

# Magnetic Resonance Imaging of Perianal Fistulas

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## KEYWORDS

• Fistula • MR imaging • Perianal • Crohn disease

## KEY POINTS

- MR imaging has been shown to accurately show the anatomy of the perianal region.
- Currently, MR imaging is also a reliable technique to assess the outcome of medical therapy using the anti-TNF agent infliximab in patients with Crohn disease with fistula-in-ano occurring during the first year of follow-up.
- Another important advantage of MR imaging is the multiplanar assessment. However, imaging planes must be correctly aligned to the anal canal.
- Despite the closure of draining external orifices after infliximab therapy, fistula tracks persist with varying degrees of residual inflammation, which may cause recurrent fistulas and pelvic abscesses.

## INTRODUCTION

Perianal fistulas are a major cause of morbidity. Fistulas are defined as an abnormal communication between 2 epithelium-lined surfaces. In the case of a perianal fistula, the connection is between the mucosal layer of the anal canal and the perianal skin.

Perianal fistulas predominantly affect young adults, especially men in their fourth decade.<sup>1</sup>

Treatment of perianal fistulizing disease is medical or surgical. Patients with Crohn disease are first treated with antibiotics, immunosuppressive agents, or anti-tumor necrosis factor (anti-TNF) antibodies. Fistulas not related to Crohn disease are usually treated with surgery.<sup>2</sup>

Recurrence after therapy is the most common problem. To avoid recurrence after medical or surgical therapy, detailed information must be obtained about the location of any fistula track and the affected pelvic structures. High-resolution magnetic resonance (MR) imaging allows precise

assessment of the relationship of the fistula track to the pelvic floor structures, and identification of secondary fistulas or abscesses.

## NORMAL ANAL CANAL ANATOMY

Underneath the mucosa, the anal canal consists of an internal layer of circular smooth muscle (the internal sphincter) and an outer striated muscle layer (the external sphincter). The 2 sphincters are separated by the intersphincteric space, which contains predominantly fat (**Fig. 1**). This space forms a natural plane of lower resistance in which fistulas can easily spread.<sup>3</sup> The external sphincter is surrounded by the fat-containing ischioanal and ischioanal space.<sup>2</sup>

The internal sphincter is continuous with the circular smooth muscle of the rectum. It is responsible for 85% of the anal resting tone.<sup>4</sup> In most individuals, disruption of the sphincter will not cause loss of continence.<sup>5</sup>

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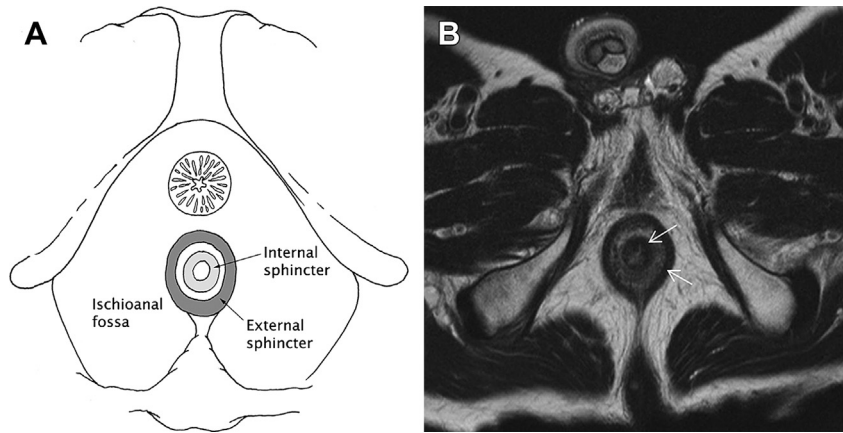
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**Fig. 1.** Drawing (A) and axial T2-weighted MR image (B) show the normal anatomy of the perianal region (at the level of the mid-anal canal). *Arrows indicate internal and external sphincter.*

The external sphincter is continuous with the puborectal and levator ani muscles (**Fig. 2**). It contributes only 15% of the anal resting tone, but its strong voluntary contractions resist defecation. A disruption of the external sphincter can lead to incontinence.<sup>5</sup>

MR imaging has been shown to accurately show the anatomy of the perianal region. On axial T2-weighted images, the internal and external anal sphincter appear as circular structures with low signal intensity.

After intravenous administration of gadolinium, the internal and external sphincter can be easily distinguished on T1-weighted images by their different contrast enhancement. The internal sphincter muscle enhances to a higher degree than the external sphincter muscle (**Fig. 3**).<sup>6,7</sup>

**CAUSE OF PERIANAL FISTULAS**

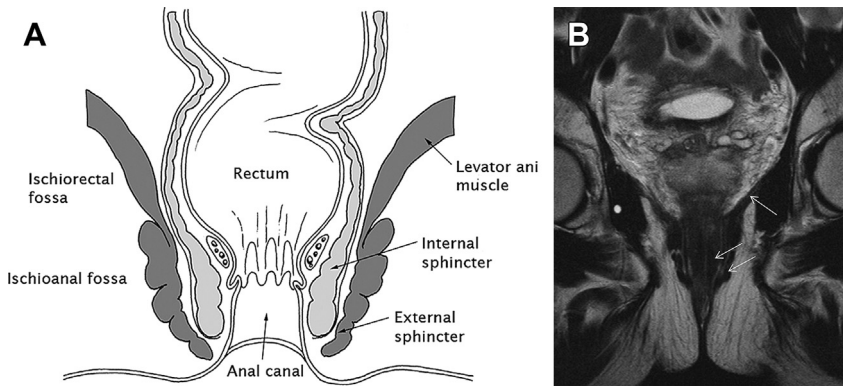
In patients without Crohn disease, perianal fistulas usually arise from infected or obstructed

intersphincteric anal glands (cryptogenic fistulas).<sup>8</sup> The anal glands lie at the level of the dentate line in the mid-anal canal and can penetrate the internal sphincter toward the intersphincteric plane (intersphincteric fistula). From this space, the infection may track down the intersphincteric plane to the skin. Alternatively, infection may pass both layers of the anal sphincter to enter the ischiorectal space (transsphincteric fistula).<sup>5</sup>

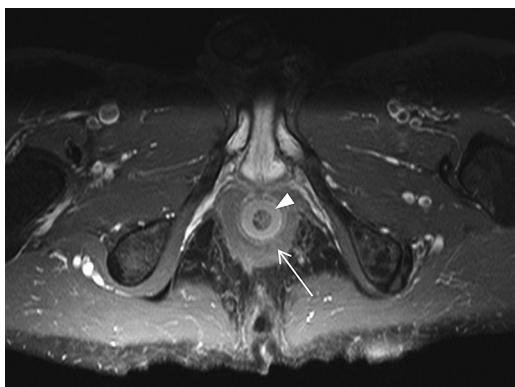
The cause of perianal fistulas in Crohn disease may be a fistula arising from inflamed or infected anal glands, and/or penetration of fissures or ulcers in the rectum or anal canal.<sup>8–10</sup>

**DIAGNOSIS: ACCURACY AND APPLICATION OF MR IMAGING**

The use of MR imaging in the evaluation of perianal fistulas has been reported in many studies,<sup>11–13</sup> showing it to be the preferred technique for pre-operative evaluation of perianal fistulas and improved patient outcome.<sup>4</sup> MR imaging has a



**Fig. 2.** Drawing (A) and T2-weighted image (B) show the normal anatomy of the perianal region in the coronal plane. *Arrows indicate internal and external sphincter.*



**Fig. 3.** Normal anatomy of the anal sphincter complex on axial T1-weighted image after administration of gadolinium. Note the high degree of enhancement of the internal sphincter (arrowheads) compared with the intermediate signal intensity of the external sphincter (arrows).

high sensitivity and specificity in the detection of primary and secondary tracks, abscesses, and internal openings.

Endoscopic ultrasound can be equivalent to MR imaging in complementing examination under anesthesia.<sup>14</sup> In clinical practice, MR imaging is used more frequently than endoscopic ultrasound. Endoscopic ultrasound is operator-dependent, and in patients with severe proctitis or anal strictures, its tolerability is suboptimal. Furthermore, the limited field of view is a considerable inconvenience, precluding the use of endoscopic ultrasound to assess suprasphincteric and extrasphincteric tracks or secondary extensions.<sup>4</sup>

Several studies have reported that preoperative pelvic MR imaging findings change surgical management in 10% to 15% of patients,<sup>14–16</sup> or reveal important additional information in 21% of patients, particularly those with Crohn disease.<sup>13</sup>

In a larger study of patients with a recurrent anal fistula, the postoperative recurrence rate was as low as 16% when surgeons always acted based on the MR imaging findings. The rate of recurrence was 30% when surgeons occasionally acted based on MR imaging results, and 57% when MR imaging results were ignored.<sup>4,17</sup>

Currently, MR imaging is also a reliable technique to assess the outcome of medical therapy using the anti-TNF agent infliximab in patients with Crohn disease with fistula-in-ano occurring during the first year of follow-up (**Fig. 4**).<sup>18</sup> This result was confirmed by 3 similar studies,<sup>19–21</sup> and also by another study using endoscopic ultrasound.<sup>22</sup>

However, in the long-term follow-up, the improvements observed at MR imaging correlate

with the clinical and endoscopic response to infliximab in only half of the patients.<sup>23</sup>

## MR IMAGING PROTOCOL/TECHNIQUE

Various MR imaging techniques have been described.<sup>4,24</sup>

### Imaging Coils

Two types of coils can be used: the endoanal and the external phased array coils. Use of endoanal coils was initially proposed to improve MR imaging evaluation of perianal fistulas, but these coils are poorly tolerated in symptomatic patients.<sup>4,25</sup>

Advantages of the external phased array coil include the larger field of view, which prevents fistula extensions from being overlooked, especially in patients with Crohn disease, and the wide availability of these coils. Furthermore, MR imaging with phased array surface coils requires no patient preparation and is well tolerated.

### Imaging Sequences

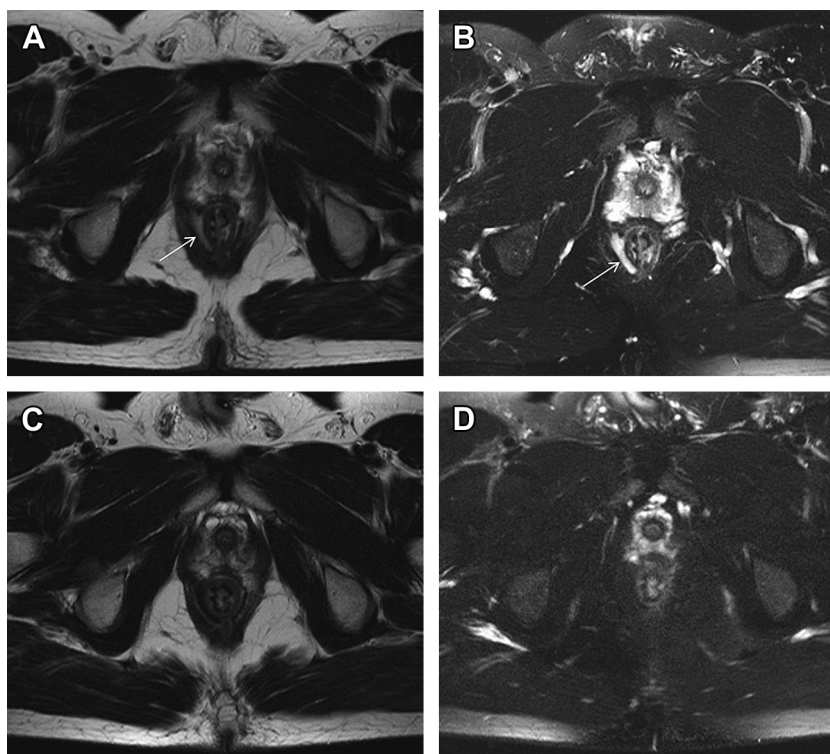
On T2-weighted MR sequences, active fistulas and abscesses are hyperintense.<sup>2</sup>

T1-weighted contrast-enhanced fat-suppressed MR imaging sequences are used to further improve the contrast of pelvic MR imaging and to distinguish inflamed tissue from normal perineal tissues.<sup>25,26</sup> Furthermore, images with fat suppression better illustrate the activity of the fistulas.<sup>18</sup>

A gadolinium-enhanced T1-weighted sequence is helpful in differentiating between fluid and granulation tissue, which is important in abscesses. Pus has high signal intensity on T2-weighted images, and thus cannot be reliably distinguished from edema and inflammation. The use of dynamic contrast-enhanced MR imaging for determining the degree of activity in perianal Crohn disease might be helpful in selecting a subpopulation of patients with perianal Crohn disease who should be monitored more closely for development of more extensive disease.<sup>27</sup>

Another recent development is the introduction of 3.0-Tesla (T) imaging. 3.0-T imaging further improves spatial resolution and secondary diagnostic accuracy.<sup>28</sup> The finer detail helps in detecting and characterizing even smaller fistula tracks. However, comparative studies with 1.5-T or 3.0-T have not been reported.

Use of diffusion-weighted sequences for evaluating perianal fistulas has been reported.<sup>29</sup> Because inflammatory tissues usually have high signal intensity at diffusion-weighted imaging, this technique is used as an adjunct to T2-weighted imaging for diagnosing anal fistulas.



**Fig. 4.** A 37-year-old man with Crohn disease who underwent a subtotal colectomy with ileorectal anastomosis. T2-weighted MR images without (A) and with (B) fat suppression before treatment show an intersphincteric fistula at the right side (arrows). (C, D) Short-term MR imaging follow-up (10 weeks) after infliximab treatment (5 mg/kg) shows disappearance of the fistula.

### Imaging Planes

Another important advantage of MR imaging is the multiplanar assessment. However, imaging planes must be correctly aligned to the anal canal. Therefore, a sequence in the sagittal plane is first performed. The transverse and coronal sequences must be aligned with the anal canal at the sagittal sequence, oriented perpendicularly (transverse) and parallel (sagittal) to the long axis of the anal canal.<sup>4</sup>

The specific protocol and sequence parameters applied at the authors' institution are provided in detail in the first table: sagittal fat-suppressed T2-weighted turbo spin echo (TSE), axial fat-suppressed T2-weighted TSE, axial oblique T2-weighted TSE (short axis), coronal oblique T2-weighted TSE (long axis), and axial oblique and coronal oblique fat-suppressed T1-weighted TSE with gadolinium (Table 1).

### CLASSIFICATION

Fistulas may be classified according to the course of the fistula from the anal canal to the skin and its relationships to the internal and external sphincters.

In 1976, Parks and colleagues<sup>30</sup> proposed an anatomic precise classification system for perianal fistulas that uses the external sphincter as a central point of reference. This classification was developed primarily for surgical treatment and is therefore especially important for patients treated surgically.

Five types of perianal fistulas were described: intersphincteric, transsphincteric, suprasphincteric, extrasphincteric, and superficial.

1. Intersphincteric fistulas course from the internal opening in the anal canal through the internal sphincter and the intersphincteric plane to the perianal skin. The fistula is entirely confined by the external sphincter; the ischioanal and ischioanal fossae are unaffected (Fig. 5).
2. Instead of tracking down the intersphincteric plane to the skin, the transsphincteric fistula perforates through both layers of the sphincter complex into the ischioanal and ischioanal fossae (Fig. 6).
3. Less frequent is a suprasphincteric fistula, wherein the tract passes upward in the intersphincteric plane over the top of the puborectal muscle and then descends through the levator plate to the ischioanal fossa and finally to the skin (Fig. 7).

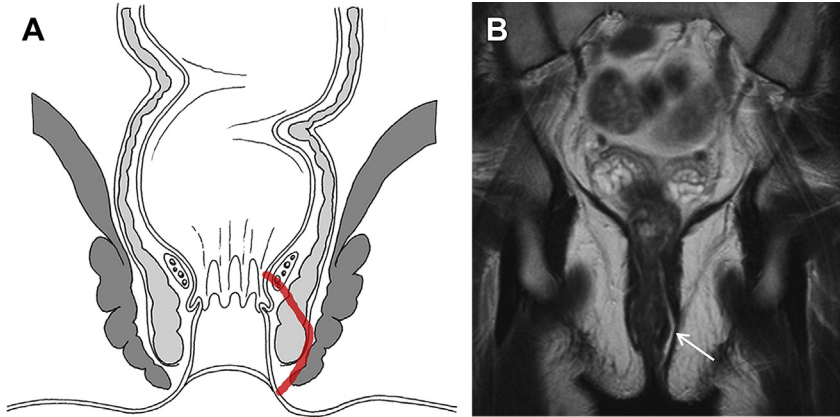
**Table 1**  
**MR imaging protocol**

Scan Parameters	Scan Name					
	T2_TSE_sagittal_FS	T2_TSE_axial_FS	T2_TSE_axial oblique	T2_TSE_coronal oblique	T1_TSE_axial oblique_FS	T1_TSE_coronal oblique_FS
Sequence type	Turbo spin echo (TSE)	Turbo spin echo (TSE)	Turbo spin echo (TSE)	Turbo spin echo (TSE)	Turbo spin echo (TSE)	Turbo spin echo (TSE)
Orientation	Sagittal	Axial	Axial oblique	Coronal oblique	Axial oblique	Coronal oblique
Number of slices	20	30	20	20	26	20
Slice thickness (mm)	4	6	6	6	4	4
Slice gap (mm)	0.8	1.2	1.26	1.26	0	0
Field of View (mm)	259 × 360	230 × 320	230 × 320	270 × 320	309 × 380	380 × 380
TR (ms)	8870	6960	8870	8780	730	580
TE (ms)	134	134	134	134	11	11
Number of averages	3	4	3	2	3	3
Fat suppression	Yes	Yes	No	No	Yes	Yes
Matrix	368 × 512	368 × 512	368 × 512	432 × 512	416 × 512	512 × 512
Pixel resolution (mm)	0.7 × 0.7 × 4.0	0.6 × 0.6 × 6.0	0.6 × 0.6 × 6.0	0.6 × 0.6 × 6.0	0.7 × 0.7 × 4.0	0.7 × 0.7 × 4.0
Acquisition time (min:s)	1:39	3:16	1:30	1:38	5:48	5:39
Extra information			Orientation axial to anal canal	Orientation coronal to anal canal	Acquired twice, once before and once after contrast administration, axial to anal canal	After contrast administration, coronal to anal canal
Less commonly mentioned, but can be added if desired						
Parallel imaging	GRAPPA, factor 2	GRAPPA, factor 2	GRAPPA, factor 2	GRAPPA, factor 2	GRAPPA, factor 2	GRAPPA, factor 2
Bandwidth (Hz/Px)	305	305	305	305	195	195
Turbo factor	61	61	61	61	3	3

Parameters were established with the Aera 1.5 Tesla system (Siemens, Erlangen, Germany).

**Abbreviations:** FS, fat suppression; GRAPPA, Generalized Autocalibrating Partially Parallel Acquisitions; Hz, hertz; Px, pixel; T1, T1-weighted; T2, T2-weighted; TSE, turbo spin echo.





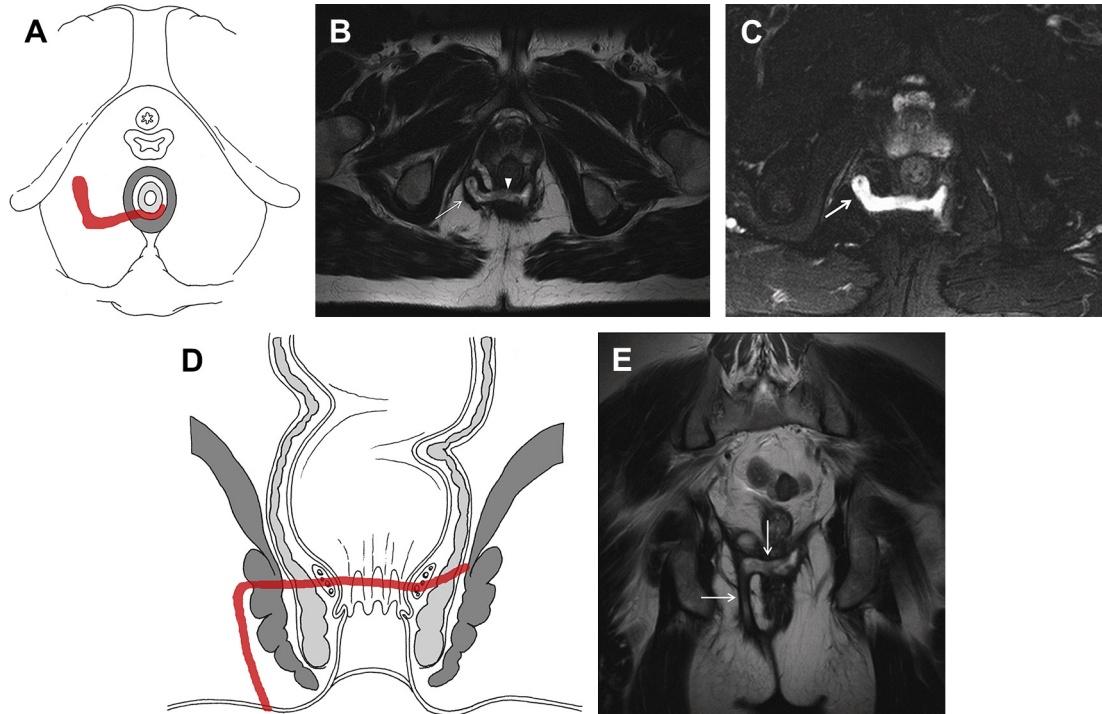
**Fig. 5.** Drawing (A) and T2-weighted image (B) in the coronal plane show a left intersphincteric fistula (A; red line, B; arrow) extending from the anal canal to the skin, crossing through the intersphincteric space.

- 4. Relatively rare are extrasphincteric fistulas in which the tract passes from the rectal mucosa through the ischioanal fossa and levator muscles to the skin. This type of fistula lies outside the anal sphincter complex, and the anal canal is not involved (Fig. 8).
- 5. Superficial fistulas were not included in the original publication by Parks and colleagues,<sup>30</sup> but

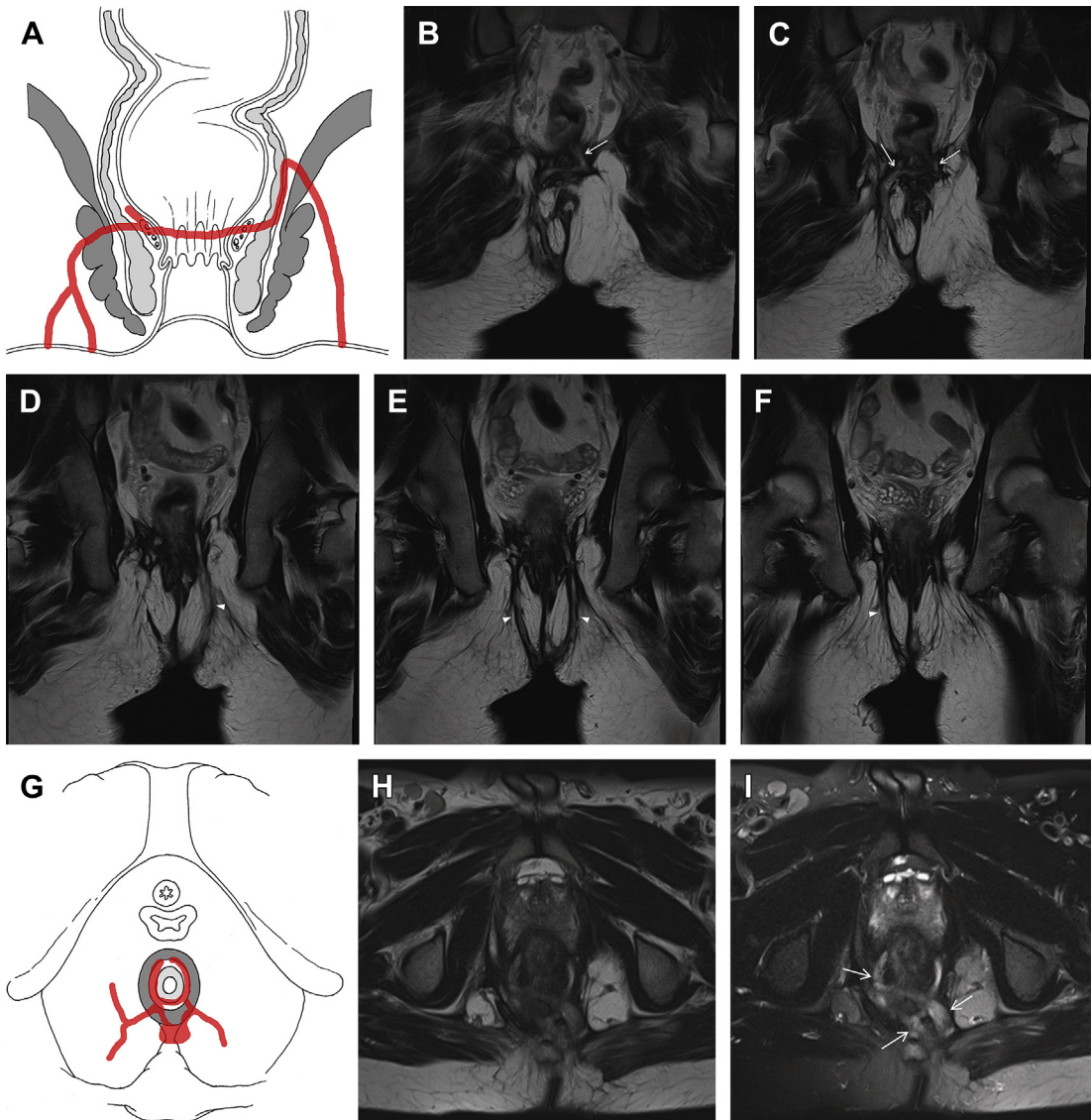
have been added to the classification. These fistulas do not involve the anal sphincter complex, and MR imaging is not needed routinely.

**MR GRADING OF PERIANAL FISTULAS**

Through adding MR imaging findings, the St James’s University Hospital classification became



**Fig. 6.** Drawing of axial view (A) and axial T2-weighted images without (B) and with (C) fat suppression show a right transsphincteric fistula (A; red line) crossing both layers of the sphincter complex, complicated by an abscess (B, C; arrows) in the right ischiorectal fossa, with an internal opening at the 6 o’clock position (B; arrowheads). Drawing of coronal view (D) and coronal T2-weighted image without fat suppression (E) show the craniocaudal extension of the fistula in the right ischiorectal fossa (D; red line, E; arrows).



**Fig. 7.** A 35-year-old man with Crohn disease and a complex suprasphincteric fistula. Drawing of coronal view (A) and coronal (B–F) T1-weighted image after administration of gadolinium show upward fistula extensions through the intersphincteric space, over the top of the levator ani muscle (A; red line, B and C; arrows). The fistulas then descend through the ischiorectal fossa at both sides to reach the skin (D–F; arrowheads). Drawing in axial view (G) and axial T2-weighted images without (H) and with (I) fat suppression show the extensive supralevator horseshoe ramifications (G; red line, H and I; arrows).

a morphologic assessment of the location of anal fistulas to the sphincter complex to guide the surgical management.<sup>5</sup>

The score ranges from 1 to 5 and indicates the primary fistulous track and the secondary ramifications and associated abscesses.

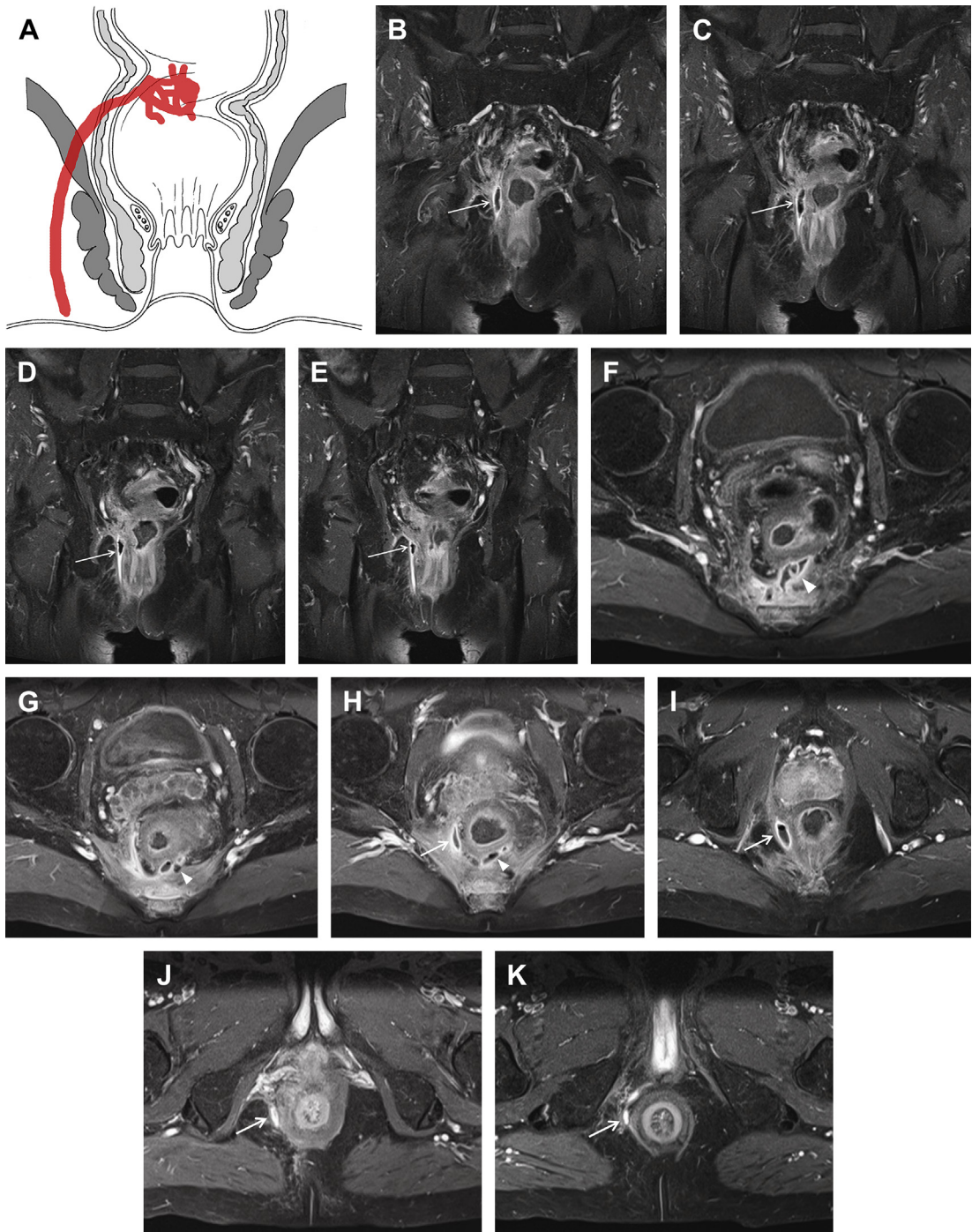
#### **Grade 1: Single Intersphincteric Fistula**

A single intersphincteric fistula extends from the skin to the anal canal in the plane between the

sphincters. There is no ramification of the fistula within the sphincter complex, and the ischioanal and ischiorectal fossae are unaffected at MR imaging.

#### **Grade 2: Single or Multibranched Intersphincteric Fistula with Abscess**

Intersphincteric fistulas with an abscess or secondary track are confined within the sphincter (horseshoe fistula or abscess).



**Fig. 8.** Extrasphincteric fistula in a patient with known diverticulitis of the sigmoid (A; red line). Drawing of coronal view (A) and coronal (B–E) and axial (F–K) T1-weighted images after administration of gadolinium show inflammatory changes surrounding the rectum (supralelevator disease) (F–H; arrowheads) and the right translevator fistula crossing the ischiorectal fossa, outside the sphincter complex (B–E, H–K; arrows).



### ***Grade 3: Unbranched Transsphincteric Fistula***

Unbranched transsphincteric fistulas extend through both layers of the sphincter complex with extensions in the ischioanal or ischiorectal fossa.

### ***Grade 4: Transsphincteric Fistula with Abscess or Secondary Track Within the Ischiorectal or Ischioanal Fossa***

A transsphincteric fistula can be complicated by sepsis in the ischiorectal or ischioanal fossa.

### ***Grade 5: Translevatoric or Supralelevatoric Fistula***

In rare cases, fistulas extend above the levator ani muscle. Suprasphincteric fistulas extend upward in the intersphincteric plane and over the top of the levator ani; extrasphincteric fistulas are extensions of primary pelvic disease down through the levator plate.

This MR imaging classification is significantly associated with patient outcome ( $P<.001$ ). MR imaging grades 1 and 2 were associated with a satisfactory outcome (no further surgery needed), whereas grades 3 through 5 were associated with unsatisfactory outcome (further surgery needed).<sup>5</sup>

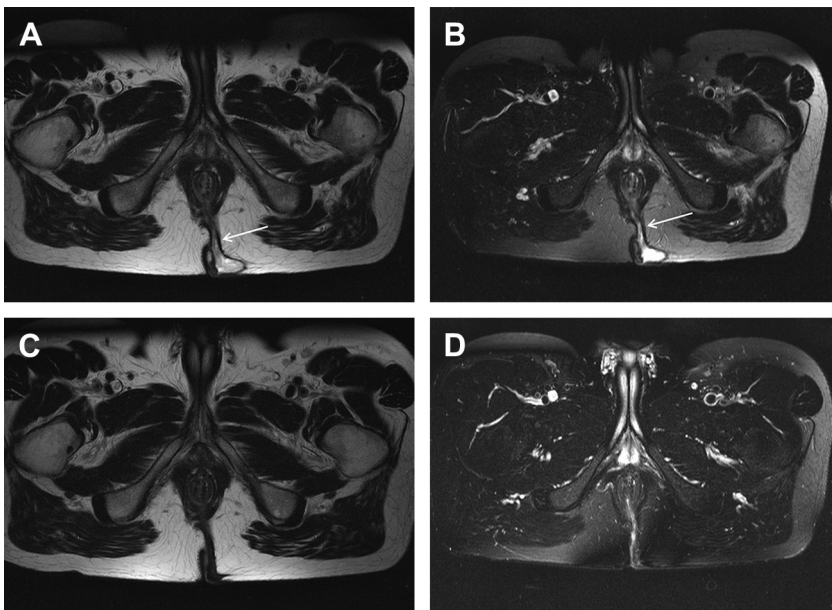
To provide a more accurate evaluation of disease activity, the Leuven MR imaging-based activity score was developed to evaluate the

activity of anal fistulas of patients with Crohn disease during medical treatment (**Fig. 9**).<sup>18</sup> This score correlates with clinical disease activity and response to medical therapy. Both anatomic parameters and parameters reflecting active inflammation are evaluated in the MR imaging score. Anatomic criteria are based on the Parks classification. The location of the primary track (intersphincteric, transsphincteric, or extrasphincteric) and the extension (infralevatoric or supralevatoric), and the complexity of the track (single, single-branched, or multiple) are described.

Criteria of fistula activity are T2 hyperintense appearance of the fistula track, presence of hyperintense cavities, and thickening of the rectal wall (**Table 2**). The MR imaging score was reliable in assessing the fistula tracks, with a good interobserver concordance ( $P<.001$ ).<sup>18</sup>

Despite the closure of draining external orifices after infliximab therapy, fistula tracks persist with varying degrees of residual inflammation, which may cause recurrent fistulas and pelvic abscesses. More specifically, the inflammatory components of the score improve more consistently than the anatomic criteria, indicating that fistula tracks can persist while inflammation is subsiding.<sup>18</sup>

Gadolinium-enhanced T1-weighted images are not used in the Leuven MR imaging-based score.<sup>18</sup> Some authors, however, have found that fistulas are more conspicuous on these images than on T2-weighted images.<sup>31,32</sup> Hyperintensity



**Fig. 9.** A 49-year-old man with perianal fistulizing Crohn disease. Axial T2-weighted images without (A) and with (B) fat suppression before treatment show an active transsphincteric fistula (arrows): severe T2 hyperintensity of the fistula track. MR imaging score: 19/22. After treatment, the fistula track is still present but is rather inactive, as evident by the hypointensity on the T2-weighted images (C, D). MR imaging score: 11/22.

**Table 2**  
**MR imaging–based score for severity of**  
**perianal Crohn disease**

Number of fistula tracks	
None	0
Single, unbranched	1
Single, branched	2
Multiple	3
Location	
Extrasphincteric or intersphincteric	1
Transsphincteric	2
Suprasphincteric	3
Extension	
Infralevatoric	1
Supralevatoric	2
Hyperintensity on T2-weighted images	
Absent	0
Mild	4
Pronounced	8
Collections (cavities >3 mm diameter)	
Absent	0
Present	4
Rectal wall involvement	
Normal	0
Thickened	2

Data from Van Assche G, Vanbeckevoort D, Bielen D, et al. Magnetic resonance imaging of the effects of infliximab on perianal fistulizing Crohn disease. *Am J Gastroenterol* 2003;98(2):332–9.

on T1 can be seen from increased tissue perfusion and vascular permeability.<sup>33</sup> As local vascularization and permeability increase with the severity of inflammatory disease, the postcontrast enhancement of inflammatory tissue reflects the degree of inflammatory activity of the tissue.<sup>34,35</sup>

The Leuven MR imaging–based score of disease severity can be used to evaluate response to treatment with infliximab remission induction therapy. One study noted a clinical response in 44% of patients, but a relapse was observed in 57% of these patients.<sup>21</sup> In all 4 relapsing patients, MR imaging scores were indicative of persistence of active perianal fistulizing disease. The inclusion of contrast enhancement or tissue infiltration does not add value to the MR imaging–based score.<sup>21</sup>

**SUMMARY**

Imaging now plays an important role in the surgical and nonsurgical evaluation of anal fistulas. High-resolution MR imaging is currently the preferred

technique, allowing precise assessment of the relationship between the fistula track and the pelvic floor structures, and identification of secondary fistulas or abscesses.

The St James’s University Hospital MR imaging classification is developed to give the exact location and characteristics of the fistula track to guide surgeons in their surgical approach.

With the development in medical therapy, clinicians now want to know the actual status or activity of the fistula disease. It guides their decisions whether to start or continue medical treatment, or whether surgical intervention is warranted.

The Leuven MR imaging–based activity score was specifically developed to evaluate the activity of anal fistulas, especially in patients with Crohn disease. This score correlates well with clinical disease activity and the response to medical treatment.

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