Comparative study of standard radiology, sinuscopy and sinusomanometry in the maxillary sinus of the adult

(about 465 maxillary sinuses)

B. M. G. Bertrand and T. A. J. Robillard, Louvain, Belgium

SUMMARY

The authors examine the correlations among standard X-ray, sinuscopy and sinuso-manometry for 465 maxillary sinuses in the adult. Good overall correspondence does exist between radiography and sinuscopy (51.59 to 90.91%) but there is no real correlation between sinusomanometry and a sinuscopy that fails to visualize the ostium. Correlation is excellent when the morphologic appearance of the ostium is studied in conjunction with the sinusomanometric findings (82.09%).

This study demonstrates the morphologic and the functional examinations to be rigorously complementary and indissociable.

The aim of this work is to compare three paraclinical examinations, standard X-ray, sinuscopy and sinusomanometry, in chronic sinusitis of the adult, the intention being to identify correlations among the three examinations while defining their limitations and their value.

MATERIAL

The study covers a twenty-three-month period, from September '82 to early August '84. It comprises 465 maxillary sinuses in 247 patients of whom 128 were women and 119 men, all being adults of more than 15 years of age. The breakdown by age-group is relatively even, except for a peak concerning the 25 to 35 year old group (Figure 1).

The radiographic study of these 465 sinuses is summarized by Figure 2. We have chosen the "Waters" incidence, the nose-chin X-ray, since it is the one that best distinguishes the maxillary sinuses while avoiding radiographic projection of the petrous portions.

We propose a division into four radiographic categories according to the gravity of the lesions observed (Figure 2).
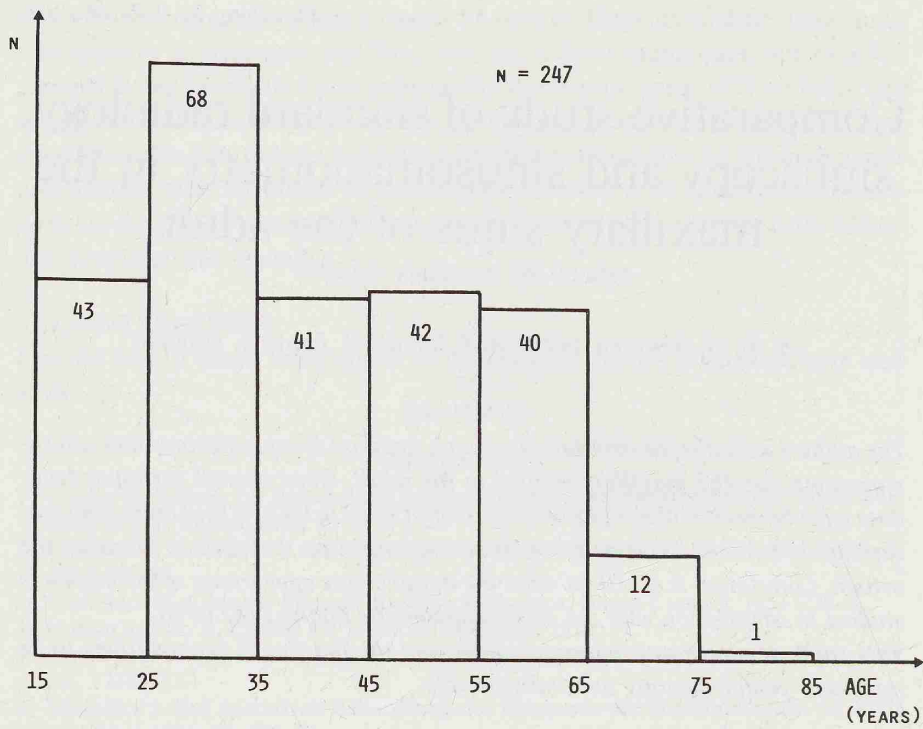
Figure 1.   Material.

CLASS	DESCRIPTION	N	%
1	▽ △ ▽	48	10.32
2	▽ △ ▽	172	36.98
3	▽ △ ▽	135	29.03
4	▽ △ ▽	28	23.65

Figure 2.
Radiographic examination by
"Waters".
(N = 465)

Class 1 represents a normal X-ray, comprising 48 cases, i.e. about 10% of all the sinuses we investigated.

Class 2 comprises minor lesions seen by X-ray: one or two isolated polypoid formations in the lower part, or else a homogenous surrounding mucosal thickening of less than 4 mm. We have included in this category 172 cases meeting these criteria, i.e. about 37% of our material and in the most representative of our study.

Class 3 comprises lesions shown by X-ray to be of medium severity. Here there may be several, 3, 4 or even 5 polypoid formations, possibly confluent, in the lower part. Or else there may be surrounding mucosal thickening, which this time exceeds 4 mm but still does not entirely block the antral lumen. This classification covers 135 sinuses.

Class 4 comprises major radiographic lesions, where a mass of confluent polyps very seriously reduces the antral lumen. The category also includes complete veiling of the maxillary sinus. 110 of our cases are represented here, i.e. 23.65% of all the sinuses we studied.

Sinuscopy was practised according to Terrier's technique, under local anaesthesia. Puncture is made at the culminating point of the inferior meatus. After withdrawal of the trocar, Hopkin's optics of 170°, 155°, 110° and 70° are successively introduced through the cannula and so enable the sinus to be studied systematically.

We propose that the sinuscopic picture also be subdivided into four categories according to the gravity of the lesions considered in an overall manner (Table 1).

Class 1 refers to a normal sinuscopic appearance, where the mucosa is normoplastic and transparent. It includes 35 cases, representing approximately 7.5% of the study.

Class 2 refers to sinuscopic lesions of minor gravity. The mucosa is hyperplastic and congested; the presence of isolated polypoid formations is tolerated. This category comprises 201 cases, i.e. approximately 43.22% of our material.

Class 3 comprises sinuscopic lesions of medium gravity, where several confluent polypoid formations considerably reduce the antral lumen. This category includes 161 cases, i.e. nearly 34.62%.

Table 1. Sinuscopic examination.

class	description	N	%
1	normal aspect	35	7.52
2	slight pathology	201	43.22
3	medium pathology	161	34.62
4	severe pathology	68	14.62

N = 465

Our *Class 4* comprises severe sinuscopic lesions, for instance those polypoid formations that very seriously reduce the antral lumen and are generally accompanied by relatively abundant mucopurulent secretions. This category includes 68 cases, equivalent to approximately 14–15%.

Figure 3 summarizes our sinusomanometric study. Per-operative sinusomanometry has also enabled us to define four categories, which are a simplification of the classification proposed by Melon and Daele (1979).

In *Class 1* cases the situation is normal, with no resistance either to injection or to aspiration of air. We found this to be so for 206 sinuses, representing about 45.37% of those we explored.

Class 2 describes a situation where air is easily injected, whereas aspiration is difficult or even impossible. This condition, which has been termed "internal valve" or "nasal valve", was found 22 times, representing 4.84% of the sinuses.

For *Class 3* the situation is the reverse, there being an external or antral valve. We found only seven examples of this.

In *Class 4,* both the injection and the aspiration of air are difficult. This situation, termed "double valve" or "bi-valve", is the one most frequently encountered in our study. We did indeed find 219 cases, representing 48.23% of the sinuses studied.
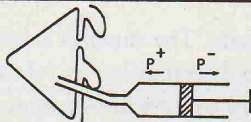
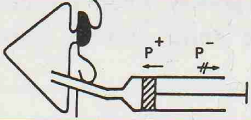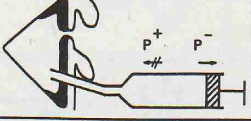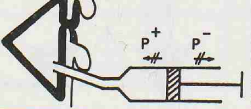| CLASS	DESCRIPTION	TYPE	N	%
1		NORMAL	206	45.37
2		INTERNAL VALVE	22	4.84
3		EXTERNAL VALVE	7	1.54
4		DOUBLE VALVE	219	48.23

Figure 3.
Sinusomanometrie
examination.
(N = 454)

METHOD

Table 2 compares the various radiographic and sinuscopic categories.

There is a good correlation between, on the one hand, the slight or moderately severe radiographic lesions and, on the other hand, the slight or moderately severe sinuscopic lesions.

Where the X-ray picture is normal, sinuscopy is more pessimistic and in 29 cases out of 48 it describes lesions of slight or medium gravity. In contrast, where radiography shows serious lesions, sinuscopy is more optimistic, describing conditions of less advanced severity in 71 out of 110 instances.

Table 2.   X-ray vs sinuscopy.

SSC	Rx 1	2	3	4	total
1	19 (4.08%)	13 (2.79%)	1 (0.21%)	2 (0.43%)	35 (7.52%)
2	25 (5.37%)	109 (23.44%)	43 (9.24%)	24 (5.16%)	201 (43.22%)
3	4 (0.86%)	39 (8.38%)	73 (15.69%)	45 (9.67%)	161 (34.62%)
4	0 (0%)	11 (2.36%)	18 (3.87%)	39 (8.38%)	68 (14.62%)
total	48 (10.32%)	172 (36.98%)	135 (29.03%)	110 (23.65%)	465 (100%)

N = 465; Rx = X-ray; SSC = sinuscopy.

This discordance can be explained by the greater precision of the examination by sinuscopy, and by the superposition on to a single radiographic plane of antral lesions that are distributed over the volume of the cavity, thus artificially accentuating the pathology of the X-ray picture.

There is a good overall correspondence between lesions as seen by X-ray or by sinuscopy, since the concordance is 51.59% for the equivalent categories, and this concordance increases to 90.91% if a discrepance of only one class is taken to be acceptable.

Table 3 compares radiography and sinusomanometry. One can see straightaway the low incidence of partial valves, either internal or external, and their only slight radiographic correspondence. When the X-ray is pathologic, one notes a

Table 3.   X-ray vs sinusomanometry.

SMM	Rx 1	2	3	4	total
1	29 (6.38%)	89 (19.60%)	54 (11.89%)	34 (7.48%)	206 (45.37%)
2	4 (0.88%)	6 (1.32%)	8 (1.76%)	4 (0.88%)	22 (4.84%)
3	1 (0.22%)	2 (0.44%)	1 (0.22%)	3 (0.66%)	7 (1.54%)
4	11 (2.42%)	73 (16.07%)	69 (15.19%)	66 (14.53%)	219 (48.23%)
total	45 (9.91%)	170 (37.44%)	132 (29.07%)	107 (23.56%)	454 (100%)

N = 454; Rx = X-ray; SMM = sinusomanometry.

majority of ostial dyspermeability, about 51.07%. When the sinusomanometry findings are normal, there is but little correspondence with a normal X-ray. Radiography does not therefore give information on ostial permeability and there is no real correspondence between radiography and sinusomanometry, except perhaps for the predominance of a double valve in pathologic X-rays (Table 3). Table 4 sets out is parallel sinusomanometry and sinuscopy seen as a whole, i.e. in an overall exploration of the entire antral mucosa except for the ostium.

Here too, there is little correlation to be noted between the partial valve, whether internal or external, and the classification by sinuscopy. In the presence of sinuscopic pathology, here too the double valve predominates.

Table 4.   Sinuscopy vs sinusomanometry.

SMM	SSC				
	1	2	3	4	total
1	30 (6.60%)	111 (24.44%)	53 (11.67%)	12 (2.64%)	206 (45.37%)
2	1 (0.22%)	10 (2.20%)	10 (2.20%)	1 (0.22%)	22 (4.84%)
3	1 (0.22%)	1 (0.22%)	3 (0.66%)	2 (0.44%)	7 (1.54%)
4	3 (0.66%)	74 (16.29%)	90 (19.82%)	42 (11.45%)	219 (48.23%)
total	35 (7.70%)	196 (43.17%)	156 (34.36%)	67 (14.75%)	454 (100%)

N = 454; SSC = sinusoscopy; SMM = sinusomanometry.

Where sinusomanometry is normal there is relatively little correspondence with normal sinuscopy. As does the X-ray, overall sinuscopy studies the whole mucosa except for the ostium, and its correlation with sinusomanometry is poor. At the most, a moderate predominance of the double valve is to be noted on the case of pathologic sinuscopy (Table 4).

It therefore appeared to us to be of interest to study ostial morphology, with visualization by sinuscopy and comparison to sinusomanometric findings. We propose a classification of the ostia into six categories (Figure 4).

Of these, *Class 1* comprises ostia that are normal as regards both size and morphology. 126 such cases were encountered, representing about 27% of the statistic material.

Class 2 comprises the ostia of small dimensions, represented by 58 cases and equivalent to approximately 12.47% of the sinuses.

Class 3 comprises ostia of normal size which, for various reasons, appear to be occluded. We took 25 such cases into account, representing 5.37% of the total.

Class 4 comprises multiple ostia, those where 2 or 3 ostia are present. We counted 35 such cases, representing 7.52% of the total.

Our *Class 5* comprises ostia that were both small and occluded. We counted 20 of these, representing about 4.30% of the total number.

*Class 6* groups together those ostia not visualized. Apart from various technical

CLASS	SCOP. ASPECT	DESCRIPTION	N	%
1		NORMAL	126	27.09
2		SMALL	58	12.47
3		OCCLUDED	25	5.37
4		MULTIPLE	35	7.52
2 + 3		SMALL & OCCLUDED	20	4.30
N.V.		NON-VISUALIZED	201	43.22

Figure 4.
Classification of antral ostia.
(N = 465)

reasons, the main cause for failure to visualize an ostium is the presence of extensive lesions of the antral mucosa that mask the ostial field. This NV (non-visualized) category includes 201 cases, which is equivalent to approximately 43.22% of our material (Figure 4).

We then compared the various morphologic types of ostium with the sinusomanometric findings (Table 5).

When the ostium was normal, we found the sinusomanometry to be normal in 110 cases out of 124.

Among the Class 2 ostia, which were small in size, normal and pathologic sinusomanometric findings were approximately evenly represented, for we encoun-

Table 5. Ostial morphology vs sinusomanometry.

SMM	ostium 1	2	3	4	2 + 3	n.v.	total
1	110	30	6	29	3	28	206
	(24.22%)	(6.60%)	(1.32%)	(6.38%)	(0.66%)	(6.16%)	(45.37%)
2	6	1	1	1	1	12	22
	(1.32%)	(0.22%)	(0.22%)	(0.22%)	(0.22%)	(2.64%)	(4.84%)
3	0	1	1	0	0	5	7
	(0%)	(0.22%)	(0.22%)	(0%)	(0%)	(1.10%)	(1.54%)
4	8	23	17	4	16	151	219
	(1.76%)	(5.06%)	(3.74%)	(0.88%)	(3.52%)	(33.25%)	(48.23%)
total	124	55	25	34	20	196	454
	(27.31%)	(12.11%)	(5.50%)	(7.48%)	(4.40%)	(43.17%)	(100%)

N = 454; SMM = sinusomanometry.

tered 30 cases with normal and 25 cases with pathologic sinusomanometry.
Class 3 comprises the occluded ostia and it essentially concerns cases with a
pathologic sinusomanometry, since we found this in 19 out of 25 cases.

In the cases of multiple ostia, we found 29 normal and 5 pathological sinusomano-
metric results. This is understandable in view of the high proportion of accessory
ostia large enough to ensure normal sinusomanometry.

Where we were dealing with a small occluded ostium, 17 out of 20 times we noted
a pathologic sinusomanometry.

In our final category, which covered the non-visualized ostia, we found pathologi-
cal sinusomanometry 168 times out of 196, the great majority of these concerning
cases of double valve.

The 28 cases of non-visualized ostia where sinusomanometry was normal were
those in which per-operative accidents of technique had prevented correct visual-
ization of the ostium.

Thus an excellent correlation does exist between the appearance of the ostium
and the sinusomanometry that can be expected of it (82.09%). Among the non-
visualized ostia, accounting for 43.17% of our statistic material, 3/4 have a double
valve while the remaining 1/4 have partial valves or normal sinusomanometric
findings.

DISCUSSION (Figure 5)

1. The correspondence between radiographic and sinuscopic lesions is good,
   there being a 90% rate of concordance for divergence by one class.

2. Regarding the comparison between radiography and sinusomanometry on the
   one hand and between sinuscopy and sinusomanometry on the other, there is
   no real correlation except (and that is why we have kept the single-line links on
   the diagram) for lesions belonging to Classes 2, 3 and 4, both radiographic and
   sinuscopic. These lesions give rise to double valve in the majority of cases.

3. The best score is attained by the excellent correlation existing between ostial
   morphology and sinusomanometry, since in 82.09% of cases the appearance of
   the ostium does correspond to what might be expected from the sinusomano-
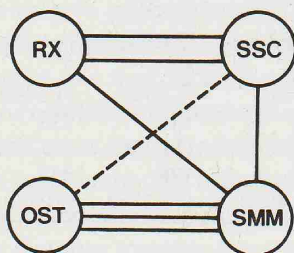   metric findings.

Figure 5.   Diagram of the correlations between the
various techniques.

CONCLUSIONS

If we seek to establish the assessment, both morphologic and functional, of a chronic maxillary sinusitis, there must be additional techniques available.

It is imperative to complete the standard X-ray by sinusomanometry in view of the poor correlation between these two examinations. Similarly, and for the same reasons, sinuscopy should be accompanied by sinusomanometry, particularly in cases where the ostium has failed to be visualized, sinuscopy retains its full value and enables 17% of the false negative cases to be avoided.

RÉSUMÉ

La corrélation entre la radiographie standard en incidence de Waters, la sinuso-scopie et la sinusomanométrie a été étudiée par un échantillonage de 465 sinus maxillaires d'adultes souffrant de sinusite maxillaire chronique.

Une bonne correspondance globale est trouvée entre radiographie et sinususco-pie (51.49 à 90.91%). Mais il n'y a pas de corrélation réelle entre la radiographie et la sinusomanométrie, ni entre la sinusoscopie qui n'envisage pas l'aspect ostial, et la sinusomanométrie. La corrélation devient excellente lorsque l'aspect mor-phologique de l'ostium est comparé à la sinusomanométrie (82.09%). Le travail démontre que les examens morphologiques et fonctionnels des sinus maxillaires sont tout à fait complémentaires et ne peuvent être dissociés.

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B. M. G. Bertrand
Cliniques Universitaires UCL de Mont-Godinne
Service d'ORL et de Chirurgie cervico-faciale
B-5180 Yvoir
Belgium