Surgeon volume and reoperation risk after midurethral sling surgery

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BACKGROUND: Emerging research supports that fewer complications occur in patients who undergo surgery by higher surgical volume surgeons. The midurethral sling surgery has been involved in recent warnings and litigation, which further supports a need to understand features that enhance its safety and efficacy.

OBJECTIVE: The purpose of this study was to measure the impact of a surgeon's volume on their patient's rate of reoperation after midurethral sling surgery.

STUDY DESIGN: This was a retrospective cohort study that evaluated all surgeons who performed synthetic mesh midurethral sling surgery for stress urinary incontinence at a large managed care organization with >4.5 million members from 2005–2016. Physicians Current Procedural Terminology and International Classification of Diseases, version 9/10, codes were used to identify the procedures and the reoperations that were performed. The system-wide medical record was queried for demographic and perioperative data. The primary outcome was the overall reoperation rate after midurethral sling surgery. Concentration curves were used to identify the impact of a surgeon's surgical volume on their rate of reoperation. Demographics, characteristics, and reoperation of patients were compared with the use of chi-square test for categoric variables and Wilcoxon rank sum test for continuous variables. Poisson regression models with a robust error variance were used to calculate the unadjusted and the adjusted risk ratios of reoperation with the use of age, body mass index, marital status, race, parity, vaginal estrogen use, sling type, smoking, diabetes mellitus, and menopausal status as covariates.

RESULTS: Two hundred twenty-seven surgeons performed 13,404 midurethral sling surgeries over the study period; patients had a mean of 4.4 years of follow up. Higher-volume surgeons (>40 procedures/year, ≥95th percentile) performed 47% of the surgeries in this cohort and had an overall lower rate of reoperation (3.6% vs 4.2%; 95% confidence interval, 0.67–0.94; $P=.04$) compared with lower-volume surgeons. Higher-volume surgeons had a lower rate of reoperation for surgical failure (2.7% vs 3.6%; 95% confidence interval, 0.55–0.92; $P<.01$). Rates of reoperation for complications were similar between the 2 groups (1.1% vs 0.9%; 95% confidence interval, 0.82–1.13; $P=.32$). For patients whose condition required a reoperation secondary to complication, the rates of reoperation for urinary retention (0.9% vs 0.6%; $P=.06$), mesh exposure (0.2% vs 0.3%; $P=.31$), hemorrhage/bleeding (0.1% vs 0.0%; $P=.11$), pain (0.1% vs 0.1%; $P=.52$), and infection (0.0% vs 0.0%; $P=.37$) did not differ between higher- and lower-volume surgeons. The risk ratio for reoperation that compared higher- and lower-volume surgeons was 0.83 (95% confidence interval, 0.67–0.98; $P=.01$) in the adjusted model.

CONCLUSION: Although the reoperation rates were low for both higher- and lower-volume surgeons, higher-volume surgeons had lower overall rates of reoperation after midurethral sling surgery. This effect is seen most dramatically in reoperation for surgical failure, in which patients who have surgery with a higher-volume surgeon are 25% less likely to have postoperative stress urinary incontinence that leads to reoperation.

Key words: efficacy, midurethral sling surgery, reoperation, safety, surgeon volume

Midurethral slings (MUS) were developed in the mid-1990s[1] and have become the most commonly used surgical treatment worldwide for stress urinary incontinence (SUI), which is a condition that affects 1 in 3 adult women throughout their lives.[2] Approximately 250,000 MUSs are performed annually in the United States.[3] The MUS involves the placement of a 1-cm–wide ribbon of polypropylene mesh under the midurethra. MUS has the same treatment success rates, but less morbidity than suburethral fascial slings and open retropubic colposuspension, which are 2 traditional procedures. For example, women who undergo MUS have short-term cure rates of 62–98% and the advantage of fewer perioperative complications, are in the operating room less time, have shorter hospital stays, have lower rates of venous thromboembolism, and have lower bladder perforations compared with the open retropubic colposuspension.[2] Furthermore, success after MUS has been shown to be long-lasting, with a subjective cure rate as high as 87% after 17 years of follow up.[4]

In 2011, the Food and Drug Administration published a safety communication regarding the use of transvaginal mesh for pelvic organ prolapse (POP). This statement was in response to concerns over surgical complications that involved the use of mesh in these patients.[5] Although the Food and Drug Administration specifically excluded MUS mesh in its 2011 report and in their 2013 and 2016 updated classifications, the medicolegal community has grouped the 2 together in their litigation efforts. In the United States, >50,000 women have joined class action lawsuits for transvaginal mesh complications that resulted from SUI and prolapse procedures.[5] Because of the public and financial pressures, several companies (Endo International, Astora, Dublin, Ireland) that supply MUS have stopped producing them.[5] Although additional long-term data are needed,[2,5,6] overall reoperation after MUS is uncommon. Work from our group and other large retrospective studies have found a rate of any

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AJOG at a Glance

Why was this study conducted?

The purpose of this study was to measure the impact of a surgeon's procedural volume on the patient's rate of reoperation after midurethral sling surgery.

Key findings

Although reoperation rates were low for both higher- and lower-volume surgeons, higher-volume surgeons have lower overall rates of reoperation after midurethral sling surgery. This effect is seen most dramatically in reoperation for surgical failure, in which case patients who have surgery with a higher-volume surgeon are 25% less likely to have postoperative stress urinary incontinence that leads to reoperation.

What does this add to what is known?

Mesh litigation and warnings increasingly are impacting the availability of and comfort with midurethral sling surgery for stress urinary incontinence. This article adds to the growing literature on safety and efficacy of midurethral sling surgery and shows that higher-volume surgeons consistently have lower reoperation rates. This supports the continued use of midurethral sling surgery and the efforts to promote highly trained, experienced surgeons who perform the procedures.

reoperation of 4.5−5.5%[7,8]; reoperation for recurrent SUI and MUS mesh removal was 3.5−3.9%[7−8] and 1.0−3.4%,[7−9] respectively, at 5 years.

Emerging research finds that fewer complications occur in patients who undergo surgery by high surgical volume surgeons.[10−12] A recent systematic review of gynecologic surgeries found that a low-volume surgeon (defined in that study as a surgeon who performs a procedure once a month or less) had a 1.3 odds ratio of complications compared with those who performed procedures more frequently.[10] After placement of a MUS, there was a 37% increase in risk of reoperation for mesh removal/revision for low-volume surgeons (defined as the bottom 3 quartiles or <16 MUSs per year) in a Canadian study.[11] With additional evidence in MUS, surgeon volume could be considered as a component of the enhancement of the safety and efficacy of MUS.

Our objective was to study whether women who underwent MUS for SUI by high-volume surgeons had lower incidence of reoperations for adverse events and recurrent SUI.

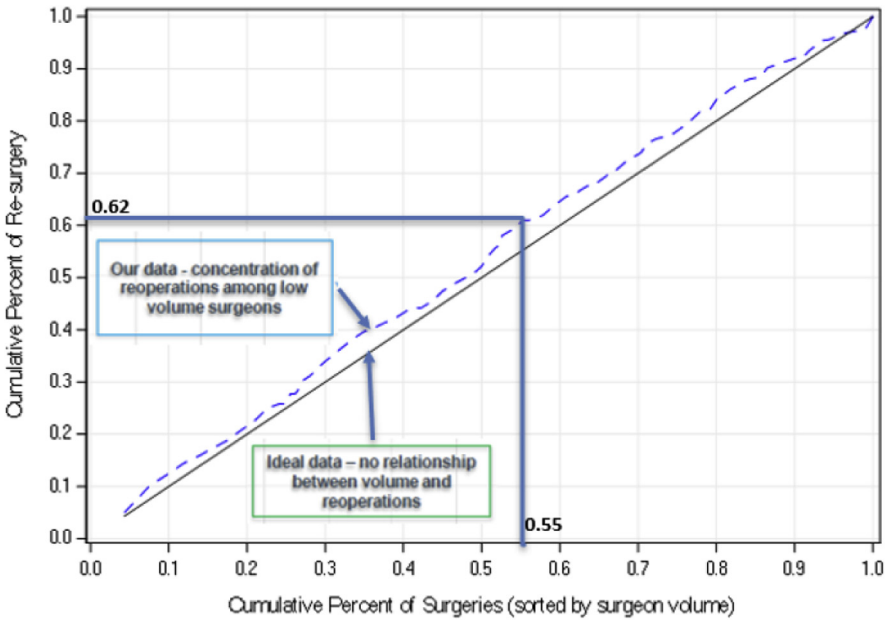
Materials and Methods

This was a subanalysis of a retrospective cohort study[8] that evaluated all surgeons who performed synthetic mesh MUS for SUI at a large managed care organization (with currently >4.5 million members) from 2005−2016. The study was approved by the Kaiser Southern California Institutional Review Board (#11508). Patients within the Kaiser system obtain all healthcare, with rare exception, within this system and have a high retention rate.[13] The systemwide medical record and linked surgical database (HealthConnect Clarity) was queried, and an algorithm was created to obtain patient data regarding primary MUS and reoperation and demographic and perioperative data with the use of physicians Current Procedural Terminology and International Classification of Diseases, version 9/10, codes. The primary outcome (overall reoperation rate after MUS) and secondary outcomes (specific reoperation rates for surgical failure and complications) were assessed. Types of reoperation for complication that were assessed were urinary retention, mesh exposure, pain, bleeding, infection, nerve injury, retropubic hematoma, bladder/urethral injury, and bowel injury. Intraoperative complications were excluded. Types of reoperation for surgical failure were assessed and included repeat MUS, bulking injection, laparoscopic and open retropubic urethropexy, abdominovaginal vesical neck suspension, Kelly plication, cystourethroplasty, and needle urethropexy. Additionally, the postoperative complications of urinary tract infection (defined as symptoms and $>10^5$ colony-forming units on urine culture), recurrent urinary tract infection, and urinary retention were assessed.

With the assistance of the Kaiser Permanente National Implant Registry, surgical implant logs that contained the product name, product number, and manufacturer, and additional codes were used to identify the MUS implants that were used. Subjects' demographic and clinical data that included age, ethnicity, marital status, body mass index (which was calculated as weight/height^2), smoking status, parity, presence or absence of diabetes mellitus, postmenopausal status, and estrogen use were obtained. MUS implants were classified as retropubic, transobturator, or single incision. Medical records and operative reports of patients with multiple implants and reoperations were reviewed individually to verify that the algorithm correctly identified the implant and instances of reoperation. Validation measures were implemented, and the accuracy of data abstraction was verified in a sample of subjects and those subjects with reoperation, and appropriate modifications were made to ensure internal validity. Subjects for whom data could not be verified or were missing were excluded.

Surgeon MUS volume, the primary exposure of interest was classified with the use of the linked databases and unique physician identifiers. With the assistance of the Kaiser Southern California Quality and Clinical Analysis group, concentration curves[14] were used to identify the impact of a surgeon's surgical volume on their rate of reoperation (Figure 1). Cumulative percentage of MUS ranked from lowest to highest on annual surgeon procedure volumes were plotted on the X axis; cumulative percentage of reoperations were plotted on the Y-axis. The 45-degree line of equality represents reoperations that are dispersed equally across surgeons with a range of MUS volumes. Curves above this line indicate reoperations that occur

FIGURE 1
Concentration curve



Fifty-five percent of the surgeries performed by lower-volume surgeons accounted for 62% of the reoperations.

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disproportionately among lower-volume surgeons. A concentration index was then used to assess the summary measurement of inequality in the reoperation rate.

All analyses were performed with SAS software (version 9.4; SAS Institute Inc, Cary, NC). Demographics, characteristics, and reoperation of patients who underwent surgery by higher- and lower-volume surgeons were compared with the use of the chi-square test for categoric variables and the Wilcoxon rank sum test for continuous variables. Poisson regression models with a robust error variance were used to calculate the unadjusted and the adjusted risk ratios of reoperation with the use of age, body mass index, marital status, race, parity, vaginal estrogen use, sling type, smoking, diabetes mellitus, and menopausal status as covariates.

Results

Demographics of the cohort

For the years 2005−2016, we identified 17,030 women who underwent a primary synthetic MUS for SUI within the health system, of which 13,404 had an identifiable surgeon and could be classified reliably into the higher- and lower-volume groups (Figure 2). The mean follow-up time was 4.4±2.77 years and did not differ between patients who underwent surgery by higher- and lower-volume surgeons. Demographics are presented in Table 1, and differences between those who underwent surgery by higher- and lower-volume surgeons are noted. Patients who underwent surgery by higher-volume surgeons were older (mean, 55.6±11.9 vs 54.1±11.7 years old; $P<.01$), were more likely to be white ($P<.01$), were more likely to be widowed ($P=.03$), were more likely to have a single incision sling (16.2% vs 4.4%; $P<.01$), and were more likely to be postmenopausal (65.0% vs 59.2%; $P<.01$), although were less likely to be a smoker (3.8 vs 5.2%; $P<.01$).

Demographics of the surgeons

The surgeries were performed by 227 unique surgeons, with a range of 11−167 surgeons performing MUS in a given year. More surgeons performed MUS over time. Surgeons performed 1−135 MUSs in a given year, with a mean volume of 10 and most performing ≤10 MUS per year (Figure 3). The concentration curve was examined, and we found that at the ≥95% (>40 MUS/year), there was a statistically significant difference in reoperation rate. The higher-volume surgeons (>40 MUS/year) performed 47% (7073/13404) of the MUS in the cohort. Most higher-volume surgeons were fellowship (75%) and gynecology (87%) trained.

Reoperation results

Patients who underwent surgery by higher-volume surgeons had a lower rate of all-cause reoperation (3.6% vs 4.2%; $P=.04$) compared with those who underwent surgery by lower-volume surgeons (Table 2). This is a relative risk of 0.86 and absolute risk reduction of 0.6% reoperation for patients who underwent surgery by higher-volume surgeons.

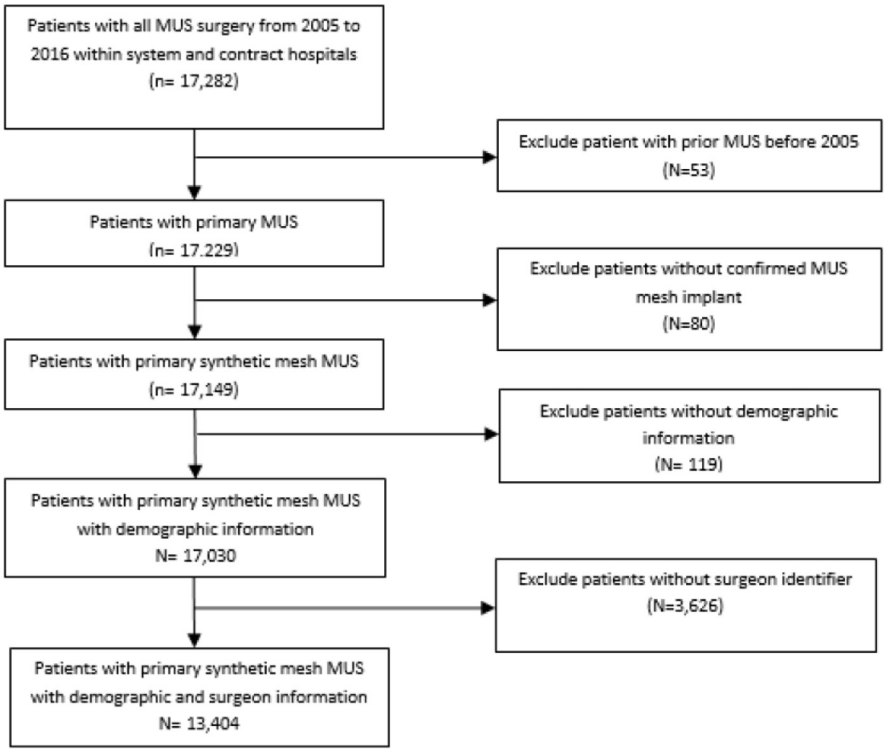
Reoperation results for mesh revision/removal because of complication

The rate of midurethral mesh sling removal/revision was similar between those patients who underwent surgery by higher- and lower-volume surgeons (1.1% vs 0.9%; $P=.32$). For patients who required a reoperation to remove or revise their midurethral mesh sling, rates of sling removal for urinary retention (0.9% vs 0.6%; $P=.06$), mesh exposure (0.2% vs 0.3%; $P=.31$), pain (0.1% vs 0.1%; $P=.52$), hemorrhage/bleeding (0.1% vs 0.0%; $P=.11$), and infection (0.0% vs 0.0%; $P=.37$) did not differ between higher- and lower-volume surgeons. There were no cases of midurethral mesh sling removal/revision for nerve injury, retropubic hematoma, bladder, urethral, or bowel injury during the study period.

Reoperation for surgical failure

Patients who underwent surgery by higher-volume surgeons for their primary MUS had a lower rate of reoperation for SUI (2.7% vs 3.6%; $P<.01$). This is a relative risk of 0.75 and absolute risk reduction of 0.9% reoperation for patients who underwent surgery by higher-

FIGURE 2
Flowchart of cohort construction



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volume surgeons. When compared with patients who underwent surgery by lower-volume surgeons, patients who underwent surgery by higher-volume surgeons had a lower rate of repeat MUS (1.5% vs 2.5%; $P<.01$) and laparoscopic retropubic urethropexy (0.0% vs 0.3%; $P<.01$). Rates of treatment for SUI after primary MUS by bulking injections (0.9% vs 0.8%; $P=.75$) and abdominal retropubic urethropexy (0.2% vs 0.1%; $P=.16$) were similar between the 2 groups. No recurrent SUI was treated with an abdominovaginal vesical neck suspension, Kelly plication, cystourethroplasty, or needle urethropexy.

Other outcomes

Patients who underwent surgery by higher-volume surgeons were no more likely to experience a urinary tract infection in the 12 months after surgery (23.5% vs 24.1%, p=0.33) than those who were operated on by lower-volume surgeons. However, patients who underwent surgery by higher-volume surgeons were less likely to experience urinary retention that required prolonged (beyond the first void trial visit, 2−4 days after surgery) catheterization (5.1% vs 6.1%; $P=.02$).

Models

Because some factors that may be associated with surgical failure or mesh removal/revision differed between those who underwent surgery by higher- and lower-volume surgeons, we performed modeling with a multivariate regression analysis. The risk ratio for reoperation that compared higher- and lower-volume surgeons was 0.86 ($P=.04$) in the unadjusted model and 0.83 ($P=.01$) in the adjusted model.

Comment

In this era of mesh litigation, safety warnings, and product withdrawals, we found that, among women with SUI who had surgery with a synthetic MUS implant, reoperation rates were low. However, we did find that, even after adjustment for potential confounders, patients who underwent surgery by higher-volume surgeons (>40 MUS/year) had a 17% lower rate of reoperation. Although rates of mesh removal/revision were similar between the groups, the rates of reoperation for SUI was 25% less likely in patients who underwent surgery by higher-volume surgeons. Although mesh-related complications were rare overall, patients who underwent surgery by higher-volume surgeons were >42% less likely to receive another synthetic MUS.

Evidence in prolapse mesh surgery,[15] hysterectomy,[16–18] and gynecology[19] supports lower reoperation rates in those patients who underwent surgery by higher-volume surgeons. One retrospective Canadian study of 59,887 MUSs explored surgeon volume and a composite reoperation for mesh-related complication outcome.[11] The study found that, among patients of higher-volume surgeons (defined in their study as ≥75%; >16 MUS/year), there was a significantly lower risk for the composite outcome (hazard ratio, 0.73 [95% confidence interval, 0.65−0.83]; absolute risk reduction, 0.63% [95% confidence interval, 0.36−0.92%]; $P<.01$). Like our study, this composite outcome did include mesh removal and revision reoperations; however, unlike our study, it did not include the indications (such as urinary retention, mesh exposure, and pain). The results differ from ours, in that we did not find any differences in reoperation for mesh removal/revision between higher- and lower-volume surgeons. However, it is difficult to compare the 2 studies in that the volume cutoffs were different, no specific totals per indication for reoperation for complication were provided, and no data on reoperation for SUI (and those for overall reoperation) are reported. A second Canadian study found that, after a surgeon performed 50 MUS per year, their patients odds of mesh revision declined, a finding that plateaued at 110 MUS per year.[20] Because this study found a nonlinear result and did not compare higher-volume to lower-volume surgeons

TABLE 1
Demographics of subjects by volume of surgeon

	Midurethral sling surgeries		
Total (n=13404)	≤40 (n=7073)	>40 (n=6331)	*P* value
Mean age, y[a]	54.1±11.69	55.6±11.94	<.0001
Age, n (%)			<.0001
20–39 Y	627 (8.9)	493 (7.8)	
40–59 Y	4245 (60.0)	3484 (55.0)	
60–79 Y	2075 (29.3)	2179 (34.4)	
≥80 Y	126 (1.8)	175 (2.8)	
Ethnicity, n (%)			<.0001
Hispanic	3917 (55.4)	3044 (48.1)	
White	2452 (34.7)	2789 (44.1)	
Asian/Pacific Island	373 (5.3)	239 (3.8)	
Black	277 (3.9)	197 (3.1)	
Others	47 (0.7)	47 (0.7)	
Unknown	7 (0.1)	15 (0.2)	
Marital status, n (%)			.0327
Married/domestic partner	5867 (68.8)	4323 (68.3)	
Divorced/separated	977 (13.8)	831 (13.1)	
Single	649 (9.2)	563 (8.9)	
Widowed	562 (7.9)	599 (9.5)	
Unknown	18 (0.3)	15 (0.2)	
Mean body mass index, kg/m^2[a]	29.5 (5.40)	29.5 (5.58)	.7253
Body mass index, n (%)			.0508
<25 kg/m^2	1446 (20.4)	1390 (21.9)	
25–29.99 kg/m^2	2716 (38.4)	2326 (36.7)	
30–34.99 kg/m^2	1842 (26.0)	1554 (25.6)	
≥35 kg/m^2	1063 (15.0)	1017 (16.1)	
Unknown	6 (0.1)	4 (0.1)	
Smokers, n (%)	365 (5.2)	243 (3.8)	<.0001
Parity[b]	3 (2,4)	3 (2,4)	.3200
Diabetes mellitus, n (%)	927 (13.1)	849 (13.4)	.6042
Postmenopausal, n (%)	4186 (59.2)	4113 (65.0)	<.0001
Type of midurethral sling, n (%)			<.0001
Retropubic	4392 (62.1)	4065 (64.2)	
Transobturator	2370 (33.5)	1241(19.6)	
Single-incision	311 (4.4)	1025 (16.2)	

[a] Data are presented as mean±standard deviation; [b] Data are presented as median (interquartile range).

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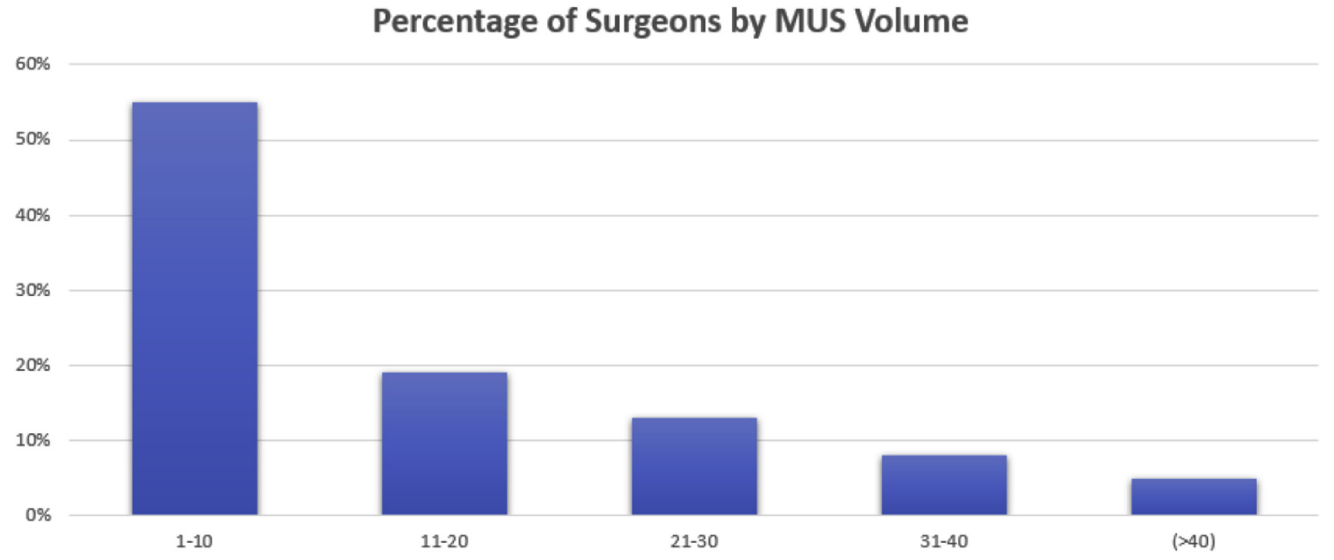
directly, it is hard to draw comparisons. However, we did find a similar cutoff of MUS per year to define higher-volume surgeons. An exhaustive search of PubMed with the use of MeSh terms ("Suburethral Slings," "reoperation," "urinary incontinence, stress," "recurrence," "surgeon volume," and "surgeon experience") confirmed no other evidence regarding the impact of surgeon MUS volume on reoperation for SUI. Our results advance the literature on

FIGURE 3
Surgeon midurethral sling volume distribution



Distribution of surgeon midurethral sling volume.

MUS, midurethral sling.

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MUS and provide these data on reoperation for recurrent SUI after MUS.

Despite small absolute risk reductions, our results do support the performance of MUS by a higher-volume surgeon. Advanced training through fellowship may be one avenue to obtain the experience needed to perform MUS and is supported by vaginal mesh regulatory notifications and expert opinion.[20–23] After this training is obtained, performing a higher-volume of MUS may be needed to continue to perform the procedure with low complication and recurrent SUI rates. Furthermore, medical centers could consider having potential surgeons demonstrate a level of experience, training, or volume before credentialing them to perform MUS.[23]

Limitations

This study has several limitations, many of which are inherent to its retrospective design. Data were entered into the medical record at the surgeon's discretion, and it is possible that the indication for reoperation could have been miscoded or documented. However, the methods of this study and the extensive verifications of data enhanced the ability to correctly report the indication for reoperation. This study set out to report postoperative complications or SUI that required reoperation in the operating room and thus could not detect complications or SUI that was managed conservatively (non-operatively) in an office setting. By reporting only on patients who underwent reoperation, we minimized the risk of inaccurate coding that can occur in the office and thus the associated overestimation of complications that can occur. Although patients within the managed care organization almost exclusively received care within the system, it is possible that patients received their primary MUS or reoperation outside of the system and thus would not be included in our study outcomes. Residual confounding is possible, despite measurement and adjustment for several covariates. For example, the degree of incontinence before the index MUS and repeat sling could not be measured. Office urethral bulking procedures were not captured in our review; thus, there may be patients who received this as treatment for recurrent SUI who were not accounted for in the study. Also, we did not assess intraoperative adverse events, given that these events have been well-characterized in other randomized controlled trials.[24] Patients of higher-volume surgeons were less likely to need prolonged catheterization and no more likely to need a reoperation for mesh removal/revision for urinary retention. Although the reason is not clear that this difference did not extend to reoperation, it is possible that the difference that was seen immediately after surgery does not persist over time (thus did not necessitate reoperation for mesh removal/revision) or that the practice patterns may differ between patients who underwent surgery by these different volume surgeons.

Strengths

Our study has several strengths. This is a large ethnically diverse cohort study that represented all MUS that were performed within a large managed care organization and thus captures the reoperation rate of its patients. Our study captured data on a diverse group of surgeons who operated at multiple medical centers, who used a wide range of MUS approaches and MUS synthetic mesh implants, thereby representing

TABLE 2
Reoperation after midurethral sling surgery for higher- vs lower-volume surgeons

	Midurethral sling surgeries, n (%)		
Total (n=13404)	≤40 (n=7073)	>40 (n=6331)	*P* value
Overall reoperation	296 (4.2)	225 (3.6)	.0414
Mesh removal/revision	64 (0.9)	68 (1.1)	
Surgical failure	256 (3.6)	170 (2.7)	
Reoperation for mesh removal/revision	64 (0.9)	68 (1.1)	.3219
Urinary retention	44 (0.6)	57 (0.9)	.0629
Mesh exposure	18 (0.3)	11 (0.2)	.3152
Pain	8 (0.1)	5 (0.1)	.5263
Bleeding	2 (0.0)	6 (0.1)	.1156
Infection	3 (0.0)	1 (0.0)	.3730
Nerve injury	0	0	
Retropubic hematoma	0	0	
Bladder/urethral injury	0	0	
Bowel injury	0	0	
Reoperation for stress urinary incontinence	256 (3.6)	170 (2.7)	.0021
Midurethral sling	178 (2.5)	98 (1.5)	<.0001
Bulking injection	60 (0.8)	57 (0.9)	.7464
Laparoscopic Burch	21 (0.3)	3 (0.0)	.0006
Burch	7 (0.1)	12 (0.2)	.1641
Abdominovaginal vesical neck suspension	0	0	
Kelly plication	0	0	
Cystourethroplasty	0	0	
Needle urethropexy	0	0	

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typical practice patterns and enhancing generalizability. Implants were linked to patient electronic medical records, which enhanced internal validity. Multiple relevant covariates were available, and a multivariable analysis was performed to confirm a statistically significant difference between higher- and lower-volume surgeons. Data on the indication for mesh removal/revision were obtained that consequently enhanced our understanding of the reason behind the mesh removal.

Importance to clinical and patient care

The implications for clinical care and patient safety of our study are significant. Although this study continues to demonstrate the overall low rates of reoperation rates after MUS in both lower- and higher-volume surgeons, patients who underwent surgery by higher-volume surgeons have lower overall rates of reoperation after MUS. This effect is seen most dramatically in reoperation for SUI, for which patients who have surgery with a higher-volume surgeon are 25% less likely to have postoperative SUIs that lead to reoperation. Similarly, patients who undergo surgery by higher-volume surgeons are less likely to need prolonged postoperative catheterization. Within our large managed care organization, we have continued to implement specialized pelvic floor centers that result in more high-volume surgeons that we believe will continue to improve surgical efficacy and safety. Our surgical efficacy and safety results can be considered by other medical organizations that seek improvement in surgical outcomes. ■

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References

1. Ulmsten U, Petros P. Intravaginal slingplasty (IVS): an ambulatory surgical procedure for treatment of female urinary incontinence. Scand J Urol Nephrol 1995;29:75–82.

2. Ford AA, Rogerson L, Cody JD, Aluko P, Ogah J. Mid-urethral sling operations for stress

urinary incontinence in women. Cochrane Database Syst Rev 2017;7:CD006375.
3. US Food & Drug Administration. Considerations about surgical mesh for SUI. Available ate: https://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/ImplantsandProsthetics/UroGynSurgicalMesh/ucm345219.htm. Accessed September 19, 2018.
4. Nilsson CG, Palva KR, Aarnio R, Morcos E, Falconer C. Seventeen years' follow-up of the tension-free vaginal tape procedure for female stress urinary incontinence. Int Urogynecol J 2013;24:1265–9.
5. Nager CW. Midurethral slings: evidence-based medicine vs the medicolegal system. Am J Obstet Gynecol 2016;214:708.e1–5.
6. Nguyen JN, Jakus-Waldman SM, Walter AJ, White T, Menefee SA. Perioperative complications and reoperations after incontinence and prolapse surgeries using prosthetic implants. Obstet Gynecol 2012;119:539–46.
7. Gurol-Urganci I, Geary RS, Mamza JB, et al. Long-term rate of mesh sling removal following midurethral mesh sling insertion among women with stress urinary incontinence. JAMA 2018;320:1659–69.
8. Berger AA, Tan-Kim J, Menefee S. Long-term risk of reoperation after synthetic mesh midurethral sling surgery for stress urinary incontinence. Obstet Gynecol 2019;134:1–10.
9. Funk MJ, Siddiqui NY, Pate V, Amundsen CL, Wu JM. Sling for mesh erosion and urinary retention: long-term risk and predictors. Am J Obstet Gynecol 2013;208:73.e1–7.
10. Mowat A, Maher C, Ballard E. Surgical outcomes for low-volume vs high-volume surgeons in gynecology surgery: a systematic review and meta-analysis. Am J Obstet Gynecol 2016;215:21–33.
11. Welk B, Al-Hothi A, Winick-Ng J. Removal or revision of vaginal mesh used in the treatment of stress urinary incontinence. JAMA Surg 2015;l150:1167–75.
12. Sung VW, Rogers ML, Myers DL, Clark MA. Impact of hospital and surgeon volumes on outcomes following pelvic reconstructive surgery in the United States. Am J Obstet Gynecol 2006;195:1778–83.
13. Gould MK, Tang T, Liu ILA, et al. Recent trends in the identification of incidental pulmonary nodules. Am J Respir Crit Care Med 2015;192:1208–14.
14. Kanter MH, Huang YC, Kally Z, et al. Using concentration curves to assess organization-specific relationships between surgeon volumes and outcomes. Jt Comm J Qual Patient Saf 2018;44:321–7.
15. Kelly EC, Winick-Ng J, Welk B. Surgeon experience and complications of transvaginal prolapse mesh. Obstet Gynecol 2016;128:65–71.
16. Boyd LR, Novetsky AP, Curtin JP. Effect of surgical volume on route of hysterectomy and short-term morbidity. Obstet Gynecol 2010;116:909–15.
17. Worley MJ Jr, Anwandter C, Sun CC, et al. Impact of surgeon volume on patient safety in laparoscopic gynecologic surgery. Gynecol Oncol 2012;125:241–4.
18. Ruiz MP, Chen L, Hou JY, et al. Outcomes of hysterectomy performed by very low-volume surgeons. Obstet Gynecol 2018;131:981–90.
19. Mowat A, Maher C, Ballard E. Surgical outcomes for low-volume vs high-volume surgeons in gynecology surgery: a systematic review and meta-analysis. Am J Obstet Gynecol 2016;215:21–33.
20. Brennand EA, Quan H. Evaluation of the effect of surgeon's operative volume and specialty on likelihood of revision after mesh midurethral sling placement. Obstet Gynecol 2019;133:1099–108.
21. US Food & Drug Administration. Urogynecologic surgical mesh: update on the safety and effectiveness of transvaginal placement for pelvic organ prolapse. Available at: http://www.fda.gov/downloads/medicaldevices/safety/alertsandnotices/UCM262760.pdf. Published 2011. Accessed February 11, 2018.
22. Chapple CR, Raz S, Brubaker L, Zimmern PE. Mesh sling in an era of uncertainty: lessons learned and the way forward. Eur Urol 2013;64:525–9.
23. American Urogynecologic Society. Position Statement on Restriction of Surgical Options for Pelvic Floor Disorders. Available at: https://www.augs.org/assets/1/6/Position_Statement_Surgical_Options_for_PFDs.pdf. Accessed December 1, 2018.
24. Richter HE, Albo ME, Zyczynski HM, et al. Retropubic versus transobturator midurethral slings for stress incontinence. N Engl J Med 2010;362:2066–76.

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