International Journal of Gynecology and Obstetrics (2006) **92**, 279—288

International Journal of
GYNECOLOGY
& OBSTETRICS

www.elsevier.com/locate/ijgo

SURGERY AND TECHNOLOGY

The use of graft materials in vaginal pelvic floor surgery

M. Huebner *, Y. Hsu, D.E. Fenner

Pelvic Floor Research Group and Division of Gynecology, Department of Obstetrics and Gynecology, University of Michigan, Ann Arbor, MI, USA

KEYWORDS
Vaginal pelvic floor surgery;
Synthetic or biological graft materials;
Mesh;
Erosion

Abstract

Objective: To review recent literature on graft materials used in vaginal pelvic floor surgery. *Methods:* A Pubmed-search ("anterior vaginal wall" or "cystocele"), ("posterior vaginal wall" or "rectocele") and ("vaginal vault" or "pelvic prolapse") and ("mesh" or "erosion" or "graft" or "synthetic") from 1995 to 2005 was performed; recent reviews [Birch C. The use of prosthetics in pelvic reconstructive surgery. Best Pract Res Clin Obstet Gynaecol 2005;19:979—91 [1]; Maher C, Baessler K. Surgical management of anterior vaginal wall prolapse: an evidence-based literature review. Int Urogynecol J Pelvic Floor Dysfunct 2005 (May 25) [Electronic Publication] [2]; Maher C, Baessler K. Surgical management of posterior vaginal wall prolapse: an evidence-based literature review. Int Urogynecol J Pelvic Floor Dysfunct 2006;17:84—8 [3]; Altman D, Mellgren A, Zetterstrom J. Rectocele repair using biomaterial augmentation: current documentation and clinical experience. Obstet Gynecol Surv 2005;60:753—60 [4] were added. *Result:* There are few prospective randomized trials that prove the benefit of implanting grafts in vaginal pelvic floor surgery. Many articles are retrospective case series with small sample sizes or incomplete outcome variables. Serious complications such as erosions are often not mentioned. Inconsistent or unclear criteria for anatomic cure make it difficult to compare outcomes. Quality of life issues such as dyspareunia, urinary or bowel symptoms are often ignored. *Conclusion:* Due to a lack of well-designed prospective randomized trials, recommendations for using graft materials in vaginal reconstructive surgery cannot be made. At this time, grafts should have limited use in a carefully selected patient population.

* Corresponding author. Tel.: +1 734 764 8429; fax: +1 734 647 9727.
E-mail address: mhuebner@med.umich.edu (M. Huebner).

0020-7292/$ - see front matter
doi:10.1016/j.ijgo.2005.11.005

1. Introduction

Annually, approximately 300,000 American women suffering from pelvic floor disorders require surgery [5]. No data was available for estimates of surgery worldwide. Around one third of these procedures are for recurrent disease [6]. Thus, it has become increasingly important to improve surgical strategies to decrease the incidence of surgical failure and recurrent prolapse.

Recently, the use of surgical mesh in pelvic floor surgery has become increasingly popular. While general surgeons have had decades of experience using mesh in hernia surgery, the design and development of grafts in gynecologic procedures is still ongoing. Many materials have been used without proper trials and are recommended by manufacturers rather than from data showing long-term improvement of patients' symptoms or decreased recurrence rates. The increasing variety of available materials combined with a paucity of well-conducted clinical trials make the choice of whether to use grafts or which one to use difficult. Therefore, it is the aim of this article to present a critical overview on the use of grafts for vaginal reconstructive surgery. Sacrocolpopexy and urethral slings will not be addressed as there are already excellent reviews in the published literature [7,8].

2. Classification

It is first important to understand the molecular and biomechanical properties differences between different grafts prior to graft selection. Grafts differ in composition (monofilament vs. multifilament), pore size, flexibility [9], architecture (knitted or woven) and whether they are synthetic or biological. The ideal graft material should be chemical inert, non-toxic, non-allergic, non-inflammatory, resistant to infection, non-carcinogenic, solid, sterilizable, convenient and affordable [10,11].

A standardized classification system has been proposed to distinguish between the different types of synthetic mesh shown in Table 1.

Pore size determines migration and infiltration of macrophages and leucocytes into the graft site to prevent infection. Fibroblasts, new blood vessel formation and collagen fibers also require a large enough pore size to be able to migrate into new materials. Rejection of materials with small pore size such as nylon has been reported [13]. Pore sizes also influence mechanical properties such as stiffness. Meshes with smaller pore sizes are stiffer increasing the likelihood of erosion, pain, and poor function. Tape flexibility or low stiffness is at least one of the reasons for the outstanding success of the Gynecare tension-free vaginal tape (TVT) (polypropylene tape, pore size >75 nm) in terms of graft erosion [14].

Complications from synthetic materials have led to an increased use of biomaterials in pelvic reconstructive surgery. These can be divided into allografts (human donor), autografts (self donor) and xenografts (animal donor). Of these, porcine xenografts such as small intestinal submucosa (SIS, Cook Biotech, Inc., West Lafayette, IN, USA) or dermis (Pelvicol/Pelvisoft, C.R. Bard, NJ, USA) are the most popular. How these biomaterials compare to synthetics in terms of surgical outcomes has not been well studied.

More recently, absorbable materials have been developed which mimic some behaviors of synthetics and biological materials. Polyglactin 910 retains at least 25% of its strength beyond 21 days in vivo [15]. Vypro (Johnson and Johnson, USA) appears to be a combination of absorbable polyglactin 910 and polypropylene.

3. Indications

This section has been organized into the following headings: anterior wall repair; posterior wall repair; combined anterior and posterior wall; and vaginal vault prolapse repair.

Table 1 Amid classification [12]

1	2	3	4
Macroporous	Microporous	Macroporous/Microporous	Submicronic pores
>75 nm	<10 nm		
Examples			
Atrium	Gore-Tex	Mersilene (woven Dacron)	Silastic
Marlex		Surgipro (woven Polypropylene)	Cellgard
Prolene		PTFE (Teflon)	
Trelex			

One difficulty in comparing different studies is that there is no accepted definition for anatomical cure. Therefore, "cure" is often defined using different standards by different authors making comparison of success rates complicated. Another difficulty of comparing studies is that functional outcomes such as sexual, urinary, or bowel function are not universally reported, and validated questionnaires are rarely used. It is also important to take into account de novo adverse symptoms or complications such as dyspareunia, urinary urgency, graft infection or erosion. One should not sacrifice quality of life and functional outcomes for optimal anatomic results.

4. Anterior vaginal wall—cystocele repair

4.1. Synthetic meshes

The anatomic cure rate for anterior colporrhaphy using graft materials ranges from 42% to 100%. While the majority of the reported literature consists of retrospective case series, Weber et al. [16] designed a randomized controlled trial on 114 women with anterior wall prolapse. Patients were assigned to standard anterior colporrhaphy ($n=39$), ultralateral colporrhaphy ($n=35$) and anterior wall repair with polyglactin 910-mesh ($n=35$, Vicryl, Ethicon, Somerville, NJ, USA). Power calculation was performed, number of patients per group was estimated to be 31 (power of at least 80%, chance of type I error limited to 5%). Their mean age was 64.7 ± 11.1 years. All patients were evaluated after 6 months, 1 and 2 years (mean follow-up 23.3 months) by a blinded research nurse experienced in POP-Q examinations [17]. The three techniques provided similar anatomic cure rates (Stages 0, 1: 30%, 46%, 42%, respectively) suggesting no advantage to the addition of the synthetic grafts in anterior repair. There was one case of mesh erosion (2.9% of $n=35$) which required surgical treatment. Groups also had similar outcomes for urinary symptoms, voiding, and sexual function.

Yan et al. [18] prospectively enrolled 30 patients undergoing cystocele repair using polypropylene ($n=27$) , Vypro ($n=1$, Ethicon, Somerville, NJ, USA) and polyester ($n=3$). At mean follow-up (6.7 months, range 2—12) the anatomical success rate of all patients was reported 97% (stage 0 or stage I). Mesh erosion occurred in two patients (7%); four patients complained of persistent urge incontinence (13%); and three developed de novo urge incontinence (10%). Sexual function was reported as improved in three (21%), and decreased in five (36%) with a 36% rate of dyspareunia.

Rodriguez et al. [19] conducted a prospective study of 98 patients with stage II—IV cystocele associated with concomitant lateral and apical defects. They used a transvaginal paravaginal approach by attaching a piece of polypropylene mesh to the uterosacral ligaments, the bladder neck and the obturator fascia. Postoperative POP-Q assessments showed 85% of patients with stage 0—I support though length of follow-up is not reported. There was a 3% rate of de novo stress and urge urinary incontinence. Patients reported overall improvement in quality of life due to genitourinary symptoms ($p<0.005$, Incontinence Symptom Score, ISS). No erosions were reported.

Flood et al. [20] reviewed their experience with 142 patients undergoing a modified anterior colporrhaphy with polypropylene mesh. Mean age was 65 years, average parity 2.6. No recurrent anterior vaginal prolapse beyond stage II was found with mean follow-up of 3.2 years. However, there were three cases of erosions (2.1%) that required surgery and five patients complained of dyspareunia.

In contrast to other retrospective series, Cronje et al. [21] showed a high rate of recurrence anterior wall prolapse (28.6%) using Vypro mesh (Johnson and Johnson, Brussels, Belgium) on 28 patients undergoing anterior colposuspension. Urinary retention was also reported in 7.1% leading the authors to conclude that mesh should not be recommended in cystocele repair.

All reviewed articles of this section are listed in Table 2.

4.2. Biological materials

Gandhi et al. [29] conducted a prospective, randomized trial of anterior colporrhaphy on 154 patients with or without the use of cadaveric fascia lata ($n=76$ vs. $v=78$, Tutoplast, Mentor Corporation, Santa Barbara, CA). "Failure" was defined as stage II anterior wall prolapse. Recurrent anterior vaginal wall prolapse occurred in 21.0% of those with graft vs. 29.0% of those without graft (median follow-up of 13 months, range 1.4—50, $p=0.229$) suggesting no surgical improvement with the use of the graft. No major complications were reported. Other studies have found success rates of 83—100% using cadaveric fascia lata [30,31].

One study reported a 84.2% success rate using cadaveric dermal allograft with a 5.3% rate of both de novo urge and infection requiring removal [32].

Table 2 Synthetic mesh used on anterior wall surgery

Author	*n*/*n* at follow-up	Used material	Mean follow-up (months)	Cure rate, anat. stage 0, 1	Adverse effects	Erosion
Weber et al., 2001 [16]	114/109	Polyglactin 910 ($n=35$)	23.3	42%	DND 5.0% (SA 38%), DNU 26%, DNUI 14.0%, DNSUI 8.0%	2.9% ST
Yan et al., 2004 [18]	30	Polypropylene, Vypro, Polyester	6.7	97%	DYS 16.7% (due to ant. wall, SA 47%), DNUI 10%	6.7% ST
Rodriguez et al., 2005 [19]	98	Polypropylene	Not reported	85%	DNUI 3.1%, DNSUI 3.1%, one bladder wall haematoma	0%
Flood et al., 1998 [20]	142/140	Polypropylene	38.4	100%	DYS 3.6%	2.1% ST
Cronje et al., 2004 [21]	28	Vypro	5	81%	UR 7.1%	
De Tayrac et al., 2002 [22]	48	Polypropylene	18	97.9%		8.3%
Palma et al., 2005 [23]	15	Polypropylene	3	100%		
de Tayrac et al., 2005 [24]	87/84	Polypropylene	24	91.6%		8.3%, 4.8% ST
Bader et al., 2004 [25]	40	Polypropylene	16.4	95%		7.5% 2.5% ST
Migliari et al., 2000 [26]	12	Polypropylene	20.5	75%	DND 8.3%, DNU 16.7 %	0%
Migliari et al., 1999 [27]	15	60% Polyglactin 910, 40% Polyester	23.4	93%	DND 20%	0%
Julian et al., 1996 [28]	24	Polypropylene ($n=12$)	24	100%	25% "mesh related complications"	

DND: de novo dyspareunia, DYS: dyspareunia (general), SA: sexually active, DNU: de novo urgency, DNUI: de novo urge incontinence, DNSUI: de novo stress urinary incontinence, UR: urinary retention, ST: surgically treated.

Porcine xenografts grafts have also been used with a 93.1% success using Pelvicol (C.R. Bard, NJ, USA) [33], and a 87.1% success rate using Intexen [34] (AMS, Minnetonka, MN, USA). Listed in Table 3 are the studies using biological materials on anterior wall surgery.

5. Posterior vaginal wall—rectocele repair

In an attempt to reduce the risk of rectocele recurrence, a variety of graft materials and meshes have been employed to try and strengthen vaginal

Table 3 Biological mesh used on anterior wall surgery

Author	*n*/*n* at follow-up	Used material	Mean follow-up (months)	Cure rate, anat. stage 0, 1	Adverse effects
Gandhi et al., 2005 [29]	154/153	Cadaveric fascia lata ($n=76$) no patch ($n=78$)	13	79% vs. 71%	No major
Frederick et al., 2005 [30]	295/251	Cadaveric sling	6	93% cystocele repair	
Groutz et al., 2001 [31]	21	Cadaveric fascia lata	20	100%	
Chung et al., 2002 [32]	19	cadaveric dermal allograft	28	84%	1 infection with removal
Leboeuf et al., 2004 [33]	43	24 four-defect repair, 19 FDR and Pelvicol	15	100% vs. 93.1%	No major
Gomelsky et al., 2004 [34]	70	Porcine, Intexen, AMS	24	87.1%	Recurrent vault prolapse 2%, de novo rectoceles 8.6%
Clemons et al., 2003 [35]	33	AlloDerm graft	18	59%	1 febrile morbidity, 1 cystotomy, 1 anterior wall breakdown
Salomon et al., 2004 [36]	27	Pelvicol	14	81%	Removal in 1 case (4%) due to persistent pain

Table 4 Posterior wall surgery

Author	*n*/*n* at follow-up	Used material	Mean follow-up (months)	Cure rate, anat. stage 0, 1	Adverse effects	Erosion
Lim et al., 2005 [38]	90/31	Vypro II	6	83.9%	CON 18%, DD 20.5, SVB 15.4%, DND 3.4%	12.9%
Oster et al., 1981 [39]	15	Autologous dermis	31.2	100%	IN 6,7%, CON 33%, DYS 20%	
Kohli et al., 2003 [37]	43/30	Dermal allograft	12.9	93%		0%
Altman et al., 2005 [40]	32/29	Pelvicol	12	62%	DD 45%	
De Tayrac et al., 2005 [41]	26/25	Polypropylene	22.7	96%	DND 7.7%, DD 10%	12%, ST 8%

repairs. Different surgical techniques for repair have also been used including traditional transvaginal colporrhaphy, defect directed approach [37] as well as a transperineal approach. There are no randomized trials comparing graft versus no graft in isolated posterior defects.

5.1. Synthetic meshes

More recently, other retrospective series have been published describing the use of synthetic mesh in transvaginal repairs. The largest series from Lim et al. [38] uses Vypro II mesh (polyglactin/polypropylene, Ethicon, Hamburg, Germany). They conducted a retrospective chart review on 90 patients with 6-month follow-up data on 31 patients. Of the 31 patients, there was an 83.9% anatomic cure rate although the criteria used were not described. This group was also found to have a vaginal erosion rate of 12.9%. Of the original 90 patients, 78 returned questionnaires about pre-operative and postoperative symptoms which showed postoperative 18% had difficulty with constipation, 20.5% difficulty with defecation, 15.4% with sensation of vaginal bulge and a 3.4% de novo dyspareunia rate of 59 patients who were sexually active.

5.2. Biological materials

Synthetic mesh placement in the posterior wall can lead to loss of flexibility of the vagina and restriction of the rectum such that it cannot expand during evacuation or coitus leading to fecal urgency and dyspareunia. Therefore, a few studies have used biologic materials to reinforce posterior repairs. Oster and Astrup [39] reported in 1981 the first retrospective case series using dermal autograft for the repair of "large" rectoceles in fifteen patients. Patients were followed from 1 to 4 years with a mean of 2.6 years. No patients had rectocele recurrence, one had a post-operative vaginal infection, five had constipation, and three patients complained of dyspareunia.

Kohli and Miklos performed [37] defect directed repairs with the placement of cadaveric dermal grafts over a 1-year period. Thirty women were followed for an average of 12.9 months. No patients reported dyspareunia and 2 of 30 or 7% of patients had an anatomical failure with the posterior wall at 0.5 cm or greater below the hymen.

In contrast, another study by Altman et al. [40] using collagen mesh (Pelvicol, C.R. Bard, NJ, USA) had less satisfactory results. By 12 months, 11 of 29 patients (38%) had recurrent rectoceles that were $\geq$Stage II. Although there was statistically significant improvement in symptoms, 45% of patients continued to have difficulty with rectal emptying and 17% continued to have to digitally empty the rectum postoperatively. Neither of these studies had major intraoperative or postoperative complications such as graft infection, erosion, or fistula formation. While this suggests that biological meshes may be safer with less erosions when compared to synthetics, prospective, randomized trials are needed to evaluate their effect on defecation and sexual function as well as improved long term reduction in recurrences. Table 4 shows the reviewed studies of this section.

6. Combined procedures—cystocele and rectocele repair

6.1. Synthetic meshes

Sand et al. [15] performed a prospective randomized trial with a sample of 160 women with anterior wall prolapse to the hymen or beyond. All patients were randomly assigned to anterior and/or posterior repair either with or without polyglactin 910 mesh (Vicryl mesh, Ethicon, Somerville, NJ, USA) (n=80 vs. n=80). The two groups did not differ significantly in age (62.5 vs. 65.0 years), weight, parity, or estrogen status. 17 patients were lost for follow-up. The remaining 143 were available for

the follow-up evaluation (mean 12 months). The anatomical success rate after 12 months (stages 0, 1) for cystocele repair was significant improved in the group that received the polyglactin 910 (75%) compared to the group that achieved normal repair (57%) ($p = 0.02$). However, no significant difference was found between groups for the rectocele repair (mesh: 91.2%, no mesh 90.0%, $p = 0.71$). No cases of erosion occurred in this study. Functional outcome was not described.

Milani et al. [42] recruited 63 women for a prospective observational study using polypropylene mesh (Prolene Ethicon, Somerville, NJ, USA) for both anterior and posterior repairs ($n = 32$ with cystocele repair, $n = 31$ with rectocele repair). Anatomic cure rate was high in both groups (anterior repair stage 0: 93.8%, stage 1: 6.2%, posterior repair stage 0: 93.8%, stage 1: 0%, stage 2: 6.2%). In the anterior repair group urinary symptoms did not change postoperatively though mesh erosion occurred in 13%. In the posterior group there was one case of de novo fecal incontinence, 6.5% of mesh erosion rate and one pelvic abscess. They also reported a high rate of post-operative dyspareunia at 69% (pre-operatively 6%). Despite their good anatomic results, the authors recommended abandoning the use of prosthetic material in prolapse surgery due to the high risk of dyspareunia and mesh erosion.

The largest retrospective case series was by Cosson et al. [43,44], describing a new technique using the Prolift mesh (Gynecare, France) for anterior and posterior vaginal wall prolapse repair in 687 women. Cystocele repair was performed by a transversally attached mesh through the obturator foramen, rectocele repair by adding a posterior mesh anchored through the sacrospinous ligaments. Unfortunately, the follow-up time was only 3.6 months making their success rate of 94.7% unreliable. During this period, they reported a 6.7% rate of granuloma formation or vaginal erosion which needed surgically treatment and a 5.4% rate of de novo stress urinary incontinence.

Dwyer et al. [45] performed a retrospective analysis of polypropylene mesh (Atrium, Hudson, New Hampshire, USA) in anterior, posterior and combined prolapse repair in 97 patients. Their anatomical results varied from 91.5% (anterior repair), 93.9% (posterior repair) and 88.2% (combined surgery). The reported improved functional outcomes postoperatively for SUI (34.2%), urge (38.0%), urge incontinence (32.1%), constipation (19.1%), dyspareunia (11.5%) and voiding difficulty (37.1%). However, they also had complications including mesh erosion (9.0%) and one case of rectovaginal fistula.

We could find no series using biological materials in combination for anterior and posterior wall prolapse.

Table 5 shows the studies using synthetic mesh in combined surgery.

6.2. Vaginal vault/apical suspension

Intravaginal slingplasties (IVS) using synthetic mesh [49,13] has gained popularity as a less invasive alternative to traditional procedures for vaginal vault prolapse such as abdominal sacrocolpopexy, sacrospinous ligament suspension, or uterosacral

Table 5 Synthetic mesh used on anterior and posterior wall surgery

Author	*n*/*n* at follow-up	Used material	Mean follow-up (months)	Cure rate, anat. stage 0, 1, anterior vs. posterior	Adverse effects	Erosion anterior vs. posterior
Sand et al., 2001 [15]	161/143	Polyglactin 910	12	75% 91.2%		0%
Milani et al., 2004 [42]	63	Polypropylene	17	100% 93.8	DND 12.5%, IN 3.2%, DYS 63% (increase)	13% 6.5%
Cosson et al., 2005 [44]	687	Prolift	3.6	94.7	DNSUI 5.4%	6.7% ST
Dwyer et al., 2004 [45]	97	Polypropylene	29	91.5% ant. 93.9% post. 88.2% comb.	DND 2.6%, DNU 2.6%, one rectovag. fistula, 2 postop. Hemorrhages >500 ml	9.0%
Adhoute et al., 2004 [46]	52	Polypropylene	27	95% 100%		3.8%
Borrell Palanca et al., 2004 [47]	31	Polypropylene	23.5	100%	DNU 9.7%, UR 3.2%	3.2%
Canepa et al., 2001 [48]	16	Polypropylene	24.3	93.8%	DND 0%, DNU 12.5%	

DND: de novo dyspareunia, IN: Infection, DYS: dyspareunia (general), DNSUI: de novo stress urinary incontinence, DNU: de novo urgency, UR: urinary retention, ST: surgically treated.

ligament suspension. Today the intravaginal slingplasties (anterior and posterior) are used despite a lack of published data and based on the experiences of only a few surgeons.

Petros [49] was the first to describe the posterior IVS or infracoccygeal sacropexy. Women included in this study ($n=75$) had at least a second degree vaginal vault prolapse after hysterectomy, being prolapse to the introitus. The success-rate was 94% on follow-up (1.5—54 months). Mesh erosion occurred in 5.6%.

Farnsworth [13] described his results on 93 patients with recurrent apical prolapse (at least stage 2 or 3). The mean age was 65 years. Two patients were lost for follow-up. During the study period, he switched from nylon ($n=49$, Medhealth Supplies, WA, USA) to a multifilament polypropylene mesh (Tyco Healthcare, USA) due to a 10% rejection rate. This adverse effect was not reported with the new synthetic material. At 12-month follow-up, his anatomic success rate was 91%.

In contrast to the above results, Baessler et al. [50] reported managing 19 women with complications following anterior and posterior intravaginal slingplasty who were referred for sling removal. For anterior slings, complications included mesh infection, retropubic abscess, vesico-vaginal fistula, pain and voiding difficulties. The main indication for the removal of the posterior intravaginal slings was severe pain, especially during defecation and sexual intercourse. All these complications were alleviated by removal of the synthetic slings suggesting a significant risk of harm associated with the procedure leaving the risk vs. benefit ratio of the procedure in doubt without further trials.

The remainder of the techniques described in the literature uses synthetic materials to reinforce traditional apical suspensions. Lo et al. [51] used polypropylene mesh for sacrospinous ligament suspension in 15 patients with severe recurrent vaginal vault or uterus prolapse. Their mean age was 55 years, follow-up was 2.9 years. Asymptomatic stage I recurrence was reported in two patients (13.3%) while de novo dyspareunia occurred in 25% and mesh erosion occurred in 6.7%. Rutman et al. [52] used polypropylene mesh during uterosacral ligament suspension on 50 patients (mean age = 67 years). After a follow-up of 6 months two patients had apical recurrence (4%). Erosion was occurred in one patient. Forty-nine patients (98%) described improvement of their symptoms. Shah et al. [53] described their experience using mesh (not described) combined with sacrospinous ligament suspension. The cure rate was reported with 93.1%. At a follow-up of 24 weeks, perineal pain occurred in 3.4%, frequency in 6.8%, urgency 6.9%, sacral pain in 13.7% and dyspareunia in 60%. Similar to the criticism of the IVS, the high rate of complications associated with the use of mesh in apical repairs leaves their application in doubt. In addition the anatomic cure rates do not appear improved over traditional techniques [54].

Table 6 lists the reviewed articles of this section.

Table 6 Synthetic mesh used in vaginal vault suspension (UI: urge incontinence, SUI: stress urinary incontinence, CON: constipation, DD: difficult defecation, DND: de novo dyspareunia)

Author	*n*/*n* (follow-up)	Used material	Technique	Mean follow-up (months)	Cure rate, anat. (no vault prolapse)	Adverse effects	Erosion
Petros, 2001 [49]	71	Nylon	Posterior IVS	1.5 to 54	94.0%		5.6%
Farnsworth, 2002 [13]	91	Nylon ($n=49$) Polypropylene ($n=44$)	Posterior IVS	12	91.0%		Nylon rejection 10%
Lo et al., 2005 [51]	15	Polypropylene	SSLS	34.8	100.0%	DND 16.7%	6.7%
Rutman et al., 2005 [52]	50	Polypropylene	SULC complex	6	92.0%	1 unilateral ureteral obstruction	2.0%
Shah et al., 2004 [53]	29	not mentioned	H-shaped mesh	25.14	93.1%	DND 60%, sacral pain 13.7%	0%
Biertho et al., 2004 [55]	34	Polypropylene	Posterior IVS	12	91.2%	1 bleeding from an internal hemorrhoid	2.9%
Jordaan et al., 2005 [56]	42/33	Polyglactin and Prolene (Vypro)	Posterior IVS	13	71.0%	UI 42.9%, SUI 14.3%, CON 24%, DD 14.3%, DND 4.8%	

7. Conclusion

While the reduction of surgical failure rates in vaginal reconstructive surgery is of critical importance, the addition of graft materials must be shown to improve anatomical outcomes and at least maintain if not improve lower urinary tract, bowel, and sexual function as well as quality of life for the patient. Unfortunately, the current literature does not meet these criteria.

Normal vaginal function requires compliant, flexible tissue and the ability to distend without pain. These criteria make the use of graft materials in the vagina more problematic than in other areas such as inguinal or abdominal hernias. The ideal material, flexible, yet durable, with low morbidity, including erosion and pain has not been found or at least adequately reported in the literature. A monofilament, with a macropore size, that remains flexible or dissolves after appropriate collagen deposition has occurred would seem appropriate for a synthetic graft. The ideal biological graft would last long enough to provide sufficient scaffolding for collagen deposition, yet be flexible and have low erosion rates. Without conducting well-powered randomized controlled trials, we are left with limited reports of functional outcomes and complication rates in evaluating the current grafts in vaginal reconstructive surgery.

However, some conclusions are suggested by the existing review. While there are clear differences between different graft materials, no one material appears to be ideal. There may be a role for the use of grafts in anterior vaginal wall prolapse, although the two randomized controls trials came to differing conclusions regarding its application. The use of grafts in this area seems to have a relatively low complication rate and acceptable functional outcomes. The use of graft materials for posterior wall prolapse is more problematic due to disabling de novo functional problems such as dyspareunia and pain with defecation. The high rates of complications for grafts in apical suspension procedures should discourage practitioners from adopting its routine use. Overall, the indiscriminate use of grafts in vaginal reconstructive surgery is inappropriate at this time.

Acknowledgment

Funded by Deutsche Forschungsgemeinschaft (DFG), HU1502/1-1.

References

[1] Birch C. The use of prosthetics in pelvic reconstructive surgery. Best Pract Res Clin Obstet Gynaecol 2005;19: 979–91.
[2] Maher C, Baessler K. Surgical management of anterior vaginal wall prolapse: an evidencebased literature review. Int Urogynecol J Pelvic Floor Dysfunct 2005 (May) [Electronic Publication].
[3] Maher C, Baessler K. Surgical management of posterior vaginal wall prolapse: an evidence-based literature review. Int Urogynecol J Pelvic Floor Dysfunct 2006;17:86–8.
[4] Altman D, Mellgren A, Zetterstrom J. Rectocele repair using biomaterial augmentation: current documentation and clinical experience. Obstet Gynecol Surv 2005;60: 753–60.
[5] Boyles SH, Weber AM, Meyn L. Procedures for pelvic organ prolapse in the United States, 1979—1997. Am J Obstet Gynecol 2003;188:108–15.
[6] Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. Obstet Gynecol 1997;89: 501–6.
[7] Stanton SL. Mid-urethral tapes: which? Review of available commercial mid-urethral tapes for the correction of stress incontinence. BJOG 2004;111(Suppl 1):41–5.
[8] Nygaard IE, McCreery R, Brubaker L, Connolly A, Cundiff G, Weber AM, et al. Pelvic floor disorders network. Abdominal sacrocolpopexy: a comprehensive review. Obstet Gynecol 2004;104:805–23.
[9] Fenner DE. New surgical mesh. Clin Obstet Gynecol 2000; 43:650–8.
[10] Cumberland VH. A preliminary report on the use of prefabricated nylon weave in the repair of ventral hernia. Med J Aust 1952;1:143–4.
[11] Scales JT. Materials for hernia repair. Proc R Soc Med 1953; 46:647–52.
[12] Amid PK. Classification of biomaterials and their related complications in abdominal wall surgery. Hernia 1997; 1:15–21.
[13] Farnsworth BN. Posterior intravaginal slingplasty (infracoccygeal sacropexy) for severe posthysterectomy vaginal vault prolapse—a preliminary report on efficacy and safety. Int Urogynecol J Pelvic Floor Dysfunct 2002; 13:4–8.
[14] Dietz HP, Vancaillie P, Svehla M, Walsh W, Steensma AB, Vancaillie TG. Mechanical properties of urogynecologic implant materials. Int Urogynecol J Pelvic Floor Dysfunct 2003;14:239–43.
[15] Sand PK, Koduri S, Lobel RW, Winkler HA, Tomezsko J, Culligan PJ, et al. Prospective randomized trial of polyglactin 910 mesh to prevent recurrence of cystoceles and rectoceles. Am J Obstet Gynecol 2001;184:1357–62 [discussion 1362–1364].
[16] Weber AM, Walters MD, Piedmonte MR, Ballard LA. Anterior colporrhaphy: a randomized trial of three surgical techniques. Am J Obstet Gynecol 2001;185:1299–304 [discussion 1304–1306].
[17] Bump RC, Mattiasson A., Bø K, Brubaker LP, De Lancey JO, Klarskov P, et al. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. Am J Obstet Gynecol 1996;175:10–7.
[18] Yan A, Anne M, Karine A, Vanessa F, Christophe P, Anne T, et al. Cystocele repair by a synthetic vaginal mesh secured anteriorly through the obturator foramen. Eur J Obstet Gynecol Reprod Biol 2004;115:90–4.

[19] Rodriguez LV, Bukkapatnam R, Shah SM, Raz S. Transvaginal paravaginal repair of high-grade cystocele central and lateral defects with concomitant suburethral sling: report of early results, outcomes, and patient satisfaction with a new technique. Urology 2005 (Nov);66(5 Suppl): 57–65.
[20] Flood CG, Drutz HP, Waja L. Anterior colporrhaphy reinforced with Marlex mesh for the treatment of cystoceles. Int Urogynecol J Pelvic Floor Dysfunct 1998;9:200–4.
[21] Cronje HS, Prollius A. Vaginal anterior colposuspension (VACS) for cystocele. Int J Gynecol Obstet 2004;87:46–7.
[22] De Tayrac R, Gervaise A, Fernandez H. Cystocele repair by the vaginal route with a tension-free sub-bladder prosthesis. J Gynecol Obstet Biol Reprod (Paris) 2002;31:597–9.
[23] Palma P, Rane A, Riccetto C, Herrmann V, Dambros M, Tarazona A. Transobturator correction of cystocele. Actas Urol Esp 2005;29(1):89–92.
[24] De Tayrac R, Gervaise A, Chauveaud A, Fernandez H. Tension-free polypropylene mesh for vaginal repair of anterior vaginal wall prolapse. J Reprod Med 2005;50: 75–80.
[25] Bader G, Fauconnier A, Roger N, Heitz D, Ville Y. Cystocele repair by vaginal approach with a tension-free transversal polypropylene mesh. Technique and results. Gynecol Obstet Fertil 2004;32:280–4.
[26] Migliari R, De Angelis M, Madeddu G, Verdacchi T. Tension-free vaginal mesh repair for anterior vaginal wall prolapse. Eur Urol 2000;38:151–5.
[27] Migliari R, Usai E. Treatment results using a mixed fiber mesh in patients with grade IV cystocele. J Urol 1999;161: 1255–8 [Comment in: J Urol 1999;162:1388].
[28] Julian TM. The efficacy of Marlex mesh in the repair of severe, recurrent vaginal prolapse of the anterior midvaginal wall. Am J Obstet Gynecol 1996;175:1472–5.
[29] Gandhi S, Goldberg RP, Kwon C, Koduri S, Beaumont JL, Abramov Y, et al. A prospective randomized trial using solvent dehydrated fascia lata for the prevention of recurrent anterior vaginal wall prolapse. Am J Obstet Gynecol 2005;192:1649–54.
[30] Frederick RW, Leach GE. Cadaveric prolapse repair with sling: intermediate outcomes with 6 months to 5 years of follow-up. J Urol 2005;173:1229–33.
[31] Groutz A, Chaikin DC, Theusen E, Blaivas JG. Use of cadaveric solvent-dehydrated fascia lata for cystocele repair-preliminary results. Urology 2001;58:179–83.
[32] Chung SY, Franks M, Smith CP, Lee JY, Lu SH, Chancellor M. Technique of combined pubovaginal sling and cystocele repair using a single piece of cadaveric dermal graft. Urology 2002;59:538–41.
[33] Leboeuf L, Miles RA, Kim SS, Gousse AE. Grade 4 cystocele repair using four-defect repair and porcine xenograft acellular matrix (Pelvicol): outcome measures using SEAPI. Urology 2004;64:282–6.
[34] Gomelsky A, Rudy DC, Dmochowski RR. Porcine dermis interposition graft for repair of high grade anterior compartment defects with or without concomitant pelvic organ prolapse procedures. J Urol 2004;171:1581–4.
[35] Clemons JL, Myers DL, Aguilar VC, Arya LA. Vaginal paravaginal repair with an AlloDerm graft. Am J Obstet Gynecol 2003;189:1612–8 [discussion 1618–1619].
[36] Salomon LJ, Detchev R, Barranger E, Cortez A, Callard P, Darai E. Treatment of anterior vaginal wall prolapse with porcine skin collagen implant by the transobturator route: preliminary results. Eur Urol 2004;45:219–25.
[37] Kohli N, Miklos JR. Dermal graft-augmented rectocele repair. Int Urogynecol J Pelvic Floor Dysfunct 2003;14: 146–9 [Electronic publication 2003 Feb 13].
[38] Lim YN, Rane A, Muller R. An ambispective observational study in the safety and efficacy of posterior colporrhaphy with composite Vicryl-Prolene mesh. Int Urogynecol J Pelvic Floor Dysfunct 2005;16:126–231 [discussion 131. Electonic publication 2004 Sep 25. Erratum in: Int Urogynecol J Pelvic Floor Dysfunct. 2005;16:170].
[39] Oster S, Astrup A. A new vaginal operation for recurrent and large rectocele using dermis transplant. Acta Obstet Gynecol Scand 1981;60:493–5.
[40] Altman D, Zetterstrom J, Lopez A, Anzen B, Falconer C, Hjern F, et al. Functional and anatomic outcome after transvaginal rectocele repair using collagen mesh: a prospective study. Dis Colon Rectum 2005;48:1233–41 [discussion 1241–1242; author reply 1242].
[41] de Tayrac R, Picone O, Chauveaud-Lambling A, Fernandez H. A 2-year anatomical and functional assessment of transvaginal rectocele repair using a polypropylene mesh. Int Urogynecol J Pelvic Floor Dysfunct 2005.
[42] Milani R, Salvatore S, Soligo M, Pifarotti P, Meschia M, Cortese M. Functional and anatomical outcome of anterior and posterior vaginal prolapse repair with prolene mesh. BJOG 2005;112:107–11.
[43] Cosson M, Caquant F, Collinet P, Rosenthal C, Clave H, Debodinance P. et al. Prolift (Mesh (Gynecare) For Pelivc Organ Prolapse. Surgical Treatment Using The TVM Group Technique: A etrospective Study Of 96 Women Of Less Than 50 Years Old. ICS 2005 Presentation.
[44] Cosson M, Caquant F, Collinet P, Rosenthal C, Clave H, Debodinance P. et al. Prolift (Mesh (Gynecare) For Pelivc Organ Prolapse. Surgical Treatment Using The TVM Group Technique: A Retrospective Study Of 687 Pationes. ICS 2005 Presentation.
[45] Dwyer PL, O'Reilly BA. Transvaginal repair of anterior and posterior compartment prolapse with Atrium polypropylene mesh. BJOG 2004;111:831–6.
[46] Adhoute F, Soyeur L, Pariente JL, Le Guillou M, Ferriere JM. Use of transvaginal polypropylene mesh (Gynemesh) for the treatment of pelvic floor disorders in women. Prospective study in 52 patients. Prog Urol 2004 (Apr);14(2):192–6.
[47] Borrell Palanca A, Chicote Perez F, Queipo Zaragoza JA, Beltran Meseguer JF, Esteve Claramunt J, Pastor Sempere F. Cystocele repair with a polypropylene mesh: our experience. Arch Esp Urol 2004;57:391–6.
[48] Canepa G, Ricciotti G, Introini C, Vigliercio G, Puppo P. Horseshoe-shaped marlex mesh for the treatment of pelvic floor prolapse. Eur Urol 2001;39(Suppl 2):23–6 [discussion 27].
[49] Petros PE. Vault prolapse II: restoration of dynamic vaginal supports by infracoccygeal sacropexy, an axial day-case vaginal procedure. Int Urogynecol J Pelvic Floor Dysfunct 2001;12:296–303.
[50] Baessler K, Hewson AD, Tunn R, Schuessler B, Maher CF. Severe mesh complications following intravaginal slingplasty. Obstet Gynecol 2005;106:713–6.
[51] Lo TS, Horng SG, Huang HJ, Lee SJ, Liang CC. Repair of recurrent vaginal vault prolapse using sacrospinous ligament fixation with mesh interposition and reinforcement. Acta Obstet Gynecol Scand 2005;84:992–5.
[52] Rutman MP, Deng DY, Rodriguez L, Raz S. Repair of vaginal vault prolapse and pelvic floor relaxation using polypropylene mesh: 3. Neurourol Urodyn 2005;24:654–8.
[53] Shah DK, Paul EM, Rastinehad AR, Eisenberg ER, Badlani GH. Short-term outcome analysis of total pelvic reconstruction with mesh: the vaginal approach. J Urol 2004; 171:261–3.
[54] Morley GW, DeLancey JO. Sacrospinous ligament fixation for eversion of the vagina. Am J Obstet Gynecol 1988;

158:872–81 [Comment in: Am J Obstet Gynecol. 1990;162: 295–296].

[55] Biertho I, Dallemagne B, Dewandre JM, Markiewicz S, Monami B, Wahlen C, et al. Intravaginal slingplasty: short term results. Acta Chir Belg 2004;104:700–4.

[56] Jordaan DJ, Prollius A, Cronje HS, Nel M. Posterior intravaginal slingplasty for vaginal prolapse. Int Urogynecol J Pelvic Floor Dysfunct 2005;27:1–4 [Electronic Publication].