



## Approaches to Pelvic Organ Prolapse Surgery

W10, 29 August 2011 09:00 - 12:00

Start	End	Topic	Speakers
09:00	09:20	Surgical anatomy for the reconstructive surgeon	<ul style="list-style-type: none"> <li>• Christian Winters</li> </ul>
09:20	09:50	Anterior compartment repair	<ul style="list-style-type: none"> <li>• Sandip Vasavada</li> </ul>
09:50	10:30	Apical and posterior compartment repairs (including robotic repair)	<ul style="list-style-type: none"> <li>• Kimberly Kenton</li> </ul>
10:30	11:00	Break	None
11:00	11:30	Mesh Repair: pros and cons	<ul style="list-style-type: none"> <li>• Christian Winters</li> </ul>
11:30	12:00	Complications of prolapse repair based on case discussion	<ul style="list-style-type: none"> <li>• Philippe Zimmern</li> </ul>

### Aims of course/workshop

This course is intended to update the reconstructive pelvic surgeon and all interested trainees on the pros and cons of modern surgical approaches in the management of pelvic organ prolapse. This interactive course will feature short lectures on current debates with each approach, including robotic surgery. The course will include multiple surgical video clips, and provocative case discussions to enhance the interaction with the audience.

### Educational Objectives

At the request of SUFU as a tribute to Dr Rodney Appell, this program was organized the past 2 years and was presented in San Francisco and in Toronto. Attendance was very good at both meetings. In fact, in Toronto, more people wanted to attend than were allowed to. The feedback from the attendees was overall positive. Syllabus issues came up each year, the first time because the syllabus was short and this year because it was available on-line but no one had a copy with them at the time of the meeting. In Toronto, we increased the surgical videos but more was wanted according to the comments received. Some video clips in Mac did not transfer well and caused delays during the course. So this is an area of needed improvement for our group. Speakers had acceptable scores, except for the substitute for Dr Winters. The meeting ended on time. All speakers gave their approval to attend next year's meeting, including Dr Winters.

### Anatomy of Pelvic Support

The pelvic floor consists of muscular and fascial tissues acting as a supportive structure, which prevents the female pelvic organs from being pushed out by intra-abdominal pressure. There are three levels of vaginal support. The upper third of the vagina (level I) and uterus are supported by fibers from the uterosacral and cardinal ligaments. This supports the upper vagina above the pelvic diaphragm. These fibers mainly merge into the pericervical ring of connective tissue and into the upper vagina. The middle third of the vagina is attached by the mid portion of the endopelvic fascia (level II). The anterior wall of the vagina in this location is held in place by the lateral attachments of the pubocervical fascia to the fascia over the obturator internus muscle at the arcus tendineus fascia pelvis (white line). The posterior vaginal wall is supported laterally by the lateral attachments of the rectovaginal fascia to the fascia overlying the iliococcygeus muscle. At the lower third of the vagina (level III), the vagina merges with the fascia of the endopelvic fascia and pubourethral ligaments anteriorly to the medial margins of the pubococcygeus. The lower extent of the pubocervical fascia merges into the urogenital diaphragm and the rectovaginal fascia merges into the perineal body. Therefore, in the distal third of the vagina, the endopelvic fascia structures are inserting laterally to the pubourethral ligament and the arcus tendineus, and to the perineal body posteriorly.

### Types of Prolapse

Cystocele: There are four different areas within the connective tissue support of the bladder that predispose one to cystocele if the connective tissue support fails. There are four anatomic defects that can account for the development of cystourethrocele:

- a. Paravaginal defect (lateral defect)
- b. Transverse defect
- c. Midline defect (central defect)
- d. Distal defect (urethrocele)

The paravaginal defect occurs when a separation of the pubocervical fascia from its lateral attachment to the fascia over the obturator internus muscle occurs at the level of the arcus tendineus fascia pelvis. This represents a break of the pubocervical fascia from the white line. This loss of lateral attachments can occur both unilaterally or bilaterally. Usually, a cystourethrocele is seen when this lateral loss of support occurs, and this defect usually predisposes one to symptoms of stress urinary incontinence.

The transverse defect is a separation of the pubocervical fascia from its attachment to the pericervical ring of tissue at the apex of the vagina (level I).

The midline defect is any break in the central portion of the hammock-like sling of pubocervical fascia upon which the bladder is resting. Commonly, this condition can create stress incontinence as well because the hammock-like break in the pubocervical fascia does involve the area underneath the bladder neck. These occur commonly in patients with lateral defects

The distal defect is an avulsion of the urethral attachment to the urogenital diaphragm as it passes under the pubic symphysis. Essentially, these patients lose the lateral attachment to the urethra, to the arcus tendineus, and pubourethral ligament. In addition, these patients lose the anterior attachment of the urethra to the pubic symphysis, and may predispose to SUI.

Uterine or vaginal vault prolapse: In patients with a loss of the level I support of the uterosacral ligaments and cardinal ligaments, the apex of the vagina (cervix or vaginal cuff) loses its attachment. This condition will lead to prolapse of the vaginal cuff and/or prolapse of the uterus.

Enterocoele: An enterocoele is a herniation of the cul de sac peritoneum with or without intraperitoneal contents into the fascial layers between the vagina and rectal walls. An enterocoele may range from a small bulge posteriorly in the upper part of the vagina to a large defect which protrudes beyond the introitus with visible small bowel internally. The upper aspect of the posterior vaginal wall is where enterocoeles occur as a result of a separation of the rectovaginal septum from the level I complex of support. Iatrogenic enterocoeles develop after surgical procedures that distort the normal horizontal axis toward the vertical.

Rectocoele: As the hammock of rectovaginal fascia overlying the rectum breaks, a bulge of the rectum into the vaginal canal occurs. A transverse defect rectocoele occurs simply by a detachment of the perineal body from the rectovaginal fascia. The hammock of rectovaginal fascia supporting the rectum remains intact but separates from the perineal body. A midline vertical defect is created by a midline separation of the rectovaginal fascia, and a separation of the rectovaginal fascia can occur from the its lateral attachments. Rectocoeles are more commonly situated in the mid to distal aspect of the posterior vaginal wall.

Anterior defects (cystocele): A central defect cystocele is surgically repaired by the reduction of the prolapsing bladder and re-approximation of the attenuated pubocervical fascia using plicating sutures. This operation, the anterior colporrhaphy is the most frequently utilized procedure in the correction of cystocele, and is associated with success rates from 30 – 75 %. The anterior colporrhaphy only corrects central defects, and does not correct other forms of prolapse.

A lateral defect cystocele is corrected by the reapproximation of the vagina to the pelvic sidewalls. This operation is completed by placing a row of interrupted sutures from the vagina into the pelvic sidewall at the arcus tendineus, extending all the way to the ischial spine. Multiple sutures are placed to provide support, and this is accomplished abdominally, laparoscopically or transvaginally. When 1 performs this repair through the vagina, a graft material is usually secured to each pelvic sidewall traversing under the bladder. This provides support to the central cystocele component as well. Utilizing these techniques, the success rates of these procedures is reported from 80 – 95%.

A transverse cystocele occurs when the pubocervical attachments separate from the level I (cardinal and uterosacral) support which stabilizes the apex of the vagina. In an isolated transverse defect, the cystocele is repaired simply by restoring this support. This is most commonly performed by re-establishing cuff support. This explains why many women with cystocele may have correction after an abdominal colpopexy or uterosacral cuff suspension.

Posterior defects (rectocele): A rectocele is repaired by re-approximating the rectovaginal fascia together, usually with interrupted sutures in an operation called a posterior colporrhaphy. The operation extends distally toward the perineal body, and involves incorporating levator fascia into the repair distally. In fact, many posterior repairs involve placcation and re-inforcement of the perineal body. One must take great care not to narrow the vagina excessively, as this may cause sexual dysfunction. Graft materials can be incorporated in this repair, and many have adopted the use of grafts, particularly for repeat repairs. A site-specific rectocele repair is accomplished when 1 re-approximates the rectovaginal fascia (which is intact) to the perineal body. This detachment can be responsible for large distal rectoceles that can become symptomatic. This can be accomplished through a small, distal transverse or diamond-type incision. Success rates of 66%-75% have been recorded, with the major complications being pain and/or sexual dysfunction.

Enterocoele: The most common form of enterocele repair is that of transvaginal sac isolation and closure. The enterocele sac is isolated after making an incision near (or through) the cuff of the vagina. After the sac is dissected out, the bowel contents are reduced, and the sac is closed proximally near the “neck” of the sac. Following this the remaining sac is dissected out and discarded. The enterocele can also be repaired transabdominally. The bowel is lifted out of the pelvis, and a cul-de-plasty is performed with permanent, interrupted sutures.

Apical Prolapse of the vaginal cuff: There are a wide number of procedures to correct apical vaginal prolapse. The importance of recognizing and correcting apical defects is important. This is the means by which the upper vagina is stabilized proximally, and this protects against widening of the genital hiatus. There are a number of abdominal, vaginal and laparoscopic approaches to the correction of apical prolapse, and the surgeon should be well versed to perform several of these procedures. The sacrospinous ligament fixation (SSLF) achieves a functional vagina and vault prolapse cure in 67-79% of patients. The sutures are placed directly into the body of the sacrospinous ligament as there is a potential for significant vascular or neurologic injury. The apex can be sutured directly to the iliococcygeus fascia, or to the uterosacral ligament remnants usually isolated via a transvaginal, intraperitoneal approach.

The abdominal sacral colpopexy is one of the most successful ways to correct apical prolapse. This procedure is accomplished via abdominal, laparoscopic, or robotic approaches. A graft is utilized to secure the apex of the vaginal to the sacrum. Most authors now fix the graft material to the sacral promontory. A synthetic mesh should be utilized, as there is Level I evidence demonstrating the superiority of permanent mesh materials to biologic graft materials in women undergoing colpopexy. All women should undergo a cul-de-plasty to prevent recurrent enterocele. Success rates as high as 95% have been reported by multiple authors, with an acceptably low graft erosion rate.

#### References

1. Herbst A, Mishell D, Stenchever M, Droegemueller W. Disorders of the abdominal wall and pelvic support, in Stenchever MA (Ed.) Comprehensive Gynecology, 2<sup>nd</sup> edition, Moseby Yearbook, Philadelphia, 1992, page 594.
2. Karram M, Miklos J, Sze E. Pelvic prolapse and lower urinary tract dysfunction in females in Urinary Incontinence, O'Donnell P (Ed.), 1<sup>st</sup> edition, Moseby Yearbook, Philadelphia, 1997, page 302.
3. DeLancey J, Richardson A. Anatomy of genital support in Urogynecologic Surgery, Gathersberg Maryland, 1992, Aspen.

Slide 1

**Pelvic Floor Prolapse:  
Anatomic, Functional and  
Surgical Principles**

---

J. Christian Winters, M.D.  
Professor and Chairman, Department of Urology  
Louisiana State University Health Sciences Center  
New Orleans, Louisiana

LSU

---

---

---

---

---

---

---

---

Slide 2

**Pelvic Organ Support**

- Both static and dynamic forces important
- Pelvic organ stability dependent on:
  - Bony structures
  - Pelvic floor musculature
  - Fascial condensations
  - Intact innervation
- Understanding of normal anatomy aids in restoring pelvic organ function & position

LSU

---

---

---

---

---

---

---

---

Slide 3

**Pelvic Floor Musculature**

- Striated musculature providing 2 main functions:
  1. Support of visceropelvic organs
  2. Maintenance of urinary and fecal continence.
- Not “bowl”, but horizontal or flat.
- Pelvic diaphragm - levator ani and coccygeus muscles.
  - Levator ani = pubococcygeus, iliococcygeus.

LSU

---

---

---

---

---

---

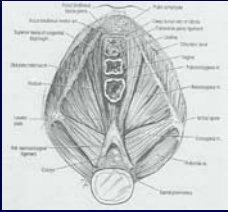
---

---

Slide 4

**Anterior Levator Ani group**  
**"Puboviscera"**

- Pubococcygeus (puborectalis)
- Directly attached to the bladder, urethra, vagina, rectum.
- Actively contribute to visceral control
- Crucial during increased abdominal pressure.



Anderson J and Graydy R. Anatomy and Embryology in Novak's Text of Gynecology

LSU

---

---

---

---

---

---

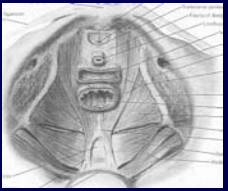
---

---

Slide 5

**Posterior Levator Ani Group**  
**"Diaphragmatic"**

- Iliococcygeus and coccygeus.
- Originate from more posterior portions of tendinous arc and ischial spines.
- The two sides fuse in midline posterior to the rectum and attach to the coccyx.
- This horizontal plate extends from the rectal hiatus to the coccyx, and the upper vagina and cervix are situated in this horizontal plane created by levator plate.



Source: Netter's Atlas of Anatomy

LSU

---

---

---

---

---

---

---

---

Slide 6

**Levator Ani – Muscle Composition**

- Type I muscle fibers – slow twitch and provide a sustained tone of pelvic floor.
  - Support pelvis in normal activity.
- Type II fibers – fast twitch fibers reflexively contract during sudden increases in intraabdominal pressure (ie cough etc).

LSU

---

---

---

---

---

---


---

---

Slide 7

### Levator Ani - Function

- Tonic contraction of pubococcygeus muscle closes the genital hiatus.
- Pelvic muscle contraction leads to elevation of the visceral organs and vaginal closure.
  - The vagina and rectum are supported over the levator plate, which elevates these organs and narrows the genital hiatus by traction from the levator ani.



From: Wall L, Mettler S: Novak's Text of Gynecology

LSU

---

---

---

---

---

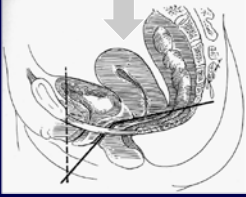
---

---

---

Slide 8

### Vaginal Support



LSU

---

---

---

---

---

---

---

---

Slide 9

### Pelvic Floor Support

Combination of :

- Pelvic Floor Musculature
- Connective Tissue Attachments

LSU

---

---

---

---

---

---

---

---

Slide 10

### Endopelvic Fascia

- Sheet of fibroareolar tissue following blood supply to visceral organs. "*Retroperitoneal Mesentery*"
- Attaches the cervix and vagina to the lateral pelvic sidewall.
- Composed of 2 parts:
  1. Parametrium (connected to uterus) which are the uterosacral and cardinal ligaments.
  2. Paracolpium (connected to vagina). The parametrium fuses to the paracolpium and this extends all the way to perineal body.

LSU

---

---

---

---

---

---


---

---

Slide 11

### Uterosacral and Cardinal Ligaments

- Two different parts of a single mass of tissue.
- Uterosacral ligaments are the visible and palpable medial margin of this tissue complex.
  - Stabilize cervix and upper vagina posteriorly to sacrum.



Source: Netter's Atlas of Anatomy

LSU

---

---

---

---

---

---


---

---

Slide 12

### Uterosacral and Cardinal Ligaments

- Cardinal ligaments - are thick condensations of fascia originating from the greater sciatic foramen inserting into the lateral aspect of the cervix and upper vagina.
  - Important in support of bladder base as it is contiguous with perivesical fascia.
- Support cervix (uterus) and upper vagina to maintain a posterior position over the levator plate, which pulls them away from genital hiatus.



Source: Netter's Atlas of Anatomy

LSU

---

---

---

---

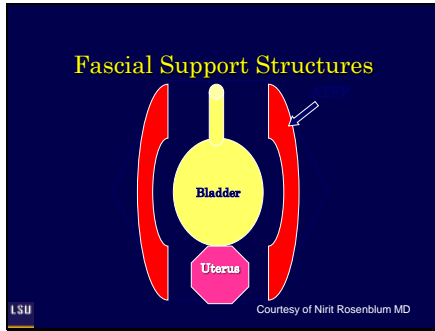
---

---

---

---

Slide 13



---

---

---

---

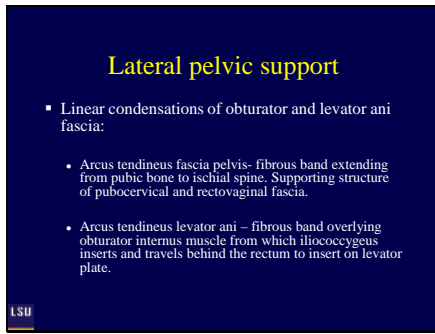
---

---

---

---

Slide 14



---

---

---

---

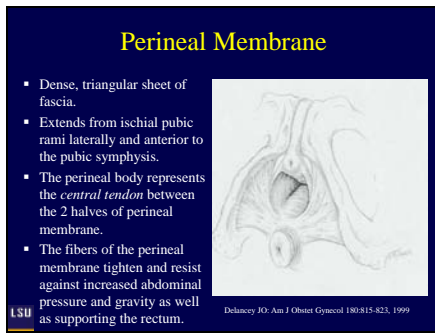
---

---

---

---

Slide 15



---

---

---

---

---

---

---

---



Slide 16

### Levels of Vaginal Support

**Level I:**  
Uterosacral and Cardinal Ligaments

**Level II:**  
Arcus Tendineus Fascia Pelvis  
Pubocervical and Rectovaginal Fascia (Proximal)

**Level III:**  
Pubocervical and Rectovaginal Fascia (Distal)  
Pubourethral Ligament and Perineal Body

LSU Source: JOL: Am J Obstet Gynecol. 166:1717, 1992

---

---

---

---

---

---

---

---

Slide 17

### Fascial Support Structures: Level II

**(a) Pubocervical & Rectovaginal**

**(b) Defects in Rectovaginal Fascia**

LSU Source: J Miklos MD and N Kohli MD

---

---

---

---

---

---

---

---

Slide 18

### Fascial Support Structures

- Level I support
  - Uterosacral
  - Cardinal
- Level II support
  - Pubocervical
  - Rectovaginal

LSU Source: Miklos J and Kohli N

---

---

---

---

---

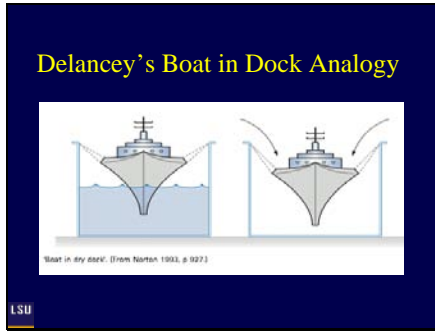
---

---

---



Slide 22



---

---

---

---

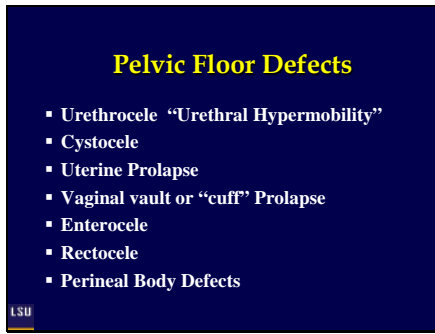
---

---

---

---

Slide 23



---

---

---

---

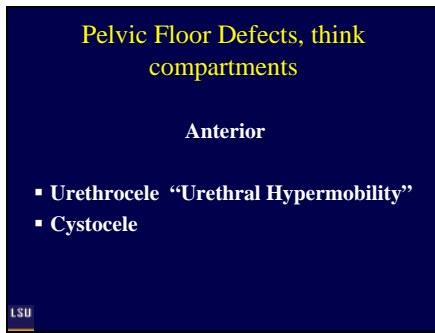
---

---

---

---

Slide 24



---

---

---

---

---

---

---

---

Slide 25

**Pelvic Floor Defects, think compartments!!**

Middle or Apical Compartment

- Uterine Prolapse
- Vaginal vault or “cuff” Prolapse
- Enterocele

LSU

---

---

---

---

---

---

---

---

Slide 26

**Pelvic Floor Defects, think compartments!!**

Posterior Compartment

- Enterocele
- Rectocele
- Perineal body defects

LSU

---

---

---

---

---

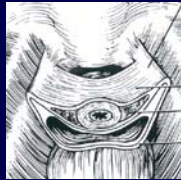
---

---

---

Slide 27

**Urethral Support**



*A lattice-like network of the endopelvic fascia divides and supports the urethra anteriorly and posteriorly.*

*Anteriorly*  
*pubovesical = pubourethral fascia*

*Posteriorly:*  
*pubocervical = periurethral fascia*

*Laterally*  
*urethropelvic = lateral attachments*

Source: Brinkley E. *Pelvic Floor Anatomy in "The Female Pelvic Floor."*

LSU

---

---

---

---

---

---

---

---

Slide 28



---

---

---

---

---

---

---

---

Slide 29



---

---

---

---

---

---

---

---

Slide 30

**Integral Theory**

- Pubourethral Ligament
- Suburethral Vaginal Hammock
- Pubococcygeus muscle

All three structures work together by drawing the urethra forward against the pubourethral ligament and closing the urethra.

*The PCM muscle can only contract so much, if there is excessive vaginal laxity, it can't draw urethra against the PUL to achieve closure.*

LSU

---

---

---

---

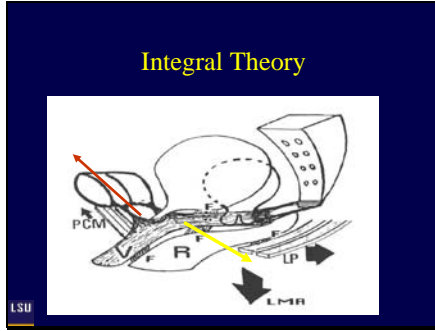
---

---

---

---

Slide 31



---

---

---

---

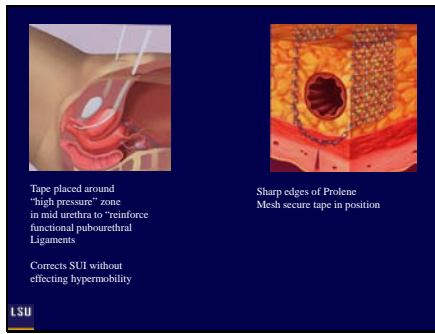
---

---

---

---

Slide 32



---

---

---

---

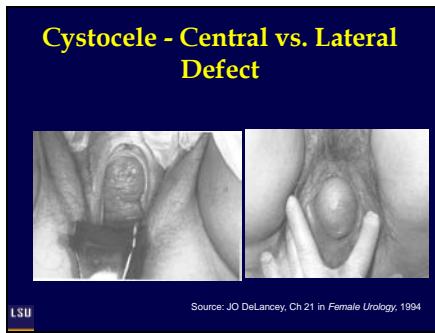
---

---

---

---

Slide 33



---

---

---

---

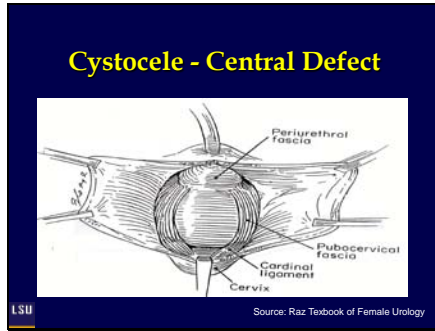
---

---

---

---

Slide 34



---

---

---

---

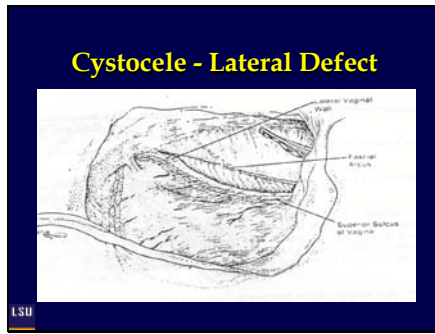
---

---

---

---

Slide 35



---

---

---

---

---

---

---

---

Slide 36

### Enterocoele

- A herniation of the cul-de-sac peritoneum with or without intra-peritoneal contents into the fascial layers between the vagina and rectal walls.
- An isolated enterocoele may result from a transverse separation of the rectovaginal septum to the Level I area of support.

---

---

---

---

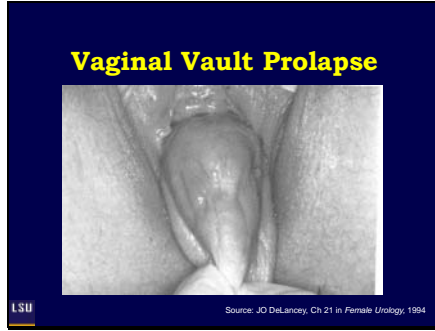
---

---

---

---

Slide 37



---

---

---

---

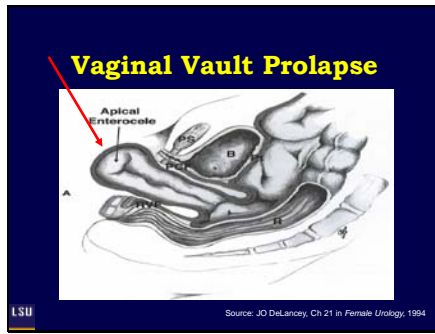
---

---

---

---

Slide 38



---

---

---

---

---

---

---

---

Slide 39



---

---

---

---

---

---

---

---



Slide 40

**Pelvic Exam: Objectives**

- Inspection
- Assess vaginal integrity
- Assess pelvic anatomy
  - Normal vs abnormal
  - Presence or absence of prolapse
- Assess presence or absence of SUI
- Rectal exam
- Supine vs Standing

LSU

---

---

---

---

---

---

---

---

Slide 41

**Prolapse: Classifications**

- Pelvic organ prolapse quantitative (POPQ)
  - Accurate
  - Time consuming & labor intensive
- Baden Walker Half-way
  - Easier
  - Some subjective

Bump RC, et al The standardisation of terminology of female pelvic organ prolapse and pelvic floor dysfunction Am J Obstet Gynecol 1996; 175:10-17.

LSU

---

---

---

---

---

---

---

---

Slide 42

**Baden Walker Classification**

- Introitus is reference point
- Grade 0: No prolapse
- Grade 1: Prolapse descends toward introitus with strain
- Grade 2: Prolapse descends to introitus with strain
- Grade 3: Prolapse descends beyond introitus with strain
- Grade 4: Prolapse descends beyond introitus at rest

LSU

---

---

---

---

---

---

---

---

Slide 43

### POPQ Exam

**3 Compartments, 9 Points**

- Anterior Wall
  - POINTS Aa & Ba
- Apex
  - C, D (omit D if hysterectomy)
- Posterior
  - Bp & Ap
- Genital hiatus (gh)
- Perineal body (pb)
- Total vaginal length (tv)

Points Aa & Ap are always appointed exactly 3 cm from reference hymenal ring.

Patient valsalva and measure descent of points.

- This example, points Aa and Ap are both -3.

LSU Bump RC, et al Am J Obstet Gynecol 1996

---

---

---

---

---

---

---

---

---

---

Slide 44

Complete Vaginal Vault Eversion (B)				Normal Support of Uterine Cervix (A)		
Aa	Ba	C		Aa	Ba	C
+3	+8	+8		-3	-3	-8
Ap	gh	pb	tvl	Ap	gh	pb
4.5	1.5	8	10	2	3	10
+3	+8	--		-3	-3	-10

LSU

---

---

---

---

---

---

---

---

---

---

Slide 45

### Stages for POPQ

- Stage 0 - no prolapse demonstrated,
  - All points are at their highest possible level above the hymen
- Stage I - most distal portion of prolapse is more than 1 cm above the level of the hymen
- Stage II - most distal portion of prolapse is 1 cm or less proximal to or distal to the hymen
- Stage III - most distal portion of prolapse is more than 1 cm below the hymen but protrudes no further than two cm less than the total vaginal length
- Stage IV - essentially complete eversion of the total length of the lower genital tract

LSU

---

---

---

---

---

---

---

---

---

---

Slide 46

### Pelvic Exam Classifications

**Table 1** A chart showing the most commonly used classification systems of cystoceles.

Grade	POP-Q standard	POP-Q short	Balen-Noller Half-way
0	All points 2 cm above hymen (value = -3) and points C and D are above the hymen equal to or within 2 cm of total vaginal length	-	No prolapse
1	All points >1 cm above hymen (value = -1)	Prolapse 1 cm above hymen	Bladder toward introitus with straining
2	Leading edge of prolapse within 1 cm of hymen (value = 0, 1, 2)	Prolapse descends to introitus, 1 cm above or below hymen	Bladder to introitus with straining
3	Maximal prolapse protrudes >1 cm beyond hymen, but <2 cm of the total vaginal length (value = 1 to 2)	Prolapse descends beyond introitus but not complete vaginal vault eversion	Bladder outside of introitus with straining
4	Maximal prolapse protrudes to within 2 cm of total vaginal length (value = 3)	Complete vaginal vault eversion	Bladder outside introitus of rest

Abb. Aq, measurement of points 2 cm above and/or within 1 cm anteriorly and posteriorly, respectively. Ba, Bp, representative of the most dependent portions of the anterior and posterior walls. C, represents cervical vaginal wall; D, represents posterior fornix or vaginal apex (not measured). P, patient has vulvovaginal hypermobility. Abbreviation: POP-Q, Pelvic Organ Prolapse Quantification.

Yamada BS and Kobashi KC. Urogenital prolapse and occult stress urinary incontinence. *Nat Clin Pract Urol* 2007

---

---

---

---

---

---

---

---

---

---

Slide 47

### Levels of Vaginal Support: "Site Specific Defects"

- Uterine Prolapse (Level 1)
- Vaginal vault or "cuff" Prolapse (Level 1)
- Enterocele (Level 1)
- Cystocele (Level 2)
- Rectocele (Level 2)
- "Urethral Hypermobility" (Level 3)
- Perineal Body Defects (Level 3)

LSU Lancet JOL: Am J Obstet Gynecol 166:1717, 1992

---

---

---

---

---

---

---

---

---

---

Slide 48

### Surgical Approach

	Vaginal	Abdominal
Aa Urethra	Anterior repair Pentya Sling	Retropublic urethropexy Sling
Ba Bladder	Anterior repair Paravaginal repair "Four point" suspension	Wedge colectomy Paravaginal repair
C Cervix/Cuff	Uterosacral ligament suspension Ileococcygeous suspension Coccygeous suspension Colpocleisis	Uterosacral ligament suspension Sacrococcygeous suspension
D Culsac	McCall	Hilban Moschowitz
Pg and Pb Rectum	Site specific repair Classic "plication"	Colpoperineopexy

LSU

---

---

---

---

---

---

---

---

---

---

Slide 49

**Summary**

- Pelvic floor anatomy is complex, often challenging to master.
- Proper support is achieved by a contiguous connective tissue network enhanced by properly functioning levator ani function.
- It is important for the pelvic surgeon to understand these concepts and incorporate these principles into anatomic repair of site-specific defects.

LSU

---

---

---

---

---

---

---

---

## Anterior Compartment Repairs

Sandip Vasavada, MD  
Center for Female Urology and Pelvic  
Reconstructive Surgery  
The Glickman Urological and Kidney Institute  
The Cleveland Clinic

---

---

---

---

---

---

---

---

## “Traditional repairs vs Augmented repairs”

- Should we abandon “traditional repairs”?
- If no, then what situations to use
  - First time occurrence of prolapse
  - Thin tissues/ atrophic
  - Sexually active patients?
- Constant need to “innovate” or “keep up”
- Is this because traditional repairs are doomed to failure.....

---

---

---

---

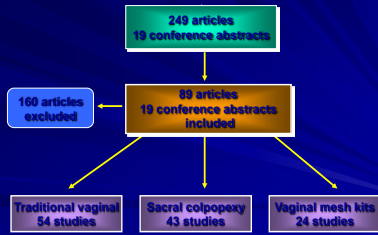
---

---

---

---

Systematic Review of all Prolapse Surgeries.  
From Diwadkar et al, (Obst and Gynec, Feb 2009)



---

---

---

---

---

---

---

---

## Results of Traditional Vaginal Repairs

Diwadkar et al 2009.

- 7827 patients
- Longest mean follow-up of 32.6 months
- Most common complications:
  - Urinary tract infection 3.5%
  - Hemorrhage or hematoma 2.8%
  - Dyspareunia 1.5%

---

---

---

---

---

---

---

---

## Results of Sacral Colpopexy

- 5639 patients
- Mean follow-up of 26.5 months
- Most common complications:
  - Pain 2.3%
  - Mesh erosion 2.2%
  - Visceral injury 1.7%
  - Wound complications 1.5%

---

---

---

---

---

---

---

---

---

---

## Results of Vaginal Mesh Kits

- 3425 patients
- Mean follow-up of 17.1 months
- Most common complications:
  - Mesh erosion or infection 5.8%
  - Fistulas 0.2%
  - Dyspareunia 2.2%

---

---

---

---

---

---

---

---

---

---

	Traditional Vaginal Repairs			Sacral Colpopexy			Mesh Kits		
	%	95% CI	Range	%	95% CI	Range	%	95% CI	Range
Total complication rate	15.3	14.7-16.3	0-52.8	17.1	16.1-18.1	0-52.2	14.5	13.3-15.7	0-23.1
Reoperation for prolapse recurrence	3.9	3.5-4.4	0-29.1	2.3	1.9-2.7	0-31.3	1.3	1.0-1.7	0-16.0
Total reoperation rate	5.8	5.3-6.3	0-29.2	7.1	6.4-7.8	0-26.2	8.5	7.6-9.4	0-30.0

---

---

---

---

---

---

---

---

---

---

	Traditional Vaginal Repairs			Sacral Colpopexy			Mesh Kits		
	%	95% CI	Range	%	95% CI	Range	%	95% CI	Range
Total complication rate	15.3	14.7-16.3	0-52.8	17.1	16.1-18.1	0-52.2	14.5	13.3-15.7	0-23.1
Reoperation for prolapse recurrence	3.9	3.5-4.4	0-29.1	2.3	1.9-2.7	0-31.3	1.3	1.0-1.7	0-16.0
Total reoperation rate	5.8	5.3-6.3	0-29.2	7.1	6.4-7.8	0-26.2	8.5	7.6-9.4	0-30.0

---

---

---

---

---

---

---

---

---

---

Complication Grade By Repair Group

	Traditional Vaginal Repairs		Sacral Colpopexy		Mesh Kits	
	%	95% CI	%	95% CI	%	95% CI
<b>Dindo Grade I</b>	6.2	5.7-6.7	5.5	4.9-6.1	3.9	3.3-4.6
<b>Dindo Grade II</b>	6.9	6.4-7.6	5.8	5.2-6.4	2.2	1.7-2.7
<b>Dindo Grade IIIa</b>	0.2	0.1-0.4	1.0	0.7-1.2	1.3	0.9-1.6
<b>Dindo Grade IIIb</b>	1.9	1.7-2.3	4.8	4.2-5.4	<b>7.2</b>	<b>6.3-8.0</b>

---

---

---

---

---

---

---

---

---

---

- Conclusions of Review
- Traditional vaginal procedures
    - Highest reoperation rate for prolapse recurrence
    - Lowest rates of complications that required surgical intervention
    - Lowest total reoperation rate
  - Vaginal mesh kits
    - Shortest follow-up period
    - Highest rate of complications that required surgical intervention
    - Highest total reoperation rate (recurrence + complications)

---

---

---

---

---

---

---

---

---

---

- Challenges in Vaginal Prolapse Surgery
- Anterior Vaginal Wall Prolapse
  - Apical Prolapse
    - At time of hysterectomy
    - Post-hysterectomy
  - Posterior Vaginal Wall Prolapse

---

---

---

---

---

---

---

---

---

---




---

---

---

---

---

---

---

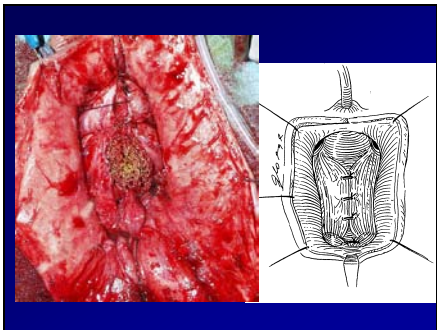
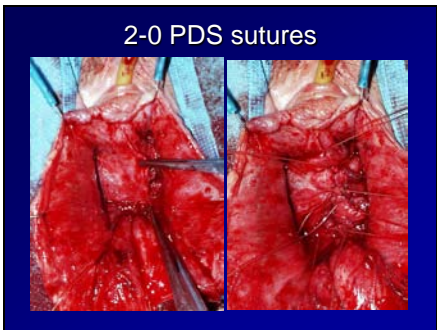
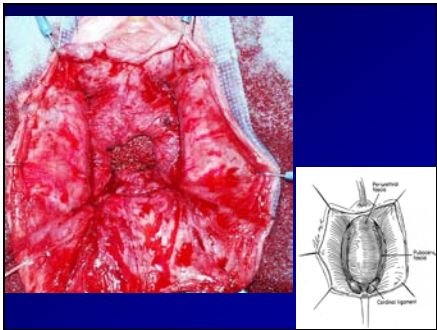
---

---

---







---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---



## Lateral or Paravaginal Defect

---

---

---

---

---

---

---

---

## Paravaginal Defects

- Lateral support of pubocervical fascia to condensation of obturator internus and levator fascia's (White line of arcus tendineus)
- Widespread belief that AVW prolapse patients have co-existent lateral and central defects (up to 80%)
- *If so many patients have lateral defects that are not routinely corrected, why do our central defect only repairs work most of the time*

---

---

---

---

---

---

---

---

## Paravaginal Defect Retropubic repair

- Can be done open or laparoscopically
- Four to six non absorbable sutures
- Success rates good for retropubic and laparoscopic
- Minimal morbidity (aside from access route)

---

---

---

---

---

---

---

---

## Paravaginal Defect Correction Vaginal

- Identify lateral defect
- Enter paravaginal space
- Re-approximate pubocervical fascia with ATRP (interrupted non absorbable sutures)

---

---

---

---

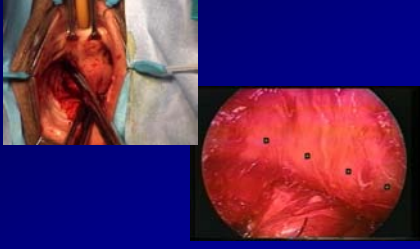
---

---

---

---

Vaginal Correction of Lateral Defect



---

---

---

---

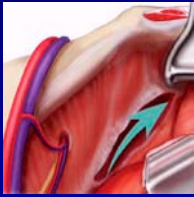
---

---

---

---

Vaginal Correction of Lateral Defect



---

---

---

---

---

---

---

---

Vaginal Correction of Lateral Defect



---

---

---

---

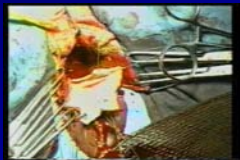
---

---

---

---

Vaginal Correction of Lateral Defect



---

---

---

---

---

---

---

---

## Paravaginal Defect Repairs Vaginal corrective repairs

Study (year)	No. of pts	Study design	Follow-up		Cure * (%)	Failed (%)
			Mean.	range		
White (1909) <sup>6</sup>	19	Retrospective cohort	NR	Up to 3 yrs	100	0
Shull et al (1934) <sup>12</sup>	62	Retrospective cohort	1.6 yrs	0.1 – 5.6 yrs	76	24
Farrell & Ling (1997) <sup>14</sup>	27	Retrospective cohort	8 mo.	NR	80	20
Nguyen & Bhatia (1999) <sup>20</sup>	10	Retrospective cohort	1 yr.	NR	100	0
Elkins et al (2000) <sup>24</sup>	25	Retrospective cohort	NR	0.5 – 3 yrs	76	24
Mallapragada et al (2001) <sup>25</sup>	35	Retrospective cohort	20 mo.	8 – 35 mo	97	3
Young (2001) <sup>25</sup>	100	Retrospective cohort	11 mo.	1 – 36 mo.	78	22

NR – not reported

Barber, M and Vasavada, S

---

---

---

---

---

---

---

---

---

---

## Patch Augmentation for AVW Prolapse

- Poor quality tissues used for durable repair
- High recurrent prolapse rates (29-42%)
- What to do for patients with 2-3 previous failed repairs ?
- Younger patient population: what will happen to results over time?
- What happens to sexual function with patch?
- “Bladder Cripples”

---

---

---

---

---

---

---

---

---

---

## Rationale for Patch Augmentation for AVW Prolapse

- Simultaneous Central and Lateral Defect Support
- Reinforce weak tissues
- Materials for augmentation
  - Autologous ?
  - Allograft (fascia, dermis): falling out of favor ?
  - Xenograft (porcine, bovine): Cross linked vs not
    - Incisional dehiscence
    - Granulation
    - encapsulation
- Synthetic (prolene, soft prolene mesh, marlex, gortex, etc.)

?dyspareunia

---

---

---

---

---

---

---

---

---

---

## Defining success

- Some degree of loss of anatomic support is normal
- Perfect anatomic support is associated w/ worse HRQOL (PFIQ 10pts worse for Stage 0 than Stage 1 or greater)
- Symptomatic cure is more clinically relevant than anatomic cure
- Definitions of anatomic success commonly used are too strict and often not clinically relevant

---

---

---

---

---

---

---

---

---

---

## What is a failure after POP surgery?

- Reoperation or retreatment?
- Recurrence of symptoms?
- Anatomic recurrence
  - Stage 2+?
  - Beyond hymen?
  - Stage 3+?

---

---

---

---

---

---

---

---

## Anterior colporrhaphy: A randomized trial of three surgical techniques

Anne M. Weber, MD, Mark D. Walters, MD, Markon R. Fiedlmeier, MA, and Leslie A. Ballard, MD  
Cleveland, Ohio  
*Int J Gynec Obstet* 2001;112:1289-2003

- RCT, n = 114, May 1996 – 2000
- Cure: POPQ Aa & Ba  $\leq$  -2
- % Cure at last follow-up
  - Standard 30%
  - Standard + Polyglactin 910 mesh 42% NS
  - "Ultralateral" anterior colporrhaphy 46%
- Mean follow-up: 23.3 months (4.5 to 43 months)

Cleveland Clinic

Courtesy of Matt Barber

---

---

---

---

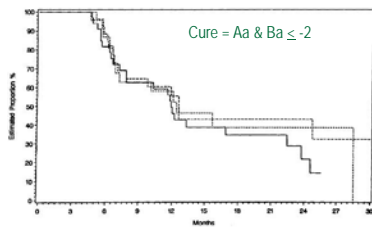
---

---

---

---

## Randomized Trial of 3 methods of Anterior Repair



Cleveland Clinic

Weber et al, AJOG 2001

---

---

---

---

---

---

---

---

## Definition of Cure

- 2001 NIH Workshop on Standardization:
  - "Optimal" anatomic outcome – Stage 0
  - "Satisfactory" anatomic outcome – Stage 1
- NIH definitions too strict [Weber et al. IJUGJ 2001](#)
  - over 75% of women presenting for annual exams would not meet "optimal" definition and 40% would not meet the "satisfactory" anatomic outcome definition.

Cleveland Clinic

[Swift et al, AJOG 2000](#)  
[Swift et al, AJOG 2005](#)  
[Trowbridge et al, AJOG 2008](#)

---

---

---

---

---

---

---

---

## Definition of Cure

- The hymen is an important threshold for symptom development.
- The pelvic symptom that best correlates with advanced prolapse is a vaginal bulge that can be seen or felt.
- The absence of vaginal bulge symptoms postoperatively has a significant relationship with a patients assessment of treatment success and HRQOL while anatomic success alone does not.

---

---

---

---

---

---

---

---

---

---

## NIH Pelvic Floor Disorders Network Recommendation

Success after POP surgery:

- No prolapse beyond the hymen  
(Aa, Ba, C, Ap, Bp  $\leq$  0)
- No vaginal bulge symptoms and
- No retreatment

---

---

---

---

---

---

---

---

---

---

## Objective

Reanalyze the results of the trial by Weber et al comparing three techniques for surgical correction of anterior vaginal prolapse using more clinically relevant definitions anatomic and symptomatic prolapse recurrence.

---

---

---

---

---

---

---

---

---

---

## Methods

- Re-analysis of trial by Weber et al
- 114 subjects undergoing surgery for anterior vaginal prolapse randomized (1:1:1) to one of three techniques
- Exclusions: any planned incontinence procedure other than suburethral plication.
- Pre- and Post-operative data abstracted from original care report forms.
- Follow-up at 6, 12, 24 months:
  - POPQ exam by blinded examiner
  - Symptom questionnaires (VAS)

---

---

---

---

---

---

---

---

---

---

## Methods

- Prolapse VAS : "How much are you bothered by symptoms related to vaginal prolapse" (0 "not at all" – 100 "extremely")
- Treatment success:
  - POPQ Ba, Bp, C  $\leq$  0 cm
  - Absence of prolapse symptoms (VAS < 20)
  - No retreatment

---

---

---

---

---

---

---

---

## Analysis

- Originally sample size adequate detect a 30% difference between groups w/ 80% power, alpha .05
- No differences between groups anticipated so primary analysis performed in aggregate.
- To minimize impact of missing data, primary analysis focused on outcomes at one year.
- Time to failure presented using Kaplan Meier survival curves

---

---

---

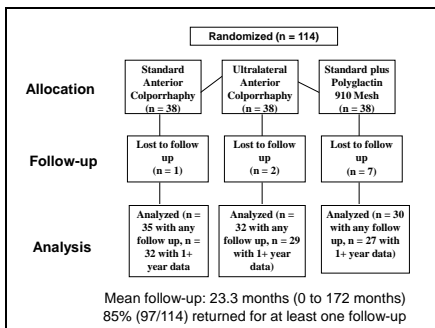
---

---

---

---

---



---

---

---

---

---

---

---

---

## Concurrent Surgery

- TVH 53%
- Posterior colporrhaphy 94%
- Enterocele repair 26%
- Vaginal vault suspension 44%

---

---

---

---

---

---

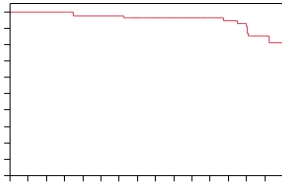
---

---





**Time to develop prolapse beyond the hymen, symptoms or retreatment**



Cleveland Clinic

---

---

---

---

---

---

---

---

**Limitations**

- Small sample size
- Loss to follow-up
- Lack of validated HRQOL questionnaires available

Cleveland Clinic

---

---

---

---

---

---

---

---

**Conclusions**

- The success rate of anterior colporrhaphy varies considerably depending upon the definition of treatment success used.
- When strict anatomic criteria are used, the success rate is low.
- When more clinically relevant criteria are used, treatment success is better with only 10% developing anatomic recurrence beyond the hymen, 5% developing symptomatic recurrence and 1% undergoing retreatment during the study follow-up.

Cleveland Clinic

---

---

---

---

---

---

---

---

**Cystocele Conclusions**

- Ⓢ Key to success is recognition and correction of all defects
- Ⓢ Address central and lateral defects (central more an issue)
- Ⓢ Good apical support cannot be overemphasized
- Ⓢ Patch augmentation for anterior repair with wide pore polypropylene mesh is encouraging
- Ⓢ Success rates may be better but at a cost for some complications
- Ⓢ Traditional repairs probably work better than we have quoted them to.....

---

---

---


---

---

---

---

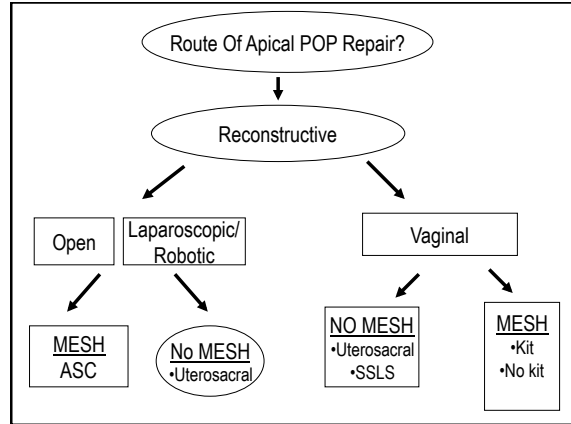
---



## Selecting the Best Operation for Apical Prolapse Repair


Kimberly Kenton M.D., M.S.  
Associate Professor  
Director, Female Pelvic Medicine & Reconstructive Surgery Fellowship  
Obstetrics & Gynecology Residency

Division of Female Pelvic Medicine and Reconstructive Surgery  
Departments of Obstetrics & Gynecology and Urology  
Loyola University Stritch School of Medicine  
USA  
*Loyola Female Pelvic Medicine & Reconstructive Surgery*



## What is “Best” Operation Apical POP?

- Colpocleisis
- Vaginal uterosacral suspension
- Sacrospinous ligament suspension
- Vaginal mesh repair
- Sacrocolpopexy



*Loyola Female Pelvic Medicine & Reconstructive Surgery*

## What is “Best” Operation for POP?


- Colpocleisis
- Vaginal uterosacral suspension
- Sacrospinous ligament suspension
- Vaginal mesh repair
- Sacrocolpopexy

Answer: ALL OF THE ABOVE

*Loyola Female Pelvic Medicine & Reconstructive Surgery*


## So, how should we select the best operation for prolapse repair?

- Determine outcomes meaningful to patients
- Know individual patient’s goals
- Know procedures



*Loyola Female Pelvic Medicine & Reconstructive Surgery*

- Optimize
  - Patient satisfaction
  - Patient outcomes
  - Patient quality of life
- Minimize
  - Complication
  - Recovery



*Loyola Female Pelvic Medicine & Reconstructive Surgery*

## Post-operative Satisfaction


- Correlates with achievement of pre-operative goals  
(Hullfish K 2005, Elkadry E 2003)
- Inversely correlates (3 month & 1-year) with
  - Feeling “unprepared” for surgery
  - Perception of routine post-operative events as complications
  - Development of NEW symptoms, ie: OAB  
(Elkadry E 2003, Mahajan S 2006)

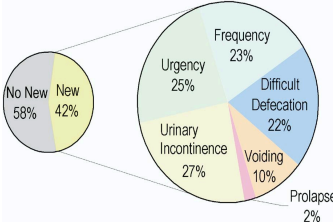


**Loyola Female Pelvic Medicine & Reconstructive Surgery**

## Bulge gone ≠ Patient satisfaction

- No bulge... now has
  - SUI
  - UUI
  - Dyspareunia
  - Complication
  - Mesh erosion ....



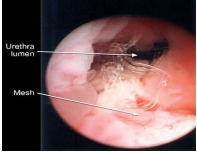
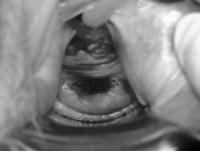


Pham T et al

**Loyola Female Pelvic Medicine & Reconstructive Surgery**

## Magnitude & Consequences of Complications


- “NOT better” ≠ “WORSE”
- Persistent symptoms ≠ Persistent + NEW symptoms

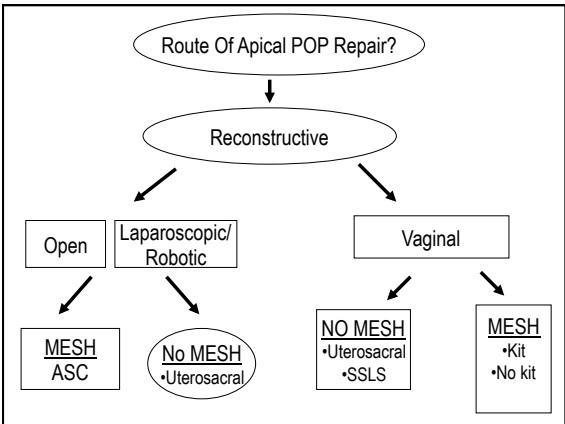
**Loyola Female Pelvic Medicine & Reconstructive Surgery**

## Can We Help Set “Realistic” Expectations

- Asked women to rate their preparedness after surgical consent counseling & signing informed consent
- 42% *still not* completely prepared for surgery
- “Prepared” vs. “Not Prepared”
  - Higher PGI-I
  - Higher PFDI scores
  - More satisfied
  - **No difference in POP-Q**
- “Not Prepared”
  - Complications – 44%
  - Physician documentation – 8%



**Loyola Female Pelvic Medicine & Reconstructive Surgery**



## 2010 Cochrane Review

### ASC vs SSLS


□ 3 RCT

- ASC
  - Lower rate of recurrent vault POP
  - Lower grade POP when recurrence
  - > time to recurrence
  - Less dyspareunia


- SSLS
  - Shorter OR time
  - Quicker recovery
  - Less expensive

**Loyola Female Pelvic Medicine & Reconstructive Surgery**

## ASC vs SSSL




- 101 RCT to ASC vs bilateral SSSL
- Composite outcome (N=80)
  - No POP symptoms, apex above levators, no POP > hymen
- ASC “cure” 58% vs SSSL 29%
- Trial stopped at interim analysis



Benson JT, Lucente V, McClellan E. Vaginal versus abdominal reconstructive surgery for the treatment of pelvic support defects: a prospective randomized study with long-term follow-up. *Journal of Obstetrics and Gynecology* 1996;175(6):1418-22.

## ASC vs SSSL



- 6 months: Apex  $\geq$  Hymen
- N=89, vault

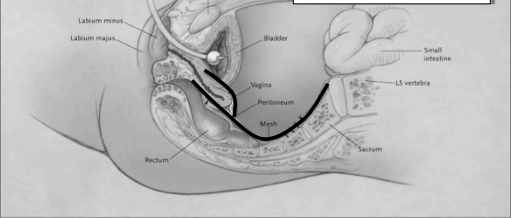
	Apex	Anterior	Posterior	Subjective
ASC	4%	7%	17%	94%
SSSL	19%	14%	7%	91%

Maher CF, et al. Abdominal sacral colpopexy or vaginal sacrospinous colpopexy for vaginal vault prolapse: A prospective randomized study. *Am J Obstet Gynecol* 2004;190:20-6.


**Loyola Female Pelvic Medicine & Reconstructive Surgery**

### Technique

- Mesh to anterior & posterior vagina
- 2 strips vs “Y”
- Promontory vs S3




## ASC: Symptoms Improve



- Bowel
  - Reductions of obstructive defecatory & other bowel symptoms
  - Concomitant posterior repair doesn't improve symptoms
- Sexual
  - More women were sexually active
  - Fewer women reported sexual interference from prolapse or dyspareunia

**Loyola Female Pelvic Medicine & Reconstructive Surgery**


## Concomitant Repairs



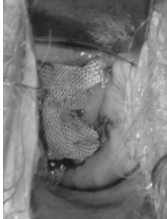
- Typically not necessary
- Genital hiatus narrows with correction of apex
- No need for concomitant anterior/posterior repair
- Correction of apex corrects posterior and anterior vaginal wall defects
  - Guaihi M. *Int Urogyn J* 2008.

**Loyola Female Pelvic Medicine & Reconstructive Surgery**

## ASC Morbidity



- Mesh erosion
  - 5-fold increased risk of mesh erosion with concomitant TAH
    - With 14-27%
    - Without TAH 0-1.3%
- Erosion rates in literature 3% with polypropylene; higher with other meshes




**Loyola Female Pelvic Medicine & Reconstructive Surgery**




## Minimally Invasive ASC

- Nearly all Level III evidence
  - Short-term
  - Outcomes similar to open
- Duplicate open technique
  - Improved durability
- Advantages
  - Decrease GI & incisional complications
  - Quicker recovery



*Loyola Female Pelvic Medicine & Reconstructive Surgery*



## Open vs Robotic ASC

**Case-series**

N=178: 73 robot & 105 open


- 6-weeks
- Anatomic outcomes good and similar (POP-Q)
- Robotic
  - Longer OR times
  - Less blood loss
  - Shorter hospital stay

N=28: 89%, 1-year follow-up

- Validated Measures
- Pelvic floor symptoms improved
- Sexual function improved
- 100 % anatomic cure

Geller E et al 2008, 2011

*Loyola Female Pelvic Medicine & Reconstructive Surgery*




## Minimally Invasive ASC

Laparoscopic vs Robotic ASC: 1 RCT

- Anatomic & functional outcomes similar
- Robotic
  - Longer OR time
  - ↑ post-operative pain

Paraiso M et al 2010


*Loyola Female Pelvic Medicine & Reconstructive Surgery*



## Laparoscopic ASC

Video

*Loyola Female Pelvic Medicine & Reconstructive Surgery*




## Hysteropexy


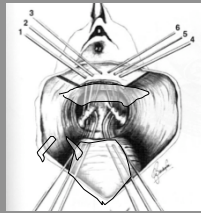
- Uterine preservation
  - Minimize risk of hysterectomy-associated mesh erosion
  - Patient desire
- Single Level 1 RCT (1-year)
  - HysteroPEXY inferior to VH + USLS
    - 3x ↑ POP symptoms
    - 23% reoperation apical or anterior POP
    - 8-years: Reoperation 26% vs 14%
- Conflicting Level 2 & 3

Roovers et al 2004, 2008

*Loyola Female Pelvic Medicine & Reconstructive Surgery*



## Uterosacral Ligament Suspension (USLS)

*Loyola Female Pelvic Medicine & Reconstructive Surgery*

**USLS**

- Video clip

Loyola Female Pelvic Medicine & Reconstructive Surgery

**USLS**

Case Series	N	Follow-up	Cure
Jenkins 1997	50	6 - 48 mo	100%
Webb 1998	693	11 - 22 mo	82%
Shull 2000	289	2 - 6 yrs	87%
Barber 2000	46	16 mo	90%
Karram 2001	202	22 mo	95%
Silva 2006	72	5 yrs	85%

Loyola Female Pelvic Medicine & Reconstructive Surgery

**Complications: USLS**

- 1-11% ureteral obstruction rate
  - 0.9% requiring intervention
- Neural pain S1-S4 trunks of sacral plexus
  - Pain in buttock with numbness down post thigh requiring stitch removal
- Small bowel injury/pelvic abscess
- Suture erosion

<sup>1</sup>Gustilo-Ashby AM. Am J Obstet Gynecol 2006;194:1478-85.  
<sup>2</sup>Lowenstein L et al Int Urogyn J 2007; 12:109-110  
<sup>3</sup>Siddique SA et al Int Urogyn J 2006; 17:642-5  
<sup>4</sup>Flynn MK et al Am J Obstet Gynecol 2006; 195:1869-72  
<sup>5</sup>Karram M et al Am J Obstet Gynecol 2001;185:1339-43  
<sup>6</sup>Jenkins VR Am J Obstet Gynecol 1997;176:1073-7

Loyola Female Pelvic Medicine & Reconstructive Surgery


**Apical Vaginal Mesh**

- No adequately powered comparative studies demonstrate improved anatomic or functional outcomes
- ? Increased risks
  - Dyspareunia
  - Pain
  - Mesh erosion

Loyola Female Pelvic Medicine & Reconstructive Surgery

**Conclusions**

- Selecting the "best" operation for APICAL POP repair



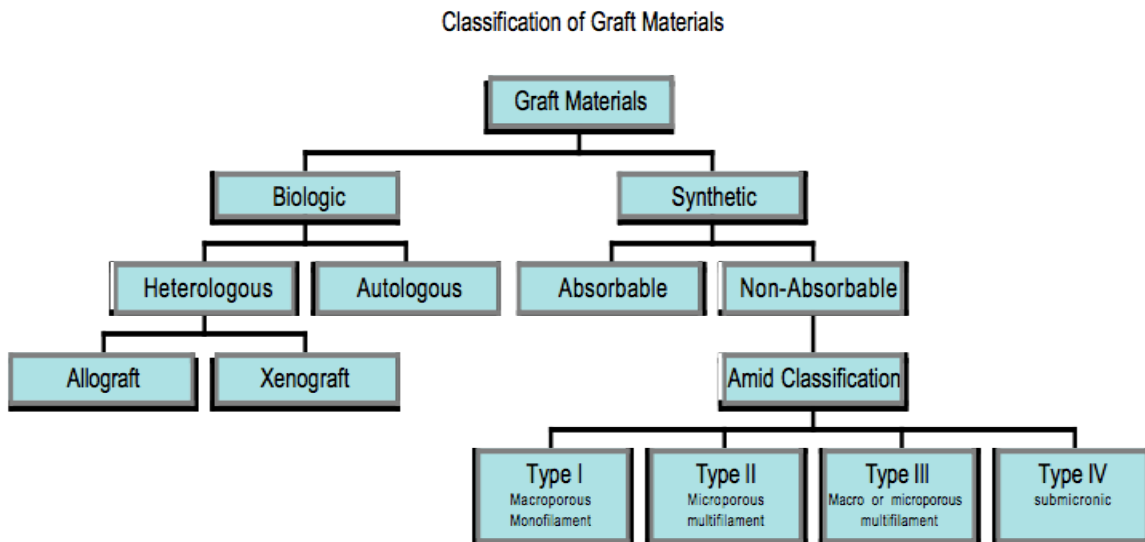
Balancing adverse outcomes & success

Loyola Female Pelvic Medicine & Reconstructive Surgery



### CLASSIFICATION OF GRAFT MATERIALS

**The ideal implant should be readily available and affordable. More importantly the graft material should be biocompatible, chemically inert, noncarcinogenic, mechanically strong, sterile, and have minimal risk of infection or rejection.** The optimal implant, once healed, would restore normal pelvic anatomy without a detrimental effect on function. It should be more or equally durable to autologous tissues. **Currently, no grafts fulfill these ideal characteristics.** Grafts can be categorized by source (synthetic and biologic). Synthetic graft materials are usually classified absorbable or non absorbable (permanent). Permanent graft materials are usually classified by pore size (macroporous, microporous, submicroporous and combined) and material structure (monofilament, multifilament). Biological grafts are classified by source: autologous, or heterologous, which are further categorized as allografts or xenografts.



#### Synthetic Grafts:

**These grafts are readily available, cost effective, have no potential for disease transmission, and do not require harvesting. In addition, these grafts have higher tensile strength and are flexible enough for pelvic surgery.**

Host Response to Grafts: Translational Data

Many materials used for interposition grafts, are reported to be chemically and physically inert and non immunogenic. However, none are biologically inert. The presence of a graft induces a foreign body response, which follows a stepwise cascade regardless of the material. **The degree of response and amount of tissue in-growth is determined by the nature of the material, its structure, and the amount implanted for biologic grafts. For long term biologic graft survival, it appears as though incorporation by the host through a process known as graft remodeling is necessary. Although synthetic mesh material is a permanent substrate, many of these principles of tissue incorporation (not remodeling) are necessary to prevent infection, extrusion or erosion.**

#### SURGICAL TECHNIQUES USING GRAFT MATERIALS

**While there is comparative evidence supporting the use of synthetic material in abdominal sacral colpopexies (ASC), routine use of synthetic or biologic implants in transvaginal reconstructive procedures has not been validated in the literature.**

##### Vaginal Approach

##### Anterior compartment

A variety of methods have been described utilizing graft materials to reinforce vaginal approaches to prolapse repair. Procedures incorporating mesh without suture fixation, in addition



to a traditional colporrhaphy procedure have been described. Usually, after plicating the endopelvic fascia, mesh has been placed in the retropubic space without suture fixation or folded into the imbricated endopelvic connective tissue. More commonly, pelvic surgeons have adopted the use of suture fixation of graft materials to augment anterior compartment repairs. Based on the surgical principles of the vaginal paravaginal repair this procedure requires entry into the retropubic space and suture fixation of the lateral attachments of the graft material to the ATFP. Others have reported fixation of the graft materials to the obturator internus fascia and/or the ATFP. Plication of the central defect is generally performed at the author's discretion, with most performing an anterior colporrhaphy prior to securing the graft.

#### Posterior Compartment

Graft reinforcement of the posterior compartment is accomplished by augmenting the rectovaginal fascia. This is most commonly performed transvaginally in conjunction with posterior colporrhaphy or site specific repairs. After lateral extension of the dissection to expose the rectovaginal fascia, levator ani complex and perineal body, synthetic or biologic materials have been attached to these structures to reinforce the repair. Most commonly a trapezoid or triangular shaped graft is secured to the most proximal position of the rectovaginal fascia or iliococcygeus fascia and to the levator ani musculature or perineal body distally.

#### Abdominal Approach

**The abdominal sacral colpopexy is the most commonly performed procedure via the abdominal route utilizing graft materials for the correction of vaginal prolapse.** The components of a successful colpopexy include permanent mesh fixation to the vaginal apex, complete closure of the cul de sac, secure fixation of the mesh to the sacrum (or sacral promontory) and closure of the peritoneum over the graft material. In a comparative study, Culligan et al demonstrated that patients undergoing colpopexy with permanent mesh materials fared better than those who had cadaveric fascia placed as the supportive graft to the vaginal apex. Numerous authors reporting multiple variations of the techniques of abdominal sacral colpopexy with permanent materials have reported universally excellent success rates.

#### Prosthetic Systems and Kits


Based on the success of transobturator midurethral slings, several kits have been introduced for the management of pelvic organ prolapse. These include Prolift® (Gynecare, Ethicon, Somerville, NJ) and Apogee® (vaginal vault and posterior repair system)/Perigee® (transobturator anterior prolapse repair system) (American Medical Systems, Minnetonka, MN) and Avaulta® (Bard, Covington, GA). Graft materials are more commonly polypropylene mesh (Prolift®, Avaulta® and Apogee®/Perigee®), however, the Apogee/Perigee system also has the option of using porcine dermis (Intexene®). Full thickness vaginal dissection is first completed. Access to the retropubic space is then obtained. The surgeon should be able to easily palpate the obturator membrane behind the inferior pubic ramus and the ischial spine. Anteriorly, the distal arms are placed after passing the trocar through the obturator membrane, arcus tendineus fascia pelvis and exits beneath the inferior pubic ramus. This pass is nearly identical to that performed for the outside in transobturator suburethral sling. Proximally, the trocar is passed through the obturator membrane inferolaterally, through the iliococcygeus muscle exiting just anterior to the ipsilateral ischial spine. The grafts can then be positioned in the anterior compartment following plication of the central defect (at the surgeon's discretion) to complete the anterior compartment repair. Posteriorly the trocar is introduced through the buttock inferior and lateral to the anus through the ischioanal fossa and exits the iliococcygeus at the level of the ischial spine or through the sacral spinous ligament. A total compartmental repair is completed by placement of both anterior and posterior systems.

#### Reference:

Togami J, Krlin R, **Winters J**: Graft materials in prolapse surgery. In, AUA Update Series. Vol XXVII, Lesson XXXI, 2008

Slide 1

**GRAFT MATERIALS IN VAGINAL SURGERY: CURRENT CLINICAL IMPLICATIONS**



*J. Christian Winters, M.D.*  
H Eustis Reilly Professor of Urology and Gynecology  
Chairman, Department of Urology  
Louisiana State University Health Sciences Center  
New Orleans, Louisiana, USA  
cwinte@lsuhsc.edu

LSU

---

---

---

---

---

---

---

---

Slide 2

**ICI, 2009**

▣ Grade A Evidence:

- The use of PPM for transvaginal anterior wall repair improves 1 year anatomic outcomes. This advantage should be weighed against the risk of mesh-related complications and uncertainty regarding long-term functional outcomes.
- Synthetic grafts are superior in AS Colpopexy, less complications than transvaginal placement

LSU

---

---

---

---

---

---

---

---

Slide 3

**ICI, 2009**

▣ Grade B evidence:

- *There is no evidence to support the use of synthetic mesh for transvaginal repair (or augmentation of repair) in the posterior vaginal wall.*

LSU

---

---

---

---

---

---

---

---

Slide 4

### Graft Materials: Implications

- Biologic grafts “remodel” - *Transformation*
- Synthetic grafts “incorporate” - *Bioacceptance*
  
- Synthetic grafts are superior in AS Colpopexy
- Synthetic reinforcement of the anterior compartment *MAY* be more efficacious than conventional repair
- Role for posterior grafts unknown

LSU 4

---

---

---

---

---

---

---

---

Slide 5

### Failure of surgical procedures

- Risk factors:
  - Age
- Conditions that challenge the repair:
  - chronic constipation
  - COPD / smoking
  - Obesity
  - vaginal parity
  - impaired wound healing (diabetes mellitus, steroid use)
- *Deficient tissue quality.*
  - Abnormal collagen matrix
  - Deficient fibroblasts

LSU Falomier C Acta Obstet Gynecol Scand 1998;77:87-94  
Am J Obstet Gynecol 2005;192:42E-52E

---

---

---

---

---

---

---

---

Slide 6

### Ideal Implant

- Readily available and affordable
- Biocompatible and chemically inert
- Noncarcinogenic
- Strong, sterile
- Minimal risk of infection or rejection
- No detrimental effect on pelvic function
- More durable than autologous tissue

LSU 6

---

---

---

---

---

---

---

---

Slide 7

### Host Response to Graft: Translational

- ❑ NO graft materials biologically inert
- ❑ Foreign body response REGARDLESS of material.
- ❑ Variable biofilm forms (important)
- ❑ Influx of proteins follows (immunoglobulins / fibrinogen)
- ❑ Proteins undergo conformational change
  - Bind antibodies, macrophages and fibroblasts and *Neovascularization* then occurs

LSU 7

---

---

---

---

---

---

---

---

Slide 8

### Host Response

- ❑ Incorporation: Infiltration of host tissue into graft
  - "Bioacceptance"
- ❑ Remodeling, infiltration of host tissue into graft and transforming material into host
  - "Bioacceptance"
  - Transformation of function

LSU 8

---

---

---

---

---

---

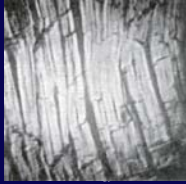
---

---

Slide 9

### Tissue Ingrowth

- ❑ An orderly arrangement of collagen fibers and connective tissue facilitates an ingrowth of host tissue.
- ❑ If an intergration of host tissue occurs, the implant retains it's strength.
- ❑ *Does irradiation or freezing effect this arrangement?*



LSU 9

---

---

---

---

---

---

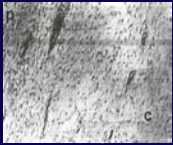
---

---

Slide 10

### Host Tissue Ingrowth

- Neovascularization and fibroblasts infiltrate at periphery and superficial surfaces of the graft.  
Cohen, K., et al. Ann. Plast. Surg. 19:439-445, 1982.  
DeFronzo, J., Frankfort, A. Clin. Orthop. Rel. Res. 303:36-64, 1994.  
Lammie, E., et al. J. Endoth. 10:595-603, 2000.
- Central portion of graft acellular for years.  
Mattson, J., et al. J. Biomechanics 18:145-170, 2002.
- Once entire graft infiltrated, transformation process is completed.



360, 1986.

LSU 10

---

---

---

---

---

---

---

---

Slide 11

### Host Tissue Incorporation

- It appears that for long-term biologic graft survival, host tissue incorporation must occur to facilitate a process of graft remodeling, "transformation" into host.*
- "Graft remodeling"
- Assumes function of host

LSU 11

---

---

---

---

---

---

---

---

Slide 12

### Biologic Materials

- Allografts**
  - Cadaveric Fascia Lata
    - Freeze Dried
    - Solvent Dehydrated
      - Tuoplast®
    - Irradiated
    - Cryopreserved.
  - Dermis (Basement Membrane)
    - Repliform®
  - Dermis (No Basement Membrane)
    - DuraDerm®
    - Urogen®
- Xenografts**
  - Porcine Intestinal Submucosa
    - Stratisis®
  - Porcine Dermis
    - Dermatrix®
    - Pelvicol®
  - Bovine Pericardium
    - Tissue-Guard®

LSU 12

---

---

---

---

---

---

---

---

Slide 13

### Processing of Graft Material

- ❑ Federal guidelines direct the harvesting and transplantation of tissues.
- ❑ No guidelines for tissue processing and packaging:
  - Sterilization: Proprietary process to destroy bacteria and viruses.
  - Packaging:
    - Frozen
    - Freeze-dried
    - Solvent Dehydrated
    - Cryopreservation

LSU 13

---

---

---

---

---

---

---

---

Slide 14

### Allografts: Antigenicity

- ❑ The risk of transmission of HIV from soft tissue allografts is 1 / 8,000,000.  
Buck, B, et al. Clin Orthop 251:249-253, 1990.
- ❑ Commercially available fascial allografts contain traces of genetic material.
  - *The integrity of the genetic material and potential for amplification are unknown.*  
Sudhakaran P, et al. J Urol 161:396(A), 1999.  
Choo J, Bell T. J Urol 166:122-124, 2001.
- ❑ Processed tissue retains donor antigens, however after implantation these antigens are replaced by host antigens.  
Fitzgerald M, et al. BJU Int 86:826-828, 2000.

LSU 14

---

---

---

---

---

---

---

---

Slide 15

### Xenografts

- ❑ Porcine dermis most frequently utilized.
- ❑ Standardized preparation methods decrease variability of grafts.
- ❑ Fenestrated grafts facilitate incorporation
- ❑ What about cross-linking?
  - Stabilize the implant
  - Prevent incorporation

LSU 15

---

---

---

---

---

---

---

---

Slide 16

**What happens to graft material after implantation?**

- Potential mechanisms for failure:
  - Tissue failure (rupture)
  - Tissue rejection
  - Tissue degeneration.

*It appears that tissue remodeling is necessary for long-term implant durability.*

LSU 16

---

---

---

---

---

---

---

---

Slide 17

**Tissue Failure**

- Much early emphasis placed on biomechanical comparison of graft strength.
  - Biomechanical testing endpoints:
    - Stiffness [elongation (displacement) of material during load]
    - Maximum load to failure
- Major limitation is that testing process does not replicate forces placed on sling after implantation. (Winters, et al. Urology 55:867, 2000.)
- Little data demonstrating graft rupture as mechanism of failure.

LSU 17

---

---

---

---

---

---

---

---

Slide 18

**Tissue Rejection**

- Very little data demonstrating host rejection of allograft.
- Inflammatory cells around allograft more commonly represent generalized inflammation, not rejection.

LSU 18

---

---

---

---

---

---

---

---

Slide 19

### Tissue Degeneration

- Many authors describe the graft material as thinned, or frankly absent upon re-exploration.  
Carbone J, et al. J Urol 165:1605-1611.  
Fitzgerald M, et al. Am J Obstet Gynecol 181: 1339-1346, 1999.
- This appears to be the most common appearance of the failed allografts.
- "Autolysis"... Fitzgerald, et al 1999.

LSU 19

---

---

---

---

---

---

---

---

Slide 20

### Allografts: Poor Results

- Failure as a result of "autolysis" in 20% of freeze-dried gamma irradiated fascia lata grafts.
  - Objective cure rate using allograft was the same as autologous fascia.  
Fitzgerald M, et al. BJU Int 84: 785-788, 1999.  
Fitzgerald M, et al. Am J Obstet Gynecol 181: 1339-1346, 1999.
- 28 - 38% failure rate using freeze-dried irradiated and solvent dehydrated irradiated grafts.  
Carbone J, et al. J Urol 165:1605-1611.  
Huang V-H, et al. Urology 58: 943-946, 2001

LSU 20

---

---

---

---

---

---

---

---

Slide 21

### Synthetic Graft Materials

Case for Synthetics:

1. Readily available
2. Inexpensive
3. Favorable tensile strength
4. Permanent, durable material
5. No potential disease transmission
6. Does not emulate function of host tissue

*Incorporation, not remodeling*

LSU 21

---

---

---

---

---

---

---

---



Slide 22

### Mesh Characteristics

- Amid Classification:
  - Type 1: Macroporous and Monofilament
    - Desirable for vaginal surgery: large pores promote tissue ingrowth and host defenses against bacteria.
    - Flexible, easier to implant.
  - Type 2: Microporous with small pore size
  - Type 3: Macroporous, multifilament mesh - small interstices
  - Type 4: "Coated" biomaterials with extremely small pore size

LSU 22

---

---

---

---

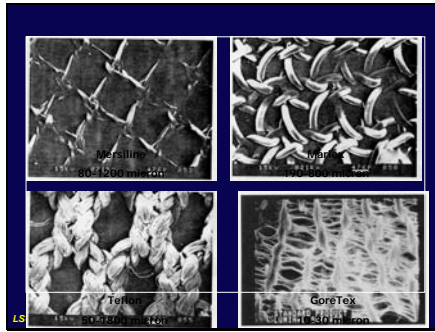
---

---

---

---

Slide 23



---

---

---

---

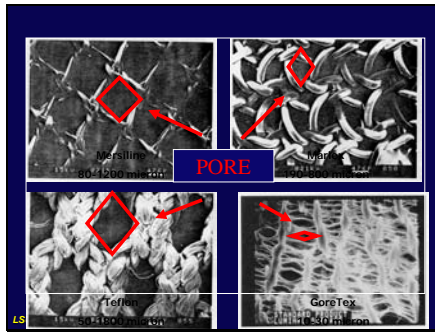
---

---

---

---

Slide 24



---

---

---

---

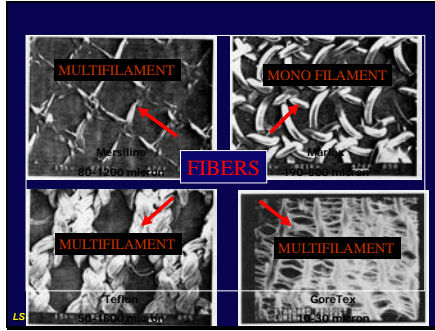
---

---

---

---

Slide 25



---

---

---

---

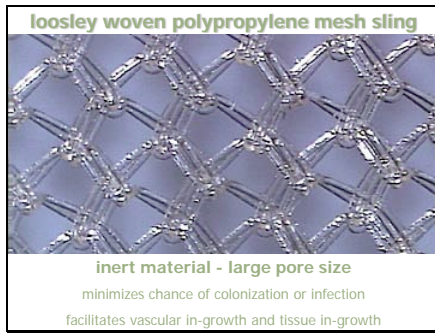
---

---

---

---

Slide 26



---

---

---

---

---

---

---

---

Slide 27

**Time-Dependent variations in graft materials: Animal model**

- ❑ 6 different graft materials
- ❑ Time controlled explant in an animal model
- ❑ Immunohistochemical analysis
- ❑ Degree of inflammation varied
  - Significant differences with mesh having lowest degree
- ❑ Degree of scarring varied
  - Mesh having highest degree

LSU Krambeck AE, et al. Urology 2006 27

---

---

---

---

---

---

---

---

Slide 28

### Histopathologic Comparison

- Compare the histopathologic characteristics of these various sling materials after explantation during sling revision surgery.
- Sling grafts removed following sling revision surgery
- 2 Sites:
  - LSU, New Orleans
  - Vanderbilt Medical Center
- Systematic gross and microscopic assessment
  - 1 pathologist (ENB) for control

Woodruff A, et al Urology 2008

LSU 28

---

---

---

---

---

---

---

---

Slide 29

### Results

- Varying degrees of:
  - graft degradation
  - gross appearance
  - host tissue infiltration
  - Fibroblast count
  - Neovascularity
- Differential host response amongst various graft materials.

LSU 29

---

---

---

---

---

---

---

---

Slide 30

### Sling Graft Histopathology: A Comparison Time Controlled



Porcine Dermis



Polypropylene mesh

Woodruff A, et al Urology 2008

LSU 30

---

---

---

---

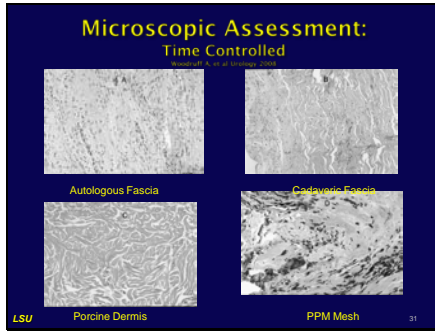
---

---

---

---

Slide 31



---

---

---

---

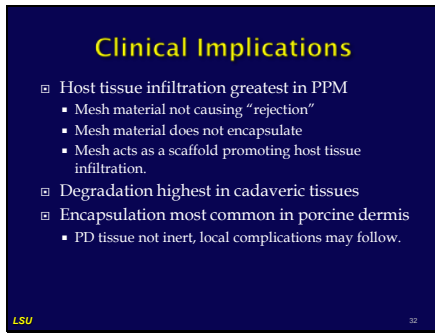
---

---

---

---

Slide 32



---

---

---

---

---

---

---

---

Slide 33



---

---

---

---

---

---

---

---

Slide 34

### Allograft Slings: Intermediate Failures

- ▣ 11 / 121 intermediate failures using fresh frozen cadaveric fascia.
  - No intermediate failures identified following autologous slings.

O'Reilly K and Govier F. J Urol 167: 1356-1358, 2002  
Govier F, et al. AUA 2002 # 419

- ▣ Failure rate of 5.7% at 6 months increased to 32% at 14 months using dermal allograft.

Owens D and Winters J. NeuroUrol Urodynam, 2004.

LSU 34

---

---

---

---

---

---

---

---

---

---

Slide 35

### Synthetic Slings: Outcomes

Author	Ref	n	EU	Cure	Imp	Fail
Ulmsten	BJOG 9950	3 yr	86%	12%	2%	
Ulmsten	IUJ98	131	1yr	91%	7%	2%
Wang	JRM98	70	<18m	87%	4%	9%
Olsson	GObinv99	51	3 yr	90%	6%	4%
Moran	BJUInt00	40	1yr	80%	17%	3%
Klutke	Uro100	20	3wk	85%	10%	5%
Jacquetin	JOBBio00	156	1-3yr	89%		
Maltau	TidNor99	84	4m	96%		4%
Ulmsten	IUJ 01	72	5 yr	85%	11%	5%
Nilsson	ObGyn0464	7.6yr	81%	16%	3%	

LSU 35

---

---

---

---

---

---

---

---

---

---

Slide 36

### Synthetic Slings: Complications

- ▣ Erosion after sling reported btw. 0-23% of patients, most undergoing synthetic sling.
  - Type of mesh and technique of mesh placement seems to effect rates of erosion.
  - Erosion of midurethral slings appears rare:
    1. True incidence unknown due to underreporting.
    2. More frequent than biologic or autologous grafts
- Extrusion occurs from 0-13.8% of patients.
  - Higher rates reported with unwoven, bonded Oblape

Bullock T, et al. BJU Int, 2006

LSU 36

---

---

---

---

---

---

---

---

---

---

Slide 37

### Biologic Materials: Prolapse repair

	# Pts	Material	Success Rates
Chancellor	19	Cadaveric Dermis	85%
Groutz	21	Cadaveric Fascia	91%
Kobashi	132	Cadaveric Fascia	76%
Gahndi	76	Cadaveric Fascia	79%
Clemons	33	Cadaveric Dermis	59%
Wheeler	36	Porcine Dermis	50%
Gomelski	70	Porcine Dermis	80%

LSU 37

---

---

---

---

---

---

---

---

---

---

Slide 38

### Synthetic Mesh: Case Series Outcomes

	Mesh type	Number of patients	Length of follow-up	Successful outcome
Dwyer 2004	Self cut	97	29 months	94%
Amrute 2007	Self cut	76	30	95%
de Tayrac 2007	Kit	143	13	92.3%
Gauruder-B 2007	Kit	120	12	93%
Rane 2008	Kit	70	24	96%
de Vita 2008	Self cut	80	21	100%
van Raalte 2008	Kit	97	19	87%
Elmer 2009	Kit	261	12	80%
Milani 2009	Kit	46	12	93%
Wetta 2009	Kit	48	14	98%
Feiner 2009	Kit	100	12	87%
Carey 2009	Kit + VSD	95	12	85%
Ebou 2010	Self cut	123	12	97%

LSU

---

---

---

---

---

---

---

---

---

---

Slide 39

### Mesh vs No Mesh Outcomes

	Mesh type	Number of patients	Length of follow-up	Successful outcome
Sivasiloglu 2007	Self cut	45 mesh	12	Mesh 91%
		45 no mesh		No mesh 72
Niemenan 2008	Self cut	105 mesh	24	Mesh 89
		97 no mesh		No mesh 59
Nguyen 2008	Kit	38 mesh	12	Mesh 87
		37 no mesh		No mesh 55
Carey 2009	Self cut	69 mesh	12	Mesh 81
		70 no mesh		No mesh 67

LSU

---

---

---

---

---

---

---

---

---

---

Slide 40

### Mesh vs No Mesh Complications

	Extrusion	Dyspareunia
Sivastiloglu 2007	7%	Mesh 4.6% No mesh 0
Niemenan 2008	8	Mesh score improved No mesh score decreased
Nguyen 2008	5	Mesh 9% No mesh 16
Carey 2009	5.6	Mesh 16.7 No mesh 15.2

LSU

---

---

---

---

---

---

---

---

Slide 41

## U.S. Food and Drug Administration

### CENTER FOR DEVICES AND RADIOLOGICAL HEALTH

FDA Public Health Notification: Serious Complications Associated with Transvaginal Placement of Surgical Mesh in Repair of Pelvic Organ Prolapse and Stress Urinary Incontinence  
Issued: October 20, 2008

Dear Healthcare Practitioner:

This is to alert you to complications associated with transvaginal placement of surgical mesh to treat Pelvic Organ Prolapse (POP) and Stress Urinary Incontinence (SUI). Although rare, these complications can have serious consequences. Following is information regarding the adverse events that have been reported to the FDA and recommendations to reduce the risks.

LSU

---

---

---

---

---

---

---

---

Slide 42

### Recommendations for Physicians

- Obtain specialized training for each mesh placement technique, and be aware of its risks.
- Inform patients that implantation of surgical mesh is permanent, and that some complications associated with the implanted mesh may require additional surgery that may or may not correct the complication.
- Inform patients about the potential for serious complications and their effect on quality of life, including pain during sexual intercourse, scarring, and narrowing of the vaginal wall (in POP repair).
- Provide patients with a written copy of the patient labeling from the surgical mesh manufacturer, if available.

<http://www.fda.gov/cdrh/safety/102008-surgalmesh.html>

LSU

---

---

---

---

---

---


---

---

Slide 43

### Abdominal Sacral Colpopexy

- Multiple authors report a 90+ % success rate
- Many consider gold standard
- Synthetic mesh superior to biologic materials
  - Maher et al (Cochrane database 2007)
  - Calligan et al (Am J Obstet Gynecol, 2008)
- Mesh erosion rate of approx 1% (PPM)
  - Nygard et al (Obstet Gynecol, 2004)



LSU

---

---

---

---

---

---

---

---

Slide 44

### Graft Materials: Implications

- Biologic grafts undergo a process of "remodeling" - *Transformation*
- Synthetic grafts undergo a process of "incorporation" - *Bioacceptance*

LSU

---

---

---

---

---

---

---

---

Slide 45

### Contemporary Principles for the Practicing Clinician

- Synthetic grafts have been shown to be superior to biologic grafts for abdominal sacrocolpopexy and suburethral sling procedures in the literature through prospective randomized trials and prospective case series.
- Macroporous monofilament synthetic grafts and non-cross linked biologic grafts appear to have the best integration into native tissues. Microporous synthetic grafts are more likely to become infected.
- Solvent dehydration and irradiation of biologic grafts appear to weaken the integrity of the material and may prevent proper tissue integration.
- Level I and II data seem to support the use of grafts (biologic or synthetic) for anterior repair but erosion rates are higher, especially with the non-absorbable meshes.
- There is no conclusive data to recommend the use of grafts posteriorly.

LSU

---

---

---

---

---

---

---

---



## Slide 46

**Summary**

- ▣ **Biologic Materials:**
  - Variability in outcomes btw grafts
  - Intermediate failures more common
  - Think Transformation
- ▣ **Synthetic Mesh**
  - Type I Macroporous monofilament most desirable
  - Abdominal sacrocolpopexy:
    - Nonabsorbable mesh is fairly standard
    - Recent adverse publicity is not about this
  - Posterior vaginal repair: mesh disadvantages appear to outweigh advantages
  - Anterior vaginal repair:
    - Balance pros and cons
    - Inform patient; involve her in choice
  - Think technique and volume!

---

---

---

---

---

---

---

---

Slide 1

## Case Presentation

**Philippe  
ZIMMERN**



---

---

---

---

---

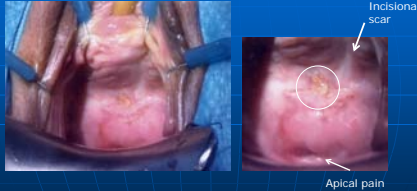
---

---

---

Slide 2

Case 1: 48 y old; Anterior and apical meshes followed by dyspareunia



---

---

---

---

---

---

---

---

Slide 3

### MANAGEMENT

- One year since mesh placement
- 3 Prior excisions in the office
- Pain over exposed mesh and at vaginal apex
- Recurrent cystocele

=> What do you recommend?

---

---

---

---

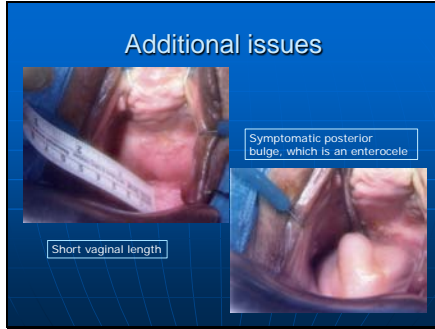
---

---

---

---

Slide 4



---

---

---

---

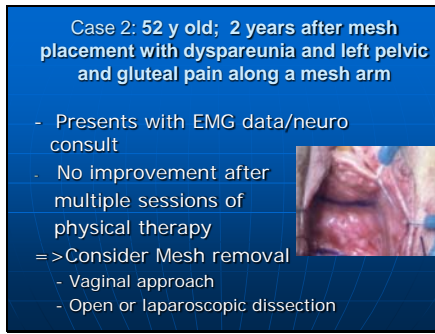
---

---

---

---

Slide 5



---

---

---

---

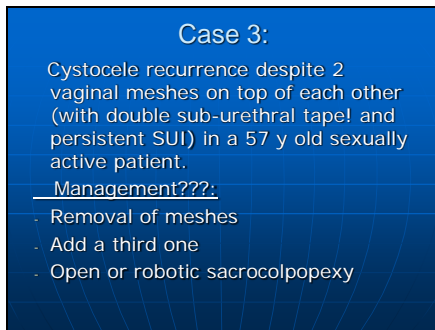
---

---

---

---

Slide 6



---

---

---

---

---

---

---

---

Slide 7

Case 4: Vaginal mesh extrusion and vesico-vaginal fistula in trigone

- Vaginal repair
- Open repair, with possible ureteric reimplants
- Tissue interposition/SP tube

---

---

---

---

---

---

---

---

Slide 8

Case 5: Cystocele with prophylactic tape placement with complications

---

---

---

---

---


---

---

---

Slide 9

Case 6: 47 y old OR nurse. 3 prior mesh removals. Recurrent cystocele with SUI. Options?



---

---

---

---

---

---

---

---

Slide 10

Mgt Options: Recurrent cystocele after mesh removal

- . Pessary
- . Colpocleisis
- . Anterior vaginal wall suspension
- . Open or robotic mesh repair. Very difficult clivage plane, with risk of bladder injury and secondary mesh erosion in the bladder

---

---

---

---

---

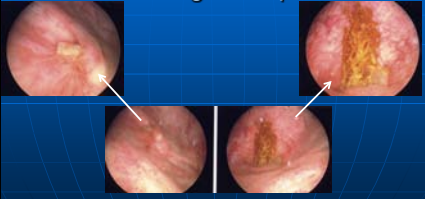
---

---

---

Slide 11

Case 7: Intravesical erosion after inadvertent entry in the bladder during initial procedure



---

---

---

---

---

---

---

---

Slide 12

Approach

- Transvaginal
  - Open ended ureteral catheters
  - Inverted U shape anterior vaginal flap
  - Divide the mesh on the midline
  - Dissect the bladder off the mesh both sides
  - Close bladder in multiple layers
  - Verify watertightness
  - Close vaginal wall flap
  - Catheter indwelling for 3 weeks

---

---

---

---

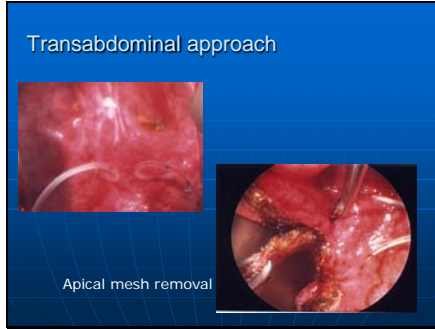
---

---

---

---

Slide 13



---

---

---

---

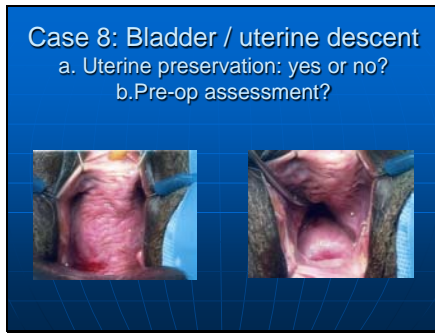
---

---

---

---

Slide 14



---

---

---

---

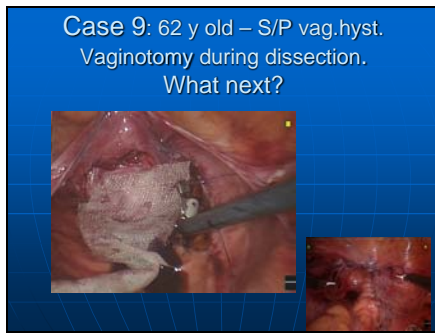
---

---

---

---

Slide 15



---

---

---

---

---

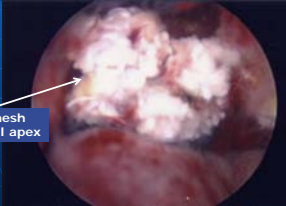
---

---

---

Slide 16

Case 10: 61 y old - 5 y after mesh sacrocolpopexy.  
Sx: recurrent vaginal pain and bleeding.  
3 prior vaginal excisions of mesh in OR



Eroded mesh at vaginal apex

The image is an endoscopic view of the vaginal apex. It shows a white, mesh-like structure that has become eroded and is surrounded by red, inflamed tissue. A white arrow points to the eroded mesh. The background is dark, likely the vaginal wall.

---

---

---

---

---

---

---

---