Pelvic MRI in Postoperative Assessment of Patients with Congenital Anorectal Malformations:

What the surgeon wants to know

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Learning objectives :

- Identify the aims of surgical correction of anorectal malformations (ARMs)
- Enumerate indications of surgery redo
- Describe the MRI technique and protocol used for postoperative assessment
- Describe how to approach the MRI study in cases of surgically corrected ARMs

Background:

- Anorectal malformations (ARMs) are a rare type of malformations that involves the anorectum with a heterogeneous spectrum of anatomic abnormalities that vary in their functional prognosis. .
- ARMs are usually associated with anomalies of urogenital system, spine and vertebrae .
- The aim of surgical correction is anatomical reconstruction of the anorectum , with achieving socially accepted fecal and urinary continence and avoiding complications as sexual dysfunction.

Postoperative assessment

- Poor muscle quality, abnormal bowel location and obtuse anorectal angle all have been implicated in patients with poor soiling outcomes.

- MRI is a valuable tool to asses the operated cases of ARMs and to determine if there is need for reoperation .

MOST COMMON REPORTED POSTOPERATIVE Complications:

- Stool and urinary incontinence.
- Constipation with stool impaction and overflow incontinence (pseudoincontinence)

Corrective surgery :

These complications can significantly affect the quality of life and redo surgeries are needed in cases with suboptimal results.

Indications of redo surgeries are :

- **Mal positioned neoanus.**
- **Persistent or recurrent fistula.**
- **Rectal prolapse.**
- **Obliterated or stenosed neoanus.**
- **Posterior urethral divrticulum.**

Technique :

- 1.5 or 3 T machine could be used.
- Patient should lie in supine position .
- Appropriate sedation is usually needed.
- Foley's catheter introduced from the anal canal in to the rectum, for better identification of rectum, saline can be instilled in to the rectum (high signal intensity in T2WI)
- No oral or IV contrast used.

Protocol

- T1 and T2 Turbo spin echo TSE (Axial , Sagittal and Coronal).
- Axial T2 with Fat suppression.
- Coronal T2WI should include the kidneys in the field of view . (? Renal anomalies)
- Sagittal T2 WI of the lumbar spine (? Spine anomalies)
- T2 Coronal oblique angulated in line parallel to anal canal is an optional sequence for clarification of bowel relation to sphincteric muscle complex.
- Slices should be as thin as possible 3-5mm with small inter slice distance(0-0.25mm)

HOW TO APPROACH THE MRI STUDY ?

1) Position of pulled through bowel

- Location of the neorectum should be central within the sphincteric muscle complex.

- The amount of mesenteric fat around the pulled bowel should be assessed because it can predispose to incontinence , even with proper bowel location. (Axial T1,T2WI without fat suppression).

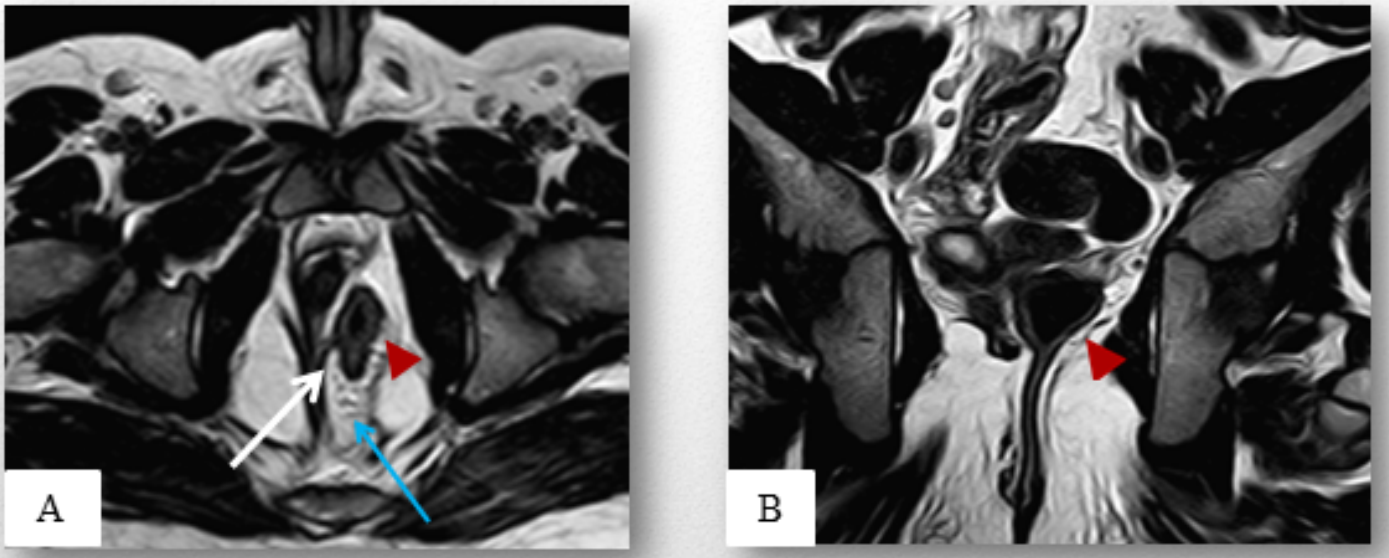


Fig 1: Patient with operated ARM , **A)** (axial T2WI) and **B)** (coronal T2WI) of the same patient , showing eccentrically located neorectum (**arrow head**)seen malpositioned to the left, out side the left puborectalis muscle (**white arrow**). Also note the mesenteric fat surrounding the rectum**(blue arrow)** which can predispose to incontinence.

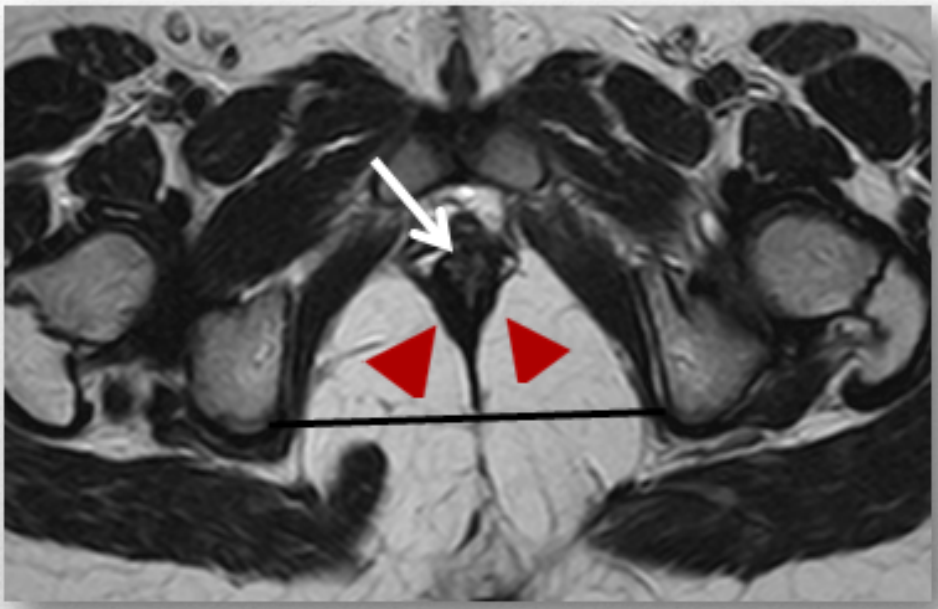


Fig 2: shows anterior displacement of the neorectum(arrow) at the level of the external anal sphincter (arrowhead) in a patient with operated high ARM and complaining of stool incontinence. The bowel is seen anterior to the line joining the posterior aspect of the ischial rami (black line). Normally the bowel should be in the middle of the line joining the posterior border of ischial rami in both sides.

2) ANORECTAL ANGLE (ARA) MEASURMENT

- ARA is the angle between line drawn along posterior rectal wall and line drawn along longitudinal axis of the anal canal.

- It represents the puborectalis muscle function, at rest it measures around 90, widened ARA at rest represents pelvic hypotonia.

- **The key image for assessment is Mid sagittal plane.**

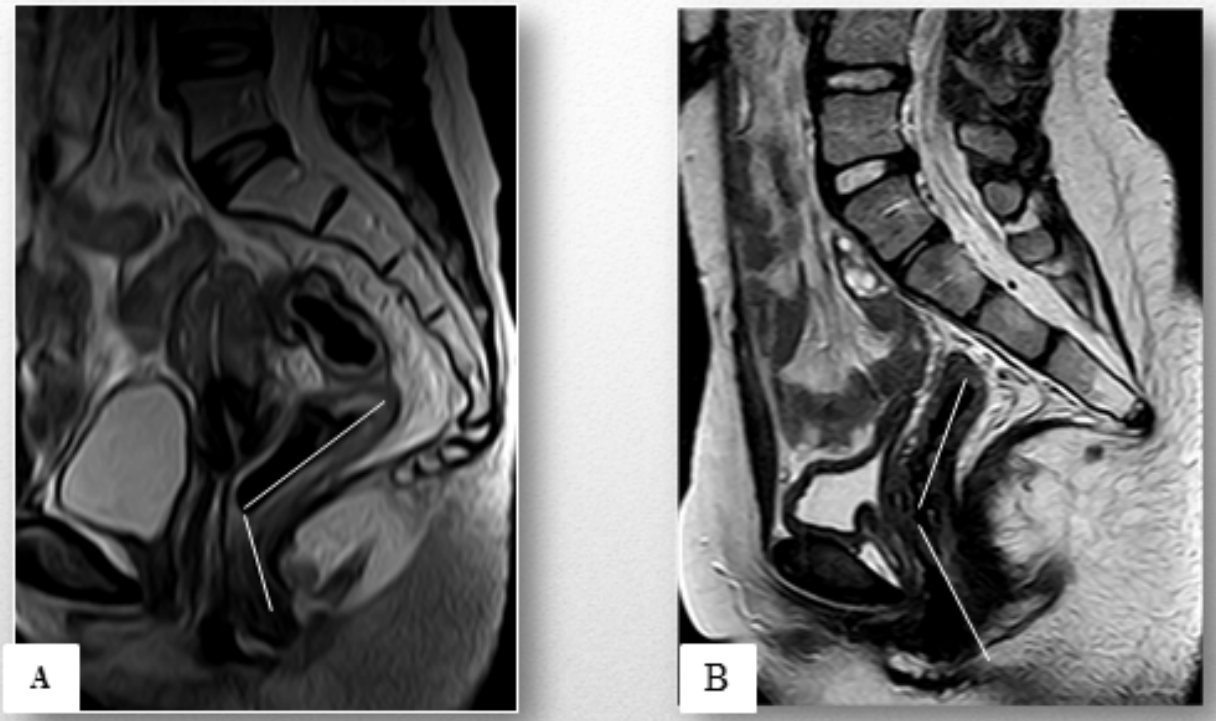


Fig 3 : Sagittal T2WI in two different patients at rest , note the normal ARA**(A)** compared to the obtuse ARA at rest in **(B).**

3) Pelvic hiatus :

- Key image for assessment is the mid sagittal plane.
- Pelvic hiatus is the anterior opening of the pelvic diaphragm through which the rectum passes.
- Widened pelvic hiatus is associated with poor fecal continence outcome.

Fig 4 : Sagittal T2WI shows a patient with normal pelvic hiatus .

- Hiatal line (H line) (Red): from the mid of the back of the symphysis pubis to the posterior aspect of anorectal angle.
- Pubococcygeal line (PCL) (White)
- **Normal hiatal/PCL is around 0.5**

Fig 5: Shows the markedly widened hiatus, H/PCL ratio >>0.5.

4) Position of Anorectal junction

- **The normal position of the anorectal junction is above the puboccegeal line (PCL)** (corresponds to the pelvic floor level)

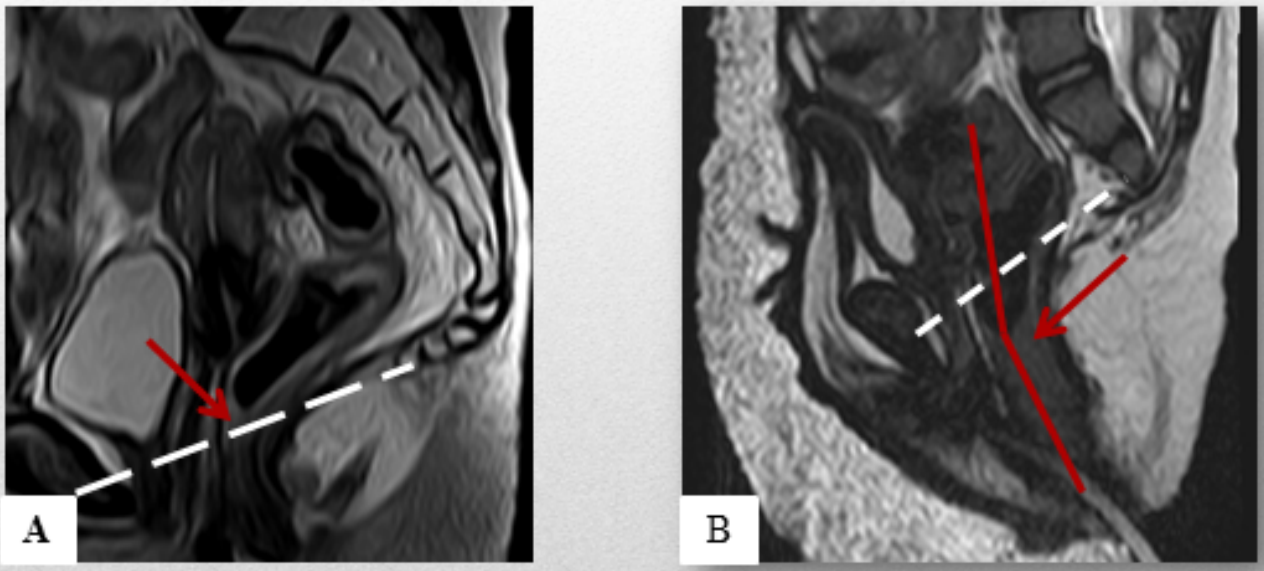


Fig 6: 2 patients with normal **(A)** and abnormal position **(B)** of the anorectal junction (arrows) in relation to the PCL (Dashed line). Also note the widened ARA in B (red lines)

4)Sphincteric muscle complex

- Muscle complex assessment is subjective and is based on comparison between both sides , or comparison with healthy individuals of same age.

- The external anal sphincter ,illeoccoccegeal and the puborectalis muscles are the most important structures in the sphincteric muscle complex responsible for maintaining continence.

A)Illeoccoccegeal muscle: Best assessed in coronal images.

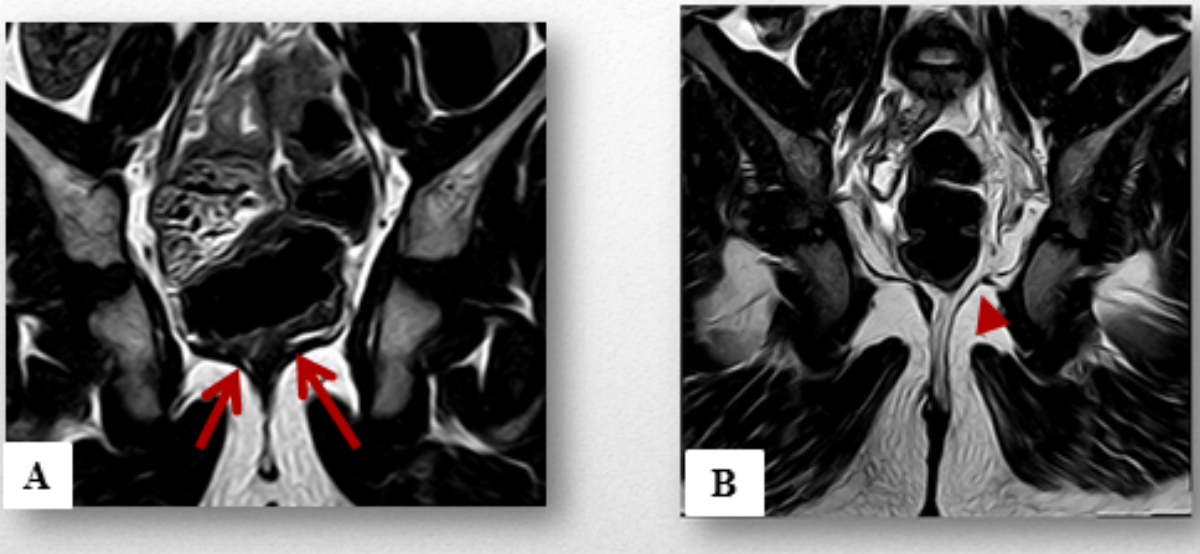


Fig 7 : Coronal T2WI in two different patients. Compare the well devolved illeo coccegeal muscle bilaterally (red arrows) appearing as an inverted umbrella with rectal ampulla resting on it **(A)** to the thinned left illeococcegeal muscle (red arrowhead) **(B)**.

B) Levator plate : Is mid line raphe formed by the fusion of illeococgeal muscle fibers posteriorly.

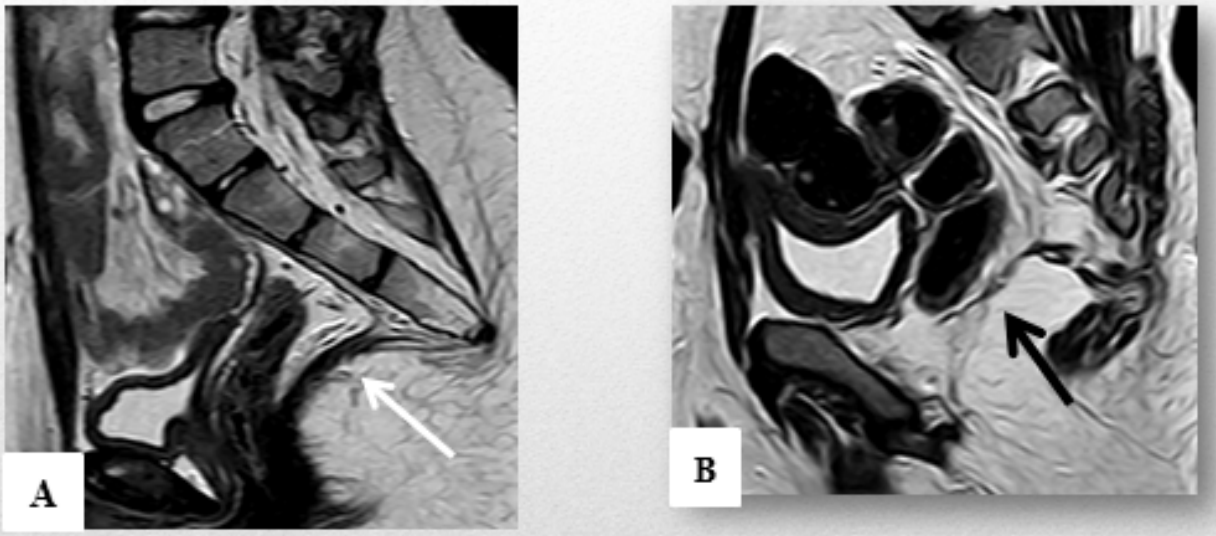


Fig 8: Sagittal T2WI of two different patients .Compare the well developed levator plate (white arrow) in **(A)** to the thinned interrupted levator plate (black arrow) in **(B)**

C)Puborectalis : arises from the symphysis pubis forming a U shaped sling around the rectum at level of anorectal junction.

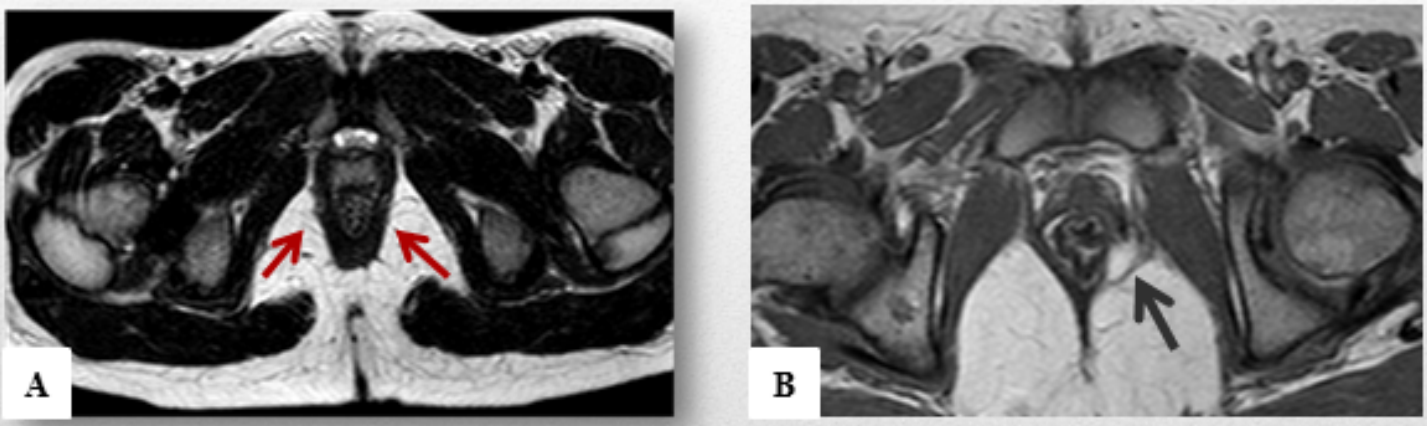
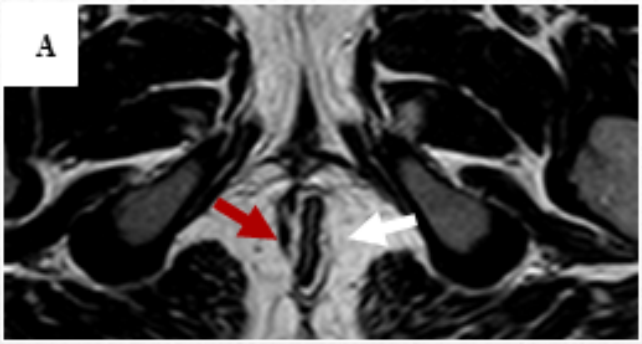


Fig 9 : A) axial T2WI showing well developed puborectalis muscle bilaterally (red arrows) . **B)** axial T1WI showing thinned atrophic left puborectalis muscle (black arrow).

D)External anal sphincter:



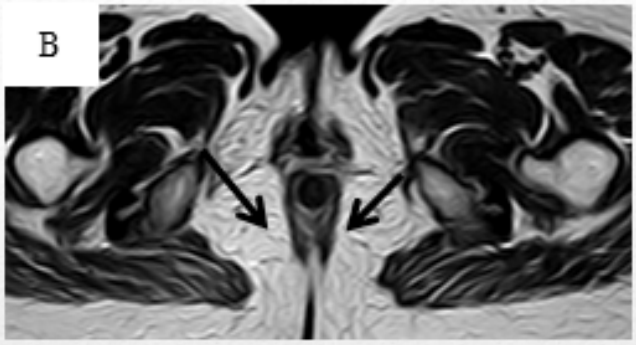


Fig 10: A) axial T2WI showing patient with abnormal external anal sphincter with corrugated right side (Red thick arrow) and atrophic left side (white thick arrow). **B)** axial, **C)** coronal T2WIs showing patient with well developed external anal sphincter(black arrows). Note the well developed puborectalis muscle seen on coronal image (red arrows).

4) Associated genitourinary anomalies

- ARMs are usually associated with genitourinary anomalies , their incidence is higher among the high type complex ARMs.
- Urological anomalies are best assessed in T2 coronal images.
- Pelvic and genital anomalies are best seen in axial and coronal T2 weighted images.

a) Urological anomalies

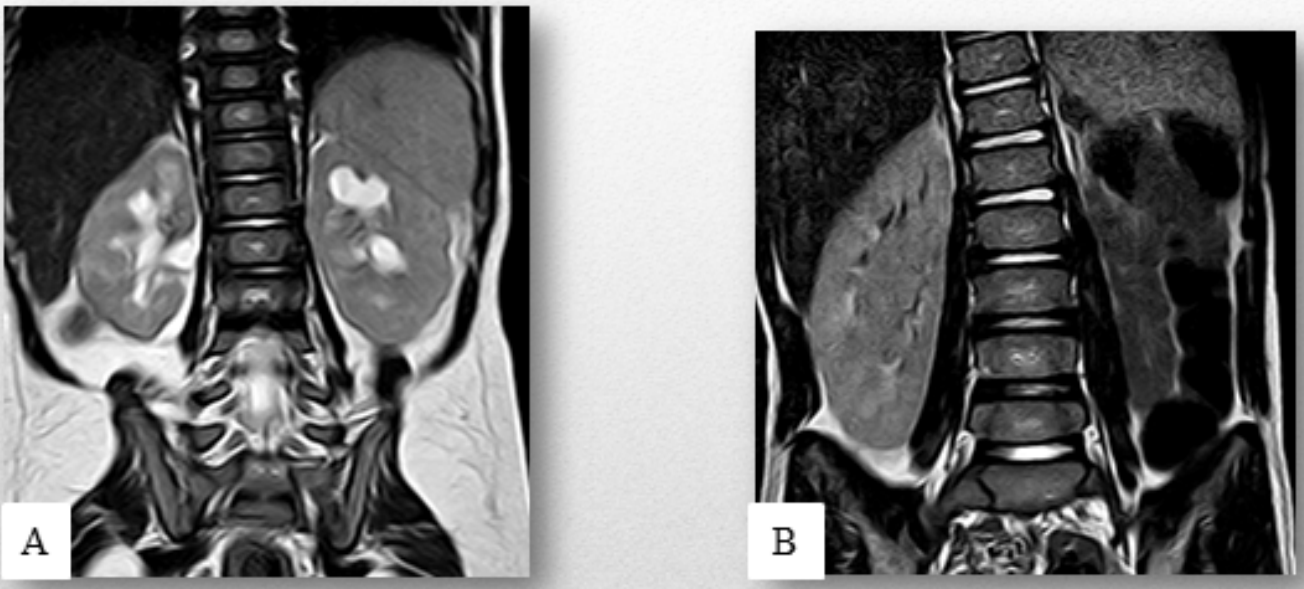


Fig 11: Two different patients with history of operated ARMs. **A)** Dilated pelvicalyceal system bilaterally, ascending cystourtherogram (not shown) showed vesicouretric reflux , **B)** absent left kidney with compensatory hypertrophy of the right kidney.

b)Genital tract anomalies has incidence of 20-50 % among patients with ARMs and up to 90% in patients with cloacal malformations.

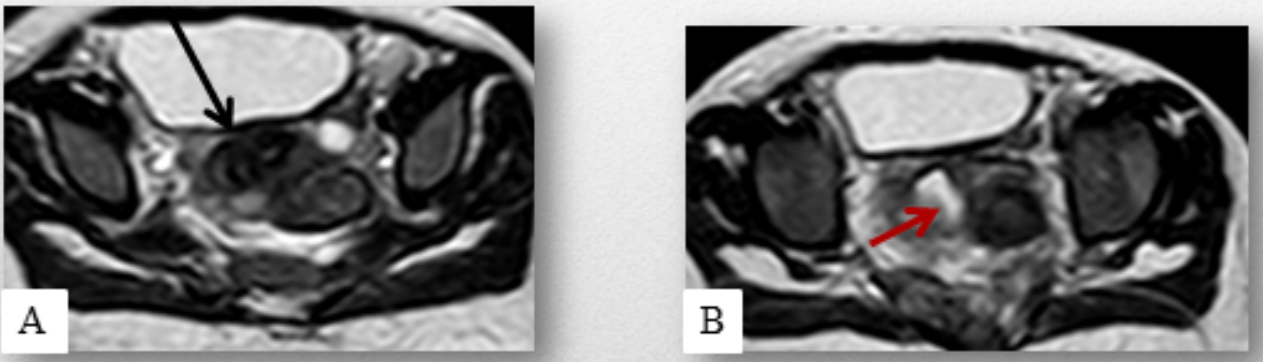


Fig 12: axial T2WI in a neonate with cloacal malformation . **A)** septated uterus (black arrow), **B)** septated vagina with right hemivagina distended with fluid (red arrow)

C) Fistula : can be missed easily in MRI, fluoroscopic studies are the standard of care in its diagnosis. Fistula appears as high signal intensity track in T2WI.

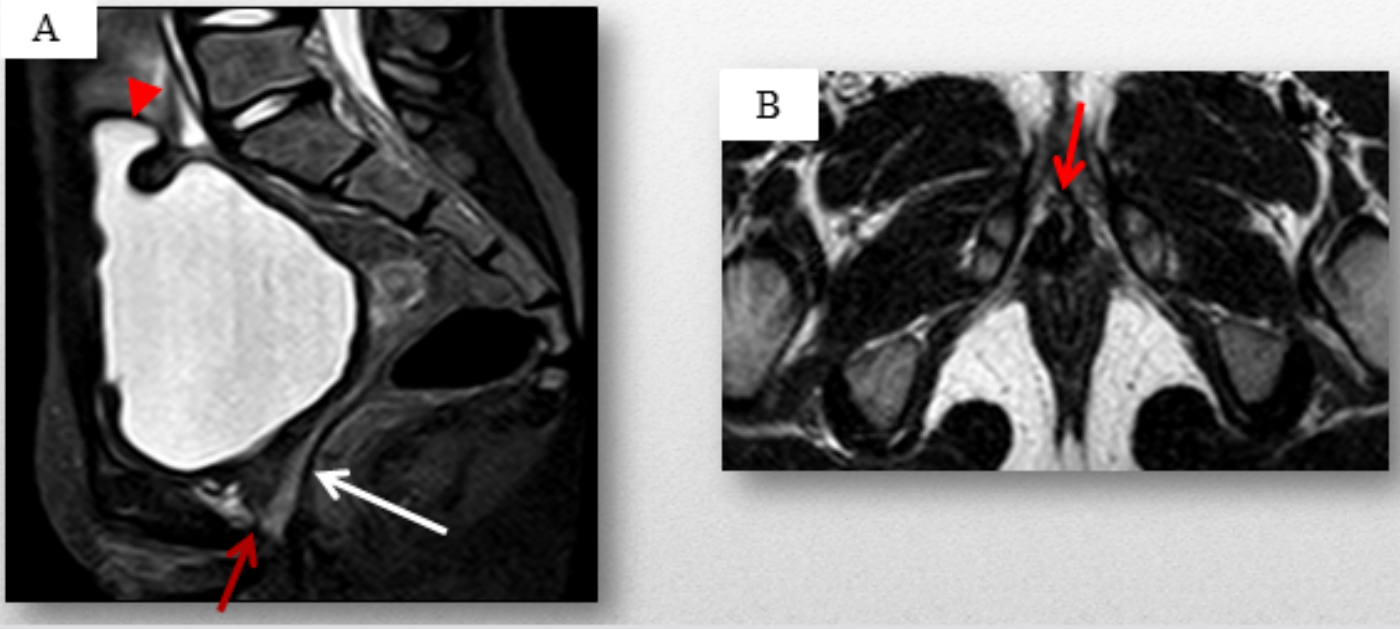


Fig 13: Sagittal **(A)** and axial **(B)** T2WI in a 10 year old female patient with operated high anorectal malformation , showing urachal diverticulum (red arrowhead) , and the urethra terminating in the distal vagina (red arrows) , with the vagina seen distended proximal to that connection (white arrow).

d) Posterior urethral diverticulum :complication of fistula ligation in patients with rectourethral fistulas when a part of the terminal rectal stump is left attached to the posterior urethra.

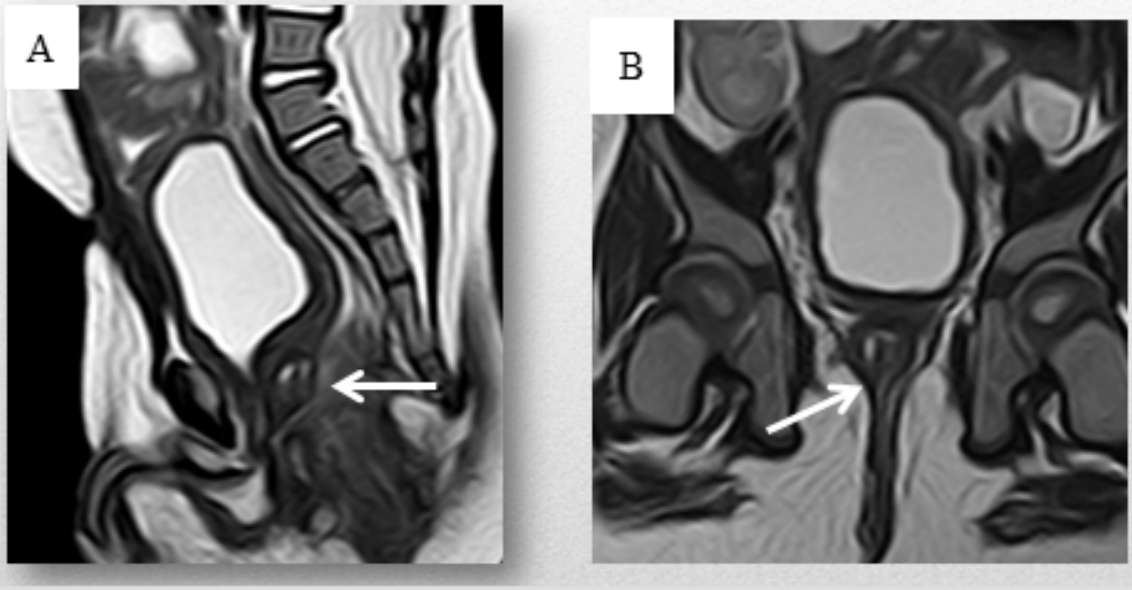


Fig 14: Sagittal **(A)** and coronal **(B)** T2WI ,in a 9 month old boy with operated anorectal malformation . A small structure (white arrow) noted in relation to the prostatic urethra ,representing urethral diverticulum.

4) Associated vertebral and spinal anomalies

- The incidence of reported vertebral and spinal anomalies in patients with ARMs varies between 16.6 and 38.3 % in different studies .

- Vertebral anomalies range from sacral dysplasia to complete agenesis

- Spinal anomalies include: filum terminal lipoma , low lying conus medualaris , syringomyelia and tethered cord .

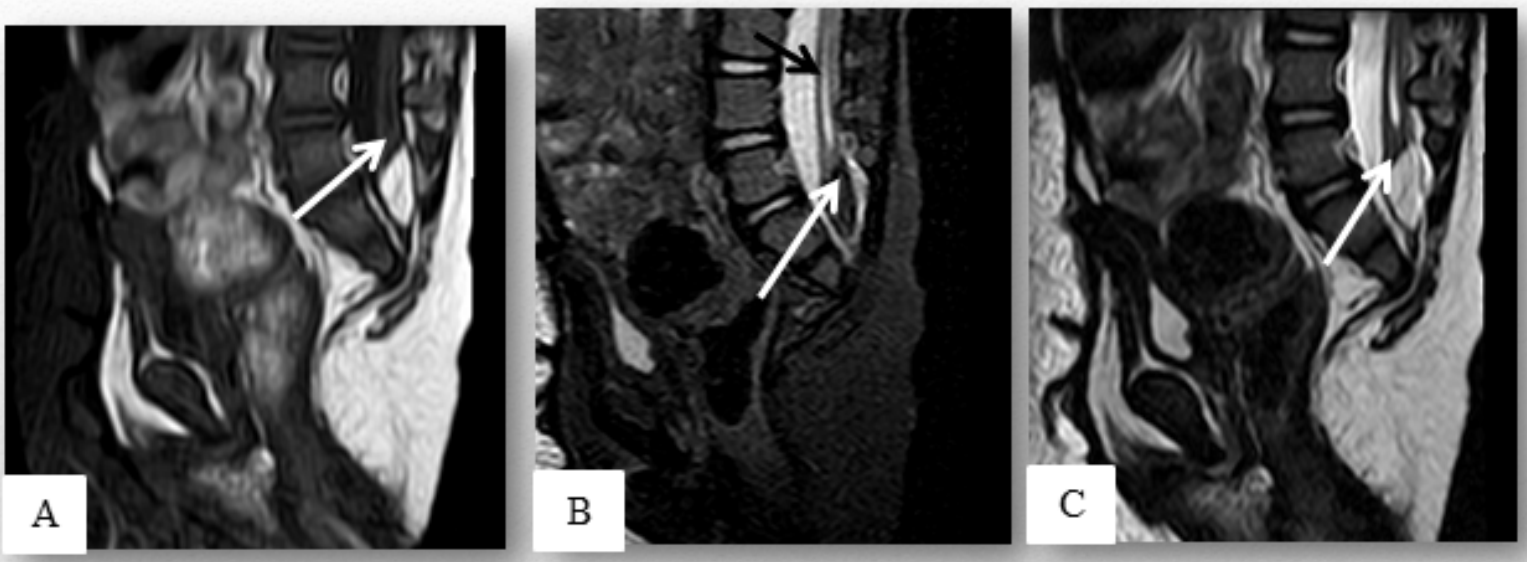


Fig 15: 3 year old female with history of corrected cloaca . Sagittal T1**(A),** STIR**(B)** and T2**(C)** images shows near total sacral agenesis with only S1and S2 seen with associated low lying tethered cord (black arrow) and intraspinal filum terminal lipoma (white arrow).

Conclusion:What to include in your report?

1. The position of the pulled through bowel and the possibility of excess mesenteric fat presence around the pulled bowel.
2. Measurement of the anorectal angle.
3. Assessment of the pelvic hiatus.
4. Position of the anorectal junction.
5. Quality and shape of pelvic floor muscles.
6. Associated or persistent genitourinary anomalies.
7. Associated Vertebral and spinal anomalies .

Acknowledgement:

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