Rhinology, 42, 126-130, 2004

The role of septal deviation in adult chronic rhinosinusitis: a study of 500 patients*

R.P.S. Harar, N.K. Chadha, G. Rogers

The Royal National Throat, Nose and Ear Hospital, Gray's Inn Road, Kings Cross, London WC1X 8DA, United Kingdom

SUMMARY

Septal deviation is a common finding and its role in the pathogenesis of chronic rhinosinusitis remains uncertain. The aim of this study was to assess the impact of septal deviation in the region of the ostiomeatal complex with regards to sinus disease, as staged by the Lund-Mackay scoring system in a group of adult patients with symptoms of chronic rhinosinusitis. Five hundred consecutive patients who had undergone CT scanning of the paranasal sinuses for possible chronic sinus disease between Sept. 2002 and Dec. 2003 were recruited. Septal deviation at the ostiomeatal complex on coronal CT scan was evaluated using Radworks diagnostic 5.1 software (Applicare Medical Imaging BU). There were 219 patients with CT positive sinus disease. 281 of the patients had normal sinus CT scans (control group) and were therefore patients with rhinitis rather than rhinosinusitis. Our study showed no significant difference between the chronic rhinosinusitis group and the control group with regards to septal deviation. Nor were we able to demonstrate any correlation between the severity of septal deformity at the ostiomeatal complex region and the severity of sinus disease or OMC disease.

Key words: septal deviation; chronic sinusitis; computerised tomography; paranasal sinuses; ostiomeatal complex.

INTRODUCTION

Septal deviation is a common finding and its role in the pathogenesis of chronic rhinosinusitis remains uncertain (Collet et al., 2001). Clinical studies suggest that the prevalence of septal deviation increases with age. Gray reported a prevalence of bilateral nasal septal deviation in 27% and unilateral in 31% from a series of 2380 infants (Gray, 1980). Van der Veken showed that the prevalence of septal deviation in children increases from 16% to 72% in a linear fashion from 3 to 14 years of age (Van der Veken et al., 1990). Among a cohort of 2112 adults, Gray reported a septal deviation rate of 79% (Gray, 1980). In radiological studies lower prevalence rates of septal deviation are reported with Calhoun finding septal deviation in 19.5% and Jones in 24% of control populations (Calhoun et al., 1991; Jones, 1997). Rhinosinusitis in the general population is higher in childhood, although paradoxically this occurs when the prevalence of septal deviation is at its lowest (Collet et al., 2001). Among children of 2 to 12 years CT evidence of sinus pathology is found in 60% of symptomatic and 46% of normal children (Cotter et al., 1999).

Jensen reported sinus abnormality on plain radiology assessment in 27% of his patients about to undergo septoplasty (Jensen and Dommerby, 1986). In addition, Matschke reported sinus pathology in 50% of a series of 150 patients who had rhinomanometrically proven nasal septal deformity and obstruction (Matschke and Fliebach, 1985). Elahi, Calhoun and Yousem reported a higher incidence and severity of sinus disease with increasing septal deviation in the region of the ostiomeatal complex (OMC) as assessed by CT scan (Calhoun et al., 1991; Elahi et al., 1997; Elahi and Frenkiel, 2000; Yousem et al., 1991). Danese found an association between septal ridges and spurs and ipsilateral sinus disease as assessed by CT scan (Danese et al., 1997).

Three hypotheses exist to explain the pathophysiology of septal deviation and chronic rhinosinusitis. The first is mechanical and is Stammberger's theory of stenosis of the ostiomeatal complex from either the anatomical configuration or hypertrophied mucosa causing obstruction and stagnation of secretions which may then become infected or perpetuate infection (Stammberger and Posawetz, 1990). The second hypothesis is aerodynamic. Blaugrund and Danese propose that septal devia-

*Received for publication: February 1, 2004; accepted: May 5, 2004

tion results in an increase in the velocity of nasal airflow, which leads to mucosal desiccation and diminished mucociliary function (Danese et al., 1997; Blaugrund, 1989). This is supported by the work of Ginzel who found a delayed saccharin clearance time in patients with septal deflection (Ginzel and Illum, 1980). However, Passali's repeat of this study found no such differences between subjects with straight and deviated nasal septums (Passali et al., 1999). The third theory was proposed by Bachert, who demonstrated alterations of maxillary sinus pressure and ventilation with septal deviations in the region of the ostiomeatal complex (Bachert, 1987). He found diminished antral pressures in association with posterior septal deviations.

The aim of this study was to assess the impact of septal deviation in the region of the ostiomeatal complex with regards to sinus disease, as staged by the Lund-Mackay (LM) scoring system in a group of adult patients with symptoms of chronic rhinosinusitis (Lund and Mackay, 1993). No studies exist to date using the LM scoring system to evaluate the impact of the septum on chronic rhinosinusitis. The LM scoring system is known to be one of the most reliable and reproducible computerised tomographic staging systems available (Olowole, 1996).

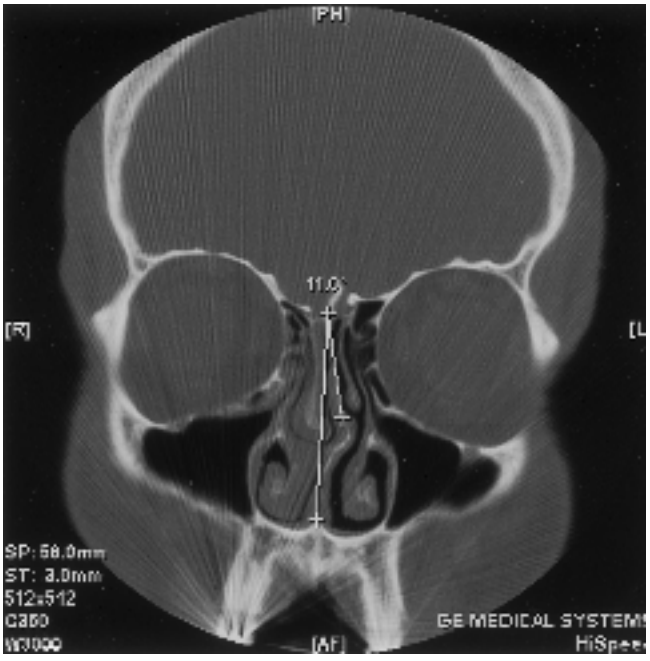

Figure 1. Coronal sinus CT image demonstrating technique for measurement of the nasal septal angle at the ostiomeatal complex.

MATERIALS AND METHODS

Consecutive patients who had undergone CT scanning of the paranasal sinuses for possible chronic sinus disease between Sept. 2002 and Dec. 2003 were evaluated until data on a series of 500 cases was acquired. All patients satisfied the standard definition of chronic rhinosinusitis – persistent nasal symptoms (nasal congestion, discharge, postnasal drip, hyposmia or facial pain) of greater than twelve weeks duration that are refractory to medical treatment. Exclusion criteria included previous nasal or sinus surgery, facial trauma, nasal polyposis, neoplasia, septal perforation, fungal sinusitis, odontogenic sinusitis, immunodeficiency and mucociliary disorders.

The sinus CT protocol at The Royal National Throat, Nose and Ear Hospital is to obtain 3mm thick coronal sections through the ostiomeatal complex and 5mm thick coronal sections through the rest of the paranasal sinuses. Each coronal CT scan was evaluated using Radworks diagnostic 5.1 software (Applicare Medical Imaging BU), which allows the accurate measurement of the nasal septal angle (NSA). This is defined as the angle between a line drawn from the superior insertion of the septum at the crista galli to the inferior insertion of the septum at the level maxillary crest and another line from the superior insertion of the septum at the crista galli to the apex of the septal deviation in the region of the ostiomeatal complex (Figure 1). Disease in the paranasal sinuses was scored using the LM system (Lund and Mackay, 1993). All the CT imaging evaluations were performed by the first author to ensure reproducibility of the data. All the data was entered on to a computer database and analysed using SPSS version 11.5 for windows software.

RESULTS

There were 219 patients with CT positive sinus disease. 281 of the patients had normal sinus CT scans and are therefore patients with rhinitis rather than rhinosinusitis. They are included as a control group. The patient characteristics of each group are presented in Table 1. Patients are well matched with regards to age and sex distribution in both groups. There is no significant difference using the Mann-Whitney test, between

Table 1. Overall results of septal deviation and sinus disease in both groups.

	Disease group (n=219)	Control group (n=281)
Mean Age	44.9 (sd14.31)	42.1 (14.0)
Sex ratio (Male: Female)	116:103 (53%:47%)	123:158 (43.8%:56.2%)
Mean septal angle to right	4.62° (sd3.14) (n=123)	4.21° (sd2.97) (n=146)
Mean septal angle to left	4.39° (sd3.01) (n=96)	4.21° (sd3.41) (n=135)
LM score for right side	2.7(sd2.17)	0
LM score for left side	3.02 (sd2.29)	0
Overall LM score	5.7 (sd4.04)	0

Table 2. Septal deviation with increasing sinus disease.

LM score	Mean NSA to left	Mean NSA to right	Number of cases
0	4.21^0	4.21^0	281
1	4.77^0	4.85^0	40
2	4.82^0	5.89^0	23
3	3.5^0	3.81^0	14
4	3.61^0	4.79^0	20
5	2.68^0	4.26^0	13
6	4.09^0	5.37^0	20
7	4.83^0	5.07^0	12
8	2.66^0	3.9^0	13
9	3.79^0	3.62^0	16
10	3.77^0	4.38^0	13
11	5.94^0	3.6^0	8
12	5.55^0	7^0	6
13	2.73^0	8.35^0	5
14	8.45^0	2.65^0	4
15		2.25^0	2
16		3.7^0	1
17	5.1^0		1
18		2.6^0	2

Table 3. Sinus disease with increasing septal deviation to the right in the patients with chronic rhinosinusitis.

NSA to the right (degrees)	Left LM score	Right LM score	Total LM score	Number of patients
<1°	3.6	4.1	7.7	11
1-2°	3	2.8	5.8	20
2-3°	3.5	3.4	6.9	14
3-4°	3.1	4	7.1	15
4-5°	2.0	2.9	4.9	17
5-6°	3.9	3.7	7.6	7
6-7°	2.0	3.2	5.2	12
7-8°	1.0	2.0	3.6	5
8-9°	2.8	3.2	6.0	11
9-10°	2.2	1.8	4.0	5
10-11°				0
11-12°	1.3	0.7	2.0	3
12-10°	6	6.0	12	1
13-14°	0	1.0	1	1
>14°	3	1.0	4	1
0-5°	3.0	3.4	6.4	77
5-10°	2.7	2.8	5.5	40
>10°	2.2	1.7	3.8	6

Table 4. Sinus disease with increasing septal deviation to the left in the patients with chronic rhinosinusitis.

NSA to the left (degrees)	Left LM score	Right LM score	Total LM score	Number of patients
<1°	2.4	3.5	5.8	11
1-2°	2.9	2.7	5.6	9
2-3°	2.1	2.8	4.9	17
3-4°	1.8	2.4	4.2	18
4-5°	2.8	2.9	5.6	8
5-6°	3.8	3.9	7.7	9
6-7°	1.9	1.4	3.3	7
7-8°	3.0	3.0	6.0	5
8-9°	2.0	3.0	5.0	4
9-10°	4.0	5.0	9	1
10-11°	0.5	1.0	1.5	2
11-12°	6.5	5.5	12	2
>12°	2.3	3.0	5.3	3
<5°	2.2	2.8	5.0	63
5-10°	2.8	2.9	5.7	26
>10°	3.1	3.4	6.5	7

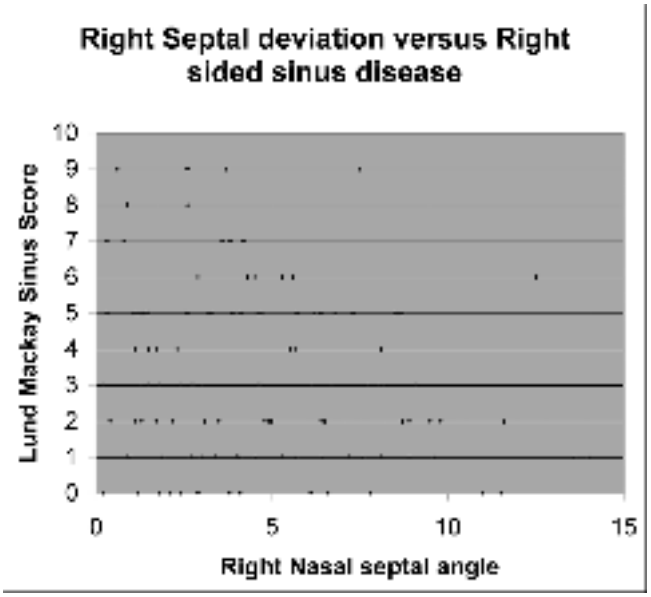

Figure 2. Scatter plot graph of right sided sinus disease in the chronic rhinosinusitis group of patients versus their right sided septal deviation.

the two group's septal deviations, as measured by the nasal septal angle. In the chronic rhinosinusitis group septal deviation was arbitrarily classified as mild ($<5^0$), moderate ($5\text{-}10^0$) or severe ($>10^0$) and again there were no differences between the three subgroups and the control group using a Mann-Whitney test. In addition there were no statistical differences between the three subgroups.

The nasal septal angle as a function of the LM score is presented in Table 2. There is no correlation using the Spearman Rank Correlation test between the severity of sinus disease, as assessed by the ipsilateral LM score and ipsilateral septal deviation at the ostiomeatal complex, as assessed by the nasal septal angle. Conversely, the LM score as a function of NSA in the chronic rhinosinusitis disease group is presented in Tables 3 & 4 and as expected, there is no association between the severity of sinus disease and the severity of septal deformity. This is graphically depicted in Figures 2 and 3. There was no correlation between the NSA and OMC LM score. In addition there was no difference in OMC scores between the three

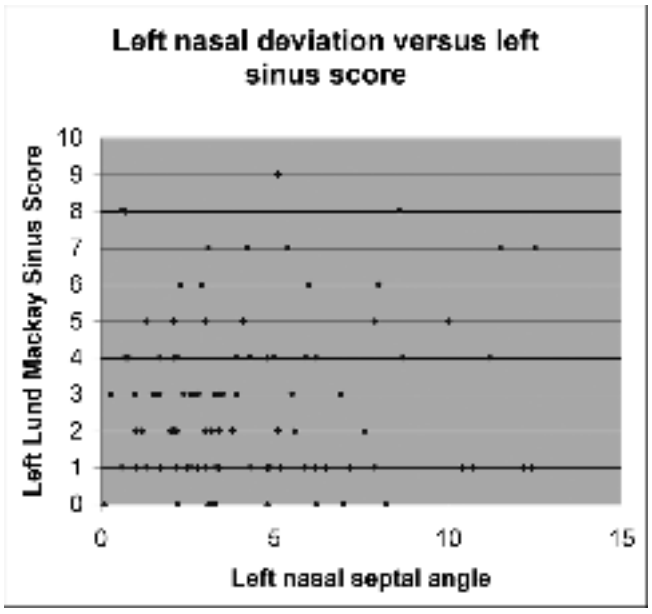

Figure 3. Scatter plot graph of left sided sinus disease in the chronic rhinosinusitis group of patients versus their left sided septal deviation.

groups of septal deviation (mild, moderate and severe) using the Mann-Whitney test.

Ninety patients had higher LM scores on the right side than the left side. In this group, there were 45 patients with nasal deviation to the right and an equal number to the left. The NSA was similar in both groups. The mean NSA was 4.21^0 to the right and 4.26^0 to the left. Sixty five patients had higher LM scores on the left side than the right side. In this group there were 36 patients with nasal deviation to the right and 29 to the left. The mean NSA was 4.57^0 to the right and 4.23^0 to the left. There were 21 patients who had a higher asymmetry of the LM score on the right than the left by 2 points and there were only 7 patients who had the opposite. In these 28 patients there was no statistical correlation between the ipsilateral LM score and the severity of the ipsilateral septal deviation.

DISCUSSION

The majority of the literature would support the role of septal deviation in its effect on OMC obstruction and resultant sinus disease. An increased incidence and severity of sinus disease correlated to an increasing angle of septal deviation in the OMC area is reported by a number of authors (Matschke and Fliebach, 1985; Yousem et al., 1991; Calhoun et al., 1991; Elahi et al., 1997; Elahi and Frenkiel, 2000). Yousem et al. in a series of 100 patients evaluated the morphological features that predispose to sinusitis and concluded that patients with evidence of sinusitis on CT scanning had a higher degree of septal deviation than those without (Yousem et al., 1991). They further showed that the degree of sinusitis was not significantly different ipsilateral and contralateral to the side of the septal deviation. They concluded that nasal septal deviation affected both the ipsilateral and contralateral sinuses without drawing any inferences as to the possible nature of the relationship. Similarly, Calhoun et al. studied the sinus CT scans of patients with sinusitis (n=100) and as a control group used patients with orbital pathology (n=82) (Calhoun et al., 1991). Septal deformity was found in 40% of the rhinosinusitis disease group versus 19.5% of the control group. They also demonstrated a correlation between septal deviation and ethmoid sinus disease and OMC obstruction, although the degree of septal deformity was never quantified. They further documented a significant association with OMC obstruction and ethmoid disease on the side to which the septum deviated, in contradiction to Yousem et al.. Elahi et al. evaluated 122 patients with sinus disease and found a correlation between septal deviation and bilateral sinus disease and contralateral middle turbinate abnormalities and ethmoid bulla prominence (Elahi et al., 1997). In a later similar study, with perhaps the same patient group, Elahi evaluated the sinus CT images of 150 patients with sinusitis and compared that to a control group of 150 patients (Elahi and Frenkiel, 2000). As before, they found an increasing severity of bilateral sinus disease with increasing septal deviations. There was a statistically significant increase in sinus opacification in the ethmoid, maxillary and frontal sinuses with increasing septal deviation. In addition there was a correlation with OMC obstruction and septal deviation. He found a significant increase in middle turbinate and lateral nasal wall abnormalities contralateral to the direction of the septal deviation, which resulted in OMC obstruction and hence accounted for the symmetry of sinus disease. The angle of septal deviation was 8.6° in the disease group and 6.9° in controls, but he does not comment on the significance of this difference. In our study it would appear that in those patients with asymmetry of sinus disease, deviation of the septum to that side was not the case, even in those with a greater asymmetry of disease. In our series sinus disease was nearly symmetrically distributed between the left and right paranasal sinuses.

The findings of our study parallel those of Jones', who found septal deviation in 24% of controls (CT scan done for orbital pathology, n=100) and in 24% of the rhinosinusitis group (n=100) (Jones, 1997). Our study showed no significant difference between the rhinosinusitis group and the control group with regards to septal deviation. Nor were we able to demonstrate a link between the severity of septal deformity at the OMC region and the severity of sinus disease or OMC disease. It may be that there is an association between rhinosinusitis and extreme septal deviation, and we have failed to find an association because the numbers were small in our series, with only 13 patients having a NSA of greater than 10°.

Although in general our radiographers defer scanning patients who have an acute coryzal illness, a possible criticism of our study is the possibility that some of our patients may have had

a recent episode of acute rhinosinusitis, and have been incorrectly labelled into the chronic rhinosinusitis disease group rather than the control group of rhinitis patients. In addition, some bias may be introduced by using a control group of rhinitis patients rather than a sample of the general population. Nevertheless, even if a comparison between the control and disease groups is excluded, we have still demonstrated that a correlation between sinus disease and septal deviation does not exist.

Chronic rhinosinusitis is a group of disorders known to be associated with allergy, asthma, dental disease, nasal polyps, immunodeficiency, mucociliary disorders, trauma, medications, surgery, noxious chemicals and micro-organisms (viral, bacterial and fungal). There are many factors and processes that may play a role in the aetiology of chronic rhinosinusitis. Though we have attempted to recruit a homogeneous group as possible into this study, our series will still contain a group of disorders for whom a single unifying aetiology is probably not possible. There may well be a subgroup of patients for whom septal deviation is a risk factor in the pathogenesis of chronic rhinosinusitis but they would represent the occasional exception. Septal deviation does not lead to stenosis of the ostiomeatal complex and is not a predisposing factor in the pathogenesis of chronic rhinosinusitis. This may be explained by our observation that in general, patients with septal deviation have compensatory ipsilateral atrophy of the middle turbinate, which avoids crowding and stenosis of the OMC.

This is the largest study to date to evaluate the impact of septal deviation at the OMC region and sinus disease. We concluded there is no causal association. However, we have only studied the septum at the OMC, and as mentioned previously there may be an aerodynamic mechanism linking rhinosinusitis and septal deviation. Further studies should use acoustic rhinometry or other objective rhinological measures to assess the impact of the mean total septal deviation on chronic rhinosinusitis.

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Mr. R. P. S. Harar
2 The Boulevard
Manor Rd
Woodford Green IG8 8GW
United Kingdom

E-mail: harar@freenetname.co.uk