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ORIGINAL ARTICLE

Outcomes of trocar-guided Gynemesh PS™ versus single-incision trocarless Polyform™ transvaginal mesh procedures

Maryse Larouche · Lisa Merovitz · José A. Correa · Jens-Erik Walter

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Abstract
Introduction and hypothesis The aim of the study was to compare rates of success, mesh exposure, and surgical re-intervention after trocar-guided Gynemesh PS™ and trocarless Polyform™ transvaginal mesh procedures.
Methods We conducted a retrospective cohort study of all transvaginal mesh procedures performed at our centers between January 2008 and May 2012. Multiple logistic regression models were used to explore the binary outcomes of objective and subjective success rates, as well as mesh exposure and re-intervention rates, between the two procedures after adjustment for patient's age, parity, body mass index, smoking status, previous hysterectomy, previous prolapse surgery, and follow-up time.
Results We included 103 transvaginal mesh procedures (47 trocar-guided Gynemesh PS™ and 56 trocarless Polyform™). In both groups, Pelvic Organ Prolapse Quantification (POP-Q) scores were significantly improved after the procedure. Median follow-up was 340 days and interquartile range (IQR) 152–644. Objective success rates were 55.3 % (26/47) in the trocar group and 60.7 % (34/56) in the trocarless group (p=0.9), whereas subjective success was 83.0 % (39/47) and 94.6 % (53/56), respectively (p=0.1). The adjusted odds of developing mesh exposure were significantly less after trocarless transvaginal mesh procedures compared to trocar-guided ones [odds ratio (OR) 0.16, 95 % confidence interval (CI) 0.03–0.97]. Surgical re-interventions, aimed mostly at treating recurrent prolapse, mesh exposure, and latent stress urinary incontinence, were also significantly less frequent after trocarless procedures [5 patients (8.9 %) requiring re-intervention versus 15 (31.9 %), respectively, adjusted OR 0.15, 95 % CI 0.04–0.60].
Conclusions Trocar-guided Gynemesh PS™ and trocarless Polyform™ transvaginal mesh systems result in similar objective and subjective success rates. The newer Polyform™ mesh results in significantly fewer mesh exposures and surgical re-interventions.

Keywords Pelvic floor repair · Polypropylene mesh · Sacrospinous ligament suspension · Single-incision · Surgical mesh · Transvaginal mesh

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M. Larouche · J.-E. Walter (✉)
Department of Obstetrics and Gynecology, McGill University Health Centre, 687 Pine Avenue West, Room F8.59, Montreal, QC, Canada H3A 1A1
e-mail: walter.je@gmail.com

L. Merovitz
Department of Obstetrics and Gynecology, St-Mary's Hospital, Montreal, QC, Canada

J. A. Correa
Department of Mathematics and Statistics, McGill University, Montreal, QC, Canada

Introduction

Due to the high recurrence rate of native tissue repairs for pelvic organ prolapse, a variety of procedures using mesh have been developed with the goal of improving success rates. Trocar-guided type I polypropylene transvaginal mesh systems have been the subject of much scrutiny since the initial 2008 US Food and Drug Administration (FDA) advisory concerning severe complications that may result from their use [1]. Concerns grew after the 2011 FDA advisory which stated that these complications are not rare [2]. Anterior compartment prolapse repair with polypropylene mesh was found to result in less anatomical and symptomatic recurrent anterior

prolapse than traditional colporrhaphy [3]. However, transobturator trocar-guided transvaginal mesh systems result in 11.4 % mesh exposure and 6.8 % surgical re-intervention due to exposure [3]. These are also associated with increased incidences of de novo stress urinary incontinence and unmasked prolapse in untreated apical/posterior compartments [3]. Five years later, the use of transvaginal mesh systems remains controversial.

Newer single-incision trocarless transvaginal mesh systems have been introduced that allow placement of mesh without trocars, thus theoretically decreasing the potential for visceral, vascular, or nerve injury during placement. These trocarless systems also utilize apical fixation points, which seem to allow a better anatomical positioning in the support of pelvic organs [4]. In addition, newer polypropylene mesh systems have different intrinsic properties. Meshes used in trocarless systems, including Polyform™, have a lighter weight per cubic millimeter and were found to be 70–90 % less stiff in ex vivo studies than previous generations of transvaginal mesh systems, like Gynemesh™ [5, 6]. They also tend to consist of a smaller surface area of mesh per kit.

To our knowledge, there have only been few case series reporting outcomes of single-incision trocarless transvaginal mesh systems [4, 7–10]. The results of these studies showed excellent anatomical success rates combined with low mesh exposure rates of 0–6.5 % [4, 7–10]. Judging from our center's experience with these newer trocarless transvaginal mesh systems and from those recent publications, we hypothesized that mesh exposures are less frequent after trocarless Polyform™ transvaginal mesh procedures than after trocar-guided Gynemesh PS™ procedures. We aimed to compare adverse outcomes between those two types of procedures.

Materials and methods

We developed a retrospective cohort study including all cases of transvaginal mesh procedures that were performed by two urogynecologists at our academic teaching centers between January 2008 and May 2012. Both of these surgeons are fellowship-trained and were in practice for approximately 1 year prior to performing their first procedure in the study. One of these surgeons performs an average of 25 transvaginal mesh procedures per year, and the second performed an average of five such procedures annually. Cases were identified by going over all the clinic charts of those two physicians, selecting only patients who had undergone either a trocar-guided Gynemesh PS™ or a trocarless Polyform™ transvaginal mesh procedure. Patients were excluded if their file was found to be missing either preoperative evaluation, operative report, or objective postoperative clinical evaluation. They were also excluded if other types of mesh were placed concomitantly. The initial decision to use a trocar-guided Gynemesh PS™ or trocarless Polyform™ transvaginal mesh system was based primarily on surgeon preference and the technical evolution of available transvaginal mesh systems. Ethics approval was obtained from the McGill University Health Centre Research Ethics Board.

Data recorded included patient's age at intervention, parity, body mass index, smoking status, previous hysterectomy, previous prolapse surgery, pre- and postoperative symptoms, pre- and postoperative Pelvic Organ Prolapse Quantification (POP-Q) or prolapse stage only in some cases, description of surgical procedure, operative time, estimated blood loss, intraoperative, immediate postoperative or delayed complications, and subjective satisfaction rates with surgery.

Objective success was defined as POP-Q stage 0 or I in all compartments [11]. We also looked at leading edge of prolapse proximal to or at the level of the hymen (most dependent compartment at 0 cm), which correlates more closely with patients' symptoms of prolapse [12]. Objective success in each compartment was then evaluated separately. Subjective satisfaction was based on documented patient satisfaction with the surgery. At postoperative follow-up visits, most patients were asked to rate their satisfaction with the surgery on a percentage scale. If they were 60 % satisfied or more, they were considered satisfied. Some other patients were asked simply if they were satisfied with the surgery, and their answer was documented as "satisfied" or "not satisfied."

For each categorical outcome of interest, we report counts and percentages. For continuous variables, we report means and standard deviations if there was evidence of a normal distribution of values and median and range or interquartile range (IQR) otherwise.

Separate multivariable logistic regression analyses were used to investigate objective and subjective success rates, as well as mesh exposure and re-intervention rates, between the two types of procedures. The independent variables used in each model were the same: patient's age, parity, body mass index, smoking status, previous hysterectomy, previous prolapse surgery, and follow-up time. The variables age, parity, body mass index, and follow-up time were modeled as continuous variables. Smoking status, previous hysterectomy, and previous prolapse surgery were modeled as binary variables (yes vs no).

In each analysis, the assumption of linearity in the logit for all continuous variables was assessed by Box-Tidwell test [13]. Multicollinearity was assessed by checking the variance inflation factor on a multivariable regression model with the same dependent and independent variables [14]. The -2 log likelihood ratio test was used to test the overall significance of the model. The significance of the variables in the model was assessed by the Wald chi-square (χ^2) test. The fit of the model was assessed by the Hosmer-Lemeshow goodness of fit χ^2 test [15]. To assess outliers and detect influential observations, logistic regression diagnostics were performed by plotting

several diagnostic statistics against the predicted values, using estimated values and Pearson and deviance residuals [15].

All hypothesis tests were two-sided and were performed at the 0.05 level of significance. All analyses were done using SAS, version 9.2 (SAS Institute Inc., Cary, NC, USA).

Results

A total of 116 cases of transvaginal mesh procedures were identified. Four patients were excluded from the study due to missing information in their file. Three were missing postoperative evaluation, and one patient was missing both preoperative POP-Q and postoperative evaluation. Nine other patients were excluded because they had more than one type of transvaginal mesh placed, or because the mesh placed was neither Gynemesh PS™ nor Polyform™. One hundred and three transvaginal mesh procedures were included in the study. In 47 cases, a trocar-guided Gynemesh PS™ transvaginal mesh system (Prolift, Ethicon, Somerville, NJ, USA) was used, and in 56 cases, a trocarless Polyform™ transvaginal mesh system (46 Pinnacle, Boston Scientific, Natick, MA, USA and 10 Uphold, Boston Scientific, Natick, MA, USA) was placed. Median follow-up was 340 days, IQR 152–644.

Baseline characteristics of the two groups of patients were similar (Table 1). Relevant intraoperative information can be found in Table 2. All Uphold meshes were placed anteriorly. Concomitant procedures performed consisted mostly of traditional repairs. None of the patients underwent a concomitant hysterectomy, and all of them had an intraoperative cystoscopy to exclude urinary tract injuries. Concomitant incontinence procedure was performed for symptomatic or latent stress urinary incontinence, or as prophylaxis, when patients preferred to decrease the risk of postoperative stress incontinence. Of those incontinence procedures, 79 were transobturator mid-urethral slings, and 3 were retropubic mid-urethral slings. Other concomitant procedures included 11 sacrospinous ligament suspensions and 2 iliococcygeal vault suspensions in the trocar group.

In both groups, POP-Q scores were significantly improved after transvaginal mesh procedure, without compromising total vaginal length (Table 3). Crude rates of success, whether objective or subjective, were higher in the trocarless group as compared to the trocar group. The number of patients with objective success were 26/47 (55.3 %) and 34/56 (60.7 %) in the trocar and trocarless groups, respectively. However, logistic regression analysis to investigate the probability of success between groups, after adjusting for the covariates already listed above, showed no statistically significant differences [odds ratio (OR) 1.04, 95 % confidence interval (CI) 0.41–2.68]. When anatomical success was redefined as leading edge of prolapse at or above the level of the hymen (0 cm), this outcome was found in 38/47 (80.1 %) of patients in the trocar group and 49/56 (87.5 %) of patients in the trocarless group ($p=0.5$). Subjective success was found in 39/47

Table 1 Patients' characteristics

	Trocar ($n=47$)	Trocarless ($n=56$)
Age in years, mean (SD)	69.3 (7.8)	69.7 (8.2)
Parity, median (IQR)	2 (2–3)	3 (2–4)
Postmenopausal, *n* (%)	47	54 (96.4)
BMI, median (IQR)[a]	24.8 (22.5–29.1)	26.3 (23.2–29.4)
Smokers, *n* (%)[b]		
Non-smoker	31 (66.0)	40 (76.9)
Ex-smoker	12 (25.5)	9 (17.3)
Current smoker	4 (8.5)	3 (5.8)
Past surgeries, *n* (%)		
Previous hysterectomy	26 (55.3)	31 (55.4)
Previous prolapse surgery	12 (25.5)	20 (35.7)
Previous repeat prolapse surgery	0	2 (3.6)
Previous surgery for urinary incontinence	4 (8.5)	4 (7.1)

BMI body mass index, *IQR* interquartile range

[a] Missing 1 BMI in trocar group and 7 BMIs in trocarless group

[b] Missing 4 smoking status in trocarless group

Table 2 Intraoperative factors

	Trocar ($n=47$)	Trocarless ($n=56$)
Compartment of mesh placement, *n* (%)		
Anterior	42 (89.4)	44 (78.6)
Posterior	0	11 (19.6)
Total	5 (10.6)	1 (1.8)
All operated compartments, *n* (%)		
Anterior only	20 (42.6)	0
Anterior and apical	3 (6.4)	17 (30.4)
Total (anterior, posterior, and apical)	15 (31.9)	30 (53.6)
Anterior and posterior without apical intervention	9 (19.1)	0
Posterior and apical	0	9 (16.1)
Concomitant sacrospinous suspension	11 (23.4)	NA
Concomitant incontinence procedure, *n* (%)	34 (72.3)	48 (85.7)
Anesthesia, *n* (%)		
General	20 (42.6)	31 (55.4)
Regional	27 (57.4)	25 (44.6)
Operative time, median (IQR) in h:min[a]	1:37 (1:22–2:14)	1:24 (1:10–1:37)
Estimated blood loss, median (IQR) in ml	150 (100–200)	100 (100–162.5)

[a] Missing operative time for 4 patients in the trocarless group

Table 3 Pre- and postoperative POP-Q scores

POP-Q points	Trocar				Trocarless			
	Preoperative	*n*	Postoperative	*n*	Preoperative	*n*	Postoperative	*n*
Aa	2 (−2; 3)	45	−2.5 (−3; 2)	45	1 (−3; 3)	53	−2 (−3; 0)	50
Ba	2 (−2; 5)	43	−2 (−3; 8)	45	2 (−2.5; 8)	51	−2 (−3; 0.5)	50
C	−3.5 (−7; 8)	45	−7 (−9; 8)	45	−1 (−8; 9)	51	−7.5 (−10; −1)	50
gh	3.5 (2; 7)	43	3 (1.5; 5)	43	4 (1.5; 7)	51	3 (1.5; 5)	46
pb	2.5 (1.5; 4)	43	3 (2; 4)	44	2.5 (2; 4)	51	3 (2; 4)	46
tvl	9 (6; 11)	45	9 (6.5; 11)	45	9 (5; 10)	53	9 (6; 10.5)	47
Ap	−2 (−3; 3)	45	−2 (−3; 0)	45	−2 (−3; 3)	53	−3 (−3; 0)	49
Bp	−1 (−3; 1)	43	−2 (−3; 0)	45	−1 (−3; 6)	51	−2.5 (−3; −0)	49
D	−7 (−8; −1)	15	−8 (−10; −3)	11	−5 (−9; 9)	27	−8.5 (−9; −6)	20

Scores presented as median (range)

(83.0 %) and 53/56 (94.6 %) of patients in the trocar-guided and trocarless groups, respectively. Again, the difference between the groups was not found to be statistically significant after adjustment (OR 3.75, 95 % CI 0.84–16.83).

Separating the outcomes of Pinnacle and Uphold procedures resulted in objective success of 27/46 (58.7 %) and 7/10 (70 %) and subjective success of 43/46 (93.5 %) and 9/10 (90 %), respectively.

In the trocar-guided Gynemesh PS™ group, 18 patients underwent a procedure that addressed the apical compartment (5 total Prolifts, 2 iliococcygeal vault suspension, and 11 sacrospinous ligament suspensions). That subgroup of patients had an objective success rate of 55.6 % (10/18), an anatomical success with leading edge of prolapse at or above the level of the hymen of 77.8 % (14/18), and a subjective success rate of 83.3 % (15/18).

Of the 43 patients who had objective prolapse stage II or more demonstrated during their follow-up (21 in the trocar group and 22 in the trocarless group), 42.9 % (9/21) and 59.1 % (13/22), respectively, were true recurrences in the meshed compartment. In the trocar group, five of those had anterior mesh placement and four had total transvaginal mesh (three of those recurred anteriorly and one at the apical level). Of the true recurrences in the trocarless group, nine had anterior Pinnacle, one had total Pinnacle (anterior recurrence), and three had anterior Uphold. Three patients had a recurrence in a compartment that had been treated with traditional colporrhaphy at the time of mesh placement (two anterior Prolifts with posterior recurrence and one posterior Pinnacle with anterior recurrence). Three patients in each group had de novo prolapse in the compartment without mesh (three anterior Prolifts and three anterior Pinnacles with de novo posterior compartment prolapse). Finally, seven patients (33 %) in the trocar group and five patients (22.7 %) in the trocarless group had asymptomatic stage II–III prolapse in another compartment that was not addressed during surgery and that persisted after the procedure.

Rates of intraoperative and short-term postoperative complications were similar between the two groups (Table 4). All three documented bladder injuries had been identified and repaired intraoperatively. Concerning long-term postoperative complications, significantly fewer patients developed mesh exposure in the trocarless group compared to the trocar-guided group (adjusted OR 0.16, 95 % CI 0.03–0.97, p=0.047). In the trocar group, 10 of the 11 mesh exposures occurred in the anterior compartment, and 1 patient had both anterior and posterior exposures after total transvaginal mesh. In the trocarless group, both mesh exposures occurred after anterior Uphold procedures. Overall, 46 % (6/13) of mesh exposures were treated conservatively with local estrogen cream application. The rest were managed surgically. Persistent postoperative pelvic pain was treated with injections of triamcinolone and long-acting local anesthetic at the site of palpation tenderness for two patients (4.3 %) after anterior Prolift and for one patient (1.86 %) after anterior Pinnacle. One patient who had an anterior Pinnacle underwent surgical release of a tense painful left sacrospinous ligament mesh arm attachment. One patient in the trocar-guided group had pelvic pain associated with mesh exposure, which was treated surgically. This last patient underwent multiple re-interventions, which will be described further in the next paragraph.

There were fewer surgical re-interventions for all indications in the trocarless group compared to the trocar group (Table 5) (adjusted OR 0.15, 95 % CI 0.04–0.60, p=0.01). A mid-urethral sling transection for voiding dysfunction was the only re-intervention in the group of patients who underwent an Uphold procedure. Two women in the trocar group underwent more than one re-intervention. The first had undergone a total Prolift transvaginal mesh procedure with a concomitant transobturator sling. She developed recurrent prolapse close to 2 years later. She then had a vaginal

Table 4 Complications

	Trocar (n=47)	Trocarless (n=56)
Intraoperative		
Blood loss of 500 ml or more	1 (2.1)	2 (3.6)
Bladder injury	2 (4.3)	1 (1.8)
Bowel injury	0	0
Short-term postoperative		
Short-term voiding dysfunction	18 (38.3)	22 (39.3)
Vaginal bleeding	1 (2.1)	2 (3.6)
Hematoma	1 (2.1)	1 (1.8)
Cystitis	1 (2.1)	1 (1.8)
Cuff cellulitis	1 (2.1)	1 (1.8)
Anemia	1 (2.1)	3 (5.4)
Long-term postoperative		
Mesh exposure	11 (23.4)	2 (3.6)
Treated conservatively	4	2
Treated surgically	7	0
Granulation tissue	8 (17.0)	3 (5.4)
Treated conservatively	7	3
Treated surgically	1	0
Vaginal adhesions	4 (8.5)	2 (3.6)
Released in office	3	2
Released in operating room	1	0
Pelvic pain at any postoperative visit	9 (19.1)	4 (8.9)
At 6 months	7	1
At 1 year or more	4	1
Requiring triamcinolone injections	2	1
Requiring surgery	1	1

Data presented as n (%)

Table 5 Indications for surgical re-interventions

	Trocar (n=47)	Trocarless (n=56)
Mesh exposure	7	0
Prolapse recurrence in compartment with mesh	3	2
De novo prolapse in different compartment	2	0
Stress urinary incontinence	4	2
Vaginal adhesions	1	0
Postoperative severe vaginal bleeding	1	1
Urethral dilatation/transection of sling	0	1
Skin incision granuloma excision	1	0
Persistent pelvic pain	1	1
Total number of patients who had a re-intervention, n (%)	15 (31.9)	5 (8.9)

Data presented as n. Some patients had more than 1 indication for the re-intervention, and 2 patients in the trocar group had more than 1 re-intervention

hysterectomy with sacrospinous ligament suspension and posterior repair. Almost 1 year later, she underwent a repeat anterior repair for recurrent cystocele with a retropubic sling for recurrent stress urinary incontinence. The second patient also had undergone a total Prolift transvaginal mesh procedure. She then had a revision of symptomatic exposed mesh, as mentioned previously, concurrent with a vaginal enterocele repair. She subsequently developed apical recurrence and underwent an abdominal sacrocolpopexy. In the next 2 years, she underwent two outpatient procedure room surgical excisions of mesh exposed in the anterior vaginal wall, but remains free of pain and dyspareunia.

Dyspareunia was reported by 13 women preoperatively (4 in the trocar-guided group and 9 in the trocarless group) and by 4 women postoperatively (2 in each group). None of those who underwent uterine-preserving transvaginal mesh procedure were diagnosed with postoperative cervical elongation. Only one patient was noted to have an increased distance between POP-Q C and D points (11 cm) resulting from failed paracervical support 3 years after a total trocar-guided transvaginal mesh procedure. At that point, she underwent a successful laparoscopically assisted vaginal hysterectomy and sacrocolpopexy.

Although other interventions, such as anticholinergic pharmacotherapy, were often combined with surgery, compared to the preoperative period, less urinary symptoms were reported after both types of transvaginal mesh procedures [83 % (39/47) vs 43.5 % (20/46) in the trocar group and 81.5 % (44/54) vs 42.6 % (23/54) in the trocarless group, respectively]. Specifically, the rates of subjective stress urinary incontinence were 42.6 % (20/47) and 40.0 % (22/55) preoperatively and 17 % (8/47) and 20.0 % (11/55) postoperatively for the trocar and trocarless groups, respectively. In patients who had concomitant mid-urethral sling inserted, subjective postoperative stress urinary incontinence rates were 14.7 % (5/34) and 17.0 % (8/47) in the trocar and trocarless groups, respectively. Postoperative de novo stress urinary incontinence was found in 8.5 % (4/47) of patients in the trocar group and 7.4 % (4/54) of patients in the trocarless group. The rates of urge incontinence were 53.2 % (25/47) and 41.8 % (23/55) preoperatively and 19.1 % (9/47) and 5.6 % (3/54) postoperatively for the trocar and trocarless groups, respectively.

Discussion

The two types of transvaginal mesh systems resulted in similar success rates. Both groups had significant improvements in POP-Q scores postoperatively. However, single-incision trocarless Polyform™ transvaginal mesh systems resulted in fewer mesh exposures and surgical re-interventions than trocar-guided Gynemesh PS™ systems.

In both groups, objective success rates were comparable to published literature. We found 55.3 % objective success at a median follow-up of 340 days after trocar-guided transvaginal mesh procedures. Previous publications reported 43–89 % success at 1–2 years follow-up [16–18]. In the trocarless group, satisfactory anatomical outcomes were found in 60.7 %, consistent with recently published trials with success rates of 69–92 % at 1 year [7, 8, 19]. The pathophysiology of mesh failure remains enigmatic. Often it unmasks prolapse in other compartments, but the reason behind recurrence in the same compartment may be related to mesh arm release from ligamentous support. Likely local inflammation incites a fibrous capsule that allows the mesh arm to slip in time. Alternately, prolapse can develop distal to the leading edge of the mesh itself.

Concern has been raised about transvaginal mesh repair predisposing to de novo prolapse in the untreated compartment. Two studies by Withagen et al. (2010 and 2012) found respectively 23 and 47 % de novo prolapse in the untreated compartment 1 year after trocar-guided transvaginal mesh procedures, compared to 17 % after native tissue repair [20, 21]. Withagen et al. hypothesized that this might result from "supraphysiologic reduction of prolapse" in the treated compartment, leading to a greater proportion of the forces exerted on the pelvic floor affecting the untreated compartment [21]. We found 10.6 % (5/47) de novo or recurrent prolapse in the compartment without mesh in the trocar-guided group and 8.9 % (5/56) in the trocarless group. One study demonstrated that transvaginal mesh procedures that include apical level I support, such as trocarless systems, result in lower rates of de novo prolapse in the untreated compartment [21]. It would be interesting to determine in larger prospective studies whether de novo prolapse in the untreated compartment is actually an issue after trocarless transvaginal mesh procedures compared to native tissue repairs.

We encountered a significantly lower mesh exposure rate in the trocarless transvaginal mesh group compared to the trocar-guided group. The mesh exposure rate after a trocarless procedure was 3.6 %. Case series of patients undergoing single-incision trocarless transvaginal mesh procedures resulted in mesh exposure rates of 0–6.5 % at 1 year [4, 7–10, 19], which appear to be lower than the reported 11.4 % mesh exposure rate associated with trocar-guided transvaginal mesh procedures [3]. In addition, the overall rate of surgical re-intervention in our study was significantly lower after trocarless transvaginal mesh procedures than after trocar-guided ones. Nine percent of patients required a re-intervention in the trocarless group, and none of those were for mesh exposure. The absence of surgical re-intervention for mesh exposure after Polyform™ transvaginal mesh placement in our study contrasts with results of studies on trocar-guided Gynemesh PS™ transvaginal mesh which have reported 3.2–9 % re-intervention for this indication [3, 16, 17, 22]. The intrinsic properties of newer mesh materials, found to have lighter weight and increased elasticity, likely contributed to the lower mesh exposure and re-intervention rates associated with trocarless transvaginal mesh systems [5, 6]. Other potential explanations for these findings are the concurrent apical support of all trocarless systems, allowing better anatomical positioning of the mesh, as well as the smaller surface area of mesh used in trocarless systems. We found that rates of other complications were uncommon and were similar between both groups.

Due to the retrospective nature of the study, we did encounter some missing data in patients' charts. This prevented us from performing an analysis of certain parameters. For example, dyspareunia was reported by 13 patients preoperatively and by only 4 patients postoperatively. However, dyspareunia was not reported consistently in patients' files. Since patients answered a standard non-validated questionnaire developed by one of our physicians at the initial visit, questioning about sexual activity and dyspareunia was done relatively consistently at the preoperative evaluation. As it is not routine practice in our clinic to administer a postoperative standardized questionnaire, dyspareunia was probably assessed much more sporadically after surgery. This lack of consistency prevented us from drawing conclusions about the rate of postoperative dyspareunia in our study population.

Although other therapies might also have been used, such as medical or behavioral intervention, both groups of patients reported lower rates of urinary symptoms, including urge and stress urinary incontinence, after transvaginal mesh procedure. De novo stress urinary incontinence rates of 8.5 % in the trocar group and 7.4 % in the trocarless group are comparable to those seen in the literature after transvaginal mesh (12.3–13 %) [3, 17]. The rate of persistent stress urinary incontinence after mid-urethral sling concurrently with transvaginal mesh was also similar to previously published reports (16 % overall compared to 17–27 % in the literature) [23, 24].

Uterine-sparing prolapse repair surgery is gaining popularity. There are still limited data about outcomes of such procedures, but some studies using transvaginal mesh systems showed promising results [4, 25, 26]. Our study population included 21 patients (44.7 %) in the trocar-guided group and 25 patients (44.6 %) in the trocarless group who underwent uterine-preserving transvaginal mesh repair. In these cases, uterine preservation was not associated with increased risk of surgical failure (adjusted OR for anatomical success following previous hysterectomy compared to uterine preserving surgery 0.66, 95 % CI 0.24–1.85).

Conclusion

Trocar-guided Gynemesh PS™ and trocarless Polyform™ transvaginal mesh systems result in similar objective and

subjective success rates. Our study showed that procedures using single-incision trocarless Polyform™ transvaginal mesh systems are safe minimally invasive surgeries that result in significantly fewer mesh exposures and need for surgical re-intervention compared to trocar-guided Gynemesh PS™ transvaginal mesh procedures. Randomized controlled trials are needed to further explore the benefits and risks associated with trocarless Polyform™ transvaginal mesh systems.

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