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Outcomes after Middle Turbinate Resection: Revisiting a Controversial Topic

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Abstract

OBJECTIVE—To evaluate differences in endoscopy exam, olfactory function, and quality-of-life (QOL) status after endoscopic sinus surgery (ESS) for patients with and without bilateral middle turbinate (BMT) resection.

STUDY DESIGN—Open, prospective, multi-institutional cohort

SUBJECTS and METHODS—Subjects completing enrollment interviews, computed tomography, and endoscopy exam were asked to provide pre- and postoperative responses to the Smell Identification Test (SIT), Rhinosinusitis Disability Index (RSDI), Chronic Sinusitis Survey (CSS), and the Medical Outcomes Study Short Form-36 Health Survey (SF-36). Bivariate and multivariate analyses were performed at the 0.05 alpha level.

RESULTS—47 subjects with BMT resection were compared to 195 subjects without BMT resection with a mean follow-up of 17.4 months postoperatively. Patients with BMT resection were more likely to have asthma ($p=0.001$), aspirin intolerance ($p=0.022$), nasal polyposis ($p=0.025$), and prior sinus surgery ($p=0.002$). Patients with BMT resection had significantly higher baseline disease burden measured by endoscopy, CT, and SIT scores ($p<0.001$). No significant differences in improvement were found in RSDI, CSS, or SF-36 scores between patients with BMT resection and those with BMT preservation ($p>0.050$). Patients undergoing BMT resection were more likely to show improvements in mean endoscopy (-4.5 ± 5.2 vs. -1.9 ± 4.3 ; $p=0.005$) and olfaction (5.3 ± 10.8 vs. 1.3 ± 7.6 , $p=0.045$) compared to those with BMT preservation.

CONCLUSION—This investigation found no difference in baseline QOL between or QOL improvement after ESS. Patients undergoing BMT resection did, however, show greater improvements in endoscopy and SIT scores which persisted after controlling for confounding factors.

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Keywords

Middle turbinate; quality-of-life; endoscopic; surgery; chronic rhinosinusitis; sinusitis; resection

INTRODUCTION

The surgical fate of the middle turbinate has remained a point of contention throughout the history of sinus surgery. Early teaching was divided, with Wigand advocating routine middle turbinate resection whereas Messerkingler taught routine preservation.¹⁻³ Those in favor of resection discussed improvement in intraoperative and postoperative visualization, decreased synechiae formation, and improved sinus ostial patency.⁴⁻⁵ Those who advocated preservation described risks of atrophic rhinitis, anosmia, postoperative epistaxis, destruction of intra-operative landmarks, and iatrogenic frontal sinusitis.⁶⁻⁷

Over the last twenty-five years a number of outcome investigations have attempted to address issues surrounding middle turbinate resection. Most studies have been from single institutions, are retrospective in nature, and have given little consideration to the control of potentially confounding factors.⁷ Therefore, it can be difficult to draw firm conclusions on which to base clinical decision-making regarding middle turbinate resection. The goal of this study was to prospectively evaluate endoscopy exam, olfactory function, and quality-of-life (QOL) status after endoscopic sinus surgery (ESS) for patients with and without bilateral middle turbinate resection, while controlling for factors which might confound these outcomes.

MATERIALS and METHODS

Study Population

Adult (≥ 18 years) study subjects were enrolled from the following three performance sites as part of a multi-institutional, prospective open cohort: Oregon Health & Science University (OHSU), the Medical College of Wisconsin (MCW), and Stanford University between July, 2004 and June, 2008. All patients had a diagnosis of chronic rhinosinusitis (CRS) based on the Rhinosinusitis Task Force criteria.⁸ Patients were enrolled after failing at least three weeks of broad-spectrum or culture directed antibiotics in addition to a trial of oral and topical steroid therapy. All investigational protocols and informed consent were approved by the Institutional Review Boards at each study site.

Covariates and Outcome Measures

Demographic data and social history were self-reported by the patient and included: age, gender, race and/or ethnicity, and current cigarette use. Presence of medical comorbidities was documented by the investigating surgeon at each performance site and included: asthma, nasal polyposis, allergies confirmed by either skin prick testing or modified radioallergic sorbent testing (mRAST), acetylsalicylic acid (ASA) intolerance, depression, and history of prior sinus surgery. Preoperative computed tomography (CT) scan and endoscopy exam were scored by each surgeon using the Lund-MacKay and Lund-Kennedy scoring systems.⁹⁻¹⁰ The Smell Identification Test (SIT; Sensonics, Inc., Haddon Heights, NJ) was administered as an objective measure of olfactory function.¹¹ Two validated disease-specific QOL instruments, the Rhinosinusitis Disability Index (RSDI) and the Chronic Sinusitis Survey (CSS), and one general health-related QOL instrument, the Medical Outcomes Study Short Form-36 Health Survey (SF-36) were administered preoperatively by an experienced research coordinator.¹²⁻¹⁴

Subjects were followed postoperatively at 6 month, 12 month, and 18 month time points wherein data on endoscopy exam, olfaction, and QOL were routinely collected. The final postoperative clinic visit collected during the study period was utilized for all outcome analyses. All investigating surgeons were blinded to QOL survey responses for the study duration.

Bilateral Middle Turbinate Resection

In this observational study, the decision to resect or preserve the middle turbinate was based on the patient's disease process as defined by signs, symptoms, CT scan, and intraoperative clinical judgment. No randomization or other method of preoperative assignment to resection or preservation was utilized. The technique of middle turbinate resection was similar at each site, utilizing through-cutting instruments to remove the anteroinferior two-thirds of the turbinate. This spared the superior, sagittally-oriented portion of the middle turbinate as a landmark and a small stump posteriorly in the region of the sphenopalatine foramen.

Statistical Analyses

Baseline factors including demographics, medical comorbidities, extent of surgery, and measures of disease severity (CT, endoscopy, SIT, QOL) were compared between the group with bilateral middle turbinate (BMT) resection and subjects with BMT preservation using Mann-Whitney U tests, Independent t-tests, and chi-square or Fisher's exact test where appropriate. Overall improvement between preoperative and postoperative time points was assessed using the Wilcoxon signed-rank test. Outcomes after surgery were assessed by comparing change scores (postoperative minus preoperative) between BMT resection and BMT preservation groups with regards to endoscopy, olfaction, and QOL. Simple multivariate, linear regression was performed to control for potential confounding baseline factors including the following measures: asthma, allergy, ASA intolerance, nasal polyposis, prior sinus surgery, CT score, and extent of surgery including: maxillary antrostomy, partial and total ethmoidectomy, sphenoidotomy, frontal sinusotomy. Unadjusted for multiple comparisons, a p-value ≤ 0.05 was considered statistically significant for all analyses with means and standard deviations ($\pm$ SD) reported for descriptive analyses and mean standard errors ($\pm$ SE) for all inferential statistics.

RESULTS

Two hundred and seventy-six patients were enrolled between three sites (OHSU, n=110; MCW, n=101; and Stanford University, n=56) with a minimum of 6 month postoperative follow-up. Patients with unilateral middle turbinate resection were excluded (n=34), leaving 47 patients representing the BMT resection group and 195 patients representing the BMT preservation group. Postoperative follow-up time points are shown in Table 1 and collectively averaged 17.4 ± 7.1 months for all subjects.

Baseline characteristics of both groups are described in Table 2. Bivariate analysis showed that patients undergoing BMT resection were statistically more likely to have asthma, ASA intolerance, nasal polyposis, and prior sinus surgery, whereas patients with BMT preservation were more likely to present with septal deviation.

Patients undergoing BMT resection also appeared to have significantly higher baseline disease burden as indicated by CT, endoscopy, and SIT scores compared to patients with BMT preservation ($p < 0.001$; Table 3). Interestingly, there were no significant differences in baseline disease-specific or general QOL between the resection or preservation groups ($p > 0.050$; Table 4). Patients undergoing BMT resection also tended to have more extensive

surgery with higher rates of complete ethmoidectomy, sphenoidotomy, and frontal sinusotomy than those with BMT preservation (Table 5).

Overall, both groups showed strong significant improvement over time in QOL scores, endoscopy exam, and olfactory function between preoperative and postoperative scores ($p < 0.001$, data not shown). There was no difference in outcomes between patients evaluated at early or late time points ($p > 0.050$; data not shown). Change scores (postoperative minus preoperative) for each comparison group are shown in Table 6. No significant differences in improvement were found in CSS, RSDI, or SF-36 scores with bivariate comparisons between patients with BMT resection and those with BMT preservation ($p > 0.050$). Patients undergoing BMT resection were more likely to show improvements in average endoscopy (-4.5 ± 5.2 vs. -1.9 ± 4.3 ; $p = 0.005$) and olfaction (5.3 ± 10.8 vs. 1.3 ± 7.6 , $p = 0.045$) compared to those with BMT preservation. Significant differences in endoscopy and olfaction remained with multivariate linear regression modeling after adjusting for nasal polyposis, history of prior sinus surgery, CT score, extent of surgery, allergies, asthma, and ASA intolerance. Final models found that, on average, subjects with BMT resection had a 7.5% greater improvement in postoperative endoscopy score and an 8.5% improvement in SIT score compared to patients with BMT preservation.

DISCUSSION

A great number of reviews have been published attempting to address the issues surrounding middle turbinate resection. By and large, studies have failed to show significant deleterious effects related to middle turbinate resection such as atrophic rhinitis, nasal obstruction, or olfactory loss.^{4,5,15,16} Several studies have actually shown statistically significant but relatively modest increases in maxillary ostial patency rates after middle turbinate resection.¹⁷ Often discussed is the possible risk of iatrogenic frontal sinusitis secondary to lateralization of the remnant turbinate stump. This was first suggested in a retrospective series detailed by Swanson et al.¹⁸ however subsequent investigations by Duncavage and Saidi have refuted these findings.^{19,20} More recently, a prospective study by Marchioni and colleagues examined middle turbinate resection in patients with nasal polyposis.²¹ In this study, 22 patients with middle turbinate resection and 34 patients with turbinate preservation were followed for three years. Patients with middle turbinate resection were shown to have earlier relapse of polyposis as judged by endoscopy examination. However, potential confounding factors such as extent of surgery and presence of medical comorbidities were not controlled for and postoperative QOL differences between the groups were not specifically compared.

The present study prospectively followed a multi-institutional cohort undergoing endoscopic sinus surgery with BMT resection performed at the discretion of the surgeon. As might be expected, patients who had BMT resection had greater disease burden at baseline as measured by objective testing and were more likely to have comorbidities associated with severe inflammatory processes. These findings underscore the importance of controlling for baseline differences in particular study groups, a methodology rarely considered in previous investigations. Despite differences in objective disease severity and medical comorbidities, there were no differences in baseline QOL between the groups nor was there a difference in QOL improvement after surgery. Patients undergoing BMT resection did show greater improvements in average endoscopy and olfactory function, which persisted after controlling for potential confounding factors.

Although patients with BMT resection demonstrated statistically greater improvements in endoscopy evaluation, the clinical relevance of this finding is debatable. In fact, the Lund-Kennedy endoscopy score may be inherently changed by middle turbinate resection itself as

it requires evaluators to distinguish polyps “limited to the middle meatus” from those “extending into the nasal cavity.” Removing the middle turbinate would blur the anatomic boundary between the nasal cavity and middle meatus, obfuscating subsequent endoscopy scores. However, the study by Marchioni did show earlier return of polyps by endoscopy which argues that this finding may in fact be valid. A theory held by some is that resection of the middle turbinate in cases of polypectomy prolongs the time to symptomatic recurrence by decreasing mucosal surface area on which polyps may grow and later obstruct the sinonasal cavities. Given that polyps may take years to recur, the present study offers little insight into this question, given an average follow-up of 17.4 months. Further study into this assertion is warranted, likely with large retrospective reviews which can span decades of time.

The fact that patients undergoing BMT resection had greater improvement in olfaction is quite interesting. Early teachings warned of possible olfactory loss related to middle turbinate resection.⁶ The premise of this argument is that olfactory epithelium may be found in the superior-most aspects of the middle turbinate. However, Friedman followed olfactory scores preoperatively and 8 weeks postoperatively showing no difference in scores based on whether the middle turbinate was resected or preserved.²²

A mechanistic explanation wherein middle turbinate resection could lead to improved olfaction can be found in a study reported by Leopold in 1988.²³ In that study, the volume of the space between the mid-portion of the septum and the middle turbinate correlated strongly with olfactory acuity as measured by Odorant Confusion Matrix and SIT. Resection of the middle turbinate, especially in instances of severe inflammation or polyps, might increase airflow to the olfactory cleft, allowing odorant molecules access to the olfactory epithelium. Although statistically significant, the difference in average olfactory improvement scores in the present study (5.3 ± 10.8 vs 1.3 ± 7.6) is rather modest and borders what one would consider clinically relevant. Similar to endoscopy score, patients with MT resection also had worse baseline olfaction than patients with MT preservation and thus had greater room for improvement. These findings will need to be reproduced before any firm conclusions can be drawn.

It should be stressed that this study does not directly address the question of whether the middle turbinate should be routinely resected or routinely preserved. The answer to that question would require a randomized controlled surgical trial, something that is unlikely to happen in the United States and probably unnecessary given the generally good outcomes reported after ESS. Rather, it shows that judicious resection of the middle turbinate (when the surgeon deems it a contributing disease factor) can be done with no apparent consequence to long-term disease-specific or general QOL outcomes. In fact, this finding supports the concept that Kennedy proposed years ago that “the most important variable in this decision process (whether to resect or preserve the middle turbinate) is whether the middle turbinate, in any given situation, is involved in the disease process.”⁶ Scientists and surgeons alike strive for concrete answers and absolutes. However, the available evidence to date suggests that the decision to preserve or resect the middle turbinate can be left to the discretion of the surgeon with little or no negative consequence to long-term outcomes after sinus surgery.

CONCLUSION

Patients undergoing BMT resection had greater disease burden at baseline as measured by objective testing and were more likely to have comorbidities associated with severe inflammatory processes than those in whom the middle turbinate was preserved. Despite these findings, there was no difference in baseline QOL between the groups nor was there a

difference in QOL improvement after surgery. Patients undergoing BMT resection did, however, show greater improvements in endoscopy and SIT scores which persisted after controlling for confounding factors.

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Table 1

Available follow-up for cohort subjects with and without bilateral middle turbinate resection

Last follow-up time:	n (%)
6 months postoperatively	25 (10.3)
12 months postoperatively	57 (23.6)
18 months postoperatively	160 (66.1)

Table 2

Total cohort demographics and comorbid conditions for subjects with and without bilateral middle turbinate resection

Demographics:	BMT resection (n=47)		BMT Preservation (n=195)		p-value
	Mean ± SD	n (%)	Mean ± SD	n (%)	
Follow-up (months)	18.9 ± 1.3		17.1 ± 6.5		0.200
Age (years)	48.8 ± 15.2		48.7 ± 14.1		0.981
Gender					
Males		26 (55.3)		101 (51.8)	
Females		21 (44.6)		94 (48.2)	0.664
Comorbid conditions:					
Allergy		19 (40.4)		57 (29.2)	0.138
Asthma		29 (61.7)		69 (35.4)	0.001
ASA Intolerance		11 (23.4)		21 (10.8)	0.022
Nasal polypsis		26 (55.3)		73 (37.4)	0.025
Depression		5 (10.6)		31 (15.9)	0.494
Prior sinus surgery		40 (85.1)		120 (61.5)	0.002
Septal deviation		4 (8.5)		48 (24.6)	0.017
Current smoker		1 (2.1)		11 (5.6)	0.470

Follow-up time was compared using Mann-Whitney U test. Independent t-test was used to compare age. Chi-square or Fisher's exact test, for cell sizes ≤ 5, were used for all frequency comparisons. BMT = bilateral middle turbinate. SD = standard deviation. ASA = acetylsalicylic acid. p≤0.05 is statistically significant.

Table 3

Preoperative clinical measures for subjects with and without bilateral middle turbinate resection

	BMT resection (n=47)		BMT Preservation (n=195)	
	Mean $\pm$ SD	[range]	Mean $\pm$ SD	p-value
Preoperative Clinical measures:				
CT score	16.3 $\pm$ 5.1	[0, 24]	12.0 $\pm$ 6.5	[0, 24] <0.001
Endoscopy score	10.0 $\pm$ 4.5	[0, 20]	6.3 $\pm$ 4.5	[0, 20] <0.001
SIT score	20.0 $\pm$ 10.8	[1, 40]	27.6 $\pm$ 9.7	[4, 39] <0.001

BMT = bilateral middle turbinate. SD = standard deviation. CT = computed tomography. SIT = Snell Identification Test. p $\leq$ 0.05 is statistically significant.

Table 4

Preoperative quality-of-life outcome measures for subjects with and without bilateral middle turbinate resection

	BMT resection (n=47)		BMT Preservation (n=195)	
	Mean ± SD	[range]	Mean ± SD	p-value
Preoperative Quality of Life:				
RSDI – total	44.9 ± 21.1	[14, 116]	47.9 ± 20.7	[6, 115] 0.227
CSS – total	36.3 ± 17.8	[0, 84]	38.6 ± 19.3	[0, 92] 0.476
SF-36 General Health	53.1 ± 24.0	[0, 100]	53.2 ± 23.6	[5, 100] 0.955
SF-36 Physical Function	71.8 ± 26.5	[0, 100]	74.6 ± 24.2	[0, 100] 0.639
SF-36 Physical Role	48.9 ± 40.4	[0, 100]	42.5 ± 42.3	[0, 100] 0.258
SF-36 Emotional Role	75.9 ± 35.2	[0, 100]	63.4 ± 42.1	[0, 100] 0.092
SF-36 Social Function	66.8 ± 26.4	[0, 100]	63.7 ± 26.0	[0, 100] 0.393
SF-36 Bodily Pain	58.7 ± 22.0	[0, 100]	56.0 ± 24.1	[0, 100] 0.418
SF-36 Vitality	40.0 ± 24.0	[0, 90]	35.7 ± 22.7	[0, 90] 0.247
SF-36 Mental Health	70.7 ± 17.9	[8, 96]	65.3 ± 21.1	[0, 100] 0.118

BMT = bilateral middle turbinate. SD = standard deviation. RSDI = Rhinosinusitis Disability Index. CSS = Chronic Sinusitis Survey. SF-36 = the Medical Outcomes Short Form-36. The RSDI and CSS are disease-specific quality of life survey instruments, while the SF-36 is a general health quality of life survey. p<0.05 is statistically significant.

Table 5

Prevalence of concurrent surgical procedures for subjects with and without bilateral middle turbinate resection

Surgical procedures:	BMT resection (n=47) n (%)	BMT Preservation (n=195) n (%)	p-value
Maxillary antrostomy	45 (95.7)	171 (87.7)	0.186
Partial ethmoidectomy	5 (10.6)	48 (24.6)	0.048
Total ethmoidectomy	43 (91.5)	141 (72.3)	0.004
Sphenoidotomy	36 (76.6)	108 (55.4)	0.008
Frontal (Draf I, IIa,IIb,or III)	41 (87.2)	116 (59.5)	<0.001

BMT = bilateral middle turbinate. $p \leq 0.05$ is statistically significant. Surgical procedures combine both unilateral and bilateral procedures.

Adjusted regression effect estimates for improvement in clinical and QoL outcome measures for subjects with and without bilateral middle turbinate resection

Table 6

Model outcome:	BMT resection (n=47) Mean $\pm$ SD	BMT preservation (n=195) Mean $\pm$ SD	Adjusted β^* Mean $\pm$ SE	(95% CI)	p-value
Endoscopy	-4.5 $\pm$ 5.2	-1.9 $\pm$ 4.3	-1.5 $\pm$ 0.7	(-2.9, -0.1)	0.044
SIT	5.3 $\pm$ 10.8	1.3 $\pm$ 7.6	3.4 $\pm$ 1.5	(0.5, 6.3)	0.022
RSDI - total	-17.7 $\pm$ 20.3	-18.3 $\pm$ 18.4	-0.01 $\pm$ 3.3	(-6.5, 6.3)	0.976
CSS - total	22.5 $\pm$ 22.1	19.0 $\pm$ 22.0	5.0 $\pm$ 3.9	(-2.7, 12.7)	0.203
SF-36 General Health	6.6 $\pm$ 21.1	4.2 $\pm$ 18.4	4.2 $\pm$ 3.3	(-2.3, 10.7)	0.201
SF-36 Physical Function	10.2 $\pm$ 24.1	6.0 $\pm$ 18.4	1.1 $\pm$ 3.4	(-5.5, 7.8)	0.742
SF-36 Physical Role	14.9 $\pm$ 45.9	23.0 $\pm$ 42.7	-7.3 $\pm$ 7.6	(-22.2, 7.7)	0.338
SF-36 Emotional Role	3.5 $\pm$ 41.3	14.3 $\pm$ 39.3	-9.7 $\pm$ 7.0	(-23.4, 4.0)	0.164
SF-36 Social Function	5.3 $\pm$ 28.9	8.4 $\pm$ 29.3	-2.6 $\pm$ 5.1	(-12.5, 7.4)	0.613
SF-36 Bodily Pain	5.0 $\pm$ 22.3	7.5 $\pm$ 22.1	-2.8 $\pm$ 3.9	(-10.5, 4.9)	0.472
SF-36 Vitality	15.0 $\pm$ 21.3	14.4 $\pm$ 22.4	1.6 $\pm$ 3.9	(-6.1, 9.2)	0.686
SF-36 Mental Health	7.2 $\pm$ 15.0	8.2 $\pm$ 16.2	-0.7 $\pm$ 2.8	(-6.2, 4.8)	0.805

Adjusted effect estimates for BMT resection for postoperative improvement for each outcome.

β^* is controlled for asthma, allergy, acetylsalicylic (ASA) intolerance, nasal polyposis, prior sinus surgery, CT score, and extent of surgery.