



Perianal sepsis: surgical perspective and practical MRI reporting for radiologists

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Abstract

This article describes the development of a structured MRI reporting template and diagrammatic worksheet for perianal sepsis through collaboration between radiologists and colorectal surgeons at our institution, and the rationale behind each component of the worksheet. Benefits of this reporting worksheet include optimizing communication of key imaging findings that have a real impact on patient management, less time spent on reporting the study, and easier comparison between studies. We illustrate the utility of the report template with case studies. We summarize the current surgical approaches to perianal sepsis to help radiologists focus on reporting the findings relevant to surgical planning.

Keywords Perianal fistula · Perianal sepsis · MRI anal canal · Structured reporting

Background

Perianal sepsis refers to the spectrum of disease that includes perianal abscesses, ischiorectal abscesses and fistulae-in-ano. Fistula-in-ano or perianal fistula is an epithelium-lined tract between the anal canal or low rectum and the perineal skin. In the surgical literature, fistula-in-ano may be classified as “simple” or “complex”. Complex fistulae are those where surgical treatment poses a higher risk of adversely affecting continence. Examples include fistulae with extension tracts, recurrent fistulae and high fistulae that encompass a greater amount of muscle of the anal sphincter

complex. Fistulae occurring in patients with inflammatory bowel disease (IBD), preexisting fecal incontinence, history of locoregional irradiation, and anterior fistulae occurring in female patients (given the attenuated nature of the anterior sphincter complex in women) are also considered complex [1]. Simple fistulae are those without complex features; in general, these include intersphincteric and low transsphincteric fistulae.

The cryptoglandular theory of fistula formation postulates that infection begins in an obstructed submucosal anal gland located in the intersphincteric plane near the level of the dentate line [2, 3]. Most simple fistulae have been ascribed to this long-standing and generally accepted theory. More recent literature suggests that additional aetiologies of fistula formation exist [4, 5]. In IBDs such as Crohn’s disease, infection commonly arises from transmural inflammation of the anorectum leading to complex perianal sepsis. Extensions are common with supralelevator abscesses and translevator tracts. The estimated incidence of perianal fistula in the general population is 1–2 in 10,000/year, with a 2:1 male-to-female ratio [6, 7]. The cumulative incidence of perianal fistula in patients with Crohn’s disease is much higher than in the general population, approximately 20–23% [8, 9].

The aims of imaging perianal fistulae are to a) determine the relationship of the fistula to the sphincter complex, and b) to identify any “extensions” (i.e., secondary fistula tracts and abscess cavities). Simple fistulae generally do not

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require imaging to guide management. Imaging modalities for characterizing perianal fistulae include traditional fistulography, CT, ultrasound (including endoanal and perineal), and MRI. The advantages of MRI include noninvasiveness, lack of exposure to ionizing radiation, superior contrast resolution, wide field of view, multiplanar capability, and operator independence. Surgeons at our institution use MRI to aid management of complex perianal sepsis in addition to history, examination, and endoanal ultrasound. The American Society of Colon and Rectal Surgeons supports preoperative imaging of complex fistulae (including with MRI) in their clinical practice guidelines [1]. Preoperative MR imaging is particularly useful for patients with Crohn's disease [10, 11], recurrent fistulae [12] and supralelevator sepsis [13]. In an evidence-based review investigating methods of discriminating simple from complex perianal fistulae published in 2008, Sahni et al. reported that MRI had a sensitivity of 97% and specificity of 96% in detecting complex perianal fistulae. MRI (positive likelihood ratio 22.7) outperformed clinical examination (2.1) and endoanal ultrasound (6.2) for characterizing perianal fistula as complex in this review [14]. Endoanal ultrasound is a real-time examination that can be additive but is limited by poor visualization beyond the external sphincter of the anal canal and above the levator plate, and is operator dependent.

MR imaging techniques for evaluation of perianal conditions [15] and Crohn's disease of the anorectum [16, 17] have been comprehensively reviewed recently. Our institutional MR protocol for all cases of suspected complex perianal sepsis is performed using an external body phase-array coil with the patient in supine position on a 3T scanner (while imaging at 1.5T is possible, the higher field strength yields increase signal-to-noise ratio). We use this protocol irrespective of aetiology of perianal sepsis (e.g., Crohn's disease status). One exception is in the presence of a known anorectal-vaginal fistula, where the vagina can be distended (e.g., using water-soluble ultrasound gel) to facilitate fistula detection [18]. Our protocol commences with a three-plane planning scout scan and a sagittal T2-weighted (T2-W) sequence of the pelvis. Oblique axial and oblique coronal T2-W sequences aligned to the long-axis of the anal canal (with and without fat suppression) are then planned and acquired to delineate anatomy of perianal sepsis with respect to the anal sphincter complex and levator plate. If renal function permits, we administer intravenous gadolinium-based contrast medium and acquire high-resolution volumetric T1-W sequences with fat suppression, which are important in demonstrating abscesses requiring drainage and the presence and activity of fistulae. Diffusion-weighted imaging (DWI) may be a useful adjunct to the anatomic sequences in perianal fistula characterization [19]. DWI

sequences of the anal canal are fast to acquire and together with the apparent diffusion coefficient maps may supplement the anatomic sequences to improve reader interpretation of perianal fistulae, similar to its application in MR enterography for Crohn's disease assessment [20, 21]. DWI may be particularly useful when gadolinium-based contrast is contraindicated; however, we prefer to acquire contrast-enhanced sequences whenever possible at our institution. Several MRI-based Crohn's disease severity indices that encompass fistulizing perianal disease, for instance, the Van Assche score and Lemann index, have been published [22, 23]. These are in addition to clinical severity indices such as the Perineal Disease Activity Index [24]. However, these indices have not been formally or consistently adopted in surgical decision making for perianal sepsis to date.

The Parks classification of fistula-in-ano is the most widely used among surgeons [25], based on physical examination. Five types of primary tract include superficial, intersphincteric, transsphincteric, suprasphincteric, and extrasphincteric. Any tract can be complicated by extensions which include ramifications (secondary tracts) and abscesses. The clock-face annotation is used to refer to the position of these features relative to the anorectal lumen with the patient in the lithotomy position. Intersphincteric fistulae are the most common, accounting for 54% of patients presenting to a major referral hospital in one study [26]. Fistulae of increasing complexity are also rarer, with transsphincteric, suprasphincteric, and extrasphincteric fistulae accounting for 21, 3 and 3%, respectively.

Surgical management

Surgical management is determined by the complexity of the fistula. The underlying aetiology of the fistula (cryptoglandular vs Crohn's disease), the location, and topography of the fistula (including the amount of anal sphincter complex involved), and the preexisting comorbidities (e.g., previous fistulae, perineal surgery, irradiation, vaginal delivery, pre-existing incontinence) all influence this decision.

The key principles of the surgical treatment of perianal fistulae are (a) to eliminate septic foci and any associated fistula tract, while (b) preserving anal sphincteric function and continence. A progressive trade-off exists between the extent of operative sphincter division, postoperative healing rates, and functional compromise.

Definitive surgical interventions include fistulotomy, cutting setons, mucosal advancement flaps, ligation of intersphincteric fistula tract, metallic clips, and biomaterials including glue variants and fistula plugs. Palliative strategies include noncutting setons. Newer techniques have emerged,

(a)

**Concord Hospital
MRI Perianal Fistula Worksheet**

Patient Name

MRN DOB

Date of Scan

Radiologist

Internal Opening

Position: ____ o'clock
 Location in anal canal
 Lower 1/3
 Middle 1/3
 Upper 1/3

External Opening

Position: ____ o'clock

Type of Primary Fistula
 (circle one)
 Superficial (ie no muscle involvement)
 Inter-sphincteric
 Trans-sphincteric
 Supra-sphincteric
 Extra-sphincteric

Accessory tracts/Extensions
 No
 Yes

Suprlevator Sepsis
 No
 Yes

Associated Abscess
 (circle one or more)
 Superficial
 Inters-sphincteric
 Ischio-rectal fossa
 Supra-levator

Evidence of previous sphincter injury
 No
 Yes

Activity
 Active
 Fibrotic

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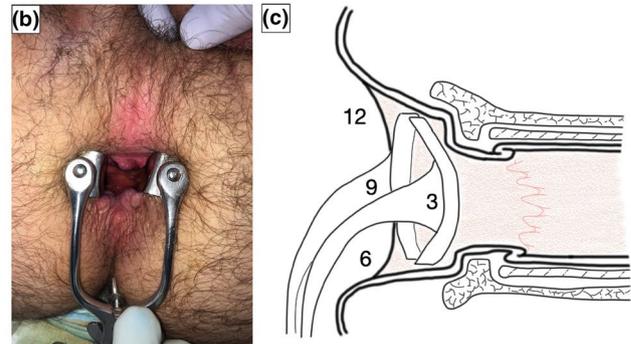


Fig. 1 a Structured MRI reporting template for perianal sepsis developed via collaboration between radiologists and surgeons at our institution. The diagram at the top right corner is the view of the anal canal with the patient in the lithotomy position, with the anal verge closest (large solid dark circle), the dentate line (gray), and the ano-

rectal junction farthest (small solid dark circle). This diagram is useful for indicating any seton placement. **b** Clinical view of the anal canal with the patient in the lithotomy position. **c** Schematic of anal canal and rectum with anal retractor, indicating o'clock positions

such as video-assisted anal fistula treatment (VAAFT) and stem cell therapy. These interventions have been comprehensively reviewed elsewhere [4, 27, 28] and detailed description is beyond the scope of this article.

Management of perianal sepsis in fistulizing Crohn's disease is particularly difficult. Typical perianal fistulae in Crohn's disease tend to be large, multiple, branching, and are more likely than cryptoglandular abscess to be of higher grade (e.g., suprasphincteric or extrasphincteric) [29]. Perianal disease may also be associated with concomitant manifestations elsewhere in the gastrointestinal tract in Crohn's

disease patients [30]. Surgical intervention for a patient with Crohn's disease presenting with a symptomatic perianal fistula is associated with the increased risk of disease recurrence, incontinence, and poor wound healing especially if proctitis is present [31]. The primary treatment of perianal Crohn's fistula is medical with biological therapy, with infliximab being the first line agent [1]. Noncutting "loose" setons may be placed and remain in situ long term to gain controlled and continuous sepsis drainage during the initiation of biological agents.



Fig. 2 Sagittal and oblique coronal T2-W images of patients with short (a and b) and long (c and d) anal canals. Such natural variations make it more meaningful to describe the location of internal open-

ing of a fistula in terms of upper, middle, and lower thirds of the anal canal rather than distance from the anal verge

Background to the structured reporting template

Discussions at our colorectal surgical-radiology meeting highlighted the challenges in accurately and efficiently communicating and understanding the MRI findings of a perianal fistula from a text-only report faced by both radiologists and surgeons, respectively. As a result, radiologists and surgeons at our institution collaborated to develop a structured reporting template (Fig. 1) to standardize communication and summarize the salient MRI findings for perianal sepsis that will influence management. The radiologist illustrates the findings and topography of fistula tract(s) on a diagram of the pelvis in sagittal, oblique axial, and coronal planes. We describe some technical and anatomic considerations for radiologists and surgeons in correlating imaging and clinical findings in perianal fistulae. These served as the rationale for each section of the worksheet.

Radiologists and surgeons: different perspectives on the same patient

At our institution we perform the MRI examination with a body coil on a 3T unit in supine position. Meanwhile, intraoperative clinical assessment is performed with the patient in the lithotomy position. The locations of findings are denoted by the anal clock annotation. Findings at the perianal skin such as an external opening of a fistula can change position significantly between the position of scanning (supine) and intraoperative assessment (lithotomy). This is one potential cause for clinical-radiology discrepancy. Regardless of this difference, it is very helpful for radiologists to have access to a contemporaneous examination under anesthesia (EUA) report by the surgeon when reporting the MRI study.

There is anatomic variation in the length of the anal canal. From a surgical perspective, the treatment decision is based on the location of the internal opening (IO) and the path

taken by the fistula tract for each patient. At intraoperative assessment, the anal canal is palpated, and the surgeon classifies the internal opening into low, middle, and upper thirds of the anal canal. The location of the IO is an important factor in the surgeon's decision to perform up-front fistulotomy. Higher internal openings are usually associated with a fistula tract that involves a greater amount of external anal sphincter, hence fistulotomy in this situation will be associated increase morbidity, predominantly increase risk of incontinence.

Prior to worksheet reporting, our radiologists reported electronic caliper measurements of the distance of the IO from the anal verge in millimeters. This exact distance is less useful for the surgeon clinically due to the anatomic variation in length of the anal canal (Fig. 2). Distances measured from MR imaging can be difficult to correlate with distances during intraoperative clinical examination and endoanal sonography (real-time user-dependent imaging modality).

Since the introduction of template reporting, and describing the IO as upper, middle, and lower third of the anal canal, surgeons have found this to be more helpful.

Worksheet explained

Our worksheet includes all the essential elements of a MRI report by a radiologist to help the surgeon make management decisions for a patient with perianal sepsis.

- Internal opening (IO)
 - Report the position using o'clock position
 - Location in the anal canal or rectum
 - Surgeons clinically divide the anal canal length into lower, middle, and upper thirds of the anal canal (or above the anal canal) and find this more

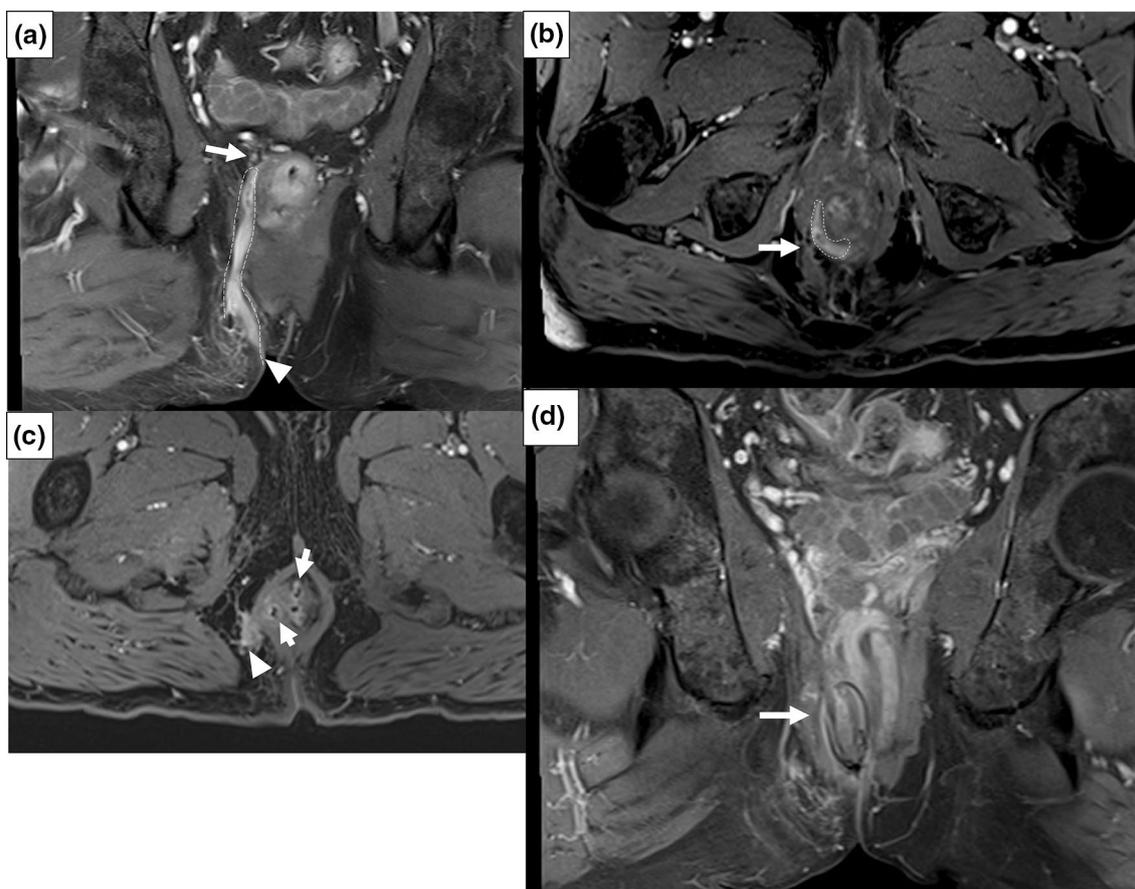


Fig. 3 Contrast-enhanced oblique axial (**b** and **c**) and coronal (**a** and **d**) T1-W fat-suppressed images from case 1 showing **a** an extrasphincteric fistula (dotted tract) from the right side of the rectum (arrow) to an external opening in the perineum at 7 o'clock position (arrowhead). **b** Above the levator plate, there is sepsis around the right side of the rectum (dotted area and arrow). **c** and **d** In the mid-

to-lower anal canal, there are two setsons in the intersphincteric plane from the previous placements (arrows), and these are not draining the current sepsis. The lower part of the tract of the extrasphincteric fistula is in the right ischioanal fossa (arrowhead in **c**). **e** The MRI reporting worksheet is drawn and shared with the surgeon via PACS

(e)

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MRI Perianal Fistula Worksheet**

Patient Name Patient 1

MRN DOB

Date of Scan

Radiologist

Internal Opening

Position: ... 7... o'clock (possible)

Location in **anal canal**
 tower-1/3
 Middle-1/3
 Upper-1/3

External Opening

Position: ... 7... o'clock

Type of Primary Fistula
 (circle one)
 Superficial (ie no muscle involvement)
 Inter-sphincteric
 Trans-sphincteric
 Supra-sphincteric
 Extra-sphincteric

Accessory tracts/Extensions
 No
 Yes

Supralelevator Sepsis
 No
 Yes

Associated Abscess No
 (circle one or more)
 Superficial
 Inters-phincteric
 Ischio-rectal fossa
 Supra-levator

Evidence of previous sphincter injury
 No
 Yes

Activity
 Active
 Fibrotic

Internal Opening •
External Opening*

ANTERIOR 12
9 3
6 ANAL VERGE

Rectum

setons

Dotted line = possible 7 o'clock internal opening

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Fig. 3 (continued)

useful than a discrete distance from the anal verge for decision making

- Reporting tip: The IO may be difficult to see on MRI [32]. Goodsall’s rule may be helpful in predicting IO location when an external opening is posterior to the transverse anal line, but this rule can be unreliable for anterior fistulae [33, 34]
- The position of the IO should be confirmed on MRI using two planes (either oblique axial and coronal, or oblique axial and sagittal), to confirm the craniocaudal location in the anorectum
- External opening (EO)
 - Report the position using o’clock position
 - Reporting tip: the EO is seen clinically as a defect in the perineal skin or buttock, but the EO may not always be seen on MRI. Therefore, it is useful for the radiologist to have prior knowledge of clinically

apparent EO from the surgeon because this can serve as a hint to possible subtle underlying sepsis or fistula tract that may otherwise be missed or underestimated

- Type of primary fistula tract
 - Reporting tip: use the Parks classification
- Any accessory tracts/extensions
 - Accessory tracts and extensions may require surgical exploration
 - Reporting tip: These can be very complex and difficult and time consuming to describe. Despite best radiologist efforts in reporting complex extensions, we have found that the most time-efficient and accurate way to communicate is to present a visual diagram for the surgeon
- Supralelevator sepsis
 - Sepsis above the levator plate can be occult on clinical bedside digital rectal examination (DRE) and on endoanal US
 - Reporting tip: supralelevator sepsis/abscess must not be missed because it would require surgical intervention
- Associated abscesses
 - These require surgical drainage
 - The presence of an abscess and its precise location may be a challenge to define in an awake patient
 - Abscesses may be multiple and highly irregular in shape and configuration. Again, for complex cases, a visual diagram for the surgeon is the most time-efficient and accurate way of communicating. The location is important for planning treatment
- Evidence of previous sphincter injury
 - This includes evidence of prior surgery
 - Surgical material remaining in situ will be evident on MRI as signal voids, such as loop-shaped setons or a drainage catheter in an abscess cavity. Postsurgical fibrosis is hypointense on all sequences without contrast enhancement. Other surgical materials such as plugs and glue are generally not visible on MRI. Advancement flaps may be visible, however, it may be subtle to detect. Correlation with a contemporaneous operative and/or EUA report is very useful.
 - If MR is performed in the early postoperative period, blood products may be recognized as hyperintensity on precontrast T1-W sequences [35]



Fig. 4 **a** Intraoperative photograph, **(b and d)** sagittal T2-W and **(c and e)** contrast-enhanced oblique axial T1-W fat-suppressed images from case 2. **b and c** Internal opening of a transsphincteric fistula at 3 o'clock position middle-third of the anal canal (arrowhead in **c**) with bifurcating extensions in a T-shape within the left ischioanal fossa (arrow and dotted lines in **b and c**). **d and e** There are associ-

ated abscesses in the anovaginal septum (arrow and dotted lines) and in the intersphincteric plane (solid white line in **d**). The morphology of this complex perianal sepsis can be communicated accurately and efficiently by means of the reporting worksheet **f** to make a real impact on clinical management

- Surgeons will correlate these imaging data with their clinical assessment of sphincter function (including history, examination, imaging, and adjuncts such as anorectal manometry)
- Activity
 - Fistula tracts can be classified as active or fibrotic based on their appearance on MRI

(f)

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MRI Perianal Fistula Worksheet**

Patient NamePatient 2.....

MRN DOB

Date of Scan

Radiologist

Internal Opening

Position: ...4... o'clock
Location in anal canal
Lower 1/3
Middle 1/3
Upper 1/3

External Opening

Position: ...2... o'clock

Type of Primary Fistula

(circle one)
Superficial (ie no muscle involvement)
Inter-sphincteric
Trans-sphincteric
Supra-sphincteric
Extra-sphincteric

Accessory tracts/Extensions

No
Yes

Supralelevator Sepsis

No
Yes

Associated Abscess Yes x 2

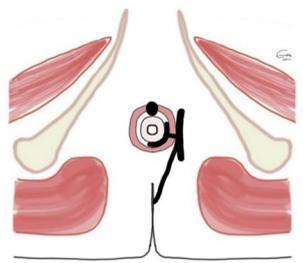
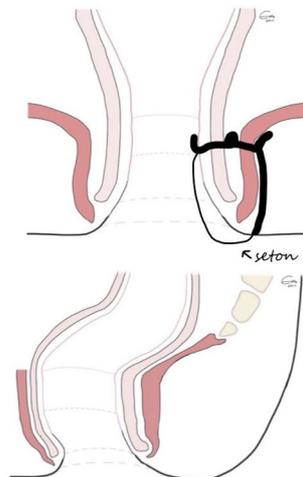
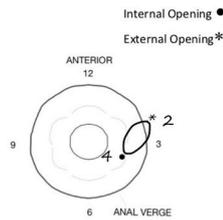
(circle one or more)
Superficial
Inters-sphincteric + Anal septum
Ischio-rectal fossa
Supra-levator

Evidence of previous sphincter injury

No
Yes

Activity

Active
Fibrotic



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material in situ. The worksheet is finally scanned into our Picture Archiving and Communication System (PACS) so that it is available for viewing as part of the patient’s electronic medical record. This is sent together with a radiological template report.

Case studies

Informed consent was obtained from all individual participants included in this study.

Case 1

A 65-year-old male presented for MR imaging to reassess ongoing complex perianal sepsis despite multiple prior surgeries that included seton placement. This patient had no documented history of Crohn’s disease (Fig. 3).

Case 2

A 24-year-old female presented for MRI evaluation of complex perianal sepsis prior to VAAFT (video-assisted anal fistula treatment) procedure. She had fistulizing perianal Crohn’s disease previously treated with multiple surgeries including seton insertion (Fig. 4).

Case 3

A 32-year-old male current smoker with Crohn’s disease presented for MRI evaluation of complex perianal sepsis previously managed surgically including seton insertion (Fig. 5).

Fig. 4 (continued)

- Active tracts have fluid or pus within the tract, and require management. These typically enhance, with or without T2 hypointense walls. The distinction between fluid and pus is less relevant from a surgical perspective. Fibrotic tracts are T2 hypointense with no fluid or pus within the tract and no associated enhancement
- Reporting tip: Management of active tracts (surgical) differs from fibrotic tracts (nonoperative). Look for reduction of tract size, T2 hyperintensity and enhancement in tracts which are in the process of healing [17]

The radiologist then draws the fistula tract(s) and associated abscess(es) on the three-plane schematic diagrams (see case studies), as well as the location of any perianal surgical

Conclusion

Perianal sepsis, particularly when involving complex perianal fistulae, can be a challenge for the radiologist to report. Effectively and accurately conveying the complexity of the disease in terms of its precise anatomy can be a demanding task. Even then, lengthy reports can be difficult for the surgeon to read and for the next radiologist to compare. Through collaboration with our colorectal surgical colleagues we have developed a perianal fistula worksheet whereby all the information that the surgeon requires from the MRI is described concisely on the worksheet, together with a visual roadmap of the perianal disease. We have found this to be an extremely efficient way of reporting, and it vastly improves the communication of imaging findings with our surgical colleagues.

Fig. 5 **a** Clinical photograph, oblique axial T2-W fat-suppressed images through the **b** middle-third and **c** lower-third of the anal canal, **d** sagittal T2-W, and **e** oblique coronal T2-W fat-suppressed images from case 3. Photographs were acquired at completion of surgery approximately one week following MR imaging. **a** Multiple setons are in situ (arrow and arrowheads). **b** There is an internal opening of a transphincteric fistula at 1 o'clock position middle-third of the anal canal (arrowhead, labeled fistula 1 on the worksheet). **c** There is an internal opening of another transphincteric fistula at 6 o'clock position lower-third of the anal canal (arrow, labeled fistula 2 on the worksheet) with adjacent horse-shoe-shaped sepsis just external to the sphincter complex, around the puborectalis (dotted line). **d** Fistula 2 branches and leads to two external openings (arrows). **e** The coronal image shows fistula 1 (arrowhead) and sepsis in the right ischioanal fossa located inferior to the levator plate associated with fistula 2 (arrow). **f** Another potential external opening is seen in the right buttock clinically (white arrow) when the patient is examined in the lithotomy position. This should prompt a search for an underlying fistula on MRI, as an external opening may be missed on MRI because it can be hidden within a skin fold. **g** The opening is seen in a skin fold (white arrow) with no underlying fistula track. **h** The reporting worksheet provides a roadmap for the surgeon

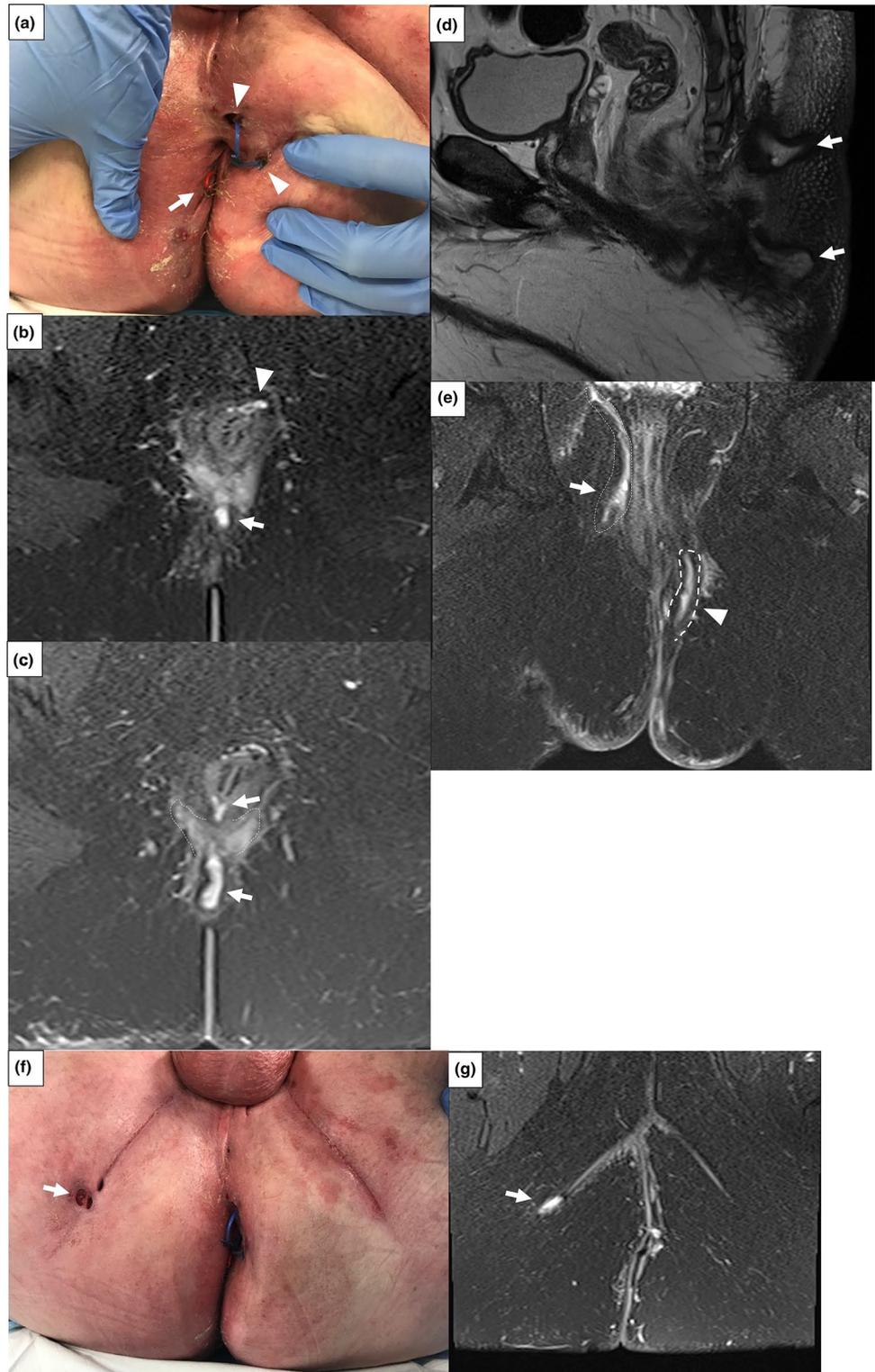


Fig. 5 (continued)

(h)

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MRI Perianal Fistula Worksheet**

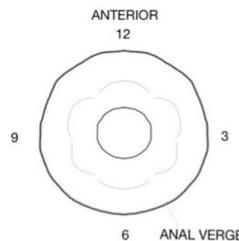
Patient Name *Patient 3*

MRN DOB

Date of Scan

Radiologist

Internal Opening ●
External Opening*



Internal Opening

①

②

Position: o'clock

1

6

Location in anal canal

Lower 1/3

Lower 1/3

Middle 1/3

Middle 1/3

Upper 1/3

External Opening

Position: o'clock

1

6 (x2)

Type of Primary Fistula

(circle one)

Superficial (ie no muscle involvement)

Inter-sphincteric

Trans-sphincteric

Trans

Trans

Supra-sphincteric

Extra-sphincteric

Accessory tracts/Extensions

No

Yes

Yes

Yes

Supralevator Sepsis

No

No

No

Associated Abscess

(circle one or more)

Superficial

Inters-phincteric

Ischio-rectal fossa

Supra-levator

No

No

Evidence of previous sphincter injury

① No

Yes

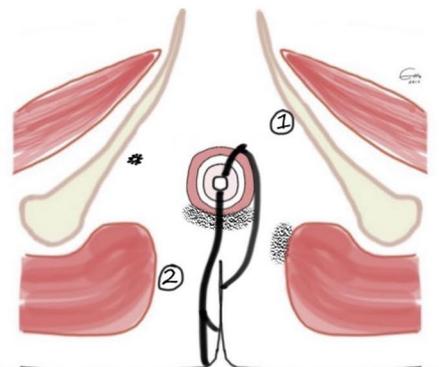
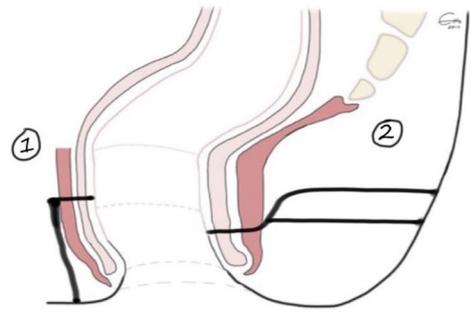
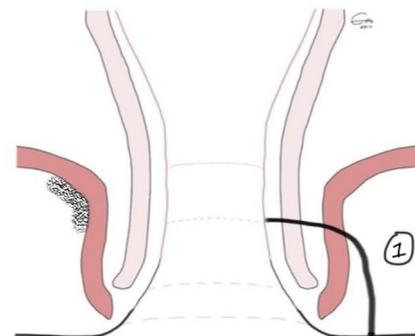
Activity

Active

Fibrotic

Active

Active



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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with ethical standards of the institutional and with the 1964 Helsinki declaration and its later amendments or comparable ethics standards.

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