MR imaging classification of perianal fistulas: All that the radiologist need to know

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Learning objectives

Perianal fistulization is an uncommon but important condition of gastrointestinal tract that causes substantial morbidity and it has a tendency to recur despite adequate surgery.

Until recently, imaging had a limited role in the preoperative assessment of perianal fistulas. It is now increasingly recognized that preoperative imaging, notably Magnetic Resonance (MR) imaging, can help identify infected tracks and abscesses that would otherwise have been missed.

MR imaging has been shown to demonstrate accurately the perianal anatomy and to influence subsequent surgery and markedly reduce the chance of recurrent disease as a result.

In this electronical presentation we review the anatomy of the perianal region and useful MR imaging protocols for this evaluation. We describe an MR imaging-based grading system for perianal fistulas (The St James's University Hospital Classification) and, most important, how the radiologist is well placed to answer the surgical questions that must be solved for treatment to be effective.

Images for this section:
Background

Anatomy, Etiology, Prevalence and Surgical Management

Anatomy

The anal canal is essentially a cylinder surrounded by two muscular sphincters, the internal and external anal sphincters (Fig. 1 on page 9, 2 on page 10 and 3 on page 11). The internal sphincter is involuntary and is composed of smooth muscle continuous with circular smooth muscle of the rectum. It is responsible for 85% of the resting anal tone. The external sphincter is composed of striated muscle and has a posterior attachment to the anococcygeal ligament and anterior attachment to the perineal body and urogenital diaphragm (and bulbocavernous muscle in men) and merges proximally with the puborectalis muscle (which defines the anorectal junction), which itself merges with the levator plate of the pelvic floor. It contributes only 15% of the resting anal tone, but its strong voluntary contractions resist defecation. The internal sphincter can be divided without causing a loss of continence but a division of the external sphincter can lead to incontinence.

The intersphincteric space is the surgical plane of dissection between the internal and external sphincters where it exists as a sheet of fat containing loose areolar tissue. The fat-filled ischiorectal fossa lies lateral to the sphincter complex and is traversed by a network of fibroelastic connective tissue fibers.

Etiology

Most authorities believe that it is the infection of the intersphincteric glands that is the initiating event in anal fistula, in a process known as the "Cryptoglandular Hypothesis". The glands are branched glandular structures with a stratified columnar epithelial lining, numbering about six, that are distributed fairly evenly around the anus, with ducts opening into the crypts of Morgagni located just above the anal valves at the level of the dentate line. The majority of the glands are subepithelial in position, with a few lying in the longitudinal layer deep to the internal sphincter; some may be located in the external sphincter. Should an abscess develop in an infected gland, this is most likely to discharge spontaneously into the anal canal providing the abscess is superficial to the internal sphincter, but if the abscess is deep to the sphincter, the sphincter will act as a barrier, and when the abscess ruptures, pus will track along the path of least resistance, usually along an intersphincteric or transsphincteric route, forming a sinus and eventually a fistula when the track reaches the skin to create an external opening. A fistulous track has a central core of acute on chronic inflammatory tissue surrounded by chronically inflamed fibrous tissue. Part of the lumen of a chronic track may become lined with epithelium from adjacent epithelium around either the external or internal opening.

Abscess cavities may develop along the course of fistulous tracks. It is believed that gland infection results in an intersphincteric abscess if draining duct becomes blocked by infected debris.
However, perianal fistulas may also be caused by other conditions and events, including Crohn disease, trauma during childbirth, pelvic infection, tuberculosis, pelvic malignancy and radiation therapy. Most notable is Crohn's disease, in which fistula formation is unrelated to anal gland infection, and is due instead to the primary disease, trauma, or tumor. Disease processes not affecting the anus, such as diverticulitis, may create extrasphincteric tracks into the rectum or may communicate directly with other viscera or the vagina.

Prevalence:

Perianal fistulas have a prevalence of approximately 0.01% and predominantly affect young adults. Perianal fistulas are commoner in men, with a male-female ratio of approximately 2:1. Patients most commonly present with discharge (65%) but local pain due to inflammation is also frequent.

Surgical Approaches

Surgeons describe the site and direction of fistulous tracks by referring to the "anal clock" (fig. 4 on page 12); that is, the view of the anal region usually used for fistula surgery. At 12 o'clock is the anterior perineum and at 6 o'clock, the natal cleft; 3 o'clock refers to the left lateral aspect, and 9 o'clock, to the right of the anal canal. Fortunately, these descriptions correspond exactly with the view of the anal canal on axial MR images, and it is helpful for surgical colleagues if the radiologists relate the MR imaging findings to the anal clock.

Surgical management of perianal fistulas depend on the nature of the primary fistula and any secondary fistulous tracks or associate abscesses. In the simple intersphincteric fistulas, the surgeons performs a fistulotomy or fistulectomy, in which the internal sphincter is divided to lay open track. In perianal abscess, the treatment generally consist of simple incision and drainage first of the most fluctuant part of the abscess.

The main problem in surgical management is balancing how much of the sphincter complex has to be divided to achieve healing, against the risk of inducing incontinence. Approximately 1 in 20 patients will experience some flatus incontinence from division of the internal sphincter. Preservation of fecal continence is the paramount consideration and treatment approaches aim to preserve the integrity of external sphincter.

In cases in which fistulotomy would involve cutting too much of the sphincter, setons may be used. Setons are threads that are tied through the fistula, which keep the fistula open and draining. Although the track may never heal completely, acute sepsis is avoided. Patients may have setons in situ for many years. Other surgical options include core-out fistulectomy or advancement flaps. Surgery in Crohn's disease has to be sphincter conserving, because there are usually multiple tracks and the nature of the disease makes recurrence common.

All sepsis must be eradicated surgically to prevent fistula recurrence. The identification of all fistula components, the external and internal openings, type of track, and any secondary extension, is therefore essential for surgical planning. Anal fistulas surgery has a significant
recurrence rate, up to 25%. This may be due to some part of the track system not being recognized at surgery, inadequate drainage of sepsis, or false communications formed by injudicious probing. The role of radiology is to demonstrate clinically undetected sepsis, guide initial surgery, and reveal the site of residual sepsis in recurrent fistula. The objective must be that preoperative imaging improves surgical outcome in both primary and recurrent fistula surgery.

**Images linked within the text of this section:**

**Fig.:** Illustration of normal anatomy of perianal region in the axial plane
Fig.

Additional images for this section:
**Fig. 1**: Illustration of normal anatomy of perianal region in the axial plane
Fig. 3
Perianal Fistulas Classification:

Fistulas may be thus classified according to the route taken by this primary tract that links the internal and external opening. There are two basic classifications: The Parks classification and St James's University Hospital Classification.

Parks classification:

Parks et al described the course and the relationship of perianal fistulas to the sphincter mechanism with reference to the coronal plane. Parks et al carefully analyzed a consecutive series of 400 patients referred to the surgeons of St Mark’s Hospital, London, England. They found that they were able to assign all fistulas into one of four groups: intersphincteric, transspincteric, suprasphincteric, and extraspincteric. Of importance, most of these groupings could be explained in terms of the crypt glandular hypothesis.

The intersphincteric fistula (Fig. 5 on page 37) composed 45% of cases in the series of Parks et al. This fistula does not penetrate the adjacent external sphincter, which forms a relative barrier to spread. The track runs within the longitudinal layer between internal and external sphincters, and may exit through or medial to the subcutaneous external sphincter.

Some fistulas can cross the external sphincter and reach the ischiorectal fossa, this results in a transspincteric fistula which composed 30% of cases (Fig. 5 on page 37).

Other fistulas may spread upward in the intersphincteric space and loop over the puborectalis muscle, where cross the levator plate to reach the perianal skin (Fig. 6 on page 38). The suprasphincteric fistula composed 20% of the cases in the series of Parks et al.

The fourth type of perianal fistula is the extrasphincteric fistula that composed the 5% of the cases and consists in a direct communication between the perineum and rectum (or other viscer) with no anal canal involvement (Fig. 6 on page 38). This fistula entered the rectum or anorectal junction directly. The infection of the anal glands cannot explain this type of fistula and Parks et al stressed that primary rectal or pelvic disease (eg: diverticular disease, rectal Crohn disease, carcinoma) should be sought when this type was encountered.

St James's University Hospital Classification

The MR imaging’s based classification used in our institution, the St James's University Hospital classification, consists of five grades and relates the Parks surgical classification to anatomy seen at MR imaging in both axial and coronal planes (Fig. 7 on page 39). We believe that this system is easy to use because it utilizes axial anatomic landmarks familiar to radiologists. Its application relies on simple evaluation of this anatomy and reproducible
discriminators. Furthermore, the system has been validated in cases with surgical proof and has been shown to correlate better than initial surgical assessment with long-term outcome.

**Grade 1: Simple Linear Intersphincteric Fistula** (Fig. 8 on page 40). In a simple linear intersphincteric fistula, the fistulous track extends from the anal canal to the skin of the perineum or natal cleft, and the ischiorectal and ischioanal fossa are clear. There is no ramification of the track within the sphincter complex. The enhancing track is seen in the plane between the sphincters and is entirely confined by the external sphincter (Fig. 9a on page 41 and 9b on page 42). Fistulous tracks arising behind the transverse anal line, which are by far the most common type, enter the anal canal in the midline posteriorly (Fig. 10 on page 43).

**Grade 2: Intersphincteric Fistula with Abscess or Secondary Track** (Fig. 11 on page 44). Intersphincteric fistulas with an abscess or secondary track are also bounded by the external sphincter. Secondary fistulous tracks may be of the horseshoe type, crossing the midline, or they may ramify in the ipsilateral intersphincteric plane (Fig. 11 on page 44). Even when there is abscess formation, this process is confined within the sphincter complex regardless of imaging plane or sequence. Intersphincteric abscesses and secondary fistulous tracks are well shown by dynamic contrast-enhanced MR imaging. On these contrast-enhanced images, the pus in the central cavity has low signal intensity and is surrounded by a brightly enhancing rim. A horseshoe fistula, in which the process extends to the opposite side, is best demonstrated in the axial plane.

**Grade 3: Transphincteric Fistula** (Fig. 12 on page 45). The transphincteric fistula pierces through both layers of the sphincter complex and then arcs down to the skin through the ischiorectal and ischioanal fossa. Thus, a transphincteric fistula may disrupt the normal fat of the ischiorectal and ischioanal fossa with secondary edema and hyperemia (Fig. 13 on page 46). These fistulas are distinguished by the site of the enteric entry point in the middle third of the anal canal (ie, corresponding to the position of the dentate line), as seen on coronal images. Because these fistulas disrupt the integrity of the sphincter mechanism, their tracks must be excised by dividing both layers of the sphincter, thus risking fecal incontinence.

**Grade 4: Transphincteric Fistula with Abscess or Secondary Track within the Ischiorectal Fossa** (Fig. 13 on page 46). A transphincteric fistula can be complicated by sepsis in the ischiorectal or ischioanal fossa. Such an abscess may manifest as an expansion along the primary track or as a structure distorting or filling the ischiorectal fossa. Axial and coronal dynamic contrast-enhanced MR imaging clearly depicts a transphincteric abscess, which characteristically has a central focus of low-signal-intensity pus (Fig. 13 on page 46). As with grade 3 lesions, the key anatomic discriminator of a grade 4 fistula is the track crossing the external sphincter. The track or its associated abscess clearly involves the ischiorectal or ischioanal fossa (Fig. 13 on page 46).

**Grade 5: Supralevator and Translevator Disease** (Fig. 14 on page 47). In rare cases, perianal fistulous disease extends above the insertion of the levator ani muscle. Suprasphincteric fistulas extend upward in the intersphincteric plane and over the top of thelevator ani to pierce downward through the ischiorectal fossa (Fig. 14 on page 47).
Extrasphincteric fistulas reflect extension of primary pelvic disease down through the levator plate. These fistulas pose problems for management because further assessment is needed to detect pelvic sepsis. Coronal dynamic contrast-enhanced MR imaging elegantly demonstrates breaches of the levator plate, which is clearly shown in this plane. In some translevator fistulas, horseshoe ramifications to the contralateral side may occur.

**Preoperative evaluation and treatment of perianal fistulas**

The accuracy of MR imaging has been confirmed by comparison with surgery. Initial reports suggested a concordance rate of 86% to 88%, with later reports describing up to 100% sensitivity for detecting the primary track, 96% sensitivity for abscesses, 100% sensitivity for horseshoe extensions, and 96% sensitivity for internal openings. MR imaging has been shown to be particularly useful in complex fistula secondary to Crohn's disease which is often associated with large abscesses and multiple tracks.

The objectives in performing and interpreting any imaging study for perianal fistulas are simple:

1. **To determine the relationship of any fistulous track to the sphincter complex.** Is the sphincter involved? does the track traverse both layers of the sphincter (trans-sphincteric) or only the internal sphincter (intersphincteric)? And can the track be safety laid open with only a low risk of postoperative incontinence?

2. **To identify any secondary fistulous tracks and the sites of any abscess cavities:** are there any extension from the primary tract that need to be treated to prevent recurrence?, and, if so, where they are? Failure to detect and eradicate these may lead to relapse and thus therapeutic failure.

In recent years, MR imaging has emerged as the leading contender for preoperative classification of perianal fistulas. The MR imaging appearance of this condition shows greater concordance with surgical findings than does any other imaging evaluation. The ability of MR imaging to help not only accurately classify tracks but also identify disease that otherwise would have been missed has had an important effect on surgical treatment and, ultimately, patient outcome.

**Technique for MR imaging Perianal Fistula**

We used the phased array coil to perform our examinations. MR imaging examinations performed with a body coil require no patient preparation, are well tolerated and provide excellent anatomic detail of the anal sphincters and the overview required for surgical management. Use of endoanai coils was initially hoped to further improve the MR imaging evaluation of perianal fistulas, but this technique is poorly tolerated in symptomatic patients. Examination with a body or phased-array coil has become standard practice, not least because endoluminal coils specifically designed for anal imaging remain relatively unavailable.

**MR Sequences** *(Fig. 15 on page 48):*

Unenhanced T1-weighted images provide an excellent anatomic overview of the sphincter complex, levator plate, and the ischiorectal fossa *(Fig. 16 on page 49)* Fistulous tracks,
inflammation, and abscesses, however, appear as areas of low to intermediate signal intensity and may not be distinguished from normal structures such as the sphincters and levator ani muscles (Fig. 16 on page 49) on T2-weighted Fat suppressed (Fig. 17 on page 50) and STIR images, pathologic processes including fistulas, secondary fistulous tracks, and fluid collections are clearly depicted. They appear as areas of high signal intensity in contrast with the lower signal intensity of the sphincters, muscles, and fat. In some cases, STIR imaging failed to demonstrate secondary tracks, and in others it did not reveal small residual abscesses within edematous inflammatory change.

We used gradient-echo T1-weighted Fat suppressed dynamic intravenous contrast material-enhanced MR imaging combined with T2-weighted imaging to assess perianal fistulas and their complications. With use of this technique, active fistulous tracks, secondary ramifications (Fig. 18 on page 53 and 19 on page 54) and abscesses (Fig. 20 on page 55 and 21 on page 56) are clearly demonstrated. The tracks brilliantly enhance as do the walls of abscess cavities. Retained pus remains unenhanced, with resulting ring enhancement (Fig. 20 on page 55 and 21 on page 56), an appearance that is typical of abscess formation elsewhere in the body. This breath-hold technique is rapid, noninvasive, and well tolerated, a particular advantage in patients with acutely inflamed perianal regions.

**Images Planes:**

It is central to success that imaging planes are correctly aligned with respect to the organ of interest, namely the anal canal. Because the anal canal is tilted forward from the vertical by approximately 45°, straight transverse and coronal images will fail to achieve this alignment because of marked partial volume effect. Oblique transverse (Fig. 22 on page 51) and coronal (Fig. 23 on page 52) planes oriented orthogonal and parallel, respectively, to the anal sphincter are therefore necessary and are most easily planned by using a midline sagittal image. It is important that the imaged volume extend several centimeters above the levators and include the whole presacral space, both of which are common sites for extensions. The entire perineum should also be included.
Images linked within the text of this section:

Fig.
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**Fig.**: T1-Weighted MRI image
Fig.: T2 weighted MRI image
Fig.: Axial T1-weighted Fat suppressed dynamic intravenous contrast material-enhanced MR imaging shows a left transs finteric fistula and inflammatory changes in the left ischiorrectal fossa, grade 3 perianal fistula.
Fig.: Coronal T1- weighted Fat suppressed dynamic intravenous contrast material-enhanced MR imaging shows a left transsphincteric fistula and inflammatory changes in the left ischiorrectal fossa, grade 3 perianal fistula.
**Fig.** Axial T1-weighted Fat suppressed dynamic intravenous contrast material-enhanced MR imaging shows a right transsphincteric fistula with a right ischiorectal fossa abscess containing nonenhancing pus, grade 4 perianal fistula; and a left transssfinteric fistula and inflammatory changes in the left ischiorrectal fossa, grade 3 perianal fistula.
**Fig.**: Coronal T1- weighted Fat suppressed dynamic intravenous contrast material-enhanced MR imaging shows a right transsphincteric fistula with a right ischiorectal fossa abscess containing nonenhancing pus, grade 4 perianal fistula; and a left transsphincteric fistula and inflammatory changes in the left ischiorrectal fossa, grade 3 perianal fistula.
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Fig.: Grade 1 perianal fistula. Axial dynamic contrast-enhanced MR image shows a posterior midline intersphincteric fistula.
Fig.

Additional images for this section:
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Fig. 6: Grade 1 perianal fistula. Axial dynamic contrast-enhanced MR image shows a posterior midline intersphincteric fistula
Fig. 7
Fig. 10
Fig. 12
Fig. 13: T1-Weighted MRI image
**Fig. 14:** T2 weighted MRI image
Fig. 15
Fig. 16
Fig. 17: Axial T1-weighted Fat suppressed dynamic intravenous contrast material-enhanced MR imaging shows a left transsphincteric fistula and inflammatory changes in the left ischiorrectal fossa, grade 3 perianal fistula.
Fig. 18: Coronal T1- weighted Fat suppressed dynamic intravenous contrast material-enhanced MR imaging shows a left transsfi neric fistula and infl amatory changes in the left ischiorrectal fossa, grade 3 perianal fistula.
Fig. 19: Axial T1-weighted Fat suppressed dynamic intravenous contrast material-enhanced MR imaging shows a right transsphincteric fistula with a right ischiorectal fossa abscess containing nonenhancing pus, grade 4 perianal fistula; and a left transsphincteric fistula and inflammatory changes in the left ischiorectal fossa, grade 3 perianal fistula.
**Fig. 20**: Coronal T1- weighted Fat suppressed dynamic intravenous contrast material-enhanced MR imaging shows a right transsphincteric fistula with a right ischiorectal fossa abscess containing nonenhancing pus, grade 4 perianal fistula; and a left transsphincteric fistula and inflammatory changes in the left ischiorectal fossa, grade 3 perianal fistula.
Conclusion

Conclusions:

MR imaging has had a major impact on the preoperative assessment of perianal fistulas in centers specializing in their surgery. We routinely use the St James's University Hospital classification, an MR imaging-based grading system validated by surgical exploration and long term clinical outcome. This classification employs simple anatomic discriminators identifiable on axial and coronal MR images. By using this system, the radiologist can alert the referring clinician to the presence of complex disease that may require expert surgical management.

Preoperative confirmation of fistula complexity facilitates surgery planning of sphincter saving techniques and prevents sepsis being missed, which has been shown to reduce recurrence. Imaging has a significant role to play in this condition to improve patient outcome.

We hope that this electronical presentation will stimulate radiologists to provide this service to their surgeons in the expectation that this will reduce the incidence of recurrent fistula in ano and the misery that this causes.

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References


