dunham, Morrison, and Tom. Statistical analysis: Morrison. Study supervision: Tom. Medical illustration: Dunham.

Financial Disclosure: None reported.

Previous Presentation: This work was presented as a poster at the Annual Meeting of the American Society of Pediatric Otolaryngology; May 2-4, 2008; Orlando, Florida.

REFERENCES