Endoanal EUS

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Endoanal EUS Diagnostic Accuracy & Impact

- Radial endoanal EUS delivers sub-millimetric resolution of the five-layer anal wall, enabling direct visualization of internal and external sphincter integrity impossible with MRI or CT.

- EUS simultaneously images sphincters, fistula tracts, abscesses and early tumors, offering sensitivity comparable to MRI with the added benefit of real-time interventional capability.

- Same-session detection of fistula tracts, abscess pockets and solid lesions allows immediate EUS-guided needle aspiration or marker injection to plan optimal surgical route.

Endoanal EUS Clinical Value

Therapeutic roadmap

Precise anatomical mapping dictates choice between fistulotomy, seton drainage, advancement flap or sphincter repair, minimizing incontinence risk and recurrence rates.

Patient tolerance & cost

Procedure requires no sedation, uses minimal bowel prep, and can be performed in outpatient setting, enhancing compliance and reducing institutional expenditure relative to cross-sectional imaging.

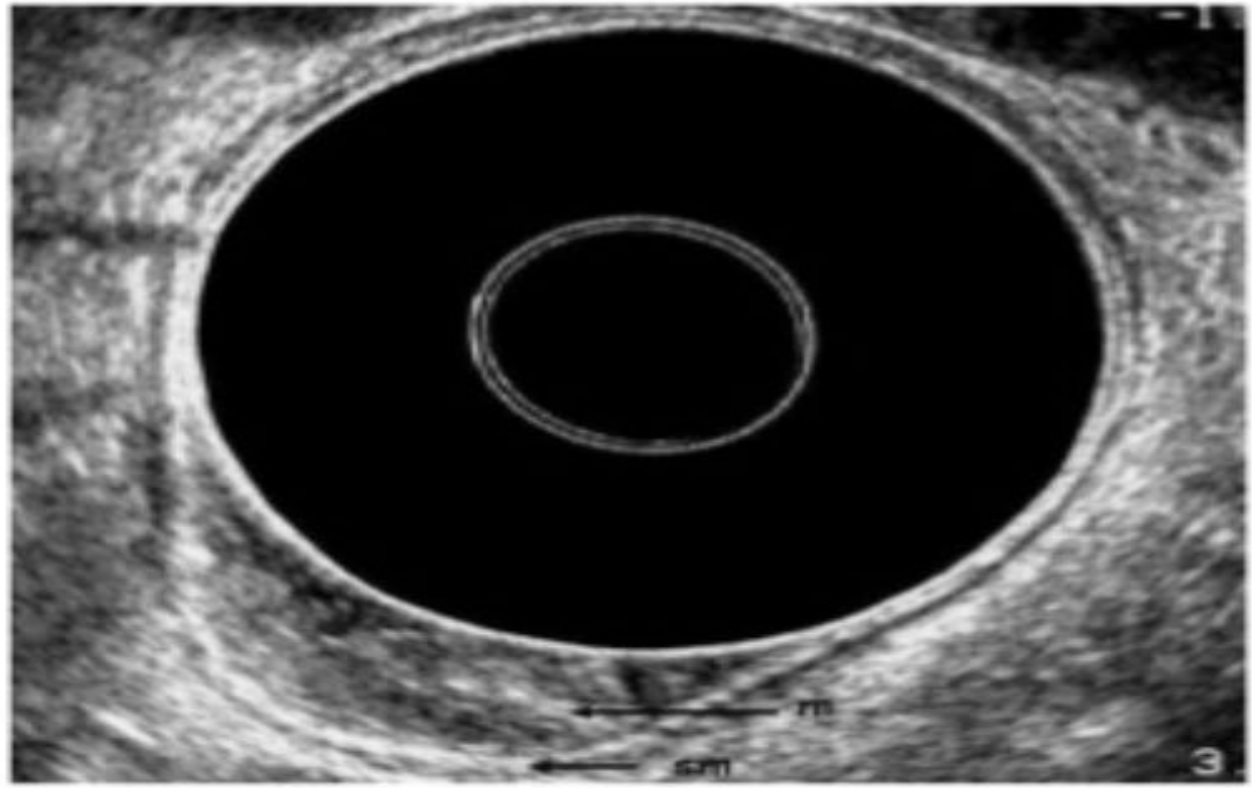
Early-stage Anal Tumor Detection

Therapeutic consequence

Accurate early staging allowed curative chemoradiation protocol instead of abdominoperineal resection, preserving continence and demonstrating EUS utility in anal cancer work-up.

uT0 rectal lesion

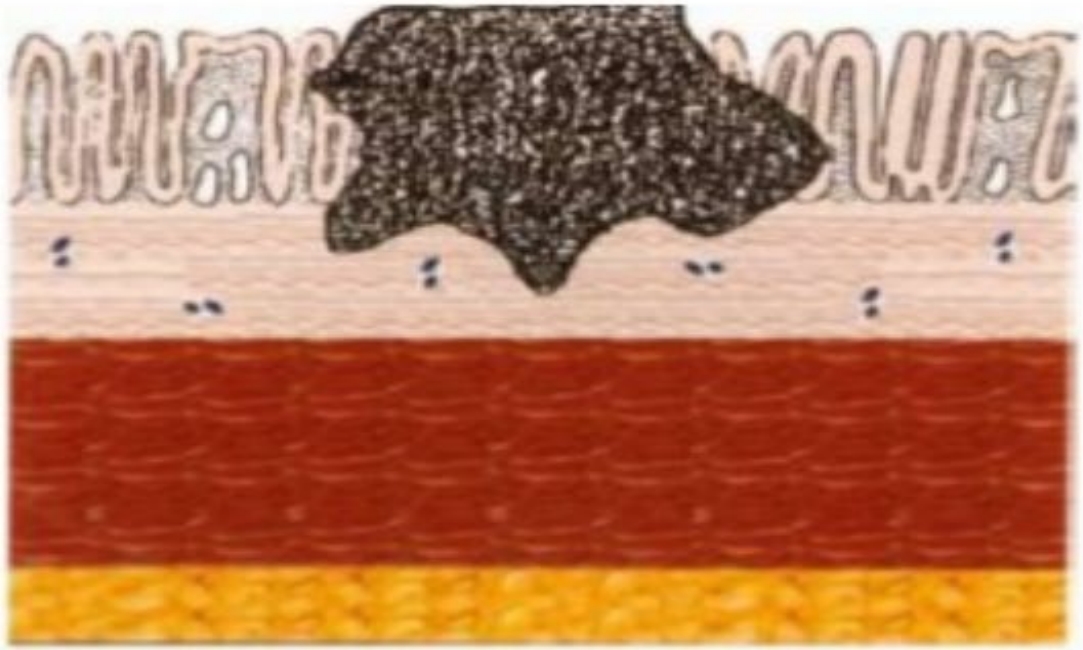
Axial ERUS image



Lesion expands inner hypoechoic (mucosa)
surrounded by uniform middle hyperechoic layer

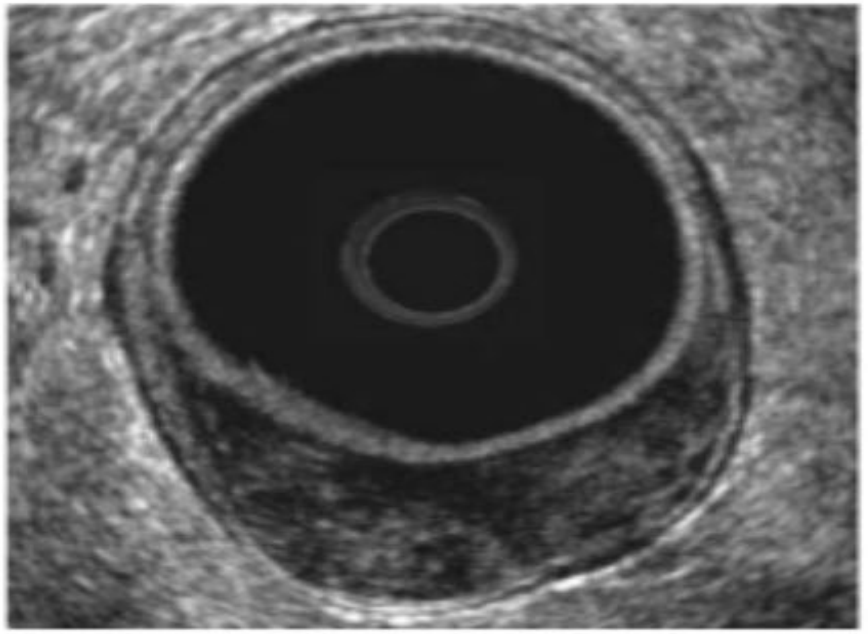
uT1 rectal lesion

Diaphragmatic representation



Diaphragmatic representation of T1 rectal tumor invading submucosa

Axial ERUS image



Tumor extended to hyperechoic submucosa layer surrounded by uniform hypoechoic muscularis layer

Santoro GA & Di Falco G. Endoluminal ultrasound in preoperative staging of rectal carcinoma. In: Santoro GA et al (eds), Atlas of endoanal & endorectal ultrasonography. Springer, Italia, 2004.

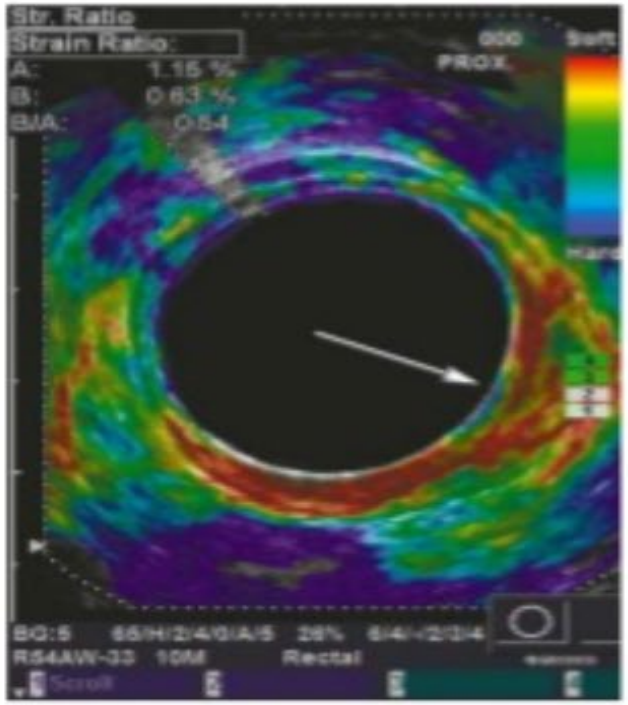
Elastography in rectal adenoma

Rectal tumor from 2 to 7 o'clock position

Difficult to determine adenoma from early adenocarcinoma

Mucosal layer not clearly distinguished from submocosal layer

Real-time Elastogram



Tumor appears softer (more red) than same-depth reference tissue

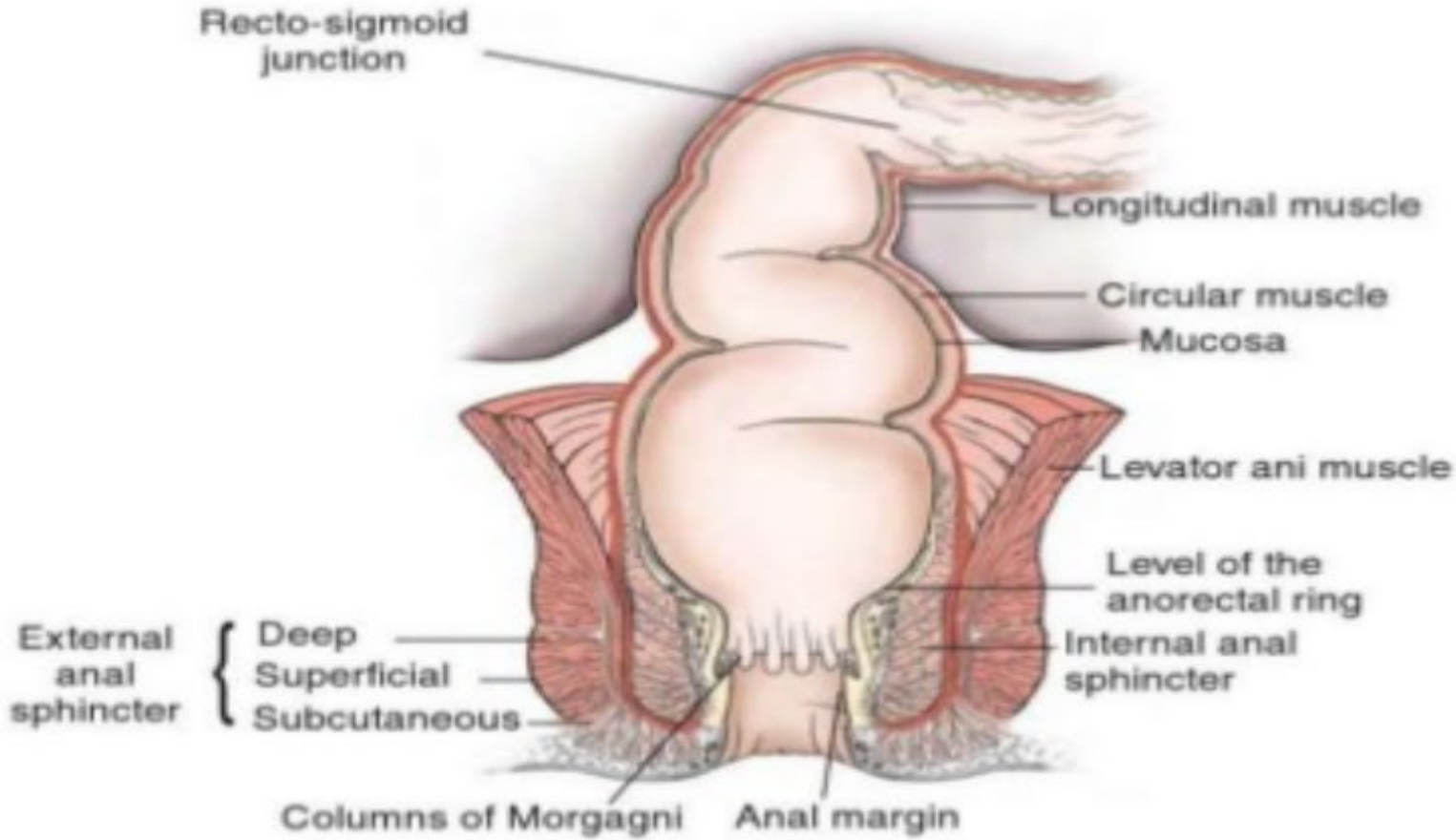
US image with strain ratio



Strain ratio = 0.54 (indicate adenoma)
Confirmed on resection specimen

Waage JER et al. Colorectal Dis 2014; 17, 124–132.

Coronal anatomy of the anal canal



Santoro JA & Di Falco G. Endosonographic anatomy of the normal anal canal.
In: Santoro JA & Di Falco G (eds), Benign anorectal diseases. Springer-Verlag, Italia, 2006.

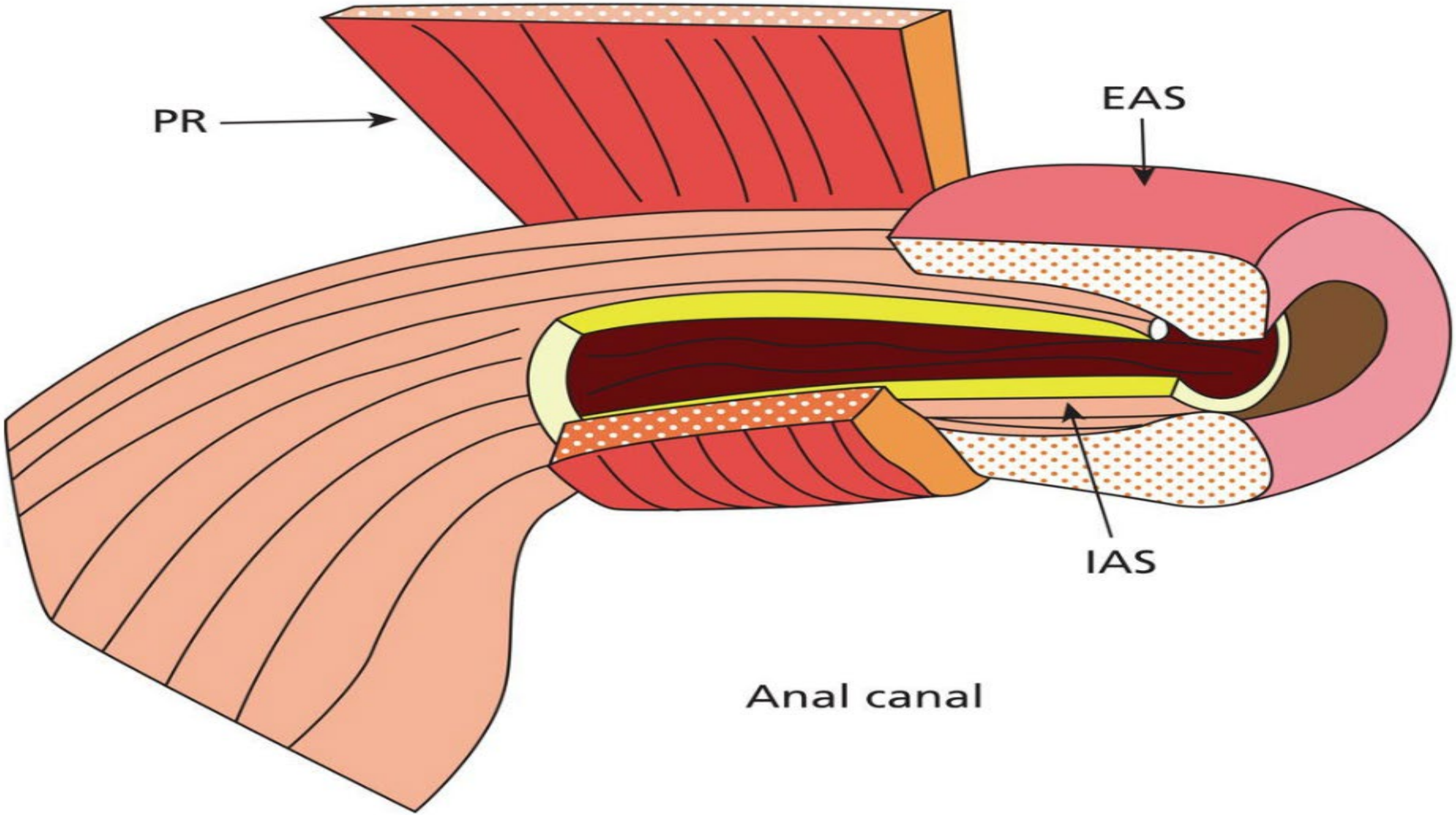
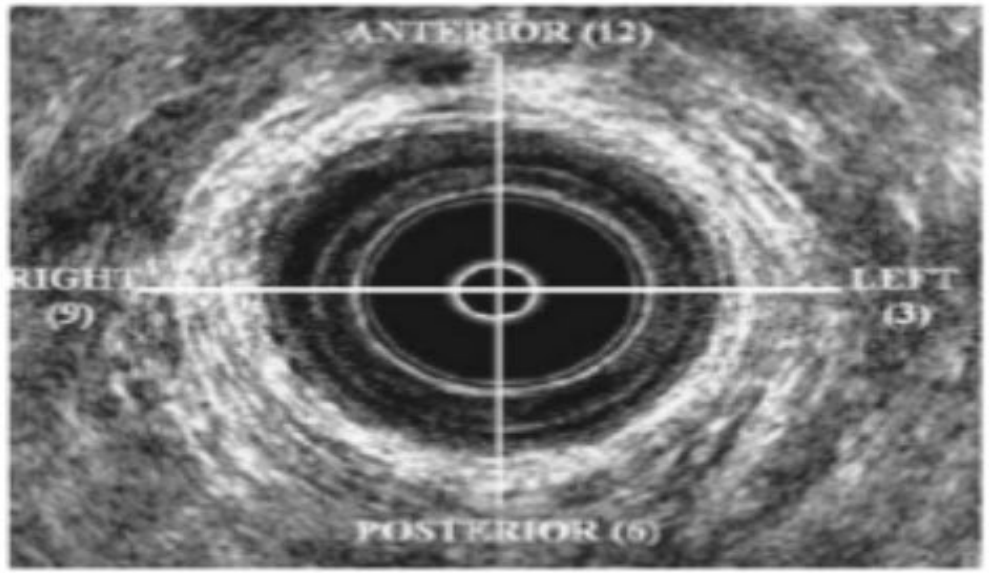


Figure 16.1 Schematic diagram of the anal canal. EAS, external anal sphincter; IAS, internal anal sphincter; PR, puborectalis muscle.

Lesion localization with patient in left lateral position



Radial positions around the anus referenced with respect to a clock
Anterior anatomical structures at 12 o'clock side of the image
Patient's left side at 3 o'clock & patient's right side at 9 o'clock
Patient's posterior side at 6 o'clock

Santoro JA & Di Falco G. Endosonographic anatomy of the normal anal canal.
In: Santoro JA & Di Falco G (eds), Benign anorectal diseases. Springer-Verlag, Italia, 2006.

Five layers of the rectal wall

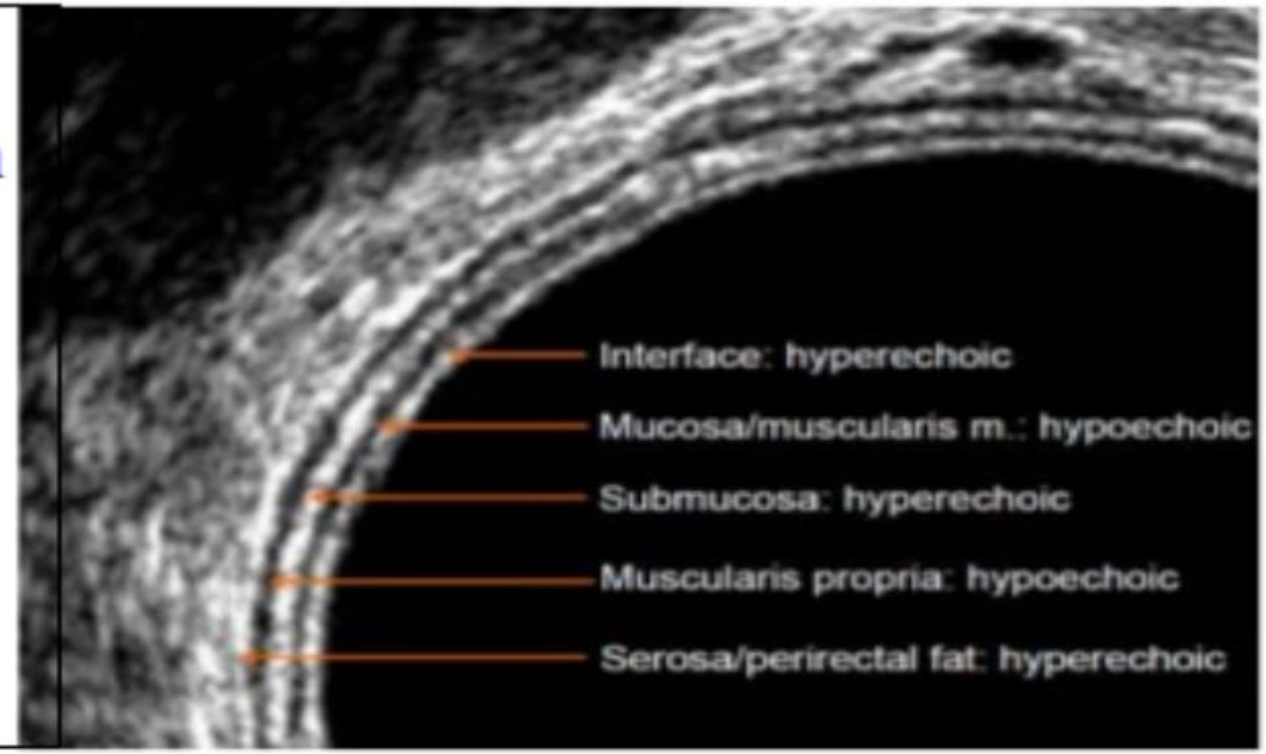
2 - 3 mm thick

Good visualization depends on

Maintain probe in center of lumen

Distension of water-filled balloon

Good contact with rectal wall



Santoro GA. Recents advances in colorectal polyps. Genoa, 11 April 2014.

Clip slide

Echogenicity of anal canal layers

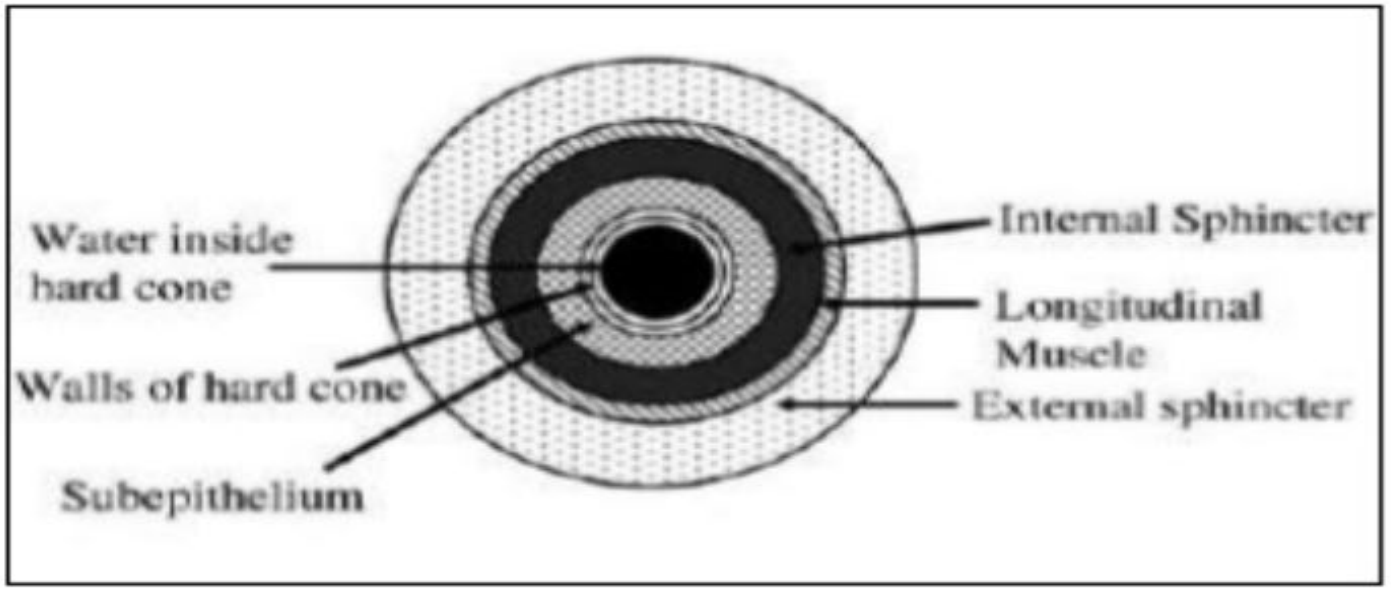
Depends on muscle type, US beam angle & probe frequency

• **Puborectalis muscle**	Hyperechoic
• **External sphincter**	
Deep part	Hyperechoic - similar to PR
Superficial part	Mixed echogenicity Similar to proximal structures
Subcutaneous part	Hyperechoic
• **Internal sphincter**	Hypoechoic - more easily identifiable
• **Longitudinal muscle**	Moderately echogenic

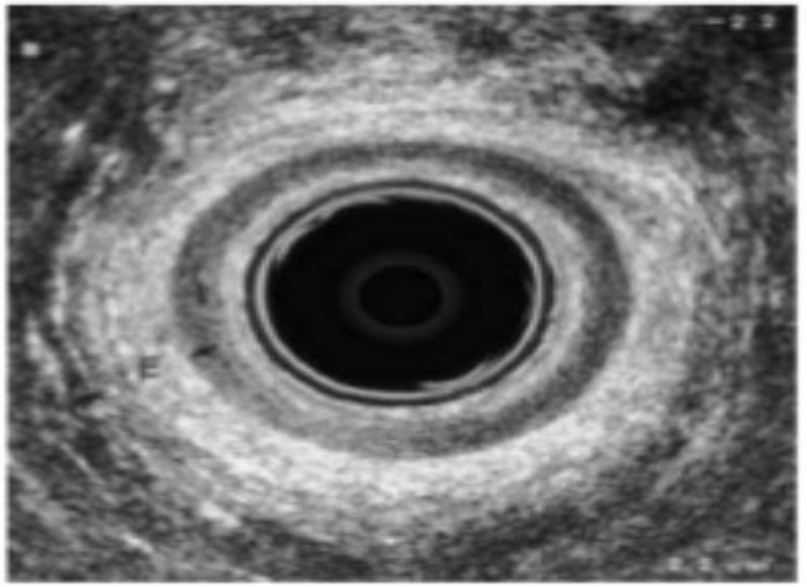
EAUS of the mid anal canal

IAS and EAS

Schematic representation[1]



Axial EAUS image[2]

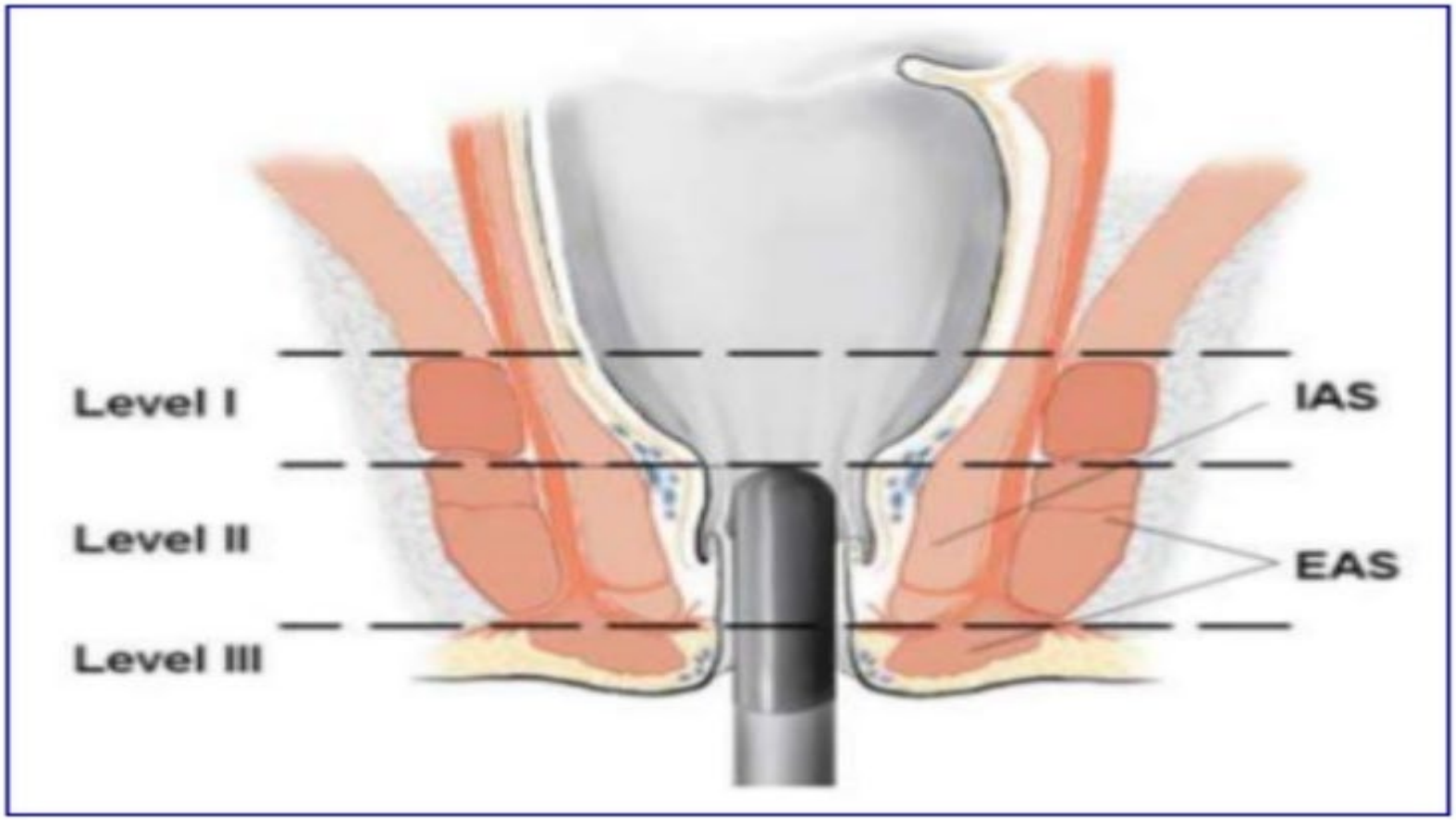


IAS: darker homogenous ring

EAS: white heterogeneous ring around IAS

(1) Fowler GE et al. BJOG 2008;115:767–772.
(2) AGA Review on Anorectal Testing Techniques. Gastroenterology 1999;116(3):735-760.

Levels of anal canal



Santoro JA & Di Falco G. Endoanal and Endorectal ultrasonography.
In: Santoro JA et al(eds), Pelviv floor disorders. Springer-Verlag, Italia, 2010.

Levels of anal canal

- **High anal canal** — At most cranial level of puborectalis
  PRM is the landmark of high anal canal
  Sling of PRM & deep part of external sphincter
- **Mid anal canal** — Level where EAS forms a complete ring
  Superficial part of EAS, IAS, perineal body,
  & transverse perineii
  Anococcygeal ligament post & vagina anteriorly
- **Low anal canal** — Level below which the IAS terminate
  Subcutaneous part of EAS

Santoro JA & Di Falco G. Endosonographic anatomy of the normal anal canal.
In: Santoro JA & Di Falco G (eds), Benign anorectal diseases. Springer-Verlag, Italia, 2006.

Normal Anal Canal Anatomy

Puborectalis Sling

The striated puborectalis muscle appears as a symmetric V-shaped echogenic band looping dorsally around the rectum and serves as the key cephalad landmark during probe withdrawal.

External Sphincter

Distal to the puborectalis, the circular external sphincter forms a uniform 4–10 mm hyperechoic ring that is anatomically thinner anteriorly in women, explaining higher obstetric injury risk.

Internal Sphincter

The smooth-muscle internal sphincter is seen as a 1–3 mm hypoechoic band inside the external muscle; its thickness increases with age due to progressive collagen deposition and sclerosis.

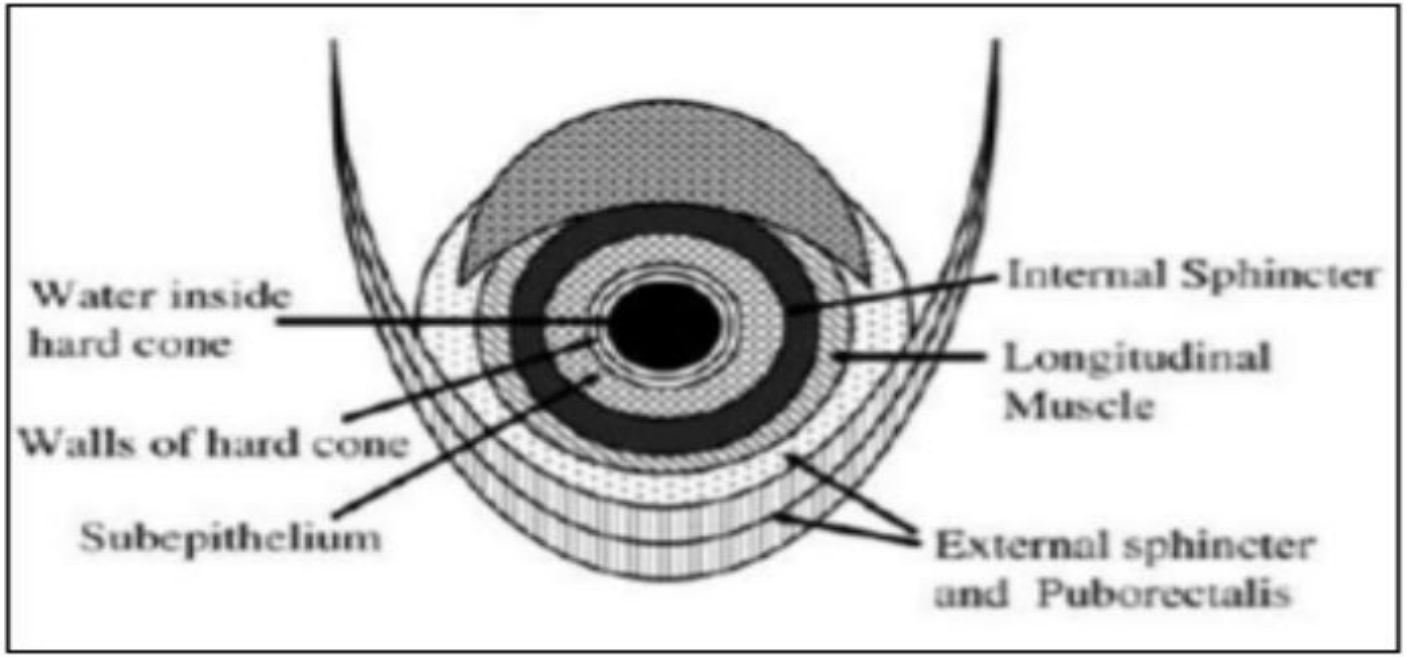
Submucosa & Mucosa

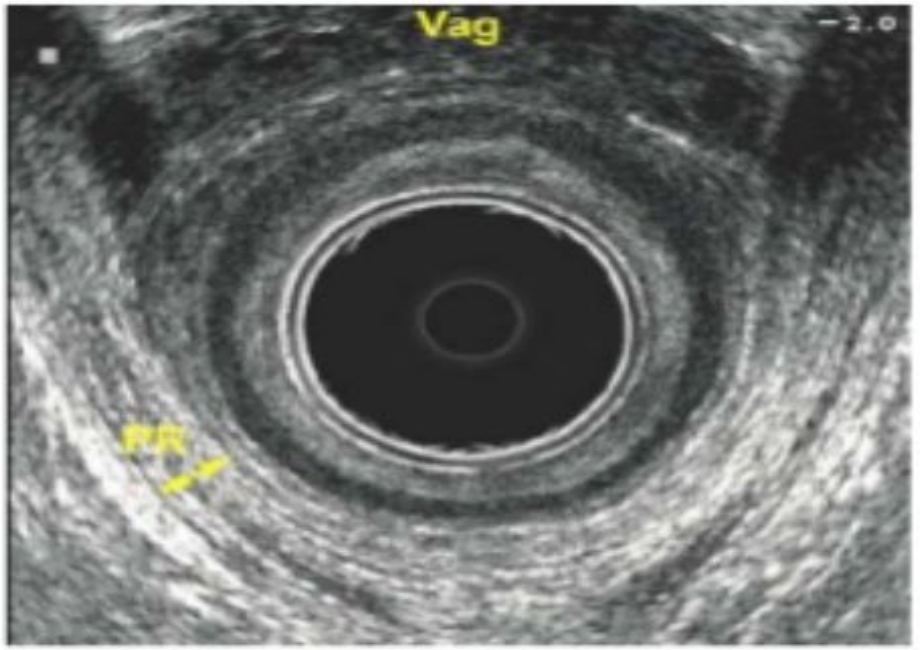
The submucosal layer has mixed echogenicity and thickens slightly with age or hemorrhoidal disease, while the mucosal surface is normally indistinct at the frequencies used.



EAUS of the high anal canal

puborectalis muscle (PRM)





"U"-shaped PRM posteriorly (arrows

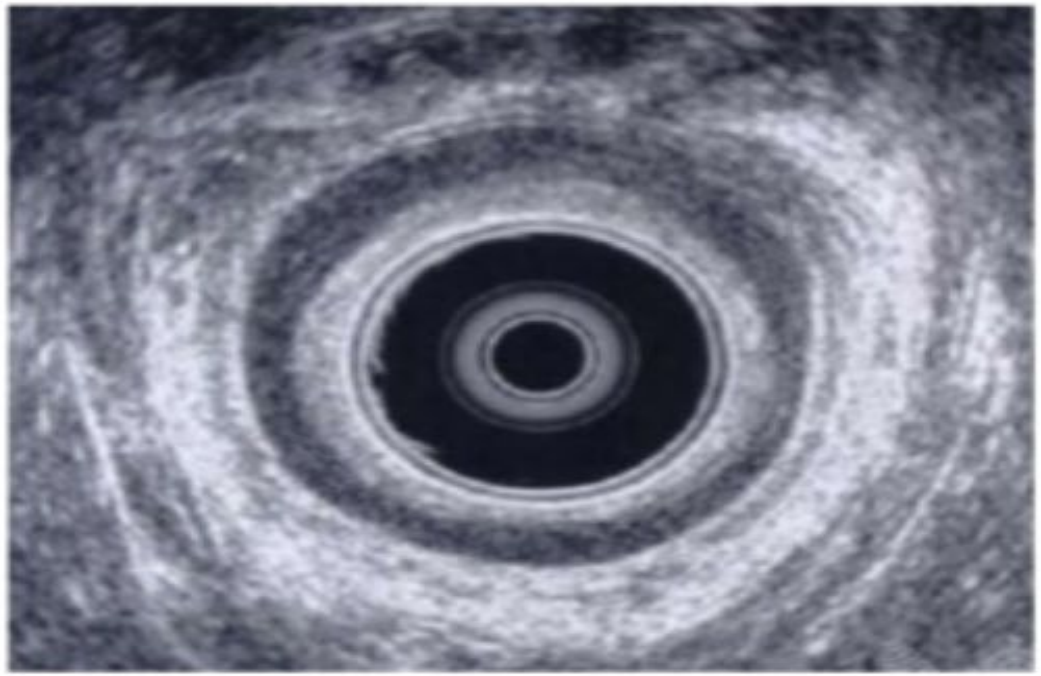
Loss of EAS in midline anteriorly

(1) Fowler GE et al. BJOG 2008; cx 115:767-772.
(2) Bertram CI. Endoanal ultrasound.
In: Stoker J et al. Imaging pelvic floor disorders, 2nd edition. Springer-Verlag Berlin, 2008.

Clip slide

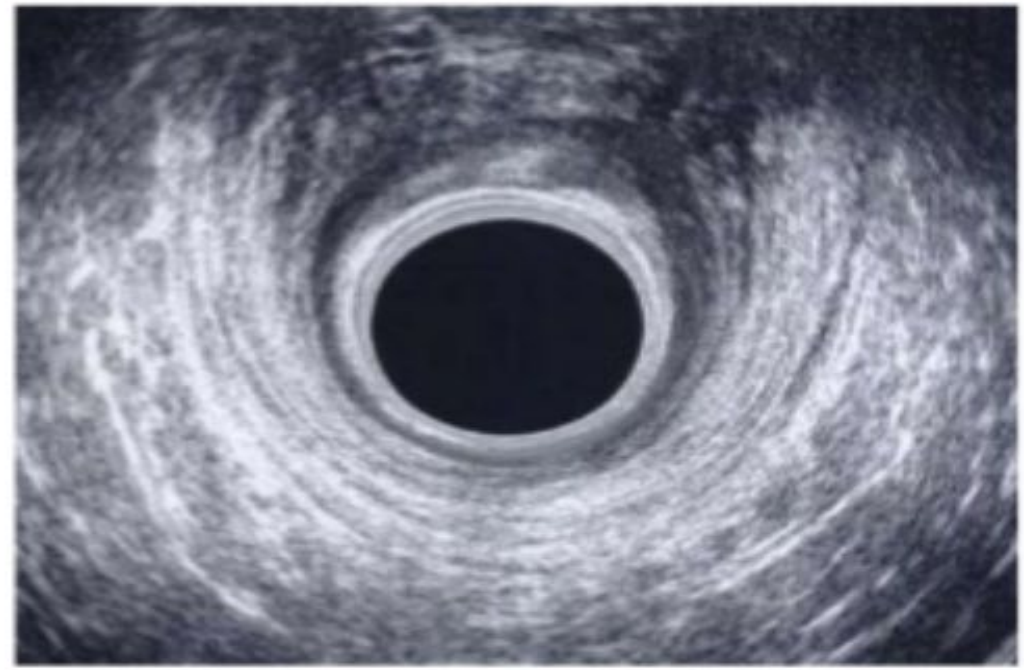
EAUS of the high anal canal

In men



Thin arc of muscle from the deep part of EAS can be seen anteriorly in males

In females



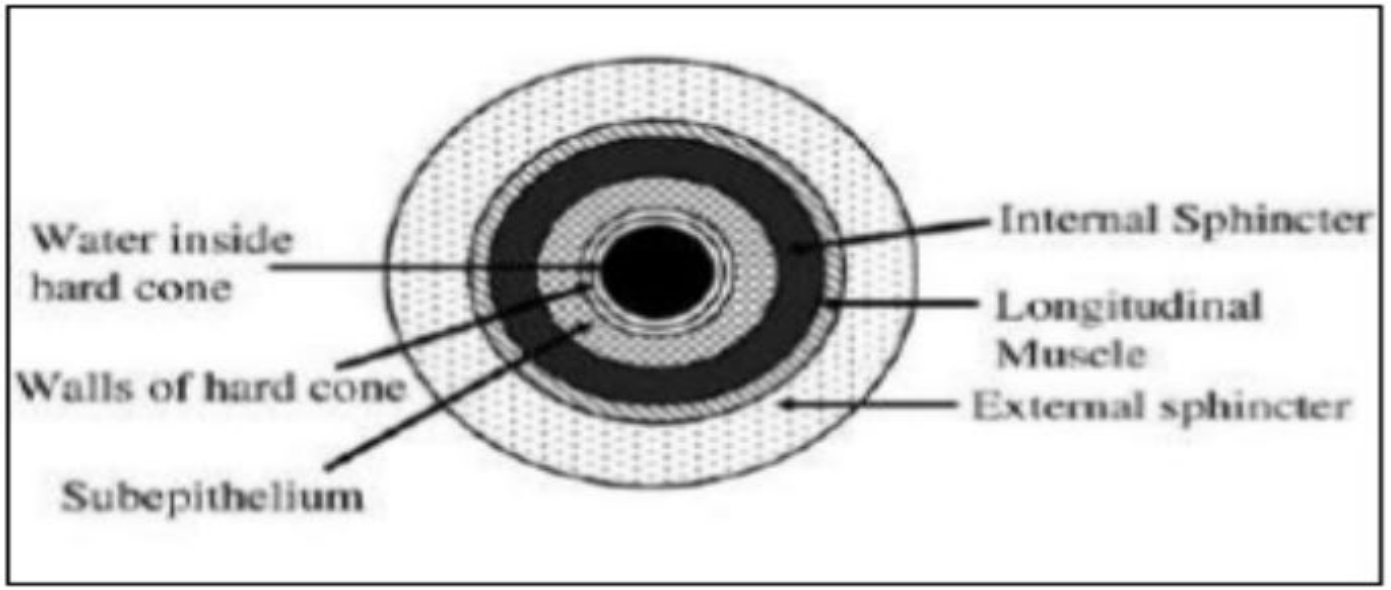
Deep part of EAS not seen anteriorly in females
Not to be taken for rupture

Santoro JA & Di Falco G. Endosonographic anatomy of the normal anal canal.
In: Santoro JA & Di Falco G (eds), Benign anorectal diseases. Springer-Verlag, Italia, 2006.

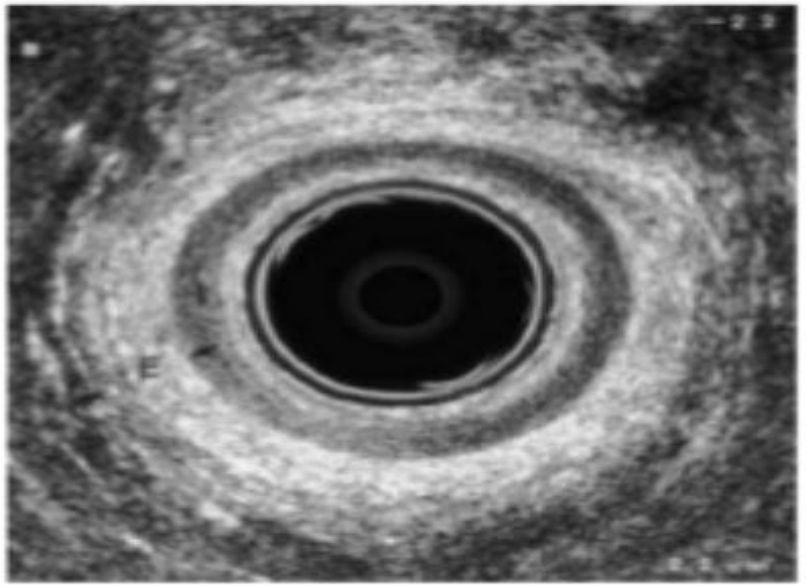
EAUS of the mid anal canal

IAS and EAS

Schematic representation[1]



Axial EAUS image[2]



IAS: darker homogenous ring

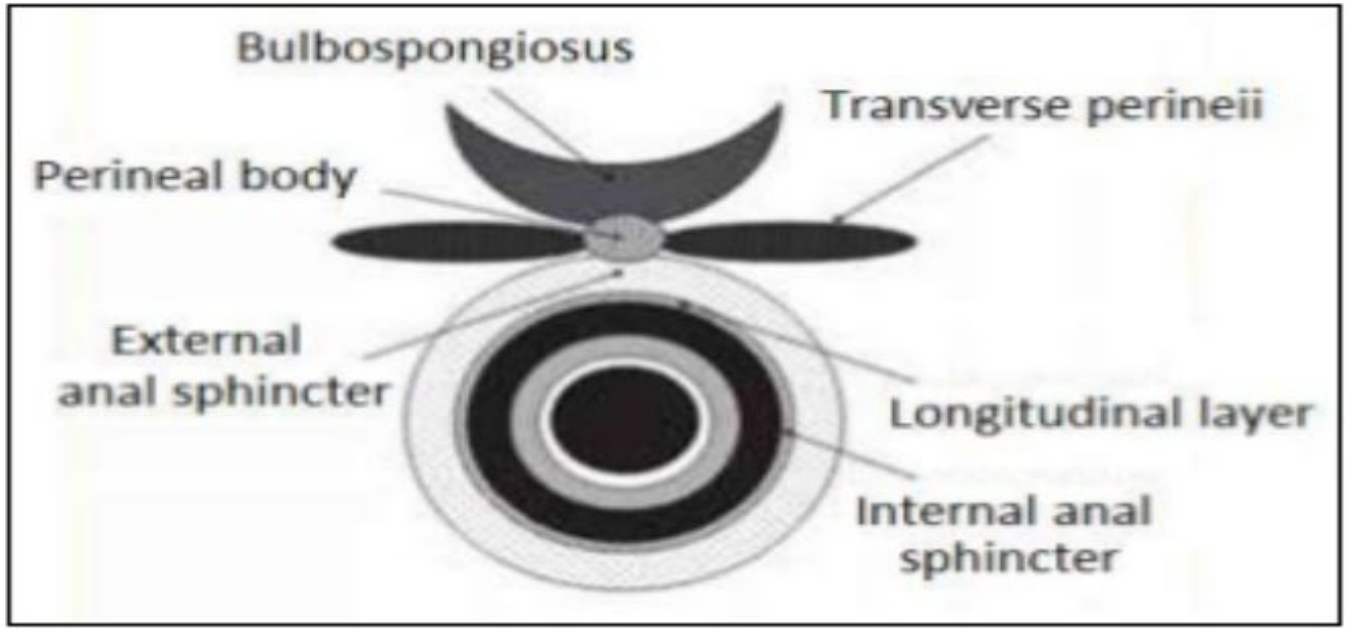
EAS: white heterogeneous ring around IAS

(1) Fowler GE et al. BJOG 2008;115:767–772.
(2) AGA Review on Anorectal Testing Techniques. Gastroenterology 1999;116(3):735-760.

Transverse perineii (TP)

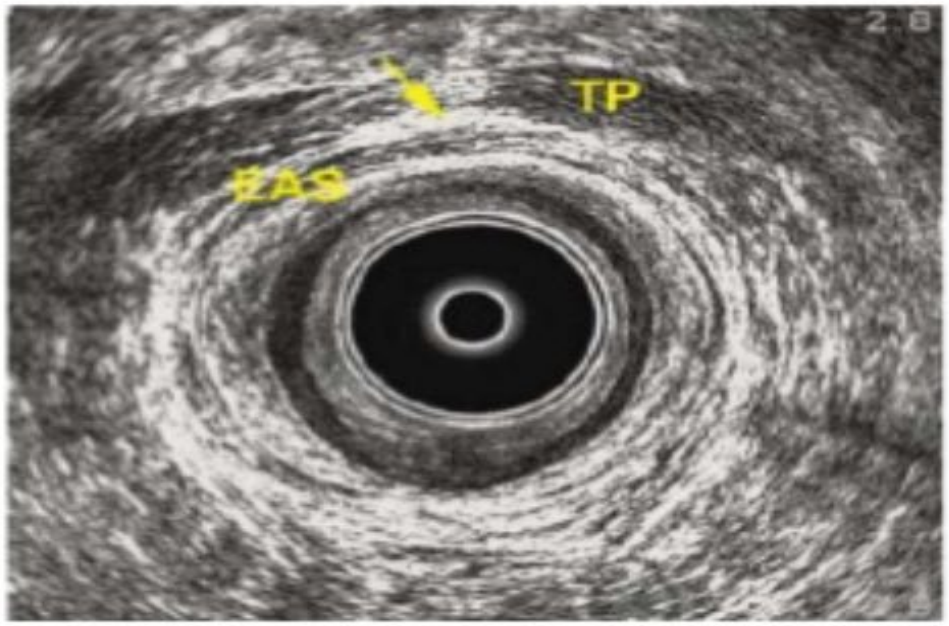
mid anal canal - imaged at 11 & 1 o'clock

Schematic representation



Bulbospongiosus muscle, TP & EAS meet in perineal body

Transverse perineii in men



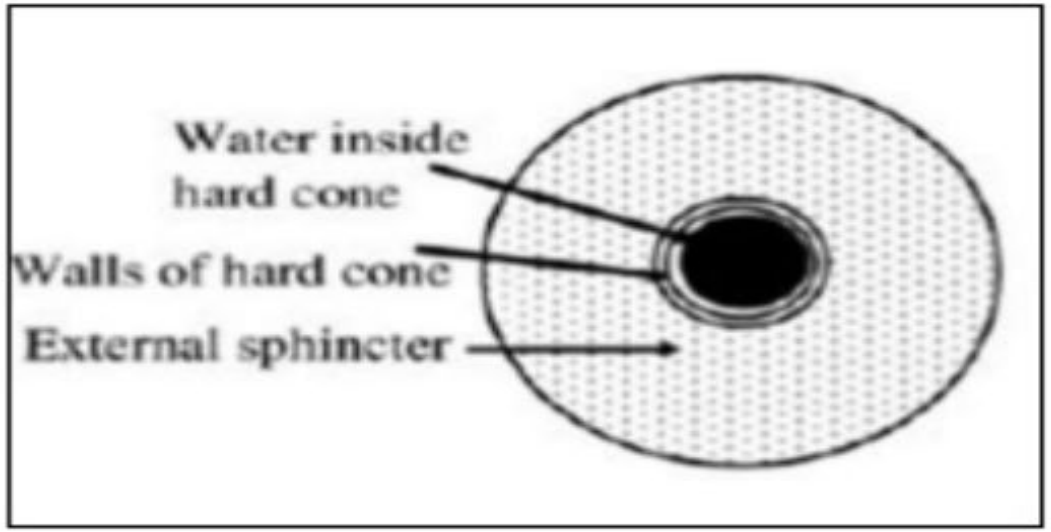
TP better defined in men
Join centre point of perineum
Creating gap between TP & EAS (arrow
In women, TP fuse into EAS

Bertram CI. Endoanal ultrasound.
In: Stoker J et al. Imaging pelvic floor disorders, 2nd edition. Springer-Verlag Berlin, 2008.

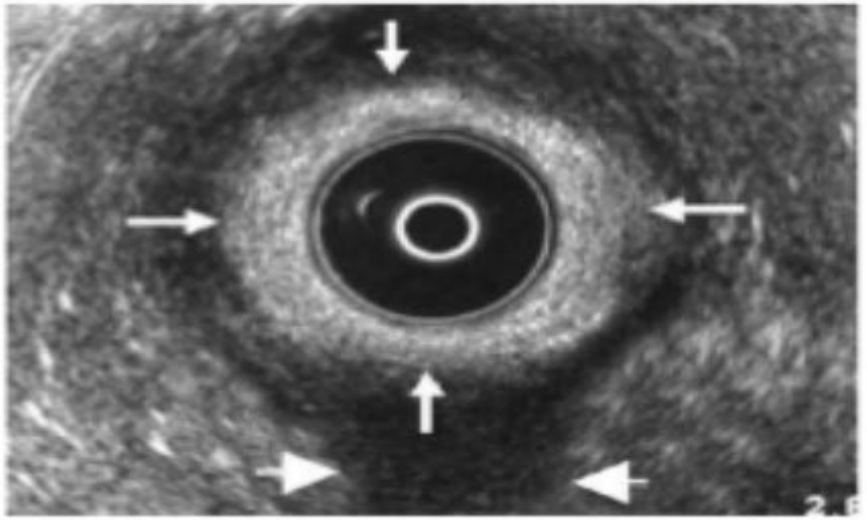
EAUS of the low anal canal

Subcutaneous EAS

Schematic representation[1]



Axial EAUS image[2]

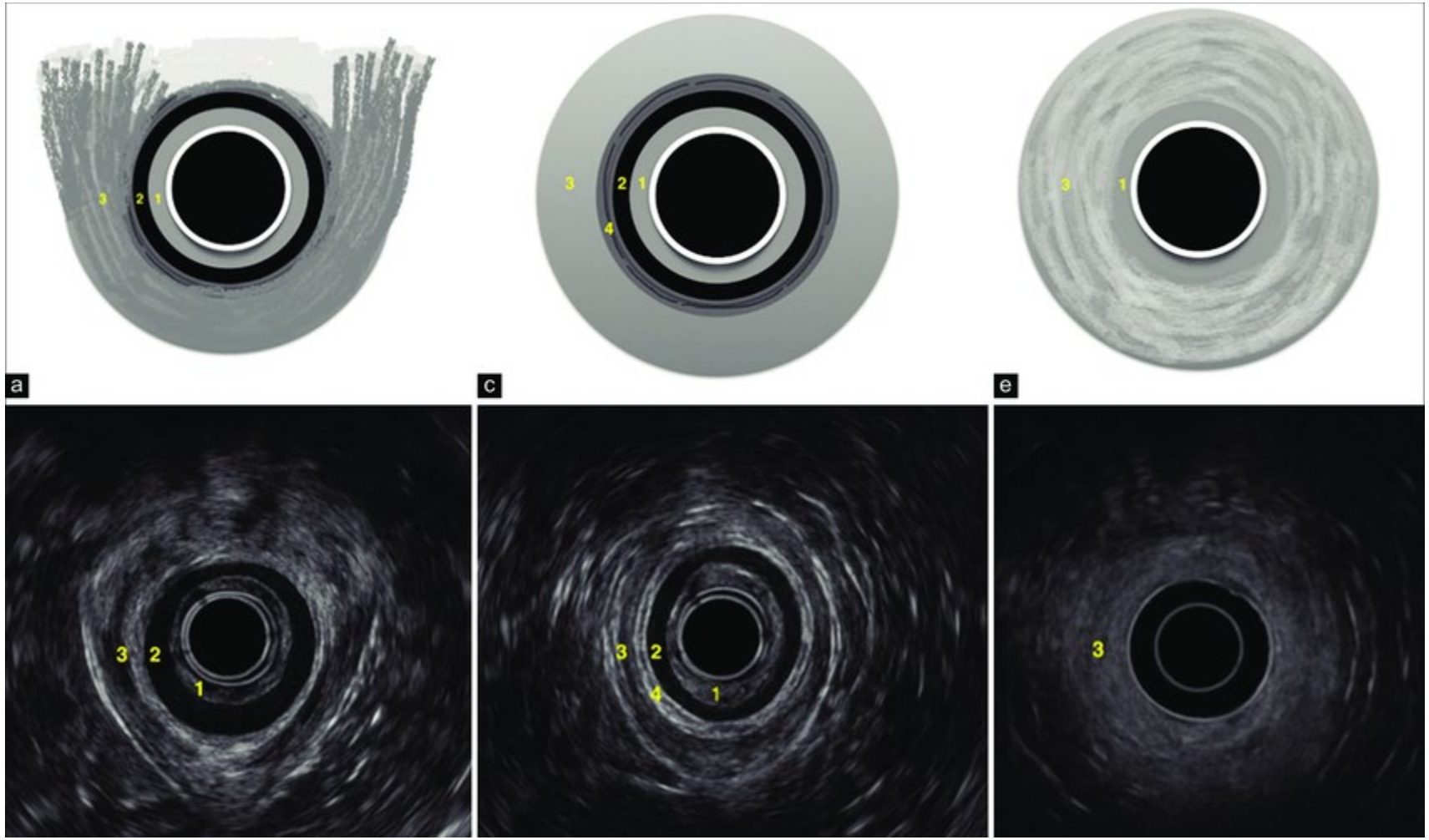


Lower canal anal caudal to IAS termination

comprising the subcutaneous EAS (arrows)

Anococcygeal ligament posteriorly (arrowhead

(1) Fowler GE et al. BJOG 2008;115:767–772.
(2) Engin G. J Ultrasound Med 2006; 25:57–73.

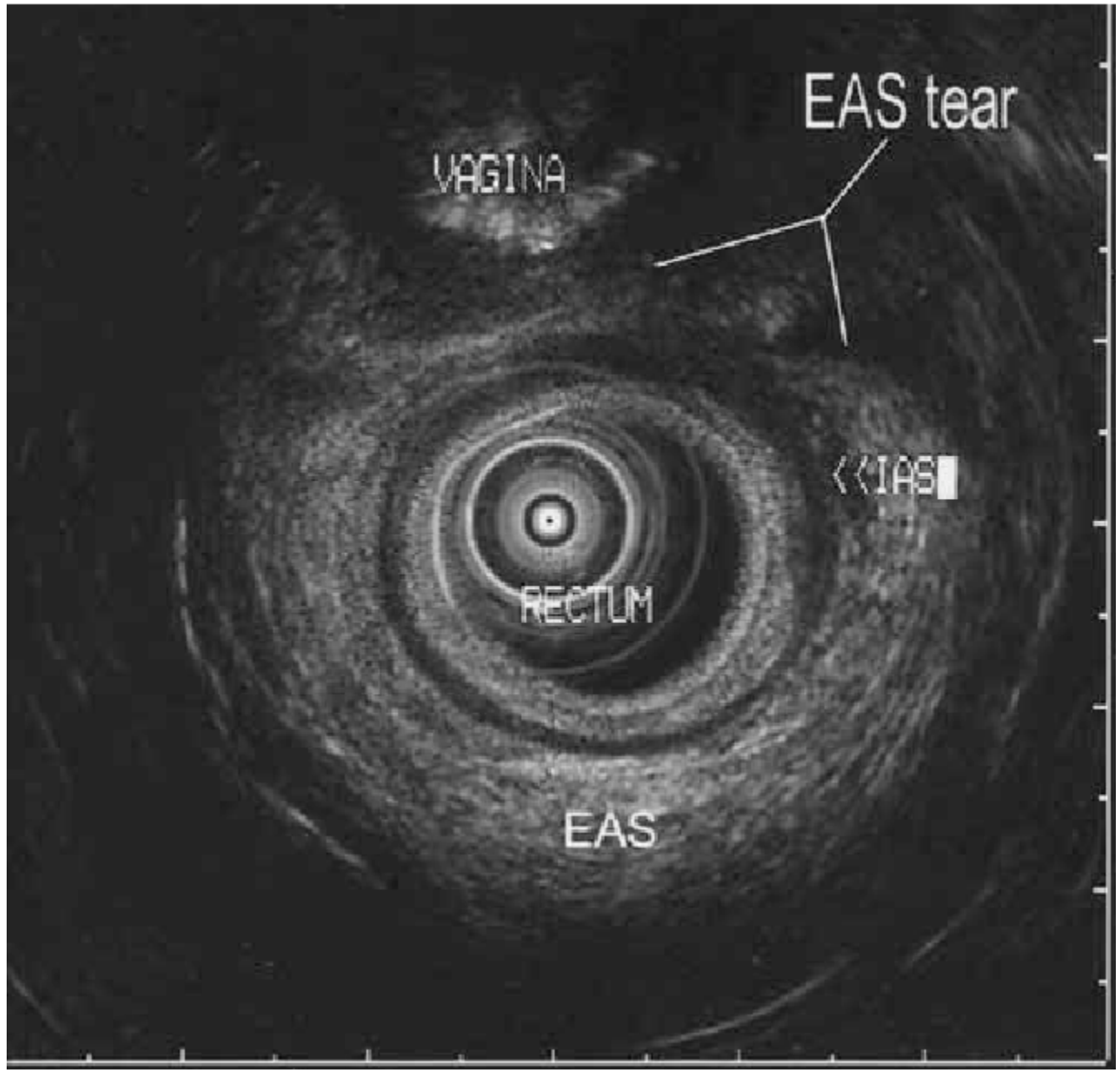

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Clip slide

Normal measurements in EAUS

150 asymptomatic nulliparous women (19 - 80 years – mean: 31)	
• **Puborectalis muscle**	6 ± 3 mm
• **Subepithelium**	2 ± 0.5 mm
• **Internal anal sphincter**	2.5 ± 0.5 mm - increased at older ages
• **Longitudinal muscle (LM)**	2 ± 0.5 mm
• **External anal sphincter**	4 ± 0.5 mm - decreased at older ages

Frudinger A et al. Radiology 2002; 224:417–423


EAS tear
VAGINA
<<IAS
RECTUM
EAS

Sonographic appearance of anal cushions of hemorrhoids

Aimaiti A, A Ba Bai Ke Re MMTJ, Ibrahim I, Chen H, Tuerdi M, Mayinuer. Sonographic appearance of anal cushions of hemorrhoids. *World J Gastroenterol* 2017; 23(20): 3664-3674 [PMID: 28611519 DOI: 10.3748/wjg.v23.i20.3664]

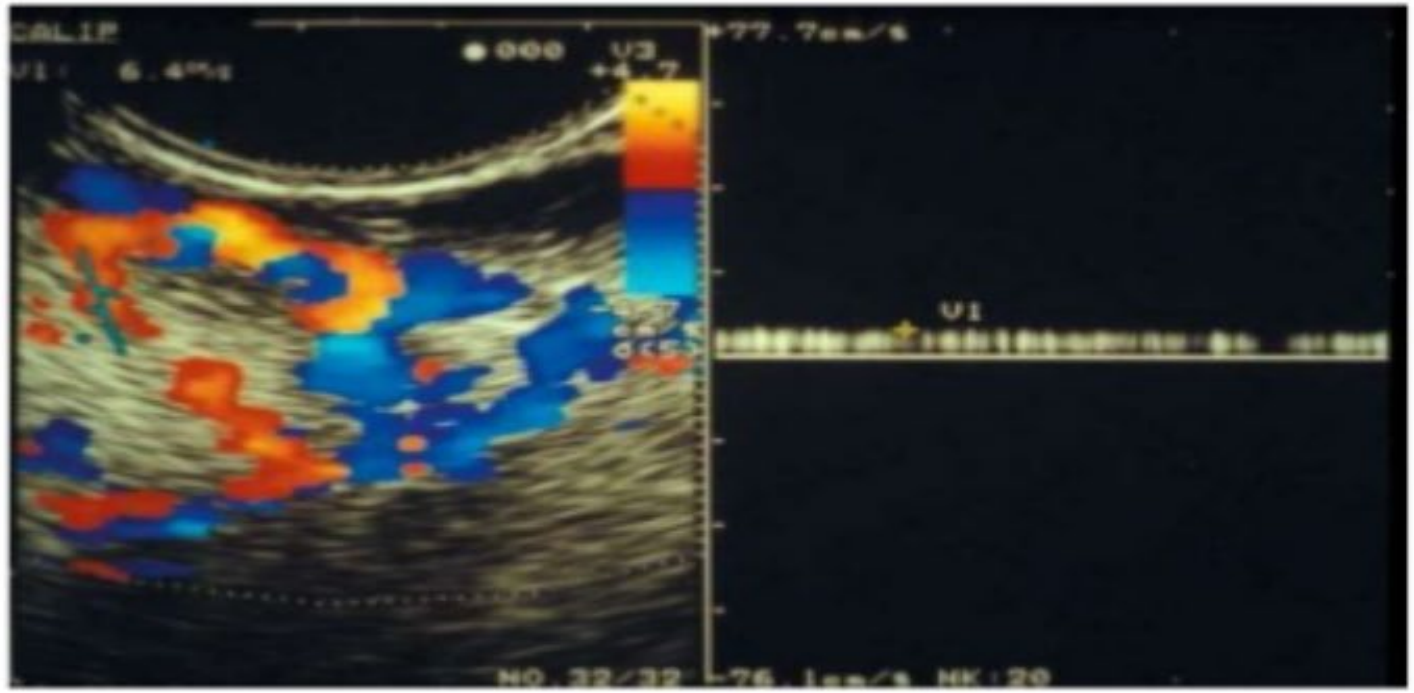


Rectal varices

Endoscopic image



Color Doppler ERUS



Color flow images of rectal varices and inflowing vessel

Sato T et al. Diagnosis and endoscopic treatments of rectal varices.
In: Da Rocha JR (ed), Endoscopic procedures in colon and rectum. InTech, 2011.

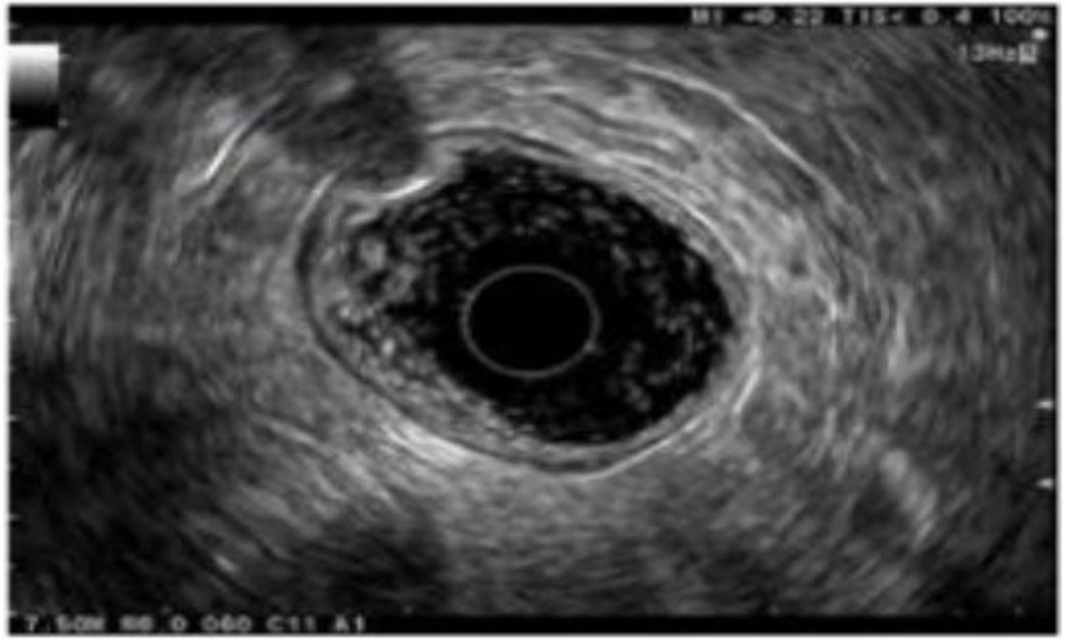
Pneumatosis coli

Endoscopic image



Multiple smooth submucosal lesions in sigmoid about 20 cm from insertion site

Axial EUS image



Air interface in the submucosa with acoustic shadowing

http://www.healio.com/gastroenterology/news/blogs/

Perirectal / Perianal Abscess

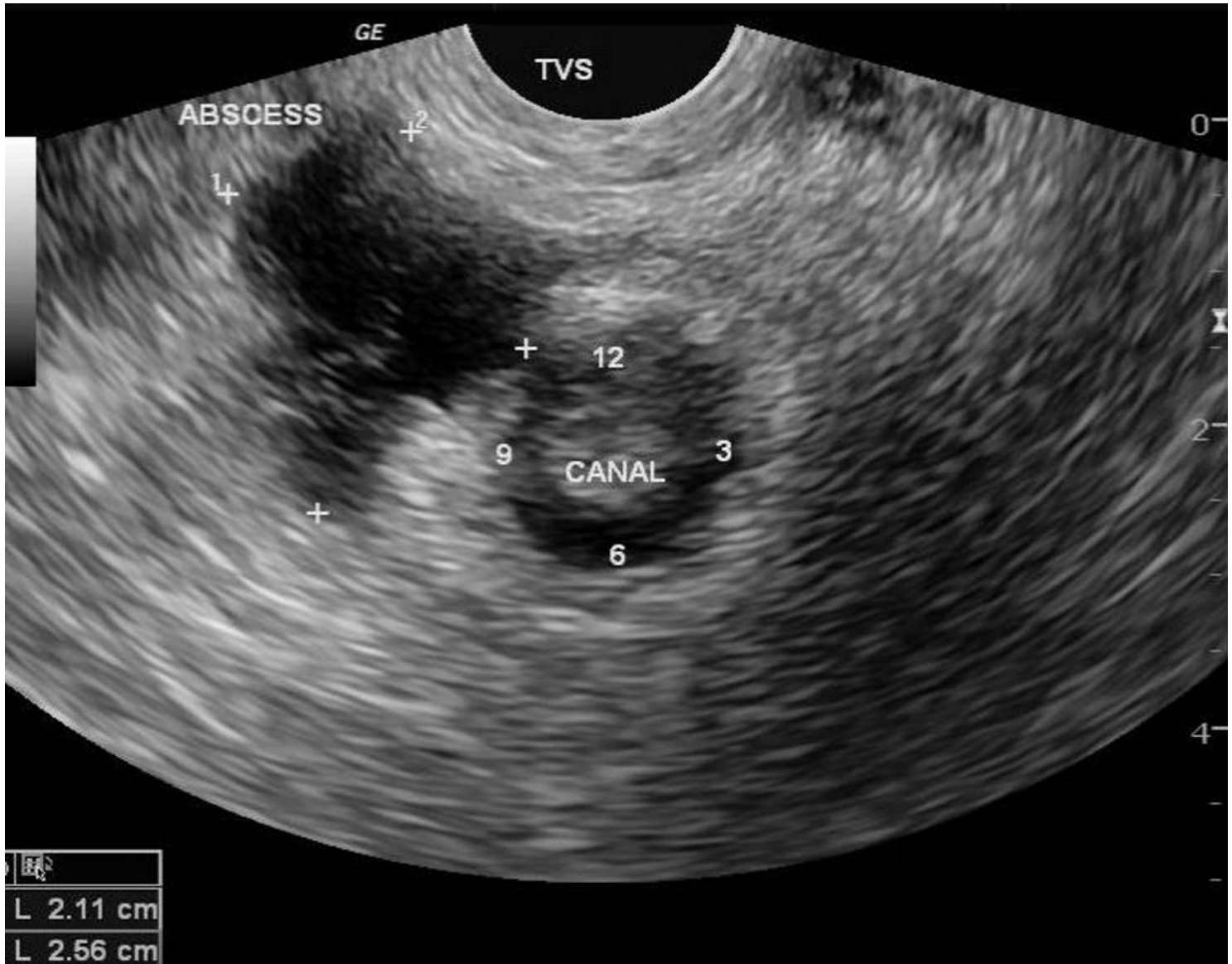




Figure 16.4 Forty percent defect in both the internal hypoechoic anal sphincter (IAS) and the outer hyperechoic external anal sphincter (EAS), likely due to obstetrical trauma.

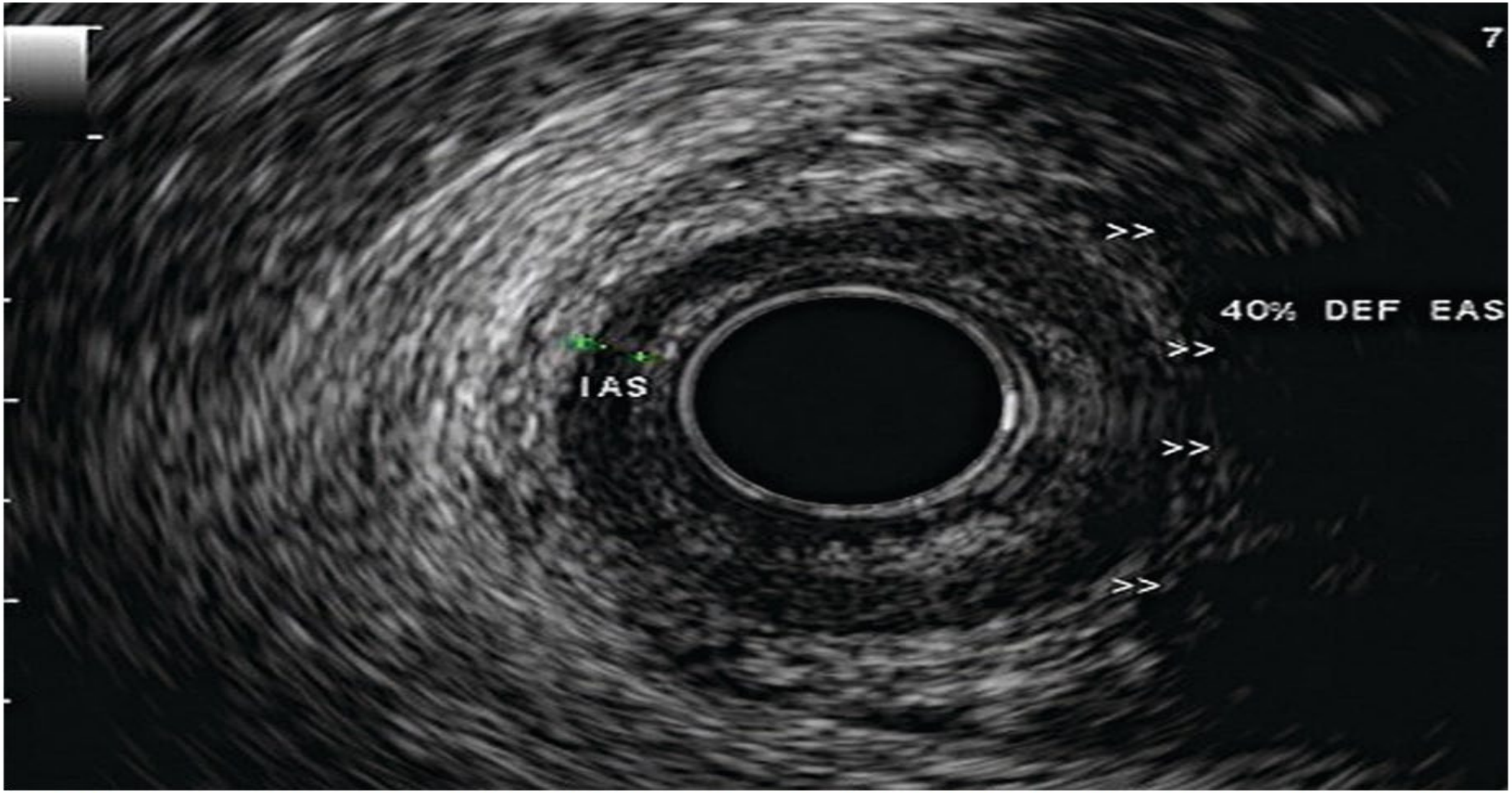


Figure 16.5 Forty percent defect in external anal sphincter (EAS), likely due to obstetrical trauma. Note that the black hypoechoic inner circular muscle layer is circumferentially intact.

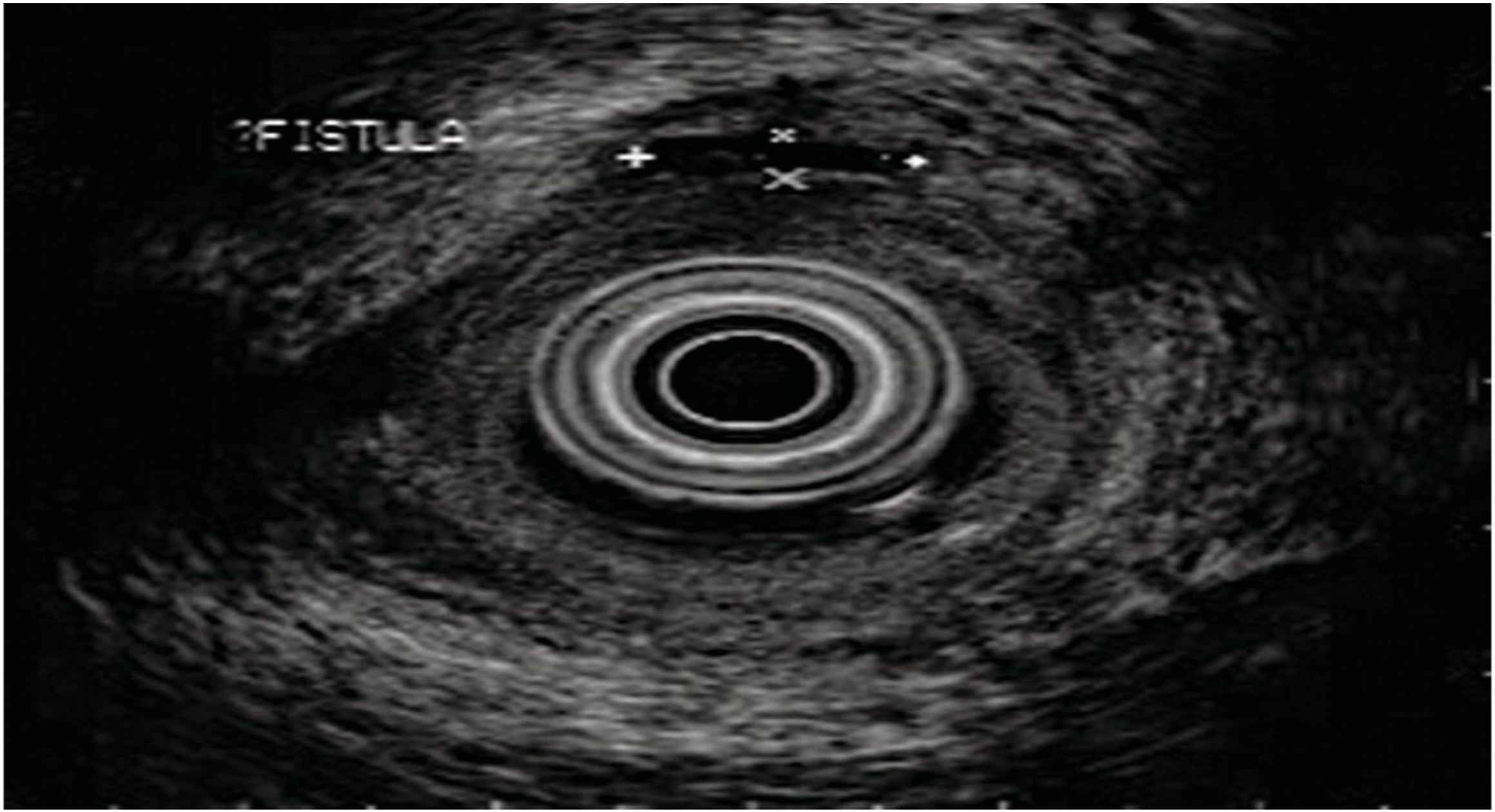


Figure 16.9 Perianal fistula. Note that the anechoic tubular structure is outside of the anal sphincters.

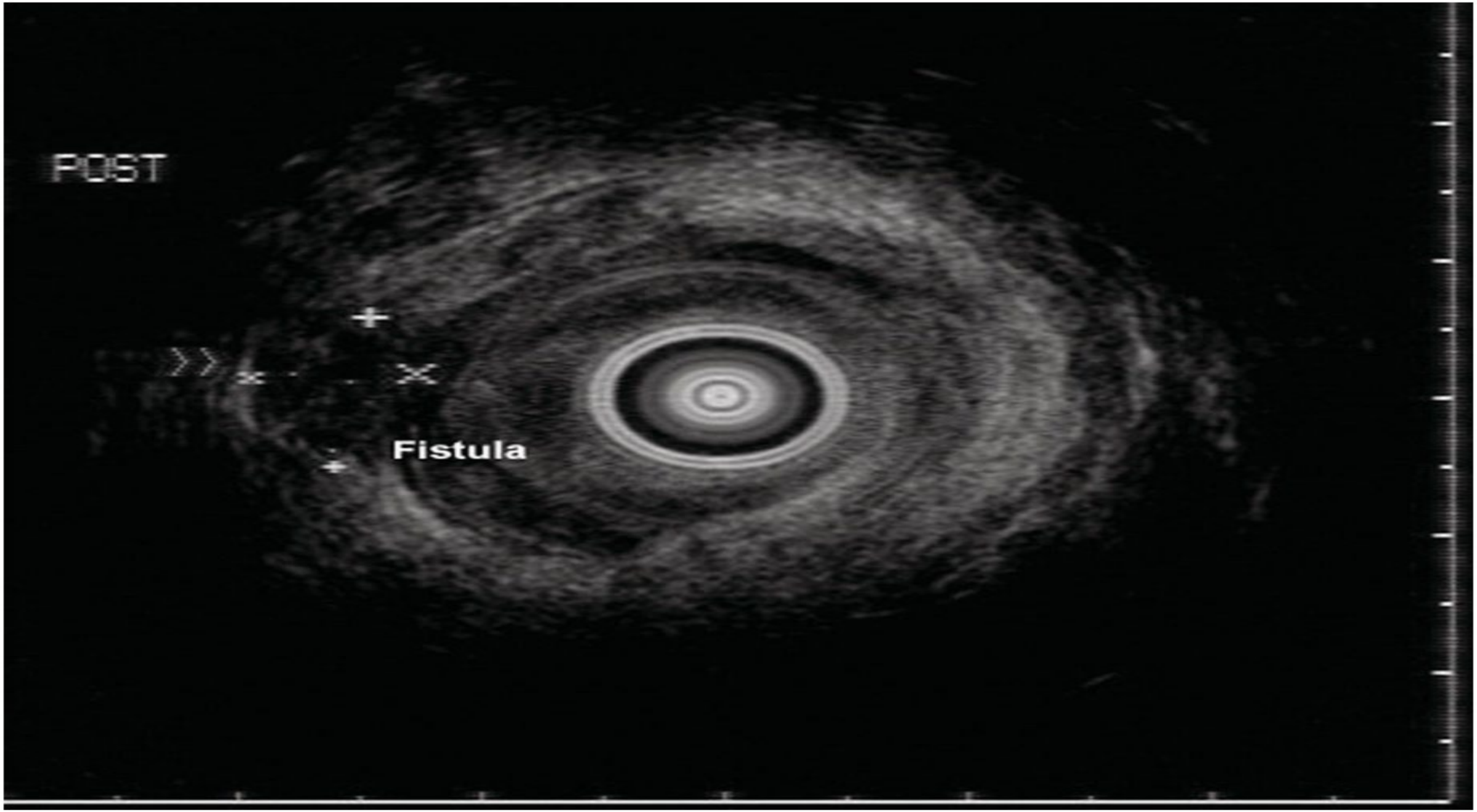


Figure 16.10 Perianal fistula with small perianal abscess measuring 11 × 7 mm.

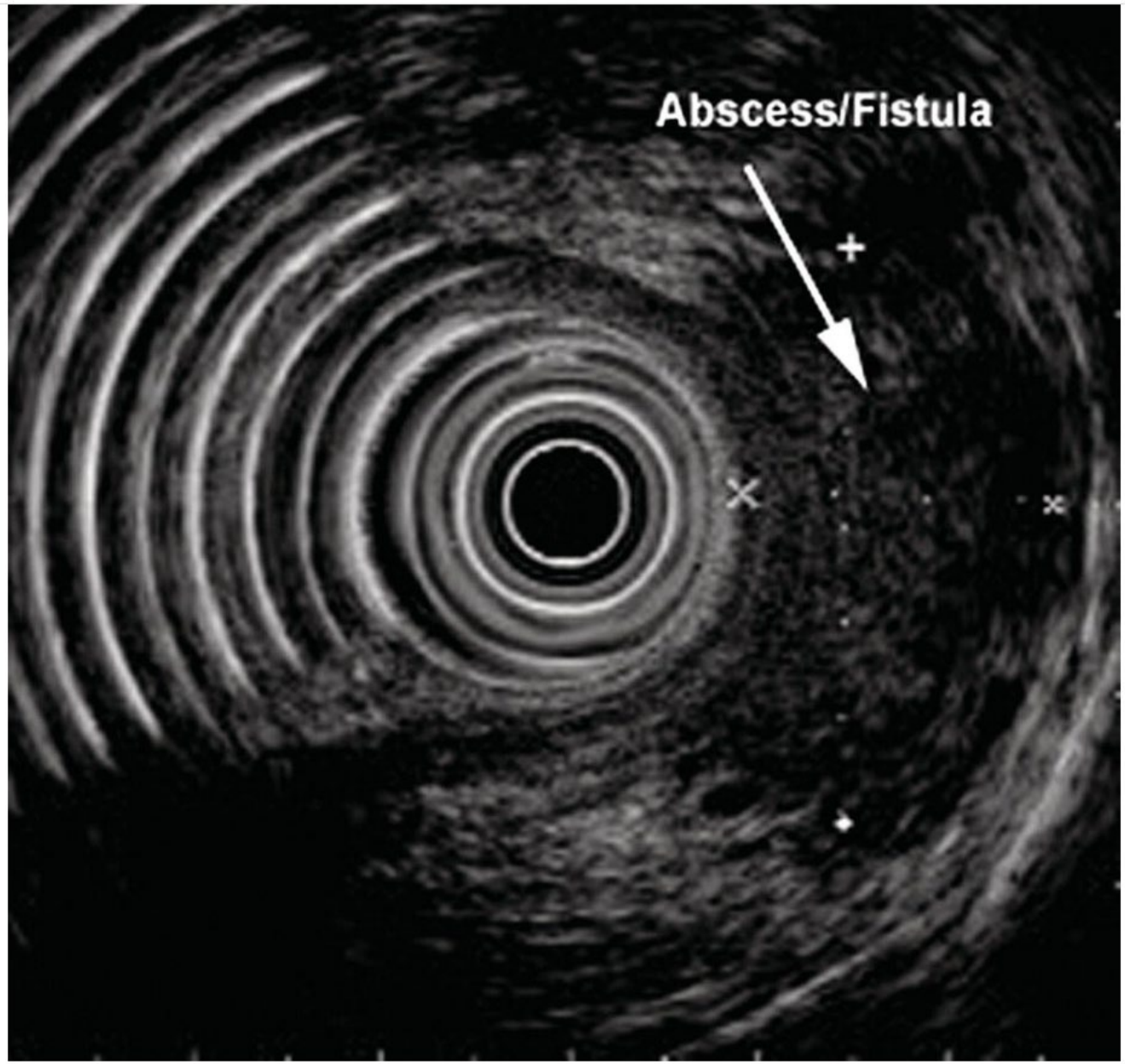


Figure 16.11 Perianal abscess and fistula.

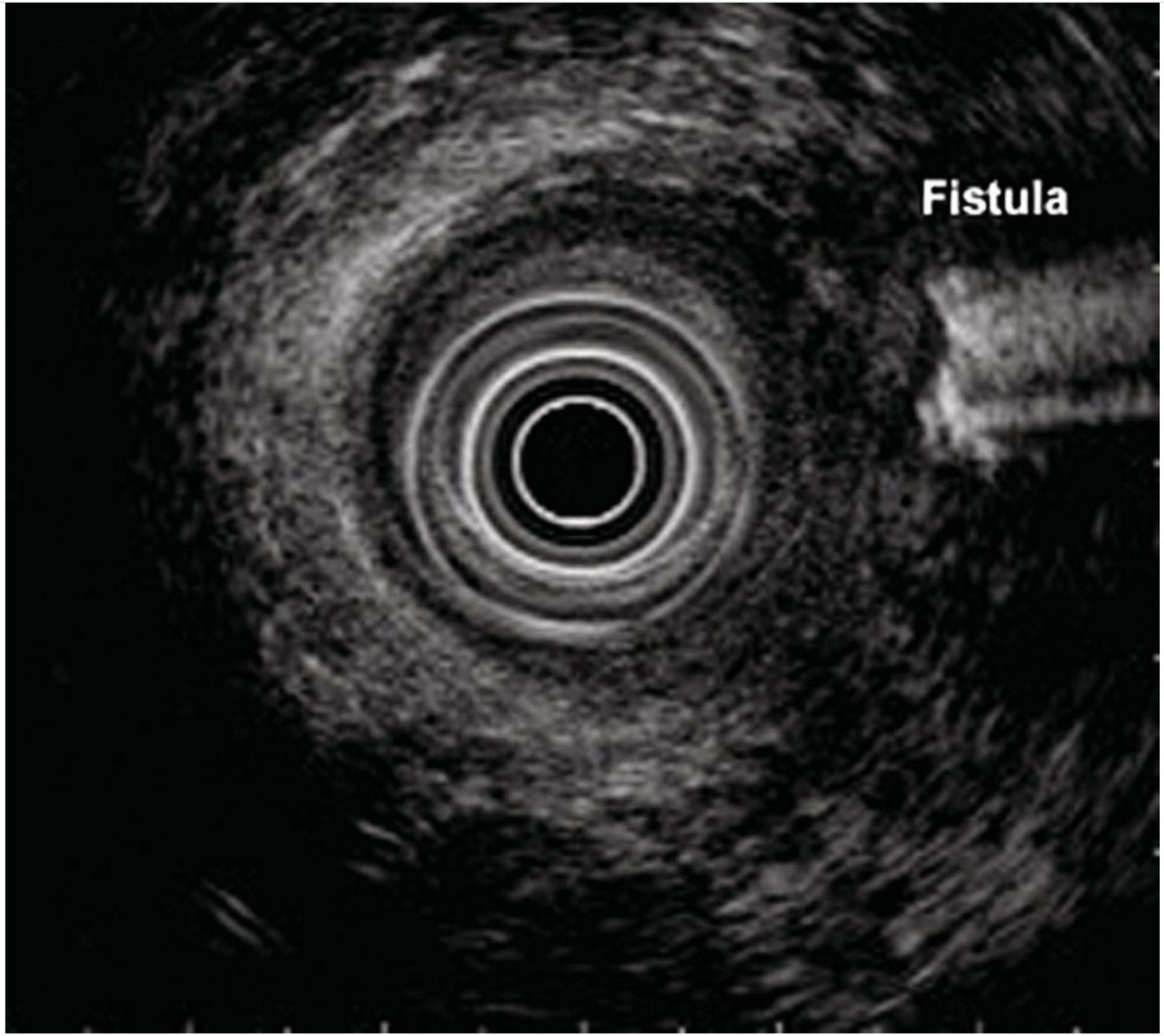


Figure 16.12 Post-hydrogen peroxide injection image of the perianal fistula and abscess shown in Figure 16.11. Note the hyperechoic signal which better delineates the fistula track in the abscess after hydrogen peroxide injection.



Fig. 2. EUS image: Radial EUS showing large trans-sphincteric fistula (*arrows*).

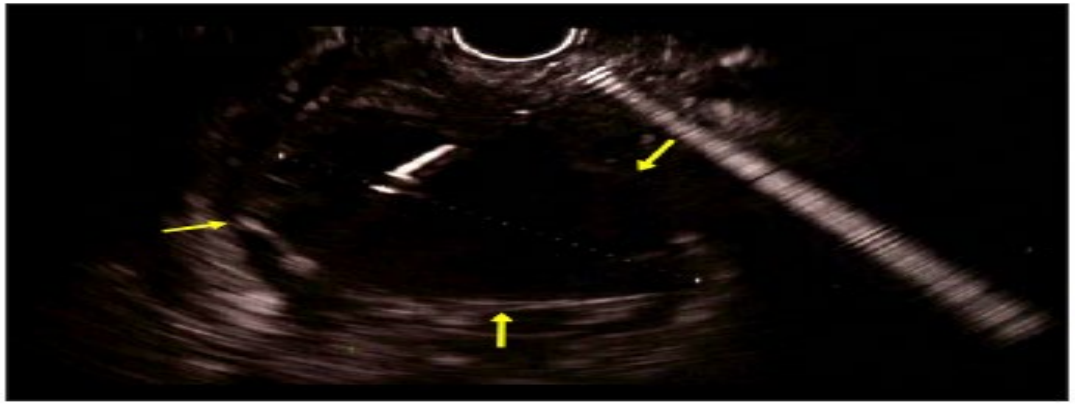


Figure 3. An endoscopic ultrasound shows a hypoechoic cavity with regular walls and homogeneous material, suggestive of an abscess.

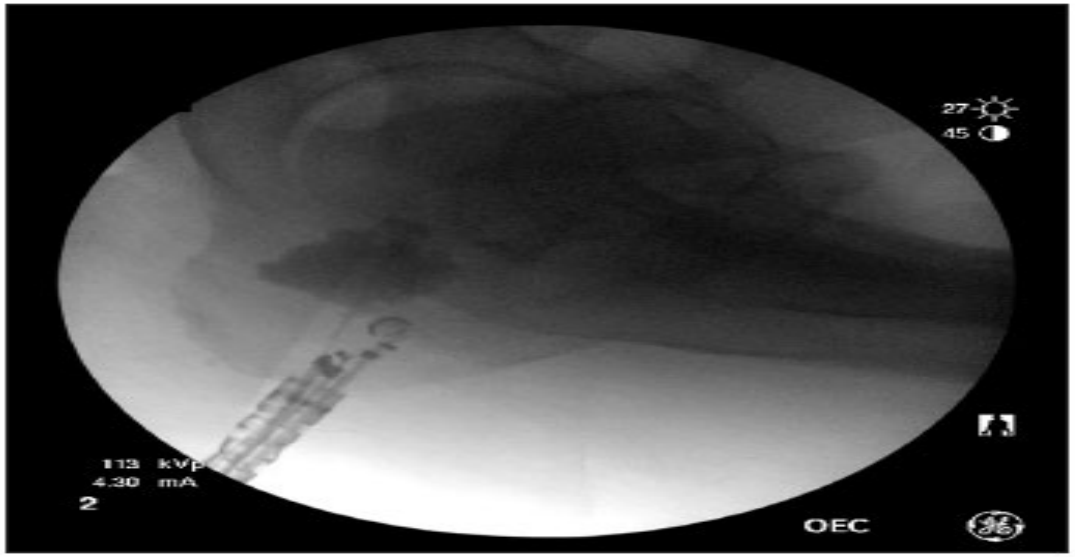


Figure 4. A guidewire is introduced and coiled into the abscess cavity under endoscopic ultrasound guidance.

solid component or vascular signal (Figure 3). A 19-gauge needle was used for fine-needle aspiration. Purulent aspirate was sent for Gram staining and culture. A 0.025-inch, 450-cm-long guidewire with a hydrophilic tip was introduced and coiled into the abscess cavity (Figure 4). A tapered-tip 4F endoscop-

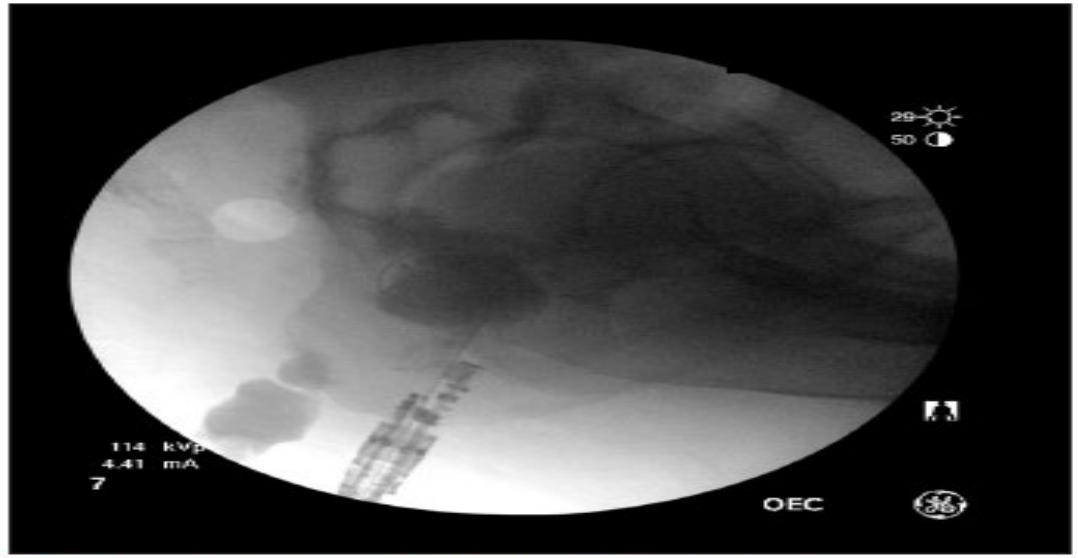


Figure 5. A 10F, 5-cm, double pigtail biliary-type plastic stent is successfully deployed. Upon contrast injection, the abscess cavity is seen to communicate with another fluid collection.

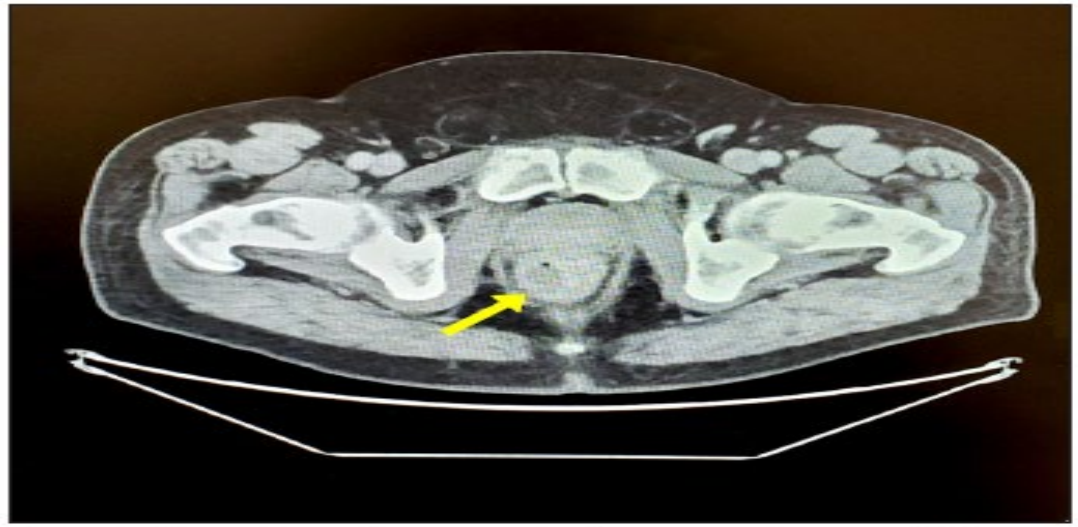


Figure 6. A postoperative computed tomography scan of the abdomen and pelvis shows that the abscess cavity is smaller.

■IAS ■EAS

Fig. 3. EES findings in cases of FI

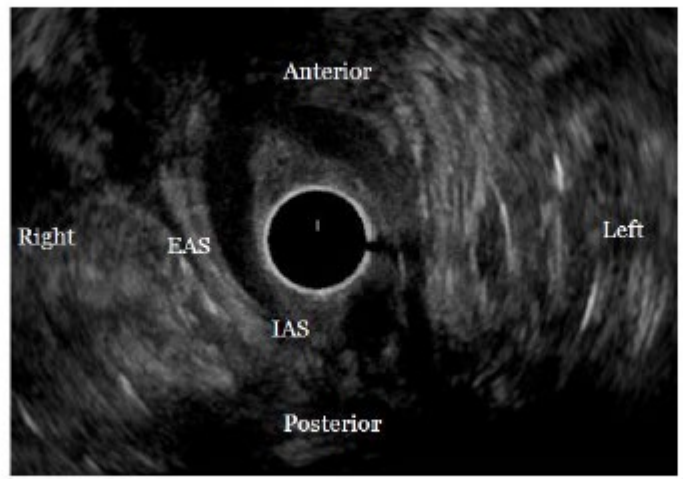


Fig. 4. Endoanal ultrasound image showing a posterior defect of IAS and both thinning and scarring of EAS

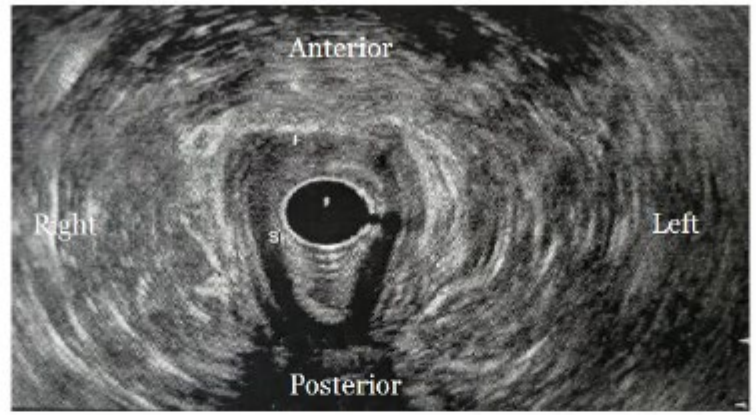


Fig. 6. Endoanal ultrasound image showing a low transsphincter fistulas (F) with IAS defect (SI)

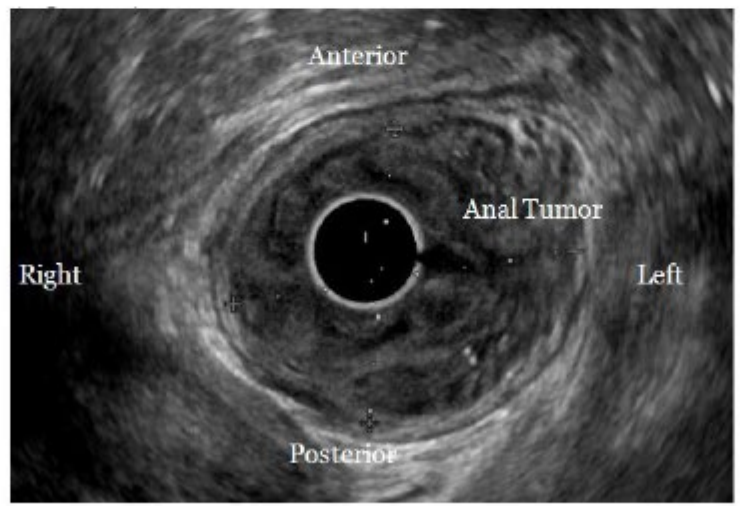


Fig. 7. Endoanal ultrasound image showing an anal tumor measuring 39×31mm, invading the mucosae and submucosae


Thank you for your attention
Pars Today