



PELVIC FLOOR ULTRASOUND

How, When, Why

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Disclosures

- Professor Hans Peter Dietz
 - ▣ Generosity of permitting educational use of his materials
- Advisory Board Member, Jan 16-17, 2018
 - ▣ GE Ultrasound, Women's Health

Objectives

- Background

- Pelvic Floor Dysfunction
 - Urinary (UI) & Fecal Incontinence (FI)
 - Pelvic Organ Prolapse (POP)
 - Levator ani trauma
 - Suburethral Slings

- Conclusion

Pelvic Floor Dysfunction

- Umbrella term to cover disorders such as POP, UI, FI descending perineal syndrome (DPS)
- Etiology multifactorial related weakened +/- or ineffective support structures. Risk factors include:
 - ▣ **Vaginal multiparity** (prolonged 2nd stage labor), **advanced age**
 - ▣ Hysterectomy, CT disorders, obesity, hypoestrogenism, radiation
 - ▣ Chronic increased intrabdominal pressure
 - Weight lifters, obesity, chronic pulmonary disease

Pelvic Floor Imaging - Choices

- Transperineal ultrasound (TPUS)
- MRI dynamic with defecography
 - ▣ Relatively expensive, limited access with defecography
- Fleuroscopic Techniques - Traditional
 - ▣ Requires opacification bladder, vagina, bowel to visualize all compartments, limited access to defecography. Challenges radiation/prep required
- Endoanal ultrasound (gold standard AS)

Pelvic Floor US Imaging: **Why Now?**

- Inexpensive, well tolerated
- Multicompartmental, FOV smaller than MR
- * Suburethral slings are not well seen CT/MR
- High resolution rapid acquisition detailed info
 - ▣ Stored volumes/cine sets, tomographic slices and multi-planar images, 3D for UG hiatus & LA
 - Increased comfort with software (3D-4D in OB)
 - ▣ Real-time (cine-loop) ability gauge stress maneuver, can sit partially upright, immediate feedback

Pelvic Floor US Imaging: **Why Bother?**

- Affect 50% women by age 50 worldwide with societal costs in billions for UI, millions for POP
 - ▣ 1/10 have surgery by age 70
 - ▣ 1/3 require repeat surgery due to failures
- Project huge increased demand for services related to increased longevity and access to less invasive treatment options

Clinical Context

- Symptoms may be variable based on affected compartment(s)
 - ▣ Pain, urinary and fecal incontinence, constipation, difficulty in voiding, a sense of pressure, and sexual dysfunction & dyspareunia
- Diminished self-image and quality of life

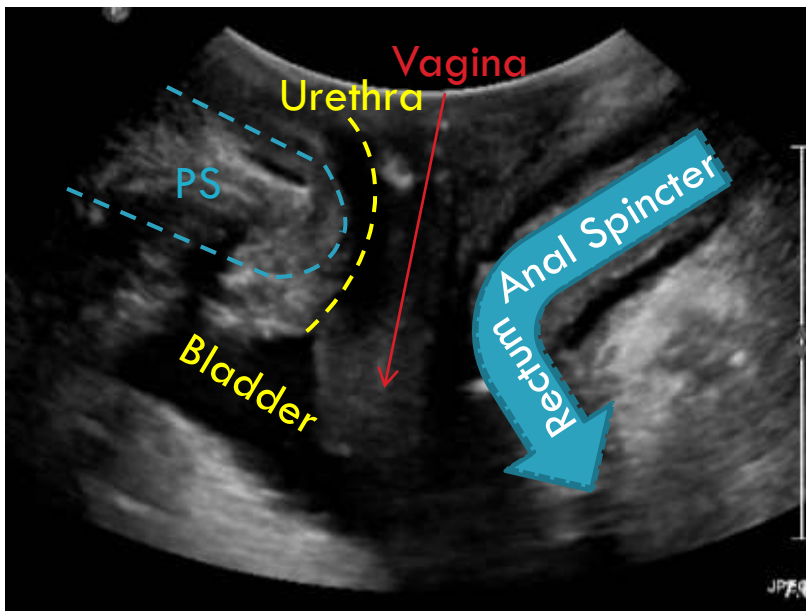


Compartments Pelvic Floor

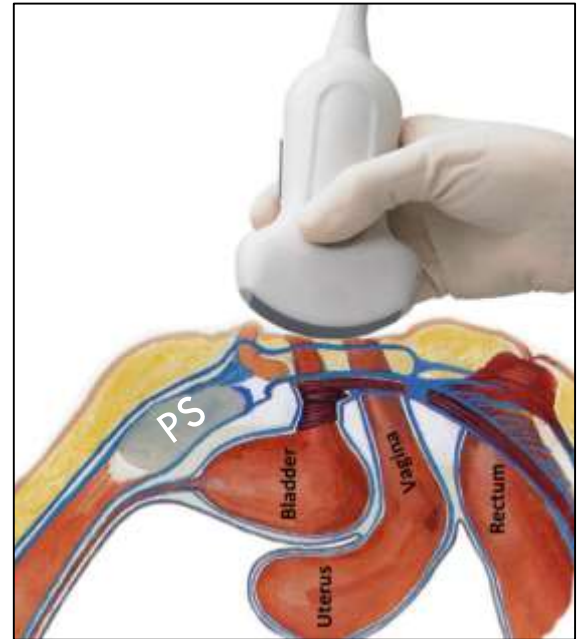


- **Anterior** - Bladder , urethra
- **Central** - Uterus-cervix-vagina
- **Posterior** - Anal sphincter and rectum

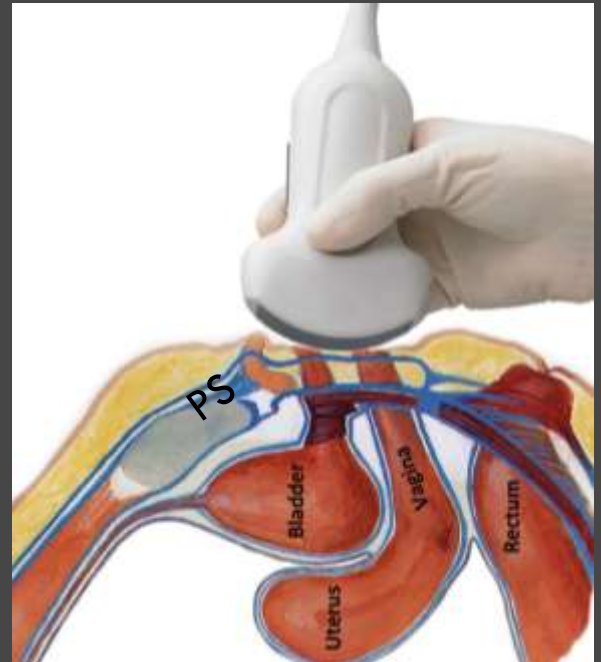
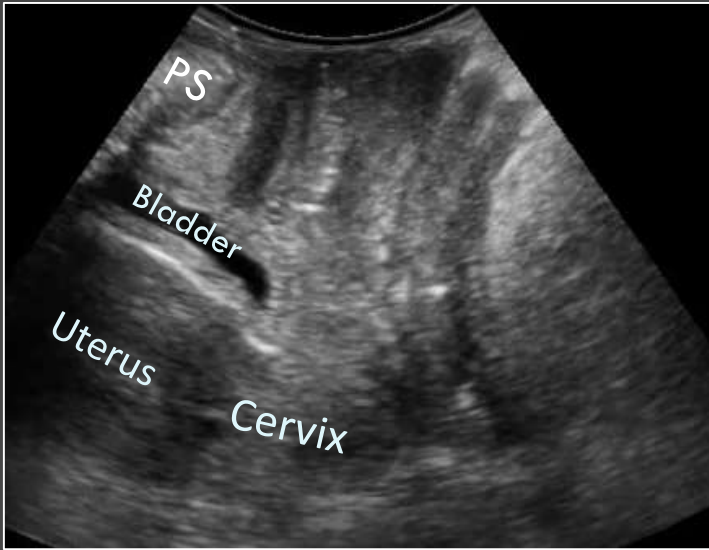
Technique: Empty bladder, dorsal lithotomy, covered transducer placed between labia, minimum pressure in order to permit full pelvic organ descent



Basic Anatomy: Diagram

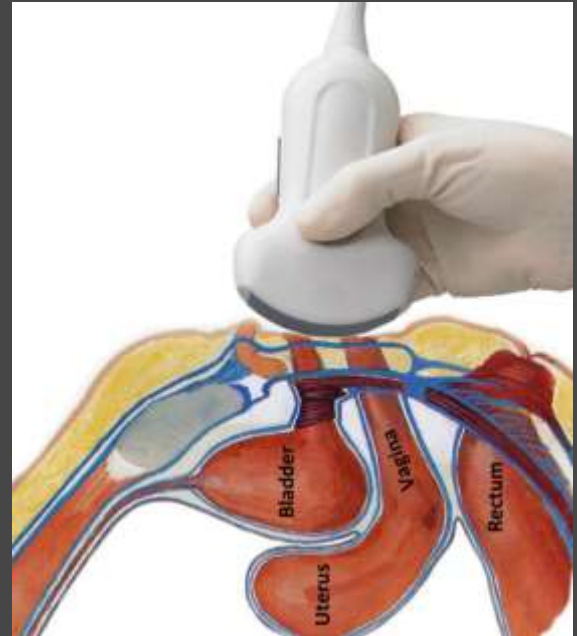


PS = Pubic Symphysis



Anatomy Review: Increase Depth

Technique: Basic Valsalva Real-Time



CASE

Normal Anatomy Review

Urinary Incontinence

- Women more susceptible
 - **Anatomy** : Urethra shorter thus less resistance to outflow when bladder contracts
 - **Life style Risks:** Vaginal Delivery/2nd stage labor prolonged

Urinary Incontinence : Types



- **Stress** : (SUI)
 - ▣ Involuntary loss urine due increase intrabdominal pressure
 - Cough, laugh, sneeze
 - Sphincteric defect / hypermobility urethra
- **Urge urinary incontinence (UUI)**
 - ▣ Detrusor over activity assoc with detrusor thickness > 5mm or damage innervation bladder
- **Overflow:** Leakage

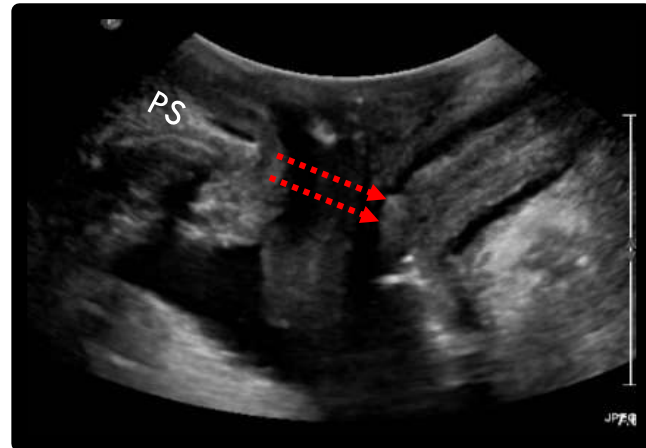
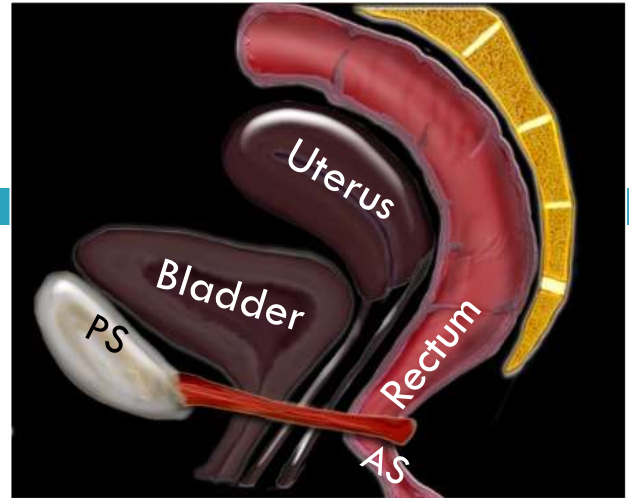
Anterior Compartment: UI & Prolapse

Often combined

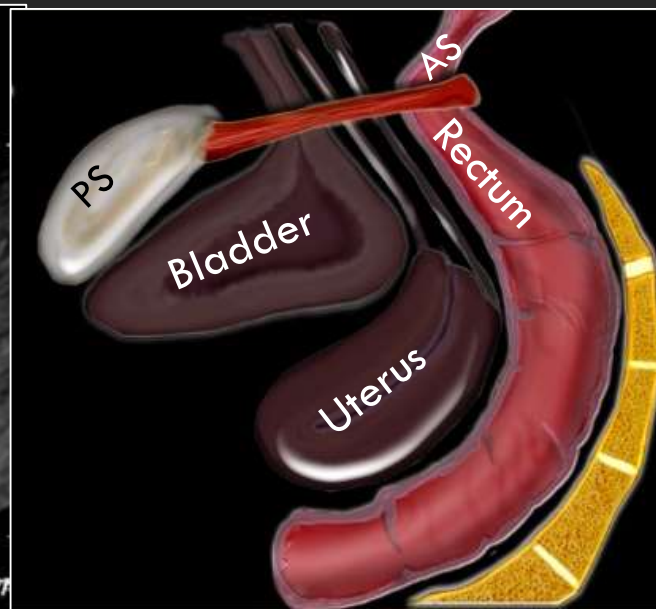
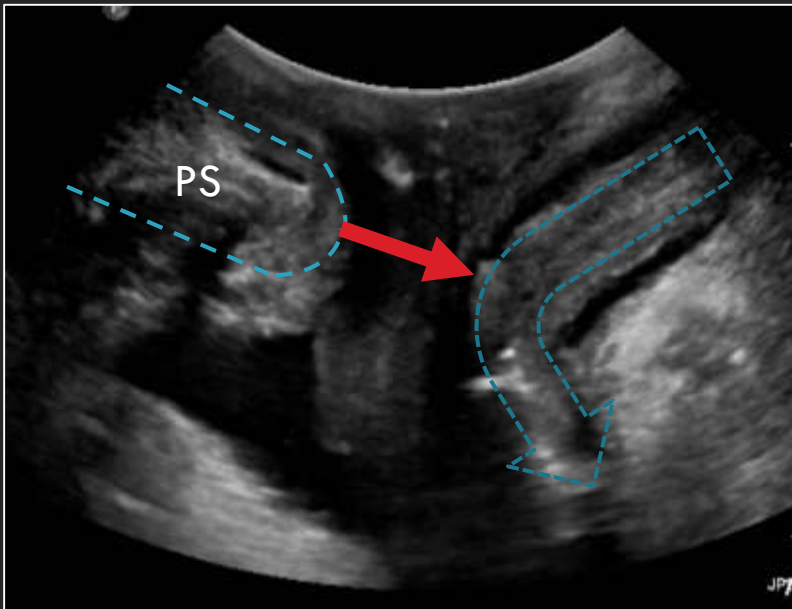
- PVR, bladder wall thickness (detrusor)
- Bladder neck : open, funnel, descend
- Urethra : rotate, descend, hypermobile (> 30 degrees), RVA $> 120^\circ$, funnel proximal 1/3
- Does cystocele develop?
 - *Due tear/stretch pubocervical fascia or levator ani*
 - *MRI grading relates distance bladder and PCL*
 - *mild (< 3.0 cm), moderate (3.0–6.0 cm), or severe (> 6.0 cm).*
- *Significant POP can mask SUI, hinder urethral hypermobility*

Prolapse Assessment

- Line between pubic symphysis-anorectal angle
 - ▣ Plane minimum dimension
 - ▣ No anchor point but reproducible
- Key— Proper push/Valsalva which is **time dependant**
 - ▣ May take 4-5 seconds to reach final organ descent
 - ▣ Rehearse in real-time with patient watch screen



Plane of Minimum Dimension



Basic Anatomy: Diagram

PS = Pubic Symphysis



Case

24 year old, nullip, continent

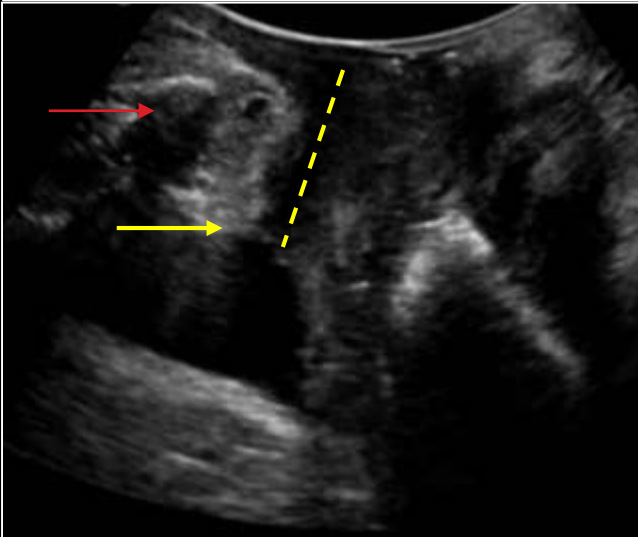
Findings: Bladder neck remains closed but descends



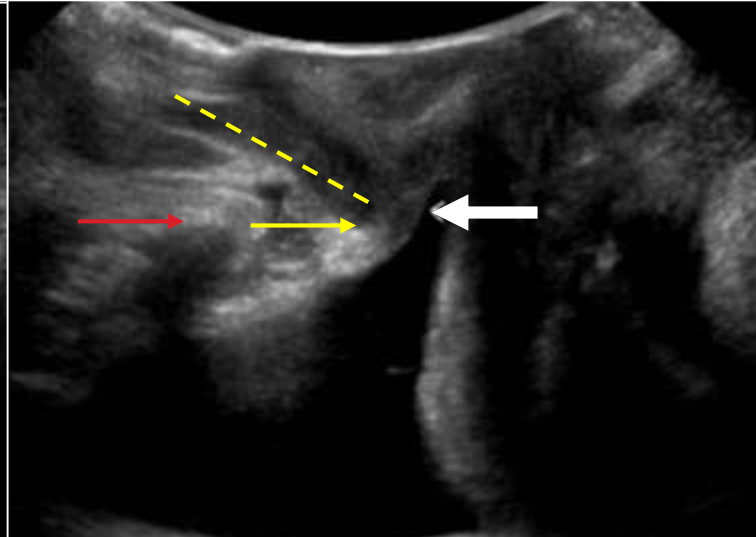
Urethra rotates horizontal



Small cystocele develops



Rest

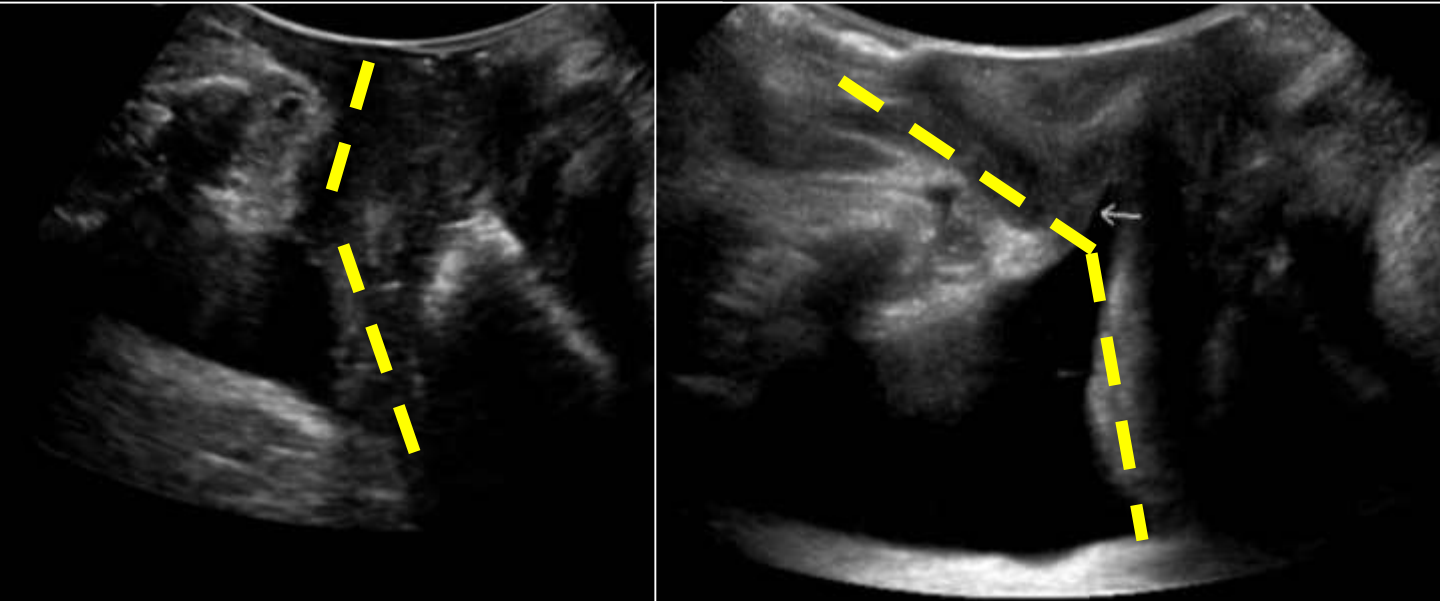


Strain

Case

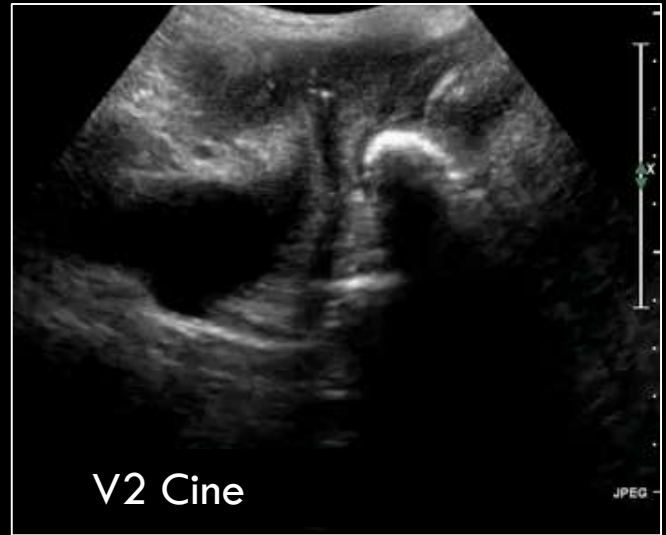
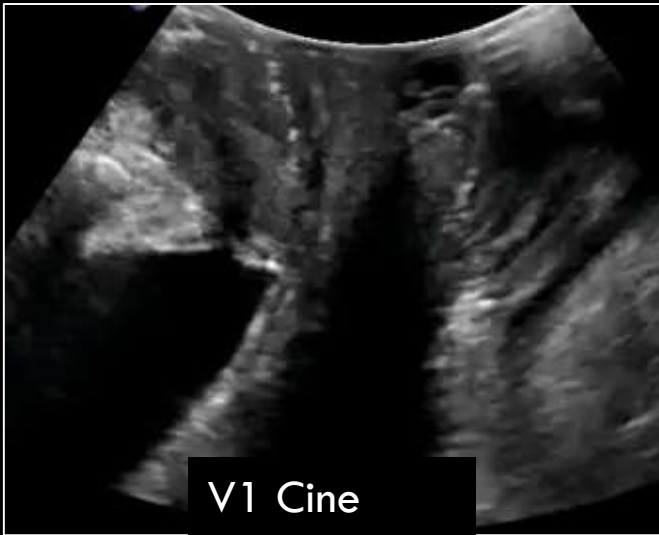
Classic Stress Urinary Incontinence

Retrovesical angle now > 120 degrees



Case

Classic Stress Urinary Incontinence



Less common
Bladder neck remains in place
Voiding dysfunction rather than SUI
Association with levator ani trauma

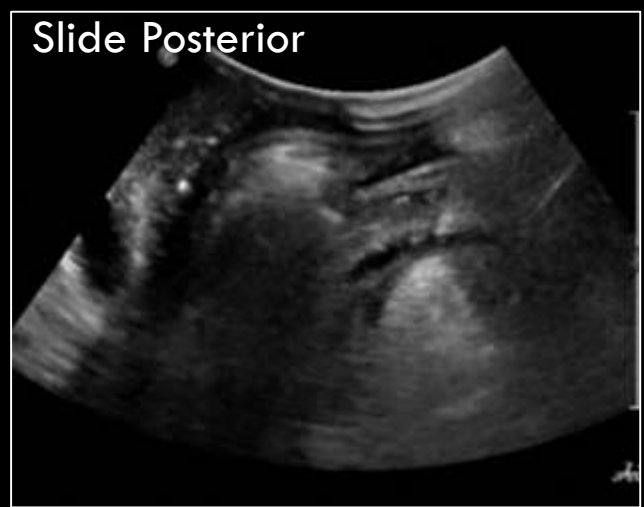


Case

Isolated Cystocele

Posterior Compartment

- Anal continence
 - ▣ Normal anorectal angle 90-130 degrees rest
 - ▣ Normal anorectal junction above or at level PS
- Pelvic Organ Prolapse
 - ▣ Perineal hypermobility & descent rectal ampulla
- Rectovaginal septum(RVS) defect
 - ▣ Rectocele -diverticular outpouching anterior wall rectum into vagina or descent into cul-de-sac: sigmoidocele, enterocele, peritonocele (fat),
- Rectal intussusception Anal sphincter trauma



Technique: Center anterior then move to posterior with maximum effort

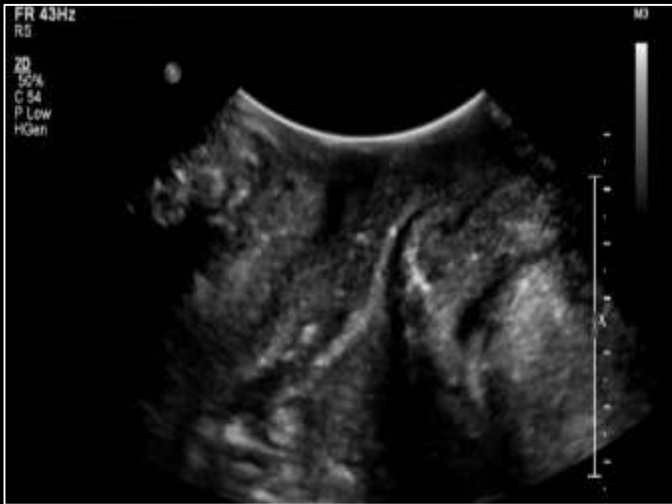
- Measure rectocele depth \perp to anterior wall of rectum, $> 1-1.5$ cm

Findings:

- Rest normal ARA which is above PS
- Strain develop rectocele, obtuse ARA, descent rectal ampulla
- Note bladder neck opens with strain

Case

Rectocele – Posterior Compartment



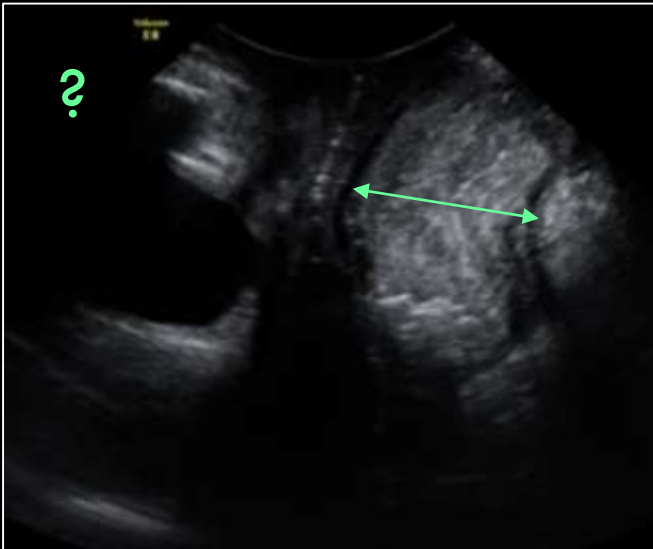
SIGMOIDOCELE



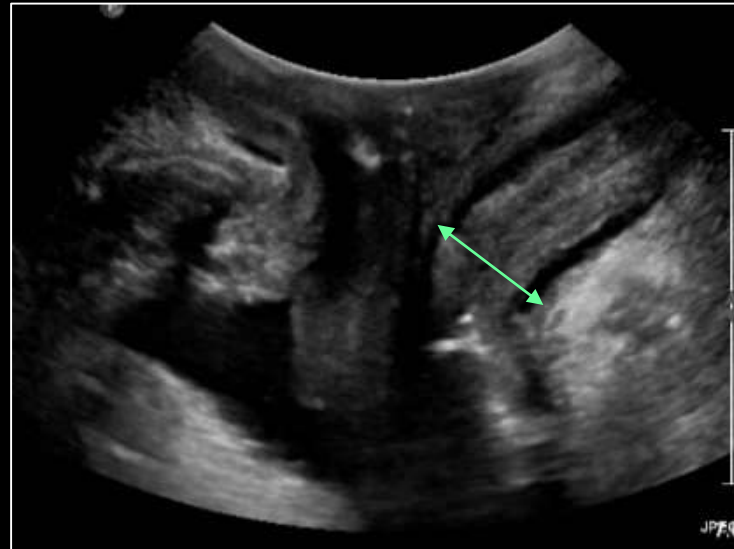
ENTEROCOLE

Case

Defects in Rectovaginal Septum



What's Abnormal ?



Normal Reference

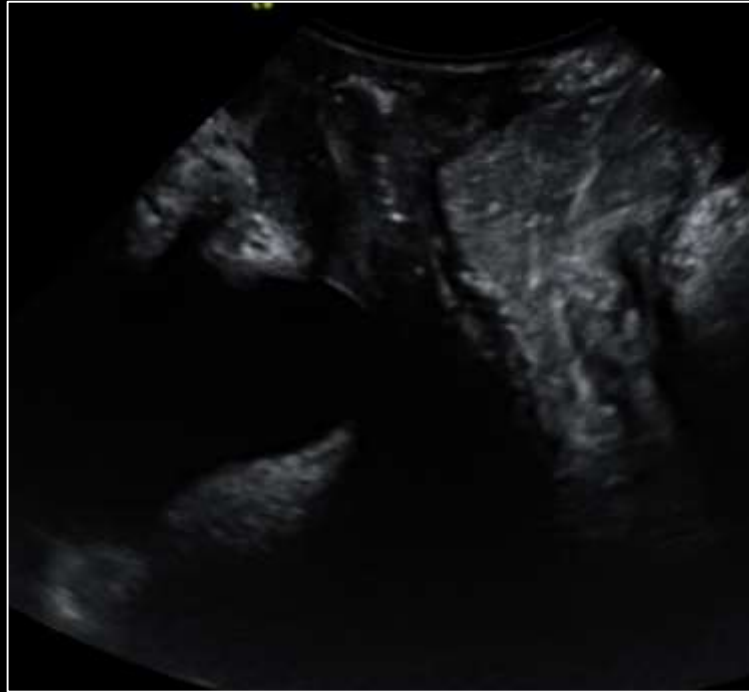
Case

Posterior Compartment

Rectal intussusception

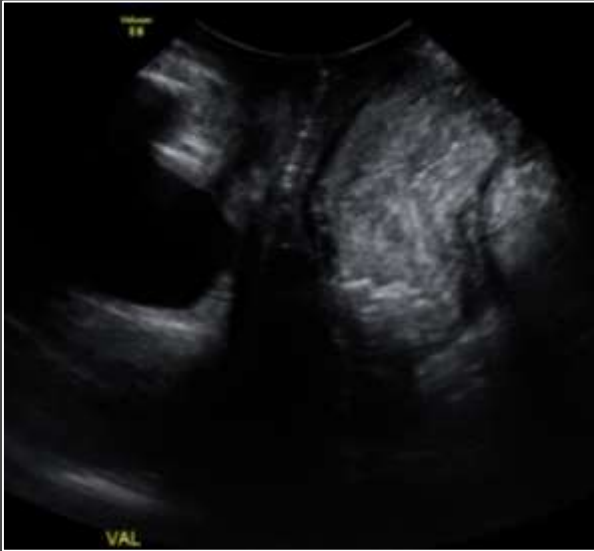
3 grades depend on extent
rectal exteriorization at end
defecation:

1. Intra-rectal minimal involvement rectal wall restricted to anal canal
2. Extend beyond anal canal (prolapse thru anus)
3. Exteriorization rectum



Case

Grade 3 Rectal Intussusception



Grade 3 rectal intussusception with exteriorization rectum

Case

Posterior Compartment

PELVIC ORGAN PROLAPSE



Pelvic Organ Prolapse (POP)

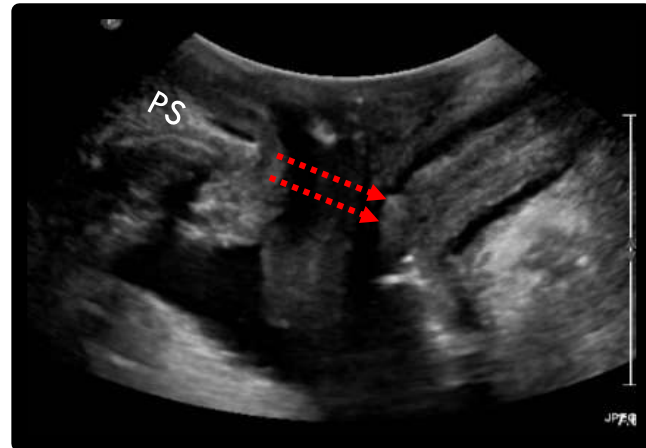
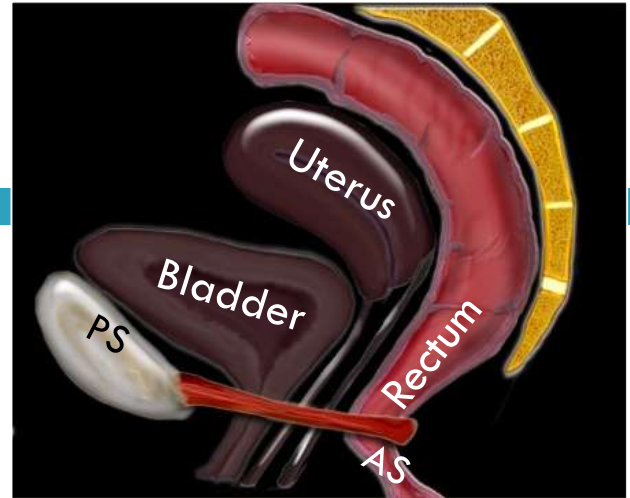
- 9% women clinical symptoms
- 30% undergo repeat operation
- Negative impact on quality of life including sexual function
- LA avulsion from pubic bone or pelvic sidewall is associated with POP
 - LA avulsion is associated with vaginal delivery

Pelvic Organ Prolapse

- **Abnormal descent vagina** involving anterior wall, posterior wall and/or apex
 - ▣ Beneath line between PS & Ano-rectal junction (TPUS)
 - ▣ Due to protrusion of adjacent pelvic organs
 - Cystocele
 - Vaginal prolapse or procidentia (uterus)
 - Defect in rectovaginal fascia permit prolapse in anterior wall rectum (rectoceles) enteroceles, sigmoidoceles
 - ▣ Important to assess all compartments prior to surgery

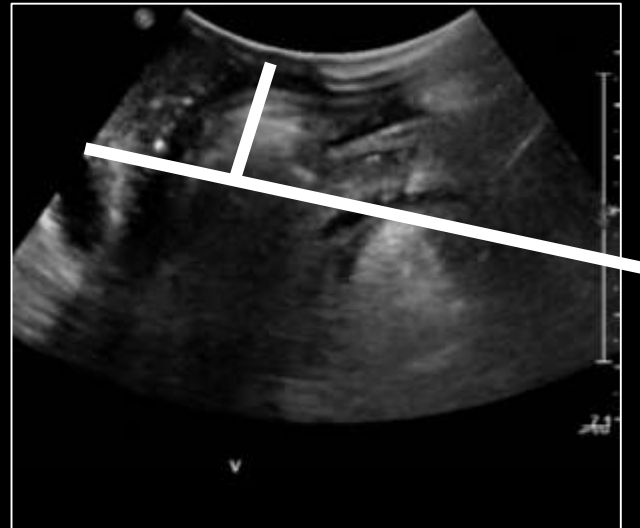
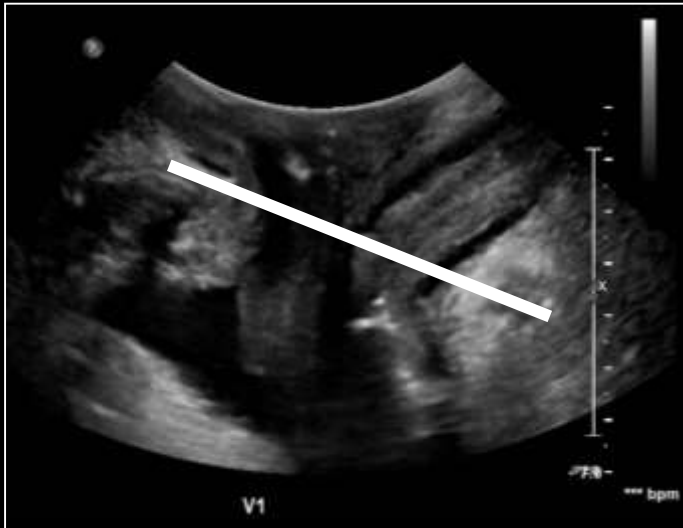
Pelvic Floor & Plane Minimum Dimension

- 2D line between pubic symphysis-anorectal angle
 - ▣ No anchor point but reproducible



Pelvic Organ Prolapse (Posterior)

Line from PS to ARA at rest.....



Case

Pelvic Organ Prolapse (posterior)



Case

Multicompartmental POP, post hysterectomy

Role: 3D & Volume Rendered



□ Key

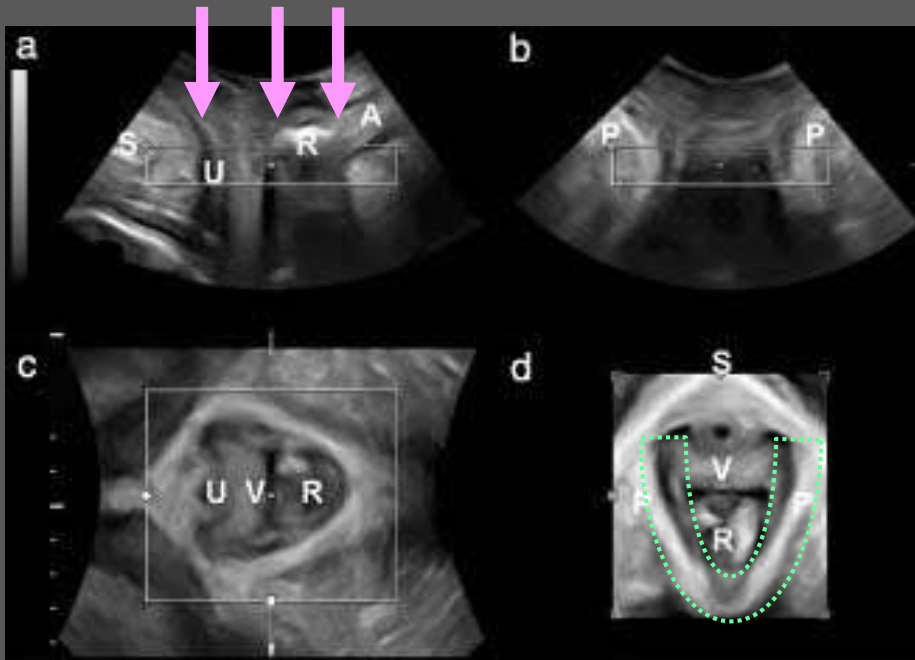
- Circumference urogenital hiatus

- Levator Ani Trauma

- Slings and Things

Pelvic Floor: Levator Ani muscles

Display Modes : MPR/Rendered



Render Plane is plane
minimal dimension from
inferior pubic symphysis
to anorectal angle
-Orient caudal to cranial

Puborectalis medial thick, ileococcygeus lateral/thinner

Urogenital Diaphragm

- Largest natural hiatus in body

- Mean 16 cm young nullip

- Mean 25 cm overall

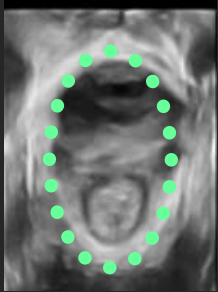
- Most caudal layer pelvic floor

- Composed of CT and peroneus muscle run from ischial rami to perineal body and EAS

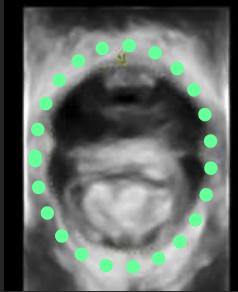
- Perineal body is site attachment for endopelvic fascia, UG diaphragm, bulbocavernosus muscle and puborectalis muscle

Urogenital Hiatus : Circumference Rendered View in Plane minimum Dimension

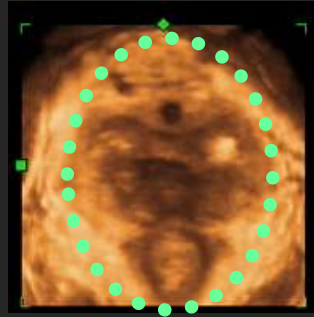
REST



Valsalva



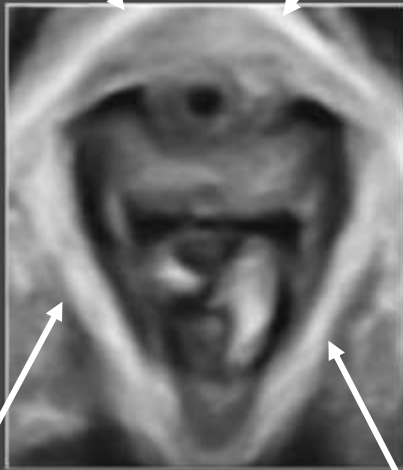
Ballooning



Hiatal biometry high reproducibility, obtain oblique angle easier than with MR

Ballooning mild 25-30; moderate 30-35; marked 35-40; severe $\geq 40 \text{ cm}^2$

Pubic symphysis



Courtesy Dr. Dietz

Puborectalis sling
including levator ani



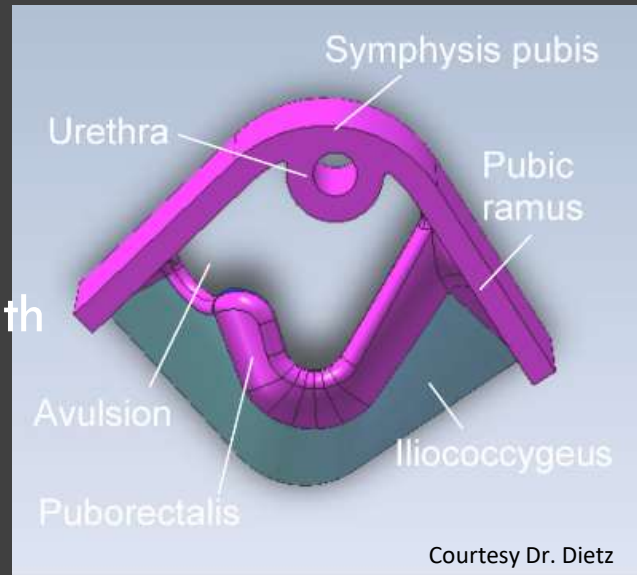
“H” configuration
normal vagina

Case

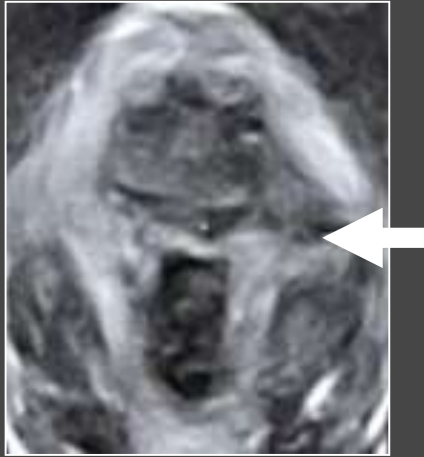
Normal

Levator Ani Avulsion

- ❑ Common post vaginal delivery (10-35% incidence)
 - ▣ Forceps increase risk ~ 3x
- ❑ Result in:
 - ▣ Reduction contraction strength
 - ▣ Increased risk prolapse (ant/central) 2-3x
 - ▣ Increased risk prolapse recurrence post surgery
- ❑ May not affect SUI or FI



Levator Ani Avulsion Defect



Normal



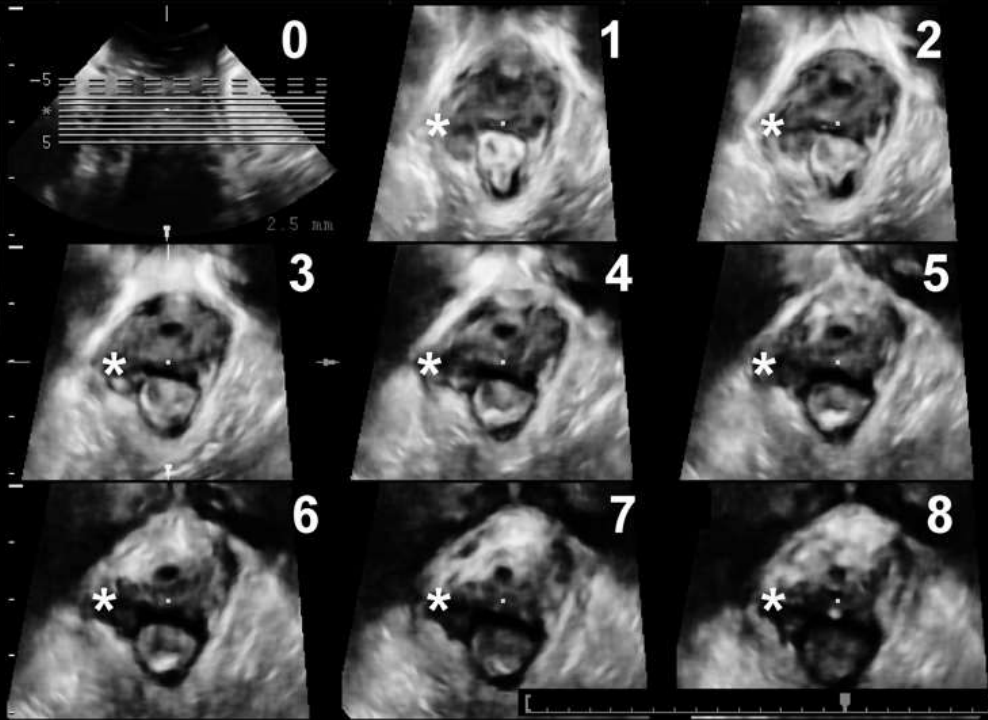
- Direct sign: avulsion of LA
- Indirect sign: disruption of “H” configuration vagina with posterior displacement vaginal fornix

Courtesy Dr. Dietz

Case

Levator ani avulsion defect

Levator ani (puborectalis) avulsion: TUI Display



Images courtesy Dr. Dietz

2.5mm slice intervals:

Complete Avulsion

- all three central slices, namely (plane of the minimal hiatal dimensions) plus the two above

Partial avulsion

- any of 3-8 slices abnormal.

? clinically important diagnosis.

Dietz HP, Bernardo MJ, Kirby A, Shek KL.. Int Urogynecol J 2011; 22: 699-704.

Courtesy Dr. Dietz

Case

RHS LA defect with muscle retraction *



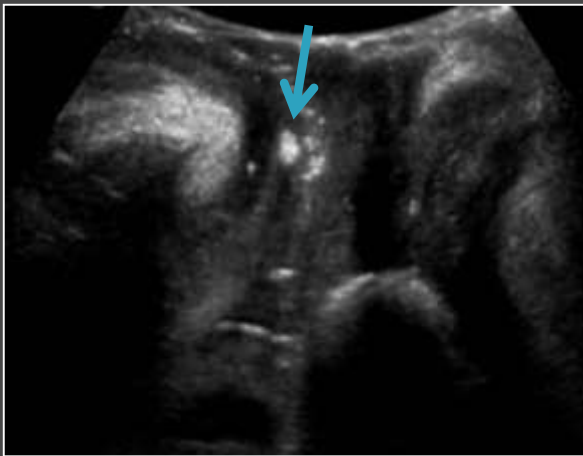
Midurethral Slings



- “ Mini surgeries”
- Continenace maintained at midurethra
 - ▣ Not bladder neck !
 - ▣ Related to failure pubourethral ligaments.
 - ▣ Suburethral slings best seen on TPUS
 - ▣ TOT may have an advantage if associated levator ani avulsions
- MUS is the most effective treatment for SUI.

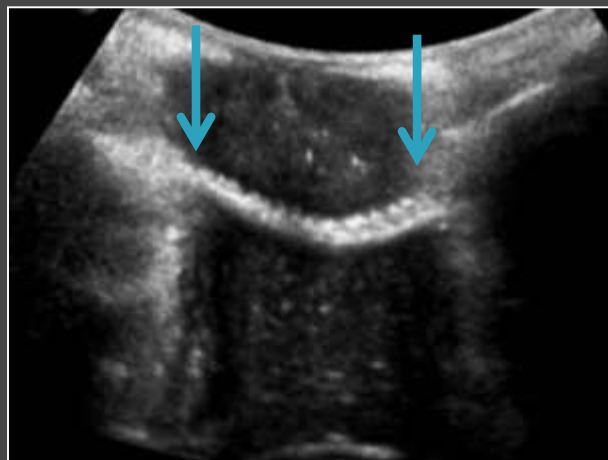
The Role of Mid-urethral Slings in 2014: Analysis of the Impact of Litigation on Practice

Colby E. Perkins et al Current Bladder Dysfunction Reports 2015 vol 10 pp39-45



Sagittal

- Mesh midurethral level

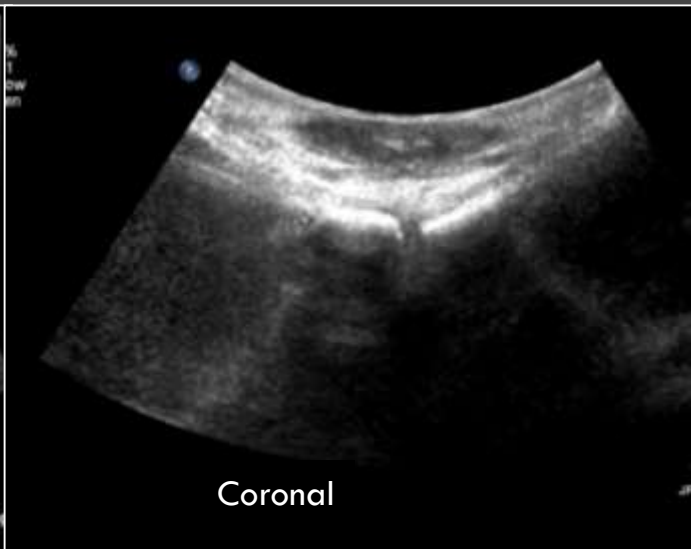


Transverse

- Relatively straight extends lateral out thru obturator foramen

Slings

2D Imaging: TOT



Case

Evaluate TOT on 2D

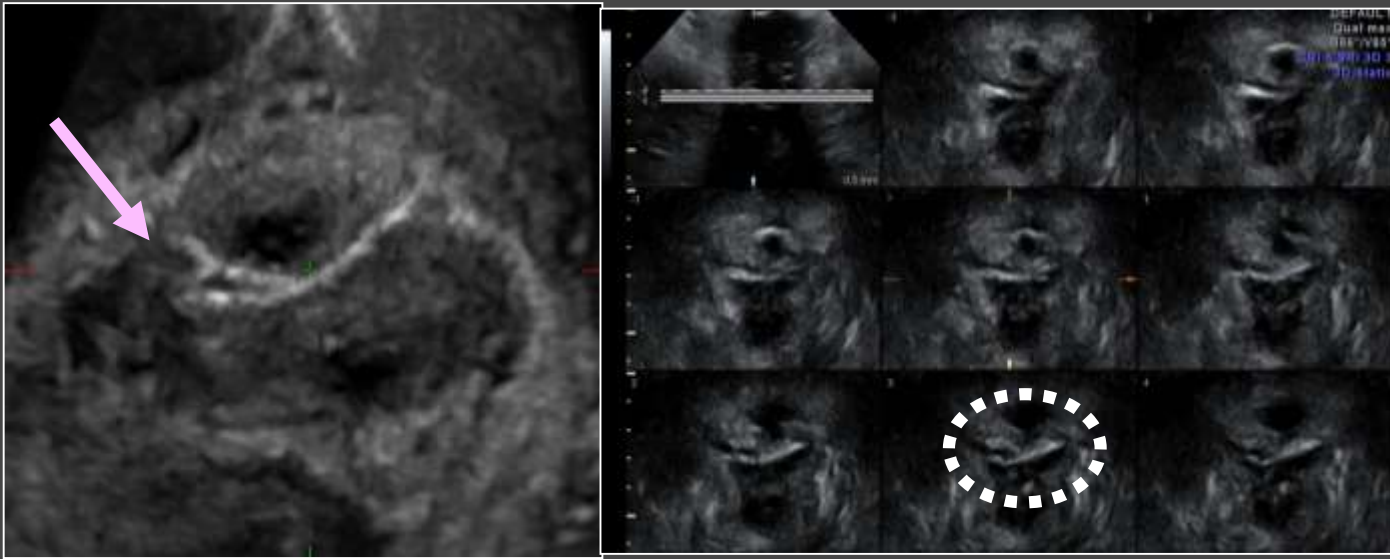


Present: Voiding Dysfunction

- Gap typically 10-15mm diameter
- Too tight, Split suburethral sling surgically

Case

Sling Complication



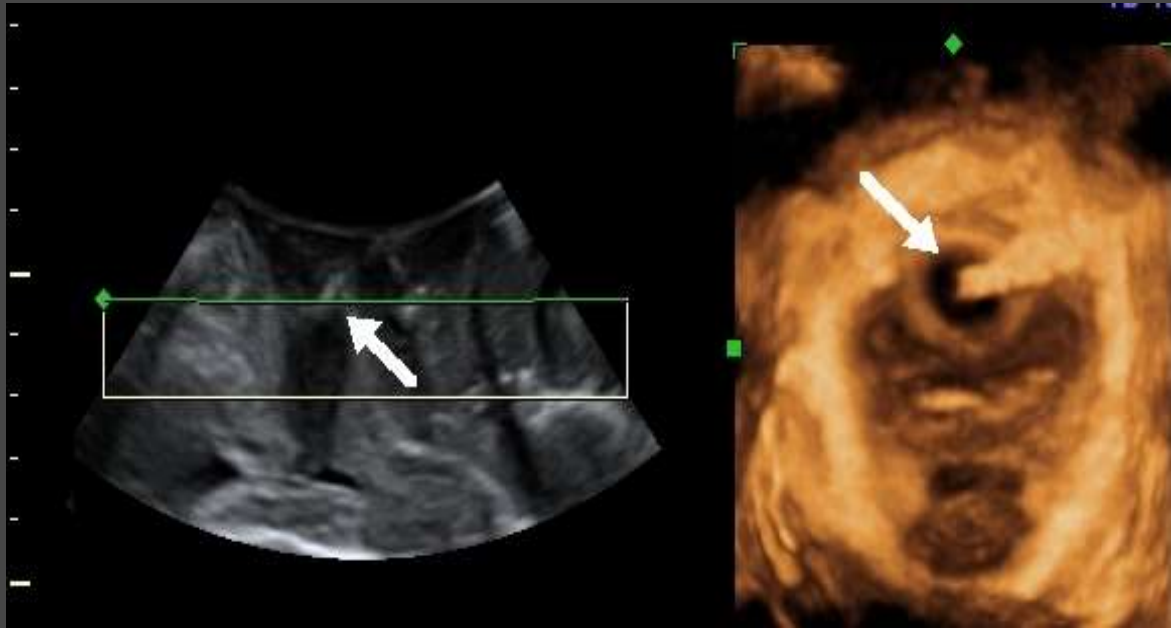
History: Persistent post-operative pain

Technique: Using coronal reformats with CT style slicing through volume.

Findings: TVT mesh fragmented right, possibly in right urethral wall
And posterior fragment in vagina

Case

Mesh Complication



History: TVT, post-operative pain
Technique: MPR with rendered view
Findings: TVT eroded into urethra

Courtesy Dr. Dietz

Case

Sling Complication

Complications

- Too tight or too loose
- Mesh erosion rate ~ 9%
- Bleeding pv 31%, Pain 13%
- Voiding dysfunction 21%
- 20% mesh arm dislodge - mesh mobile
 - ▣ *Line straight or obtuse, wide gap ? not anchored*
- *Dehiscent, fray, migrate, perforate*

Conclusion: Part 1

- Pelvic floor disorders common
- TPUS good for
 - ▣ Pelvic Organ Prolapse
 - ▣ Levator Ani Avulsions
 - ▣ Urinary Incontinence, stress
 - ▣ Assessment mid-urethral slings (MUS)
 - ▣ Biofeedback pelvic floor contractions

Thank You

Ultrasonography

Color Doppler Imaging

Power

Super Resolution

Shear Wave Imaging

SMART PHONE APPS

Quantitative Ultrasound

Solid State Circuitry

US Stethoscope of Future

Surgery without knives

Fusion Imaging

Point of Care

Biopsy

Ultrasound guided biopsy

Healing

Autonomous

Angiography

Working with ultrasound Contrast Agents

Focused Ultrasound Therapy

Contrast enhanced

Robotic Assisted Ultrasound

Remote Ultrasound

4D Imaging

Ultrafast

Ultrasound Luminal Gel Agents

Tubal imaging

Real Time Volume Imaging

BLOOD FLOW

staging of Cancer

B Flow Imaging

Fusion Imaging

Integration in medical school

Transducer Technology

Deep Infiltrating Endometriosis

Encoded pulses

Revolution



Thank you

References

- Santoro GA, Wieczorek AP, Dietz HP, et al. State of the art: an integrated approach to pelvic floor ultrasonography. *Ultrasound Obstet Gynecol* 2011;37(4):381–396. *State of the art: an integrated approach to pelvic floor ultrasonography*. H. P. Dietz³, *Ultrasound in Obstetrics & Gynecology* 37, 381–396, April 2011
- DeLancey JO. The hidden epidemic of pelvic floor dysfunction: achievable goals for improved prevention and treatment. *Am J Obstet Gynecol* 2005; 192: 1488–1495.
- Dietz HP, Shek C, Clarke B. Biometry of the pubovisceral muscle and levator hiatus by three-dimensional pelvic floor ultrasound. *Ultrasound Obstet Gynecol* 2005; 25: 580–585.
- Lekskulchai O, Dietz H. Detrusor wall thickness as a test for detrusor overactivity in women. *Ultrasound Obstet Gynecol* 2008; 32: 535–539.
- Broekhuis SR, Futterer JJ, Hendriks JCM, Barentsz JO, Vierhout ME, Kluivers KB. Symptoms of pelvic floor dysfunction are poorly correlated with findings on clinical examination and dynamic MR imaging of the pelvic floor. *Int Urogynecol J* 2009; 20: 1169–1174.
- Model A, Shek KL, Dietz HP. Do levator defects increase the risk of prolapse recurrence after pelvic floor surgery? *Neurourol Urodyn* 2009; 28: 888–889
- Dietz HP, Haylen BT, Broome J. Ultrasound in the quantification of female pelvic organ prolapse. *Ultrasound Obstet Gynecol* 2001; 18: 511–514.
- Yagel S, Valsky DV. Three-dimensional transperineal ultrasonography for evaluation of the anal sphincter complex: another dimension in understanding peripartum sphincter trauma. *Ultrasound Obstet Gynecol* 2006; 27: 119–123.
- Dietz HP, Barry C, Lim YN, Rane A. Two-dimensional and three-dimensional ultrasound imaging of suburethral slings. *Ultrasound Obstet Gynecol* 2005; 26: 175–179.
- Dietz HP, Steensma AB. Posterior compartment prolapse on two-dimensional and three-dimensional pelvic floor ultrasound: the distinction between true rectocele, perineal hypermobility and enterocele. *Ultrasound Obstet Gynecol* 2005; 26: 73–77.