Int Urogynecol J (2010) 21:285–291
DOI 10.1007/s00192-009-1005-8

ORIGINAL ARTICLE

Risk factors for mesh erosion 3 months following vaginal reconstructive surgery using commercial kits vs. fashioned mesh-augmented vaginal repairs

Peter S. Finamore · Karolynn T. Echols · Krystal Hunter · Howard B. Goldstein · Adam S. Holzberg · Babak Vakili

Received: 29 April 2009 / Accepted: 29 August 2009 / Published online: 4 December 2009

Abstract
Introduction and hypothesis Our objective was to establish the overall graft erosion rate in a synthetic graft-augmented repair 3 months postoperatively.
Methods A retrospective chart review was performed on a cohort of subjects who underwent mesh-augmented vaginal reconstructive surgery during an 18-month period. We defined graft erosion as exposure of any mesh upon visual inspection of the entire vagina at the 3-month postoperative visit. Statistical tests performed to evaluate proportional differences were the Pearson chi square and Fisher exact tests. Independent *t* test was performed to compare mean differences.
Results A total of 124 grafts were implanted. The overall erosion rate was 11.3%. There was a significantly lower erosion rate when using "commercial kits" vs. our traditional repairs (1.4% [one out of 69] vs. 23.6% [13 out of 55]; $p<0.001$).
Conclusions Our study demonstrates a significantly lower erosion rate when using a "commercial kit" to repair pelvic organ prolapse compared to our traditional synthetic graft-augmented repair.

Keywords Erosion · Mesh · Prolapse · Vaginal reconstructive surgery

This study was accepted as an oral poster at the 2009 Society of Gynecologic Surgeons annual meeting in New Orleans, LA.

P. S. Finamore (✉)
Division of Urogynecology and Pelvic Reconstructive Surgery,
Department of Obstetrics and Gynecology,
Winthrop University Hospital,
259 First Street,
Mineola, NY 11501, USA
e-mail: pfinamore@hotmail.com
e-mail: PFinamore@Winthrop.org

K. T. Echols · A. S. Holzberg
Division of Female Pelvic Medicine and Reconstructive Surgery,
Department of Obstetrics and Gynecology,
Cooper University Hospital,
Camden, NJ, USA

K. Hunter
Biostatistics Group,
Cooper University Hospital UMDNJ-RWJMS,
Camden, NJ, USA

H. B. Goldstein · B. Vakili
Center for Urogynecology and Pelvic Surgery,
Christiana Health Care System,
Newark, DE, USA

Introduction

Pelvic reconstructive surgery has been on the rise, primarily due to the rapidly expanding elderly population [1, 2]. In an attempt to minimize the morbidity of an abdominal procedure to repair prolapse while increasing the durability of traditional vaginal surgery, many pelvic surgeons have incorporated the use of synthetic graft material to augment their vaginal repairs [3–8]. Concerns over the potential complications such as erosion of the graft have made these procedures controversial.

Mesh erosion and its associated risk factors have been widely studied with abdominal sacrocolpopexy [9–14]. Investigators are attempting to reproduce this data with vaginal mesh [15–18]. The purpose of our study was to determine the erosion rate following synthetic graft-augmented vaginal reconstructive surgery in the early

postoperative period. Additionally, we sought to determine if there are any patient characteristics or graft material that may influence the rate of this complication.

Materials and methods

The Institutional Review Board at Cooper University Hospital approved this retrospective chart review. We utilized the Current Procedural Terminology code data to identify a cohort of subjects who underwent vaginal reconstructive surgery during an 18-month period (June 2005 to December 2006) by two senior urogynecologists. The only difference in surgical technique between the two surgeons was one hydrodissected prior to incision while the other did not. The thickness of dissection, location and size of incision, placement of graft material, and all other technical components of the procedures were identical between the two surgeons.

All patients underwent either a graft-augmented anterior repair, a graft-augmented posterior repair, or a combined graft-augmented anterior and posterior procedure. Only the patients who had procedures that utilized Gynemesh (Ethicon, Somerville, NJ, USA), Pelvitex (Bard Urologic Division, Covington, GA, USA), the Avaulta system (Bard Urologic Division, Covington, GA, USA), or the Prolift system (Ethicon, Somerville, NJ, USA) were included in the analysis. We had several patients who underwent a combined anterior and posterior repair and different graft material was used for each compartment. If the graft material used for each compartment was one of the above four, then both compartments were included in the analysis. However, if one of the compartments was repaired with a material not mentioned above, then only the compartment that was repaired with either Pelvitex, Gynemesh, Avaulta, or Prolift was included in the analysis.

The anterior repairs were either our "traditional arcus to arcus" repair or a "commercial kit" repair. The "traditional arcus to arcus" repair utilizes a fashioned 10×15-cm piece of synthetic mesh (either Gynemesh or Pelvitex) that is cut to fit the pelvis and then sutured with permanent suture to the arcus tendineus fascia pelvis (ATFP) on both sides utilizing a Capio Suture Device (Boston Scientific, Natick, MA, USA). The anterior "commercial kit" repair (either Prolift or Avaulta) utilizes a transobturator needle delivery device, which places the mesh arms through the ATFP on both sides, proximal and distal to the ischial spines. In all techniques described, a full thickness vaginal dissection was carried out into the space of Retzius until the ATFP was located bilaterally.

The graft-augmented posterior repair refers to a "traditional posterior repair" or a "commercial kit" repair. In the "traditional posterior repair" a fashioned piece of mesh (either Gynemesh or Pelvitex) is proximally attached to both sacrospinous ligaments (SSL) with permanent suture, again using a Capio Suture Device (Boston Scientific, Natick, MA, USA), and the apex of the fibromuscularis layer of the vaginal cuff. Laterally, it is suspended to the arcus tendineus rectovaginalis [19] until its distal attachment at the perineal body. Alternatively, with the posterior "commercial kit" repair (either Prolift or Avaulta), the proximal attachment points of the mesh are placed by the needle delivery device. The trocar is passed through the ischiorectal space exiting just distal to the ischial spines and the SSL on both sides and sometimes through the ligaments proximal to the ischial spines. The distal attachment point of the mesh varies slightly, depending on the actual "commercial kit" utilized. In all techniques described, a full thickness vaginal dissection was carried out into the pararectal space until the SSL were located bilaterally.

In the repairs considered "traditional," we used either Gynemesh or Pelvitex. The "commercial kits" utilized for reconstruction were the Prolift or the Avaulta system. Each company uses the identical mesh weave for their products, i.e., Gynemesh and Prolift are the same material and Pelvitex and Avaulta are the same material.

We defined graft erosion as any exposure of mesh upon visual inspection of the entire vagina at the 3-month postoperative visit. We considered cases by compartment so that subjects who underwent a combined anterior and posterior graft repair were counted twice (once in the anterior repair group and once in the posterior repair group). The Pearson chi square and Fisher exact tests were performed to evaluate proportional differences. Independent t test was performed to compare mean differences. Significance was set at $p<0.05$.

Results

There were 201 subjects identified as having a vaginal reconstructive surgery for prolapse during the 18-month period. Of those, eight did not return for their 3-month postoperative visit and were excluded; three were excluded because they did not have graft material placed; 17 were excluded because nonsynthetic graft material was used in the reconstruction; and 82 subjects were excluded because the mesh material used in the reconstruction was not one of the four previously mentioned graft materials. Therefore, the total number of patients included in the analysis was 91 (45.3%; Fig. 1). Demographics are listed in Table 1. Twenty-eight subjects had an anterior defect graft repair only, 30 subjects had a posterior defect graft repair only, and 33 subjects had a combined anterior and posterior procedure.

Of the patients who had a mesh-augmented anterior repair only, there were 16 "commercial kit" procedures and

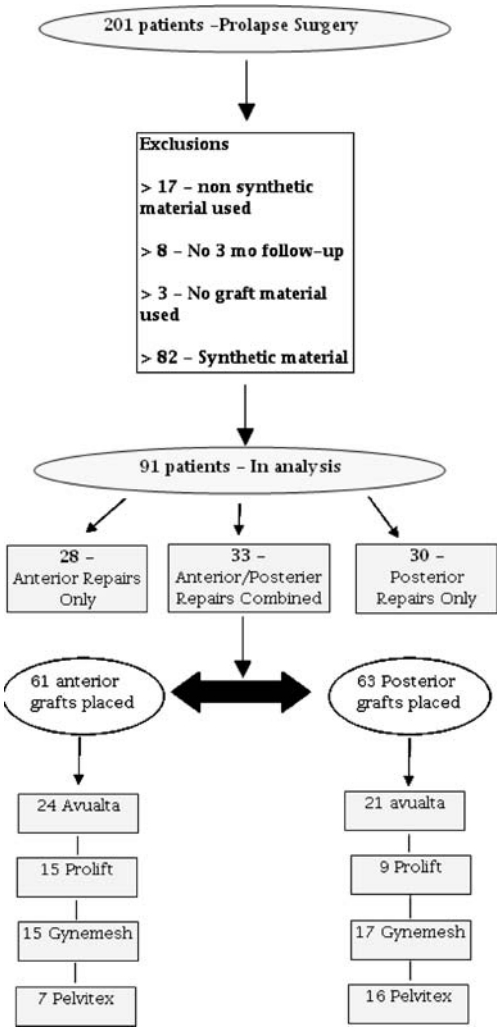

Fig. 1 Graft materials and repairs performed on entire cohort

12 "traditional arcus to arcus" repairs. The "commercial kit" repairs included seven with the Prolift system and nine with the Avaulta system. For the "traditional arcus to arcus" repairs, there were ten patients in which Gynemesh was used and two where Pelvitex was used.

Of the patients who had a mesh-augmented posterior repair only, there were seven "commercial kit" procedures and 23 "traditional posterior repairs." The "commercial kit" repairs included one with the Prolift system and six with the Avaulta system. For the "traditional posterior repairs," there were 12 patients in which Gynemesh was used and 11 in which Pelvitex was used.

Of the patients who had a combined anterior and posterior mesh-augmented repair, there were 23 "commercial kit" procedures and ten "traditional" repairs. The "commercial kits" repairs included eight with the Prolift system and 15 with the Avaulta system. For the "traditional anterior/posterior repairs," there were five patients in which Gynemesh was used and five in which Pelvitex was used.

For the purposes of our analysis, we looked at the anterior compartment and the posterior compartment separately, even if the patient underwent a combined anterior and posterior repair. In other words, if a patient underwent a combined anterior and posterior procedure she was counted twice. Therefore, the total number of grafts implanted was 124 with 61 in the anterior compartment and 63 in the posterior compartment. Of the 61 anterior grafts placed, 39 were "commercial kits" and 22 were "traditional arcus to arcus" repairs. Of the 63 posterior compartment grafts placed, 30 utilized "commercial kits" and 33 were "traditional posterior repairs" (Fig. 1).

The overall erosion rate was 11.3% (14 out of 124). There were six erosions in the anterior compartment and six erosions in the posterior compartment; additionally, one patient who had a combined anterior and posterior repair had erosion in both compartments at her 3-month visit. She was counted twice in our total number, thus we had 14 erosions. Table 2 depicts the erosion rates by product. There was no difference in the erosion rate between the two companies regardless of the approach (Bard 10.3% [seven out of 68] vs. Ethicon 12.5% [seven out of 56]; $p=0.781$). There was a significantly lower erosion rate in the "commercial kit" repairs (Avaulta plus Prolift) vs. our traditional repairs (Pelvitex plus Gynemesh; 1.4% [one out of 69] vs. 23.6% [13 out of 55]; $p<0.001$). There was no significant difference in erosion rates when we compared those patients who underwent hydrodissection (four out of 34; 11.8%) vs. those who did not (ten out of 57;17.5%; $p=0.76$). Fifty percent of patients with mesh erosions were asymptomatic at their 3-month follow-up visit (Table 3). Operating room (OR) complications are listed in Table 4. The most common ones encountered were intraoperative hemorrhage of greater than or equal to 500 ml (15 subjects) and bladder complications (five subjects).

Six patients with erosions were treated conservatively and did not need to return to the OR for treatment of the erosion. Seven patients did return to the OR for excision of eroded mesh. One of these seven had an exposure in both compartments and was counted twice in the analysis.

Discussion

General surgeons have been using synthetic mesh for hernia repairs for decades. The complications that they have encountered include infection, seroma formation, biomaterial-related intestinal obstruction, fistula formation, and shrinkage of the mesh [20]. A significant difference between using mesh for hernias and using mesh for graft-augmented vaginal reconstruction is the environment that the mesh is placed. The vagina is not a sterile environment and

Table 1 Demographics of the study cohort

	Overall	Non-erosion	Erosion	*p* value
Age (years), mean (SD)	60.9 (11.3)	60.5 (11.5)	63.1 (10.1)	0.451
BMI (kg/m^2), mean (SD)	29.7 (5.5)	29.3 (5.6)	32.2 (4.3)	0.090
Parity, mean (SD)	3.2 (2.0)	3.23 (1.6)	3.3 (3.4)	0.897
EBL at surgery, mean (SD)	292 (228)	276.3 (211.5)	388.5(303.6)	0.101
Preoperative stage of prolapse, mean (SD)	2.4 (0.52)	2.5 (0.5)	2.4 (0.5)	0.684
Tobacco use	*N*=13	11/78 (14.1%)	2/13 (15.4%)	1.000
Premenopausal	*N*=9	8/78 (10.3%)	1/13 (7.7%)	1.000
On HRT	*N*=12	9/78 (11.5%)	3/13 (23.15)	0.368
Oral HRT only	*N*=6			
Vaginal estrogen only	*N*=5			
Vaginal and oral HRT	*N*=1			
Race				
Not recorded in chart	*N*=13	13/78 (16.7%)	0/13 (0%)	
African American	*N*=2	1/78 (1.3%)	1/13 (7.7%)	0.267
Caucasian	*N*=71	59/78 (75.6%)	12/13 (92.3%)	0.284
Hispanic	*N*=4	4/78 (5.1%)	0/13 (0%)	
Asian	*N*=1	1/78 (1.3%)	0/13 (0%)	
Spontaneous vaginal deliveries	*N*=88	75/77 (97.4%)	13/13 (100%)	1.000
One or more Cesarean deliveries	*N*=2	2/77 (2.6%)	0/13 (0%)	
Diabetes mellitus	*N*=6	6/78 (7.7%)	0/13 (0%)	
Previous hysterectomy	*N*=48	40/78 (51.3%)	8/13 (61.5%)	0.493
Vaginal	*N*=19			
Abdominal	*N*=29			
Previous procedure for prolapse or incontinence	*N*=29	28/78 (35.9%)	1/13 (7.7%)	0.055
Preoperative urodynamic testing	*N*=63	54/78 (69.2%)	9/13 (69.2%)	1.000
Preoperative urodynamic proven DO	*N*=9	8/78 (10.3%)	1/13 (7.7%)	1.000
Preoperative urodynamic proven SUI	*N*=44	37/78 (47.4%)	7/13 (53.8%)	0.768
Hysterectomy with reconstruction	*N*=24	22/78 (28.2%)	2/13 (15.4%)	0.501
Bilateral salpingo-oophorectomy with reconstruction	*N*=12	9/76 (11.8%)	3/12 (25%)	0.359
Anti-incontinence procedure with reconstruction	*N*=51	43/78 (55.1%)	7/13 (53.8%)	1.000

BMI body mass index, *HRT* hormone replacement therapy, *EBL* estimated blood loss, *DO* detrusor overactivity, *SUI* stress urinary incontinence

placing a foreign material poses new and likely increased risk for some of these complications.

In vaginal mesh augmentation, the vaginal erosion rate of a type 1 macroporous mesh has been reported to be around 10% [21, 22]. Our overall erosion rate of 11.3% is comparable to what has been published. Although it is reassuring to know that our erosion rate is similar to others, it is difficult to compare different studies because of the wide variability in surgical technique. Examples of different techniques include the following: use of local anesthesia with or without epinephrine to hydrodissect prior to incision, the thickness of vaginal mucosal dissection, the type of mesh, the size of the mesh, the location and size of incision on the vaginal mucosa, and the use of dissolvable or permanent sutures to help transfix the mesh. There are

Table 2 Erosion rates by products

	Company 1 (Bard)		Company 2 (Ethicon)	
	Pelvitex	Avaulta	Gynemesh	Prolift
Number	23	45	32	24
Erosions	6	1	7	0
Erosion rate (%)	26.1	2.2	21.9	0

Table 3 Presenting complaint for the patients with erosion at the 3-month postoperative visit

Symptom of erosion	Number
Asymptomatic	7
Dyspareunia	3
Vaginal spotting	4

Table 4 OR complications for 91 reconstructive surgeries

OR complications	Number
Cystotomies	2
Proctotomies	0
EBL ≥500 ml	15
Documented transfusions	0
Lesion in bladder biopsied	3
Ureteral stent placed due to lack of efflux	1

also potential variations in nontechnical things such as the amount of bleeding that can occur in the space of Retzius—both recognized and unrecognized, hormonal status of the patients prior to surgery, and concomitant procedures such as hysterectomy and slings.

Our findings suggest that a major influence on erosion rate is the way the mesh is placed. It appears that utilizing a "commercial kit" significantly decreases the risk of erosion compared to a "traditional" mesh-augmented repair. There are several theories that could explain this. First, utilizing a "commercial kit" can decrease the operative time compared to "traditional" repairs possibly contributing to the lower erosion rate. Another theory is that there is decreased tension on the mesh when using "commercial kits." When the mesh shrinks over time, this may theoretically produce a greater amount of tension on the mesh in the fixed "traditional" repair which could lead to ischemia and possibly erosions. Another possible theory is that, when performing a "traditional" repair, it is our practice to use permanent sutures to attach the mesh to the ATFP in the anterior repair and the SSL in the posterior repair. Additionally, dissolvable sutures are often used to help keep the mesh "flat" and prevent it from bunching up or rolling upon itself. If a mesh becomes bunched or folded upon itself, it prohibits the in-growth of macrophages and fibroblasts, thus making it more likely to erode. The increased number of sutures in the "traditional" repairs may increase the "foreign body reaction" leading to more erosions.

Another potential factor that might influence erosion rate could be the size and location of vaginal incision. Our incision in the anterior compartment was vertical, from the apex of the anterior wall defect to the level of the bladder neck. The posterior wall incision was similarly vertical—from the apex of the posterior wall defect to the perineal body. When a hysterectomy was performed, the primary technique for incision and closure was in a "T" formation. The cuff would be closed horizontally, with an attempt to reapproximate the cervical ring, and then the anterior wall incision was made and, at the conclusion of the surgery, this incision would be closed vertically. We did not specifically measure the length of the incisions between the two arms of our study groups; however, this would be an interesting future study. Others have shown that the "T" formation closure may be a risk factor for erosion [13, 14]. We did not find a difference in erosion rates comparing patients with and without a concomitant hysterectomy. We only had 24 patients who had a hysterectomy with reconstruction and, therefore, our sample size may have been too small to show a difference.

The location of the erosion was usually recorded in the chart as in either the anterior or posterior compartment. During our chart review, we were often unable to determine whether this was in the midline or paravaginal areas. We believe that most erosions occurring in the midline are likely due to incisional separation and those in the paravaginal area are likely to be due to the dissection "thinning out." The incidence of mesh exposure in the incision line may be decreased by using a horizontal mattress suture for closure [23], but more studies need to be done to validate this.

Our study suggests that tobacco use did not influence erosion rate. Although our study is underpowered to make a definitive conclusion, this conflicts with what some have found in patients who undergo an abdominal sacrocolpopexy [11, 14] or a transvaginal mesh repair [15]. The duration of follow-up, surgical technique, and type of mesh vary greatly between all these studies; therefore, it would be a mistake to compare them directly. Our results did show that subjects with a greater body mass index may be at greater risk for mesh erosion; however, this difference was not statistically significant. With increased numbers, this difference may prove to be significant (Table 1). We did not find hydrodissection prior to incision to effect erosion rate, but our sample size may have been too small. We are currently looking at this specific variable to determine if it is factor in the incidence of erosion and hope to publish the results soon.

We chose the 3-month postoperative visit to determine erosion rate because it is our office practice to see patients 1 month and then 3 months following surgery. We have often noted that suture lines are not fully healed at 1 month and, if there is a small exposure of the mesh at this time, it is often healed by the 3-month visit. If there is some mesh erosion at 3 months, it will likely need intervention, i.e., local estrogen cream, office excision, or infrequently a return to the OR for revision.

There are several weaknesses in our study. The retrospective nature of the study is the primary weakness; however, the small sample size for each arm, the short-term follow-up of 3 months, the lack of efficacy data, and the lack of validated questionnaires are also weaknesses. Selection bias is another significant weakness in the study. Another flaw in the retrospective nature of this study is how our surgical technique may have evolved over the course of

the study period. From the time we first began using synthetic mesh, we have always employed a full thickness vaginal mucosal dissection; therefore, this element did not change throughout our study period. However, it is likely there may have been minor technical adjustments made when incorporating the use of commercial kits into our armamentarium. These adjustments may have altered the factors contributing to erosions that we cannot account for or measure with the design of this study. It is difficult to determine what these adjustments may have been in this type of study design, but it is worth noting as a potential weakness.

Our primary objective was to determine our erosion rate; therefore, we did not report any data on other complications that could occur when using mesh in the vagina. These complications include but are not limited to sexual dysfunction, de novo stress urinary incontinence, de novo urge incontinence, voiding dysfunction, de novo fecal incontinence, pain, failure, and reoperation risk [17, 24–26]. The retrospective nature of our study did not allow us to assess these outcomes.

In our analysis, we did not include 82 patients from our original cohort of 201 because the mesh material used in their reconstructive procedure was Polyform (Boston Scientific, Natick, MA, USA). At the time of this study, there was no "commercial kit" available by Boston Scientific to compare to Polyform. Recently, the Pinnacle System (Boston Scientific Natick, MA, USA) has been developed and become available for use. We are currently looking at our 3-month follow-up data for these patients.

In conclusion, "commercial kits" appear to have a significantly lower erosion rate compared to equivalent synthetic material used in a "traditional" repair. Longer follow-up, efficacy data, and quality of life measures are all needed to determine if there are any other advantages to performing one repair vs. another. Until more level I evidence is available, when counseling patients about the risks and benefits of synthetic graft usage in vaginal reconstructive surgery, all risk factors should be considered and all patients should be made aware of the FDA Public Health Notification released in October 2008 (http://www.fda.gov/cdrh/safety/102008-surgicalmesh.html).

Conflicts of interest Dr. Holzberg is a consultant for Boston Scientific. Dr. Vakili is a consultant for Bard Urologic. The remaining authors have no relevant disclosures.

References

1. Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL (1997) Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. Obstet Gynecol 89:501–506
2. Luber KM, Boero S, Choe JY (2001) The demographics of pelvic floor disorders: current observations and future projections. Am J Obstet Gynecol 184:1496–1503
3. Le TH, Kon L, Bhatia NN, Ostergard DR (2007) Update on the utilization of grafts in pelvic reconstruction surgeries. Curr Opin Obstet Gynecol 19:480–489
4. Novara G, Galfano A, Secco S, Ficarra V, Artibani W (2007) Prolapse surgery: an update. Curr Opin Obstet Gynecol 17:237–241
5. Silva WA, Karram MM (2005) Scientific basis for use of grafts during vaginal reconstructive procedures. Curr Opin Obstet Gynecol 17:519–529
6. Mistrangelo E, Mancuso S, Nadalini C, Lijoi D, Costantini S (2007) Rising use of synthetic mesh in transvaginal pelvic reconstructive surgery: a review of the risk of vaginal erosion. J Minim Invasive Gynecol 14:564–569
7. Iglesia CB, Fenner DE, Brubaker L (1997) The use of mesh in gynecologic surgery. Int Urogynecol J Pelvic Floor Dysfunct 8:105–115
8. Reisenauer C, Kirschniak A, Drews U, Wallwiener D (2007) Anatomical conditions for pelvic floor reconstruction with polypropylene implant and its application for the treatment of vaginal prolapse. Eur J Obstet Gynecol Reprod Biol 131:214–225
9. Begley JS, Kupferman SP, Kuznetsov DD et al (2005) Incidence and management of abdominal sacrocolpopexy mesh erosions. Am J Obstet Gynecol 192:1956–1962
10. Quiroz LH, Gutman RE, Fagan MJ, Cundiff GW (2008) Partial colpocleisis for the treatment of sacrocolpopexy mesh erosions. Int Urogynecol J Pelvic Floor Dysfunct 19:261–266
11. Lowman JK, Woodman PJ, Nosti PA, Bump RC, Terry CL, Hale DS (2008) Tobacco use is a risk factor for mesh erosion after abdominal sacral colpoperineopexy. Am J Obstet Gynecol 198(561):e1–e4
12. Su KCH, Mutone MF, Terry CL, Hale DS (2007) Abdominovaginal sacral colpoperineopexy: patient perceptions, anatomical outcomes, and graft erosions. Int Urogynecol J Pelvic Floor Dysfunct 18:503–511
13. Bensinger G, Lind L, Lesser M, Guess M, Winkler HA (2005) Abdominal sacral suspensions: analysis of complications using permanent mesh. Am J Obstet Gynecol 193:2094–2098
14. Cundiff GW, Varner E, Visco AG et al (2008) Risk factors for mesh/suture erosion following sacral colpopexy. Am J Obstet Gynecol 199(688):e1–e5
15. Araco F, Gravante G, Sorge R, De Vita D, Piccione E (2008) Risk evaluation of smoking and age on the occurrence of postoperative erosions after transvaginal mesh repair for pelvic organ prolapses. Int Urogynecol J Pelvic Floor Dysfunct 19:473–479
16. Fatoon B, Amblard J, Debodinance P, Cosson M, Jacquetin B (2007) Transvaginal repair of genital prolapse: preliminary results of a new tension-free vaginal mesh (Prolift™ technique)-a case series multicentric study. Int Urogynecol J Pelvic Floor Dysfunct 18:743–752
17. Boyles SH, McCrery R (2008) Dyspareunia and mesh erosion after vaginal mesh placement with a kit procedure. Obstet Gynecol 111:969–975
18. Amrute KV, Eisenberg ER, Rastinehad AR, Kushner L, Badlani GH (2007) Analysis of outcomes of single polypropylene mesh in total pelvic floor reconstruction. Neurourol Urodyn 26:53–58
19. Leffler KS, Thompson JR, Cundiff GW, Buller JL, Burrows LJ, Schon Ybarra MA (2001) Attachment of the rectovaginal septum to the pelvic sidewall. Am J Obstet Gynecol 185:41–43
20. Amid PK (1997) Classification of biomaterials and their related complications in abdominal wall hernia surgery. Hernia 1:15–21
21. Jakus SM, Shapiro A, Hall CD (2008) Biologic and synthetic graft use in pelvic surgery: a review. Obstet Gynecol Surv 63:253–266
22. Jia X, Glazener C, Mowatt G et al (2008) Efficacy and safety of using mesh or grafts in surgery for anterior and/or posterior

vaginal wall prolapse: systematic review and meta-analysis. BJOG 115:1350–1361
23. Brunk D (2008) Horizontal mattress stitch may avert mesh extrusion. ObGyn News 43:6
24. Bako A, Dhar R (2009) Review of synthetic mesh-related complications in pelvic floor reconstructive surgery. Int Urogynecol J Pelvic Floor Dysfunct 20:103–111
25. Natale F, La Penna C, Padoa A, Agostini M, De Simone E, Cervigni M (2009) A prospective, randomized, controlled study comparing Gynemesh, a synthetic mesh, and Pelvicol, a biologic graft, in the surgical treatment of recurrent cystocele. Int Urogynecol J Pelvic Floor Dysfunct 20:75–81
26. De Ridder D (2008) Should we use meshes in the management of vaginal prolapse? Curr Opin Urol 18:377–382