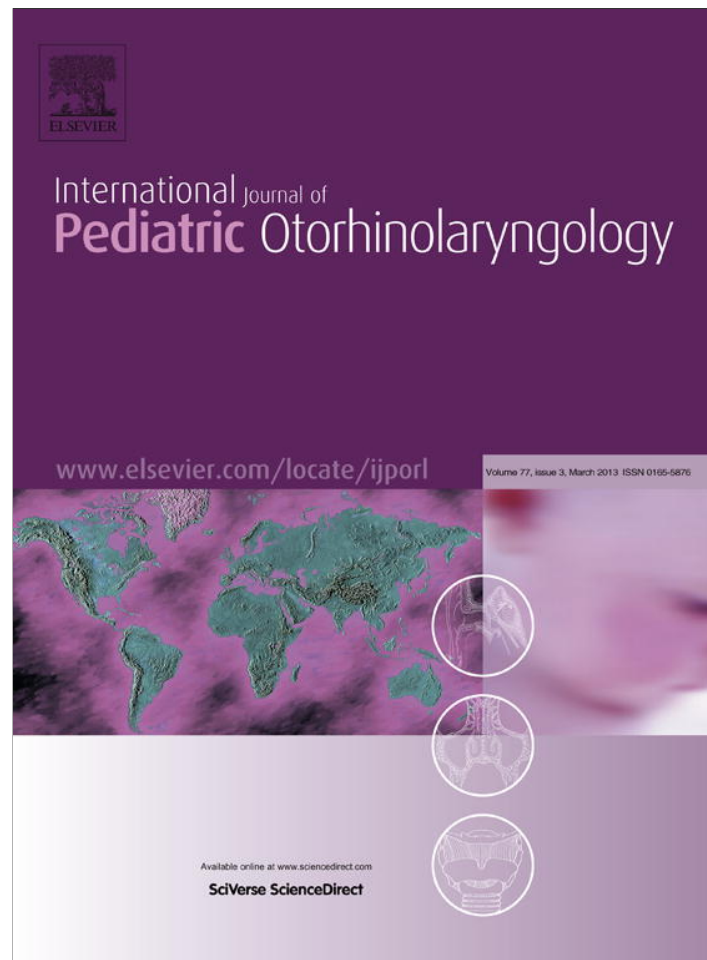


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Preauricular sinuses in the pediatric population: Techniques and recurrence rates

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ABSTRACT

Aim: To review the outcomes of two surgical techniques in the management of preauricular sinus in the pediatric population.**Methods:** The clinical records of pediatric patients who underwent surgical excision of preauricular sinus in the Department of Otolaryngology of KK Children's and Women's Hospital between January 1997 and March 2009 were retrospectively reviewed. Patients were categorized into two groups, based on the method used for sinus tract visualization or delineation: (1) Microscope group and (2) methylene blue dye and probe group. The latest information on recurrence of preauricular sinus and complications after surgery were updated by phone interview.**Results:** 208 out of 305 preauricular sinuses were included in this study ($n = 114$ in microscope group; $n = 94$ in methylene blue dye and probe group). 97 cases were excluded as these patients were not contactable by phone or had inadequate data from the clinical records. The mean age of the patients is 6.5 years old. The overall recurrence rate was 2.4% (95% confidence interval (CI) 0.010–0.055) and the overall complication rate was 6.3% (CI 0.037–0.104). Surgical excision with microscope guidance had significantly lower recurrence rate (0.9%) compared to surgical excision with methylene blue dye and probe guidance (4.3%), with an odds ratio of 28.4 (CI 1.22–659.99, $P = 0.037$). The complication rates were not statistically significant between the two groups. The recurrence and complication rates were not significantly affected by race, gender, sex, location of sinus, indication for surgery, history of previous sinus excision, presence of infection during surgery and duration of surgery.**Conclusion:** Surgical excision of preauricular sinus under microscope guidance and under methylene blue and probe guidance in our series had very low overall recurrence and complication rates compared to that reported in the literature. The microscope group had a lower recurrence rate in comparison to that of the methylene blue and probe group.

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1. Introduction

Preauricular sinuses are common congenital abnormalities in children. They were first described by Heusinger in 1864 [1]. The incidence ranged from 0.1 to 0.9% in the Western populations, although a higher incidence of 4% and 10% has been reported in Blacks and Orientals [2]. They are usually noted on routine examination as small pits adjacent to the external pinna, usually along or anterior to the ascending limb of helix, although the variant types of preauricular sinuses presenting as postauricular swelling have been reported [3]. The majority of preauricular sinuses are asymptomatic and do not require treatment. However, once they become symptomatic from acute infection, persistent or intermittent discharge, or abscess formation, surgical excision is

warranted. Various techniques for surgical extirpation of symptomatic preauricular sinus have been described with recurrence rates ranging from 3.7% to 42% [2–15]. In this study, we aim to review the surgical methods and outcomes in the management of preauricular sinus in the pediatric population.

2. Methods

The clinical records of children who underwent surgical excision of preauricular sinus in the Department of Otolaryngology at KK Women's and Children's Hospital between January 1997 and March 2009 were retrospectively reviewed. This study was approved by the Centralized Institutional Review Board (CIRB) of Singhealth Research Facilities in Singapore. The following data were collected from the clinical records:

1. Patient demographics (age, gender, race)
2. Location and laterality of preauricular sinus

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3. Indication for surgery
4. Documentation of previous incision and drainage of preauricular sinus
5. Documentation of previous excision of preauricular sinus
6. The use of microscope or methylene blue dye and probe during surgery
7. The presence of infection during surgery
8. Duration of operation
9. Presence of infection during surgery (e.g. granulation tissue, purulent discharge or abscess)
10. Duration of follow-up
11. Complications after surgery
12. Recurrence after surgery (defined as persistent discharge or recurrent infections more than a month after surgery that failed to resolve with antibiotics).

Patients were subsequently categorized into two groups, based on the method used to assist in sinus tract visualization or delineation: (1) Microscope group (Fig. 1) and (2) methylene blue dye and probe group (Figs. 2 and 3). In both groups, excision is always carried out under general anesthesia and the surgical principle includes complete removal of the tract with part of the helical cartilage. All patients enrolled in the study were contacted by phone and the latest information on recurrence of preauricular sinus and complications after surgery were recorded. Bilateral preauricular sinus surgeries on the same patient were considered



Fig. 1. The operating theater set up of excision of the sinus with the aid of microscope.



Fig. 2. Infiltration of methylene blue dye into the sinus pit.



Fig. 3. Preauricular sinus delineated with exposed (stained in blue) but not violated sac and the use of a blade to remove a portion of the conchal cartilage. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.)

as two separate cases. Statistical analysis was performed using SPSS version 18.

In our center, surgical excision of the preauricular sinus is usually performed about a month after the resolution of an acute infection. An acutely infected preauricular sinus is first treated with a course of antibiotic. If an abscess is present, incision and drainage will be performed. We routinely place the incision of the surgical drainage close to the sinus pit to facilitate future excision of the sinus tract. The placement of the drainage incision close to the pit enables an elliptical incision to enclose both the sinus pit and the scar during the elective surgical excision. If the drainage incision is initially placed far from the sinus pit, a subsequent larger or two separate elliptical incisions may be required for complete excision. In the presence of granulation tissue anterior to the sinus pit, two separate elliptical incisions may be required for complete excision of the pit and the granulation tissue (Figs. 4–8).

3. Results

There were a total of 304 cases of preauricular sinus in 281 children in this study (Fig. 9). Twenty-three patients had surgical



Fig. 4. Presence of granulation tissue anterior to sinus pit.



Fig. 5. Two elliptical incisions are made to excised both the preauricular sinus and the granulation tissue.



Fig. 7. Surgical wound post excision of the sinus and granulation tissue.



Fig. 6. The preauricular sinus is excised with a sliver of conchal cartilage and tunneled under the bridge of normal tissue to connect with the patch of granulation tissue.



Fig. 8. Wound closure with interrupted vertical mattress sutures using Monocryl 5/0.

excision of bilateral preauricular sinus (either on the same or different dates). Of the 304 cases, 96 cases were excluded as these patients were not contactable by phone or had inadequate data from the clinical records. Hence, a total of 208 cases of preauricular

sinus were included in this study ($n = 114$ in the microscope group; $n = 94$ in the methylene blue dye and probe group). Patient characteristics and location of the preauricular sinus were similar in the two groups (Table 1). The mean age of the patients was 6.5

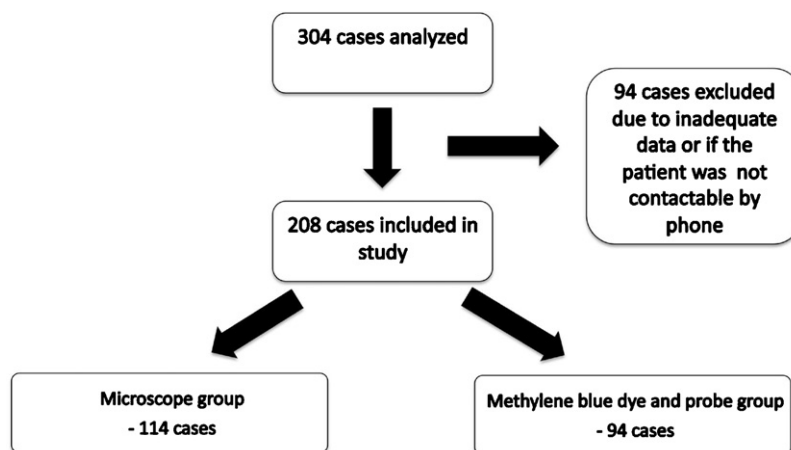


Fig. 9. Distribution of recruited cases into: (1) Microscope group and (2) methylene blue dye and probe group.

Table 1
Patient characteristics and location of sinus.

	Microscope group	Methylene blue dye and probe group	Total
Gender			
Male (%)	47 (41.2 ^a)	43 (45.7 ^a)	90 (43.3)
Female (%)	67 (58.8 ^a)	51 (54.3 ^a)	118 (56.7)
Total (%)	114 (100)	94 (100)	208 (100)
Mean age	6.19 years	6.9 years	
Race			
Chinese (%)	81 (71.1 ^a)	80 (85.1 ^a)	161 (77.4)
Malay (%)	19 (16.7 ^a)	8 (8.5 ^a)	27 (13)
Indian (%)	8 (7 ^a)	3 (3.2 ^a)	11 (5.3)
Others (%)	6 (5.3 ^a)	3 (3.2 ^a)	9 (4.3)
Total (%)	114 (100)	94 (100)	208 (100)
Laterality of sinus			
Right (%)	50 (44 ^a)	45 (48 ^a)	95 (46)
Left (%)	64 (56 ^a)	49 (52 ^a)	113 (54)
Total (%)	114 (100)	94 (100)	208 (100)
Location of sinus			
Anterior to ascending limb of helix (%)	84 (77.3 ^a)	58 (61.7 ^a)	142 (68.3)
Ascending limb of helix (%)	12 (10.5 ^a)	22 (23.4 ^a)	34 (16.3)
Not specified (%)	18 (15.8 ^a)	14 (14.9 ^a)	32 (15.4)
Total (%)	114 (100)	94 (100)	208 (100)

^a Percentage within each group.

Table 2
Indication for surgery.

Indication for surgery	No of cases (%)
Previous infection(s)	123 (59.13)
Abscess	44 (22.15)
Chronic discharge	37 (17.79)
Recurrent infection and abscess	4 (1.92)

years old (range 0.83–16 years). The mean follow up period was 6.7 months (range 0.25–84 months).

The indications for surgery are shown in Table 2. The commonest indication for surgery was previous infection (59.13%). This was followed by a history of previous abscess formation (22.15%), chronic discharge (17.79%) and both the presence of previous infections and abscess formation (1.92%). The average duration of the operation was 34.01 min for the methylene blue and dye group and 20.40 min for the microscope group.

The complications encountered were wound dehiscence and wound infection. Five (4.4%) out of 114 cases in the microscope group had complications and eight (8.5%) out of 94 cases in the methylene blue dye and probe group had complications (Table 3). Using Fisher's exact test, the difference in complication rates in the two groups was not statistically significant ($P = 0.258$). There were a total of 13 complications out of 208 cases with an overall

Table 3
Complication rates.

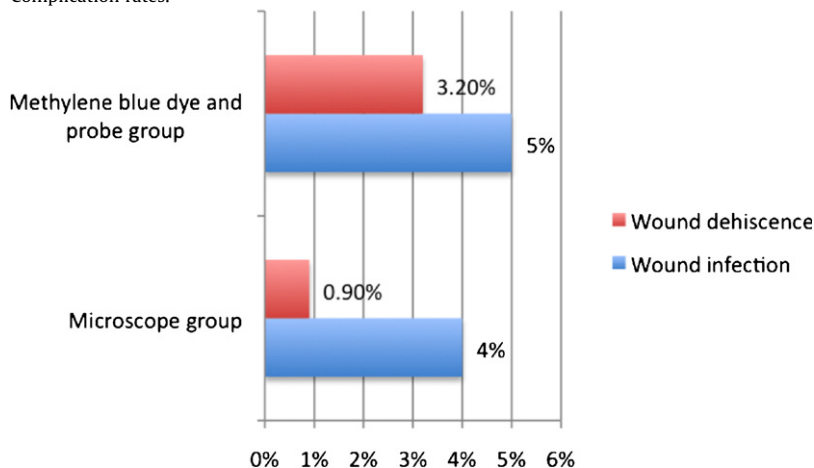
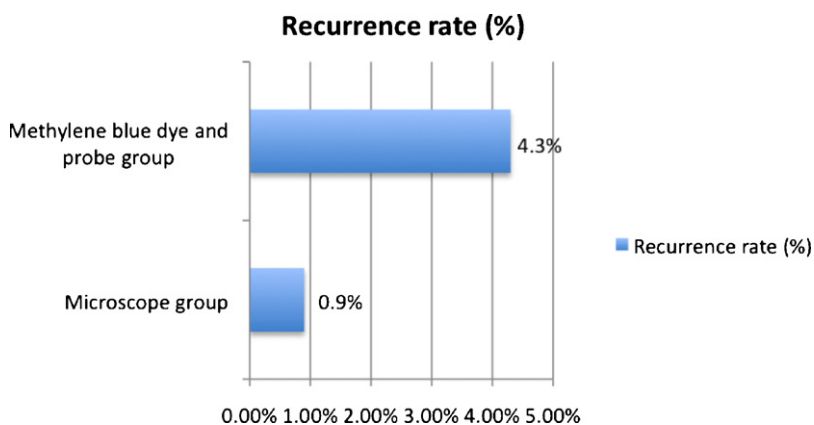


Table 4
Recurrence rates.



complication rate of 6.3% (95% confidence interval (CI) 0.037–0.104).

There was only one recurrence (0.9%) out of 114 cases in the microscope group and four recurrences (4.3%) out of 94 cases in the methylene blue dye and probe group (Table 4). Using logistic regression to adjust for other confounders, it was found that surgical excision with microscope guidance resulted in a lower recurrence rate (0.9%) compared to that of surgical excision with methylene blue dye and probe guidance (4.3%), with an odds ratio of 28.4 (CI 1.22–659.99, $P=0.037$). There were a total of 5 recurrences out of 208 cases with an overall recurrence rate of 2.4% (CI 0.010–0.055).

The complication rates were not statistically significant between the two groups. Race, gender, sex, location of sinus, indication for surgery, history of previous sinus excision, presence of infection did not significantly affect the complication rates during surgery and duration of surgery. The number of recurrences was too small to allow significant statistical analysis of potential risk factors for recurrence.

4. Discussion

The external ear is formed from six hillocks of His, which arise from the first and second branchial arches. Failure of complete fusion of the six hillocks or entrapment of ectodermal epithelium during auricular development is believed to result in the formation of preauricular sinuses [4]. They occur sporadically or are inherited in an incomplete autosomal dominant pattern, with reduced penetrance and variable expression. The preauricular sinuses are bilateral in 25–50% of cases and bilateral cases are more likely to be hereditary [5]. Although the incidence have been reported to be between 0.1 and 10% in various populations in the literature, the true incidence will be difficult to ascertain probably because majority of these patients are asymptomatic and only seek treatment if they are symptomatic from infection or from a chronically discharging sinus. In our study, preauricular sinus is seen most often in Chinese (77.3%), followed by Malays (13%) and Indians (5.3%). This is probably a reflection of the racial distribution in Singapore and concurs with a local study that showed the point prevalence of preauricular sinus in Chinese, Malay and Indians were 1.36%, 0.69% and 0.17%, respectively [15].

Majority of preauricular sinuses are located anterior to the ascending limb of helix or on the ascending limb of helix. Other rare locations reported in the literature include superior to the ascending limb of helix, along the posterior surface of helical crus (cymba concha), ear lobule and posterior to the auricle [4,11]. Although only about a quarter of patients with preauricular sinus are symptomatic [16], they can present with troublesome symptoms such as chronic discharge, pain and swelling. These patients will require surgical excision of the sinus after the infection has resolved.

Traditionally, a preauricular sinus is excised with an elliptical incision around the sinus opening and dissection of the tract was performed with the naked eye, without any aid for tract delineation or visualization. This standard approach resulted in a high recurrence rate ranging from 22 to 42% [7–9]. Subsequently, many surgical techniques have evolved, all with the aim to reduce the recurrence rate. We reviewed the English literature over the last 22 years on the surgical outcome of preauricular sinuses and found 11 studies (Table 5). Amongst the favorable techniques with a lower recurrence rate include the supraauricular approach, the use of methylene blue dye and probe and the use of a microscope during surgery and the “inside-out” technique. The supraauricular approach was first described by Prasad et al. in 1990. Most studies showed recurrence rates of less than 5% with this method [7,10,12,13,15]. The supraauricular approach involves a postauri-

cular extension of the incision and identification of the temporalis fascia (to determine the deep limit of dissection) and the cartilage of the anterior helix (which is regarded as the posterior limit of dissection). In this technique, the surgeon does not follow the fistula and tissues superficial to the temporalis fascia together with the preauricular sinus are excised. This technique may be particularly useful in the management of recurrent preauricular sinus where the sinus ramifications may not be obvious and the surgical planes may have been distorted by previous surgery [13]. In a recent prospective study by Bajwa and Kumar [13], radiofrequency-assisted supraauricular excision of preauricular sinus had a much reduced recurrence rate (3.3%) compared to that in “cold steel” supra-auricular excision (23%). In both treatment groups, the operative technique was identical except that dissection was performed with either a radiofrequency probe (in the radiofrequency group) or scissors (in the cold steel group). The lower recurrence rate in the radiofrequency group was attributed to better peri-operative visualization, easier dissection and less bleeding.

Good sinus tract visualization is also an important factor in reducing recurrence rates after surgical excision. To achieve this, some surgeons use methylene blue dye instillation with or without probing of the tract, and microscope with recurrence rates reported to be between 0 and 2% [8,9]. However, the number of cases involved in these studies were small ($n=23-50$). The use of methylene blue dye and probe raised concerns to some surgeons with the potential risk of sinus tract perforation and leakage of methylene blue dye into the operative field. However, in our experience, these risks can be avoided by not over-injecting the dye, wiping any excess dye with a gauze during injection; the use of a clamp on the probe (placed in the sinus) to prevent leakage or reflux of dye out of the sinus; and gentle probing of the tract when necessary.

Another technique with low recurrence rate was the “inside-out” technique with the aid of a microscope or magnifying glasses. This technique was first described in 2005 by Baatenburg de Jong [8] but was first introduced by Jesma in Rotterdam in the 1970s (not published at that time). This method involves a small elliptical incision around the sinus pit. Stay sutures are placed to facilitate dissection of the tract and the sinus is opened. The sinus tract and its branches are then followed from the inside and outside. A lacrimal duct probe may be used to establish the directions of the small tracts. Baatenburg de Jong reported a recurrence rate of 0% in 23 patients who underwent the “inside out” technique compared to a recurrence rate of 12.5% in 17 patients who had the classic operation. In contrary to Baatenburg de Jong’s technique, we prefer removing the sinus sac and ramifications in its entirety without opening the sac or tract while using the smallest elliptical incision possible with the aid of the microscope. With magnification under the microscope, blood vessels and surgical planes can be identified clearly, thus allowing good hemostasis. In addition, the magnified surgical field allows identification of any unintended violation of the sinus sac. If this occurs, a cuff of tissue surrounding the breached area can be excised together with the sinus to ensure complete surgical extirpation. Hence, we believe the use of a microscope and the creation of a dry operative field avoids the need to incise the sinus for tract visualization.

In our study, the use of a microscope or methylene blue dye and probe during excision of preauricular sinus has led to an overall recurrence rate of 2.4% and overall complication rate of 6.3%. The microscope group had a lower recurrence and complication rates in our study, emphasizing the importance of optical magnification during surgical dissection of the sinus. The overall low complication and recurrence rates in our series may be due to the following reasons:

Table 5
Surgical outcomes in the management of preauricular sinus over the last 22 years.

Author	Year	Study design	No. of cases	Method of excision	Recurrence rate	Complication rate	Mean follow up (months)
Bae SC et al.	2012	Retrospective study	101	Supraauricular approach	0%	Drainless group – 1.2%, Drain group – 18.2%	15.7 (range – N/A)
Bajwa H and Kumar S	2010	Prospective study	60	Supraauricular approach (with cold steel, n = 30 vs. with radiofrequency thermal ablation, n = 30)	Cold steel (23%) Radiofrequency ablation (3%)	N/A	15 (range 6–24)
Leopardi et al.	2008	Retrospective study	6	Supraauricular approach	0%	0%	20 (range 7–34)
Tang et al.	2007	Retrospective study	73	“Standard technique” with methylene blue dye injection with and without use of a lacrimal probe	Methylene blue dye alone (30%), methylene blue dye with use of a lacrimal probe (4.7%)	N/A	8 (range 1–24)
Yeo SW et al.	2006	Retrospective study	206	Classic fistulectomy	4.90%	4.90%	6.5 (range 2.5–70.8)
Baatenburg de Jong R	2005	Retrospective study	40	Classic (17 cases) “Inside-out” with aid of microscope (23 cases)	Classic (12.5%) “Inside-out” with aid of microscope (0%)	Classic (18.8%) “Inside-out” with aid of microscope (0%)	N/A (range 1–25)
Lam HC et al.	2001	Retrospective cohort	52	Standard excision (n = 25), supra-auricular approach (n = 27)	Standard excision (32%) supra-auricular approach (3.7%)	N/A	69 (range 36–156)
Gur E	1998	Retrospective study	165	Probing of tract (n = 46)	Probing of tract (10.87%), Injection of dye (2%)	N/A	95 (range 6–168)
				Injection of dye (n = 50), probing + dye injection (n = 28), no probing or dye injection (n = 41)	Probing + dye injection (0%), no probing or dye injection (21.95%)		
Currie et al.	1996	Retrospective study	159	Probe (n = 7), diathermy (n = 17), methylene blue (n = 16), all sinuses (159)	Probe (36%), diathermy (18%), methylene blue (13%), all sinuses (19%)	Probe (30%), diathermy (35%), methylene blue (13%), all sinuses (29%)	2.75 (range <1–72)
Joseph VT and Jacobson AS	1995	Retrospective study	44	Excision of “whole duct and gland”	6.80%	N/A	Minimum 6 months
Prasad et al.	1990	Retrospective study	33	Standard (n = 12), supraauricular approach with wide local excision (n = 21)	Standard (42%), supraauricular approach with wide local excision (5%)	N/A	N/A

N/A – not available.

1. The surgery is always performed under general anesthesia
2. It is performed in the absence of infection or inflammation whenever possible
3. Visualization of the sinus tract is aided with the use of microscope or methylene blue dye instillation and probing of the tract
4. Creation of a dry surgical field further aids visualization of tissue planes
5. Meticulous dissection of the sac is performed to ensure complete removal of the sac including a sliver of helical cartilage where the sac is attached
6. In the presence of granulation tissue, the granulation tissue is excised or debrided. The placement of two elliptical incisions may be required in some cases for complete excision of both the granulation tissue and sinus tract with the aim to avoid high tension closure of surgical wound.

In the literature, performing the surgery under local anesthesia and on patients who had a history of previous sinus excision had higher recurrence rates [2,11,12,14]. The higher recurrence rate when the surgery is performed under local anesthesia may be due to patient's limited compliance with surgical maneuvers (especially with deep dissection) and to confounding factors that local anesthetic infiltrations itself presents [12]. Previous sinus excision may result in distorted anatomy and scarring, making complete extirpation of the recurrent sinus difficult.

On the other hand, meticulous dissection of the sinus by an experienced surgeon under general anesthesia, radiofrequency assisted wide excision (as compared to ‘cold steel’ wide excision) and avoidance of sinus rupture have been shown to reduce recurrence rates [2,13]. Most studies showed that removal of a portion of auricular cartilage around the sinus during surgery reduces the risk of recurrence [2,7–10]. However in a study by Yeo et al. [11] in 2006, they found that removal of conchal cartilage during surgery did not impact on their recurrence rate. In their series of 191 cases, they had 4 recurrences in 71 cases where the conchal cartilage was removed during surgery. In 135 cases where the conchal cartilage was not removed, they had 6 cases of recurrences. There was no statistically significant difference in the recurrence rates between these 2 groups. However, Yeo et al. did not specify the exact area of the conchal cartilage that was removed during surgery. The presence of infection during surgery, indication for surgery, history of prior drainage of an abscess before surgery, insertion of a drain, the use of a compression dressing did not affect recurrence rates [11].

Despite the findings by Yeo et al., we advocate the routine removal of a portion of helical cartilage. In a study by Dunham et al. [17] to determine the histologic relationship of preauricular sinuses to auricular cartilage, the average sinocartilaginous distance was 425 μm . In more than 50% of the specimens reviewed, the sinocartilaginous distance was less than 0.5 mm,

and in nearly all these cases, the epithelial tract was in continuity with stromal tissue that was histologically indistinguishable from the perichondrium. The close relationship of the sinus tract to the cartilage suggests it may be difficult to dissect the tract completely from the cartilage without removing some cartilage or at least the perichondrium.

There are a few limitations in our study. The retrospective nature of the study resulted in problems with inadequate data collection and a high attrition rate. There is also a possibility of re-call bias through the telephone interview. Surgical excision of the sinuses involved multiple surgeons and surgeon factor was not adjusted for. The mean follow up period documented in the patients' clinical charts is short at only 6.7 months. However, information on recurrences and complications were updated by phone interview at least 1 year post surgery. Unfortunately, the low rate of recurrence and complication rate precludes statistical analysis of factors contributing to recurrence or complications.

5. Conclusion

Preauricular sinuses in children can be safely and effectively managed by surgical excision with the aid of a microscope or methylene blue dye and probe. Both methods have low recurrence and complication rates. The complications are usually minor and can be easily managed. The use of a microscope resulted in a shorter operating time and significantly lower recurrence rate in comparison to the use of methylene blue and probe.

Conflict of interest statement

We declare that there is no potential or actual competing interest in this study.

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