IMAGING, NEUROPHYSIOLOGY AND OTHER TESTS

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1

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† All financial ties (over the last year) that you may have with any business organisation with respect to the subjects mentioned during your presentation

Funding for speaker to attend:

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IMAGING AS A DIAGNOSTIC TEST

- To diagnose a condition or identify a structure
- Structural imaging validated against cadavers or surgical identification
- To look into the pathophysiology of conditions
- As a biofeedback tool
- To understand reasons for failures

- To be used as surrogate of the gold standard looking for
  - Additional information
  - Less variability
  - Lower cost

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IMAGING AND OTHER INVESTIGATIONS

- Imaging of upper urinary tract
- Imaging of lower urinary tract
- Pelvic organ prolapse
- Imaging of central nervous system
- Endoscopy
- Other investigations
  - Pad Test
  - Urinalysis, Chemicals tests, Tissue analysis
- Imaging in anal incontinence

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IMAGING OF UPPER URINARY TRACT

- **Summary**
- **New relevant evidence on UUT imaging for urinary incontinence and POP since the last ICI (ICI 2016) was very scarce.**
- **Imaging of the UUT is required in UI originating from a malformation, a traumatic or an iatrogenic problem of the UUT.**
- **The lower urinary tract dysfunction causing neurogenic and overflow incontinence may endanger UUT, and appropriate screening and surveillance for UUT deterioration is warranted.**
- **For patients with severe POP, imaging of the UUT is required to detect hydronephrosis.**

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IMAGING OF UPPER URINARY TRACT

Imaging of the UUT is indicated in case of:

- Suspicion of extra-urethral urinary incontinence by upper tract anomaly and fistula
- Neurogenic UI with high risk of UUT deterioration and renal dysfunction due to high storage and/or voiding detrusor pressure chronic retention with incontinence
- Severe uterine prolapse, vault prolapse or anterior vaginal wall prolapse, especially when surgical intervention is not indicated or delayed

Level of evidence 3, Grade
Recommendation C

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6

IMAGING AND OTHER INVESTIGATIONS

Imaging of the UUT is NOT indicated in the evaluation of non-neurogenic stress, urgency or mixed UI

Level of evidence 3, Grade of Recommendation C

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LOWER URINARY TRACT IMAGING

Female Incontinence and Pelvic Floor

- Cystourethrography
- Ultrasonography
- CT
- MRI

Urethral diverticulum

Post-Prostatectomy Incontinence

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LOWER URINARY TRACT IMAGING
CYSTOURETHROGRAPHY

Sometimes used in:

- preoperative evaluation of complicated/recurrent female U.I.
- evaluation of evident or suspect neurogenic urinary incontinence

Level of evidence 3, Grade of Recommendation C

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9

LOWER URINARY TRACT IMAGING
CYSTOURETHROGRAPHY

No evidence for its use in:

- primary uncomplicated SUI
- Urgency UI
- Mixed female UI

Level of evidence 3, Grade of Recommendation C

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VIDEOURODYNAMICS

Weak evidence for its use in:

- primary evaluation of female urinary incontinence

Good evidence for its use in:

- management of urinary incontinence in adult and paediatric neurogenic patients

Level of evidence 3, Grade of Recommendation C

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11

RESIDUAL URINE MEASUREMENT

Evidence for its use in:

- Initial assessment of urinary incontinence as a safety parameter to exclude voiding difficulty
- Evaluation of treatment outcome
  - use either ultrasound or catheter
  - Accuracy is higher in the use of a catheter as error +-20%

Level of evidence 3, Grade of Recommendation C

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12

FEMALE URETHRAL DIVERTICULUM

No change since ICI 6

- When suspected: image – UPP. USS, MRI, cystoscopy
- Imaging technique depends on availability
- Highest accuracy: MRI

Level of evidence 3, Grade of Recommendation C

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ENDOSCOPY OF THE LUT

What the evidence says:

- Not use in primary female urinary incontinence
- Can be considered in case of:
  - Male post prostatectomy urinary incontinence
  - Urgency incontinence particularly in case of microscopic haematuria, to rule out concomitant bladder disease
  - Recurrent or iatrogenic urinary incontinence when surgery is planned

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ENDOSCOPY OF THE LUT

What the evidence says:

- use to evaluate vesico-vaginal fistula and extra-urinary incontinence
- may use in:
  - incontinence surgery to rule out urethral or vesical injury
  - male post prostatectomy urinary incontinence
  - urgency incontinence particularly in case of microscopic haematuria, to rule out concomitant bladder disease
  - recurrent or iatrogenic UI when surgery is planned

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IMAGING OF THE NERVOUS SYSTEM

Consider neuroimaging when

- a nervous system disorder is suspected on the basis of clinical and/or neurophysiologic test findings
- Suspected congenital neurogenic incontinence with or without neurourological abnormalities- lumbosacral spine anteroposterior and lateral radiology or MRI

Level of evidence 3, Grade of Recommendation C

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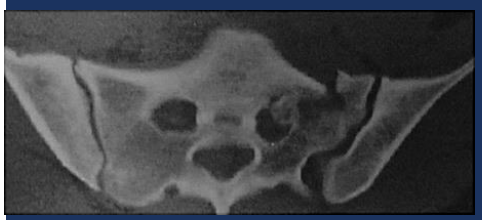
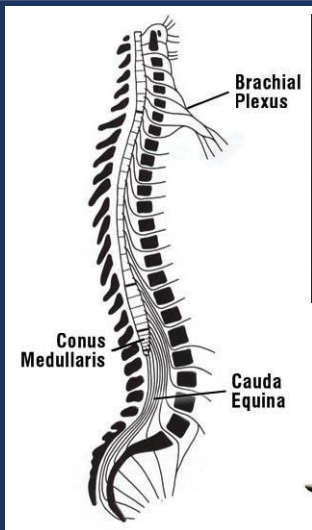
16

Imaging of Spinal Cord

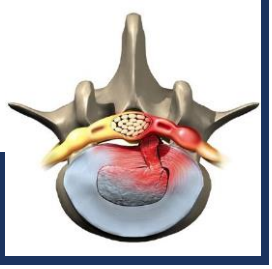


Sacrum fracture

Sacral tumors Spinal tumors



Disk herniation



diagnosis - prognosis

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US IMAGING OF THE URETHRA

Urethral imaging

- good imaging of diverticula but inferior to MRI
- the evidence for a clinical benefit of measuring urethral sphincter volume in patients with UI is absent
- data on ultrasound imaging of bladder neck funnelling are insufficient to support clinical benefit.

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US IMAGING OF THE PELVIC FLOOR

Bladder neck mobility

- Diagnostic accuracy: sensitivity and specificity >85%
- US measurement of BN movement
  - has been an interesting research tool
  - failed to provide evidence as to the pathophysiology of SUI
  - remains of little impact in our daily practice

Not recommended

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PELVIC FLOOR US IMAGING

Pelvic floor imaging

2D

- Biofeedback: 8-15% of women unable to contract unless imaged
- AP hiatal diameter correlation with LAM contraction in PFMT *

- Pathophysiology:
  - evidence suggests that PFM fail to provide adequate support to female urethra during cough in women with SUI

Level of evidence 3,
Recommendation C

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20

PELVIC FLOOR US IMAGING

- Pros
  - significant relation between hiatal area at rest and during Valsalva, with POP
  - avulsion of the puborectalis muscle is associated with a higher rate of prolapse in women with previous pelvic floor surgery
- Cons
  - Avulsions – no relationship between cadavers and 3D ultrasound
  - correlation of 0.38- 0.52 between US and perineometry
  - correlation of 0.52 to 0.62 between US and vaginal palpation
  - large variability in the intra-class correlation coefficient (ICC) for measurement of
    - urogenital hiatus (from 0.56 to 0.86 for the different dimensions)
    - muscle thickness (from 0.37 to 0.70
    - BN displacement (from 0.51 to 0.88)

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21

US IMAGING OF THE PELVIC FLOOR

Imaging of the posterior compartment

- good intraclass correlation with clinical examination (0.75 for ampullary descent, 0.93 for rectocele depth and 0.91 for rectocele width
- good degree of agreement in the diagnosis of cul-de-sac hernia in patients with evacuatory difficulty, although the two techniques did not agree as to the contents of the hernia or the degree of transvaginal descent
- 2D not inferior to \4D TPUS in assessing posterior wall disorders*

Level of evidence 3, Grade of Recommendation C

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US IMAGING OF THE PELVIC FLOOR

In summary

- It may help in investigating the pathophysiology of POP
- It may aid rehabilitation techniques of the pelvic floor
- No particular benefits were observed while imaging UI patients.
- The use of ultrasound to image the posterior compartment and defaecatory abnormalities holds more promise

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US IMAGING FOLLOWING CONTINENCE SURGERY

In summary

- No clear-cut data on the relation between sling position and surgical failure.
- Bulking agents: sens 83.3%, spec 85.7%, PPV 93.7%, NPV 66.6% vs success.
- Has a place in identifying the type of bulking agents and MUS. The exact location is useful when the surgical report is unavailable.

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US IMAGING OF THE PELVIC FLOOR

The evidence …
Fails to support the use in:

- primary evaluation of uncomplicated patients

Some benefit may exists in:

- secondary referral
- failed surgery
- suspected LUT pathology
- posterior compartment prolapse

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MRI OF THE PELVIC FLOOR BACKGROUND

- Concomitant defects of the pelvic floor
- Accurate diagnosis of concomitant defects is needed for proper treatment

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WHAT MRI CAN MEASURE

(a) Bladder neck and cervical descent/mobility:

- Position of bladder neck and cervix at rest and on Valsalva.
- Pubo-coccygeal line: A line extending from the inferior border of the pubic symphysis to the last joint of the coccyx. Bladder neck or cervical descent >2 cm below this line with straining indicates weakness of the pelvic floor.

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WHAT MRI CAN MEASURE

- (b) Intercurrent pelvic pathology: fibroids, ovarian pathology
- (c) Uterine position: anteverted or retroverted; flexion at the isthmus
- (d) Bladder abnormalities: tumor; foreign body
- (e) Urethral abnormality: diverticulum

Level of evidence 3, Grade of Recommendation C

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28

WHAT MRI CAN MEASURE

- (f) Postoperative findings: bladder neck mobility.
- (g) Pelvic floor measurements/levator defects:
  - Assessment of the configuration of pelvic floor muscles, in particular, the levator ani.
- (h) Descent of pelvic organs.

Level of evidence 3, Grade of Recommendation C

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29

MRI DIAGNOSTIC ACCURACY

- Enterocele: sens 87% and spec 80%, PPV 91%
- Cystocele: sens 100%, spec 83%, PPV 97%
- Rectocele: sens: 31-80%
  - No rectal opacification: 24% of rectoceles missed
  - With rectal opacification: 100% spec
- Uterine prolapse: sens 83%, spec 100%, PPV 100%

Level of evidence 3, Grade of Recommendation C

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30

THE CLINICAL BENEFIT OF MRI

Prolapse assessment on dynamic MR imaging

- may be useful in the posterior compartment,
- clinical assessment and dynamic MR imaging seem interchangeable in the anterior and central compartment

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MRI OF THE PELVIC FLOOR

The evidence suggests that:

- MRI is not yet indicated in the routine evaluation of patients with uncomplicated primary pelvic organ prolapse
- It can provide useful information concerning complex prolapses and can be used in difficult cases
- Useful in descriminating between causes of defecatory problems

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MRI OF THE PELVIC FLOOR

Recent findings:*

- Open magnetic resonance imaging (MRO) with vertical magnets, has allowed imagi variety of upright postures.
- MR modelling assessing urethral support suggests that the pubococcygeous and puborectalis along with the vaginal walls are the most important structures in provid urethral support.
- Comparing to clinical examination, dynamic MRI allows diagnoses of clinically occu enteroceles and could lead to altered management or surgical approach.
- Compared with ultrasound, ileoccocygeous avulsion is diagnosed more accurately v MRI
- A preoperative MRI results in a 17% increased chance of successful initial surgery a decreased risk of repeat surgery.
- 3D imaging based on MRI may establish further clinical applications.

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IMAGING TECHNIQUES FOR ANAL INCONTINENCE

- Ultrasonography (2-D & 3-D)
  - Endoanal Ultrasonography (EAUS)
  - Transvaginal
  - Transperineal
  - Translabial
  - Dynamic Anorectal Endosonography (DAE)
  - Integrated Multicompartmental Pelvic Floor Ultrasonography
- MRI- Body coil, Endoanal coil and Phased-array coil
- Defecography (Proctography)

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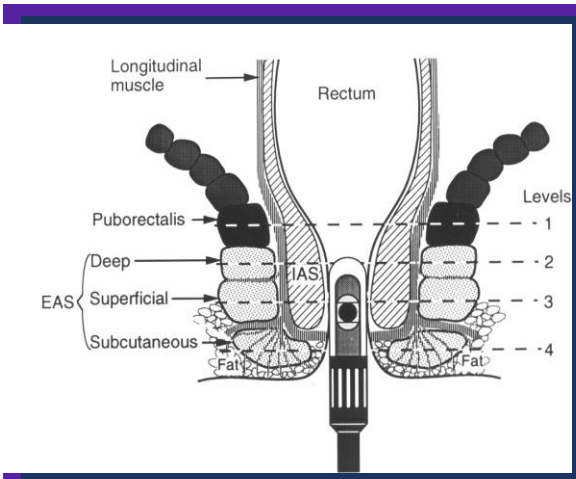
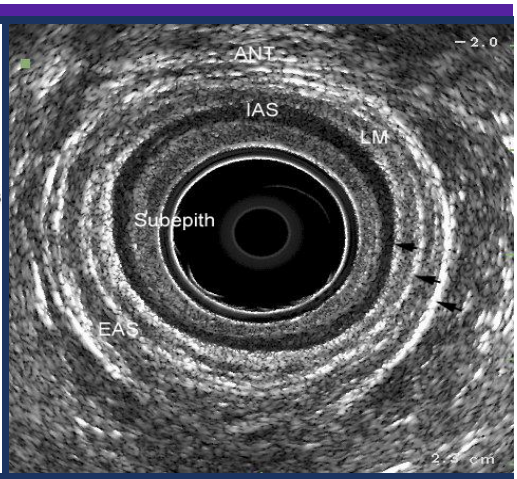
34





Normal EAUS - Deep sphincter level

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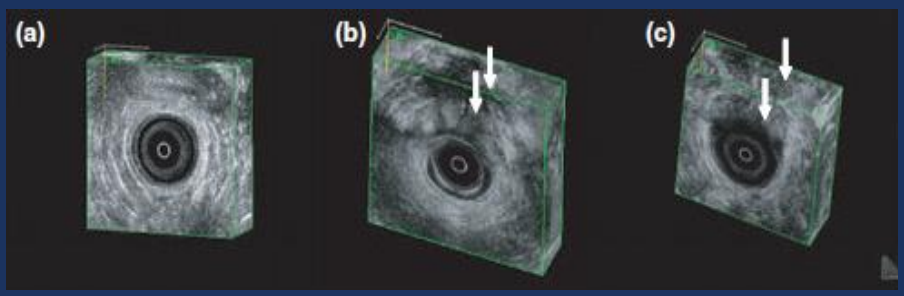
35

3-D EAUS



Normal EAS

Partial EAS & IAS Defect

Complete EAS Defect

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WHAT THE EVIDENCE SAYS

- Endoanal ultrasound is the first line imaging investigation for faecal incontinence providing accurate information about the external and/or internal sphincter tears and the likelihood of atrophy.
- 3-D EAUS offer better quality images and diagnosis of the depth of anal sphincter injury. However routine use is not recommended because of the cost.

Level of evidence 3, Grade of Recommendation C

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WHAT THE EVIDENCE SAYS

- Routine use of transperineal, transvaginal and translabial ultrasonography to image the anal sphincter complex are not recommended.
- Dynamic imaging of rectal function is required when rectal abnormalities such as prolapse are suspected.
- MRI offers no advantage over other imaging modalities except for the lack of ionising radiation and global view of the pelvis

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PAD TESTS

- Pad test optional investigative tool for urinary incontinence
- Pad test useful for clinical outcomes and research studies

- Following standards
- 20min to 1 hour pad test with fixed bladder volume (+ve >1g)
- 24 hour pad test with normal activities (+ve >1,3g)

Level of evidence 3, Grade of Recommendation C

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39

CLINICAL NEUROPHYSIOLOGICAL TESTS

The information gained by clinical examination and urodynamic testing may be enhanced by uroneurophysiological tests in selected patient groups with suspected neurogenic urinary incontinence with lesions within the nervous reflex arcs of sacral segments 2 – 5.

The recommended tests are:

Concentric needle EMG to diagnose denervation and reinnervation of pelvic floor and perineal muscles,

and sacral reflex testing to assess the integrity of the lower sacral reflex arc.

Level of evidence: 2b

Level of recommendation: B

There are many other interesting neurophysiological tests which, however, need more research to prove their validity for diagnosis and usefulness for prognosis.

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40

CONCENTRIC NEEDLE EMG SIGNAL FROM A DENERVATED MUSCLE –

PATHOLOGICAL SPONTANEOUS ACTIVITY
(ELECTRODE IN BULBOSPONGIOSUS MUSCLE)

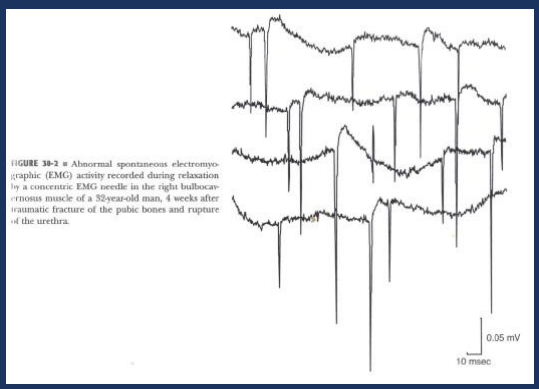

FIGURE 30-2 ■ Abnormal spontaneous electromyographic (EMG) activity recorded during relaxation by a concentric EMG needle in the right bulbocavernosus muscle of a 32-year-old man, 4 weeks after traumatic fracture of the pubic bones and rupture of the urethra.

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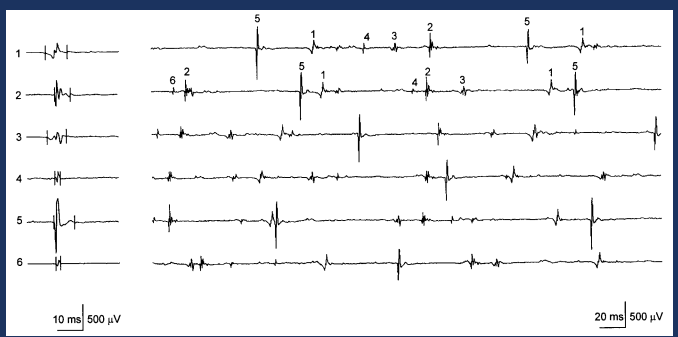
41

CONCENTRIC NEEDLE EMG SIGNAL FROM A REINNERVATED MUSCLE –

MOTOR UNIT ACTIVITY

MUPs sampled by multi-MUP analysis (left) from the left anal sphincter muscle of a 51-year old female 10 years after cauda equina compression by a herniated intervertebral disc.



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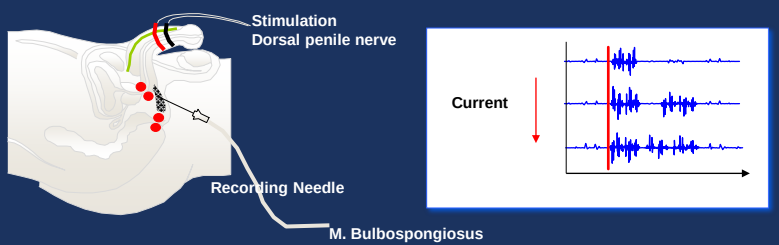
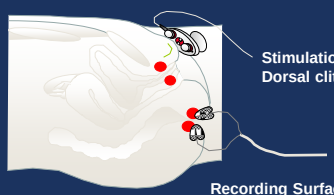
42

Bulbocavernosus Reflex





Recording Reflex Latency R1 typ. 33 ms

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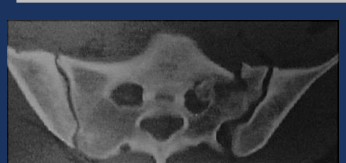
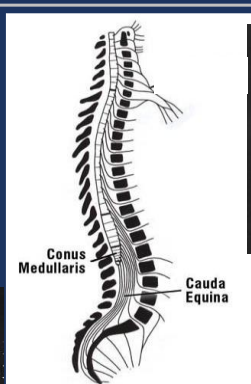
43

Application of cnEMG and bulbo-cavernosus reflex testing



Sacrum fracture



Disk herniation

Sacral tumors Spinal tumors

- diagnosis
- prognosis

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44

URINE TESTING

- Standard practice to perform urinalysis with a multiproperty stick or assess spun urine

Level of evidence 3, Grade of Recommendation C

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