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Chapter 7

Imaging of perianal fistulas

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**Abstract**
Perianal fistulas, cryptoglandular or Crohn’s disease related, have a tendency to recur. Recurrence is usually due to missed infection during surgery for cryptoglandular fistulas or insufficient response to medical treatment in Crohn’s disease. It is now recognized that preoperative imaging (endoanal ultrasound and MRI) can help to identify extensions that otherwise would be missed during surgery and therefore prevent recurrence. The purpose of this review is to give an up-to-date overview of the anal anatomy, classification of perianal fistulas and the role of imaging modalities in management of patients with perianal fistulas.

**Introduction**
Perianal fistula is a common condition with a prevalence of 1 per 10 000. Males in their 4th decade are most commonly affected. Cryptoglandular fistulas are the most common type of perianal fistulas, representing up to 90%. Around 40% of patients with Crohn’s disease will develop a perianal fistula and this is even higher in patients with anal strictures. Up to 36% of patients with Crohn’s disease present with a perianal fistula as their initial complaint.

Treatment of perianal fistulizing disease is medical or surgical. Patients with Crohn’s disease are first treated with antibiotics, immunosuppressive agents or anti–TNF antibodies. Ruling out abscesses is important before starting therapy. Setons can be placed to prevent abscesses from recurring. Fistulas not related to Crohn’s disease are usually treated by surgery. Recurrence after surgical therapy is the most common problem. Reason for recurrence is that fistula extensions are not detected during surgery; therefore preoperative imaging is very important.

**Anatomy and aetiology.**
The anal canal is lined by (sub)epithelium/mucosa with muscularis mucosae. Subsequent layers are the internal smooth muscle sphincter, the intersphincteric space (which contains the longitudinal muscle) and an outer striated muscle layer. The lower half of this outer layer is formed by the external sphincter and the upper half the puborectalis muscle. The anal sphincter is surrounded by the fat containing ischioanal space and continuous with the rectum at the anorectal junction.

At approximately 2 cm into the anal canal lies the dentate line, which forms a transition zone between anal squamous epithelium and rectal columnar epithelium. Around the dentate line are the anal glands that empty into the anal sinuses. The glands are primarily within the intersphincteric space or the internal sphincter. The commonly held cryptoglandular hypothesis states that infection of these glands can lead to the formation of anal fistulas. First an intersphincteric abscess will develop from the infected gland. If adequate drainage is not possible because of debris, this will progress to an acute anorectal abscess that needs surgical intervention. If the original intersphincteric abscess is not adequately treated a fistula can develop.

In patients with Crohn’s disease, fistulas may also develop because of the elongation of ulcers in the distal rectum (or anal fissures) that extend over time secondary to the force of defecation.
Classification of perianal fistulas

The Parks classification, although adapted to some extent, is still the most widely used classification of perianal fistulas. This classification was primarily developed for surgical treatment and is therefore especially important for patients treated surgically. Principal finding in classification is the course of the tract from the anal mucosa to the perineal skin, in relation to the most outer, striated muscle layer (figure 1).

Intersphincteric fistulas (24% of cases of primary cryptoglandular fistulas) course from the internal opening in the anal canal through the internal sphincter and the intersphincteric plane to the perineal skin. A transsphincteric fistula (58%) is a fistula that - in addition to the tract as described for an intersphincteric fistula - passes from the intersphincteric plane at varying levels through the outer striated muscle layer (thus external sphincter or puborectal muscle) into the ischioanal fat and the levator plate to the internal opening in the skin. Less frequent is a suprasphincteric fistula (3%) where the tract passes in the intersphincteric plane over the top of the puborectalis muscle and then downwards again through the levator plate to the ischioanal fossa and finally to the skin. Relative rare are extrasphincteric fistulas (less than 1%) where the tract passes from the perineal skin through the ischioanal fat and the levator plate to the internal opening in the rectum. This type of fistula is outside the anal sphincter complex altogether and in fact only found in patients after prior surgery.

Submucosal fistulas (15%) are not included in the original publication of fistula classification by Parks as these fistulas where not encountered at that tertiary referral center. However, now these fistulas are commonly added to the classification; these are superficial fistulas that do not involve the anal sphincter complex. In addition, single submucosal, intersphincteric fistulas are called simple fistulas; extra- and suprasphincteric fistulas, fistulas with secondary tracts or rectovaginal fistulas are called complex fistulas.

The extensions of the fistula are not included in the Parks classification. They may course in various directions and anatomical compartments. Horseshoe extensions are extensions that extend from both sides of the internal opening in the horizontal plane.

As relevant findings at MRI could not be indicated in the Parks classification system, a MRI based grading system has been proposed. The St. James university hospital classification for MRI is an MRI based grading system for perianal fistulas that has been validated by surgically proved cases. It is based on the Parks classification and is composed of five grades. It relates to the anatomy seen at MR images on both the axial and the coronal plane. This grading system deals not only with the primary tract but also with secondary ramifications and associated abscesses, which is needed in pre-operative and medical imaging (table 1).

<table>
<thead>
<tr>
<th>Grade</th>
<th>Fistula type</th>
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<tbody>
<tr>
<td>1</td>
<td>Simple linear intersphincteric fistula. The fistulous tract extends from the skin to the anal canal. There is no ramification within the sphincter complex. The tract is confined by the external sphincter</td>
</tr>
<tr>
<td>2</td>
<td>Intersphincteric fistula with abscess or secondary tract. The fistula is bounded by the external sphincter. Secondary tracts may be of horseshoe type or may ramify in the ipsilateral intersphincteric plane.</td>
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<tr>
<td>3</td>
<td>Trans-sphincteric fistula. The fistula pierces through both layers of the sphincter complex and then arcs down to the skin through the ischioanal fossa.</td>
</tr>
<tr>
<td>4</td>
<td>Trans-sphincteric fistula with abscess or secondary tract within the ischioanal fossa. The abscess manifests as an expansion along the primary tract or in the ischioanal fossa.</td>
</tr>
<tr>
<td>5</td>
<td>Supralelevator and translevator disease. The fistula extends above the insertion of the levator ani muscle. A suprasphincteric fistula extends upward in the intersphincteric plane and over the top of the levator ani muscle to pierce downward to the ischioanal fossa. Extrasphincteric fistulas reflect extension of primary pelvic disease down through the levator plate.</td>
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</table>

Treatment and preoperative assessment

The aim of treatment of fistulas of cryptoglandular origin is to close the fistula tract, eradicate the infection and to maintain continence. Treatment for cryptoglandular disease is often surgical. Classification is important because treatment differs between different types of tracts. Simple submucosal, intersphincteric and also low (1/3 lower part of the anal sphincter) transsphincteric tracts can be treated with fistulotomy without a (substantial) impact on continence. For higher and complex fistulas (high fistula: 2/3 upper part of the anal sphincter) retaining continence is a problem. For eradication of infection it is often necessary to cleave the external sphincter for excision or incision of the fistula tract. Cleavage often leads to moderate to poor long term results and incontinence in many individuals. For these reasons there is a trend towards treatment not involving the sphincter muscles (e.g. mucosal advancement). Less invasive treatment modalities (e.g. plug or glue) are other options, although with often disappointing results.
Examination under anaesthesia (EUA) used to be the technique for fistula examination. Probing the tract with a metal probe created secondary tracts and this technique was associated with high recurrence due to missed extensions (up to 25%)\(^\text{17}\).

Most patients (95%) with a fistula of cryptoglandular origin present with simple fistulas and therefore imaging might not be necessary at initial presentation\(^\text{16,19}\). Conversely, accurate visualization of the fistulous tract at initial presentation with subsequent optimized treatment might prevent recurrent and chronic disease. Patients with recurrent cryptoglandular fistulas present in 50% with complex fistulae, so that pre-operative visualization is mandatory in these patients. In patients with Crohn’s disease fistulas are complex in 75% of cases\(^\text{19}\). Although surgery is generally reserved for patients with abscesses, visualization of the fistula tract is important to monitor therapy response.

The extent of sphincter division during fistulotomy is determined by the location of the internal opening. The dentate line cannot be visualized with imaging techniques, but the position of the dentate line and the internal opening can be estimated using the transverse plane.

Crohn’s disease patients are treated medically. The usual first step of treatment is antibiotics (metronidazole, ciprofloxacin), although recurrence after discontinuation is common. Purine analogs (azathioprine, 6-mercaptopurine) are effective in treatment and maintaining remission\(^\text{20}\). Anti–TNF\(_\text{\alpha}\) antibodies has been introduced with good clinical results\(^\text{21,22}\). However, post therapy imaging with ultrasound and MRI proved that fistula tracts were still visible after short term treatment despite apparent clinical response\(^\text{23-25}\).

**Differential diagnosis**

Not all cases of perianal sepsis are due to perianal fistula; it can be caused by different conditions (table 2). Medical history and physical examination are important in this differentiation. Imaging can be used in inconclusive cases and localization of the disease is crucial for this differentiation (e.g. perianal fistula versus pilonidal sinus)\(^\text{26}\). In perianal fistulas, the infection is usually intersphincteric, whereas in other conditions not. Crohn’s disease as an underlying cause must always be considered, especially for complex disease.

### Table 2: Differential diagnosis of perianal sepsis

<table>
<thead>
<tr>
<th>Condition</th>
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<tr>
<td>Hidradenitis suppurativa</td>
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<tr>
<td>Acne conglobata</td>
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<tr>
<td>Pilonidal sinus</td>
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<tr>
<td>Actinomycosis</td>
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<tr>
<td>Tuberculosis</td>
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<tr>
<td>Proctitis</td>
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<tr>
<td>Human immunodeficiency virus</td>
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<tr>
<td>Lymphoma</td>
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<tr>
<td>Anal and rectal carcinoma</td>
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</tbody>
</table>

**Imaging techniques**

**Fistulography and CT**

Both fistulography and CT are now considered obsolete techniques. Few studies have been performed testing the accuracy of fistulography\(^\text{27,28}\) and CT\(^\text{29}\), all with disappointing results. Sensitivity of fistulography is in the study of Weismann et al.\(^\text{28}\) 88% and the specificity 100%. The sensitivity of 88% can be explained because in fistulography, possible extensions might not fill with contrast because of debris or granulation tissue and the anatomical relations are not visualized because pelvic floor muscles are not identified. In CT, the lack of contrast resolution prohibits differentiating fistulas from pelvic floor muscles.

**Endoanal ultrasound (EUS)**

EUS gives a detailed visualization of the anal sphincter complex\(^\text{30}\). EUS is a simple and fast technique and generally well tolerated by patients. A rotating probe covered with a hard sonolucent cone filled with water, with a 360\(^\circ\) radius and a frequency between 5 and 16 MHz is introduced in the rectum with the patient lying on the left side or supine position for women. The probe is then slowly withdrawn so that the sphincter complex can be visualized. On a normal ultrasound, the internal sphincter, intersphincteric space and external sphincter are visible as concentric circular layers. The internal sphincter is hypoechoic and 2-3 mm in width. The intersphincteric space is echogenic while the external anal sphincter has a
mixed echogenicity pattern. A tract leads to disturbance of the normal anatomy, often visible as a hypoechoic linear structure, while echogenic air bubbles can be present. Accuracy rates for correctly classifying the fistula tract are between 86.5%\textsuperscript{31} and 99%\textsuperscript{32}. In larger patient series the internal opening was detected in 62.5% to 94% of cases\textsuperscript{33-35}. The inconsistency in the literature about the accuracy of EUS for perianal fistula can be explained partially by infusion of hydrogen peroxide. Lack of the use of hydrogen peroxide results in suboptimal results\textsuperscript{36,37} as is reflected in a meta-analysis as well\textsuperscript{38}. It has been well established that hydrogen peroxide improves visualization of the fistula tract\textsuperscript{19,31,32,39-44}. Hydrogen peroxide is infused in the fistula tract where it forms small air bubbles that change the echogenicity of the tract from hypoechoic to bright hyperechoic (Figure 2). Care must be taken to sufficiently fill the track with hydrogen peroxide so that also the side branches are visualized when least resistance is in the main tract. Obviously, EUS is operator dependent.

With three-dimensional (3D) EUS a 3D volume is obtained which can be used to reconstruct in the coronal and sagittal planes, which is helpful in identifying the extent of the fistula and the relationship to surrounding structures. West et al compared in 21 patients with a cryptoglandular fistula hydrogen peroxide enhanced ultrasound with 3D reconstruction with endoanal MRI and surgery. EUS had an agreement of 81% with surgery and endoanal MRI and surgery 90%\textsuperscript{45}. To our knowledge, this is the only study that prospectively compared hydrogen peroxide enhanced ultrasound with MRI with a surgical reference standard.

MRI

MRI has a high intrinsic contrast resolution with an excellent demonstration of the anal sphincter and pelvic floor anatomy as well as identification of tracts and abscesses\textsuperscript{46}. The technique has established itself as a reliable technique for the imaging of perianal fistula\textsuperscript{47-49}.

T2-weighted sequences and a fat suppressed sequence are mainstay. A gadolinium enhanced T1-weighted sequence is very helpful for differentiating between fluid and granulation tissue, important in abscesses (Figures 3 and 4). First, a sequence in the sagittal plane is performed. The transverse and coronal sequences must be aligned with the anal canal at the sagittal sequence. There are two types of coils that can be used, the endoanal coil and phased-array external coils\textsuperscript{50}. The latter is far more widely available and most experience concerns this coil. Advantage of the endoanal coil is the higher spatial resolution, which might be beneficial in identifying small tracts and internal openings (Figure 5 and 6). Advantage of external phased array is the larger field of view – preventing missing extensions especially in patients with Crohn’s disease\textsuperscript{51} – and the wide availability. When both coils are available an approach where endoluminal MRI is used for cryptoglandular fistulas and external MRI in Crohn’s disease seems optimal.

On MR images the difference between fibrosis and active fistula tracts can be easily made. On T2-weighted images, active fistulas and abscesses, which are filled with pus and debris, are hyperintense, whereas fibrosis is hypointense. Also the difference between fluid within a tract (e.g. abscess) and active inflammation can be seen. On post contrast T1-weighted images fluid is hypointense (Figure 4) while granulation tissue enhances leading to high signal intensity (Figure 3).

The external anal sphincter has a relatively hypointense aspect and contrasts very well with the fat in the ischioanal fossa as well as the intersphincteric space on T2-weighted images. The difference between intersphincteric and trans-sphincteric tract is therefore easily made.

In a study with 52 patients with a perianal fistula, MRI with a bodycoil had a sensitivity of 81% for assessment of severity compared with outcome and a specificity of 75%\textsuperscript{51}. Other studies have shown similar results. MRI has been proven to significantly alter surgical outcome; postoperative recurrence of perianal fistula was 16% for surgeons who acted on MRI versus 57% recurrence for surgeons who did not\textsuperscript{52}.

The clinical role of EUS and MRI

EUS and MRI are both used in patients with perianal fistulas. Several studies compare the accuracy of EUS and MRI. Some have reported that MRI is more accurate\textsuperscript{36,48,52} or is less accurate\textsuperscript{54}. Differences between studies in methods used (e.g. use of hydrogen peroxide for EUS and optimal sequences and coils for MRI) and level of experience are probably important reasons for these differences.

Buchanan and colleagues\textsuperscript{52} found that MRI was 90% accurate whereas EUS (without hydrogen peroxide) was accurate in 81% and EUA in 61% in the classification of the perianal fistula.

The precise role of EUS and MRI has not been defined, as the body of evidence of comparison of state of the art EUS and MRI is meager. Both seem to have good accuracy data, where for MRI a significant impact on outcome of surgery has been demonstrated\textsuperscript{55}.

The advantage of EUS is that it is an inexpensive technique, easy to use in the hands of an experienced operator and can be used in patients with claustrophobia and metallic implants. The advantage of MRI is that it gives more overview. This is especially valuable in complex
fistulas and high fistulas, MRI can therefore be considered as primary imaging technique in patients suspected for these fistulas. When EUS is used as initial imaging technique in such patients, MRI should be performed when EUS in inconclusive (e.g. cases where the fistula cannot be followed proximal with EUS). MRI with an external coil does not need introduction of an endoanal device and patient comfort is in this respect better than for EUS and endoanal MRI.

Future of imaging techniques

Recent developments are the use of dynamic contrast enhanced MRI for determining disease activity in perianal Crohn’s disease. With this technique 2D T1-weighted scans are performed and time intensity curves are obtained, so it can be determined whether a fistula is active (by measuring the volume of enhancing pixels). To obtain time intensity curves, the dynamic contrast enhanced MRI was performed in a five-section volume that was imaged 20 consecutive times with a temporal resolution of 5 seconds (transversal 2D T1-weighted Fast Spoiled Gradient Echo sequence; MR parameters: TR/TE 7.4/2.4 msec; flip angle 30°). In patients with active fistulas, the volume of enhancing pixels was higher than in patients with an inactive fistula.

Other developments are the possibility of the use of a 3 Tesla MRI scanner. In theory a higher field strength gives a better signal-to-noise ratio, that can be used to achieve increased spatial resolution, increased temporal resolution (decreased imaging times), or a combination of the two. No studies have proven that the use of high field MRI scanners gives better patient outcome.

Conclusion

To decrease recurrence rate in patients with perianal fistulas, imaging is necessary for patients with a high likelihood of complex fistulas or patients with recurrent disease. There is a considerable body of evidence on EUS and MRI in perianal fistulas, but comparison of both techniques using state of the art techniques is meagre. However, most likely EUS and MRI are in experienced hands comparable techniques for low, simple tracks. For complex and high tracks MRI seems preferable. When such tracks are identified or suspected at EUS, MRI should be used when there is uncertainty about the proximal extension of the fistula with EUS.

Reference List