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ORIGINAL ARTICLE

Comparison of NOSE score, Glasgow Benefit Inventory, and acoustic rhinometry outcomes between young and middle-aged septoplasty patients

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ABSTRACT

Objectives: The aim of this study was to compare symptom improvement, objective nasal airflow changes, and quality of life (QoL) benefits following septoplasty between young and middle-aged adults.

Patients and Methods: Between December 2015 and May 2016, a prospective cohort analysis was performed on 56 patients who underwent septoplasty for nasal septal deviation. Participants were categorized into two groups according to their age: the young adult group (24 males, 6 females; mean age: 27.4±6.5 years; range, 18 to 40 years) and the middle-aged group (18 males, 8 females; mean age: 47.3±5.5 years; range, 41 to 60 years). Nasal obstruction was evaluated using the Nasal Obstruction Symptom Evaluation (NOSE) scale and acoustic rhinometry, including the measurement of minimal cross-sectional area and nasal volume. Quality of life was assessed preoperatively and two months postoperatively using the Glasgow Benefit Inventory (GBI). Outcomes were compared within and between groups, and correlations between symptom improvement and QoL were analyzed.

Results: Both groups demonstrated a marked reduction in NOSE scores (~80→~9; $p < 0.001$) with no significant between-group differences. Acoustic rhinometry confirmed postoperative enlargement of nasal cavities in both cohorts, and the overall percent changes did not differ by age. The GBI scores indicated improved QoL for all patients, with overall scores of +64.6 in the young groups compared with +51.9 in the middle-aged group, with significantly greater gains for younger adults in overall, psychological, and social domains ($p < 0.05$). Symptom improvement correlated positively with QoL ($\rho \approx 0.45$-0.58; $p < 0.001$).

Conclusion: Septoplasty significantly improves nasal breathing and QoL across all adult age groups. Younger patients may report greater subjective benefit, but age alone does not diminish surgical success.

Keywords: Acoustic rhinometry, Glasgow benefit inventory, nasal obstruction symptom evaluation, quality of life, septoplasty.

Nasal obstruction is one of the most common complaints in otolaryngology practice.[1] A deviated nasal septum is a major cause of chronic nasal blockage, often leading to mouth breathing, congestion, disturbed sleep, and reduced quality of life (QoL). Septoplasty, which is the surgical correction of the deviated septum, is the definitive treatment for nasal airway obstruction due to septal deviation

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and is performed frequently worldwide. By restoring a more open nasal passage, septoplasty aims to improve airflow and relieve symptoms of congestion and difficulty breathing.[2]

Septoplasty outcomes should be assessed using both objective and subjective measures. Objective measures of nasal patency include acoustic rhinometry and rhinomanometry, which quantify intranasal cross-sectional area and airflow resistance. Acoustic rhinometry is a noninvasive and reproducible method that provides values for minimal cross-sectional area (MCA) and nasal cavity volumes, and septoplasty generally produces significant postoperative improvements in objective nasal airflow parameters.[3,4] However, objective measurements do not always mirror patient-reported symptom relief, highlighting the need to interpret objective and subjective outcomes together.[5]

Patient-reported outcome measures (PROMs) are therefore crucial for assessing the clinical benefit of septoplasty. The Nasal Obstruction Symptom Evaluation (NOSE) scale is a validated, disease-specific instrument that quantifies the severity of nasal obstruction symptoms on a 0-100 scale.[6] To evaluate broader QoL change after intervention, we used the Glasgow Benefit Inventory (GBI), a validated post-interventional questionnaire designed for otolaryngologic procedures.[7] The GBI measures change in health status after an intervention across general, social support, and physical health domains and yields a total score from –100 (maximal harm) to +100 (maximal benefit).[8]

Whether patient age modifies septoplasty benefit remains incompletely defined. Aging is associated with structural and functional nasal changes, such as reduced cartilage elasticity and changes in nasal valve mechanics, and older patients may have slower wound healing and more comorbid conditions that could influence recovery and satisfaction.[9,10] In this prospective study, we compared young adults (18-40 years) and middle-aged adults (41-60 years) to assess postoperative symptom relief using the NOSE scale, objective nasal airway measurements via acoustic rhinometry, and changes in QoL measured by the GBI. We aimed to clarify whether middle-aged patients benefit to the same extent as younger patients and to inform age-appropriate counseling.

PATIENTS AND METHODS

Study design and patients

This prospective observational cohort study was conducted at Şişli Hamidiye Etfal Training and Research Hospital, Department of Otorhinolaryngology between December 2015 and May 2016. A total of 56 participants who underwent surgical treatment for nasal septal deviation were included in the study and divided into two age-based groups: the young adult group (24 males, 6 females; mean age: 27.4±6.5 years; range, 18 to 40 years) and the middle-aged group (18 males, 8 females; mean age: 47.3±5.5 years; range, 41 to 60 years). Inclusion criteria were age 18-60 years, nasal septal deviation associated with clinically significant nasal obstruction, and candidacy for septoplasty after clinical evaluation. All patients had chronic nasal obstruction refractory to medical management, including the use of topical steroids or decongestants. Exclusion criteria were prior septal surgery, nasal polyps or significant chronic rhinosinusitis, severe uncontrolled allergic rhinitis, and planned concurrent nasal surgery such as rhinoplasty or sinus surgery. Patients with comorbidities were assessed individually; only those with well-controlled conditions and no expected impact on healing were included. Written informed consent was obtained from all participants. The protocol was approved by the Şişli Hamidiye Etfal Training and Research Hospital Ethics Committee (Date: 08.12.2015, Approval No: 575). The study was conducted in accordance with the Declaration of Helsinki (2013 revision). As no randomized/interventional protocol was used, clinical trial registration was not required.

Baseline characteristics, including preoperative NOSE scores, were recorded; baseline symptom severity was comparable between age groups.

Surgical procedure

All patients underwent septoplasty under general anesthesia by experienced otolaryngology surgeons using a standard technique, consisting predominantly of submucosal resection or the Cottle technique via a hemitransfixion incision. After local anesthetic/vasoconstrictor infiltration, mucoperichondrial flaps were elevated; deviated cartilage/bone and spurs were selectively removed or repositioned while preserving an L-strut. Cartilage scoring/splinting was performed when needed to achieve midline alignment. Limited inferior turbinate management, including out-fracture or submucous reduction, was performed at the surgeon's discretion when turbinate hypertrophy was judged contributory; no aggressive turbinate procedures were performed. The incision was closed with absorbable sutures. Internal nasal splints were used in most patients for approximately seven days, while nasal packing was applied selectively and removed within one to two days. Standard postoperative care included

saline irrigations and routine medications as needed. No intraoperative or immediate postoperative complications occurred. Specifically, there were no instances of septal hematoma or acute infection.

Outcome measures and follow-up

Assessments were performed preoperatively and at two months postoperatively:

NOSE scale: Five items scored 0-4 (raw total 0-20), multiplied by 5 to yield 0-100; higher scores indicate worse obstruction. The NOSE score was recorded at baseline and at two months. Greater reductions reflected greater symptomatic improvement, as shown in supplementary file 1.

Acoustic rhinometry: Measurements were obtained using the RhinoScan SRE2000 (RhinoMetrics, Interacoustics A/S, Assens, Denmark). For each nasal cavity, MCAs were recorded for 0-2.2 cm (MCA1; nasal valve region) and 2.2-5.4 cm (MCA2; anterior/middle region), along with volumes over the same segments (Vol1 and Vol2). Measurements were performed seated with a neutral head position, mouth breathing, a well-fitted nosepiece, and repeated recordings until stable tracings were obtained. Baseline testing was performed 1-2 weeks preoperatively; postoperative testing at two months used the same protocol, at similar times of day, and without decongestants to reduce mucosal variability.

Glasgow benefit inventory: At two months, patients completed the 18-item GBI assessing perceived change after surgery, including total benefit as well as general, physical health, social support, and total. Scores range

Table 1. Baseline characteristics by age group

Characteristic	Young (18-40) (n = 30)			Middle-aged (41-60) (n = 26)			*p*
	n	%	Mean±SD	n	%	Mean±SD	
Age (year)			27.4±6.5			47.3±5.5	< 0.001
Sex							
Male	24	80.0		18	69.2		
Female	6	20.0		8	30.8		
Baseline NOSE score (0–100)			82.5±12.2			78.7±14.4	0.337
Baseline acoustic rhinometry-left side							
MCA1 (cm^2)			0.97±0.15			0.88±0.27	0.210
Vol1 (0-2.2 cm, cm^3)			2.44±0.29			2.23±0.34	0.026
MCA2 (2.2-5.4 cm, cm^2)			0.79±0.56			0.67±0.20	0.500
Vol2 (2.2-5.4 cm, cm^3)			3.08±0.49			3.09±0.67	0.538
Baseline acoustic rhinometry-right side							
MCA1 (cm^2)			0.94±0.21			0.90±0.24	0.385
Vol1 (0-2.2 cm, cm^3)			2.31±0.32			2.31±0.33	0.379
MCA2 (2.2-5.4 cm, cm^2)			0.62±0.28			0.73±0.51	0.605
Vol2 (2.2-5.4 cm, cm^3)			2.95±0.58			3.18±0.73	0.201

SD, standard deviation; NOSE: Nasal Obstruction Symptom Evaluation; MCA, minimal cross-sectional area; Vol., volume.

Table 2. NOSE scores preoperative versus postoperative by age group (2-month follow-up)

Measure	Young (18-40) (n = 30)	Middle-aged (41-60) (n = 26)	*p*
	Mean±SD	Mean±SD	
Preoperative NOSE (0-100)	82.5±12.2	78.7±14.4	0.337
Postoperative NOSE (0-100)	9.0±13.6	8.8±14.2	0.993
Change (ΔNOSE)	–73.5±17.8	–69.8±18.8	0.473
Within-group change, *p*-value (pre *vs.* post)	<0.001	<0.001	

ΔNOSE, postoperative minus preoperative (negative values indicate improvement); SD, standard deviation.

Table 3. Comparison of preoperative and postoperative acoustic rhinometry values between young (18-40) and middle-aged (41-60) septoplasty patients

Parameter (side)	Young pre-op	Young post-op	Within-group (Young)	Middle-aged pre-op	Middle-aged post-op	Within-group (Middle-aged)	Between-group (Δ change)
	Mean±SD	Mean±SD	*p*	Mean±SD	Mean±SD	*p*	*p*
MCA1 (cm^2), left	0.97±0.15	1.01±0.03	0.193	0.88±0.27	1.01±0.03	0.021	0.315
Vol1 (0-2.2 cm, cm^3), left	2.44±0.29	2.41±0.08	0.959	2.23±0.34	2.39±0.07	0.100	0.170
MCA2 (2.2-5.4 cm, cm^2), left	0.79±0.56	0.67±0.20	0.365	0.67±0.20	0.71±0.18	0.415	0.233
Vol2 (2.2-5.4 cm, cm^3), left	3.08±0.49	3.02±0.50	0.403	3.09±0.67	3.15±0.51	0.700	0.993
MCA1 (cm^2), right	0.94±0.21	1.02±0.04	0.026	0.90±0.24	1.01±0.03	0.127	0.645
Vol1 (0-2.2 cm, cm^3), right	2.31±0.32	2.41±0.07	0.044	2.31±0.33	2.39±0.07	0.732	0.247
MCA2 (2.2-5.4 cm, cm^2), right	0.62±0.28	0.71±0.23	0.067	0.73±0.51	0.70±0.25	0.457	0.384
Vol2 (2.2-5.4 cm, cm^3), right	2.95±0.58	3.14±0.44	0.057	3.18±0.73	3.28±0.64	0.534	0.393

SD, standard deviation; MCA, minimal cross-sectional area; Vol., volume; "Between-group *p* (Δ change)" compares the pre-to-post difference between age groups; Units: MCA in cm^2, Vol in cm^3.

from −100 to +100, with positive values indicating benefit, as shown in supplementary file 2.[7,8]

Routine postoperative visits occurred at one week, one month, and two months, at which point the final assessment was conducted. The 2-month time point was selected since prior work suggests obstruction-related PROMs stabilize after the early postoperative phase.[11]

Statistical analysis

Analyses were performed using IBM SPSS Statistics for Windows, version 22.0 software (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean ± standard deviation (SD); categorical variables as counts/percentages. Within-group pre-post comparisons used paired t-tests or Wilcoxon signed-rank tests as appropriate. Between-group comparisons used independent-samples t-tests for continuous variables and chi-square tests for categorical variables. The GBI scores (total and subscales) were compared between groups using t-tests. Statistical significance was set at $p < 0.05$ (two-tailed).

Correlation analyses assessed relationships between symptom change (ΔNOSE) and GBI total/subscales, and between acoustic rhinometry changes and GBI outcomes using Spearman rank correlation coefficients (ρ).

RESULTS

All 56 patients completed the two-month follow-up. Baseline symptom severity was high and similar between groups, as shown in Table 1. The mean preoperative NOSE score was 82.5±12.2 (18-40 group) and 78.7±14.4 (41-60 group) ($p = 0.337$). Baseline acoustic rhinometry was also broadly comparable, with one difference: left Vol1 was slightly larger in the younger group (2.44±0.29 cm^3 versus 2.23±0.34 cm^3; $p = 0.026$).

Both age groups demonstrated large, clinically meaningful improvement (within-group $p < 0.001$). The NOSE scores decreased from 82.5±12.2 to 9.0±13.6 in the younger cohort and from 78.7±14.4 to 8.8±14.2 in the middle-aged cohort. There were no between-group differences in postoperative NOSE scores ($p = 0.993$) or change scores (ΔNOSE −73.5±17.8 *vs.* −69.8±18.8; $p = 0.473$), as shown in Table 2.

Postoperatively, cross-sectional areas and volumes generally increased in both cohorts, as shown in Table 3 and Figure 1. In the 18-40 group,

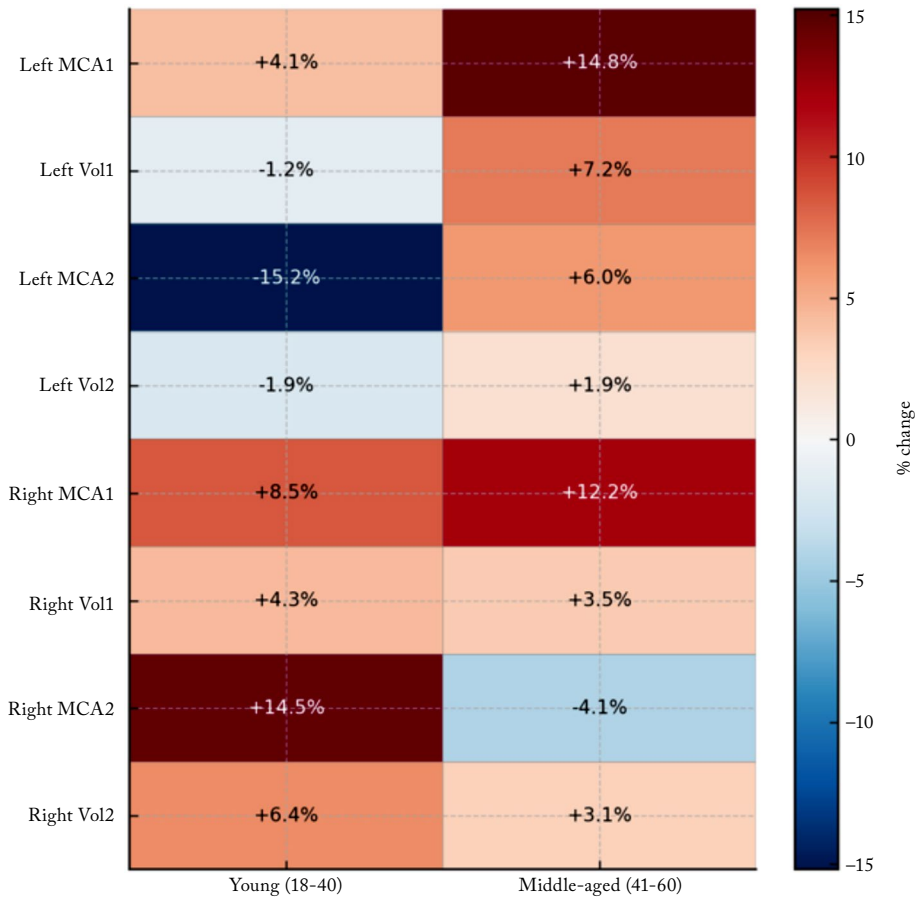

Figure 1. Percent change in acoustic rhinometry after septoplasty (positive = increase in area/volume).
MCA, minimal cross-sectional area; Vol., volume.

right MCA1 increased significantly (0.94±0.21 to 1.02±0.04 cm^2; p = 0.026), and right Vol1 increased (2.31±0.32 to 2.41±0.07 cm^3; p = 0.044). Left-sided changes were favorable but not significant (e.g., left MCA1 0.97→1.01 cm^2; p = 0.193). In the 41-60 group, left MCA1 increased significantly (0.88±0.27 to 1.01±0.03 cm^2; p = 0.021), while other parameters improved in mean without statistical significance (e.g., right MCA1 p = 0.127). Between-group comparisons of absolute and percent changes revealed no significant differences for any acoustic parameter.

All patients completed the GBI at two months. Both groups reported net positive benefit, with higher scores in the younger cohort for several domains. The GBI total was +64.6±25.3 (18-40) *vs.* +51.9±18.3 (41-60) (p = 0.038). The general subscale was +67.1±25.7 *vs.* +52.9±17.8 (p = 0.022), and social support was +63.3±34.9 *vs.* +44.9±26.6 (p = 0.011). Physical health scores were +56.1±27.2 *vs.* +41.7±27.6 and did not reach significance (p = 0.062). All domain means were positive in both cohorts, as shown in Figure 2.

Greater NOSE improvement correlated with higher overall perceived benefit. ΔNOSE correlated with GBI Total ($\rho \approx 0.46$, $p < 0.001$), and also with GBI psychological ($\rho \approx 0.46$, $p < 0.001$) and physical subscale scores ($\rho \approx 0.58$, $p < 0.001$), as shown in Table 4. The correlation with social support was positive but not significant ($\rho \approx 0.24$, p = 0.078). Among acoustic measures, left Vol2 change demonstrated a mild correlation with social support ($\rho \approx 0.45$, p = 0.031), while most other acoustic changes were not strongly correlated with GBI.

No major complications occurred during follow-up, including septal perforation, significant delayed bleeding, or infection. Two patients (one per group) had minor residual spurs without meaningful symptoms or early revision. One middle-aged patient experienced temporary dryness/crusting that resolved

Table 4. Correlations of GBI domains with symptom (absolute difference, pre-post Δ)

	GBI general		GBI psychological		GBI social support		GBI physical		NOSE	
Variables	ρ	*p*	ρ	*p*	ρ	*p*	ρ	*p*	ρ	*p*
NOSE	0.458	< 0.001*	0.456	< 0.001*	0.237	0.078	0.577	<0.001*	-	-
Left MCA1	0.051	0.709	0.035	0.798	0.203	0.134	0.000	0.998	0.096	0.482
Left Vol1	0.057	0.675	0.049	0.721	0.215	0.112	0.025	0.856	0.022	0.874
Left MCA2	0.349	0.008*	0.389	0.003*	0.406	0.002*	0.082	0.549	−0.016	0.909
Left Vol2	0.094	0.492	0.227	0.103	0.449	0.031*	−0.002	0.987	−0.007	0.959
Right MCA1	0.000	0.999	−0.027	0.842	0.133	0.329	−0.047	0.731	0.078	0.568
Right Vol1	0.014	0.918	−0.040	0.772	0.127	0.352	−0.028	0.837	0.038	0.782
Right MCA2	−0.146	0.283	−0.175	0.197	0.012	0.929	−0.062	0.651	0.012	0.933
Right Vol2	−0.099	0.467	−0.167	0.219	0.006	0.966	0.049	0.720	0.036	0.792

GBI, Glasgow Benefit Inventory; NOSE: Nasal Obstruction Symptom Evaluation; MCA, minimal cross-sectional area; * Statistically significant values are indicated.

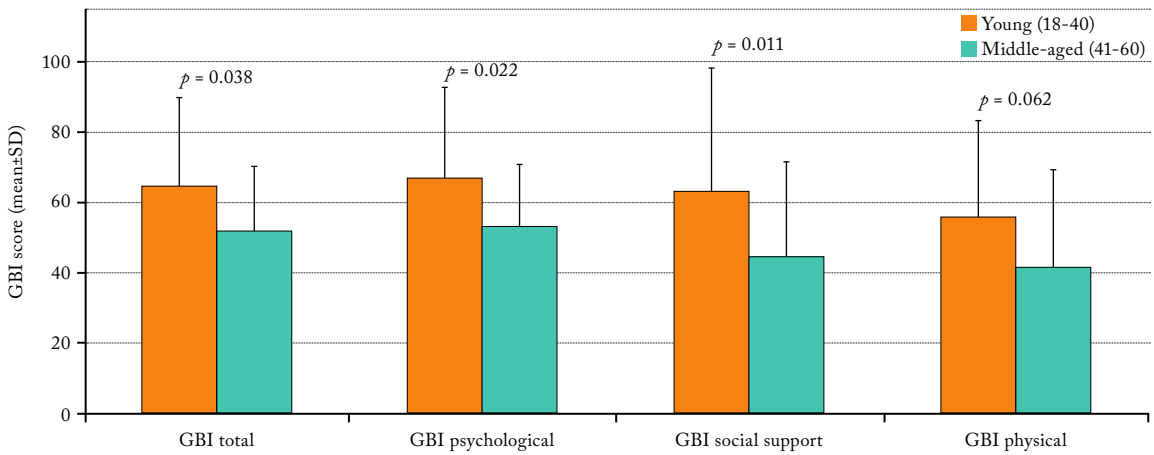

Figure 2. GBI outcomes by age group (higher = greater benefit). Bars show mean±SD for total, psychological, social support, and physical domains.

GBI, Glasgow Benefit Inventory; SD, standard deviation.

with saline irrigations. Overall, safety outcomes were comparable between cohorts.

DISCUSSION

Our findings demonstrate that septoplasty is highly effective in relieving nasal obstruction and improving QoL in both age groups, with no significant differences in the degree of objective or subjective nasal breathing improvement between young and middle-aged patients. However, we did observe that younger patients reported somewhat greater gains in certain QoL domains (notably general and social functioning) compared to their middle-aged counterparts. These results provide nuanced insight into the role of age: physiologically, septoplasty benefits appear to be age-independent, but perceptually, older patients may not experience the same magnitude of life improvement despite equal symptom relief.

The equivalence of symptom outcomes across ages is an important finding. In our cohort, both younger and middle-aged patients presented with severe baseline obstruction (mean NOSE ≈ 80) and achieved impressive reductions to single-digit scores postoperatively, reflecting a transition from near-constant nasal blockage to minimal symptoms. The ~70-75-point improvement we observed is among the largest reported in the literature, likely owing to our patients' high initial symptom burden. Recent prospective series in similarly symptomatic populations

have documented comparable benefits, with NOSE scores falling from the mid-80s preoperatively to single digits within 3-6 months after surgery.[12] By contrast, Stewart et al.'s[13] multicenter NOSE study reported mean NOSE scores improving from ~68 preoperatively to ~23 at three months post-septoplasty ($p < 0.0001$), with this improvement maintained at six months, indicating durable symptom relief.

Our objective measurements further support the consistency of surgical success across ages. Septoplasty produced significant increases in nasal valve area and cavity volume as measured by acoustic rhinometry in both groups. While the younger group demonstrated statistically significant improvements on the deviated side (e.g., right MCA1, Vol1) and the older group on their deviated side (e.g., left MCA1), ultimately both groups experienced roughly comparable net gains in airway caliber. The inherent variability of acoustic measurements and individual anatomy can make it challenging to demonstrate significance in every parameter, especially with modest sample sizes. Nonetheless, the trend was clear that nasal airflow geometry improved postoperatively in essentially all patients, young or old. This is in line with numerous studies that have documented objective nasal patency improvements after septoplasty. A recent systematic review of septoplasty outcomes noted that when objective measures such as acoustic rhinometry, rhinomanometry, and peak inspiratory flow are used, a significant improvement is usually confirmed post-surgery.[14] That said, there is anatomical and histological evidence suggesting that septal cartilage undergoes age-related changes, such as decreased cartilage proportion due to ossification and reduced chondrocyte and glycosaminoglycan content, which could theoretically reduce its flexibility or remodeling capacity.[15,16] However, our data suggest that up to age 60, the cartilage remains sufficiently responsive to surgical correction.

The more intriguing difference we found lies in the patient-reported QoL benefit, as captured by the GBI. Younger patients consistently gave higher ratings for how the surgery improved their life overall, their sense of well-being, and their social interactions. Middle-aged patients certainly benefited, as shown by a mean GBI > +50, which indicates a substantial positive change; however, this benefit was less pronounced on average compared to the younger cohort. The literature on age-related septoplasty outcomes remains mixed. A large retrospective analysis from the Swedish National Septoplasty Register reported that higher age was associated with slightly greater odds of reporting a successful outcome, suggesting that older patients may benefit at least as much as younger individuals.[17] In contrast, Habesoglu et al.[18] documented that patients over 60 had significantly lower GBI scores than those under 40, despite similar NOSE improvements. Together, these findings highlight a possible discrepancy: septoplasty appears objectively effective across age groups, yet patient-reported satisfaction may decline with increasing age, underscoring the need for further research in middle-aged patients, who comprise a substantial portion of those undergoing septoplasty. In their study, the mean GBI general score was 37 in the older group versus 52 in the younger group, a gap of 15 points. Our study found a slightly larger gap (~13 points in total GBI, ~14-18 points in subdomains) between ages 41-60 and 18-40, which might indicate that even by middle age, some decline in perceived benefit emerges. A recent 2021 study by Corredor-Rojas et al.[8] evaluated septoplasty outcomes with both NOSE and GBI one year postoperatively (mean patient age 37) and found that about 75% of patients improved in NOSE and had positive GBI. They noted an inverse correlation between NOSE and GBI, essentially, better symptom relief is related to higher QoL improvement. Our data agree with that correlation and further highlight that a subset of patients (more often older) may report less dramatic QoL changes even when symptoms improve. In the Corredor-Rojas study, interestingly, they found that while 75% had improved QoL, 25% did not, which might correspond to those with only mild baseline symptoms or other factors dampening their satisfaction. The Nordic Septoplasty Registry data also show that around 63% of patients report subjective improvement at 12 months, with success strongly tied to the severity of baseline obstruction.[14] Those with mild preoperative symptoms often do not feel much better (only ~31% improved if obstruction was mild versus 81% improved if severe). In our study, all patients had severe symptoms initially, which likely contributed to the uniformly high symptom relief and high satisfaction rates in both groups. Yet, even within severe cases, older patients reported a bit less benefit.

There are several possible explanations for why middle-aged patients might report lower GBI improvements. The aging process involves changes in the nose that septoplasty alone may not fully address. For example, older patients often have weaker nasal valve support and may suffer from nasal valve collapse or external nasal deformities, such as ptosis of the nasal tip or weakened cartilage structures.[19] Septoplasty corrects the septum but does not reinforce the nasal valves unless additional procedures (valve grafts) are done. If an older patient has a component of nasal

valve collapse, they might continue to experience some nasal breathing difficulty, especially during deep inspiration or exercise, hence perceiving less total benefit. Additionally, older individuals have drier nasal mucosa and diminished mucociliary function, which can cause persistent symptoms like crusting or congestion unrelated to septal deviation. Such issues could reduce the subjective improvement noted on GBI's physical domain, for instance.

Younger patients may derive more social and psychological benefit from improved nasal breathing as it can enhance exercise capacity, sleep quality, daytime alertness, and confidence in social interactions, particularly by reducing self-consciousness related to mouth-breathing or a hyponasal voice. These improvements can translate to feeling more energetic, outgoing, and supported, as reflected in higher social and psychological domains of the GBI.[8,20] In contrast, middle-aged patients, while certainly valuing better breathing, may experience septoplasty in a different lifestyle context; some may have already adapted their activities around long-standing nasal obstruction or may have concurrent health concerns that limit the full enjoyment of an improved airway. Older patients may also approach surgery with tempered expectations or a different frame of reference: what a younger patient describes as a "great" improvement might be perceived as only "moderate" by someone with different life priorities. Evidence suggests that patient expectations and baseline QoL scores strongly influence postoperative satisfaction. A patient in mid-life who has endured obstruction for decades may report feeling better but not "life-changingly" so, whereas a younger patient might experience septoplasty as a transformative event that restores normal sleep and exercise capacity for the first time in memory.

That said, it is crucial to emphasize that middle-aged patients still benefited greatly in our study. Their mean GBI overall score of +52 corresponds to a considerable positive change in life quality. In practical terms, most middle-aged patients reported better sleep, reduced daytime fatigue, less need for oral breathing, and improved ability to partake in activities, all of which are direct clinical outcomes of better nasal airflow. The differences we observed suggest a matter of degree rather than a dichotomy: younger patients tended to be more enthusiastic about the results. For clinicians, this finding underscores the importance of managing expectations and addressing any additional issues in older patients. For example, if subtle residual nasal valve collapse is present, incorporating adjunctive techniques such as a spreader graft or alar batten graft during septoplasty can further improve outcomes. These maneuvers are well recognized for reinforcing the internal and external nasal valves and have been shown to significantly enhance both airflow and patient-reported satisfaction, particularly in patients with persistent obstruction after standard septoplasty.[3] Ensuring that older patients have realistic expectations, specifically that septoplasty will improve breathing without necessarily eliminating all nasal aging changes, such as dryness or the continued need for saline sprays, can help achieve high satisfaction. Our data can reassure surgeons and patients that an age of up to 60 by itself is not associated with failure of septoplasty; both groups got to a NOSE of ~9, which is an excellent outcome. The slightly lower GBI in older patients is not a sign of surgical failure but perhaps a call to provide comprehensive care and support, including the treatment of concurrent rhinitis and counseling on nasal valve issues.

Our correlation analysis adds to evidence that subjective and objective outcomes in septoplasty are related but not perfectly. We observed strong associations between symptom improvement, as measured by the NOSE scale, and QoL gains, which are reflected in the GBI scores, aligning with the pattern noted in recent cohorts evaluating postoperative NOSE/GBI alongside QoL instruments.[8] In contrast, links between objective patency metrics such as acoustic rhinometry, rhinomanometry, and peak nasal inspiratory flow and patient-perceived benefit are often weaker or inconsistent, with several studies and reviews showing only modest or absent correlations.[21] At the same time, randomized and observational data consistently show that septoplasty improves patient-reported outcomes overall, even if the correlation between objective and subjective findings is not perfectly aligned.[22] Part of this is due to measurement limitations, as acoustic rhinometry captures anatomical space, whereas nasal patency perception also depends on dynamic airflow and mucosal factors, which rhinometry doesn't directly measure.[4]

Additionally, patients' sensation of airflow can plateau; once a clinically important threshold of improvement is crossed, extra anatomical gain often yields little extra perceived benefit. This observation is consistent with the concepts of minimal clinically important difference and desirable clinically important difference in nasal airway surgery, which define the smallest and the preferred magnitudes of patient-perceived improvement, respectively.[23] Thus,

while those with the largest MCA/volume gains tend to be pleased, a patient with a moderate but clinically meaningful gain may be just as satisfied if symptoms are resolved. Mechanistically, perception of patency depends more on mucosal cooling/airflow distribution than on area alone, explaining why larger geometric increases don't always feel better once a threshold is met.[24]

Therefore, use both objective and subjective tools: objective measures verify that surgery achieved its anatomical goal, while PROMs such as the NOSE scale and GBI determine whether that change translated into patient benefit, which is the true measure of success.

Most large septoplasty studies do not stratify outcomes by age, but available data support high overall effectiveness when patients are appropriately selected. Registry data and reviews suggest roughly two-thirds to three-quarters of adults are satisfied at one year.[14] Our high short-term success likely reflects severe baseline obstruction and a two-month follow-up, when benefit is clear and late issues are less likely to emerge. The first randomized controlled trial comparing septoplasty with continued medical management reported superior improvement with surgery.[25] A recent Saudi cohort using GBI found high overall improvement with lower rates in social/physical domains, mirroring our observation that general benefit is near-universal while broader lifestyle changes vary by patient context.[7]

The present study has several strengths and limitations. A primary strength is the comprehensive approach to outcomes, combining subjective symptom scoring, objective measurements, and QoL assessment, which provides a multi-dimensional view of septoplasty results. By prospectively enrolling patients and using the same evaluation timeline, we minimized recall bias in GBI (administered relatively soon after surgery, so patients clearly remember pre-op status). Furthermore, our focus on a clearly defined "middle-aged" group (up to 60) addresses a gap between the typically studied extremes (young adults and seniors > 65).

However, certain limitations must be acknowledged. The relatively short follow-up period of two months may not fully capture the long-term trajectory of patient satisfaction, as differences between age groups could potentially widen or narrow after one year. For instance, some older patients might appreciate the benefits more over time, or conversely, late issues such as oronasal dryness could emerge in others. Long-term follow-up periods, such as six to 12 months, would strengthen these conclusions. Another limitation is the sample size; with 26 patients in the older group, our power to detect small differences was limited. Additionally, our cohort was predominantly male (42/56, 75%), which may limit generalizability and preclude robust assessment of potential sex-specific differences in septoplasty outcomes. While the differences observed in GBI scores were significant, a larger study might reveal more subtle age-related effects, such as variations in complication rates or specific symptom subdomains like the sense of smell, which were not measured in this study. Furthermore, our study was conducted at a single tertiary center, and the surgical technique was not randomized; however, all surgeons followed standard septoplasty methods, and there was no indication that the technique varied systematically with patient age. We also did not formally quantify concurrent conditions such as allergic rhinitis, a factor that could potentially influence outcomes. We tried to exclude severe cases of rhinitis, but minor allergic symptoms were not grounds for exclusion, so some patients, particularly in the younger cohort, where allergies are more prevalent, may have had persistent rhinitis symptoms that could have slightly affected their NOSE or GBI. Ideally, future studies would stratify by allergy status or treat allergies in parallel to isolate the effect of septoplasty. Finally, while the GBI is a valuable general instrument, it may not fully capture the nasal-specific QoL aspects such as nasal cosmesis. In our study, septoplasty was functional (not cosmetic), so we did not assess aesthetic outcomes. However, a deviated septum can cause external nasal deviation; we did not measure patient satisfaction with nasal appearance, which could conceivably differ by age (younger patients might care more about cosmesis). We focused on function; a more holistic study could include an appearance score or rhinoplasty outcomes for those who had combined septorhinoplasty.

Age up to 60 should not be considered a deterrent to septoplasty: middle-aged patients can expect symptom relief and objective benefit comparable to younger adults. The slightly lower subjective benefit underscores the value of counseling about expected gains and proactively identifying additional contributors, such as nasal valve collapse, which may merit concurrent treatment.

Future work should extend comparisons to patients >60, examine whether adjunctive procedures, including turbinoplasty or nasal valve repair, preferentially improve satisfaction in older groups, and incorporate longer follow-up and larger cohorts (including allergy-status stratification). Registry

analyses may also clarify whether age predicts revision rates or long-term patient-rated success.

In conclusion, septoplasty reliably improves nasal airflow and QoL in adults aged 18-60. Objective and symptom outcomes improved substantially and comparably across age groups; age did not attenuate the physiological benefit. While younger patients reported modestly greater psychosocial gains, and middle-aged patients still achieved meaningful clinical improvement; therefore, age alone should not be a deterrent to surgery. Aligning expectations and addressing coexisting factors, such as nasal valve insufficiency, may further enhance satisfaction, particularly in older individuals. Larger, longer-term studies including cohorts > 60 years and assessments of adjunctive techniques are warranted.

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