CHAPTER 2

PROSPECTIVE COMPARISON OF HYDROGEN PEROXIDE-ENHANCED 3-DIMENSIONAL ENDOANAL ULTRASONOGRAPHY AND ENDOANAL MR-IMAGING OF PERIANAL FISTULAS

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ABSTRACT

The present study was performed in order to determine the agreement between hydrogen peroxide-enhanced 3D endoanal ultrasonography (3D HPUS) and endoanal MRI in the preoperative assessment of perianal fistulas. Patients with a cryptoglandular fistula underwent 3D HPUS and endoanal MRI. Both results were assessed separately by experienced observers. Both were blinded for each other's findings. A description of each fistula was made and the following characteristics were recorded: classification of the primary fistulous tract according to Parks (intersphincteric, transsphincteric, extrasphincteric, suprasphincteric) or not classified, presence of secondary tracts (circular or linear) and identification of the internal opening. 24 Patients (m:f = 20:4, median age: 42, (range 27-71) were included in the study. The median duration of the time interval between 3D HPUS and endoanal MRI was 66 days (IQR 21-160). Regarding the Parks classification, both imaging techniques agreed in 92 percent. Regarding the presence of circular or linear secondary tracts both techniques agreed in respectively 71 and 96 percent. Both techniques localized the internal opening in the same location in 92 percent. Therefore both techniques provide a useful tool for the preoperative assessment of perianal fistulas.

INTRODUCTION

Different diagnostic methods are available for the preoperative evaluation of perianal fistulas. Accurate preoperative assessment of perianal fistulas is mandatory for planning the most suitable surgical procedure. Furthermore it enables the surgeon to inform the patient on the type of surgical procedure and its possible complications. At present, the most commonly used imaging techniques are endoanal ultrasonography (EUS) and magnetic resonance imaging (MRI). EUS is a safe and relatively inexpensive technique which can also be used in patients who cannot undergo MRI because of claustrophobia, obesity, the presence of a pacemaker or metal implant. However, conventional EUS has limited value in visualizing fistulous tracts. EUS combined with instillation of hydrogen peroxide (HPUS) as a contrast medium improves visualization and provides an accurate preoperative assessment of fistulas[1-5]. A new technique is three-dimensional endoanal sonography. 3D EUS enables the reconstruction of transversal images of the anal canal in the coronal and sagittal planes. The use of 3D images provides more information on the anatomical aspects of anorectal disorders[6]. Several studies have compared EUS to MRI[7-11], some reporting better results with EUS[7,8] and others with MRI[9,10]. Until now, there are no studies comparing 3D HPUS with endoanal MRI. The purpose of this study was to assess agreement between 3D HPUS and endoanal MRI in the preoperative assessment of perianal fistulas.

PATIENTS AND METHODS

Patients

Patients with a cryptoglandular fistula who were referred to our colorectal outpatient clinic (WS, DZ) between April 2000 and April 2002 were included. Patients without a visible external opening of the fistula were excluded from the present study. Patients with a perianal fistula due to Crohn's disease and women with anovaginal or rectovaginal fistulas were also excluded.

Study design

Before the operation, all patients underwent 3D HPUS and endoanal MRI. The endoanal MRI images were interpreted at the Radiology department (SD, SH) and 3D HPUS was performed and interpreted at the Gastroenterology department (RW, RF). The observers were blinded for each others results. First the observers described the course of the fistulous tract(s). Next, the following characteristics of the fistula were recorded on a standardized case report form: classification of the primary fistulous tract according to Parks[12] (intersphincteric, transsphincteric, extrasphincteric, suprasphincteric) or "not classified"), linear and circular secondary tracks and location of an internal opening .

3-Dimensional Hydrogen Peroxide Enhanced Ultrasound

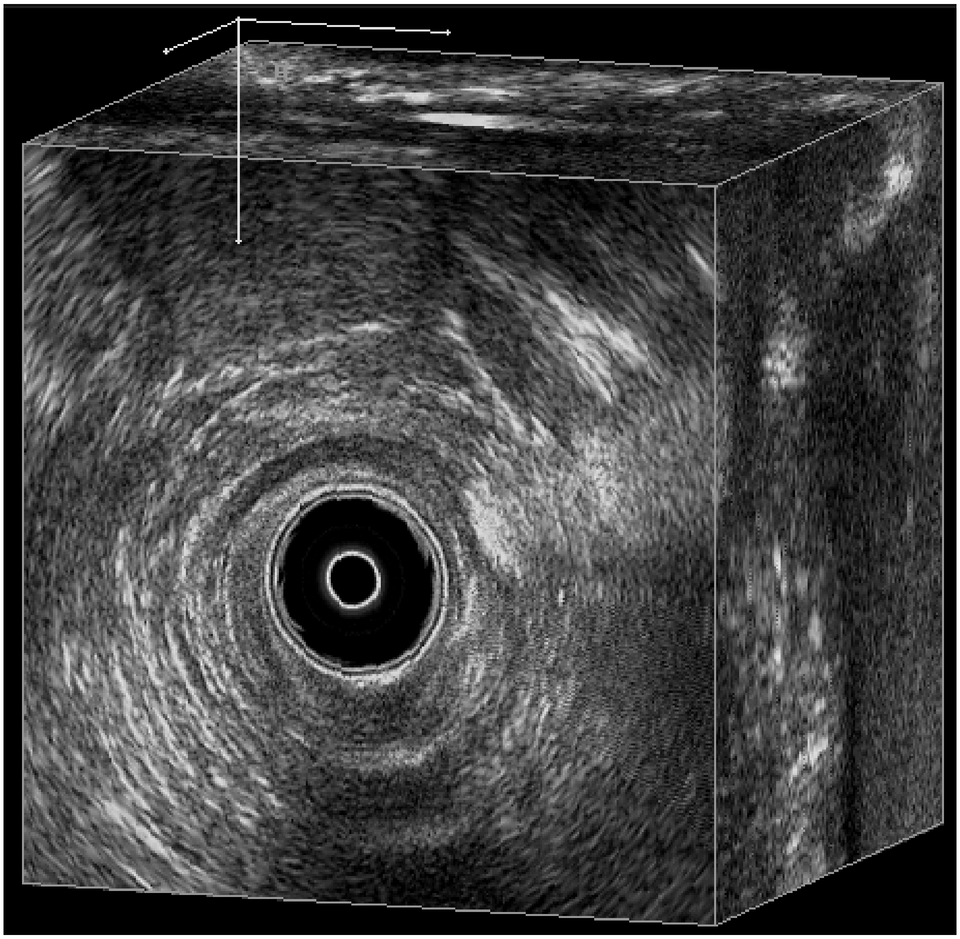
HPUS was performed using a 3D diagnostic ultrasound system (Hawk type 2102, B-K Medical) with a 7.5 MHz rotating endoprobe (type 1850, focal range 2 to 4.5 cm) covered by a hard sonolucent cone (diameter 1.7 cm) filled with water, producing a 360^{o} view. The endoprobe was introduced into the rectum and a 3D recording was made of the distal part of the rectum, the puborectalis muscle and the anal canal. This method allows visualization of fistula tracks as tube like hypoechoic lesions. After conventional endoanal ultrasound (EUS) was performed, hydrogen peroxide (3%) was introduced into the fistula track with a flexible intravenous cannula (Venflon®, Ohmeda, Helsingborg, Sweden). Hereafter EUS was repeated as described earlier. After infusion of hydrogen peroxide, which generates the formation of small air-bubbles, the ultrasonographic appearance of a fistula track changed from hypoechoic to bright hyperechoic. By comparing the images obtained with and without hydrogen peroxide the fistula track and its extensions could be identified and discriminated from previous scars. This made it possible to make a distinction between active fistulas and fibrotic tissue in previously operated patients. An internal opening was defined as an echogenic (HPUS) breach at the level of the submucosa (Figures 2.1a, 2.1b, 2.2a, 2.2b, 2,3a and 2.3b).

Endoanal Magnetic Resonance Imaging

MRI was performed at 1.5 T (Philips Medical Systems, Best, The Netherlands). The endoanal coil consisted of a fixed, rectangular, 60 mm long rigid receive coil with a width of 16 mm. The coil is contained within an 80 mm long cylindrical coil holder with a diameter of 19 mm.

Before introduction of the coil into the anal canal , a condom was placed over the coil and ultrasound gel was used as a lubricant. The coil was introduced while the patient was lying in the left lateral position. After the introduction of the coil, the patient carefully turned on the back and the position of the coil was rechecked.

In each patient, the following sequences were performed. Axial T2-weighted contrast-enhanced fast field echo (CE-FFE) with acquisition time of 5 minutes 39 seconds, imaging matrix 205x256, number of signal averages (NSA) 2, repetition time (TR) 23 ms, echo time (TE) 14 ms, flip angle 600, field of view (FOV) 140 mm, slice thickness 2 mm without gaps. Axial T2-weighted fast spin echo (FSE) with fat saturation: acquisition time 2 minutes 23 seconds, imaging matrix 186x256, NSA 3, TR 5086, TE 100 ms, flip angle 900, FOV 120 mm, slice thickness 4 mm with a gap of 0.4 mm. Coronal and sagittal T2-weighted FSE without fat saturation: acquisition time 2 minutes 34 seconds, imaging matrix 186x256, NSA 4, TR 2454 ms, TE 100 ms, flip angle 900 , FOV 120 mm, slice thickness 4 mm with gaps of 0.4 mm (Figures 2.1c, 2.1d, 2.2c, 2.2d, 2,3c and 2.3d).



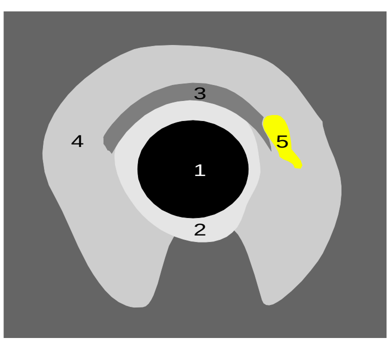


Figure 2.1a; *3D-HPUS picture of patient with a transsphincteric perianal fistula*

Figure 2.1b; *Schematic drawing clarifying 2.1a. 1=endoanal probe, 2=submucosa, 3=(part of) internal anal sphincter, 4=external anal sphincter, 5=intersphincteric part of fistula*

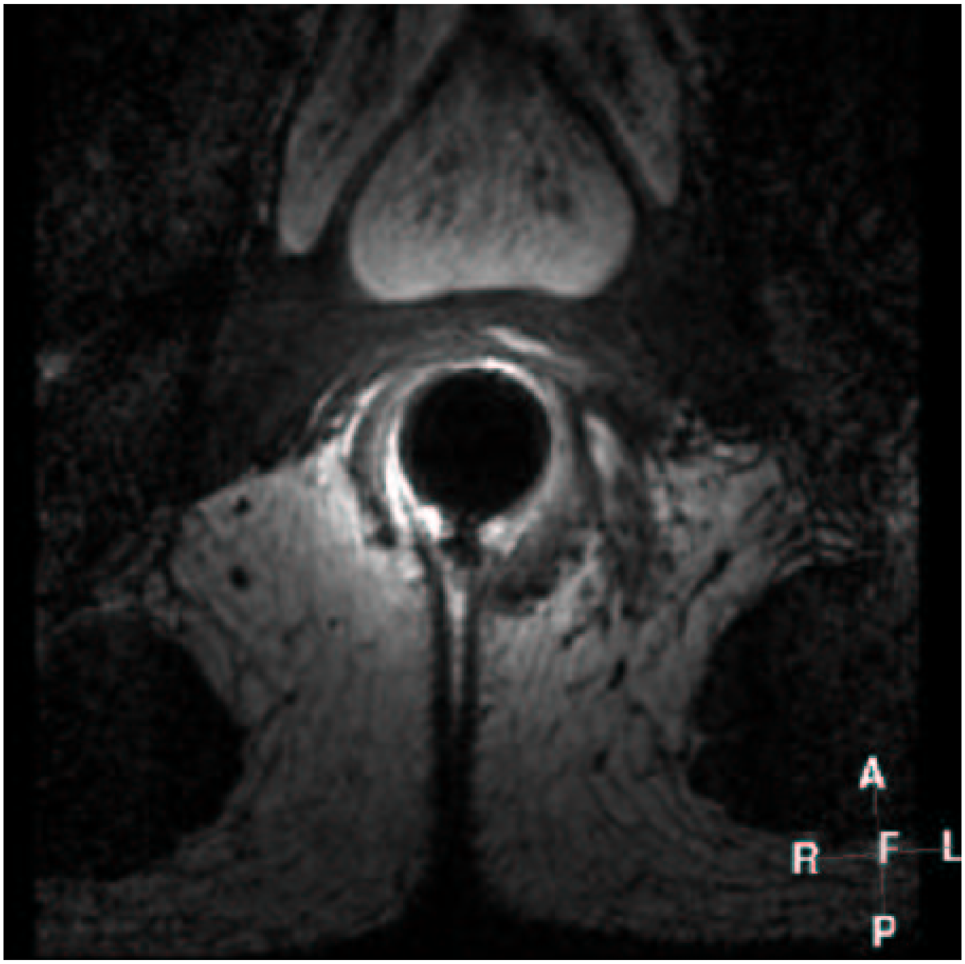


Figure 2.1c; *MRI picture of (same) patient with a transsphincteric perianal fistula*

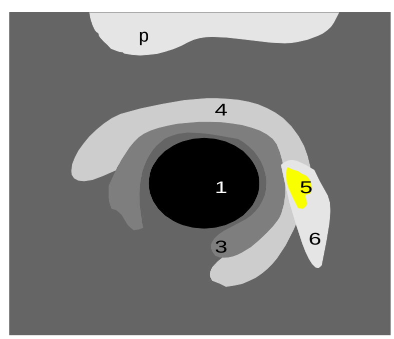
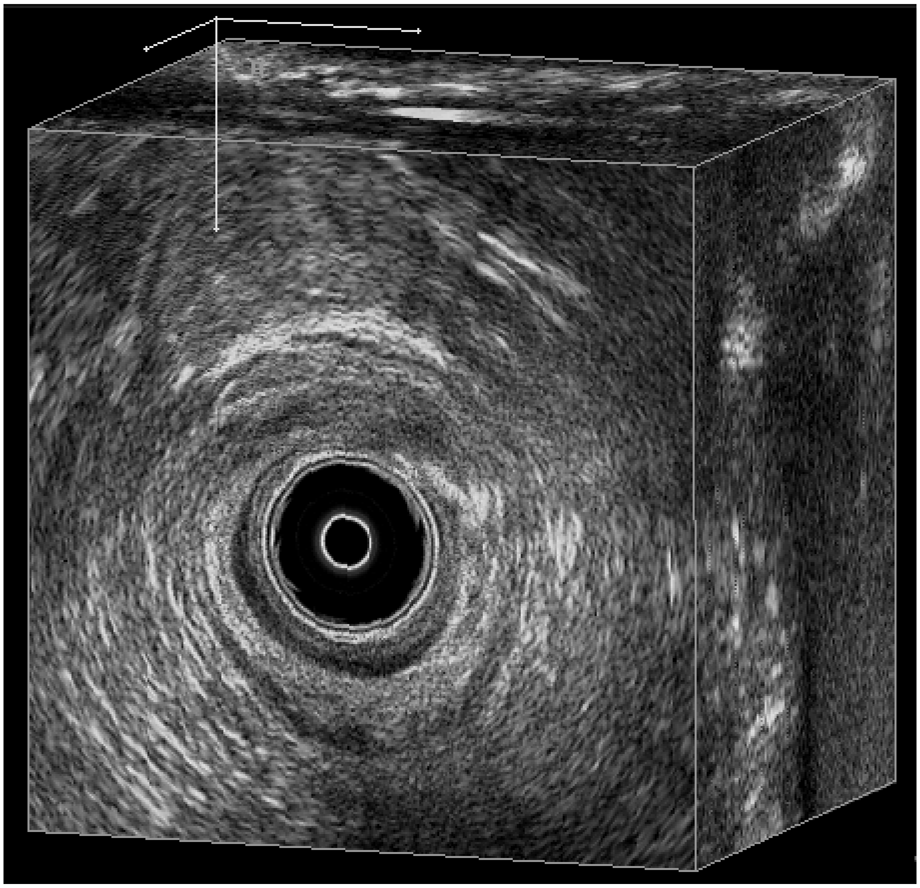


Figure 2.1d; *Schematic drawing clarifying 2.1c. 1=endoanal probe, 3=(part of) internal anal sphincter, 4=external anal sphincter, 5=part of the fistulous tract at outer margin of sphincter, 6=surrounding scarring and fibrosis, p=penis*



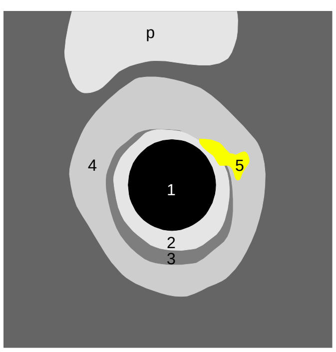


Figure 2.2a; *3D-HPUS picture of patient with a transsphincteric perianal fistula*

Figure 2.2b; *Schematic drawing clarifying 2.2a. 1=endoanal probe, 2=submucosa, 3=(part of) internal anal sphincter, 4=external anal sphincter, 5=fistula and location of internal opening, p=penis*

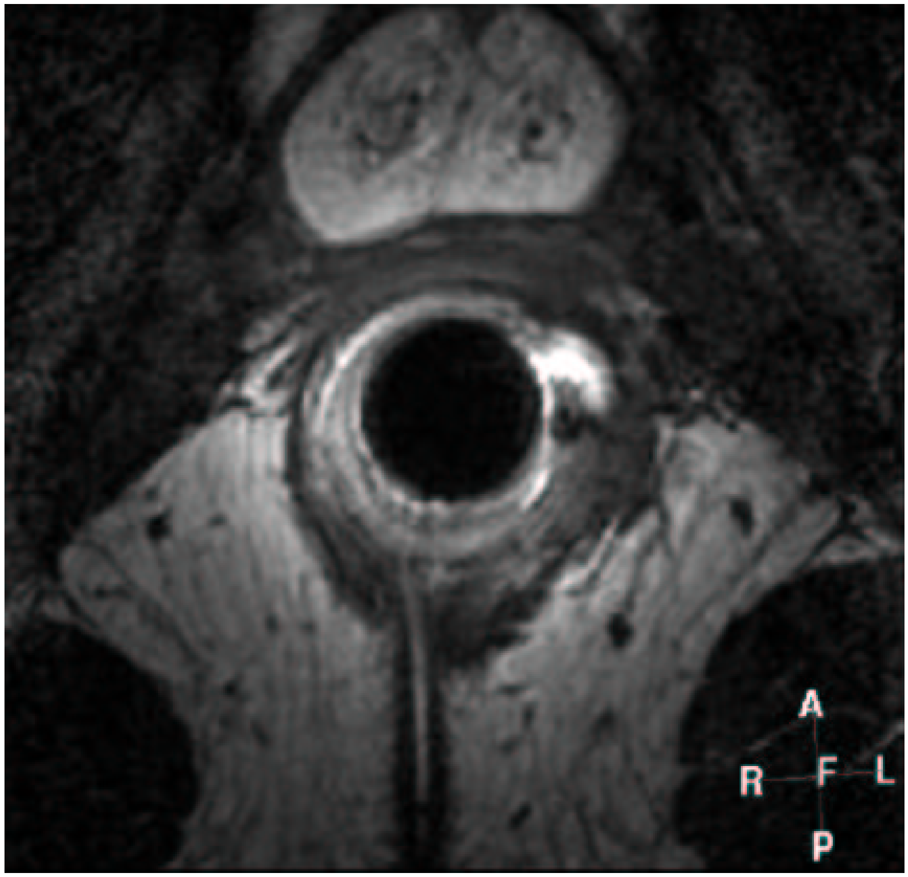


Figure 2.2c; *MRI picture of (same) patient with a transsphincteric perianal fistula*

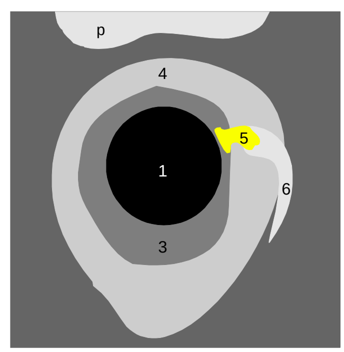
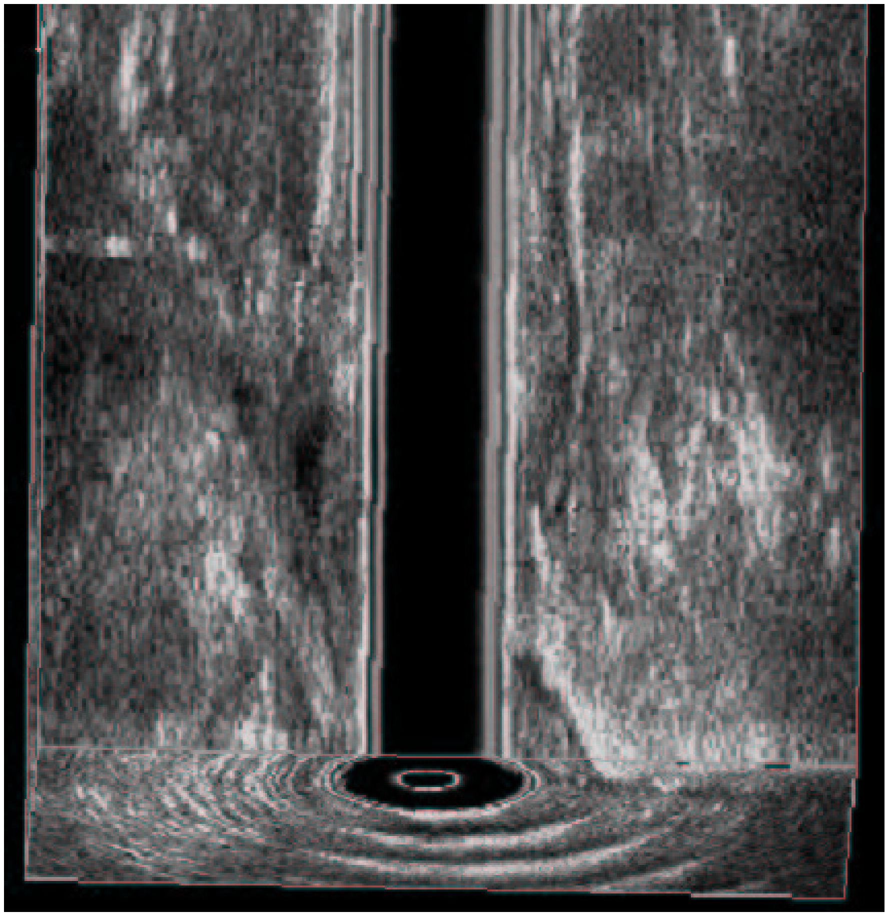


Figure 2.2d; *Schematic drawing clarifying 2.2c. 1=endoanal probe, 3=internal anal sphincter, 4=external anal sphincter, 5=fistula and location of internal opening, 6=surrounding scarring and fibrosis, p=penis*



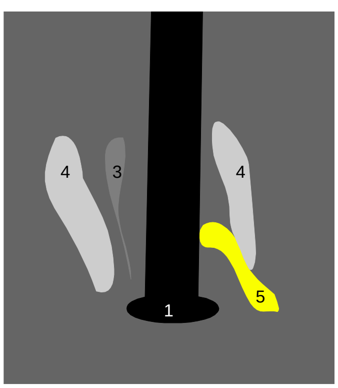


Figure 2.3a; *3D-HPUS picture of patient with an intersphincteric perianal fistula*

Figure 2.3b; *Schematic drawing clarifying 2.3a. 1=endoanal probe, 3=internal anal sphincter, 4=external anal sphincter, 5=fistula*

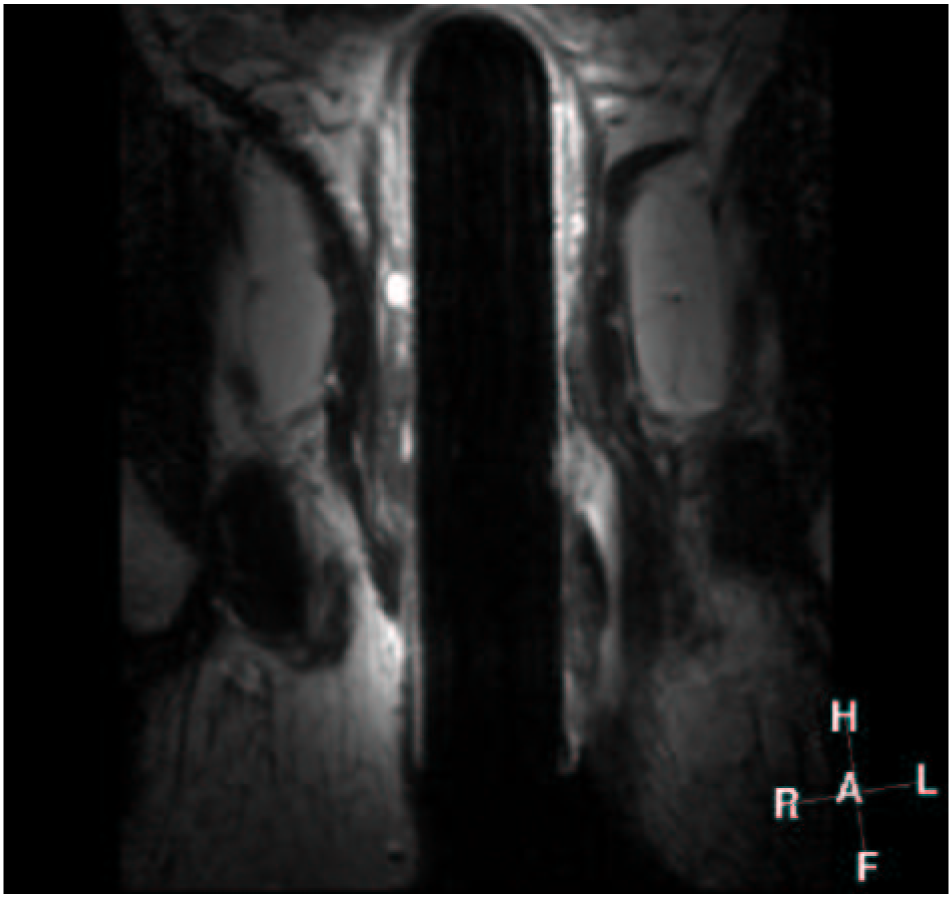
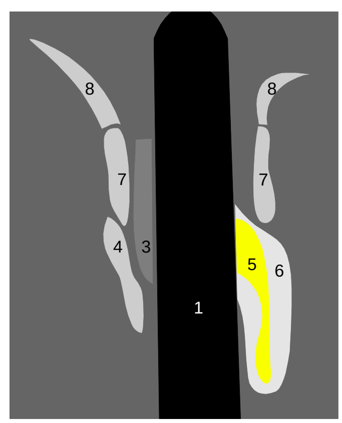


Figure 2.3c; *MRI picture of same patient with an intersphincteric perianal fistula*

Figure 2.3d; *Schematic drawing clarifying 2.3c. 1=endoanal probe, 3=internal anal sphincter, 4=external anal sphincter, 5=fistula, 6=surrounding scarring and fibrosis, 7=puborectalis muscle, 8=levator ani muscle*



Statistical analysis

3D HPUS and endoanal MRI results were compared to assess agreement between the 2 methods. Concordance rates and kappa values were calculated.

RESULTS

Twenty-four consecutive patients (m:f = 20:4, median age: 42, (range 27-71) years, underwent 3D HPUS and endoanal MRI. The median duration of the time interval between 3D HPUS and endoanal MRI was 66 days (inter quartile range: 21-160).

Regarding the classification of the primary fistulous tract, both imaging techniques agreed in 92 percent of all cases. (table 2.1).

	MRI		
3D HPUS	Intersphincteric	Transsphincteric	Not classified
Intersphincteric	**1**	1	0
Transsphincteric	0	**22**	1
Not classified	0	0	**0**

Table 2.1; *Classification of the primary fistula tract, the methods agreed in 92% (22/24). Horseshoe, extrasphincteric and suprasphincteric fistulas were not found by either method.*

Due to the high prevalence of transsphincteric fistulas a kappa value was not calculated. In one of the two patients, in whom no agreement was observed, 3D HPUS showed a transsphincteric fistula, which could not be identified by endoanal MRI. However 3D HPUS had been performed just after drainage of an abscess whereas endoanal MRI had been performed prior to drainage of the abscess. In the other patient an intersphincteric fistula was detected on 3D HPUS whereas endoanal MRI showed a transsphincteric fistula. The disagreement between the 2 techniques in this case may be explained by the long duration of the time interval between both investigations. Regarding the presence of circular tracts, both techniques agreed in 71 percent of all cases (kappa = 0.50) (table 2.2). In 6 of the 7 patients in whom no agreement was found, no circular tracts were reported by 3D HPUS, whereas MRI did detect circular tracts.

	MRI			
3D HPUS	none	Intersphincteric	Extrasphincteric	Intramuscular
None	**11**	4	2	0
Intersphincteric	1	**3**	0	0
Extrasphincteric	0	0	**0**	0
Intramuscular	0	0	0	**3**

Table 2.2; *Circular secondary tracts, the methods agreed in 71% (17/24), the kappa value is 0.50.*

A linear secondary track was reported in only one patient at 3D HPUS. With endoanal MRI this track was classified as a circular secondary track. The agreement was 96 percent. Both imaging techniques agreed in the remaining 23 patients that no linear tracts were present. Due to the low prevalence of linear secondary tracks no kappa value was calculated

	MRI				
3D HPUS	Not identified	Anterior	Posterior	Lateral (L)	Lateral (R)
Not identified	**0**	0	0	0	0
Anterior	1	**4**	0	0	0
Posterior	0	0	**16**	0	0
Left lateral	0	0	0	**2**	0
Right lateral	1	0	0	0	**0**

Table 2.3. *Localisation of the internal opening; the methods agreed in 92% (22/24), the kappa value is 0.84.*

Regarding the location of the internal opening both imaging techniques agreed in 92 percent of all cases (22/24, kappa = 0.84) (table 2.3). In 2 patients the internal opening could not be identified with endoanal MRI. In one of these two patients, no fistulous tract could be identified at all by endoanal MRI. This is the same patient as mentioned before, who had undergone drainage of an abscess just before 3D HPUS.

DISCUSSION

Fistulography was the first radiological technique employed for the preoperative evaluation of perianal fistulas. Because this technique was both cumbersome and inaccurate (chapter 1) it has been surpassed by endoanal sonography and MRI. Since the introduction of endoanal sonography in the early nineties, this imaging modality is used in the preoperative work-up of patients with a perianal fistula with increasing frequency. Despite its frequent use, there is still substantial controversy concerning the efficacy of this imaging technique. Graf and Eberhard performed preoperative endoanal sonography in 35 patients, presenting with a perianal fistula [13]. Peroperative, an internal opening was found in 17 subjects. In 9 of these 17 patients (53 percent) this opening had been correctly identified by endoanal sonography. According to other investigators, the additional value of conventional endoanal sonography is not as high as expected. They were able to identify the internal opening of the fistula in only 5 to 28 percent of their patients[14-17]. Regarding the classification of perianal fistulas, conventional endoanal sonography seems to be more accurate. Deen and colleagues[14] were able to correctly classify the fistula in 94 percent of their patients. In three other studies, endoanal sonography resulted in correct classification of the fistula in about 60 percent of all patients (table 1.1). Based on these data, Choen and co-workers stated that endoanal sonography has no added value over digital examination and careful probing[18].

When utilizing conventional endoanal sonography, it is virtually impossible to differentiate between an active fistulous tract and scar tissue[19]. This can be a major problem in patients who have undergone prior attempts at surgical repair. In 1993, Cheong et al. have suggested that the accuracy of preoperative classification, using endoanal sonography can be improved by using hydrogen peroxide as a contrast medium[1]. When hydrogen peroxide is introduced into the external opening a fistulous tract appears as hyperechoic. This way a fistulous tract is easier to identify as is the internal opening or any secondary track. Although this method gives good results an external opening must be present in order to be able to introduce hydrogen peroxide. The retrospective study in 38 patients by Cheong and colleagues[1] revealed that the preoperative classification of the fistula corresponded with peroperative findings in 92 percent of all cases. Furthermore it has been suggested that hydrogen peroxide enhanced endoanal sonography is able to accurately depict circumferential branches[20]. Poen and co-workers showed that the location of the internal opening could be accurately predicted in only 5 percent of all cases when using conventional endoanal sonography. When hydrogen peroxide was used as a contrast agent, endoanal sonography correctly identified the location of the internal opening in 48 percent. Correct classification of the fistula was possible in 98 percent of all cases[16]. Other authors have substantiated the benefit of the addition of hydrogen peroxide. (table 1.2).

When using magnetic resonance imaging, the complete sphincter complex, including the external anal sphincter and fistulous tracts is adequately visualized. Initially, MR imaging of perianal fistulas was performed using a body coil or external surface coil[21]. The introduction of endoanal coils was viewed upon by some as a major advance in the imaging of perianal fistulas[22]. However, there is considerable debate about which modality yields superior imaging results[22-25]. When comparing MRI with endoanal coil to MRI with external surface coil, Stoker and co-workers[23] showed endoanal coils to be superior (accuracy 86 percent versus 43 percent). Halligan and colleagues, however, found the use of the external surface coil to be superior. Unfortunately, the results of their comparative study are influenced by differences in imaging sequences for both coils as the more sensitive sequence (fat suppression technique) was only used for body coil[22]. Since the results of the study by Stoker and coworkers were reproduced by DeSouza and colleagues[25], it seems that magnetic resonance imaging, using an endoanal coil is the superior technique in preoperative imaging of perianal fistulas.

In most studies, surgical exploration is considered to be the 'golden standard'. Several authors have suggested that surgical exploration is actually less accurate than MR Imaging[26-29]. Barker and coworkers showed that 9 percent of all fistulas do not heal, because fistulous tracts that were identified by endoanal MRI were not recognized during surgery[28]. Until now, four studies have compared conventional endoanal sonography to either body coil MRI[29,30] or endoanal MRI[17,31]. Three of these four studies clearly show that imaging of perianal fistulas gives rise to a correct classification significantly more often using MRI than when using conventional endoanal ultrasound (table 1.3). Only Orsoni and coworkers found that EUS was a more sensitive modality for imaging of perianal fistulas than endoanal MRI. It has to be mentioned however, that all his 22 patients had fistulas due to Crohn's disease. Furthermore, the results reported by Orsoni are disputed by some workers because in their opinion the MRI technique utilized by Orsoni was suboptimal[32]. An important issue is that hydrogen peroxide has not been used as a contrast agent in any of the aforementioned studies. In our opinion, this accounts for the low efficacy that has been reported for EUS. Excellent results have been reported for the assessment of perianal fistulas when hydrogen peroxide is used as a contrast medium[1-5]. Poen et al.[2] found that the accuracy for determining the Parks classification was improved by 30 percent. A problem encountered by conventional EUS is that it is difficult to distinguish between scar tissue and active fistulas. When hydrogen peroxide is introduced into the external opening a fistula tract appears as hyperechoic. This way a fistula track is easier to identify as is the internal opening or any secondary tracks. Although this method gives good results an external opening must be visible to introduce hydrogen peroxide. Until now, no prospective trials have been conducted comparing hydrogen peroxide enhanced endoanal ultrasound and MRI.

The results of the present study indicate that 3D HPUS and endoanal MRI have a very good agreement in the preoperative evaluation of perianal fistulas. Unfortunately, a kappa value could not be calculated reliably for some of the parameters (classification of the primary fistulous tract and linear secondary tracts) due to the very low or high prevalence of a characteristic. Based on our findings, it can be concluded that both imaging techniques provide a useful tool for the preoperative evaluation of perianal fistulas, especially with regards to the classification of the primary fistulous tract as well as the localization of the internal opening. Both these aspects are of great importance to the surgeon and the patient as well. An intersphincteric fistula, for example, can be treated adequately and safely by simple fistulotomy. Treatment of a high transsphincteric fistula is far more difficult and might impair fecal continence. Regarding the presence of circular secondary tracts, the agreement between both techniques was moderate (71 percent, kappa = 0.50). Endoanal MRI seems to be more accurate in identifying these circular secondary tracts than 3D HPUS. Since linear secondary tracks were only seen in one patient on 3D HPUS and in no patients on endoanal MRI, no conclusions can be made from this finding. One of the limitations of our study that could explain some of the differences found is the time interval between 3D HPUS and endoanal MRI (The median duration between 3D HPUS and endoanal MRI was 66 days (IQR: 21-160)). It might be possible that in this time interval, the course of the fistula had changed.

CONCLUSION

Hydrogen peroxide enhanced endoanal sonography is quick, the technique is easy and the 'learning curve' to correct interpretation is relatively short. Furthermore, the investigation is relatively cheap and, even though hydrogen peroxide instillation can cause a passing sensation of pain, not very burdening to the patient. Unfortunately, hydrogen peroxide cannot be used in patients in whom the external opening is closed. Magnetic Resonance Imaging is a relatively expensive investigation. Expensive equipment is necessary and the investigation may take up to one hour. Furthermore, patients with metal implants or pacemakers cannot undergo MR imaging. Patients who have a tendency to claustrophobia also have to be excluded from this type of investigation. The present study shows that the results of 3D endoanal sonography enhanced with hydrogen peroxide and endoanal magnetic resonance imaging are comparable for evaluating perianal fistulas and can therefore both be used for reliable preoperative evaluation. Three dimensional hydrogen peroxide enhanced ultrasonography is more economic than magnetic resonance imaging and can be used for patients who can not undergo MRI. The choice of imaging modality can therefore be based on available expertise and equipment.

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CHAPTER 3

TRANSANAL ADVANCEMENT FLAP REPAIR OF TRANSSPHINCTERIC FISTULAS

Schouten WR, Zimmerman DDE, Briel JW

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