

## UROGYNECOLOGY

## Trends in use of surgical mesh for pelvic organ prolapse

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**OBJECTIVE:** Limited data exist on the rates of pelvic organ prolapse procedures utilizing mesh. The objective of this study was to examine trends in vaginal mesh prolapse procedures (VMs), abdominal sacrocolpopexy (ASC), and minimally invasive sacrocolpopexy (MISC) from 2005 to 2010.

**STUDY DESIGN:** We utilized deidentified, adjudicated health care claims data from across the United States from 2005 to 2010. Among women 18 years old or older, we identified all mesh prolapse procedures based on Current Procedural Terminology codes (57267 for VM, 57280 for ASC, and 57425 for MISC). VM procedures included all vaginal prolapse surgeries in which mesh was placed, whether in the anterior, apical, or posterior compartment. We estimated rates per 100,000 person-years (100,000py) and 95% confidence intervals (CIs).

**RESULTS:** During 78.5 million person-years of observation, we identified 60,152 mesh prolapse procedures, for a rate of 76.0 per

100,000py (95% CI, 73.6–78.5). Overall, VMs comprised 74.9% of these surgeries for an overall rate of 56.9 per 100,000py (95% CI, 55.0–58.9). Rates of ASC and MISC were considerably lower at 12.0 per 100,000py (95% CI, 11.6–12.5) and 9.5 per 100,000py (95% CI, 9.2–9.9), respectively. Among sacrocolpopexies, ASC was more common than MISC in 2005–2007; however, since 2007, the rate of MISC has increased, whereas the rate of ASC has decreased. Regarding trends by age, VM was considerably more common than sacrocolpopexies at all ages, and ASC was more common than MISC in women older than 50 years.

**CONCLUSION:** From 2005 to 2010, the rate of mesh prolapse procedures has increased, with vaginal mesh surgeries constituting the vast majority.

**Key words:** pelvic organ prolapse, sacrocolpopexy, surgery, transvaginal mesh, trends

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The recent Food and Drug Administration (FDA) safety communication regarding vaginal mesh for pelvic organ prolapse has drawn attention to the surgical management of this highly prevalent condition.<sup>1</sup> In the July 2011 update on the original 2008 public health notification,<sup>2</sup> the FDA stated that “based on an updated analysis of adverse events

## ★ EDITORS' CHOICE ★

reported to the FDA and complications described in the scientific literature, the FDA identified surgical mesh for transvaginal repair of POP [pelvic organ prolapse] as an area of continuing serious concern.”<sup>1</sup> The American Congress of Obstetricians and Gynecologists (ACOG) and the Amer-

ican Urogynecologic Society (AUGS) have recognized the critical importance of complications such as mesh exposure, erosion, and contracture and the symptoms associated with these complications.<sup>3</sup>

The first mesh kits to aid in the insertion of vaginal synthetic graft material for prolapse were cleared by the FDA in 2004 and marketed by American Medical Systems (San Jose, CA) under the names Apogee and Perigee systems.<sup>4,5</sup> Since then, there has been an influx of new prolapse mesh devices introduced in the United States.<sup>6</sup> Sales data from manufacturers indicate that 300,000 women underwent pelvic organ prolapse surgery in 2010.<sup>6</sup> Of these, one-third utilized mesh (~100,000), and three quarters of these mesh procedures were transvaginal surgeries. Thus, approximately, 75,000 procedures involved transvaginal placement of mesh. Despite these estimates, population-based estimates of vaginal and abdominal mesh prolapse surgeries are extremely limited. Furthermore, utilization of mesh for prolapse repair categorized by age and region is lacking.

Several studies have evaluated national trends in prolapse surgeries overall,<sup>7-10</sup> but these estimates provide limited informa-

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tion regarding mesh prolapse procedures specifically. One reason is that *International Classification of Diseases*, Ninth Revision, Clinical Modification (ICD-9-CM) codes for prolapse graft materials (ie, codes 70.53, 70.54, 70.55, 70.94, and 70.95) were not introduced until 2007.<sup>11</sup>

Another limitation is that ICD-9-CM procedure codes, which are utilized by a majority of national databases, do not incorporate the more specific Current Procedural Terminology (CPT) codes. Because of these limitations, the rates of specific mesh procedures have not been reported, and the impact on rates of transvaginal mesh procedures after the 2 recent FDA notifications in 2008 and 2011 is relatively unknown. It is critical to understand whether the FDA safety notifications have translated into changes in the rates of transvaginal mesh procedures.

Given the knowledge gaps in the existing literature, we sought to use the more informative CPT codes in a population-based analysis to estimate trends in prolapse mesh procedures from 2005 to 2010. Furthermore, we wanted to estimate the rates of specific prolapse procedures, such as vaginal mesh procedures (VM), abdominal sacral colpopexy (ASC), and minimally invasive sacrocolpopexy (MISC) and to estimate the trends in these surgeries based on age and region of the United States.

## MATERIALS AND METHODS

### Data source

This analysis is based on Thomson Reuters' MarketScan Commercial Claims and Encounters database and Medicare Supplemental and Coordination of Benefits database from 2005 to 2010.<sup>12</sup> These data represent the medical encounters of individuals with employment-based insurance including spouses, dependents, and retirees. Specifically, the databases contain deidentified, individual-level inpatient, outpatient, and pharmacy claims as well as detailed enrollment data from approximately 100 payers in the United States. Claims and enrollment data are validated to ensure completeness, accuracy, and reliability. Although the data are deidentified, unique individuals can be followed up over time using encrypted identification

numbers. The databases contain adjudicated, paid claims for approximately 28.3 million individuals in 2005, increasing to 48.8 million in 2010. Of note, in 2010, 55.3% of the US population had employment-based insurance.<sup>13</sup> This study was determined to be exempt from further review by the Institutional Review Board at the University of North Carolina at Chapel Hill.

### Pelvic organ prolapse mesh surgery rates

The study population included all women aged 18 years or older from 2005 to 2010. We utilized CPT codes to identify any prolapse procedures involving mesh placement. A vaginal mesh procedure was defined by the CPT code 57267 (insertion of mesh or other prosthesis for repair of pelvic floor defect, each site, vaginal approach). Because this code is listed in addition to CPT code(s) for the primary procedure(s), we defined a vaginal mesh procedure if CPT 57267 was listed at least once on a specific surgery date. For example, if the mesh was placed in both the anterior and posterior compartment and CPT 57267 was listed twice, this surgery would be counted as a single VM procedure.

We chose to evaluate trends starting in 2005 because the CPT code 57267 was released on Jan. 1, 2005.<sup>14</sup> We opted to use CPT codes instead of ICD-9-CM codes because ICD-9-CM vaginal mesh codes were not introduced until 2007.<sup>11</sup> For sacrocolpopexies, ASCs were identified using CPT code 57280, which indicates colpopexy, abdominal approach. Minimally invasive sacrocolpopexies, MISCs, were defined by CPT code 57425, a code that was released in 2004. MISC represents both laparoscopic and robotic-assisted laparoscopic sacrocolpopexies because CPT codes distinguishing these 2 types of surgeries do not exist.

Rates were calculated by dividing the total number of surgeries in each category (VM, ASC, and MISC) by the total person-time at risk. To calculate person-time at risk, we summed all periods of time when eligible women were enrolled in a health plan that contributed to the database.

We also evaluated common concurrent procedures with VM, ASC, and MISC. Specifically, we evaluated concomitant sling, CPT 57288, as well as concomitant hysterectomy. We evaluated the type of hysterectomy (total vs supracervical) based on CPT codes. Total hysterectomy included total abdominal (CPT codes 58150, 58152, 58200, and 58210), total vaginal (CPT codes 58260, 58262, 58263, 58267, 58270, 58275, 58280, 58285, 58290, 58291, 58292, 58293, and 58294), and total laparoscopic, which also included laparoscopic assisted vaginal hysterectomy (CPT codes 58545, 58546, 58548, 58550, 58552, 58553, 58554, 58570, 58571, 58572, and 58573). Supracervical hysterectomies included both abdominal supracervical (CPT code 58180) and laparoscopic supracervical (CPT codes 58541, 58542, 58543, and 58544).

### Statistical analysis

We estimated the rate of any prolapse mesh surgery overall as well as procedure-specific rates for VM, ASC, and MISC. In addition, we estimated the procedure and calendar year, procedure and location (inpatient vs outpatient), procedure and age, and procedure- and region-specific rates for prolapse mesh surgery. We estimated 95% confidence intervals (CIs) based on the Poisson distribution. Rates and CIs are reported per 100,000 person-years (100,000py).

To adjust for differences in the age distribution over calendar time and across regions, we estimated region-specific and calendar year-specific rates using Poisson regression, adjusting for age using 15 categorical variables (18-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85-89, and 90 years or older). Wald  $\chi^2$  statistics were used to test the significance of independent predictors with a 2-sided alpha of 0.05. All confidence intervals were estimated and statistical tests were conducted using Poisson regression with the dispersion parameter empirically estimated by the Pearson  $\chi^2$  divided by the degrees of freedom to account for overdispersion. The analyses were performed using SAS, version 9.2 (SAS Institute, Cary, NC).

**TABLE 1**  
**Demographics of women who underwent mesh prolapse procedures**

Characteristic	Person-years (n = 78,496,836)		Any prolapse surgery with mesh (n = 60,152) <sup>a</sup>		Vaginal mesh procedures (n = 45,042)		Abdominal sacrocolpopexy (n = 9518)		Minimally invasive sacrocolpopexy (n = 7542)	
	n	%	n	%	n	%	n	%	n	%
Calendar year										
2005	9,819,195	12.5	5291	8.8	3,627	8.1	1,466	15.4	424	5.6
2006	10,460,669	13.3	7539	12.5	5,832	12.9	1,416	14.9	541	7.2
2007	10,512,203	13.4	8599	14.3	6,756	15.0	1,466	15.4	625	8.3
2008	15,488,086	19.7	12,050	20.0	9,244	20.5	1,776	18.7	1377	18.3
2009	15,418,194	19.6	12,506	20.8	9,294	20.6	1,710	18.0	1883	25.0
2010	16,798,488	21.4	14,167	23.6	10,289	22.8	1,684	17.7	2692	35.7
Age, y										
18-29	14,145,115	18.0	490	0.8	310	0.7	94	1.0	97	1.3
30-39	14,273,280	18.2	3807	6.3	2,394	5.3	692	7.3	823	10.9
40-49	17,321,528	22.1	11,326	18.8	7,644	17.0	1,983	20.8	2018	26.8
50-59	17,194,089	21.9	18,653	31.0	13,994	31.1	3,021	31.7	2304	30.5
60-69	8,682,445	11.1	16,337	27.2	12,754	28.3	2,487	26.1	1700	22.5
70-79	4,073,367	5.2	7518	12.5	6,191	13.7	1,017	10.7	524	6.9
80+	2,807,011	3.6	2021	3.4	1,755	3.9	224	2.4	76	1.0
Region										
Northeast	9,776,689	12.5	5037	8.4	3,542	7.9	866	9.1	773	10.2
Midwest	20,620,422	26.3	14,782	24.6	11,187	24.8	2,476	26.0	1596	21.2
South	33,707,919	42.9	30,291	50.4	22,583	50.1	4,920	51.7	3827	50.7
West	13,917,189	17.7	9686	16.1	7,455	16.6	1,205	12.7	1300	17.2
Unknown	474,617	0.6	356	0.6	275	0.6	51	0.5	46	0.6

<sup>a</sup> Number of specific prolapse mesh procedures does not total 60,152 because some patients had more than 1 type of procedure.

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## RESULTS

From 2005 to 2010, women aged 18 years and older contributed a total of 78,496,836 person-years. Among these women, there were 60,152 pelvic organ prolapse procedures that involved the use of mesh. Table 1 lists the person-time contribution for the population at risk, divided by calendar year, age group (18-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80 years or older), and region of the United States. Furthermore, Table 1 describes the overall number of prolapse procedures with mesh, as well as the specific type of surgery, whether VM, ASC, or MISC.

The overall rate of any prolapse surgery with mesh was 76.0 per 100,000py

(95% CI, 73.6–78.5) (Table 2). VM comprised 74.9% of these surgeries for an overall rate of 56.9 per 100,000py (95% CI, 55.0–58.9). Rates of ASC and MISC were considerably lower at 12.0 per 100,000py (95% CI, 11.6–12.5) and 9.5 per 100,000py (95% CI, 9.2–9.9), respectively (Table 2). Although approximately half of the VM and MISC procedures were performed on an outpatient basis, a majority of the ASC procedures were inpatient surgeries (Table 2).

Regarding the trend for the total number of prolapse mesh procedures from 2005 to 2010, there was a significant increase from 53.5 per 100,000py (95% CI, 49.4–57.9) in 2005 to 83.7 per 100,000py (95% CI, 77.3–90.5) in

2010 ( $P < .0001$ ) (Figure 1). There was also a significant increase for VM procedures from 36.7 to 60.8 per 100,000py ( $P < .0001$ ) (Table 2 and Figure 1). For VM, the rate appears to increase from 2005 to 2008 and then level off from 2008 to 2010. Among sacrocolpopexies, the rate of ASCs significantly decreased from 14.8 per 100,000py (95% CI, 13.5–16.2) in 2005 to 9.9 per 100,000py (95% CI, 9.1–10.8) in 2010 ( $P < .0001$ ). In contrast, the rate of MISCs significantly increased from 4.3 to 15.9 per 100,000py ( $P < .0001$ ). By 2010, the rate of MISCs was higher than that of ASCs (Table 2).

VM was the most common type of prolapse mesh surgery with age-specific rates higher than ASC and MISC

**TABLE 2**  
**Rates per 100,000 person-years for mesh prolapse procedures**

Variable	Any prolapse surgery with mesh (n = 60,152)		Vaginal mesh procedures (n = 45,042)		Abdominal sacrocolpopexy (n = 9518)		Minimally invasive sacrocolpopexy (n = 7542)	
	Rate <sup>a</sup>	95% CI	Rate <sup>a</sup>	95% CI	Rate <sup>a</sup>	95% CI	Rate <sup>a</sup>	95% CI
Total	76.0	73.6–78.5	56.9	55.0–58.9	12.0	11.6–12.5	9.5	9.2–9.9
Procedure location								
Inpatient	40.5	39.2–41.9	27.8	26.9–28.9	10.2	9.8–10.5	4.1	3.9–4.3
Outpatient	35.5	34.4–36.7	29.1	28.1–30.1	1.9	1.8–1.9	5.4	5.2–5.6
Calendar year								
2005	53.5	49.4–57.9	36.7	33.7–39.9	14.8	13.5–16.2	4.3	3.9–4.7
2006	71.5	66.3–77.1	55.3	51.0–59.9	13.4	12.4–14.6	5.1	4.7–5.6
2007	81.1	75.1–87.6	63.7	58.7–69.2	13.8	12.7–15.0	5.9	5.4–6.4
2008	77.2	71.5–83.3	59.2	54.4–64.4	11.4	10.5–12.3	8.8	8.2–9.5
2009	80.5	74.5–87.0	59.8	55.0–65.0	11.0	10.1–12.0	12.1	11.3–13.0
2010	83.7	77.3–90.5	60.8	55.7–66.2	9.9	9.1–10.8	15.9	14.8–17.1
Age, y								
18–29	3.4	3.0–4.0	2.2	1.8–2.6	0.7	0.5–0.8	0.7	0.5–0.8
30–39	26.9	25.2–28.8	16.9	15.7–18.3	4.9	4.5–5.3	5.8	5.3–6.3
40–49	65.9	63.3–68.5	44.5	42.5–46.5	11.5	10.9–12.2	11.7	11.0–12.5
50–59	107.7	104.2–111.3	80.8	77.8–83.9	17.4	16.6–18.3	13.3	12.4–14.2
60–69	178.8	171.8–186.2	139.6	133.8–145.7	27.2	25.8–28.7	18.6	17.2–20.2
70–79	182.5	175.8–189.4	150.3	144.6–156.1	24.7	23.0–26.5	12.7	11.3–14.3
≥80	68.1	65.2–71.0	59.1	56.6–61.8	7.5	7.0–8.2	2.6	2.3–2.8
Region								
Northeast	51.1	47.4–55.1	35.9	33.1–39.0	8.8	8.1–9.6	7.8	7.1–8.6
Midwest	71.1	66.3–76.2	53.8	49.9–58.1	11.9	11.1–12.8	7.7	7.0–8.4
South	89.2	83.2–95.6	66.5	61.7–71.7	14.5	13.5–15.5	11.3	10.5–12.1
West	69.0	64.7–73.7	53.1	49.5–57.0	8.6	7.9–9.3	9.3	8.6–10.0
Unknown	73.0	64.4–82.9	56.4	49.1–64.8	10.5	8.2–13.3	9.4	7.2–12.4

CI, confidence interval.

<sup>a</sup> Rate per 100,000py.

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for all age cohorts (Table 2 and Figure 2). The age-specific rate for VM was highest in women aged 70–79 years, whereas the rates of ASC and MISC were highest in women aged 60–69 years (Table 2).

When evaluating trends by region, Figure 3 depicts the age-specific rates for any prolapse mesh procedure from 2005 to 2010 by region of the United States. This figure illustrates that all regions had significantly higher rates of prolapse mesh surgeries compared

with the Northeast, after adjusting for age ( $P < .0001$ ). Furthermore, the rates were highest in the South compared with the other regions of the United States (Table 2).

We also wanted to describe common concurrent procedures that occurred with the use of mesh for prolapse. A concomitant sling occurred in 39.9% ( $n = 24,024$ ) and a concurrent hysterectomy in 27.2% ( $n = 16,363$ ) of mesh prolapse procedures. Among hysterectomies, 14.6% ( $n = 2385$ ) were supracervical.

## COMMENT

In this population-based analysis of more than 60,000 pelvic organ prolapse procedures utilizing mesh, vaginal mesh represented the majority (74.9%) of surgeries. From 2005 to 2010, there has been a significant increase in prolapse mesh procedures, largely because of the increase in VM because rates of sacrocolpopexies (both ASC and MISC) remained relatively low. Interestingly, the rate of ASC declined over this time period, whereas the rate of

MISC increased. As for trends based on age, VM was the most common procedure across all age groups. Despite the initial FDA public health notification in October 2008,<sup>2</sup> we did not see evidence of a dramatic decrease in the rate of VM procedures after 2008, but this rate did appear to level off from 2008 to 2010.

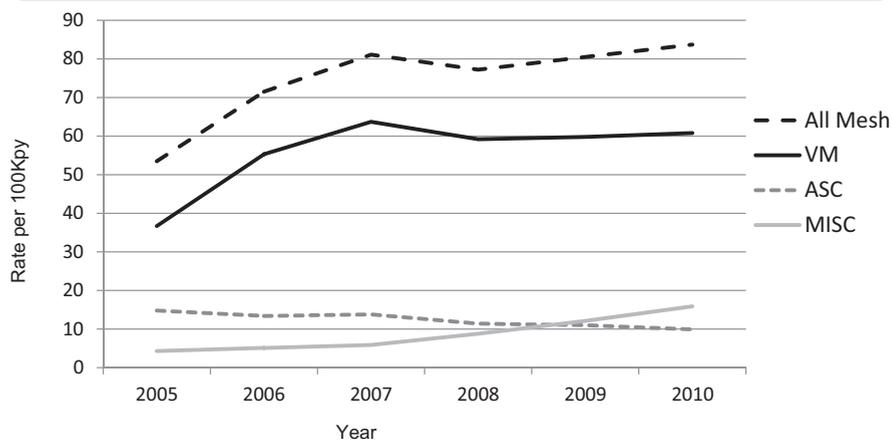
Our CPT-based approach to describe mesh use during prolapse surgery is novel because previous literature is limited. In 2010, the FDA estimated that of the 300,000 prolapse surgeries performed annually, one third utilized mesh grafts.<sup>6</sup> Our finding that 74.9% of the mesh procedures were VMs mirrors industry estimates that three quarters of mesh procedures are transvaginal. These data confirm the popularity of these surgeries in current practice.

The high rate of VM procedures further emphasizes the importance of potentially serious complications of these procedures. The July 2011 FDA update stated that there were 1503 reported complications associated with surgical mesh devices for prolapse from Jan. 1, 2008, through Dec. 31, 2010.<sup>1</sup> The most common complications included “mesh erosion through the vagina (also called exposure, extrusion, or protrusion), pain, infection, bleeding, pain during sexual intercourse (dyspareunia), organ perforation, and urinary problems. There were also reports of recurrent prolapse, neuromuscular problems, vaginal scarring/shrinkage, and emotional problems.”<sup>1</sup>

Unfortunately, many of these complications required additional interventions, and anecdotally, many urogynecologists are witnessing a dramatic increase in the number of patients with mesh complications in their practices. Although the existing literature suggests that there may be a role for mesh augmentation in the anterior compartment for improved anatomic success,<sup>3,6,15,16</sup> the FDA stated that it is not clear that that mesh augmentation is more effective than compared with native tissue repairs.<sup>1,6</sup> In their joint committee opinion, ACOG and AUGS recommended that mesh augmentation be reserved for high-risk individuals in whom the benefit of mesh placement outweighs the po-

FIGURE 1

### Annual rates per 100,000 person-years for all mesh pelvic organ prolapse procedures



Annual rates per 100,000py for all mesh pelvic organ prolapse procedures, VM, ASC, and MISC, from 2005 to 2010. Regarding the trend for the total number of prolapse mesh procedures (All mesh) over calendar time, there was a significant increase ( $P < .0001$ ). There was also a significant increase for VM procedures and MISCs from 2005 to 2010 ( $P < .0001$ ). In contrast, there was a significant decrease in the rate of ASCs over the calendar year ( $P < .0001$ ).

ASC, abdominal sacrocolpopexy; MISC, minimally invasive sacrocolpopexy; VM, vaginal mesh.

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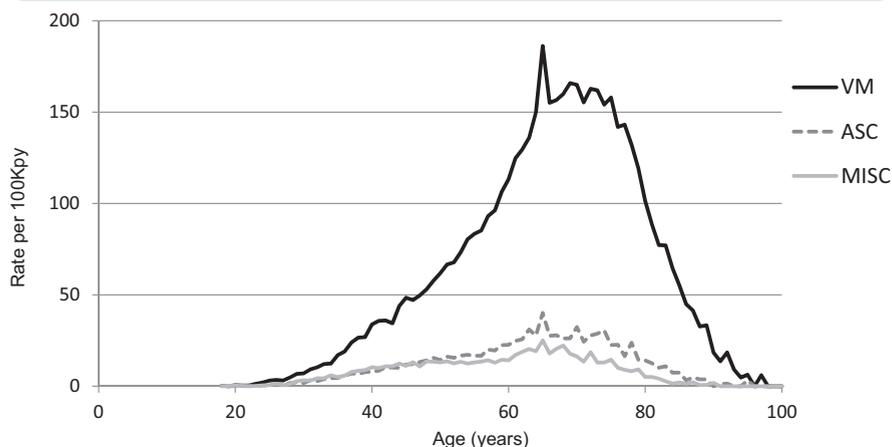
tential risks.<sup>3</sup> Although the initial FDA notification in 2008 did not have a dramatic impact on VM rates, it will be important to monitor the impact of the July 2011 update on rates of VM procedures in the coming years.

In addition to an increase in VM procedures from 2005 to 2010, our data

show an increase in the MISC rate and a decrease in the ASC rate over the study period. Because of the limited detail of CPT codes in current use, we are unable to distinguish between laparoscopic and robotic-assisted sacrocolpopexies, and we cannot definitively state what proportion of MISC is due to each of these

FIGURE 2

### Age-specific rates per 100,000 person-years for all mesh pelvic organ prolapse procedures

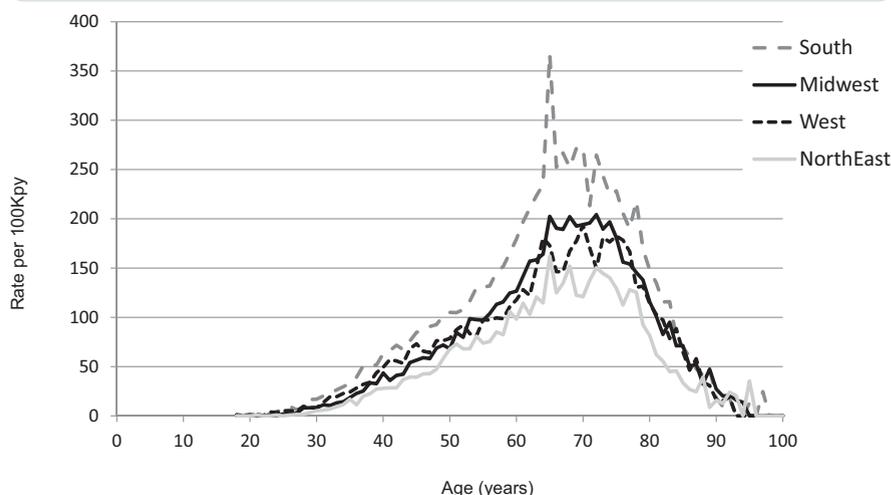


Age-specific rates per 100,000py for VM, ASC, MISC performed from 2005 to 2010.

ASC, abdominal sacrocolpopexy; MISC, minimally invasive sacrocolpopexy; VM, vaginal mesh.

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**FIGURE 3**  
**Age-specific rates for prolapse mesh procedures, stratified by region**



Age-specific rates for prolapse mesh procedures performed from 2005 to 2010, stratified by region of the United States. When evaluating regional differences in prolapse mesh surgery rates after adjusting for age, all regions have significantly higher rates when compared with the Northeast ( $P < .0001$ ).

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approaches. Jones et al<sup>9</sup> showed that laparoscopic prolapse surgeries increased among inpatients from 1979 to 2006, and Bradley et al<sup>10</sup> reported that minimally invasive inpatient prolapse procedures increased from 4.8% in 1998 to 9.4% in 2007. Although the laparoscopic sacrocolpopexy was first described in 1994,<sup>17</sup> the robotic-assisted approach was first reported in 2004.<sup>18,19</sup> In 2005, the da Vinci surgical system (Intuitive Surgical, Inc, Sunnyvale, CA) was approved by the FDA for use in gynecology.<sup>20</sup> Given this timeline, we postulate the greater proportion of the increase in the MISC rate may be secondary to an increase in the number of robotic-assisted sacrocolpopexies.

In our study, we found that a total hysterectomy (TAH) was more common than a supracervical hysterectomy (SCH) for both ASC and MISC. The literature is conflicting regarding the relationship of type of hysterectomy and the risk of mesh erosion.<sup>22</sup> Several studies suggest that there may be no difference between the risk of mesh erosion after ASC between TAH and SCH.<sup>21,22</sup> However, a large, randomized, multicenter study found an increased risk of mesh or suture erosion with ASC with concomi-

tant TAH (14%) compared with those with a prior hysterectomy (4%).<sup>23</sup> Furthermore, 2 studies that assessed robotic-assisted MISC found no erosions among subjects who had concomitant SCH.<sup>24,25</sup> These data suggest concurrent SCH may decrease the risk of mesh erosion following a sacrocolpopexy. However, minimally invasive SCH is not without its trade-offs because there is the need for continued cervical cancer screening and the risk of unanticipated premalignant or malignant uterine pathology in a morcellated SCH specimen.<sup>25-27</sup> Further research and education regarding hysterectomy choice and ASC and MISC is warranted.

The largest proportion of mesh prolapse surgeries in our study was performed in women aged 60-69 years. This age range is similar to that of prior studies investigating inpatient prolapse surgery trends in the United States because most procedures were performed in women aged 60-79 years.<sup>10,28</sup> Prior investigations have also shown the mean age of women undergoing both inpatient and outpatient prolapse surgery in the United States has increased over the last decade.<sup>8,9</sup> Regional trends have consistently shown that the South has the high-

est rates of prolapse surgery, although this is largely unexplained.<sup>9,10,28</sup> This trend could potentially be related to several factors: the increased tendency of physicians in the South to perform surgery for prolapse, a higher prevalence of disease in the South, or greater preference of surgery as a treatment option for prolapse among Southern women. These factors have not been thoroughly investigated or well explored.

In this study, we present data regarding the rates of prolapse procedures that involve the use of mesh. The strengths of this study include the use of a population-based database of adjudicated health care claims, which provides an exceptionally large cohort to evaluate. Furthermore, the utilization of CPT vs ICD-9 codes allowed us to evaluate specific prolapse procedures (ie, VM vs ASC vs MISC) as well as whether these procedures were performed on an inpatient or outpatient basis. Lastly, we evaluated trends starting in 2005 because the CPT vaginal mesh codes were introduced that year. Evaluation of prolapse mesh procedures prior to 2005 may not be particularly accurate because specific codes were not available.

Regarding limitations, it is possible that some VM procedures were not appropriately coded in 2005 because CPT code 57267 was introduced that year; however, the significant upward trend in VM rates suggests that there has likely been an increase in the use of these procedures. Another factor is that we did not have details regarding the surgical procedure in terms of the type of mesh utilized as well as the method in which mesh was placed. For MISC, the CPT code 57425 for laparoscopic colpopexy could also represent laparoscopic uterosacral ligament suspensions; thus, it is possible that we may have slightly overestimated the rate of sacral colpopexies utilizing mesh.

In addition, we were unable to evaluate certain demographic or clinical factors, such as race, body mass index, indication for surgery (ie, primary prolapse surgery or surgery for recurrent prolapse), or stage of prolapse. Lastly, our database included only those with employer-based insurance, and thus, our results may not be generalizable to those without other types of insurance or self-pay patients. Fortu-

nately, with the Medicare supplemental database, we were able to evaluate older women who had employer-based insurance and then transitioned into Medicare at 65 years of age.

In conclusion, transvaginal mesh procedures comprised 75% of all prolapse mesh surgeries, and VM was the most common mesh procedure across all age groups. Although rates of vaginal mesh procedures were significantly higher than abdominal and minimally invasive sacrocolpopexies, the rate of MISC increased, whereas that of the ASC decreased from 2005 to 2010. Although we did not see a dramatic decrease in the rate of VM procedures after the initial FDA public health notification in 2008, the rate of VM appeared to level off from 2008 to 2010. It will be important to evaluate the impact of the July 2011 FDA notification because this statement highlighted serious complications after transvaginal mesh prolapse surgery more emphatically than the 2008 statement.

Beyond evaluating trends in surgery rates, future studies should strive for rigorous, comparative effectiveness studies that incorporate patient-centered outcome measures as well as long-term, population-based data regarding complications of vaginal mesh. Despite the popularity of VM procedures, population-based data regarding the rates of repeat surgery to manage complications such as mesh erosion/exposure and mesh contracture are strikingly lacking.

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