USEFULNESS OF MAGNETIC RESONANCE IMAGING IN DIAGNOSIS AND MONITORING OF TREATMENT OF PERIANAL FISTULAS

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A fistula-in-ano (also referred to as anal fistula, rectal fistula, perianal fistula or anorectal fistula) is an abnormal tract or cavity communicating with the rectum or the anal canal by an identifiable internal opening (1). The problem is still up-to-date and remains a difficult one to handle, with an overall incidence of 8.6:100,000 annually, affecting patients with a mean age of 38.3 years. The problem is much more common in men, with a female to male ratio of 2:15. There is a wide spectrum of potential causes of fistulas, but it appears that the majority of fistulas result from infection (abscess) in the anal glands extending from the intersphincteric plane to various anorectal spaces (2). The fistula-in-ano significantly decreases the quality of life, most patients experience recurrent perianal drainage, fever, perianal pain, itching and/or recurrent abscesses (3).

Although anal fistulas were known to Hippocrates and have been described throughout the centuries, they began to receive special attention in the 19th century. In 1835, Frederick Salmon founded the Benevolent Dispensary for the Relief of the Poor Afflicted with Fistula, Piles, and Other Diseases of the Rectum and Lower Intestines, he now world famous St Mark’s Hospital in London. Much of our understanding of perianal fistulas comes from the work of surgeons at St Mark’s Hospital: Salmon, who operated on Charles Dickens; Goodsall, who described the course of fistulous tracks from the skin to the anus (4); and Parks, whose classification of fistulas in relation to anal anatomy is widely used in surgical practice (5).

In this article we will discuss the anatomy of the perirectal area, the causes of anal fistulas and MRI protocols useful to assess the position of the fistula duct. Also, we will present classification types (gradation) of fistulas in surgery based on MR imaging.

Classification of fistulas

The most common classification of fistulas is the Parks classification (5). Fistulas-in-ano have been divided into four types according to their relationship with the external sphincter. The intersphincteric type, occurring in 70% of all anal fistulas is characterized by the fistula tract running via internal sphincter to the intersphincteric space and then to the perineum. The transphincteric fistula, observed in 25% of all anal fistulas, is characterized by the tract coursing via internal and external sphincters into the ischiorectal fossa and then to the perineum. The suprasphincteric fistula and the extrasphincteric fistula are much more rare, with the frequency of 5% and 1%.

The classification, depending on the involvement of the external anal sphincter, recog-
nizes two types of the anorectal fistulas: “high” and “low”. A low fistula is one that traverses the lower 1/3 of the external anal sphincter complex, while a high fistula traverses the upper 2/3 of the external anal sphincter complex (6, 7).

According to the American Gastroenterological Association (8) there are two types of fistulas, depending on the localization and clinical signs: simple and complex anal fistulas. A simple anal fistula is low (low intersphincteric or low transsphincteric origin of the fistula tract), has a single external opening, there is no associated pain or fluctuation to suggest perianal abscess and no evidence of a rectovaginal fistula as well as no evidence of ano-rectal structure. A complex fistula is high (high intersphincteric or high transsphincteric or extrasphincteric or suprasphincteric origin of the fistula tract), may have multiple external openings, may be associated with the presence of pain or fluctuation to suggest a perianal abscess as well as with a rectovaginal fistula or an ano-rectal structure, and may be associated with the presence of active rectal disease at endoscopy (9).

The treatment of anal fistulas concentrates on the elimination of the perianal symptoms and the eradication of the fistula pathology. Preservation of the fecal continence is crucial for good results of the treatment. The results of surgical treatment depend on a lot of factors and are very divergent with successful outcomes ranging from 14 to 98 percent and postoperative incidence of fecal incontinence between 0 and 63 percent (10, 11). Both the successful eradication of a fistula and the risk of postoperative fecal incontinence vary depending on the correct fistula classification, the visualization of the fistula tract before treatment and the treatment method applied.

Using adequate and most sensitive method for preoperative examination of a fistula should be one of the factors determining the long-term results of the treatment.

Imaging methods

Implemented diagnostic imaging of the fistula aims to resolve two basic issues:
1. Is the fistula associated with the sphincter complex? If the disease affects the sphinc-
ter, does the fistula run through the two layers of the sphincter (intersphincteric fistula) or only through the internal sphinc-
ter (fistula transsphincteric)?
2. Is the presence of fistulas and abscesses secondary? Failure to detect and remedy fistulas secondary and abscesses can lead to a relapse, which would mean that the treatment was ineffective. Fistulas secondary or other consequences may occur in the intersphincteric area, the ischiorectal fossa or the extralevator space. Fistulas of the horseshoe-shaped channel may extend circumferentially and cross the centerline.

Currently, physical examination increasingly departs from identifying the fistula canal with a probe. A fistulous tract may be difficult to probe if it is narrow, obstructed, kinked or branched. Forcible probing in such cases will result in the creation of a false tract or a false internal opening, or both (12).

Fistulography is the most traditional technique used to determine the radiological anatomy of a fistula. However, it is the least reliable and the most difficult one to interpret especially when it comes to the exact location of the internal opening and the location of abscesses (2, 13).

Rectal ultrasonography was a promising method but it also turned out to be worse than examination by a specialized clinical trial (8). The sphincter mechanism and the intersphincteric zone are usually well visualized by endo-
sonography, but in some patients it may be difficult to assess the external sphincter. Fur-
thermore, this method cannot distinguish between infection and fibrosis, and insufficient penetration depth on the head rectal (superfi-
cial) prevents the recognition of branches and more distant secondary infection.

Multidetector computed tomography allowing to get a slice of less than 1 millimeter, performed with contrast agent administered rectally and intravenously, seemed to be very promising (3, 14). However, low resolution of the tissue area and homogeneous absorption values (tissue density), both before and after intravenous injection of the contrast to the sphincter, the levator, the fibrotic fistula and the active fibrotic prevent unambiguous assessment of these structures.

In many reports attention is drawn to the special role of magnetic resonance imaging, which correctly and precisely depicts the ana-
tomical perirectal area. It is also important that a classic surgical description of a patient in the lithotomy position exactly corresponds to the view of the anal canal in the axial MR image and it is very useful for surgeons when the MR imaging results obtained by radiologists are interpreted in relation to the anal clock (fig. 1).

The most recent reports in the literature, although based on relatively small groups of patients, seem to fully justify the use of MRI for preoperative evaluation of perianal fistulas. MRI has been shown to demonstrate accurately the perianal anatomy (fig. 2). MR image shows more consistency with the conclusions of the surgical procedure than any other imaging method (10, 11). Thus, a variety of MR imaging techniques, sequences (tab. 1). MR imaging in the coronal and axial plane shows the fistula in relation to the sphincter complex, the ischiorectal fossa and the levator.

MR imaging performed using the body coil does not require any preparation of the patient and is well tolerated. However, the technique using rectal coil is not well tolerated by symptomatic patients and even though it provides many valuable anatomical details of the sphincter – a small field imaging (FOV), it does not present the overall picture required for the surgical procedure (15, 16). Techniques of acquisition routinely used have found their place in the imaging of fistulas. Reinforced T1-weighted images provide an excellent view of the overall sphincter complex, the levator and the ischiorectal fossa. However, fistulas and abscesses are shown as areas of low to medium signal intensity and cannot be distinguished from normal structures such as the sphincter and the levator muscles. In contrast T2-weighted and STIR sequences, such pathological processes as fistulas, secondary fistula passages or fluid spaces are clearly visible as areas of increased signal intensity in contrast to the small signal intensity sphincter muscle and fat tissues (especially in STIR) (tab. 2).

Other techniques used are the sequences with fat saturation in T2-weighted images (12), which are very useful in assessing the local, swollen body fat.

The technique without intravenous contrast medium which has a growing significance is DWI (diffusion weight imaging). It allows to estimate the diffusion limitations in the changes related to cancer and inflammatory diseases. An active fistula has a high signal in all the diffusion coefficients and reduced ADC map signal, like abscesses. This technique is very useful to locate minor changes.

<table>
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<tr>
<th>Pulse Sequence</th>
<th>References</th>
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<tr>
<td>Inverse sequence of short time inversion STIR</td>
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<td>Images T1-dependent gradient echo sequence with or without intravenous contrast with gadolinium</td>
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<td>T2-weighted images in fast spin-echo sequence with fat suppression</td>
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<td>DWI (diffusion weighted imaging)</td>
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In the assessment of perianal fistulas and related branches (11, 17) a dynamic contrast enhancement in T1-weighted gradient echo sequence with intravenous contrast imaging is used. The channels of fistulas in the MR image are enhanced, similarly to the walls of abscesses. Central parts of the abscess with fluid are not enhanced, resulting in an enhanced image of the ring, which is the typical image of an abscess, as in other parts of the body. This technique is rapid, non-invasive and well tolerated, which is a major advantage in patients with acute inflammation around the anus.

Not enhanced T1-weighted imaging may be helpful in postoperative assessment. Firstly, if MR imaging is performed directly in the period after the surgery, when bleeding is highly visible and subsequently a potential residual channel will be accurately depicted. Secondly, the repair operation may apply „transplants” which contain fat to fill the voids created after excision of inflammatory lesions. These very intensely visible structures are easily identifiable in enhanced T1-weighted images and can be distinguished from active disease conditions, which become visible as hyperintense areas only after enhancement with a gadolinium based contrast.

The challenge for imaging tests is posed by more complicated cases of patients who have undergone a surgical operation, where anatomical structures have been significantly affected and there has been a relapse. Such individual patients are people with Crohn’s disease where very often we deal with recurrence of active inflammation. In addition, more widely used biological treatment often brings improvements without the need of surgery, but in these cases we often have to deal with fibrotic changes.

Classification of anorectal fistulas using magnetic resonance (MR)

Parks et al. (4) provided a description of the processes and showed a link between fistulas and the sphincter mechanism in relation to the front plane view. Classification based on MR imaging is currently enrolled in clinical routine. The Parks classification refers to the anatomy visible in MR images in the axial and coronal plane. This classification includes not only the presentation of the original fistula canal, but also the secondary channels and associated abscesses. It is easy to apply and it uses axial view of anatomical characteristic points known to radiologists.

Using this classification is based on the evaluation of the anatomy and repeatable markers in the pelvis (15) (tab. 3).

<table>
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<tr>
<th>Grade</th>
<th>Results</th>
<th>Example</th>
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<tr>
<td>0</td>
<td>normal image</td>
<td>fig. 2</td>
</tr>
<tr>
<td>1</td>
<td>simple linear intersphincteric fistula</td>
<td>fig. 3</td>
</tr>
<tr>
<td>2</td>
<td>intersphincteric fistula with abscess or secondary track</td>
<td>fig. 4, 5</td>
</tr>
<tr>
<td>3</td>
<td>trans-sphincteric fistula</td>
<td>fig. 6</td>
</tr>
<tr>
<td>4</td>
<td>trans-sphincteric fistula with abscess or secondary track within the ischiorectal fossa</td>
<td>fig. 7</td>
</tr>
<tr>
<td>5</td>
<td>supralever and translevator disease</td>
<td>fig. 8</td>
</tr>
</tbody>
</table>
Grade 1. Simple linear intersphincteric fistula

A simple longitudinal intersphincteric fistula channel runs from the skin of the perineum or the anal cleft into the anal canal, the ischiorectal fossa is not affected by the changes. There is no bifurcation, i.e. the division of the fistula in the – sphincter complex. The channel is visible in the intersphincteric area and is completely closed within the external sphincter – not exceeding its outline. The fistula is occurring behind the transverse line of the anus, which so far is its most common form, extending into the anal canal in the midline of the back (fig. 3).

Grade 2. Intersphincteric fistula with abscess or secondary tract

The intersphincteric fistula or the abscess secondary channel are also closed by the external sphincter. Secondary passages may be the horseshoe type ones, and pass through the center line, or may branch into the same side of the intersphincteric space (fig. 4). Even in the case of abscess formation, the area of this process is limited to the sphincter complex, regardless of the plane of the imaging sequence.

Intersphincteric abscesses and fistulas’ secondary channels are visible in the images obtained after intravenous administration of a contrast agent in the dynamic test. In these contrast-enhanced images, pus in the central area has low signal intensity and is surrounded by a significantly enhanced ring (fig. 5).

Grade 3. Transsphincteric fistula

The transsphincteric fistula passes through both layers of the sphincter complex and further down to the skin through the ischiorectal layer. Therefore, the trans-sphincteric fistula may impair the normal pattern of body fat in the sciatic-rectal area causing secondary swelling and congestion – reducing signal intensity from the surrounding fatty tissue in T2-weighted images. This form of a fistula is distinguished by the location of the opening at the level of two-thirds of the anal canal (in relation to the position dented) as seen in the image in the coronal plane (fig. 6). Since the fistula disrupts the integrity of the sphincter mechanism, the process must be interrupted by performing an incision (division) of the two layers of the sphincter, thereby creating a risk of dysfunction.
Grade 4. Transsphincteric fistula with abscess or secondary tract within the ischiorectal fossa

Transsphincteric fistula complications may occur in the form of infections within the ischiorectal fossa. An abscess may occur in the form of a widening along the original fistula canal or in the form of a mass perturbing the structure or filling the ischiorectal space. MR imaging with intravenous administration of a contrast agent in the axial and the coronal plane clearly shows a transsphincteric abscess, which has a distinctive focal point in the form of fluid area of low signal intensity (fig. 7). As in the case of grade 3 lesions, the main marker of fistulas grade 4 is the channel intercepting the external sphincter. The fistula tract along with its associated abscess clearly covers the sciatic-rectal fossa. In some cases, the channel assumes the shape of a weight including the external sphincter.

Grade 5. Supralevator and translevator disease

In rare cases, the perianal fistulas disease exceed the point of attachment of the levator muscle. The interspincteric fistulas go up to the transsphincteric area and through the upper part of the levator cross further down to the the ischio-rectal fossa. The extrasphincteric fistulas reflect the extension of the original disease down through the levator plate (fig. 8). Such fistulas are problematic in further proceedings, because further tests are needed to identify the pelvic inflammation. Here, the most useful technique is diffusion imaging in the transverse plane, and the image in the frontal plane with intravenous contrast agent is particularly useful showing the slots in the levator plate which are clearly visible in this plane. For some fistulas horseshoe translevator branches may occur in the opposite direction.

Clinical experience with the classification and its implications for patient management

We have studied in our Magnetic Resonance Department and Department of Surgery more than 200 patients with MR imaging before
their initial surgical procedure who had surgically proved fistulas. Initially, patients were operated on without access to the MR imaging findings as part of a prospective study that showed excellent anatomic and diagnostic performance for MR imaging. In addition to this very good correlation between MR imaging findings and the standard of surgical exploration, others and we noted that early patient outcomes vindicated the imaging findings in discrepant cases (10, 11). The MR imaging findings proved correct in cases in which initial surgical exploration failed to reveal fistulas.

Surgical examination can be difficult where inflammation or fibrosis edema is present. The noteworthy advantage of MR imaging is its ability to demonstrate latent infection within the intersphincteric space (i.e. pus is locked in the intersphincteric space without outlet in the skin and therefore cannot be detected with probing) – suspected abscess. In the case of 'high' fistulas (transsphincteric and extrasphincteric, grades 3-5) probing and surgery may be omitted when the characteristic anatomical points are uncertain, and the surgeon is not sure whether he/she operates above or below the levator plate.

Further work has shown that MR imaging is better than initial surgical exploration in the prediction of patient outcome.

**CONCLUSIONS**

Research using magnetic resonance imaging (MRI) has a big impact on preoperative assessment of perianal fistulas in centers specialized in their treatment (5, 6, 15, 16, 17). The classification of grading fistulas uses simple anatomical markers identified in the MR images in the coronal and axial plane. Using this system, the radiologist can alert the surgeon about the occurrence of a complex medical condition that may require a specialized surgical procedure.

When MR image shows that the ischiorectal fossa is not affected by the changes, it is possible that the extent of the disease is limited to the sphincter complex (intersphincteric fistula, grade 1 or 2). The result after a simple surgical intervention is positive. If within the ischiorectal fossa a canal or an abscess is visible, it is usually associated with a complex perianal fistula form (usually the trans-sphincteric fistula, grade 3 or 4). Accordingly, a more complex surgical procedure may be required that may pose a risk of impairing the function or colostomy may be necessary to cure the patient. When the fistula duct crosses the levator plate, we deal with a translevator fistula (grade 5) and in such a case we need to look for the cause of the infection.

**REFERENCES**


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