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Predictors of Decision to Pursue Sleep Surgery

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Abstract

Objective. To identify predictors of patient decision to pursue sleep apnea surgery following initial consultation with a sleep surgeon.

Study Design. Retrospective cohort analysis.

Setting. Outpatient tertiary care academic center.

Methods. A retrospective review of patients with obstructive sleep apnea (OSA) diagnosis, BMI < 35 kg/m², and prior positive airway pressure (PAP) trial who were evaluated at a sleep surgery clinic. Patients who completed drug-induced sleep endoscopy (DISE) and/or surgery were compared to those who did not within at least 4 months of consultation. Surveys on OSA-related symptoms and decisional conflict were completed prior to the consultation for PAP alternatives.

Results. Among 437 patients, 321 did not undergo DISE/surgery, whereas 116 completed DISE/surgery within an average of 16.8 months of consultation. Patients who underwent DISE/surgery had a significantly higher Epworth sleepiness scale score (10.1 ± 4.9 vs 8.5 ± 5.1, $P = .006$) and insomnia severity index (15.6 ± 5.5 vs 14.3 ± 5.8, $P = .037$) as well as significantly lower decisional conflict scale (DCS) scores (27.9 ± 21.8 vs 38.2 ± 24.9, $P < .001$). Multivariate analysis revealed that lower preconsultation DCS score (OR = 0.97, 95% CI [0.97, 0.99], $P < .001$) and lower BMI (OR = 0.91, 95% CI [0.85, 0.99], $P = .019$) were independently significant predictors of pursuing DISE/surgery.

Conclusion. Decisional conflict prior to consultation is significantly associated with completion of DISE/surgery. Those with higher decisional conflict are less likely to proceed with DISE/surgery after consultation on PAP alternatives. Effective interventions that improve patient understanding of OSA and enhance support in decision-making are needed.

Keywords

decisional conflict, obstructive sleep apnea, predictors, sleep surgery

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Obstructive sleep apnea (OSA) is the most common sleep-breathing disorder characterized by interruptions in breathing due to upper airway obstruction during sleep.[1] Approximately 936 million individuals suffer from OSA worldwide and the prevalence continues to rise with increasing rates of obesity.[2-4] OSA is linked to increased risks of cardiovascular disease, likelihood of motor vehicle accidents, and susceptibility to cancer and mortality, emphasizing the need for treatment.[5-7]

Although positive airway pressure (PAP) therapy remains the first-line treatment for OSA, adherence is limited with 46% to 83% of patients reporting nonadherence.[8,9] Despite recent advancements, adherence continues to be a challenge, prompting patients and clinicians to consider other treatment options. Among these alternatives are oral appliances such as mandibular advancement devices (MADs), weight loss, and positional therapy.[7-10]

Patients who are unable to tolerate PAP face a challenge in the decision-making process due to the wide range of PAP alternatives available. Specifically, patients who do not respond to or tolerate PAP and other conservative measures may consider surgical interventions. Surgeries for OSA aim to modify the upper airway anatomically with reconstructive surgery or hypoglossal nerve stimulation (HGNS).[10-12]

The factors influencing the patient's decision to pursue sleep apnea surgery remain unclear and multifaceted. When making complex medical decisions, decisional conflict increases when individuals feel uninformed about their treatment options.[13] Several studies associate low decisional conflict with higher treatment satisfaction,

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shorter decision delay, and decreased likelihood of experiencing decisional regret.[14-18] A prior study demonstrated elevated decisional conflict scores in patients presenting for sleep surgery consultation citing lack of knowledge of the treatment options as a major contributing factor.[19] However, the extent to which decisional conflict levels impact patients' decisions to pursue further evaluation or surgery remain unclear.

Optimizing treatment strategies and patient outcomes require an understanding of the factors that influence the decision-making process in patients with OSA considering sleep surgery. Identifying the factors influencing the patient decision can help providers tailor their approach to better support patients in making informed and confident decisions regarding OSA management.

This study aims to identify predictors influencing the decision to pursue sleep apnea surgery or evaluation with sleep endoscopy following initial consultation with a sleep surgeon. We hypothesize that decisional conflict score and severity of OSA-related symptoms are significant predictors for the decision to proceed with drug-induced sleep endoscopy (DISE) evaluation and/or sleep apnea surgery.

Methods

Inclusion criteria involved adult patients seen in the UCSF Snoring and Sleep Apnea Surgery Clinic in a single tertiary care institution from November 2021 to March 2024 who were referred for OSA surgery evaluation. Patients who did not complete the preconsultation survey, had not previously trialed PAP therapy at home, did not have a sleep study to review, did not have an OSA diagnosis with apnea-hypopnea index (AHI) > 5, or had a BMI > 35 kg/m² were excluded from the analysis.

Patients completed an initial online intake survey prior to their initial consultation with a sleep surgeon (Research Electronic Data Capture, UCSF, San Francisco, CA).[20,21] The survey included sleep habits, sleep apnea treatment history as well as the Epworth sleepiness scale (ESS)[22] insomnia severity index (ISI)[23], and the decisional conflict scale (DCS). For patients who completed the survey more than once, only the most recent complete survey prior to initial consultation was included.

The intake survey included a treatment interest question asking, "If you had to choose today, which therapies are you most interested in?" With options for "Do nothing," "PAP (Positive Airway Pressure)," "Weight loss," "Oral appliance," "Positional therapy," "Palate or tongue surgery," "Maxillomandibular advancement surgery," "Hypoglossal nerve stimulator implant," "Nasal surgery", "Nasal sprays," "Insomnia treatment," "Improve sleep habits," "Other," and "I don't know." Following therapy choice, the DCS-validated questions were completed relative to the treatment(s) of interest. The DCS is a validated 16-item scale scored from 0 to 100 measuring personal perceptions in decision-making (Supplemental Table S1, available online).[13] Higher scores on the DCS represent high decisional conflict. Five subscales of the DCS measure feelings of uncertainty, lack of information, unclear values, lack of support, and ineffective decision-making. Number of selected therapies from the treatment interest question, selection of a surgical option, and DCS total and subscores were evaluated.

After completion of the questionnaire, the patients were evaluated by one of two academic sleep surgeons for the clinical encounter which included a detailed sleep history and physical exam. Additionally, a comprehensive discussion of the medical and surgical options for OSA management was consistently presented to all patients during the initial consultation, irrespective of their preconsultation DCS score. Based on shared decision-making during the consultation, patients chose the following: medical therapy or behavioral changes (positional sleep, weight management), schedule nasal or soft tissue surgery with DISE exam at the time of surgery, schedule DISE evaluation for further evaluation of OSA and HNS candidacy, and consider options and instructed to return based on interest in pursuing further sleep apnea surgery evaluation. DISE exam was offered as a standalone procedure or concurrent with a nasal surgery or soft tissue surgery (including expansion sphincter pharyngoplasty, tonsillectomy, lingual tonsillectomy, or epiglottoplasty). Patients interested in pursuing DISE and/or surgery communicated this decision with the surgeon at the visit or made their decision after the visit and contacted the office to schedule or discuss further with another appointment.

We performed a retrospective cohort study to identify preconsultation predictors for patients who choose to pursue further OSA evaluation with DISE and/or treatment with surgery for OSA (DISE/surgery group) versus patients who never scheduled a procedure (no DISE/surgery group). Data were extracted at least 4 months following initial consultation to determine decision to proceed with a procedure. Visit date, patient sex, BMI, AHI, prior and current usage of PAP, prior and current usage of MAD, other therapies for OSA, the Charlson comorbidity index (CCI), preliminary plan, DISE and surgery dates, number of encounters before DISE and surgery, and procedures performed were captured via REDCap.

Descriptive statistics were performed. In univariate analysis, *t*-tests and Chi-squared analyses were employed to identify significant differences in age, sex, BMI, AHI, ESS scores, ISI, nasal obstruction symptom evaluation (NOSE) scores, CCI, DCS and subscale scores, OSA severity, current and prior treatments, and selected treatments of interest, between the cohorts. Multivariate analysis with binary logistic regression was performed with predictors of age, AHI, BMI, DCS score, ISI, ESS score, and sex to assess predictors for DISE/surgery scheduling.

This study was approved by the Institutional Review Board of the University of California, San Francisco (UCSF).

Results

A total of 437 OSA patients evaluated at the sleep surgery clinic for PAP alternatives (**Table 1**) were enrolled in this study, including 321 patients who did not pursue DISE or surgery and 116 who completed DISE/surgery. The mean age of our cohort was 55.9 ± 17.5 years, with an average BMI of 27.7 ± 3.6 kg/m². The mean apnea-hypopnea index (AHI) was 29.1 ± 20.1 with moderate OSA in 37% and severe OSA in 36% (**Table 1**).

The DISE/surgery group (**Table 2**) had the following initial procedures: DISE alone (n = 91), DISE with soft tissue surgery (n = 10), DISE with nasal surgery (n = 10), soft tissue surgery alone (n = 2), and nasal surgery alone (n = 3). Of those who had DISE alone as their initial procedure, 45 patients did not pursue eventual surgery. Initial and eventual surgeries included HGNS (n = 34), septoplasty and inferior turbinate reduction (n = 16), soft tissue surgery (n = 21), and lingual tonsillectomy (n = 6). Patients had an average of 16.8 months (range [median]: 4-32 [16] months) from initial consultation to the chart review assessing their completion of DISE or surgery. The average number of visits to schedule DISE was 1.3 ± 0.5 visits and to schedule surgery was 2.2 ± 0.8 visits (**Table 2**). The mean number of months from the initial consultation to DISE was 2.62 ± 4.93 months and to surgery was 5.96 ± 4.50 months (**Table 2**).

Patients who elected for DISE/surgery had significantly higher ESS and ISI scores compared to the no DISE/surgery group (ESS: 10.1 ± 4.9 vs 8.5 ± 5.1, $P = .006$; ISI: 15.6 ± 5.5 vs 14.3 ± 5.8, $P = .037$; **Table 1**). There were no significant differences in the AHI, NOSE score, or CCI between groups. A significantly higher proportion of those who completed DISE/surgery had previously used a MAD compared to the no DISE/surgery group (36.2% vs 22.7%, $P = .012$). Current PAP and MAD use did not reveal any significant differences between groups.

Patients who underwent DISE/surgery had significantly lower decisional conflict scores compared to the no DISE/surgery group (27.9 ± 21.8 vs 38.2 ± 24.9, $P < .001$). All DCS subscores of uncertainty, informed, values clarity, support, and effective decision (**Table 3**) were significantly

Table 2. Descriptive Statistics of Patients Who Chose to Proceed With Drug-Induced Sleep Endoscopy (DISE)/Surgery

Visits to schedule DISE (mean ± SD)	1.3 ± 0.5
Visits to schedule surgery (mean ± SD)	2.2 ± 0.8
First visit to DISE, mo (mean ± SD)	2.6 ± 4.9
First visit to surgery, mo (mean ± SD)	6.0 ± 4.5
Initial procedure	
DISE alone	91 (78.4%)
DISE and soft tissue surgery	10 (8.6%)
DISE and nasal surgery	10 (8.6%)
Soft tissue surgery	2 (1.7%)
Nasal surgery	3 (2.6%)

Table 1. Patient Characteristics

	No DISE/surgery (*N* = 321)	DISE/surgery (*N* = 116)	Total (*N* = 437)	*P*-value
Age, y (mean ± SD)	56.8 ± 17.7	53.6 ± 17.0	55.9 ± 17.5	.096
Sex assigned at birth				.349
Female	112 (35.9%)	33 (28.5%)	145 (33.2%)	-
Male	209 (65.1%)	83 (71.6%)	292 (66.8%)	-
BMI, kg/m^2 (mean ± SD)	27.8 ± 3.6	27.3 ± 3.7	27.7 ± 3.6	.170
AHI, per hour (mean ± SD)	28.6 ± 20.2	30.5 ± 20.1	29.1 ± 20.1	.190
ESS score (mean ± SD)	8.5 ± 5.1	10.1 ± 4.9	8.9 ± 5.1	.006*
ISI (mean ± SD)	14.3 ± 5.8	15.6 ± 5.5	14.7 ± 5.8	.037*
NOSE score (mean ± SD)	34.4 ± 23.3	36.3 ± 22.4	34.9 ± 23.1	.416
CCI (mean ± SD)	1.8 ± 1.8	1.5 ± 1.4	1.7 ± 1.7	.062
DCS score (mean ± SD)	38.2 ± 24.9	27.9 ± 21.8	35.5 ± 24.5	<.001*
OSA severity				.419
Mild (AHI 5 to <15)	77 (22.3%)	20 (16.7%)	97 (20.6%)	-
Moderate (AHI 15 to <30)	124 (35.8%)	49 (40.8%)	173 (37.1%)	-
Severe (AHI ≥ 30)	120 (34.7%)	47 (39.2%)	167 (35.8%)	-
Treatments				
Current PAP use	119 (37.1%)	41 (35.3%)	160 (36.6%)	1.000
Prior MAD use	73 (22.7%)	42 (36.2%)	115 (26.3%)	.012*
Current MAD use	11 (3.4%)	5 (4.3%)	16 (3.7%)	1.000

Abbreviations: AHI, apnea-hypopnea index; BMI, body mass index; CCI, Charlson comorbidity index; DCS, decisional conflict scale; ESS, Epworth sleepiness scale; ISI, insomnia severity index; MAD, mandibular advancement device; NOSE, nasal obstruction symptom evaluation; OSA, obstructive sleep apnea; PAP, positive airway pressure.

*Statistically significant findings where $P < .05$.

Table 3. Interested Therapies and Decisional Conflict Subscores

	No DISE/surgery (*N* = 321)	DISE/surgery (*N* = 116)	Total (*N* = 437)	*P*-value
Interested therapies on initial visit				
Selected ≤3 therapies	214 (66.7%)	91 (78.5%)	305 (69.8%)	.024*
Selected "I don't know"	79 (24.6%)	18 (15.5%)	97 (22.2%)	.058
Selected a surgical option	197 (61.4%)	90 (77.6%)	287 (65.7%)	.002*
Decisional conflict subscales (mean ± SD)				
Uncertainty subscore	44.3 ± 30.6	31.0 ± 29.4	40.8 ± 30.8	<.001*
Informed subscore	45.7 ± 30.6	35.8 ± 27.5	43.1 ± 30.1	.002*
Values clarity subscore	39.7 ± 29.9	30.7 ± 25.2	37.3 ± 29.0	.004*
Support subscore	28.4 ± 21.5	20.6 ± 18.4	26.3 ± 21.0	<.001*
Effective decision	34.4 ± 24.5	22.9 ± 22.1	31.3 ± 24.4	<.001*

Abbreviation: DISE, drug-induced sleep endoscopy.
*Statistically significant findings where $P < .05$.

Table 4. Odds Ratios and *P*-Values for Logistic Regression Models Predicting Patient Scheduling for Drug-Induced Sleep Endoscopy or Surgery

	Odds ratio	95% CI lower bound	95% CI upper bound	*P*-value
Male sex	1.28	0.71	2.29	.408
ESS score	1.05	0.99	1.11	.082
ISI score	1.03	0.98	1.09	.194
AHI	1.00	0.99	1.01	.970
Age	0.99	0.98	1.01	.253
DCS score	0.97	0.97	0.99	<.001*
BMI	0.91	0.85	0.99	.019*

Abbreviations: AHI, apnea-hypopnea index; BMI, body mass index; CI, confidence interval; DCS, decisional conflict scale; ESS, Epworth sleepiness scale; ISI, insomnia severity index.
*Statistically significant findings where $P < .05$.

higher in the no DISE/surgery group. In comparing the selections to the treatment interest question, a higher proportion of patients who completed DISE/surgery selected three or fewer treatment options of interest on their initial intake form (78.5% vs 66.7% selecting three or fewer options, $P = .024$) and similarly chose a surgical option (77.6% vs 61.4%, $P = .002$).

In multivariate analysis (**Table 4**), several factors were significant predictors for pursuing DISE/surgery. Lower BMI (OR = 0.91, 95% CI [0.85, 0.99], $P = .019$) was identified as a significant predictor for pursuing DISE/surgery. Lower preconsultation decisional conflict score (OR = 0.97, 95% CI [0.97, 0.99], $P < .001$) was also an independent predictor of the DISE/surgery group.

Excluding patients with mild OSA ($5 < AHI < 15$ events/h) did not reveal significant differences across all analyses.

A secondary analysis of the patients who had DISE without subsequent surgery (n = 45) compared to DISE followed by surgery (n = 46) showed that both groups had similar exam profiles for complete concentric collapse at the velum (8.9% vs 2%; $P > .05$) and lateral oropharyngeal wall collapse. Mean preconsult DCS scores for the DISE-only group were not significantly different from DISE followed by surgery (31.8 ± 22.6 vs 23.1 ± 21.4; $P = .06$). However, DCS subscores for uncertainty and support were significantly higher in the DISE-only group (**Table 5**).

Discussion

The decision to pursue sleep apnea surgery for patients who have failed PAP therapy is a complex process involving multiple factors including OSA-related symptoms, prior treatment experiences, preconsultation interest and knowledge about surgical options, and levels of decisional conflict. This study characterizes the preconsultation predictors for pursuing and scheduling DISE evaluation and/or OSA surgery. We found that patients who pursued DISE/surgery had more severe OSA-related symptoms, lower BMI, had unsuccessful trials with both PAP and MAD, and had lower preconsultation decisional conflict scores. Patients who demonstrated higher certainty in treatment choice and expressed interest in a surgical option prior to consultation were associated with completing DISE/surgery.

Additionally, almost half of all patients who underwent DISE alone as their initial procedure did not proceed with eventual surgery. Many studies demonstrate the predictive power of DISE in surgical outcomes for OSA, which can influence patient decision-making for pursuing surgery.[24,25] Despite similar DISE findings, the group that had DISE without subsequent surgery displayed higher DCS subscores for uncertainty and support.

Our study revealed significant differences in preconsultation decisional conflict scores in those who proceeded with DISE/surgery compared to patients who did not. Individuals who scheduled DISE/surgery had increased knowledge of treatment options, better clarity on personal values related to treatment, felt more supported in their decision-making process, and were more confident in their initial treatment interests, including the decision

Table 5. Decisional Conflict Scores and Subscores Between Patients Who Pursued Drug-Induced Sleep Endoscopy (DISE) Only and DISE Followed by Subsequent Surgery

	DISE only (mean ± SD)	DISE followed by surgery (mean ± SD)	*P*-value
Total DCS score	31.8 ± 22.6	23.1 ± 21.4	.061
Uncertainty subscore	37.8 ± 2.5	24.5 ± 26.4	.035*
Informed subscore	40 ± 26.2	29.2 ± 26.7	.054
Values clarity subscore	31.5 ± 24.4	27.2 ± 24.7	.405
Support subscore	24.6 ± 19.5	16.7 ± 16.4	.038*
Effective decision	26.9 ± 24.2	19.2 ± 21.0	.105

Abbreviation: DCS, decisional conflict scale.
*Statistically significant findings where $P < .05$.

to pursue surgical intervention for OSA. This finding is supported by the significant barriers to effective decision-making in OSA management: lack of knowledge about PAP alternatives and the risks and benefits of therapies.[19] Higher decisional conflict is also associated with increased anxiety and delay in decision-making.[17]

While a prior randomized controlled trial revealed that DCS improves after consultation with a sleep surgeon, this study highlights that previsit DCS continues to be a significant predictor in the ultimate decision to pursue DISE/surgery.[26] Our findings emphasize the need for better tools and paradigms to support the decision-making process in patients in managing their OSA.

Preparing patients for their sleep surgery consultation through previsit educational tools early in the referral process may lower initial decisional conflict. The same study demonstrated that DCS can improve with the implementation of previsit educational videos. Specifically, patients with high decisional conflict showed significant improvement in decisional readiness following the combination of previsit educational videos and physician counseling highlighting the importance of educational interventions even before surgical consultation.[26]

Similarly, other decision aids in the management of OSA have been shown to improve knowledge, reduce decisional conflict, and increase adherence. A randomized controlled trial found that using a decision aid prior to and during the visit improved knowledge of OSA treatment options, increased readiness for decision-making, and reduced decisional conflict.[27] The use of decision aids by parents of pediatric patients with OSA demonstrated a reduction in decisional conflict and an increase in CPAP adherence, suggesting these factors can be positively influenced.[28,29] Further studies identifying factors and tools that play key roles in decisional readiness can inform interventions to support patients in making confident decisions on OSA management.

Surgical decision-making for a chronic disease such as sleep apnea can be a complex process that evolves over time. Providers should aim to improve the process in an accessible and understandable way. Tools and paradigms to provide knowledge about sleep apnea as a chronic disease prior to and during consultation through interdisciplinary integrated care, previsit preparation, and decision aids can help enhance decision-making and optimize consultation visits.

As surgery for OSA aims to improve sleep-related quality of life, the responsibility falls to the surgeon to educate patients on all possible treatment options and partner to help patients choose the next best therapy. A comprehensive, evidence-based understanding of the limitations of each treatment outcome should be communicated along with reasonable expectations for each patient. Personal uncertainty within the decision-making process is influenced not only by the knowledge gaps of the patient but also by those of the physician, highlighting the importance of collaboration in achieving confident decisions.[30] Although the effect of shared decision-making on the ultimate decision to pursue elective surgery remains unclear, it has been shown to improve decision quality, increase decision preparation, reduce anxiety, and increase decisional satisfaction while building physician trust.[31,32]

The decision to undergo surgery for quality-of-life-based problems is a shared decision between the patient and surgeon based on an integrated understanding of treatment goals, outcome expectations, risks, and trade-offs between treatment options. Complete informed consent includes adequate discussion and support of the decision-making process. This study demonstrates the impact of pre-evaluation decisional conflict in ultimate decisions to pursue the steps towards sleep surgery including sleep endoscopy evaluation and surgery itself. This demonstrates the need to design improved paradigms of care that (1) educate patients on evidence-based treatment options, (2) match treatment goals/expectations to the selected treatment, and (3) enhance the support for informed decision-making. Reducing decisional conflict not only better prepares patients to select treatments but is associated with improved clinical outcomes, lower decisional regret, and improved adherence to the selected treatment.

Patients who elected to proceed with DISE/surgery demonstrated significantly higher scores on the ESS and ISI suggesting that individuals who experience higher levels of daytime sleepiness and OSA-related symptoms may be more inclined to pursue surgical treatment options for OSA. Patients seek surgical evaluation due to the burden of sleep apnea which includes symptom severity, impact on

quality of life, and long-term health impacts. Similar to prior studies on CPAP adherence, those with more severe symptoms were more likely to seek and adhere to treatments for their OSA.[33] Additionally, we found that a higher proportion of patients who opted for DISE/surgery had previously trialed a MAD. These findings suggest that patients who have used PAP and MAD and are seeking other alternatives may view DISE/surgery as the next possible alternative for OSA management after failing the two major medical therapies for OSA.

Multivariate analysis demonstrated that lower BMI and lower DCS scores were independent predictors of the decision to proceed with DISE/surgery. Recent studies on the impact of significant weight loss on OSA severity reduction demonstrate the importance of a multifaceted approach to sleep apnea disease reduction.[34] Lower BMI is also associated with improved surgical outcomes, and some surgical therapies have BMI thresholds, which may influence surgical candidacy discussions and the decision to undergo DISE evaluation or surgery.[10]

This study has several important limitations that should be considered. First, the study was conducted at a single tertiary care institution, which may limit the generalizability of our findings to broader populations of OSA patients. Second, this study employs a retrospective design limiting the understanding of how decisional conflict evolves over time. Relying on clinical records and patient-reported surveys may also introduce potential recall and response bias. Although this study used a standardized DCS, we were unable to capture patient perspectives through qualitative analysis to better understand the specific factors that influenced their decision-making. Data collection relied on an initial online survey administered through REDCap completed by over 90% of new patient consultations. The timing and completeness of the survey may vary influencing the reliability of patient-reported responses. Lastly, the timing to determine the decision to pursue surgery, with a minimum of 4 months following the initial consultation, may not capture long-term decision-making processes.

Conclusion

The predictors of patients choosing to pursue sleep apnea surgery in patients with OSA are multifaceted, involving factors such as the severity of OSA-related symptoms, prior treatment experiences, interest in surgical options, and preconsultation decisional conflict levels. Higher decisional conflict scores were associated with not pursuing DISE and/or surgery. Effective interventions that improve patient knowledge and understanding of OSA treatment options and enhance support in decision-making are needed.

Author Contributions

Tiffany Husman, data collection, data analysis and interpretation of results, manuscript preparation; **Amrita Bhat**, study design, data analysis and interpretation of results, manuscript preparation; **Megan L. Durr**, study design, data collection, manuscript preparation; **Jolie L. Chang**, study design, data collection, analysis interpretation of results, supervision, manuscript preparation.

Disclosures

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Supplemental Material

Additional supporting information is available in the online version of the article.

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