Perianal fistulae on MRI: What you need to know and what the surgeons need to hear.

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**Learning objectives**

- Understanding of the relevant anatomy of the anal canal, sphincters, ischiorectal fossa and levator ani.

- Summary of appropriate MRI sequences for anatomy and pathology delineation.

- Classification of perianal fistulae: Understanding of the four principle descriptions and the challenges to applying them. Recognising simple and complex fistulae.

- Understanding of techniques used for effective and clear reporting.

- Appreciation of the key principles of surgical management of perianal fistulae.

**Background**

- Perianal fistulisation is an inflammatory condition that causes significant morbidity and often requires repeated surgical treatments due to its high tendency to recur.

- To adopt the best surgical strategy and avoid recurrences, it is necessary to obtain precise radiologic information about the location of the fistulous track and the affected pelvic structures.

- MR is particularly useful in revealing hidden areas of sepsis and secondary extension, both of which can increase likelihood of recurrence. While transrectal ultrasound does accurately depict both fistulae and their relation to the anal sphincter muscles, the operator dependence, limited field of view and absence of a coronal plane of imaging are its disadvantages (1). Fistulography (CT or fluoroscopic) is limited by the fact that attenuation values of the fistula tract, the areas of fibrosis, and sphincter muscles are similar to each other. This results in poor anatomical delineation and the technique is now rarely used.
• Radiologists and trainees should therefore develop a clear and methodical approach to assessment of perianal fistulae on MRI and adopt an explicit and effective reporting terminology to aid surgical management.

Findings and procedure details

ANATOMY:

Rectum:
Sigmoid colon to Dentate Line

Dentate Line:
Hindgut (simple columnar epithelium) meets ectoderm (stratified squamous epithelium); located 2cm superior to anal verge; The dentate line is an important anatomical landmark for differentiating vasculature, nerve supply, lymphatic drainage.

The majority of internal openings of fistulae are located around the anal glands surrounding the dentate line.

Anal Canal:
Dentate line to anal verge

Internal Sphincter:
A muscular ring comprising 2.5-4cm of the anal canal, the internal sphincter is responsible for liquid and gas continence. It inferiorly contacts the external sphincter.

External Sphincter:
Made up of superficial and deep portions, this is a flat plane of muscular fibres which encircle the anus and meet in front to be inserted into the central tendinous point of the perineum. The upper edge of the muscle is ill-defined, since fibers are given off from it to join the Levator ani.

Puborectalis (Levator Ani):
A broad, thin muscle, the puborectalis is attached to the inner surface of the side of the lesser pelvis, and unites with its fellow of the opposite side to form the greater part of the floor of the pelvic cavity.

**IMAGE ORIENTATION:**

Firstly, sagittal fast spin echo T2-weighted sequence are acquired to overview the pelvis and anal canal orientation. The levator plate and entire perineum must be included.

The anal canal tilts forwards from the vertical approximately 45 degrees from the vertical in the sagittal plane - oblique axial and coronal images are therefore optimum to delineate the canal fully - for the purposes of reporting, these orthogonal planes are described as simply 'axial' and 'coronal'. Fig. 1 on page 9

T2-weighted images are preferred to effectively illustrate the anatomy - delineating the internal and external sphincters clearly.

However, fat-suppressed T2-weighted sequences (eg STIR) or fat-saturated FSE T2 images increase the conspicuity of fluid within tracks/abscesses. Fig. 2 on page 9 There is also improved delineation of soft tissue oedema.

Thus two orthogonal planes are required to display all the relevant anatomy: (Oblique) axial Fig. 3 on page 9 and (oblique) coronal Fig. 4 on page 10.

T2W images (TSE and fat-suppressed) provide good contrast between the hyperintense fluid in the tract and the hypointense fibrous wall of the fistula, while providing good delineation of the layers of the anal sphincter as well as the levator ani and ischiorectal fossae.

At our institution the standard fistula protocol includes four sequences:

T2 Axial
T2 Coronal
Fat-sat T2 Axial
Fat-Sat T2 Coronal.
Some institutions advocate the use of Gadolinium-enhanced T1-weighted images, which can be useful to differentiate a fluid-filled tract from an area of inflammation, or even a vessel. The tract wall enhances, whereas the central portion is hypointense. Abscesses are also well depicted on post-gadolinium images (2).

**Classification of Anal Fistulae:**

Relationship of the primary track with the sphincter muscles is imperative as surgical management must aim to preserve continence.

Classifications are designed to illustrate the route taken from the anal canal to the skin.

Parks et al described four principle fistula types in order to help simplify the categorisation of the many varieties of fistula. This was achieved by describing their predominant course and relationship with the perianal antomy - it is important to remember that many have a tract that could be allocated to more than one group Fig. 5 on page 10.(3)

**Intersphincteric Fistula:**

These fistulae only track in the intersphincteric space and do not traverse the external sphincter. This helps form an effective barrier against infection spread and thus these make up the majority of perianal fistulae(45%). The tract runs along the longitudinal muscle layer between the sphincters. The tract may or may not reach skin surface. Fig. 6 on page 11

**Transphincteric Fistula:**

Most commonly tracks from the internal opening at the dentate line via the internal and external anal sphincters into the ischiorectal fossa and then terminates in the perianal skin or perineum. This fistula often results in an ischiorectal fossa abscess. Fig. 7 on page 12

**Suprasphincteric Fistula:**

Passes from the internal opening at the dentate line to the intersphincteric space and then tracks superiorly to above the puborectalis muscle. It then typically curves downward peripheral to the external sphincter into the ischiorectal fossa and then to the perianal skin or perineum. These fistulas may result in a supralelevator abscess. Fig. 8 on page 13,

**Extrasphincteric Fistula:**
Least common perianal fistula - more often associated with penetrating traumatic injury, inflammatory bowel disease or pelvic inflammatory disease. Often breaches the perianal skin via ischiorectal fossa tracking upwards and through the levator ani muscles to the rectal wall completely outside the sphincter mechanism. Extrasphincteric fistulae are more commonly associated with complex tracts/collections. Fig. 10 on page 14

Since complex fistulae may be difficult to formally categorise into the Parks types, many involving a combination of tracts, classifying fistulae and sepsis by disease extent can also be useful. Shown here is a reporting classification described by Morris et al from a study at the St James University Hospital in Leeds (4). Fig. 11 on page 16

**Reporting - Key points to include:**

**Location:** Use a 'Clock Face' description (eg. '4 o'clock') for tract location at the external opening, extrasphincteric course, intersphincteric course and internal opening relative to the anal canal. Height from the anal verge must also be included.

**Course:** Description should read as per the 'surgeon's eye view'

Start at the external opening and follow course in towards the anal canal - "out-to-in". Fig. 12 on page 16

**Relationship to sphincters:**

Proximity /involvement of sphincters has connotations for increased risk of incomplete healing, fistula recurrence and sphincter injury. This in turn of course has implications for continence post-surgery and the necessity of a potential diverting colostomy to allow healing.

**Simple or Complex?**

**Simple Fistula:**

Minimal or no involvement of external sphincter or puborectalis e.g. Intersphincteric, low-lying Transsphincteric

**Complex Fistula:**

Involvement of > 30% of external sphincter
Suprasphincteric/Extrasphincteric or high fistulas (proximal to dentate line)

Fistulas with multiple, hidden or blind-ending tracts. Fig. 13 on page 16

Horseshoe tracts / collections. Fig. 14 on page 17

Deep abscess formation.

Recurrent fistulas

Fistulas related to IBD, infection (TB, HIV), radiation

**EXAMPLE REPORT:**

"The external opening of the fistula lies approximately 2cm posterior to the anal verge, in the 5 o'clock position.

The tract passes through the external sphincter in the 5 o'clock position, and tracks cranially in the intersphincteric plane by approximately 2.5cm.

The internal opening lies in the 5 o'clock position, approximately 2.5cm above the anal verge. No horseshoe collection is demonstrated. There is no ischioanal or ischiorectal collection. There is no supralevator disease.

The appearances are in keeping with a simple transphincteric fistula"

**Surgical Management**

**Simple Fistula :**

1) Fistulotomy - Lay open fistula tract, make incision over the entire length of fistula using probe/wire as a guide.

2) Fibrin plug - The fistula is extensively cleaned of the epithelial lining using a curette or gauze strip. A double-armed catheter is then inserted into the external opening and solutions of fibrinogen and thrombin are injected slowing into the fistula tract.

This results in a fibrin clot in the fistula tract that may enhance the migration and activation of fibrinoblasts and the formation of a collagen network.
The technique may have the advantage of greater preservation of sphincter function. (5) The impact on quality of life and recurrence rate is still under investigation (eg. 'FIAT' trial).

**Complex Fistulas:**

1) Seton (Staged Fistulotomy) - A suture is passed though the fistula tract. Tightening of the seton at regular intervals allows for slow transection of muscle and migration of the sphincter tract out to the skin surface, minimizing sphincter dysfunction Fig. 16 on page 18.

NB: The seton suture appearances on MRI (Fig. 17 on page 18) can mimic gas within a collection or tract demonstrated earlier (Fig. 14 on page 17)

2) Mucosal advancement flap - This technique is advocated in high-risk fistulas that cross the external sphincter at a high level or in women with anteriorly based fistulas - the technique was originally borrowed from the repair of recto-vaginal fistulas. It involves excision of the internal opening, curettage of the fistulous tract, suture ligation of the fistula, and advancement of a flap of healthy mucosa and submucosa over the previous opening via a tension-free closure. (6)

At our institution we are taking part in the Fistula-in-Ano Trial (FIAT).

Based in Birmingham FIAT will compare the Surgisis® anal fistula plug with the surgeon's preference; advancement flap, fistulotomy or cutting seton, for the treatment of transsphincteric fistula-in-ano. The aim is to improve symptom specific quality of life and to assess if use of the plug improves healing rates, improves faecal continence and reduces fistula recurrence.

The criteria for a patient's involvement in the trial include the following:

- Clinical diagnosis of high transsphincteric fistula-in-ano.
- Fistula tract # 2cm in length.
- Single internal fistula present at EUA treatable by insertion of a single fistula plug.
- Patients must have been treated with a draining seton for a minimum period of 6 weeks prior to randomisation.

The trial is evidence to the fact that continued improvement in patient outcomes relies on accurate and detailed description of perianal fistula to taylor management appropriately.
Images for this section:

**Fig. 1:** Oblique coronal images are acquired in the plane of the anal canal (blue). Oblique axial images are acquired perpendicular to this (red).

**Fig. 2:** The T2-weighted axial image clearly delineates the sphincteric anatomy (left). The focus of high signal seen anteriorly is markedly more conspicuous on the fat-saturated image (centre).
**Fig. 3:** Diagram illustrating the relevant anatomy on an axial MRI image

**Fig. 4:** Diagram illustrating the relevant anatomy on a coronal MRI image
• A: Intersphincteric (45%)
  • Do not traverse the external sphincter

• B: Transphincteric (30%)
  • Enter ischioanal space via perforating external sphincter, horseshoe fistulas are also in this category.

• C: Suprasphincteric (20%)
  • Loops over external sphincter, perforates levator ani.

• D: Extra sphincteric (5%)
  • External to sphincter muscle, often seen with supralevator abscesses; may arise from a cryptoglandular origin but also trauma, foreign body, or a pelvic abscess, such as diverticular or appendiceal abscess.

**Fig. 5:** Diagram illustrating Parks Classification of Perianal Fistulae.
Fig. 6: High signal within the intersphincteric space in the 2 o’clock position demonstrates the tract on the axial (top row) and coronal (bottom row) images - note there is no visible penetration of the external sphincter
Fig. 7: The tract can clearly be seen penetrating both the internal and external sphincters in the 7 o'clock position on these axial images.
**Fig. 8:** On these two axial images, the tract can be seen first passing through the internal sphincter in the 7 o'clock position (A), and then descending lateral to the external sphincter within the ischioanal fossa (B)

**Fig. 9:** Coronal images demonstrate the fistula tract (and abscess) within the right ischioanal fossa
**Fig. 10:** Axial and coronal images demonstrate the fistula tract passing clear of the sphincter mechanism (A), though the left ischioanal tract (B). There is clear perforation of the levator ani on the left (C).

<table>
<thead>
<tr>
<th>Type</th>
<th>Surgical Outcome</th>
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<tbody>
<tr>
<td>Type 1: Simple Intersphincteric</td>
<td>Simple surgical measures should confer a favourable outcome.</td>
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<tr>
<td>Type 2: Simple Intersphincteric + abscess / accessory tracts</td>
<td>More complex surgery may be required that may threaten continence or may require colostomy to allow healing.</td>
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<tr>
<td>Type 3: Trans sphincteric</td>
<td></td>
</tr>
<tr>
<td>Type 4: Trans sphincteric + abscess / accessory tracts</td>
<td>Source of pelvic sepsis should be sought.</td>
</tr>
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<td>Type 5: Translevator (Supralevator disease)</td>
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**Fig. 11:** The St James University Hospital Classification of Perianal Fistulae. (Morris et al)

**Fig. 12:** 'Clock Face' centred on the anal canal in the axial plane to illustrate its role in describing relative fistula tract position (A). The 'out-to-in' direction of report's description of the tract (B)
**Fig. 13:** A blind ending secondary fistulous tract (A) and multiple tracts and external openings in the coronal (B) and axial planes (C)

**Fig. 14:** Horseshoe intersphincteric fistula tract. These fistulas are often treated by unroofing of the lateral tracts and opening the deep post-anal space via an extrasphincteric incision posterior to the anus, division of the internal sphincteric component, and placement of a cutting seton. In this example, note the presence of gas within the tract on the right (arrow).
**Fig. 15:** Treatment of simple fistulae: Fistulotomy over a probe (Left). A Fibrin plug through a simple transphincteric fistula (Right).

**Fig. 16:** Silk ties, vessel loops, or even penrose drains are brought around the fistulous tract and secured with a tie to form a cutting seton. The remaining tract is then excised. The seton can then be sequentially tightened in the clinic with additional ties. The seton will allow fibrosis and scaring proximal to the ligature allowing the muscle to hold together while the fistulous tract fibroses.
**Fig. 17:** The small foci of low signal within the high signal of the fistula tract reveal the seton suture.
**Conclusion**

Appropriate sequence selection and protocolling is crucial in order to achieve the optimum potential of MRI in perianal fistula imaging.

The wide variety of anal fistula are difficult to categorise using the conventional Parks classification. Becoming familiar with the priniciple types using still images from textbooks and journals is even harder and there is no substitute for practice with the ability to 'scroll' through the fistula tract.

Finding a clear and succinct way of simplifying and then communicating the tortuous and highly varied path of a fistula is crucial for aiding surgical planning.

Appropriate selection of surgical technique will have a significant impact on healing and recurrance and the radiologist plays an important role in that process.

**Personal information**

**References**

(1).

(2).

(3).

(4).

(5).


(6).