Pelvic floor Ultrasound
Basic settings and procedures

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This document has been produced by the Special Interest Group ‘Pelvic Floor Imaging’ of IUGA. It provides instructions for the acquisition of ultrasound images and 3D/4D data sets obtained by translabial imaging, the currently most widely used method for pelvic floor imaging. It is recognised that some practitioners use transvaginal and endo-anal techniques, to which this text does not apply.

- Basic Setup:
    - Ask patient to void and empty bowel if possible.
    - Position in lithotomy, heels close to buttocks
    - 4-8 MHz curved array or similar volume transducer
        - apply a layer of gel before and after covering the probe with a transducer cover/ non-powdered glove (or plastic film), avoid air bubbles between the probe and the probe cover
        - place on introitus, vertically in midline (Fig 1).
    - Ultrasound settings:
        - Maximum aperture (up to 90 degrees)
        - 2 Focal zones
        - depth 7-9 cm
        - High harmonics,
        - SRI 4-5, CRI 2-3 or similar speckle reduction techniques if available.

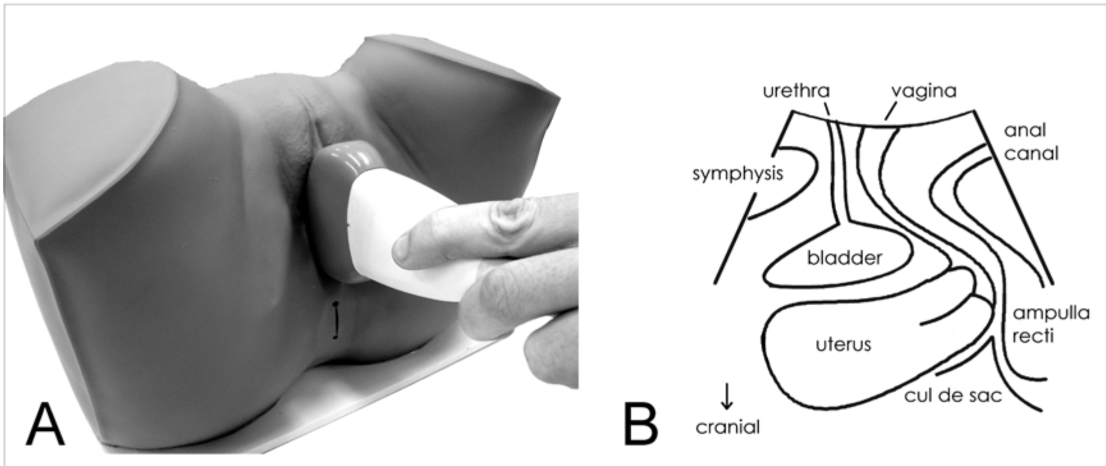

Figure 1: Transducer placement for assessment of residual urine, Detrusor Wall Thickness, organ descent, hiatal area, levator integrity.

1.) 2D image acquisition

- Leave probe on perineum once placed.
- Symphysis pubis in left hand corner, no more than 1 cm from transducer surface
- Urethra visible as black stripe to identify midsagittal plane, and the anal canal as tubular structure in the right upper quadrant.
- Residual urine: two maximal diameters vertical to each other, x*y*5.6= residual in ml (x and y measured in cm)
- Detrusor wall thickness (DWT) measured on dome, three locations in the midline, perpendicular to the mucosal surface after bladder emptying with residual <50mls.
- Split screen: images at rest (left) and on maximal Valsalva >= 6s, (right).
- Used to measure bladder neck and bladder descent (a,b), retrovesical angle (c,d) urethral rotation (e,f), (Fig 2).
- Single screen: image on maximal Valsalva to determine organ descent (Fig 3). Let the prolapse come- no pressure on perineum, without tilting the hand!
- Check for hyperechogenic structures (slings and meshes) in anterior and posterior vaginal wall.
- Check for cystic structures (urethral diverticula, Gartner cysts, nabothian follicles, ureterocele.

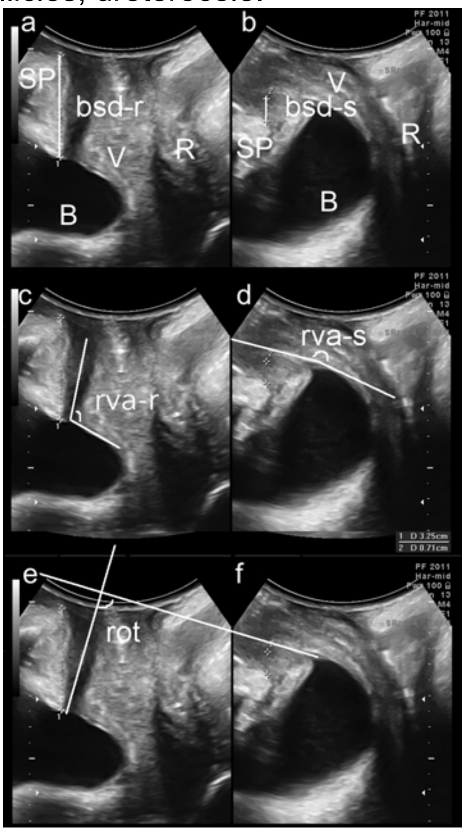

Figure 2: Split screen for BND, RVA, urethral rotation and bladder descent. BSD= bladder neck- symphysis distance, RVA= retrovesical angle, rot= rotation angle, r= at rest, s= on straining. SP= symphysis pubis, B= bladder, V= vagina, R= rectum.

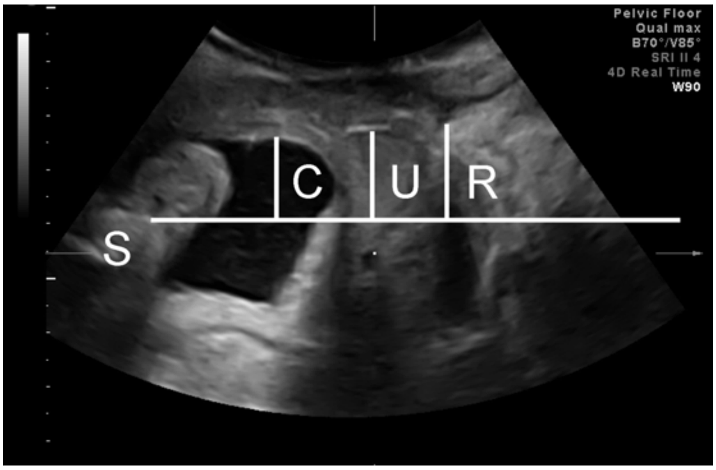

Figure 3: Single screen at maximum Valsalva (>=6s) for organ descent. S= symphysis pubis, C= cystocele, U= uterus, R= rectal ampulla.

2) 4D acquisition for prolapse/ hiatal area assessment

- Set acquisition angle at 85 degrees (or system maximum)
- 2 split screen with rendered volume on right, set the region of interest (the box shown in A) to 0.5-2 cm thickness, green line at top, place the box to include the plane of minimal hiatal dimensions (Fig 4). One may need to rotate the image so that the plane of minimal hiatal dimensions lies within the box, as in Fig 4.
- Keep right-hand image symmetrical and in the centre throughout acquisition, and keep SP in left- hand image. No pressure on transducer. Avoid levator co-activation (Fig. 5). Biofeedback teaching if there is levator coactivation. Valsalva >= 6 s.
- Measure hiatal area on rendered volume (right). Move the Box (area of interest) in A for clear image of the hiatus for measurement. Use whatever thickness (0.5-2 cm) gives you the best contour. Check distance of hiatal contour from image edge in A and B.

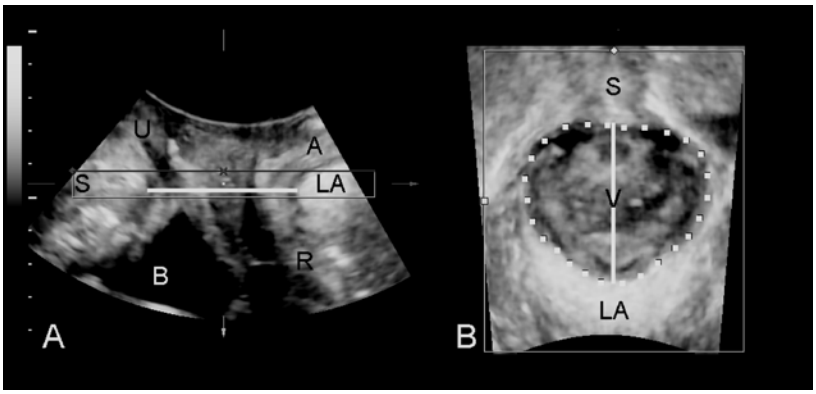

Figure 4: 4D acquisition for organ descent and hiatal ballooning (85 degree acquisition angle). The region of interest (box in A) is set between symphysis (S) on the left and the levator ani (LA) on right. B= bladder, U= urethra, R= rectal ampulla, A=anal canal, V= vagina. The dotted contour in B is the hiatus in the plane of minimal dimensions, the white line in A and B is the minimal hiatal diameter in the midsagittal (anteroposterior) plane.

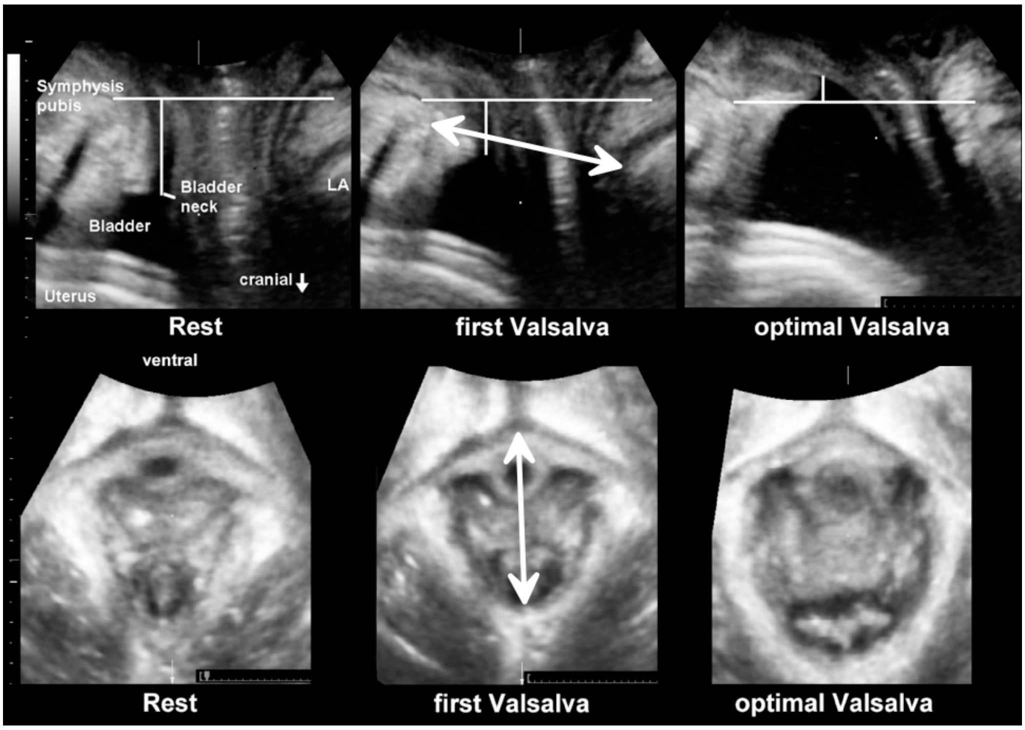

Fig. 5: Levator co-activation or co-contraction during Valsalva evidenced by a reduction in anteroposterior hiatal diameter (first Valsalva, vertical lines in central images). From Oerno et al., Ultrasound Obstet Gynecol 2007; 2007; 30: 346–350

3.) PFMC for tomographic imaging of levator integrity:

- Views as above- make sure symphysis is visible.
- Ask for PFMC, and make sure the levator ani muscle remains visible. May need pressure on the perineum.
- Rotate the A plane to place plane of minimal dimensions (minimal distance from SP to LA) in middle of box (Figure 6).

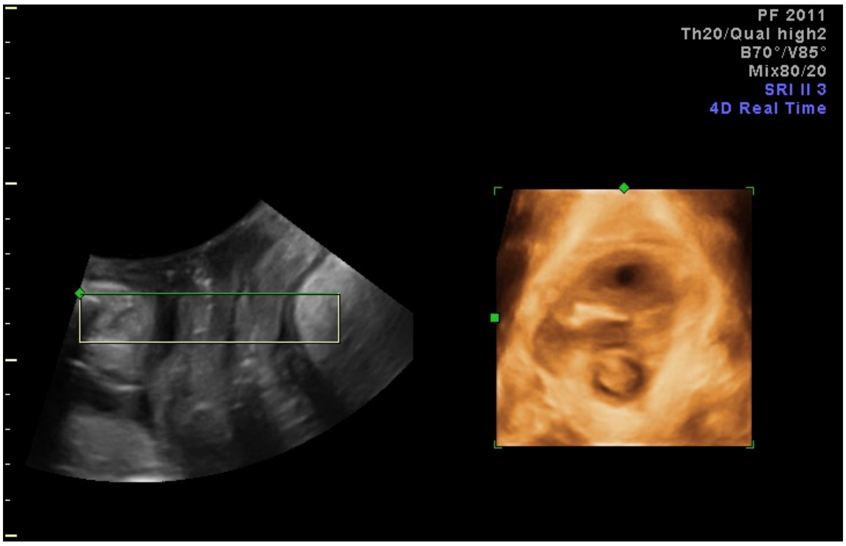

Figure 6: PFMC, plane of minimal dimensions placed in centre of box (region of interest)

- Switch to TUI (tomographic ultrasound imaging) in the C (axial) plane and rotate this plane so that the image is upright. Set the interslice interval at 2.5 mm, 8 slices (see Figure 7).
- May need further adjustment so that the SP in the 3 central slices (i.e.slice 3 to 5 in Fig 7) appear open (slice 3), closing (slice 4) and closed (slice 5) (Figure 7).
- Rate central three slices for integrity of the insertion of the puborectalis muscle.
- When in doubt measure levator-urethral gap between centre of the urethra and PR insertion (Figure 8). Limit of normal in Caucasians is 2.5 cm.

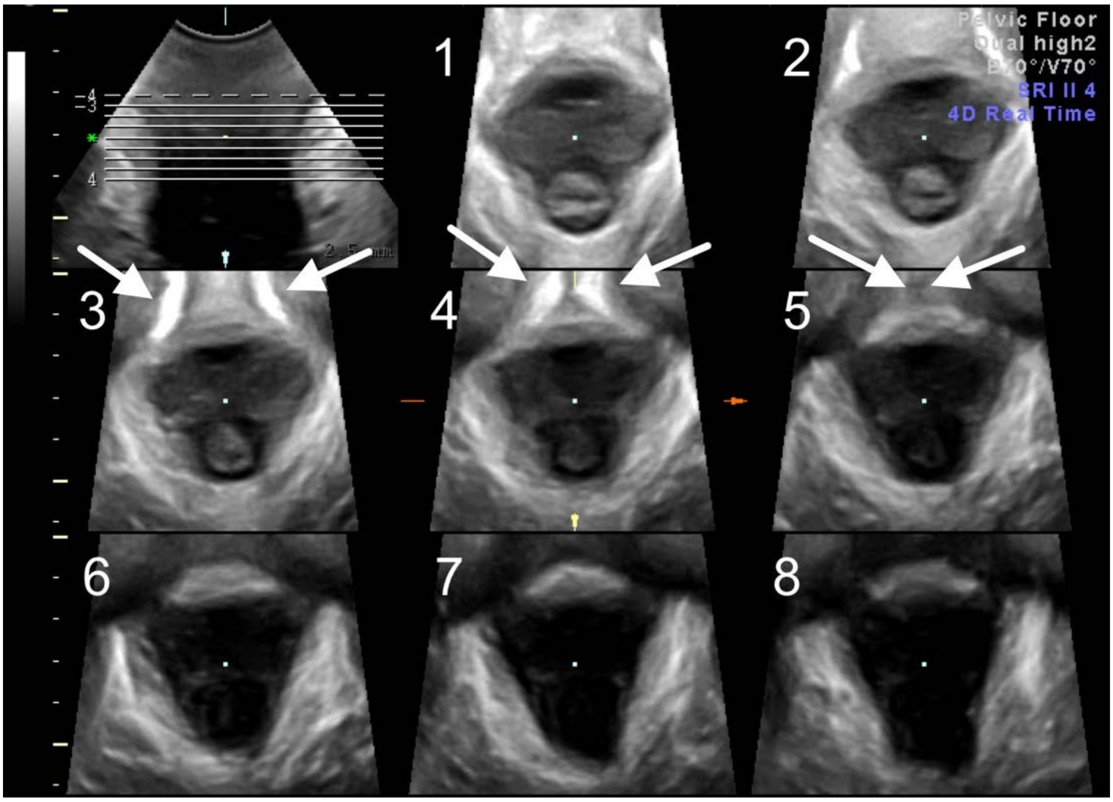

Figure 7: TUI in the C (axial) plane for assessment of levator integrity. Slice 1 is the caudal slice, slice 8 is the most cranial cranial slice.

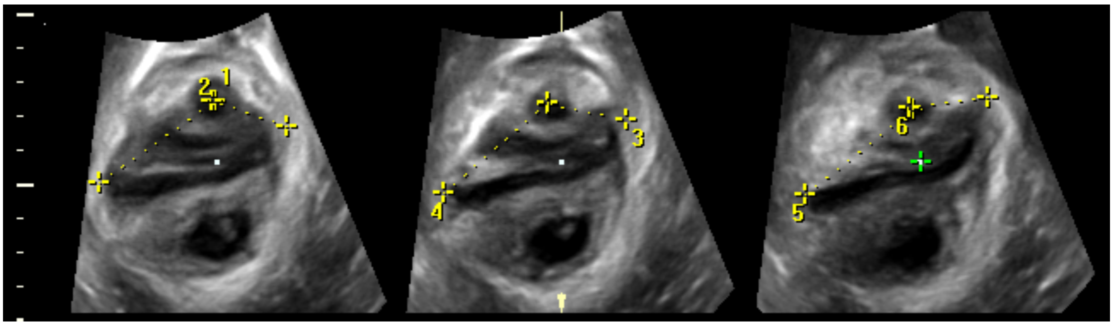

Figure 8: Levator-urethra gap measurement in the three central TUI slices in a patient with a right- sided avulsion.

4) 4D Acquisition for imaging of the anal canal

- Place transducer transversely over introitus after reducing aperture to 60 degrees. Apply additional gel centrally. Tilt the probe towards the canal (see Figure 9 A) so as to obtain a transverse view of the anal canal (see Figure 9 B)
- SRI 3-4, CRI 2-4, high harmonics, +/- VCI
- Set acquisition angle at 70 degrees to image the whole length of the anal canal.
- One focal zone as close as possible to the probe surface.

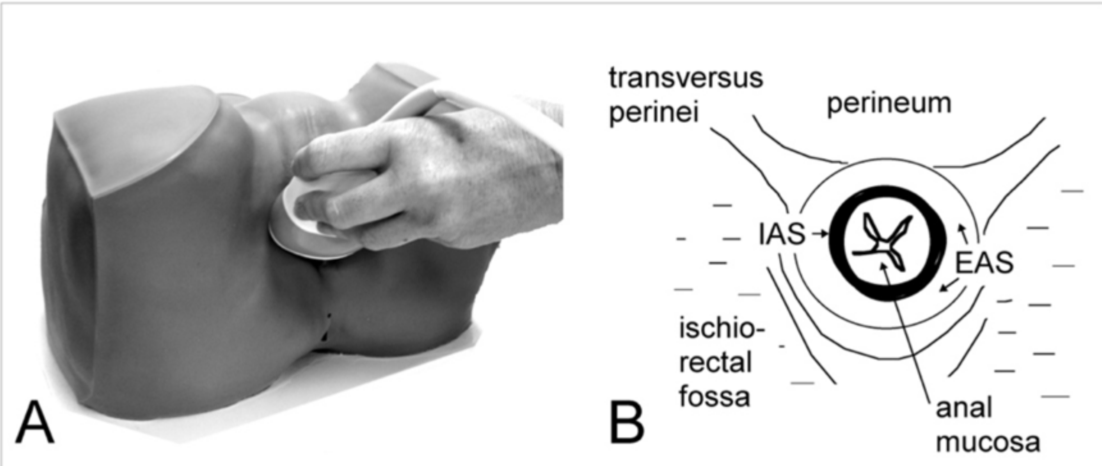

Figure 9: Transducer placement for exo-anal imaging of the anal sphincter

- view transverse plane as A, midsagittal plane as B, and identify the fascial plane separating the EAS from the levator ani in the B plane (Figure 10). If the B plane shows horizontal parallel dark stripes and if those parallel dark stripes, ie., the internal sphincter, are vertical in the C plane, then the image is properly centred.
- ask patient to perform PFMC, take care the entire EAS is within the field of vision.
- Adjust transducer pressure to stay close without deforming the ring shape of the sphincter.
- Select A plane and TUI. Adjust interslice interval to include the entire EAS (see Figure 11).
- Measure defects by determining defect angle (Figure 12) in slices 2-7.

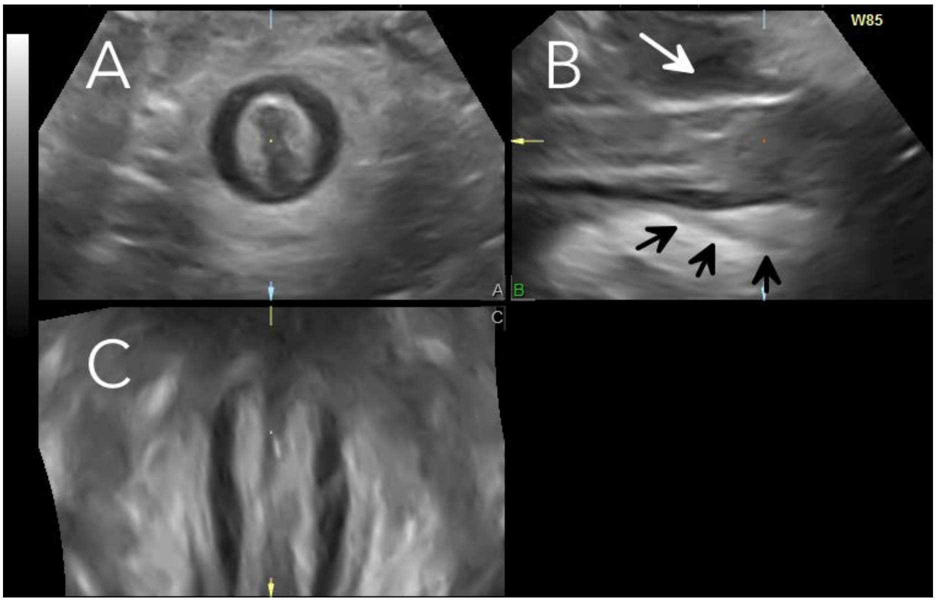

Figure 10: Identification of EAS limits in midsagittal (B) plane. The fascial plane in B (black arrows) identifies the true extent of the EAS. There is a clear deficiency of its ventral aspect (white arrow), which on tomographic imaging (examples in Figures 11 and 12) affected 3 out of 6 slices, although this defect is not visible in A.

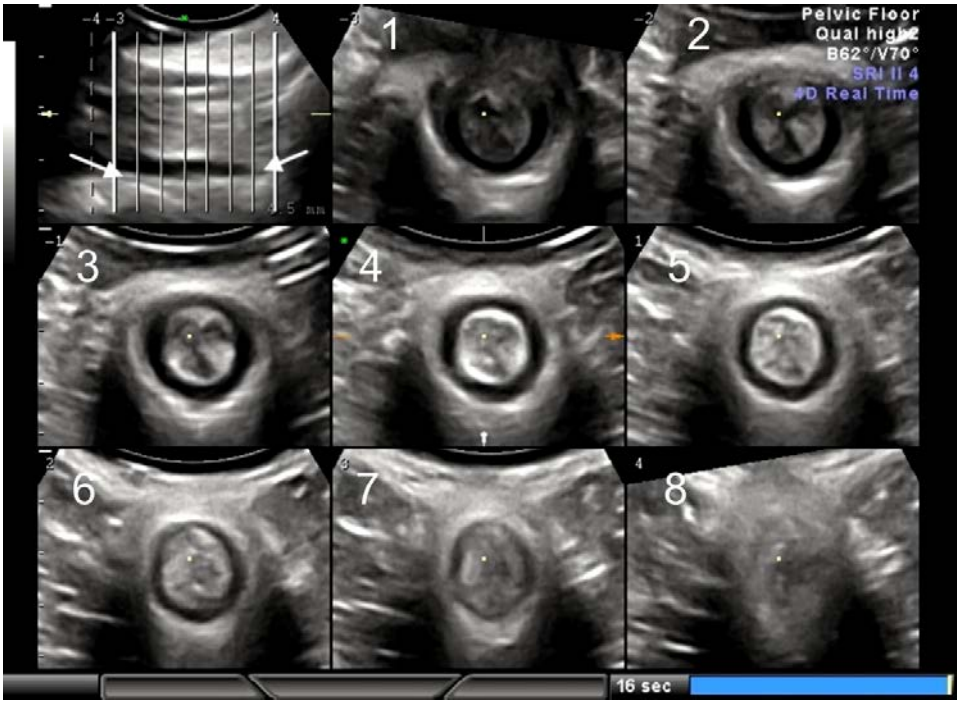

Figure 11: TUI for assessment of the anal sphincter, asymptomatic nullipara. The top left hand image in the midsagittal plane shows placement of the 8 transverse slices, which encompass the entire EAS from slice 2 to 7, with the possible exception of the most superficial part of the subcutaneous EAS.

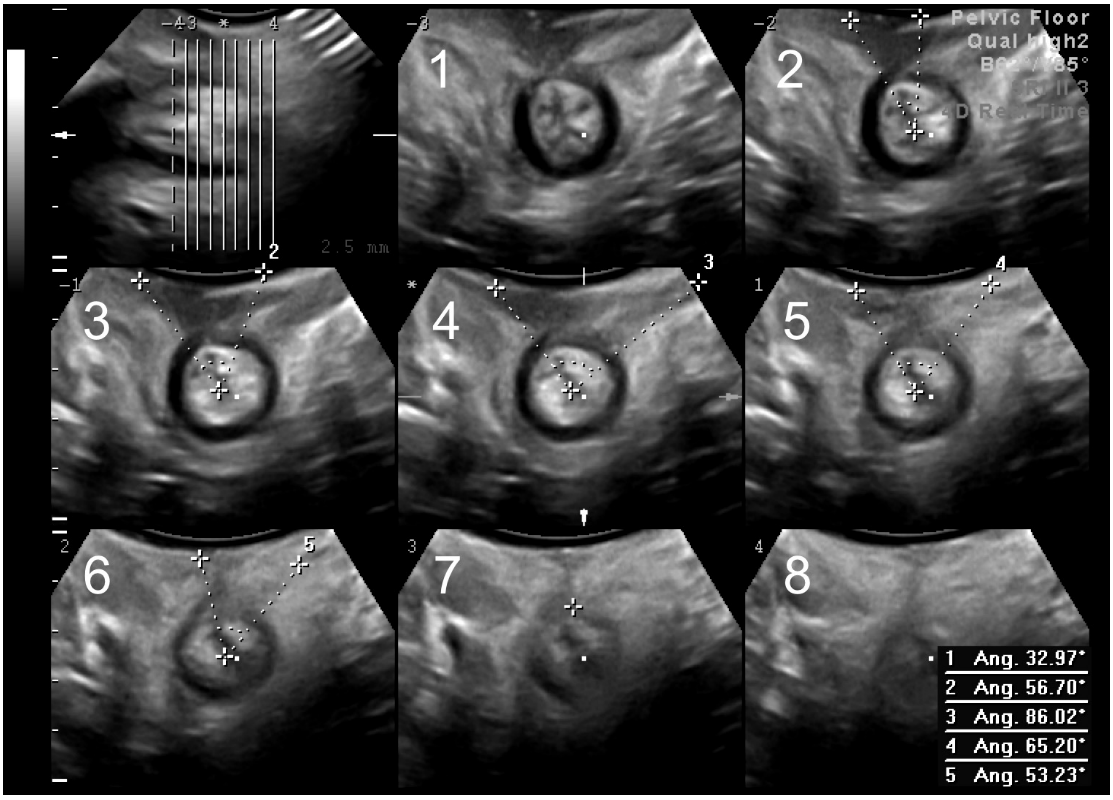

Figure 12: Measurement of EAS defect angle in symptomatic patient >20 years after EAS tear. The images show a defect of 30 degrees or more (one hour on the clock face) in slices 2-6.

5) Imaging of implants

Ultrasound imaging of implants may be required in women with sling complications such as recurrent stress incontinence, voiding dysfunction, recurrent UTIs or pain, in order to assess type, location and function. Imaging of meshes may be needed in women with recurrence, pain and if there is a suspicion of perforation into the bladder or rectum. Vaginal erosion does not seem to produce unequivocal sonographic signs.

Slings

The aim of the imaging is to describe both location and function. Therefore imaging at rest and dynamic assessment during a Valsalva maneuver is needed. In the midsagittal plane polypropylene implants are visible as hyperechogenic structures (Fig. 13) posterior to the urethra, although occasionally one may be found at the bladder neck. In the coronal or B plane such implants should be visible as a strip- like line, likewise for the axial plane. There may be asymmetrical misplacement of the implant which may be termed 'tethering', which is not always associated with symptoms. One should be careful with a diagnosis of 'perforation' which needs to be confirmed by cysto-urethroscopy.

Mid- urethral slings such as the TVT, TOT, Monarc, Sparc etc. tend to become more visible on Valsalva as they often rotate into a more horizontal position. Assessment on Vaslalva is essential as this improves visibility due to changing intonation angle, and to assess dynamic compression of the urethra. While 2D imaging provides much of the information needed, 4D imaging in the orthogonal planes, or as rendered volumes, is often helpful. Tomographic imaging may occasionally be useful.

Minislings tend to look like standard MUS and can be diffcult to distinguish. The IVS, an older sling used between 1995 and 2005, is much harder to identify and often only visible in the axial plane. The TFS (Tissue Fixation system) and more recently developed MUS such as the Advantage sling seem more hyperechogenic and tend to curl less, suggesting higher stiffness.

Describe

- Location of sling at rest and on Valsalva relative to the external and internal urethral meatus, especially if surgical removal may be contemplated. (Fig. 13)
- Location of sling relative to urethral structures: between vaginal muscularis and rhabdosphincter, within the rhabdosphincter, within the longitudinal smooth muscle, on the ventral side of the urethra, in the space of Retzius, 'tethering' (Fig.13)
- Sling shape: linear, curved, C or U shape
- Type: retropubic or transobturator (Fig. 14)
- Determine the Sling- pubis gap as a measure of urethral compression.(Fig. 13).

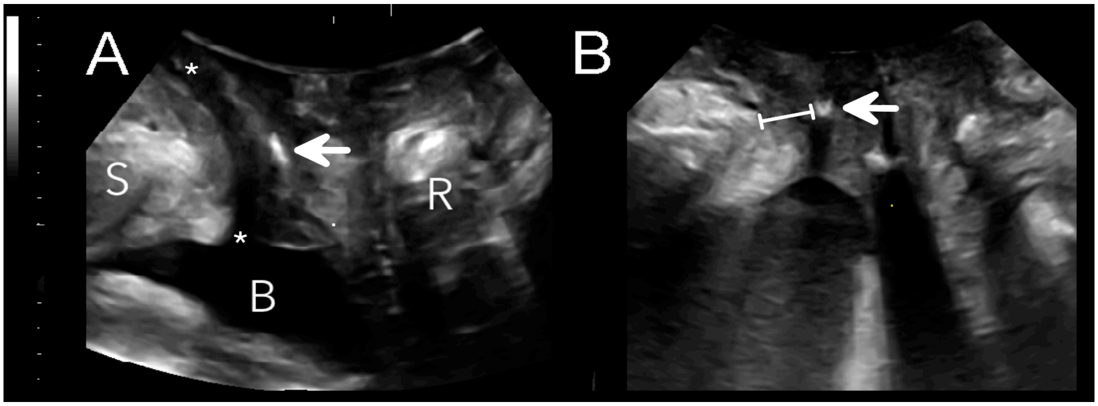

Figure 13: TVT midurethral sling imaged at rest (A) and on Valsalva (B). The stars in (A) indicate external and internal meatus, against which the location of the sling can be measured. The tape (arrow) curls tightly into a u shape in (B), and the sling pubis gap is indicated as the distance between the symphysis pubis and the sling in (B).

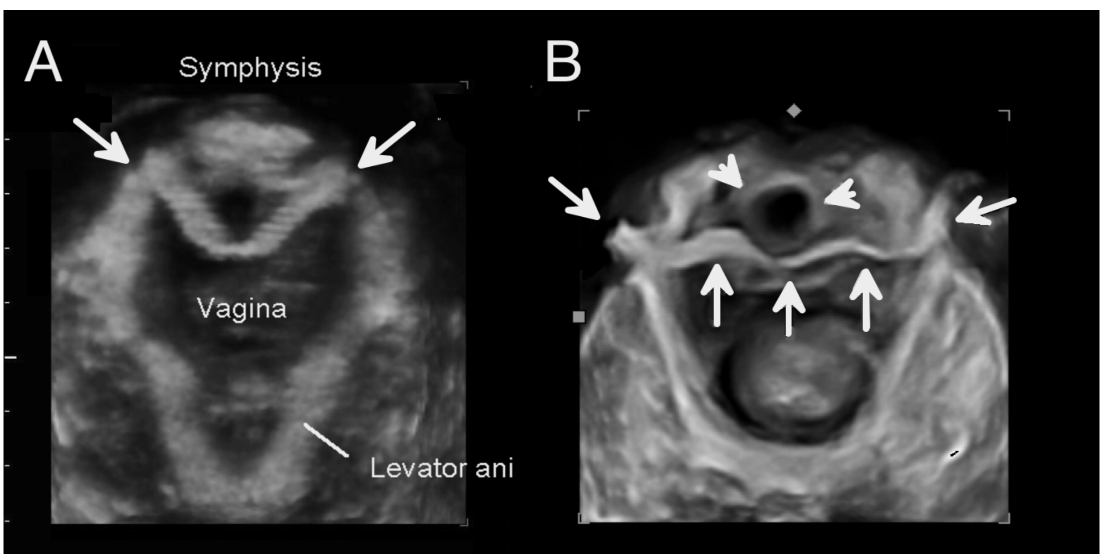

Fig. 14: The distinction between retropubic (A) and transobtorator (B) slings is most easily achieved in on axial plane imaging, whether in single planes or as here on rendered volumes. (A) shows a TVT (arrows) as a V or U shape while (B) is a transobturator sling appears as a gull- wing shape.

Meshes

As with slings the aim is to assess location and function. In the midsagittal plane, anterior and posterior compartment prolapse meshes such as Prolift, Apogee/ Perigee, Ant/ Post. Elevate, Uphold etc. can readily be observed as linear hyperechogenic structures (Figure 15), while sacrocolpopexy meshes are often too cranial to be obvious. However, in some cases they may be seen close to the trigone.

Anterior compartment meshes usually are visible as flat lines, but sometimes seem folded, especially older meshes. The Anterior Prolift was particularly large, hence it often appears folded (see Figure 15). Such meshes are sometimes difficult to visualize in detail. It is suggested that mesh appearances are described together with its location relative to the internal urethral meatus.

Posterior meshes are visible as linear structures anterior to the rectal ampulla. Recurrence posterior to such a mesh may be evident as a true rectocele, an enterocele or an intussusception. A recurrence anterior to the mesh occurs as enterocele. It is suggested that posterior compartment mesh is described by its appearance and location relative to the introitus. For mesh location, especially for more cranially placed meshes, intravaginal ultrasound may also be used. However, functional asssement requires the perineal/ trans-labial approach.

Describe

- Type: Anterior: Transobturator mesh or apically anchored mesh (Fig. 15), Sacrocolpopexy mesh (Fig. 16); posterior mesh.
- Location of mesh at rest relative to symphysis pubis and the internal urethral meatus at rest and on Valsalva, especially if surgical removal may be contemplated.
- Location of mesh relative to other structures: bladder, cervix, rectum
- Shape: linear or folded, at rest and on Valsalva
- Extent: in midsagittal and coronal/ axial planes.(Fig. 17)
- Behaviour on Valsalva: anterior, apical or global anchoring or support failure. (Fig 18)

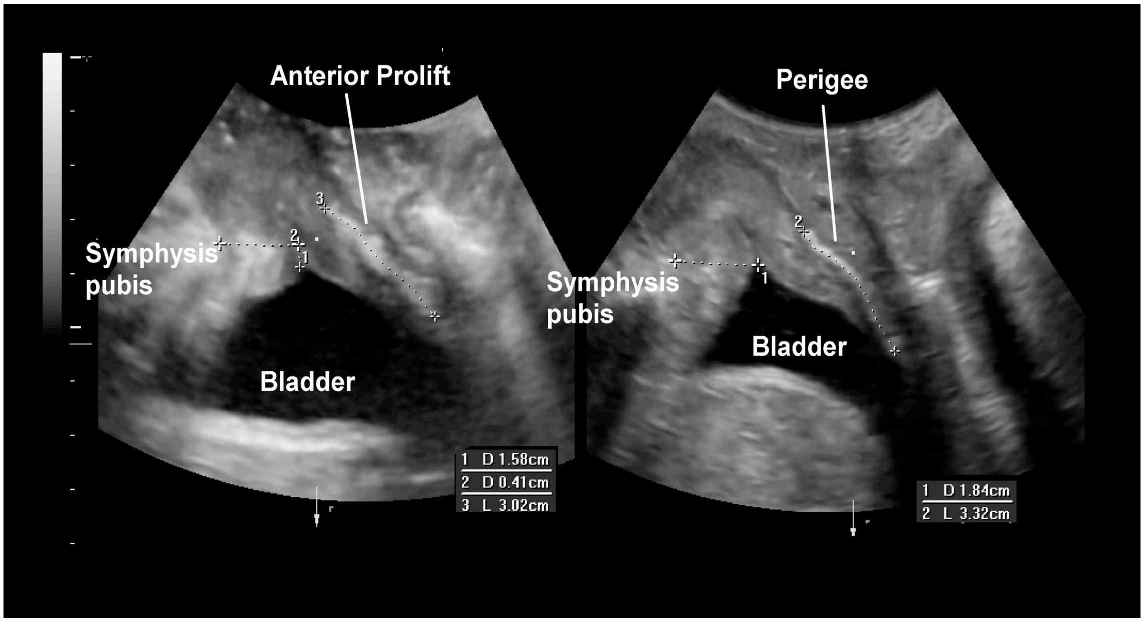

Figure 15: Meshes appear as hyperechogenic linear structures in the midsagittal plane, usually under the trigone. Prolift meshes often appear folded due to excessive mesh length in the midsagittal plane.

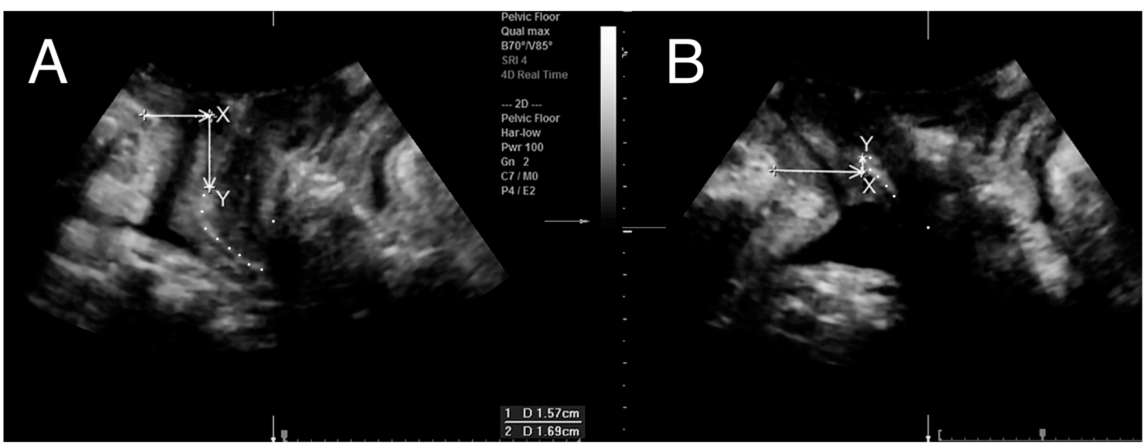

Figure 16: Laparoscopic Sacrocolpopexy mesh at rest (A) and on Valsalva (B). While such mesh is often too cranial to be clearly visible on translabial ultrasound, it may be evident under the bladder neck and trigone, similar to vaginally inserted mesh. Its cranial aspects are often obscured by prolapse of the posterior compartment, as evident in (B).

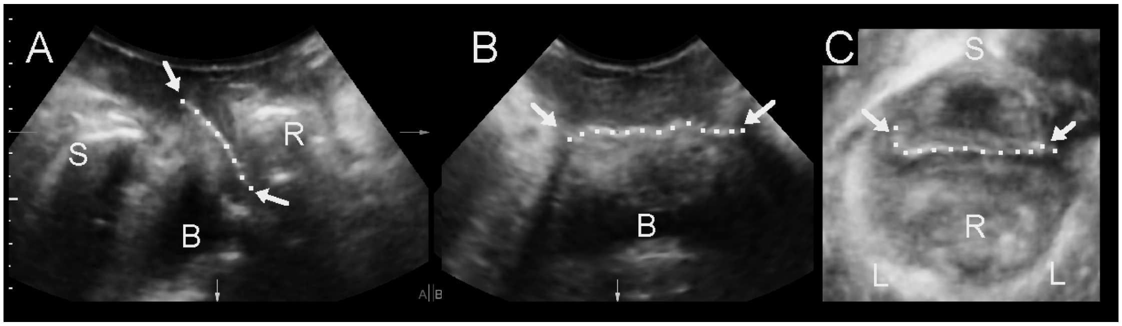

Figure 17: Determination of mesh extent in the three orthogonal planes: mid-sagittal (A), coronal (B) and axial (C).

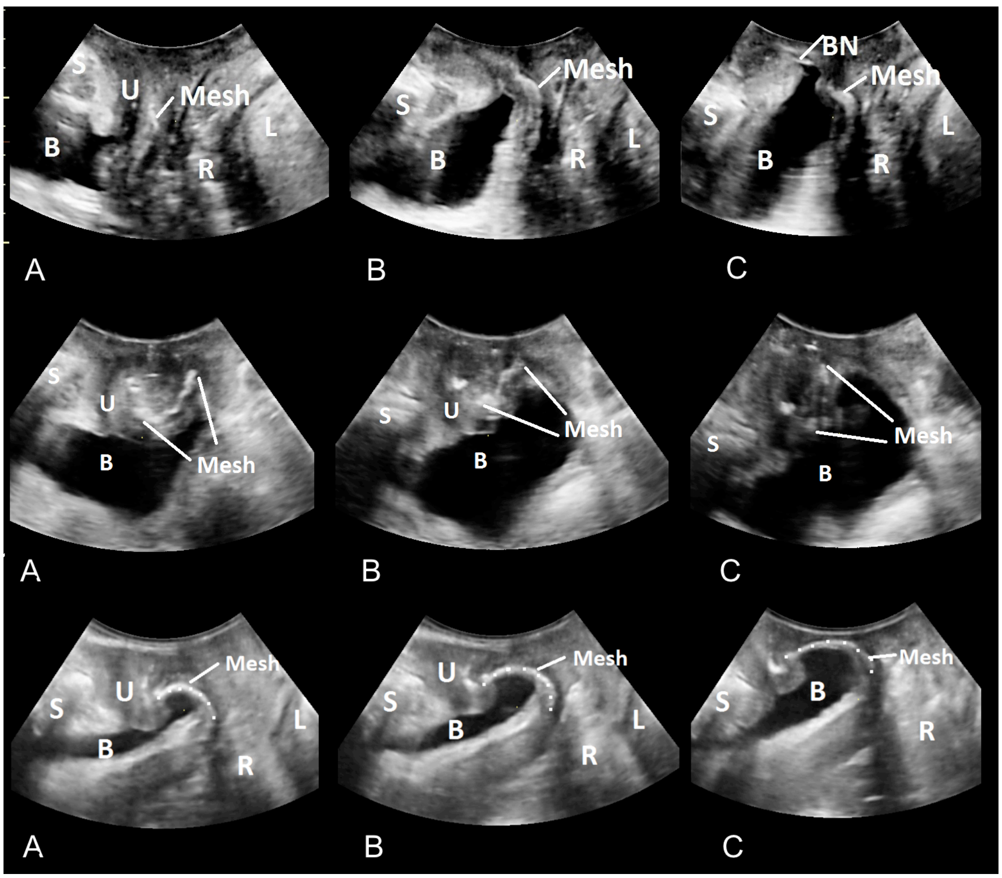

Figure 18: Forms of support failure of anterior compartment mesh: anterior failure (top row), where a cystocele recurs anterior to a well- anchored mesh; apical failure, where the top end of a mesh is detached and rotates downwards on Valsalva, resulting in a rather well supportded bladder neck and a 'high' cystocele just as after Burch colposuspension (middle row), and 'global' failure where the entire mesh is moving well below the symphysis pubis, signifying an absence of anchoring. (A) are images at rest, (B) on partial Valsalva and (C) on maximal Valsalva.

Further reading:

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Dietz HP. Ultrasonography. In: Evidence based physiotherapy for the pelvic floor: bridging research and clinical practice. 2nd Edition. K. Bo, B. Berghmans, M. van Kampen and S Morkved Eds. Butterworth Heinemann Elsevier, 2014

Shek KL, Dietz HP. Imaging of slings and meshes. Australasian Journal of Ultrasound in Medicine May 2014; 17 (2): 61-71

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Dietz HP. Pelvic Floor Ultrasound: Abnormal findings. In: Merz E. Atlas of 3D/4D Ultrasound in Obstetrics and Gynecology. Thieme Stuttgart, 2016.

Shek KL, Dietz HP. Assessment of Pelvic Organ Prolapse: A Review - Ultrasound Obstet Gynecol Gynecol 2016; 48: 681-692 DOI: 10.1002/uog.15881

Transperineal ultrasound report template Date of procedure:________

Patient details:

Indication:____

Transperineal ultrasound – performed: supine/standing
Bladder emptied: YES / NO

Residual urine volume: ______________ mls Detrusor Wall thickness: _________mm

Bladder neck descent on Valsalva: ________ cm

Urethral rotation on Valsalva: ________ degrees RVA on Valsalva: _______deg.

Comments:

____

____

Pelvic Organ measurements (Valsalva) relative to SP:

Bladder position: ________________mm

Uterus/vault: ___________________mm

Rectal ampulla: _________________mm Rectocele depth: _________mm

Enterocele: ____________________mm
Intussusception:________________

Comments:

____

____

Mesh or slings: YES/NO

If sling present, sling pubis gap measurement: ___________mm

Comments:

____

____

3D/ 4D ultrasound:

Status of levator muscle – RIGHT: Intact / Partial / Complete avulsion
LEFT: Intact / Partial / Complete avulsion

Levator hiatal area on Valsalva: _____________________cm^2
Other:____

Anal Sphincter Complex: Intact / Defects noted: IAS …. / 6 EAS .... / 6

____

____

____

Findings & Conclusion:

____

____

____

Letter Template

Date:

Re: ______________________

Ms ______ was seen for a Pelvic Floor Ultrasound on ________. She is suffering from symptoms of ________________. 2D and 3D/4D pelvic floor ultrasound was performed using a ________________ system.

Findings:

2D: The postvoid residual was ____ml. The urethra appears __________. Detrusor wall thickness was _________mm. No synthetic implants visualised.

There was _____cm of bladder neck descent on Valsalva, with a _______ retrovesical angle and ____degrees of urethral rotation. On valsalva, there is descent of the bladder to _____cm below the symphysis pubis (SP), the rectal ampulla descends to ____cm below the SP, and the rectocele depth measured __________. The vault/uterus descended to _________above/ below the SP.

3D: The puborectalis muscle was intact/ showed an avulsion on the right, and ____________ on the left. The levator hiatal area measured ______cm^2, which is _____ enlarged/ implies _______ballooning. Mrs________ was able to perform a fair, well coordinated levator contraction. Both EAS and IAS appeared normal/abnormal, with no/ a residual defect in ______ slices.

Interpretation: _______-compartment prolapse against the background of _____ puborectalis muscle and ________levator hiatal area ballooning.

A plan of management may include

____

I hope to have been of assistance.

Kind regards