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IDEAS AND INNOVATIONS

Reconstructive

Patient Outcomes following Septoplasty in Patients with Attention-deficit/Hyperactivity Disorder

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Summary: Recent research has indicated that daytime manifestations of sleep-disordered breathing, frequently caused by deviated septum, can mimic many characteristic symptoms of attention-deficit/hyperactivity disorder (ADHD) and could indicate intermittent hypoxia or hypercarbia as factors in the development of ADHD. To investigate the differences in outcomes following septoplasty between patients with ADHD and deviated septum, we used a retrospective cohort design to compare outcomes in patients diagnosed with deviated septa between June 1, 2002 and June 1, 2022. We then separated these patients into four total groups based on the presence or absence of ADHD diagnosis and the presence or absence of septoplasty. After matching cohorts to create insignificant differences in age, sex, and race, we analyzed various outcomes associated with ADHD, such as conduct disorders, anxiety disorders, fractures, and substance abuse disorders. Septoplasty reduces the risk for nearly all outcomes in patients with deviated septum, with statistically significant results present in 11 of 15 outcomes in both ADHD and non-ADHD groups. The effect of septoplasty was up to 10 times greater for the ADHD cohort. Patients with ADHD who receive septoplasty display a plethora of beneficial effects, with significantly reduced risk of common sequelae such as depression, obsessive-compulsive disorder, anxiety, and addictive disorders. The difference in outcomes indicates future prospective studies into outcomes of septoplasty in patients with ADHD. *(Plast Reconstr Surg Glob Open 2023; 11:e5008; doi: 10.1097/GOX.0000000000005008; Published online 19 May 2023.)*

INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) affects 3% of adults, causing structural changes in the brain and increasing the risk of addiction, criminality, obesity, conflict, and premature death.[1] ADHD is also strongly associated with an increased risk of unintentional traumatic injuries, potentially leading to higher rates of deviated septum, a common cause of sleep-disordered breathing (SDB).[2,3] Recent studies show surgical SDB treatments, such as adenotonsillectomy and septoplasty, reduce ADHD symptoms, and may be useful for those with deviated septum.[4,5] However, no study currently exists that investigates the differences in common sequelae of ADHD, which includes mood disorders, anxiety disorders, and addictive disorders.[1,6] Our study investigates the occurrence of these sequelae between ADHD patients with deviated septum after septoplasty.

METHODS

Using a retrospective cohort design through the TriNetX database, we identified all patients diagnosed with deviated septa (ICD-10: J34.2) between June 1, 2002, and June 1, 2022. TriNetX, LLC is compliant with data privacy regulations and laws applicable to the contributing HCO.[7] From these patients, we compared outcomes across two cohorts: patients receiving septoplasty (CPT: 30520) and not. We further separated the cohorts into those with ADHD (ICD-10: F90) and without. Outcome analysis began 14 days after the first date an individual met the index event criteria. The following outcomes were assessed: conduct disorders, phobic anxiety disorders, upper limb fracture, tic disorder, manic episode, alcohol disorder, cannabis-related disorder, tobacco use,

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adjustment disorder, depressive episode, anxiety disorders, dizziness/giddiness, decreased cognitive awareness, hallucinations, and obsessive-compulsive disorder.

The chi-square and *t* tests, depending on the type of variable, were used to compare demographic characteristics and outcomes between cohorts. Odds ratios were calculated from outcome incidence within each cohort. To prevent confounding variables, we balanced the cohorts on age, sex, and race using propensity score matching with a difference between propensity scores less than 0.1, and outcome analysis only included

Takeaways

Question: In patients with ADHD and deviated septum, how does septoplasty affect outcomes compared with those who do not undergo septoplasty?

Findings: Septoplasty reduced the risk for nearly all outcomes, with statistically significant results present in 22 of the 30 outcome comparisons.

Meaning: Septoplasty should be considered in patients with ADHD and deviated septum.

Table 1. N, Odds Ratio, and Absolute Risk of Outcomes of Interest in Each Cohort

Event—ICD 10 Code	Total No. (Excluding Patients with Outcome before Window)	No. Patients with Outcome	Risk (%)	Odds Ratio (95% CI)	*P**
Conduct disorders—F91					
Septoplasty, ADHD+	3949	59	1.49	0.588	**<0.001**
No septoplasty, ADHD+	3897	98	2.51	(0.424–0.815)	
Septoplasty, ADHD−	71,003	269	0.38	0.751	**<0.001**
No septoplasty, ADHD−	70,847	357	0.50	(0.641–0.880)	
Phobic anxiety disorders—F40					
Septoplasty, ADHD+	4070	155	3.81	0.947	**0.65**
No septoplasty, ADHD+	4011	161	4.01	(0.756–1.186)	
Septoplasty, ADHD−	70,419	1003	1.42	0.842	**<0.001**
No septoplasty, ADHD−	70,207	1184	1.69	(0.774–0.917)	
Tic disorder—F95					
Septoplasty, ADHD+	4178	13	0.31	0.266	**<0.001**
No septoplasty, ADHD+	4141	48	1.16	(0.144–0.492)	
Septoplasty, ADHD−	71,363	57	0.08	0.655	**0.015**
No septoplasty, ADHD−	71,332	87	0.12	(0.469–0.914)	
Alcohol disorder—F10					
Septoplasty, ADHD+	3956	157	3.97	0.841	**0.12**
No septoplasty, ADHD+	3906	183	4.69	(0.676–1.046)	
Septoplasty, ADHD−	69,554	1047	1.51	0.858	**<0.001**
No septoplasty, ADHD−	69,102	1209	1.75	(0.790–0.933)	
Adjustment disorders—F43.2					
Septoplasty, ADHD+	3762	164	4.36	0.809	**0.045**
No septoplasty, ADHD+	3864	206	5.33	(0.656–0.999)	
Septoplasty, ADHD−	69,588	1406	2.02	0.974	**0.5**
No septoplasty, ADHD−	69,573	1443	2.07	(0.904–1.049)	
Anxiety disorder, unspecified—F41.9					
Septoplasty, ADHD+	2621	650	24.80	0.879	**0.04**
No septoplasty, ADHD+	2647	722	27.28	(0.777–0.995)	
Septoplasty, ADHD−	60,670	5284	8.71	0.898	**<0.001**
No septoplasty, ADHD−	60,866	5847	9.61	(0.863–0.933)	
Decreased cognitive awareness—R41					
Septoplasty, ADHD+	3683	431	11.70	0.886	**0.09**
No septoplasty, ADHD+	3557	463	13.02	(0.770–1.019)	
Septoplasty, ADHD−	68,670	2914	4.24	0.868	**<0.001**
No Septoplasty, ADHD−	67,411	3273	4.86	(0.825–0.914)	
Phobic anxiety disorders—F40					
Septoplasty, ADHD+	4055	63	1.55	0.619	**0.002**
No septoplasty, ADHD+	4063	101	2.49	(0.451–0.851)	
Septoplasty, ADHD−	71,109	223	0.31	0.867	**0.12**
No septoplasty, ADHD−	71,069	257	0.36	(0.724–1.037)	
Cannabis-related disorders—F12					
Septoplasty, ADHD+	4083	112	2.74	0.693	**0.002**
No septoplasty, ADHD+	4040	158	3.91	(0.542–0.886)	

(*Continued*)

Table 1. (*Continued*)

Event—ICD 10 Code	Total No. (Excluding Patients with Outcome before Window)	No. Patients with Outcome	Risk (%)	Odds Ratio (95% CI)	*P**
Septoplasty, ADHD–	70,743	536	0.76	0.828	**<0.001**
No septoplasty, ADHD–	70,568	645	0.91	(0.738–0.929)	
Upper limb fracture—S42,S52,S62					
Septoplasty, ADHD+	3877	117	3.02	0.753	**0.024**
No septoplasty, ADHD+	3932	156	3.97	(0.590–0.961)	
Septoplasty, ADHD–	68,576	1571	2.29	1.009	**0.81**
No septoplasty, ADHD–	68,690	1560	2.27	(0.940–1.083)	
Manic episode—F30.9					
Septoplasty, ADHD+	4205	16	0.38	0.406	**<0.001**
No septoplasty, ADHD+	4184	39	0.93	(0.227–0.728)	
Septoplasty, ADHD–	71,404	57	0.08	0.759	**0.12**
No septoplasty, ADHD–	71,324	75	0.11	(0.538–1.071)	
Tobacco use—Z72.0					
Septoplasty, ADHD+	3980	174	4.37	0.785	**0.02**
No septoplasty, ADHD+	3945	217	5.50	(0.640–0.964)	
Septoplasty, ADHD–	68,904	1968	2.86	0.844	**<0.001**
No septoplasty, ADHD–	68,354	2302	3.37	(0.794–0.897)	
Depressive episode, unspecified—F32.9					
Septoplasty, ADHD+	2769	496	17.91	0.833	**<0.001**
No septoplasty, ADHD+	2808	583	20.76	(0.729–0.951)	
Septoplasty, ADHD–	61,716	4031	6.53	0.908	**<0.0001**
No septoplasty, ADHD–	62,261	4449	7.15	(0.869–0.949)	
Dizziness and giddiness—R42					
Septoplasty, ADHD+	3562	399	11.20	0.929	**0.321**
No septoplasty, ADHD+	3487	417	11.96	(0.803–1.075)	
Septoplasty, ADHD–	64,446	4758	7.38	0.865	**<0.001**
No septoplasty, ADHD–	62,441	5270	8.44	(0.830–0.901)	
Hallucinations—R44.0-3					
Septoplasty, ADHD+	4158	68	1.64	0.652	**<0.001**
No septoplasty, ADHD+	4103	102	2.49	(0.478–0.889)	
Septoplasty, ADHD–	71,084	497	0.70	0.849	**<0.001**
No septoplasty, ADHD–	70,679	581	0.82	(0.753–0.958)	

*Bolded values indicate a *t* test $P<0.05$.

patients who did not have the outcome before the index event. As this study contained only deidentified data, the relevant IRB designated it as nonhuman research not in need of approval.

RESULTS

After cohort matching was performed as described above, we had 4237 patients in each cohort with ADHD and 71,455 patients in each cohort without ADHD, for a total of 151,384 patients. As the statistical analysis for each outcome excluded patients with the event of interest before the time window, the cohort size varied slightly for each outcome, as shown in Table 1. Each outcome of interest had significant risk reductions for at least one of the surgical cohorts, with both the ADHD and septoplasty cohort and the no ADHD with septoplasty cohort showing statistically significant reduction in 11 of 15. Figure 1 contains the relative risk reduction for each outcome of interest, with asterisks denoting a statistically significant difference. Absolute risk and odds ratio for each event in the ADHD cohorts are presented in Table 1.

DISCUSSION

Our study found significant differences in outcomes between patients with deviated septum who received septoplasty compared with those who did not. The effect of septoplasty was up to 10 times greater for the ADHD cohort, with statistically significant results in 11 of 15 outcomes for both ADHD and non-ADHD groups after cohorts were balanced on age, sex, race, ethnicity, and body mass index. Absolute risks for most outcomes were less than 5%, which may have contributed to the lack of statistical significance for some events in the ADHD cohort.

Patients without ADHD displayed lower risk for most outcomes, but most differences were less than 1% decreased risk. Events with small prevalence, such as tic disorder, made it difficult to ascertain the true impact of septoplasty. However, outcomes such as anxiety disorder, occurring in nearly 10% of the cohort, suggest that the

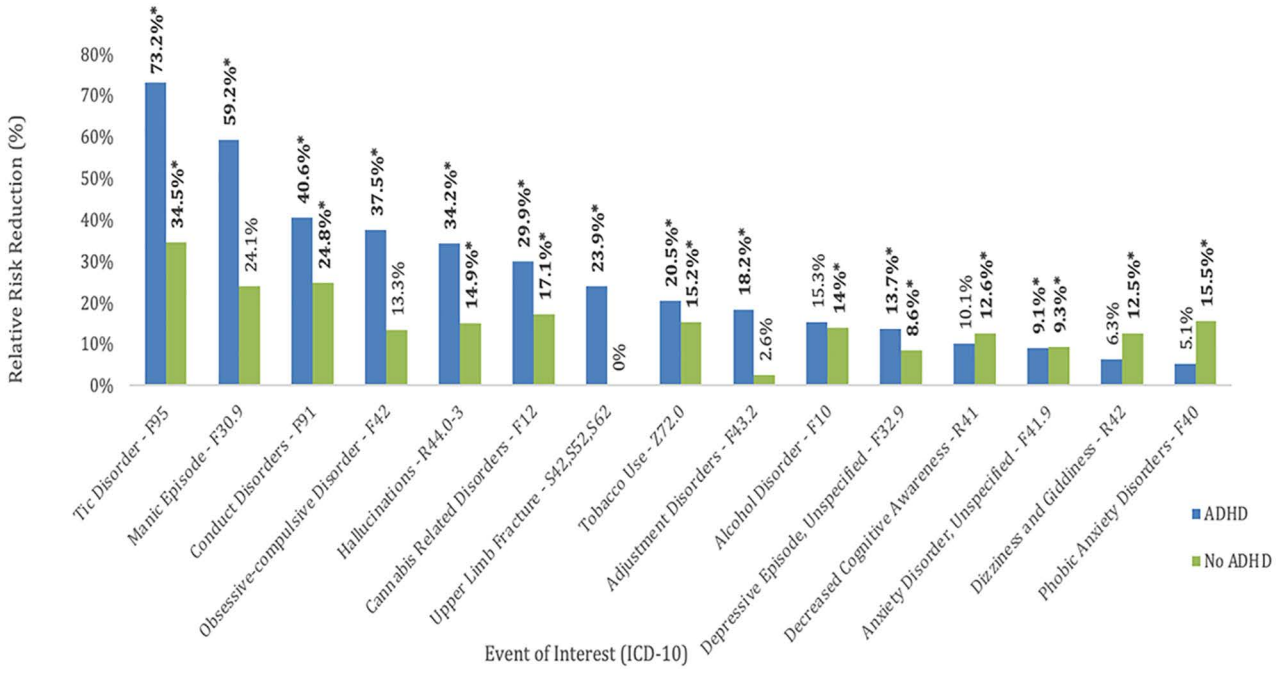

Fig. 1. RRR by outcome of interest in patients receiving surgery. RRR indicates relative risk reduction. *Bold data labels indicate significant difference from matched peers not receiving surgery ($P < 0.05$).

decreased risk observed may be a result of the surgery. Hypoxia and hypercarbia, both known to occur in SDB caused by deviated septa, may be contributory factors to mood and addictive disorders.[8] Our analysis began 2 weeks after the surgery, which is generally when patients report better nasal breathing.[9]

While the biomechanism of the observed effect was likely the same between the ADHD and non-ADHD cohorts, the ADHD cohort displayed larger differences in risk. As mentioned previously, research has demonstrated that SDB resulting in hypoxia and hypercarbia may worsen ADHD and can result in misdiagnosis, as many daytime manifestations of SDB are similar to symptoms of ADHD, such as inattention and restlessness.[3,4] However, our study is the first to investigate the impact on common sequelae of ADHD such as depression, obsessive-compulsive disorder, anxiety, and addictive disorders.[1,6] Patients with ADHD receiving septoplasty display beneficial effects from this minor outpatient procedure, including reduced risk for these conditions, possibly due to decreased likelihood of SDB or decreased severity of ADHD symptoms caused by hypoxia and hypercarbia.[10] Given the positive outcomes found in this study, it may be worth evaluating septal deviation in patients with ADHD who have a history indicative of SDB or an injury mechanism consistent with potential septal deviation. Our described benefits of septoplasty could potentially save patients' sizable amounts of health care costs related to medications and psychiatric treatment, as well as reduce future distress and improve overall life quality.

Although we did successfully account for potential confounders, such as age, sex, race, ethnicity, and body mass index, our study is not without limitations. Due to the nature of deidentified, aggregate patient data, we were unable to obtain longitudinal information, such as severity of ADHD symptoms, or identify the reason patients were receiving septoplasty. Finally, our study relied on deviated septum as a surrogate measurement of SDB. Although improvement in SDB is common after septoplasty, we cannot be sure this improvement existed, which may temper the generalizability of our results.

This is the first study on the differences in outcomes between ADHD patients with deviated septum with or without septoplasty. We found that patients with ADHD receiving septoplasty display a plethora of beneficial effects from a minor outpatient procedure. The magnitude of benefit indicates that a future prospective study could provide important information for the large, and increasing, patient population with ADHD. As more is discovered about the interactions and associations among hypoxia, hypercarbia, and ADHD, we hope our study will prompt further investigation into the potential role of deviated septa, SDB, and septoplasty in the auxiliary treatment of ADHD.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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