

## Interpretation of maxillary sinus radiographs in children

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### Abstract

Nasal symptoms are a frequent cause of referral to paediatric ENT clinics. It is the policy of our unit to view sinus radiographs without a report at the initial clinic attendance. This study demonstrates there is no statistically significant difference in the interpretation of the radiographs between two ENT surgeons and a radiologist although there was a tendency for the radiologist to have a greater specificity. This finding may have financial implications. In addition a clear sinus radiograph is shown to be a significant negative finding.

### Introduction

Nasal symptoms represent one of the commonest reasons of referral to a paediatric ENT clinic. Frequently these symptoms are due to allergic or vasomotor rhinitis. However chronic sinusitis in children is not uncommon and may present with identical symptoms. The distinction is important in practice as the treatment for the two types of disease is different and to some extent mutually incompatible. In the clinical setting radiological investigation provides the only practical means of diagnosing sinusitis. Where there is a clinical suspicion of maxillary sinus disease it is our practice to X-ray the maxillary sinuses using a single occipito-mental (Waters) view and to review the unreported films during the same clinic appointment. If the frontal or ethmoid sinuses are thought to be involved a further occipito-frontal (Caldwell) view is taken. This policy allows immediate decisions to be made regarding treatment and negates a further clinic attendance solely for the results of a radiological report.

This study was designed to determine if this approach was justified by comparing the results of antral lavage, where appropriate, with the interpretation of the sinus radiographs by two ENT surgeons and an experienced radiologist.

### Method

We studied 44 children seen prospectively over a six month period at The Royal Liverpool Children's Hospi-

tal, Alder Hey. The children were aged between one and 16 years with a median age of 6½ years. The study included only children suspected of having maxillary sinusitis on clinical grounds (Rachelefsky, 1984) and who were subsequently listed for antral lavage. All subjects had a single Waters view radiograph taken of the maxillary sinuses. The median period between the taking of the radiographs and surgery was seven days.

These radiographs were reported independently by a Registrar and Senior Registrar in ENT and a Consultant Radiologist. The radiological appearance of the maxillary antra was scored using a four point system: clear, fluid level, opaque, and mucosal thickening of more than 4 mm.

Each child underwent bilateral antral lavage performed under general anaesthesia using a Tilley Lichwitz trocar and cannula via an inferior meatal puncture. Thirty ml of normal saline was used to irrigate the sinus and the resultant washings were recorded on a four point scale: clear, mucoid, purulent and bloody.

For the purposes of this study anything other than a clear sinus on the radiograph and a clear return on irrigation was considered abnormal. (Watt-Boolsen and Karle, 1977; Revonta and Suonpaa, 1981; 1982.)

### Analysis

For this study the result of the radiographic interpretation for the three observers was compared with the results of the antral washout, the latter being the 'gold standard'.

TABLE I  
INTERPRETATION OF MAXILLARY ANTRA ON OCCIPITOMENTAL RADIOGRAPHS

	Normal	Mucosal thickening	Opaque	Fluid level	Total
ENT Registrar	32	42	14	-	88
ENT Senior Registrar	32	37	18	1	88
Radiologist	37	24	25	2	88

TABLE II  
RESULTS OF ANTRAL LAVAGE

Washings	No. of maxillary antra
Clear	48
Mucous	6
Pus	16
Blood	18
Total	88

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TABLE III  
SENSITIVITY AND SPECIFICITY FOR EACH OBSERVER

1. ENT registrar	36	4	Sensitivity = 0.90
	20	28	Specificity = 0.58
2. ENT Senior Registrar	35	5	Sensitivity = 0.88
	21	27	Specificity = 0.56
3. Radiologist	36	4	Sensitivity = 0.90
	15	33	Specificity = 0.68

To interpret the data we employed the concept of sensitivity and specificity. The sensitivity of a test is related to the probability of obtaining a false negative result whilst the specificity is related to the probability of a false positive result (Armitage and Berry, 1987).

The results for each observer have been displayed in the following manner.

	Test	
	+	-
+	True Positives	False Negatives
-	False Positives	True Negatives

The radiographic interpretations of the three observers were compared using the Cochran Q test (Armitage and Berry, 1987). Confidence intervals were constructed for the proportion showing agreement between the interpretation of the sinus radiograph and the results of the antral washout for each of the three observers.

In addition confidence intervals were calculated for the difference between proportions showing agreement between the radiographic interpretations of the three observers (Gardner and Altman, 1989).

## Results

The results of the interpretation of the preoperative radiographs is shown in Table I, and those of antral lavage in Table II. The sensitivity and specificity for the three observers interpreting the sinus radiographs is summarized in Table III.

The radiologist correctly interpreted the sinus radiograph in 77 per cent of cases and the registrar and senior registrar in 73 per cent and 66 per cent respectively. The results are displayed in Table IV, together with the 95% confidence intervals.

There was no significant difference in the interpretation of the sinus radiographs between the three observers when simply testing for  $p$  ( $Q = 0.677$ ,  $p = 0.722$ ).

In Table V the difference between the proportions showing agreement in the interpretation of the sinus radiographs is compared for the three observers.

## Discussion

The value of sinus radiographs in children has been questioned by studies that purport to show a high incidence of radiographic abnormalities in normal children

TABLE IV

	Proportion correct interpretation of radiographs	95% confidence interval for the proportions
Registrar	0.727	0.600–0.860
Senior Registrar	0.659	0.520–0.798
Radiologist	0.773	0.650–0.900

(Maresh and Washburn, 1940; Shopner and Rossi, 1973), whilst another study has shown a high incidence of abnormal findings on antral lavage in children with normal sinus radiographs (Watt-Boolsen and Karle, 1977).

Sinus radiology in children under one year of age is unreliable as a predictor of antral disease. In older children, if allowance is made for recent upper respiratory tract infections, the incidence of abnormal radiological findings in a normal paediatric population is very small (Kovatch *et al.*, 1984). The use of a single occipitomeatal radiograph means that exposure to ionizing radiation is reduced to a minimum and, as it is the maxillary antrum that is predominantly affected in sinusitis, the occipitomeatal view is the view of choice (Moilanen, 1984; Elwany *et al.*, 1985; Rachelefsky, 1984).

We have shown in this study that the use of occipitomeatal radiograph alone has a high sensitivity (90 per cent) as an investigation for sinus disease in children and therefore in contrast to other authors we feel that a clear radiograph is an important negative finding (Watt-Boolsen and Karle, 1977).

The low specificity of the radiograph was consistent with other reports (Bjuggren *et al.* 1952; Axelsson *et al.*, 1970; Watt-Boolsen and Karle, 1977; Revonta and Suonpaa, 1981; Pfeleiderer *et al.*, 1984). This may be related to the general problem of interpreting sinus radiographs in children due in part to the presence of tooth buds, and to the relatively small size of the antral cavity and hence the degree of opacity caused by even a small degree of mucosal thickening. An alternative explanation may be that inadequate ventilation of the sinus causes a thin layer of mucus to become adherent to the walls of the sinus, thus giving the radiographic impression of mucosal thickening (Bailey, 1981).

## Conclusion

This study fails to demonstrate a significant difference in the interpretation of sinus radiographs in children between a radiologist and an experienced junior ENT surgeon. However the trend in statistical thinking is moving away from rigid adherence to  $p$  values and the concept of significant and non-significant. Thus in the present paper there was a tendency for the radiologist to be more specific in his report of a sinus radiograph than his ENT colleagues. We feel this justifies our policy of viewing the unreported films at the initial clinic attendance. This has the advantage of expediting clinical decisions and preventing unnecessary clinic attendances.

However because of the marginally greater specificity of the radiologist we consider it warrants seeking a radiological opinion on doubtful films. This should improve the specificity of the policy.

There are considerable financial implications to this policy. In our unit it is estimated that the cost of reporting a single sinus radiograph is £2.82 (Lappin—Personal Communication) whilst the cost of an outpatient attendance is £24 (Liverpool Health Authority 1989). We request approximately 400 sinus radiographs per annum. If these radiographs are seen solely by a reasonably experienced ENT surgeon, and an unnecessary clinic attendance is prevented, there is a potential saving

TABLE V

	Difference between proportions showing agreement	95% Confidence interval for the differences between proportions
Registrar/Radiologist	0.046	-0.076 to 0.125
Sen Registrar/Radiologist	0.023	-0.080 to 0.102
Registrar/Sen Registrar	0.028	-0.128 to 0.101

of £11,000 per annum representing a more efficient utilization of resources.

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