Must-Know Guide to Complex Anal Fistulas: Supralevator, Extrasphincteric, and More

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Abstract

The management of complex high anal fistulas remains challenging. MRI plays a central role in their anatomical characterization, classification, and preoperative assessment. This review describes the imaging anatomy and management implications of the five peri-levator fistula types grouped as "high-5" by Garg et al.: supralevator, suprasphincteric, extrasphincteric, high intrarectal, and RIFIL fistulas.

Keywords: *EAS: External Anal Sphincter, IAS: Internal Anal Sphincter, VAAFT: video-assisted anal fistula treatment, TROPIS Transanal opening of intersphincteric space, LIFT: ligation of the intersphincteric fistula tract, CLM: Conjoined Longitudinal Muscle.*

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Introduction

Perianal fistulas are irregular connections between the perianal skin and the anal canal and typically are secondary to conditions like infections, postoperative issues, or Crohn's disease.

The term "high-5" refers to five anatomically distinct types of high anal fistulas grouped by Garg et al. It should be distinguished from grade 5 of the St. James's University Hospital MRI classification, which denotes supralevator or translevator disease. The two frameworks may overlap, but they are not equivalent; the high-5 types should not be presented as five subtypes of St. James grade 5 (5,15).

These high-5 fistulas tend to include the external anal sphincter, and fistulotomy is inappropriate because of the high risk of incontinence. Because of the significant risk of incontinence with deep fistulas that involve the external anal sphincter (EAS), MR imaging helps in planning for sphincter-preserving procedures.

This review describes the anatomy, radiological features, and classification of these five complex anal fistula types.

Materials and Methods

The MRI examinations presented are illustrative clinical examples used to demonstrate fistula anatomy and imaging findings; they do not constitute a systematic study cohort.

Patients referred with perianal discharge who underwent MR Fistulogram in 3T MRI (SIEMENS-SKYRA). The sequences used are STIR (axial, coronal, sagittal), T1 Axial, T2 coronal, T2 weighted fat suppressed images in axial and coronal DWI with b value 0,900 and 1000 with 3mm slice thickness, 3D T2 space FS, 3D space STIR, Pre contrast T1 FS Axial, Dynamic VIBE and Post contrast T1 FS (axial, sagittal and coronal) with slice thickness 3.5mm (For selective cases).

Results

High-resolution MRI was identified as the gold standard for the diagnosis of high 5 fistulas, which rendered detailed anatomical mapping of the fistulous tracts and their relationship with the levator ani muscles and sphincter complex. Contrast-enhanced studies enhanced detection of abscesses and complex tracts (8). The guidelines highlighted the use of a multidisciplinary strategy that involved surgery, fibrin glue, and

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high-level technologies like video-assisted anal fistula treatment (VAAFT), ligation of the intersphincteric fistula tract (LIFT) and Transanal opening of intersphincteric space (TROPIS). Importance of MR imaging was proved with post operative assessment and surgical outcome with long term follow-up (4).

Discussion

The recognition of high-5 anal fistulas is significant for radiologists because of the complexity continuum it represents and the subsequent effect on treatment plan. Disease assessment via imaging is predicated on surgical planning and can be utilized to improve accuracy in the surgical excision of disease (9). In this situation, MR imaging is crucial because it can reveal secondary expansions and concealed pockets of sepsis, both of which increase the risk of recurrence following surgery. Additionally, MR imaging can be used to determine the fistula's anatomical linkages and forecast the risk of postoperative faecal incontinence (3). Contrast enhanced MR imaging helps to differentiate edema and fistula clearly (8, 11). However it also helps in assessment of the activity of the disease particularly in fistulas secondary to Crohn's disease (10).

This review will attempt to address the void in literature in defining the precise role of MRI in the precision mapping of fistulae and subsequent guided surgery.

Anatomy and Pathophysiology of High 5 Anal Fistulas

1. Anatomy of the Anal Sphincter Complex (Figure 1):

The pelvic floor muscles are arranged in two cylinders, one inside the other. The inside cylinder is the terminal part of the gut - the lower rectum and anal canal - and contains mucosa, submucosa and circular and longitudinal layers of muscle. The circular muscle layer is much enhanced in the anal canal to form the bulky internal sphincter. The outer cylinder consists of the external sphincter and the puborectalis muscles (1). Externalanal sphincter is composed of striated muscle and internal sphincter is composed of smooth muscle. These two sphincters are separated by intersphincteric plane which contains fat.

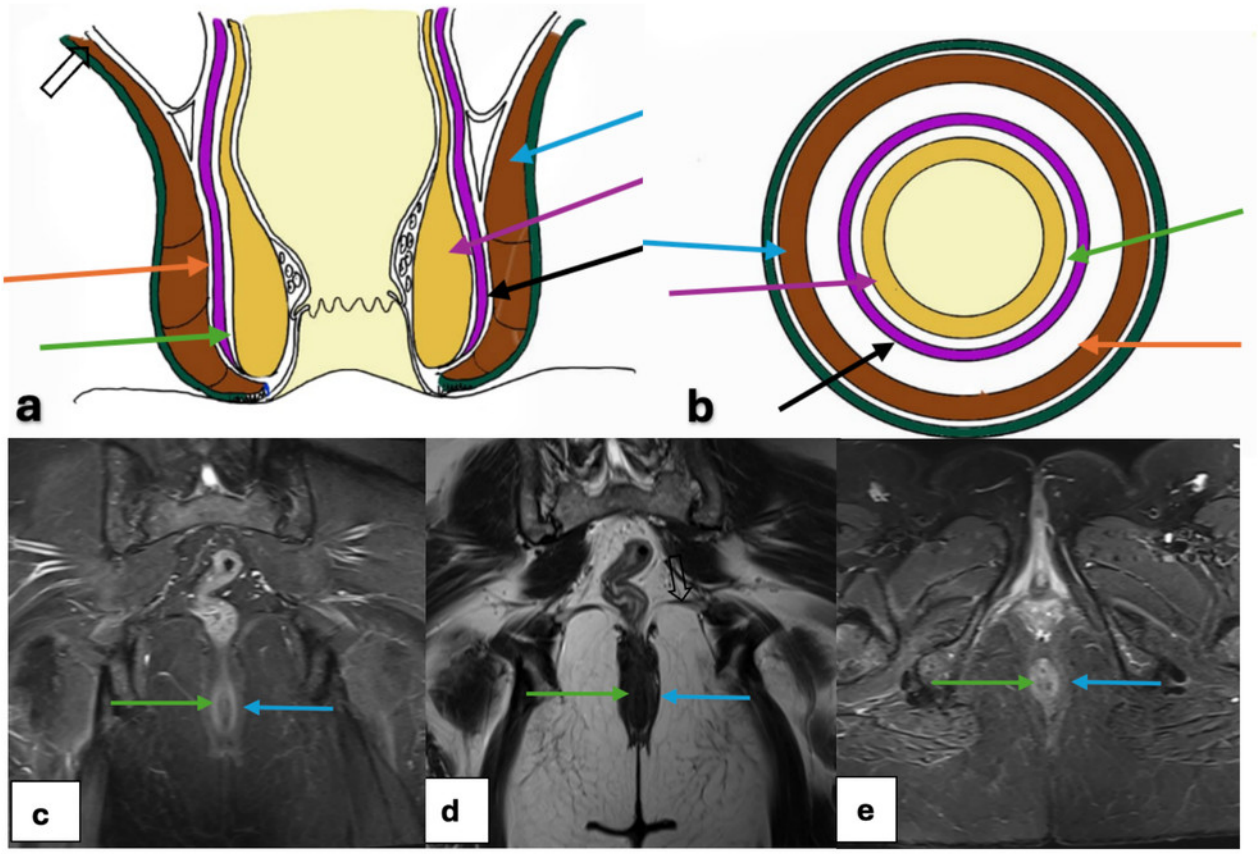


Figure 1: *Normal anatomy of sphincter complex: a) and b) coronal and axial pictorial representation c) STIR coronal d) T2 coronal* e) STIR axial *. Internal Anal sphincter (purple arrow), External anal sphincter (blue arrow), Conjoint longitudinal muscle (black arrow), Levator ani muscle (open black arrow), Inner intersphincteric space (green arrow), Middle intersphincteric space (brown arrow).*

Internal anal sphincter is the termination of rectal circular muscle in the inner aspect and outer conjoined longitudinal muscle (2). Between these layers lie potential spaces where infection or fistula tracts can spread which is the Inner Intersphincteric Space lying between IAS and CLM, middle inter-sphincteric Space lying between CLM and EAS (5). Coming to the anal clock position, 12'o clock is the anterior portion in the transverse view, 6'o clock is the posterior portion close to spine and so on (14).

2. Pathophysiology of High 5 Fistulas:

It is challenging to conceptualize the pathways followed by anal fistulas without first discussing current ideas about pathogenesis. Chiari (1) described the anal ducts or glands which discharge, at the muco-cutaneous junction of the anal canal, into the anal crypts which is called as cryptoglandular hypothesis. these glands are more tortuous in men which explains why fistulas are common in men (2). Nevertheless, there have been no other reasonable causes of the origin of anorectal infection proposed, and evidence is mounting to associate these. Eisenhammer (1958) equally considered that infection of such structures in the intersphincteric plane was cause of fistulas and advised operative procedures based on this concept. In most individuals these glands cross the internal sphincter muscle to stop within the areolar tissue of the intersphincteric space. Often they develop into small glandular structures encircled by lymphoid tissue. many glands terminate in the intersphincteric plane hence gland infection turns into an abscess. Perianal fistula is a complication of these tiny abscess (2).

Classifications:

Park's classification: Fistulae classified surgically as (1):		
1	Intersphincteric	70 %
2	Transsphincteric	25 %
3	Suprasphincteric	5 %
4	Extrasphincteric	< 1%

Park's classification does not involve superficial fistulas which don't involve the sphincter complex (7).

St. James's University Hospital Classification System divides perianal fistulas into 5 grades(15):	
Grade 1	Simple linear intersphincteric fistula, which means a simple tract between the two anal sphincters without any additional extensions or abscesses
Grade 2	Intersphincteric fistula, with abscess or additional secondary track/extension. This shows that, although still an intersphincteric fistula, the primary tract has additional secondary extensions or abscess has developed in addition to the tract
Grade 3	Transsphincteric fistula, which has a tract through both anal sphincters and may reach the ischiorectal fossa
Grade 4	Transsphincteric fistula with abscess or secondary track, which means it is similar to Grade 3, but has abscess and or additional tracks in the ischiorectal or ischioanal fossa
Grade 5	Supralevator and translevator disease. This is the highest complexity type of fistula which is seen above the levator ani muscle and will have multiple pathways of potential involvement to surrounding areas

This review focuses on the five high-5 anal fistula types described by Garg et al. (5). There are:

Supralevator Fistulas: Extend above the levator ani through the middle intersphincteric space.

Suprasphincteric Fistulas: Extend to the level of the top of the EAS and may also extend into the ischiorectal fossa.

Extrasphincteric Fistulas: Rarely transgress into the sphincter but may involve the ischiorectal fossa.

High Intra-rectal Fistulas: Located between the IAS and CLM in the wall of the rectum.

RIFIL Fistulas: Newly described fistulas traverse the roof of the ischiorectal fossa and may include levator ani muscle.

1. Suprasphincteric Fistula:

The suprasphincteric fistula crosses the levator ani and runs above the puborectalis muscle. To enter the ischiorectal fossa, these fistulas begin in the intersphincteric plane, go up to the top of the EAS, and cross the puborectalis muscle (Figure 2).

A distinctive tract that rises between the sphincter muscles and curves over the EAS into the ischiorectal fossa, frequently resulting in abscesses, is seen on radiological features of fistulas. A distinct fistulous tract with any related abscess formation is visible on T2-weighted and post-contrast T1 weighted images. Because of its close closeness to the levator muscles, this kind of fistula frequently necessitates more involved surgical care. Because of the high position of the fistula tract, surgical therapy of suprasphincteric fistulas is difficult and necessitates sphincter-

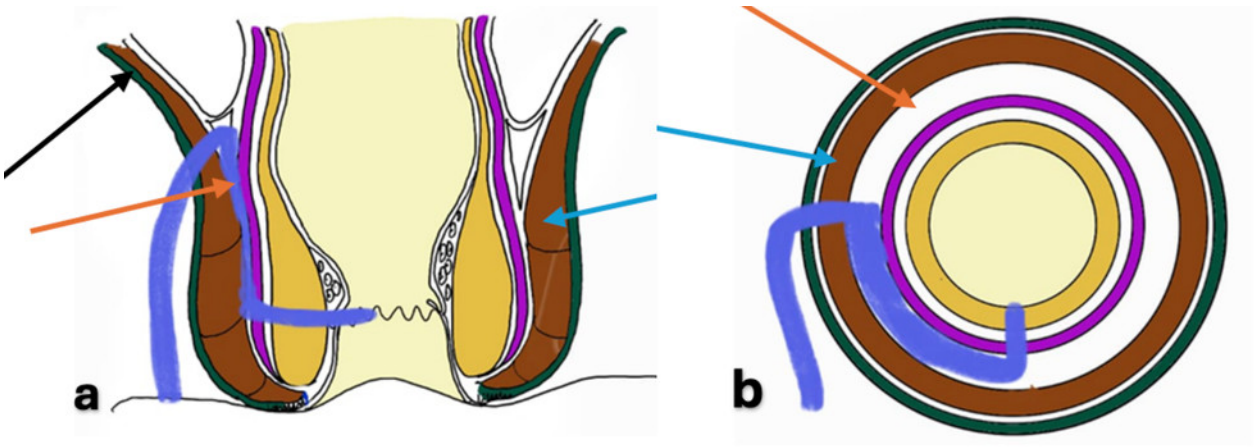


Figure 2: *Suprasphincteric fistula: Middle intersphincteric space (brown arrow), External anal sphincter (blue arrow), Levator ani muscle (black arrow). The suprasphincteric fistula passes above the puborectalis muscle, traversing the levator ani.*

preserving procedures like the LIFT or TROPIS surgery to prevent incontinence.

Figure 2: Suprasphincteric fistula: Middle intersphincteric space (brown arrow), External anal sphincter (blue arrow), Levator ani muscle (black arrow). The suprasphincteric fistula passes above the puborectalis muscle, traversing the levator ani.

2. Supralevator Fistula

Above the levator ani muscle, but without affecting the sphincter complex, is a supralevator fistula. The intersphincteric space between the sphincters has a high perianal fistula, and its top part extends to the supralevator space above the levator ani muscle (Figure 3). On T2-weighted sequences, the tract is visible above the levator ani muscle with clear borders. High intersphincteric tracts that ascend above the levator ani muscle are the outward manifestation of supralevator fistulas. During inspection, doctors can detect extra supralevator rectal openings (ASRO) and secondary supralevator abscesses. Computed tomography can be useful in detecting acute infections like supralevator abscess but cannot detect complexfistulous tracts (13). Pelvic sepsis causes the supralevator fistula, which necessitates extensive imaging prior to surgery. Because of their propensity to recur and develop supralevator abscesses, which necessitate surgeon-preserving treatments to prevent incontinence, surgical care of these fistulas is still difficult.

Figure 3: Supralevator fistula: External anal sphincter (blue arrow), Internal anal sphincter (purple arrow), Middle intersphincteric space (brown arrow), Supralevator fistula (black arrow).

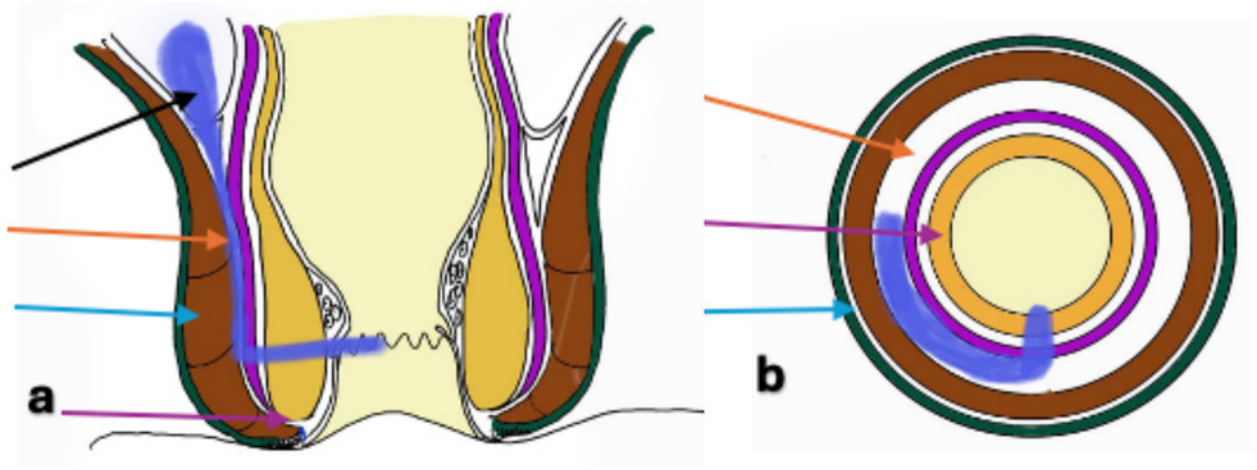


Figure 3: *Supralevator fistula: External anal sphincter (blue arrow), Internal anal sphincter (purple arrow), Middle intersphincteric space (brown arrow), Supralevator fistula (black arrow).*

3. Extrasphincteric Fistula

An extrasphincteric fistula, which arises from the rectum or sigmoid colon, completely circumvents the sphincter mechanism (Figure 4). The tract originates exterior to the sphincter mechanism,

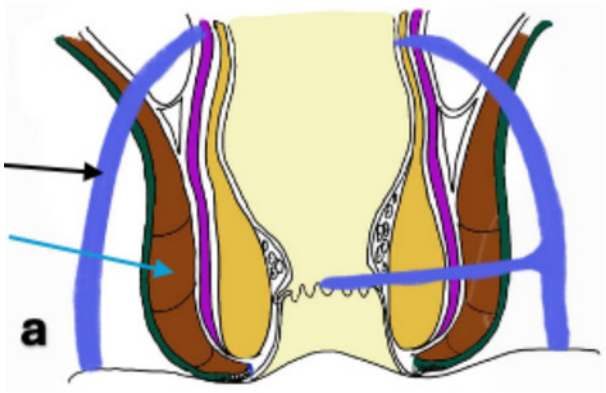


Figure 4: *Extrasphincteric fistula: External anal sphincter (blue arrow), Internal anal sphincter (purple arrow), Extrasphincteric fistula (black arrow) bypasses the sphincter mechanism altogether.*

traverses the levator ani, and frequently extends to the supralevator space associated with fat stranding or abscess formation on MRI. This variant typically does not involve sphincter muscle involvement. Causes of extrasphincteric fistulas include pelvic inflammatory disease, trauma, and surgical complications. Treatment requires management of both the fistula as well as the underlying condition, requiring sometimes a temporary colostomy, and often is very difficult to treat.

Figure 4: Extrasphincteric fistula: External anal sphincter (blue arrow), Internal anal sphincter (purple arrow), Extrasphincteric fistula (black arrow) bypasses the sphincter mechanism altogether.

4. RIFIL (Roof of ischiorectal fossa inside the levator ani muscle)

Involves the external anal sphincter (EAS), but unlike other fistulas, it does not enter the ischiorectal fossa. Instead, it extends upward between the EAS and its lateral fascia to reach the underside of the puborectalis and levator ani muscles (Figure 5). High-resolution T2-weighted MRI is important for detailed visualization of the fistula tracts, its secondary extensions, and deep fistula tracts. It extends upward between the EAS and its lateral fascia, reaching the underside of the levator ani muscle. It does not invade the ischiorectal fossa but stays within the outer space between the EAS and the levator ani muscle. The internal opening is usually at the dentate line, while the external opening is at the perineum. The standard fistulotomy procedure is not suitable for RIFIL because of the risk of damaging the anal sphincter. Instead, sphincter-sparing techniques like the TROPIS (Transanal Opening of the Intersphincteric Space) procedure are recommended.

Figure 5: Roof of ischiorectal fossa inside the levator ani muscle fistula (brown arrow). RIFIL: Roof of ischiorectal fossa inside the levator ani muscle. Levator ani muscle (black arrow).

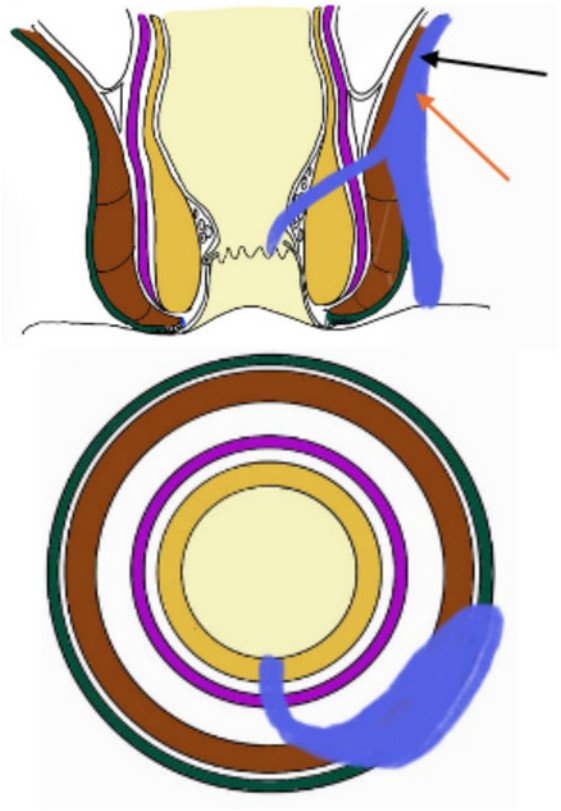


Figure 5: *Roof of ischiorectal fossa inside the levator ani muscle fistula (brown arrow). RIFIL: Roof of ischiorectal fossa inside the levator ani muscle. Levator ani muscle (black arrow).*

5. Intrarectal Fistula:

Intrarectal fistulae have tracts limited to the rectal wall, running between the internal anal sphincter (IAS) and the conjoint longitudinal muscle (CLM) and do not advance to the perianal skin (Figure 6). Endorectal ultrasound and MRI will help to show that intrarectal fistula His fistulous tract is limited to the rectal wall and will often be seen as fluid-filled on T2-weighted images. These fistulous tracts are located between the IAS and the CLM within the rectal wall, typically high in the anal canal, with an internal opening located high in the anal canal. These fistulas are often seen with inflammatory bowel disease, and sometimes medical therapy will be enough and may not require surgery. If surgical management is required, it is important to zero surgery can injure the sphincter muscles while doing the surgery. Procedures like TROPIS (laying open in to the anal cavity) have shown good effect with minimal impact on continence. Figure 6: Intrarectal Fistula: Inner intersphincteric space (black arrow), Intrarectal fistula (green arrow).

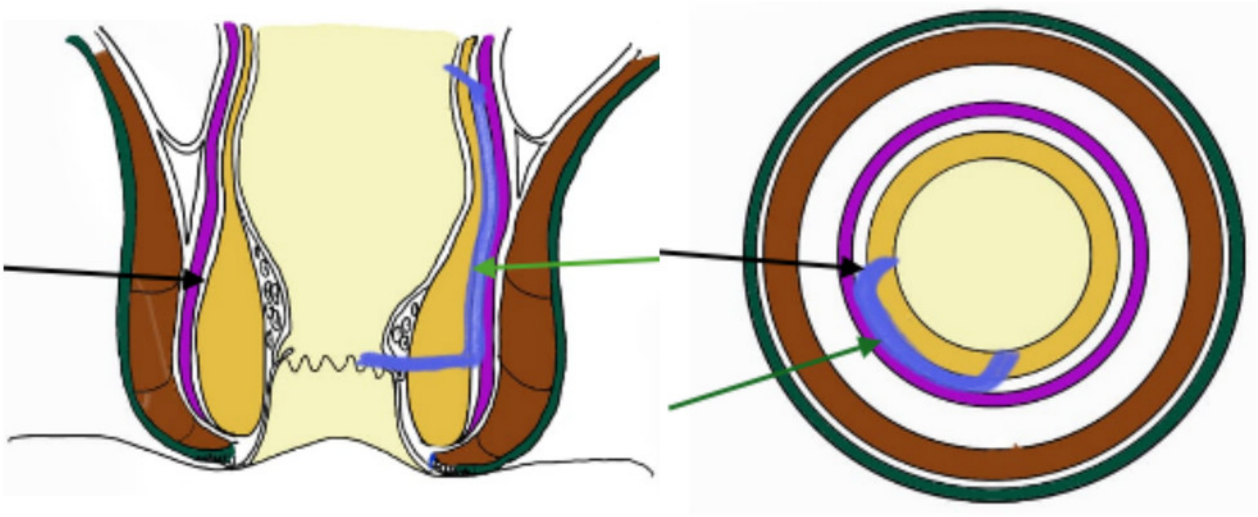


Figure 6: *Intrarectal Fistula: Inner intersphincteric space (black arrow), Intrarectal fistula (green arrow).*

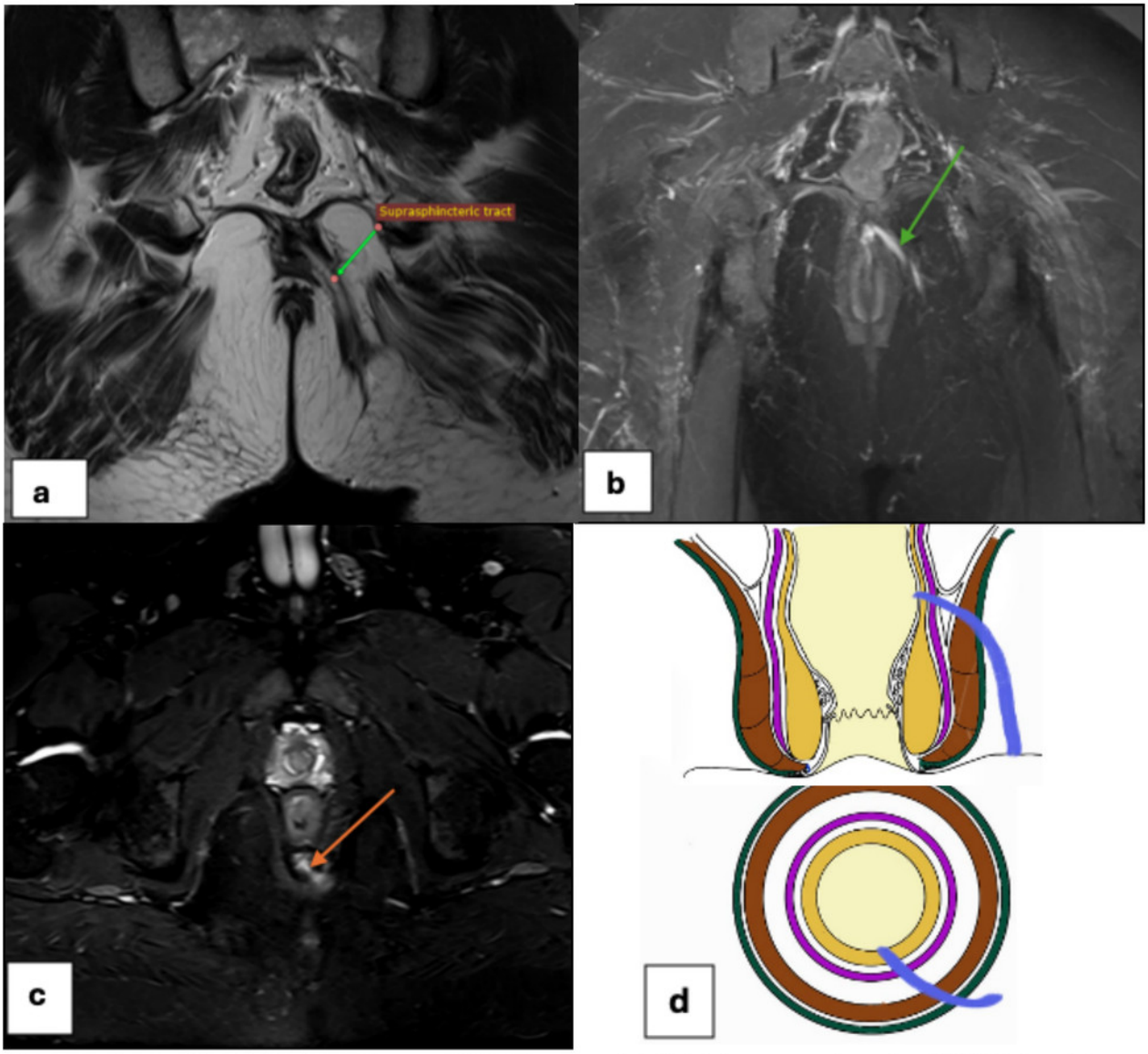


Figure 7: *Suprasphincteric fistula: a) T2 coronal b) T2 Tirm coronal c) Pictorial representation. a) and b) STIR hyperintense suprasphincteric fistulous tract with supralevator extension on the left side (greena arrow). External opening in the left medial gluteal cleft (not shown) and c) internal opening (arrow) in the lower rectum at 6' o clock position.*

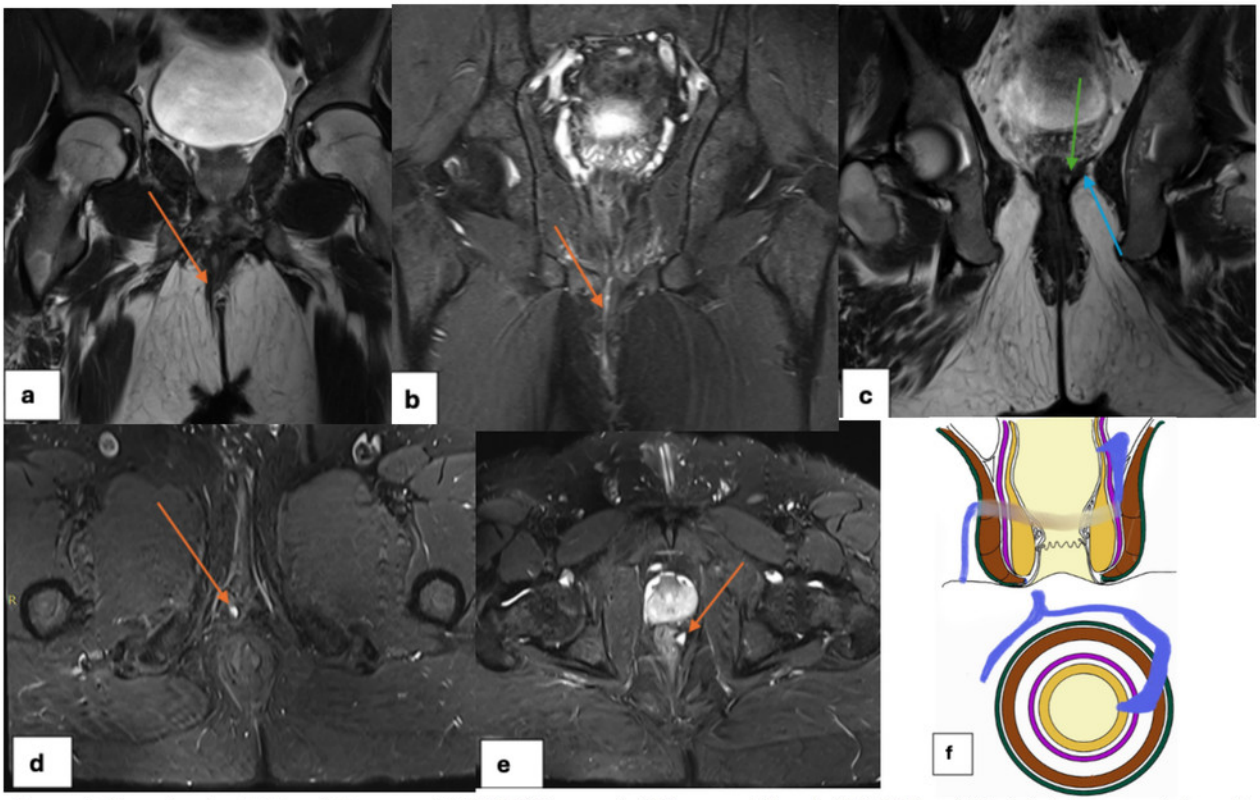


Figure 8: *Supralevator Fistula: a) T2 coronal b) T2 STIR coronal c) T2 coronal d) and e)T2 STIR axial f) pictorial representation. a) and b) T2/STIR hyperintense fistulous tract coursing along right ischioanal fossa and traversing anteriorly (d) crossing the midline with a supralevator extension (green arrow) {levator plate-blue arrow} and internal opening (e) (arrow) @ 3 o'clock position in lower rectal region.*

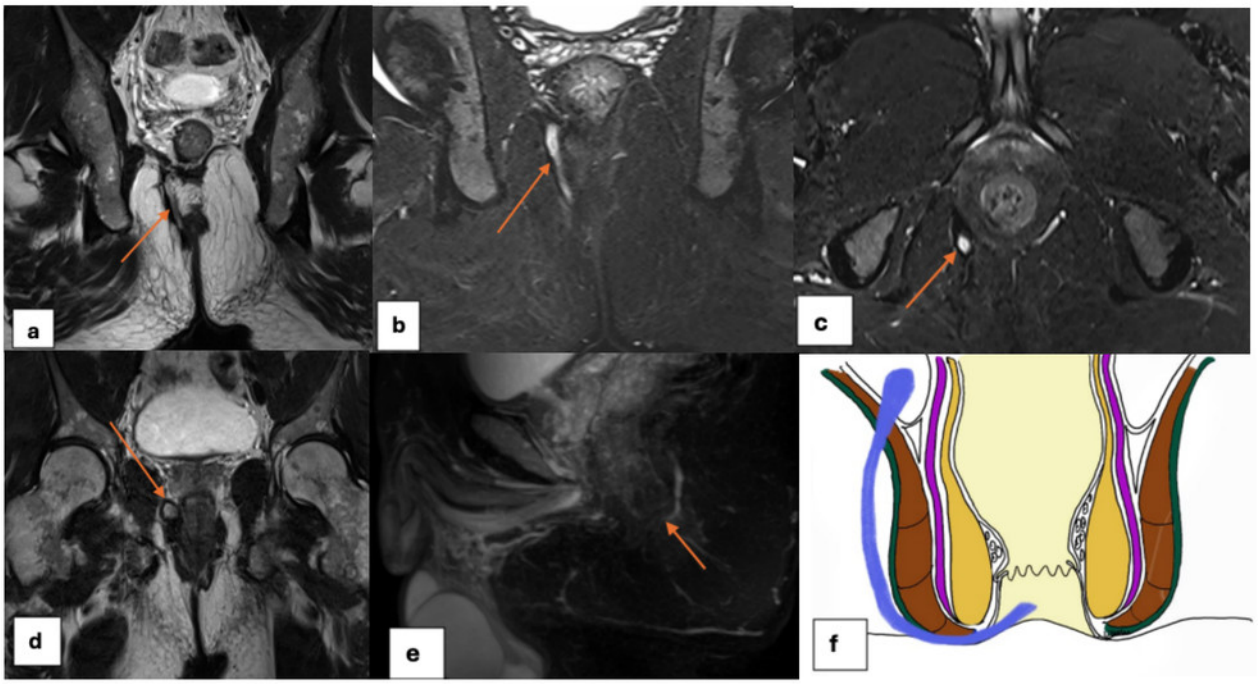


Figure 9: *Extrasphincteric Fistula: a) T2 coronal b) T2 STIR coronal c) T2 STIR axial d)T2 coronal e) T2 STIR Saggital MIP f) Pictorial representation. A) and b) Linear STIR hyperintense tract with internal opening at anal verge (e) (arrow) at 7'o clock position coursing along right ischiorectal and ischioanal fossa and piercining the levator plate forming a collection on the right side of prostate (d).*

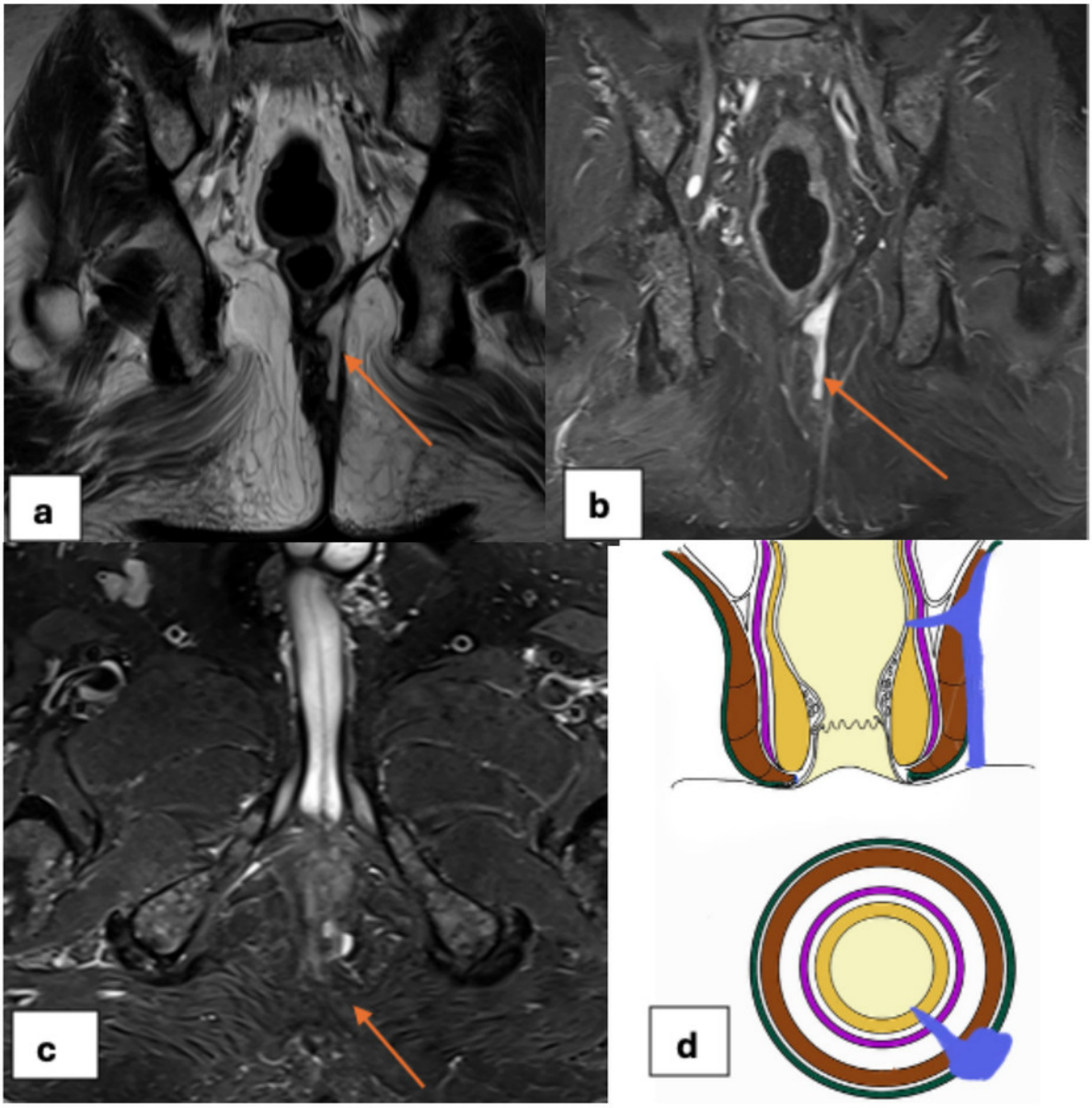


Figure 10: *RIFIL (Roof of ischiorectal fossa inside the levator ani muscle). a) T2 coronal b) T2 STIR c) T2 Coronal d) Pictorial representation. Linear STIR hyperintense extrasphincteric fistulous tract with internal opening at 5-6'o clock position 3.3 cm cranial to the anal verge traversing along the roof of ischiorectal fossa within the levator ani muscle.*

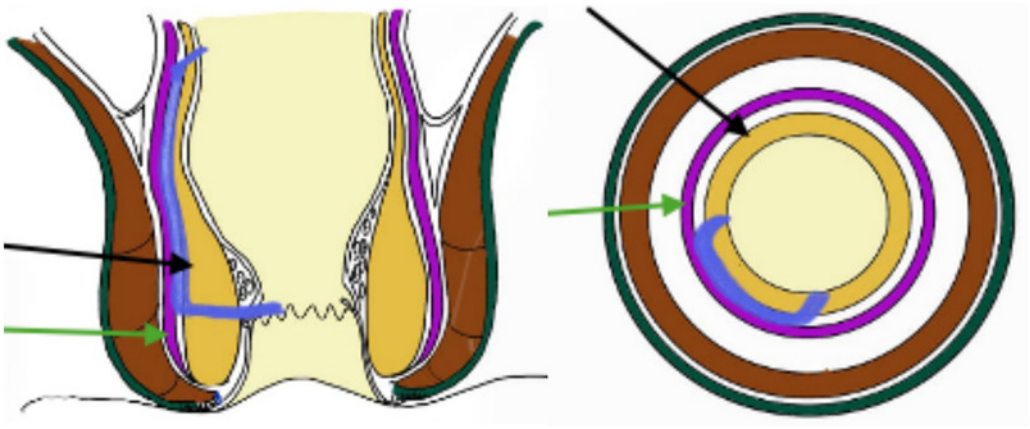


Figure 11: *Intrarectal Fistula: Pictorial representation. Intrarectal fistulae involve tracts confined within the rectal wall extending between the internal anal sphincter (IAS) (black arrow) and the conjoint longitudinal muscle (CLM) (greena arrow), not extending to the perianal skin.*

Setbacks in High 5 Fistula Management

1. Incontinence Risk: High 5 fistulas frequently involve the EAS; therefore, the risk of incontinence would be too great to perform a fistulotomy.

2. Diagnostic Confusion: The similar characteristics to other fistula types make it easy to confuse these.

3. Related Pathologies: Other conditions, such as Crohn's disease or tuberculosis, can complicate the management and rely on appropriate screening before any preoperative setting.

Conclusion:
The precise or definitive identification of high-5 perianal fistulas - Supralevator, Suprasphincteric, Extrasphincteric, RIFIL (Roof of Ischiorectal Fossa Inside Levator Ani Muscle), and High Intrarectal fistulas is incredibly significant to effective treatment and successful patient outcomes. High-5 fistulas are more involved with complex and deep pathways that greatly complicate management. When comparing high-5 fistulas to the typical five perianal fistula types classified by Parks (1) the additional depth and underlying anatomy challenges associated with high-5 fistulas become apparent. MR fistulography is a superior imaging option for the evaluation of high-5 fistulas as it provides the highest resolution images and depicts the overall depth and complex anatomy and extensions involved in high-5 fistulas. Parks' classification is important to recognize standard fistula-in-ano types; namely: intersphincteric, transsphincteric, suprasphincteric, extrasphincteric. MR imaging has changed the relevance of describing higher and more complex fistula types with high-5 fistulas characterized by deep high extensions involving or bypassing major muscular structures such as the external anal sphincter and levator ani, which may have been missed or misdiagnosed using the traditional physical examination or less complex imaging.

Advantages of MR Fistulogram in Diagnosing High-5 Fistulas

1. Detailed Assessment:
MR fistulography precisely generates high-resolution, multiplanar imaging designating accurately the pathways of high-5 fistulas, particularly with corruption extending to the supralevator space and ischiorectal fossa. This imaging allows clear distinctions to be made high-5 fistulas and the classic Parks types that have room for inappropriate classification leading to inadequate treatment.

2. Avoidance of Misclassification:
The imaging of MR allows differentiation of ambiguous fistulas; namely supralevator and suprasphincteric fistulas which overlap feature-wise. In traditional methods of imaging may introduce misclassifications, and enable respective treatment plans tailored to the destroyed characteristics of patient's fistula, thereby afterward eliminate unnecessary treatments.

3. Recognition of Accompaniments:
High-5 fistula often has additional other components related to aligning features such as supralevator abscesses, or ASRO which are difficult to recognize through imaging or examinations. Regular imaging reveals a difficult relationship to recognize MR fistulography is sensitive indicating all off the branches, allowing management into special unique features.

4. Sphincter preservation:
Because of the great risk for incontinence due to deep fistulas involving the external anal sphincter (EAS), MR imaging not only directs surgical planning related to sphincter preserving surgical techniques, but also prevents postoperative morbidity & preserves post-operative continence, which might not be retained if the anatomy and extent of the fistula was not appropriately delineated.

5. Surgical decision making:
The information gained from MR fistulography assists surgeons in making the right decision about minimally invasive procedures (either LIFT or TROPIS) as opposed to fistulotomy for high-5 cases. Furthermore, by evaluating all of the fistulous tracts and secondary extensions, this allows for a defined surgical approach with minimal recurrence, once again allowing all the factors to be intact when developing the surgical plan.

In conclusion, MR fistulogram is a valuable tool in assessment and treatment planning of high-5 perianal fistula, providing a level of anatomical detail and accuracy that is much more precise than the traditional classifications such as the Parks system, specifically by giving clear differentiations, identifying complex extensions, and supporting sphincter preserving techniques. MR imaging has proven the ability to allow clinicians

to more successfully manage these challenging fistulas. Therefore, it is critical that MR fistulograms are adopted as a standard diagnosis for high-5 fistulas, which will promote surgical success rates, and the quality of life for patients.

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Declarations

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References

1) Parks AG, Gordon PH, Hardcastle JD. A classification of fistula-in-ano. Br J Surg. 63 (1):1–12, (1976). https://doi.org/10.1002/bjs.1800630102

2) Halligan, S.J., Magnetic resonance imaging of fistula-in-ano: STIR or SPIR?, British Journal of Radiology, Volume 71, Issue 842, 1 February (1998), Pages 141–145. https://doi.org/10.1259/bjr.71.842.9579177

3) Jaime de Miguel Criado, Laura García del Salto, Patricia Fraga Rivas, Luis Felipe Aguilera del Hoyo, Leticia Gutiérrez Velasco, M. Isabel Díez Pérez de las Vacas, Ana G. Marco Sanz, Marcos Manzano Paradela, and Eduardo Fraile Moreno, MR Imaging Evaluation of Perianal Fistulas: Spectrum of Imaging Features, RadioGraphics (2012) 32:1, 175-194. https://doi.org/10.1148/rg.321115040

4) Spencer J A, et. al. Outcome after surgery for perianal fistula: predictive value of MR imaging. American Journal of Roentgenology (1998) 171:2, 403-406. https://doi.org/10.2214/ajr.171.2.9694464

References

5) Garg P, Yagnik VD, Dawka S, Kaur B, Menon GR. Guidelines to diagnose and treat perilevator high-5 anal fistulas: Supralevator, suprasphincteric, extrasphincteric, high outersphincteric, and high intrarectal fistulas. World J Gastroenterol. (2022) Apr 28;28(16):1608-1624.
https://doi.org/10.3748/wjg.v28.i16.1608

6) Bhaya, A. K., & Kumar, N. MRI with MR fistulogram for perianal fistula: a successful combination. Clin Gastrointest Magnetom, (2007) 1(1), 56-59.
https://cdn0.scrvt.com/39b415fb07de4d9656c7b516d8e2d907/1800000000012830/b47b587dbaa6/fistulogram_1800000000012830.pdf

7) Steve Halligan and Jaap Stoker Imaging of Fistula in Ano, Radiology (2006) 239:1, 18-33.
https://doi.org/10.1148/radiol.2391041043

8) Beckingham, I. J., et. al. Prospective evaluation of dynamic contrast enhanced magnetic resonance imaging in the evaluation of fistula in ano British Journal of Surgery, Volume 83, Issue 10, October (1996), Pages 1396–1398.
https://doi.org/10.1002/bjs.1800831022

9) Singh, K., et al., Magnetic Resonance Imaging (MRI) Evaluation of Perianal Fistulae with Surgical Correlation J Clin Diagn Res. (2014) Jun 20;8(6):RC01–RC04
https://doi.org/10.7860/JCDR/2014/7328.4417

10) Chiara Villa, Giovanni Pompili, Giuseppe Franceschelli, Alice Munari, Giovanni Radaelli, Giovanni Maconi, Gian Paolo Cornalba, Role of magnetic resonance imaging in evaluation of the activity of perianal Crohn's disease, European Journal of Radiology, Volume 81, Issue 4, (2012), Pages 616-622, ISSN 0720-048X.
https://doi.org/10.1016/j.ejrad.2011.01.046

11) Daabis, N., et al. MRI evaluation of perianal fistulas. The Egyptian Journal of Radiology and Nuclear Medicine, Volume 44, Issue 4, December (2013), Pages 705-711.
https://doi.org/10.1016/j.ejrnm.2013.09.003

12) Pomerri, F., et al. Radiologic diagnosis of anal fistulas with radio-opaque markers. La Radiologia Medica, 01 Jun (1988), 75(6):632-637.
https://europepmc.org/article/med/3387616

13) Emily J. Bubbers , Kyle G. Cologne, Management of Complex Anal Fistulas. Clin Colon Rectal Surg (2016); 29(01): 043-049.
https://doi.org/10.1055/s-0035-1570392

14) Torkzad, M.R., Karlbom, U., MRI for assessment of anal fistula. Insights Imaging 1, 62–71 (2010).
https://doi.org/10.1007/s13244-010-0022-y

15) Morris J, Spencer JA, Ambrose NS. MR imaging classification of perianal fistulas and its implications for patient management. RadioGraphics. 2000;20(3):623-635; discussion 635-637.
https://doi.org/10.1148/radiographics.20.3.g00mc15623