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Original Research Article

Association between Mladina septal deviation type and subjective nasal obstruction in adults: a cross-sectional study

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ABSTRACT

Background: Septal deviation is often recorded simply as present or absent, although patients with similar findings report very different symptoms. We assessed whether the endoscopic Mladina deformity type is associated with patient-reported nasal obstruction, and whether it explains symptom burden better than a binary "deviation" label.
Methods: In this cross-sectional study at a secondary care hospital, Mirzapur, Bangladesh (May 2023-April 2025), 236 consecutive adults with nasal symptoms underwent rigid nasal endoscopy and completed the Nasal Obstruction Symptom Evaluation (NOSE) scale. Septa were classified as no deformity or Mladina types 1-7. Groups were compared with Kruskal-Wallis and Dunn tests. Two adjusted linear models, binary deviation (Model A) and Mladina type (Model B), were compared by adjusted R^2, AIC and likelihood-ratio test, and by cross-validated AUC for severe-to-extreme obstruction (NOSE ≥55).
Results: Septal deformity was present in 200 patients (84.7%); type 1 (17.8%) and type 3 (14.4%) were commonest. NOSE scores differed strongly across types ($H=122.7$, $p<0.001$, $\varepsilon^2=0.52$), with the highest medians in types 7 (70) and 4 (65) and the lowest in type 1 (30). Model B explained 23 percentage points more variance than Model A (adjusted R^2 0.545 vs 0.315; ΔAIC 91.2; LR $\chi^2=103.2$, $p<0.001$) and better discriminated severe-to-extreme obstruction (AUC 0.804 vs 0.683; ΔAUC 0.121, 95% CI 0.063-0.180).
Conclusions: Mladina deformity type is strongly associated with subjective nasal obstruction and accounts for symptom burden better than noting a deviation alone. Recording the type may improve clinical assessment.

Keywords: Nasal septum, Nasal obstruction, Mladina classification, NOSE scale, Nasal endoscopy, Patient-reported outcome measures

INTRODUCTION

Deviation of the nasal septum is among the most frequent findings in otorhinolaryngology and is present, to some degree, in most adults.[1,2] It is also the commonest indication for septoplasty. Yet the relationship between the anatomical finding and the patient's complaint is inconsistent: many people with a visibly deviated septum breathe comfortably, while others with apparently minor deformities report marked obstruction.[3,4] Objective airway measures such as rhinomanometry and acoustic rhinometry also correlate only weakly with symptoms, which has shifted attention towards validated patient-reported outcome measures.[4,5]

The NOSE scale is a brief, validated, disease-specific instrument widely used to quantify obstruction and surgical outcomes.[6,7] Severity bands for the NOSE score have been proposed to support clinical decisions.[8] On the anatomical side, routine records often describe the septum only as "deviated" or "straight", sometimes with a side. This binary description discards information on where and how the septum is deformed.

Mladina's classification divides septal deformities into seven types according to the location and shape of the deformity, separating anterior vertical ridges from posterior ridges, S-shaped septa, basal spurs and combined forms.[9,10] It is reproducible, can be applied at

endoscopy and has been used in large multinational series.[2,11] Deformities that narrow the internal nasal valve or contact the lateral wall would be expected to cause more symptoms than those that do not.[12,13] Whether the Mladina type tracks patient-reported obstruction, and whether it adds meaningful information over a simple "deviation present" label, has received little formal study.[10]

We therefore aimed to describe the distribution of Mladina types among adults presenting with nasal symptoms in a secondary-care hospital in Bangladesh, to assess the association between Mladina type and NOSE score, and to test whether the Mladina type explains symptom burden better than a binary deviation label.

METHODS

Study design and setting

This was an observational cross-sectional study conducted in the ENT OPD of a secondary care hospital, Mirzapur, Bangladesh, over 24 months from May 2023 to April 2025. The study was approved by the ethical committee of the participating hospital and conducted according to the Declaration of Helsinki. Written informed consent was obtained from all participants. It is reported according to the STROBE statement for cross-sectional studies.[14]

Participants

Consecutive adults (18-70 years) attending the outpatient clinic with any nasal complaint were screened. Exclusion criteria were previous septal, turbinate or sinonasal surgery; nasal polyposis or sinonasal neoplasm; acute upper respiratory tract infection (URTI) within the preceding 4 weeks; septal perforation; craniofacial anomaly; and an incomplete NOSE questionnaire. Patients with no septal deformity at endoscopy were retained as a reference group.

Sample size

Assuming an effect size (Cohen's f) of 0.28 for differences in NOSE score across eight septal categories, α=0.05 and power of 80%, a minimum of 191 participants was required. Allowing 15% for incomplete or non-evaluable records (191 ÷ 0.85), the target was 225 participants.

Endoscopic assessment and Mladina classification

After topical decongestion with 0.05% oxymetazoline and 4% lidocaine for 10 minutes, rigid nasal endoscopy (0°, 4 mm) was performed in the sitting position and recorded. The septum was classified as no deformity or as one of seven Mladina types: type 1, unilateral vertical ridge in the valve region not disturbing the valve; type 2, unilateral vertical ridge in the valve region that contacts the lateral wall; type 3, unilateral vertical ridge deeper in the cavity opposite the middle turbinate head; type 4, S-shaped septum with ridges on opposite sides; type 5, unilateral basal horizontal spur; type 6, basal spur on one side with a deep gutter on the opposite side; and type 7, combinations not described by types 1-6.[9,10]

Side was recorded as the side of the convexity or spur; types 4 and 6 were recorded as bilateral and as the spur side, respectively, and type 7 according to the dominant component. Inferior turbinate hypertrophy was assessed after decongestion.

All endoscopies were performed by the principal investigator. To maintain blinding, the NOSE questionnaire was completed before endoscopy with a clinic nurse, sealed in an envelope labelled only with the study ID and held by the nurse; Mladina type was entered on a separate form, and the two data sets were linked by a data clerk only after recruitment closed. A second otolaryngologist, blinded to both the first rating and the questionnaire, independently classified recorded videos of every fourth consecutive patient (n=59) to assess inter-rater agreement.

NOSE scale

The five-item NOSE scale asks about congestion, blockage, trouble breathing through the nose, trouble sleeping and difficulty getting enough air during exertion over the previous month.[6] Each item is scored 0-4 and the sum is multiplied by 5 to give a total of 0-100. A Bengali version prepared by forward-backward translation and pilot-tested in 20 patients was used, administered by a trained nurse to patients with limited literacy. Scores were graded as mild (5-25), moderate (30-50), severe (55-75) or extreme (80-100).[8] For binary analyses, NOSE ≥55 was defined as severe-to-extreme obstruction.

Covariates

Age, sex, residence, smoking, allergic rhinitis diagnosed clinically according to ARIA criteria, previous nasal trauma and duration of obstruction were recorded on a structured proforma.[15]

Statistical analysis

Continuous data are presented as mean±standard deviation (SD) or median and interquartile range (IQR), and categorical data as number and percentage. Patients with and without deformity were compared using the t test, Mann-Whitney U test, χ^2 or Fisher's exact test. Because Mladina type is a nominal variable, its relationship with NOSE was expressed as an association rather than a rank correlation. NOSE scores across the eight septal categories, and across types 1-7 only, were compared with the Kruskal-Wallis test, with epsilon-squared (ε^2) as the effect size and Dunn's post hoc test with Bonferroni correction.[16] The binary label was

summarised by a point-biserial correlation. Internal consistency of the NOSE scale was estimated by Cronbach's α, and inter-rater agreement by Cohen's κ.[17]

Two multivariable linear regression models of NOSE total were fitted, each adjusted for age, sex, allergic rhinitis, inferior turbinate hypertrophy and symptom duration (log_2-transformed, so that β represents the change per doubling of duration): Model A included septal deviation present/absent; Model B replaced it with Mladina type (reference: no deformity). Because NOSE is bounded and residual variance was heterogeneous (Breusch-Pagan p=0.005 and 0.038), heteroscedasticity-consistent (HC3) standard errors were used. Residual distribution, influence (Cook's distance) and collinearity (variance inflation factor, VIF) were examined. Models were compared by adjusted R^2, Akaike and Bayesian information criteria (AIC, BIC) and a likelihood-ratio test for nested models. In this cross-sectional design, "explains" and "discriminates" refer to statistical association, not prospective prediction.

For severe-to-extreme obstruction (NOSE ≥55), ridge (L2)-penalised logistic regression on standardised predictors was used, because no patient without deformity reached this threshold (quasi-complete separation). Penalty fixed priori (inverse regularisation strength C=1) and robustness was checked at C=0.1 and 10. Out-of-fold predicted probabilities were obtained by stratified 10-fold cross-validation; AUC for each model and the AUC for each model and the AUC difference were calculated from these predictions, and 95% confidence intervals from 2,000 bootstrap resamples of the out-of-fold predictions calculated from these predictions, and 95% CI from 2,000 bootstrap resamples of out-of-fold predictions. Two-sided p<0.05 was considered significant. There were no missing data among analysed participants; patients with incomplete questionnaires were excluded (complete-case analysis). Analyses used Python 3.12.3 with SciPy 1.17.1, statsmodels 0.15.0, scikit-learn 1.8.0 and scikit-posthocs 0.16.1.

RESULTS

Participants

Of 251 adults screened, 15 were excluded: previous nasal surgery, 5; nasal polyposis or neoplasm, 4; acute URTI within 4 weeks, 2; incomplete questionnaire, 4; septal perforation, 0; craniofacial anomaly, 0. The screening/exclusion flow is not part of the article figures; Figure 1 is the NOSE box plot. The remaining 236 were analysed. Mean age was 38.5±11.1 years (range 18-70) and 140 (59.3%) were male. Septal deformity was present in 200 (84.7%) and absent in 36 (15.3%). Patients with and without deformity were similar in age, sex, residence, smoking, allergic rhinitis and turbinate hypertrophy, but those with deformity had longer symptom duration and higher NOSE scores (Table 1).

Distribution of Mladina types and NOSE scores

Type 1 was the commonest deformity (42, 17.8%), followed by type 3 (34, 14.4%) and type 5 (31, 13.1%); type 4 was least frequent (20, 8.5%) (Table 2). Among the 200 deformities, the convexity or spur was right-sided in 96, left-sided in 75 and bilateral in 29 (all 20 type 4 and 9 type 7 cases). The NOSE scale showed excellent internal consistency (Cronbach's α=0.95). Overall median NOSE was 45 (IQR 30-60); obstruction was mild in 52 (22.0%), moderate in 97 (41.1%), severe in 72 (30.5%) and extreme in 13 (5.5%), and 2 (0.8%) scored zero. Thus 85 patients (36.0%) had severe-to-extreme obstruction. Inter-rater agreement for Mladina type was almost perfect (86.4% agreement; κ=0.84; n=59).

Association between Mladina type and NOSE score

The binary deviation label was moderately associated with NOSE (median 50 vs 17.5; Mann-Whitney p<0.001; point-biserial r=0.50). However, NOSE scores differed substantially among deformity types, with a large effect size (Table 2 and Figure 1). The highest scores were in type 7 (median 70) and type 4 (median 65), in which 72.7% and 75.0% had severe-to-extreme obstruction, followed by type 5 (55; 58.1%) and type 3 (50; 47.1%). Type 1 had low scores (median 30), with severe-to-extreme obstruction in only 4.8%. On post hoc testing, type 1 scores were lower than those of types 3, 4, 5 and 7 (all p<0.001) and type 6 (p=0.021), but not significantly lower than type 2 (p=0.090). Type 2 scores were lower than types 4 (p=0.009) and 7 (p=0.002), and type 6 was lower than type 7 (p=0.027). Types 3, 4, 5 and 7 did not differ significantly from one another.

Mladina type versus a binary deviation label

After adjustment, septal deviation present was associated with a 27.31-point higher NOSE score in Model A. In Model B the adjusted difference varied almost fivefold between types, from 9.42 points for type 1 to 42.37 and 45.43 points for types 4 and 7 (Table 3). Model B explained 23.1 percentage points more of the variance than Model A (adjusted R^2 0.545 vs 0.315), with lower AIC (1948.6 vs 2039.8) and BIC, and the likelihood-ratio test confirmed a significant improvement (χ^2=103.2, df=6, p<0.001). Allergic rhinitis and inferior turbinate hypertrophy were independently associated with higher scores in both models; age, sex and symptom duration were not. Omitting symptom duration did not change model fit (adjusted R^2 0.318 and 0.547). Residuals were approximately normal (skewness=-0.32; Shapiro-Wilk p=0.057), no observation was influential (maximum Cook's distance 0.05), collinearity was low (maximum VIF 1.86), and conclusions were unchanged with conventional standard errors.

For severe-to-extreme obstruction (n=85), the model including Mladina type discriminated better than the binary model (cross-validated AUC 0.804, 95% CI 0.747-

0.857 vs 0.683, 95% CI 0.612-0.754; ΔAUC 0.121, 95% CI 0.063-0.180; p<0.001) (Figure 2). Results were stable across penalty values (Model A 0.683-0.685; Model B 0.798-0.804 for C=0.1 to 10).

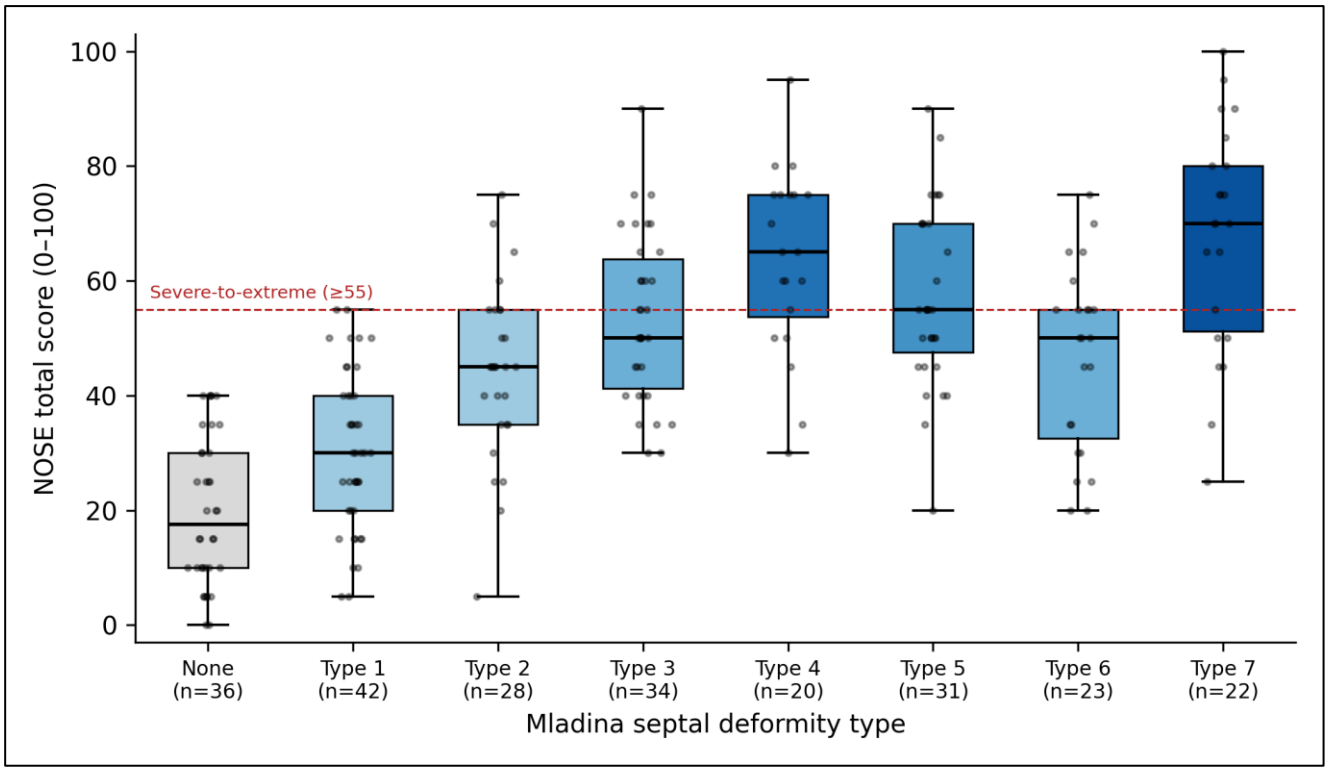

Figure 1: Distribution of NOSE total scores by endoscopic septal category.

*Boxes show median and IQR; whiskers extend to 1.5 × IQR; dots are individual patients. The dashed line marks the threshold for severe-to-extreme obstruction (NOSE ≥55).

Table 1: Baseline characteristics of participants by presence of septal deformity.

Characteristics	All, (n=236)	Deformity, (n=200)	No deformity, (n=36)	P value
Age, (in years), mean±SD	38.5±11.1	38.7±11.3	37.4±10.3	0.514
Sex: Male, n (%)	140 (59.3)	120 (60.0)	20 (55.6)	0.752
Residence: Rural, n (%)	136 (57.6)	117 (58.5)	19 (52.8)	0.648
Smoking: Yes, n (%)	51 (21.6)	42 (21.0)	9 (25.0)	0.751
Allergic rhinitis: Yes, n (%)	76 (32.2)	67 (33.5)	9 (25.0)	0.417
Previous nasal trauma: Yes, n (%)	31 (13.1)	29 (14.5)	2 (5.6)	0.185
Inferior turbinate hypertrophy: Yes, n (%)	72 (30.5)	66 (33.0)	6 (16.7)	0.078
Symptom duration, months, median (IQR)	12.0 (7.0-20.0)	12.0 (8.0-21.0)	7.0 (5.0-13.0)	<0.001
NOSE total, median (IQR)	45.0 (30-60)	50.0 (35-65)	17.5 (10.0-30.0)	<0.001

*Values are mean±SD, n (%) or median (IQR). p values from independent-samples t test, χ^2 or Fisher's exact test, or Mann-Whitney U test. NOSE-Nasal obstruction symptom evaluation.

Table 2: NOSE scores according to endoscopic Mladina septal deformity type.

Septal category	n (%)	NOSE, mean±SD	NOSE, median (IQR)	NOSE ≥55, n (%)
No deformity	36 (15.3)	19.7±12.9	17.5 (10.0-30.0)	0 (0.0)
Type 1	42 (17.8)	30.2±13.7	30.0 (20.0-40.0)	2 (4.8)
Type 2	28 (11.9)	44.1±15.2	45.0 (35.0-55.0)	8 (28.6)
Type 3	34 (14.4)	53.4±14.5	50.0 (41.2-63.8)	16 (47.1)
Type 4	20 (8.5)	63.8±16.2	65.0 (53.8-75.0)	15 (75.0)
Type 5	31 (13.1)	57.1±15.6	55.0 (47.5-70.0)	18 (58.1)
Type 6	23 (9.7)	46.5±16.2	50.0 (32.5-55.0)	10 (43.5)
Type 7	22 (9.3)	67.7±19.9	70.0 (51.2-80.0)	16 (72.7)

*Percentages of n are of the total cohort (n=236); NOSE ≥55 (severe-to-extreme obstruction) percentages are within each category. Kruskal-Wallis across all eight categories: H=122.7, df=7, p<0.001, ε^2=0.52; across types 1-7 only: H=75.8, df=6, p<0.001, ε^2=0.38.

Table 3: Multivariable linear regression of NOSE total score: binary deviation label (Model A) versus Mladina type (Model B).

Variables	Model A β (95% CI)	P value	Model B β (95% CI)	P value
Septal deviation present (vs absent)	27.31 (21.97 to 32.65)	<0.001	-	
Mladina type 1 (vs no deformity)	-		9.42 (3.53 to 15.32)	0.002
Mladina type 2 (vs no deformity)	-		23.21 (15.82 to 30.59)	<0.001
Mladina type 3 (vs no deformity)	-		31.20 (24.83 to 37.56)	<0.001
Mladina type 4 (vs no deformity)	-		42.37 (34.00 to 50.74)	<0.001
Mladina type 5 (vs no deformity)	-		33.76 (26.81 to 40.72)	<0.001
Mladina type 6 (vs no deformity)	-		26.17 (18.54 to 33.81)	<0.001
Mladina type 7 (vs no deformity)	-		45.43 (35.40 to 55.46)	<0.001
Age (per year)	-0.05 (-0.28 to 0.18)	0.682	0.00 (-0.19 to 0.19)	0.989
Male sex	-0.98 (-5.81 to 3.86)	0.692	-1.33 (-5.39 to 2.73)	0.522
Allergic rhinitis	7.02 (1.89 to 12.14)	0.007	7.78 (3.31 to 12.24)	<0.001
Inferior turbinate hypertrophy	11.88 (6.41 to 17.35)	<0.001	6.88 (2.18 to 11.58)	0.004
Symptom duration (per doubling)	0.23 (-1.98 to 2.43)	0.841	0.24 (-1.67 to 2.15)	0.808
R^2 / adjusted R^2	0.332/ 0.315		0.569/ 0.545	
AIC / BIC	2039.8/ 2064.0		1948.6/ 1993.6	
Cross-validated AUC, NOSE ≥55 (95% CI)	0.683 (0.612-0.754)		0.804 (0.747-0.857)	

*β, adjusted difference in NOSE points with HC3 robust 95% CI. Both models adjusted for age, sex, allergic rhinitis, inferior turbinate hypertrophy and $\log_2$ symptom duration. Likelihood-ratio test, model B vs A: χ^2=103.2, df=6, p<0.001. AUC from ridge-penalised logistic models, 10-fold cross-validated, with bootstrap CI of out-of-fold predictions; ΔAUC 0.121 (95% CI 0.063-0.180), p<0.001. AIC, Akaike information criterion; BIC, Bayesian information criterion.

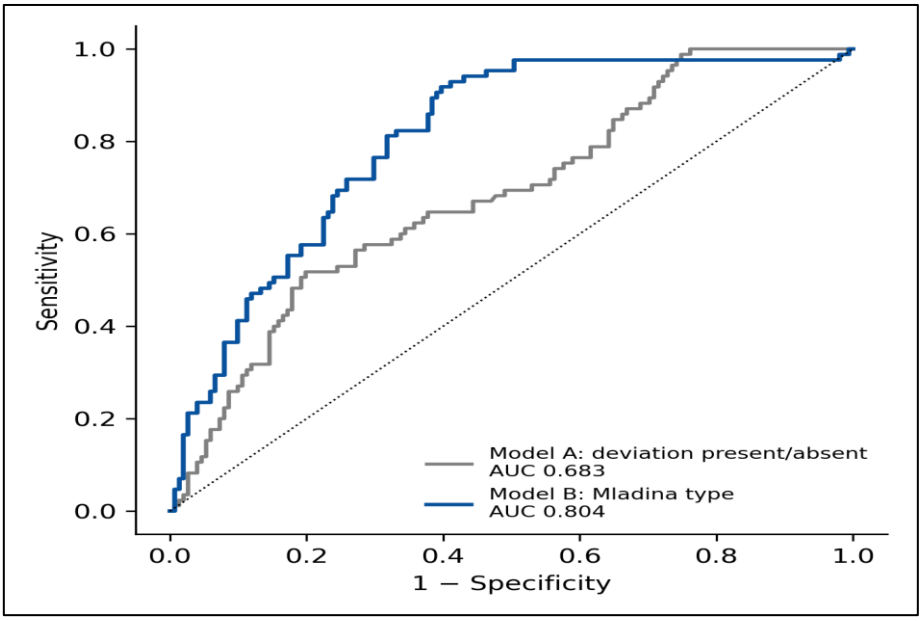

Figure 2: Cross-validated receiver operating characteristic curves for identifying severe-to-extreme nasal obstruction (NOSE ≥55).

*Model A, septal deviation present/absent; Model B, Mladina type. Both adjusted for age, sex, allergic rhinitis, inferior turbinate hypertrophy and symptom duration.

DISCUSSION

In this cross-sectional study of adults with nasal complaints, the endoscopic Mladina type was strongly associated with patient-reported nasal obstruction. More importantly, the type of deformity accounted for symptom burden considerably better than simply

recording that the septum was deviated, explaining 23 percentage points more of the variance in NOSE scores and improving discrimination of severe-to-extreme obstruction.

The gradient across types is anatomically plausible. Type 1 deformities are anterior ridges that do not reach the lateral wall, and patients with them scored only modestly higher than those with a straight septum. Type 2 ridges, which narrow the internal nasal valve, the flow-limiting segment of the airway, were associated with higher scores, although the difference from type 1 was not significant after Bonferroni correction.[12,13] S-shaped (type 4) and combined (type 7) deformities, which narrow both cavities or several levels, carried the heaviest burden, and basal spurs (type 5) were also symptomatic, possibly because of contact with the inferior turbinate. These findings are consistent with the premise underlying Mladina's system that the location and configuration of the deformity, rather than its mere presence, determine function.[9-11]

The weaker performance of the binary label has practical importance. Because type 1 was the commonest deformity, a large share of patients labelled "deviated" had little obstruction, which dilutes the association between deviation and symptoms. This may partly explain why associations between septal findings, objective tests and symptoms have been inconsistent, and why patient-reported benefit after septoplasty varies.[4,5,7,18] A pragmatic randomised trial showed that septoplasty improves patient-reported outcomes on average compared with non-surgical management; better anatomical phenotyping could help identify those most likely to benefit.[18] A standardised classification such as Mladina's, which showed almost perfect inter-rater agreement here, adds little time to routine endoscopy and could be incorporated into clinical records and surgical audit.[2,10]

Allergic rhinitis and inferior turbinate hypertrophy independently increased NOSE scores, reflecting the mucosal component of obstruction.[15,19] Notably, the coefficient for turbinate hypertrophy fell from 11.88 in Model A to 6.88 in Model B, and hypertrophy was more frequent with types 4 and 7 (50.0% each) than without deformity (16.7%). This overlap is consistent with compensatory turbinate hypertrophy accompanying specific septal configurations, so part of the effect attributed to turbinates in the binary model is captured by septal type.[19] Mucosal disease should therefore be assessed and treated alongside septal anatomy.

This study has limitations. First, types 1 and 2 are distinguished partly by whether the ridge disturbs the nasal valve, a functional criterion, so part of the observed gradient is built into the classification itself; this may overstate its independent anatomical value. Second, the study was performed at a single centre, and patients attending with nasal symptoms may not represent the general population. Third, the cross-sectional design shows association but not causation or response to treatment, and the models were not validated in an external cohort. Fourth, objective airway measurements were not performed, and the Bengali NOSE translation, although pilot-tested, has not undergone full psychometric validation. Fifth, one investigator performed all endoscopies; although questionnaires were sealed and linked only after recruitment, a single assessor may introduce classification bias. Finally, some types had small numbers, limiting pairwise comparisons, and type 7 may group heterogeneous anatomy. Strengths include consecutive recruitment, a reference group without deformity, blinded assessment with reliability testing, robust modelling and a direct comparison of the two ways of describing the septum.

CONCLUSION

The Mladina type of septal deformity is strongly associated with patient-reported nasal obstruction and accounts for symptom severity substantially better than recording a deviation as present or absent. Anterior non-obstructing (type 1) deformities are associated with few symptoms, whereas S-shaped, spur and combined deformities are associated with moderate to severe obstruction. Routine documentation of the Mladina type alongside the NOSE score is recommended, and prospective studies should examine whether the type predicts surgical outcome.

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