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## Comparison between the Accuracy of Endoanal Ultrasonography and Body Coil MRI in Preoperative Assessment of Internal Opening of Perianal Fistula Complex

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### Abstract

**Background and Aim:** Surgery for anal fistula is a commonly performed practice. Integral part of fistula surgery is identification of the internal opening if high recurrence rate is to be diminished. In this study, accuracy of endoanal ultrasound versus body coil M.R.I in detection of the internal fistula opening was evaluated by comparing both modalities with the intra operative findings as a standard reference.

**Material and Methods:** In this prospective comparative study 60 patients were enrolled in during the period from (December 2012 to June 2014). Both Endoanal Ultrasonography (2D/3D) with or without H<sub>2</sub>O<sub>2</sub> enhancement and Body coil phased array M.R.I were done for all patients. Internal opening site was localized by each modality with the surgeons performing the operations blinded to preoperative findings. Both results of the two modalities were compared against intraoperative findings as a standard reference to assess accuracy of each modality as well as the agreement between them.

**Results:** Regarding the diagnosis of the internal opening of the perianal fistula by both modalities, our study showed that the Endoanal Ultrasound had accurately diagnosed 53 cases out of 60 (88.3%) while 7 cases were inaccurately diagnosed (11.7%). On the other hand; The M.R.I had accurately diagnosed 29 cases out of 60 (48.3%) with inaccurate 31 cases (51.7%).

**Conclusion:** Endoanal ultrasonography with the recent innovations of 3D technique and the enhanced view with H<sub>2</sub>O<sub>2</sub>, is more accurate than Body coil M.R.I in localization of the internal opening of the perianal fistula complex thus; it can be considered the first choice when planning for fistula surgery especially that it has more advantages over M.R.I as its quickness (takes <10minutes), and portability (can be performed in the operating room). Also no radiation hazards are encountered with EAUS, like those in C.T or conventional fistulography.

**Key Words:** *Fistula – Endoanal ultrasonography – Internal opening – Body coil M.R.I – H<sub>2</sub>O<sub>2</sub>.*

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### Introduction

**EVERY** effort should be made to localize the correct internal opening preoperatively. Besides clinical examination, many investigations can help in preoperative localization of the internal opening [1-5].

The famous Goodsall's rule relates the radial location of the internal opening of the fistula to the position of the external opening. However, fallacies in Goodsall's rule have been reported and its overall accuracy is limited [6,7]. Thus, it is unsafe to confidently rely on Goodsall's rule for identification of the internal opening. It is now well established that preoperative imaging modalities can alert the surgeon to fistula components that might otherwise be missed [8,9]. From these modalities is the fistulography and computed tomography (CT) which have been disappointing and give insufficient data for surgery planning, beside that fistulography is shown to be inaccurate in many instances. In recent years, MR imaging has emerged as the leading contender for preoperative classification of fistula in ano. Endoanal ultrasonography (EAUS) has been increasingly used in the preoperative evaluation of anal fistulae. Initial EAUS evaluation was not satisfactory [10], but the diagnostic accuracy of EAUS has improved with technical advancements in ultrasonography, including the use of H<sub>2</sub>O<sub>2</sub> as a contrast agent and 3D image reconstruction [11,12].

The image is no longer limited to the axial plane in 3D-EAUS. Instead, it is possible to cut across any part of the data set in the coronal, sagittal, or oblique plane. This property is expected to be helpful in tracing the tract and internal opening [1].

The aim of this work is to compare between the accuracy of the endoanal ultrasonography and body coil M.R.I in preoperative localization of the internal opening of perianal fistulae through the extent of agreement of each modality with the surgical findings as a standard reference as well as estimating the degree of concordance between both modalities.

### Patients and Methods

Ethical committee approval and informed consent were obtained. This prospective comparative study included 60 patients who were enrolled from Colorectal Unit General Surgery Department Kasr El-Aini Hospital-Faculty of Medicine-Cairo University and from referrals from private clinics during the period from (December 2012 to June 2014). The inclusion criteria were patients diagnosed and had symptoms of any type of perianal fistula whether it was high or low, recurrent or not. Patients with intolerable or in acute pain or who could not tolerate or refused to undergo Endoanal ultrasonography and those who did not sign the consent form were excluded from the study. The age of included patients is ranging from 18 years old to 65 years old (Mean age 39 years old) and from both sexes (55 males and 5 females). Clinical history taking (age, occupation, presentation, history of anorectal diseases e.g. anorectal abscess, history of previous anorectal surgery e.g. abscess drainage or fistulotomy, ) and physical examination was performed in all patients to exclude cases which did not match with the criteria. A total of 60 patients who were suspected of having fistula in ano had done routine labs and underwent preoperative digital examination and 10-MHz anal endosonography (BK MEDICAL U.S SCANNER 1202) and body coil phased array MR imaging. Internal opening was determined with reviewers blinded to findings of both assessment. Results obtained, were compared with the intraoperative findings as a standard reference to assess accuracy for each modality. Postoperative antibiotics, analgesics and sitz baths were prescribed and follow-up was on weekly basis until complete healing of the perianal wound.

#### Ultrasound:

All scans were performed with the B K Medical Systems Flex Focus 1202® scanner and B-K 2052® probe (B K Medical, Herlev, Denmark) which is present in Kasr Al-Ainy Colorectal Unit. The patient takes an enema to clear the rectum and after a digital rectal examination, a rigid rotating probe with a 360° radius and an ultrasound frequency of between 6MHz and 16MHz was introduced into

the rectum while the patient is in a left lateral position. The probe is then slowly withdrawn so that the pelvic floor and subsequently the sphincter complex are seen. The diameter of the probe is small enough to minimize any distortion of the anal canal. The ultrasound was performed systematically from the upper third to the lower third of the anal canal. Manual 2D-EAUS was performed first to confirm the diagnosis, followed by computerized 0.2-mm sections along a 6-cm length then the 3D-EAUS image was subsequently reconstructed using specialized software provided by the manufacturer. 3D EAUS was performed at a frequency of 13MHz which provides a focal range of 5-25mm, an axial resolution of 0.3mm and a lateral resolution of 1.2mm. When the diagnosis was unclear, examination was repeated whilst instilling diluted (3%) hydrogen peroxide from 10ml syringe into a flexible cannula (16-21 G Angiocath) through the external opening. Only 44 patients out of 60 (73.3%) underwent hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) enhanced endosonography, the remaining 16 patients (26.7%) didn't have; due to either closed external opening or intolerability of the patient to the dye (H<sub>2</sub>O<sub>2</sub>).

#### 2D-US:

We evaluated the visualization of the Internal Fistula Opening (IFO) empty or with hydrogen peroxide injected. Hydrogen peroxide was not injected if the external opening was closed or if the patient was unable to tolerate the injection, and was used selectively in those with acute sepsis.

#### 3D-US:

A three-dimensional ultrasound was then performed without removing the probe, which allowed us to obtain sagittal and coronal images of the anal canal. We reassessed the site of the Internal fistula opening thus, improving the information obtained from the 2D-EAUS.

#### M.R.I:

The body coil phased array M.R.I was done and interpreted by the radiology department in Kasr Al-Ainy Hospitals-Cairo university and private radiology centers. It was done either before or after the Endoanal Ultrasonography with average time gap of 7-10 days. The MRI reports were including beside the localization of the internal opening; comments on the site of the primary tracts and its relation to the sphincter complex, secondary tracts, and the presence or absence of abscess cavities.

#### Surgery:

Fistula surgery was performed after investigations had been done with average time gap of 3-

5 days with general anesthesia without muscle relaxation (to identify the tone of puborectalis and external anal sphincter) except cases of low fistulae in which surgery was performed with spinal anesthesia.

Patients were placed in the lithotomy position and examination under anesthesia is performed using a Hill-Ferguson retractor and Lockhart Mummery fistula probes to search for the internal fistulous opening through the external fistulous opening (sometimes with the use of methylene blue injected through the external opening).

Once the internal fistulous opening was identified, the tract is laid open (fistulotomy) or excised (fistulectomy). The edges were not routinely marsupialized. The surgeons were blinded to both results of Ultrasonography and M.R.I and intra operative findings were recorded and used as a standard reference to be compared with findings of both modalities of investigations to assess the degree of accuracy of each modality, through its agreement with the surgical findings. Furthermore, the agreement between both modalities was evaluated.

**Results**

*Demographic and descriptive data:*

The study was conducted on 60 patients.

- Gender distribution: The study included 55 males (91.7%) and 5 females (8.3%) Fig. (1).

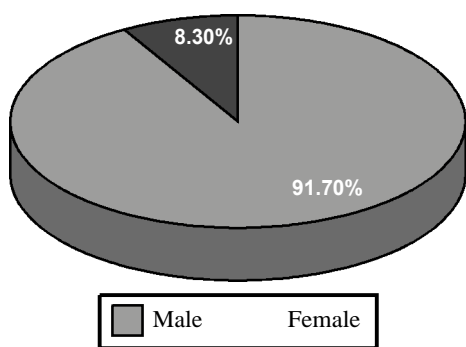


Fig. (1): Gender distribution.

- Age distribution:

Table (1): Age distribution.

	N	Minimum	Maximum	Mean	Std. Deviation
Age	60	18	65	39.53	10.998
Valid N (listwise)	60				

- Clinical data: At time of the study, all patients were having perianal fistulae due to cryptoglandular etiology with no cases with Chron's disease.

All types of fistulae were included whether high or low, recurrent or non recurrent cases (Table 2).

Table (2): Number and percentage of recurrent cases.

	Frequency	Percent
Valid:		
No	43	71.7
Yes	17	28.3
Total	60	100

The type of fistulae (according to surgical findings) were 26 with intersphincteric fistula (43.3%), 18 with transsphincteric fistula (30%), 9 with suprasphincteric fistula (15%) and 7 with extrasphincteric fistula (11.7%). Fig. (2).

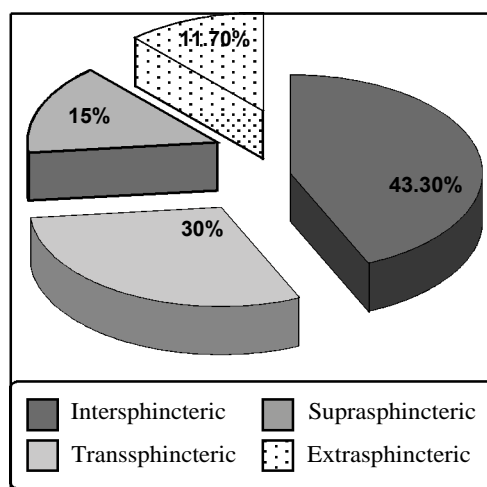


Fig. (2): Percentage of type of fistulae in the study.

- Analysis of the results obtained from our study (2013-2014) revealed the following:

*Internal opening:*

Regarding the diagnosis of the internal opening of the perianal fistula, our study showed that the Endoanal Ultrasound had accurately diagnosed 53 cases out of 60 (88.3%) while 7 cases were inaccurately diagnosed (11.7%) as shown in (Table 3).

Table (3): Accuracy of EAUS in detection of internal opening.

	Frequency	Percent
Valid:		
Inaccurate	7	11.7
Accurate	53	88.3
Total	60	100

The M.R.I had accurately diagnosed 29 cases out of 60 (48.3%) with inaccurate 31 cases (51.7%) as shown in (Table 4).

Table (4): Accuracy of MRI in detection of internal opening.

	Frequency	Percent
<i>Valid:</i>		
Inaccurate	31	51.7
Accurate	29	48.3
Total	60	100

As shown in Fig. (3), The overall agreement between both modalities was in only (50%) of all the cases. This percentage was as (43.3%) of all cases agreement in the accurate diagnosis and (6.7%) of all cases agreement in the inaccurate diagnosis. As shown in (Table 5), agreement analysis showed statistically non significant agreement between the 2 modalities in diagnosing the internal opening ( $p=0.758$ ).

On the other hand, ultrasound was accurate while MRI was inaccurate in (45%) of cases; however MRI was accurate while ultrasound was inaccurate in only (5%) of all cases. Thus we can

conclude that ultrasound is more accurate than MRI in diagnosing the internal opening.

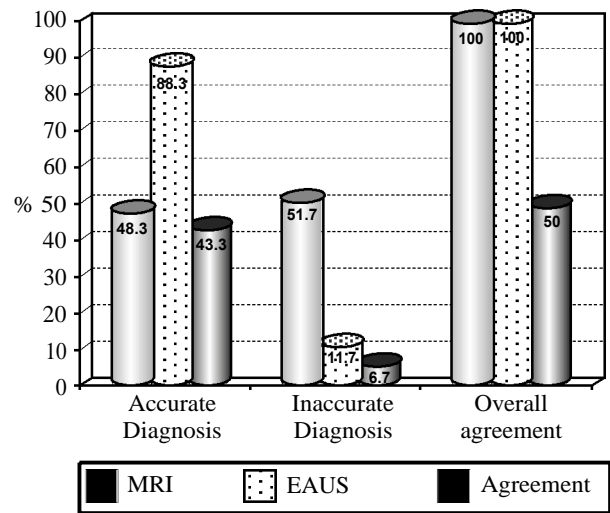


Fig. (3): Bar chart showing agreement percentage between EAUS and MRI in internal opening diagnosis.

Table (5): Cross table between Int. Open-MRI Accuracy and Int. Open-US Accuracy.

		Crosstab		
		Int. Open-US Accuracy		
		Inaccurate	Accurate	Total
Int.Open-MRI Accuracy	<i>Inaccurate:</i>			
	Count	4	27	31
	% within Int. Open-MRI Accuracy	12.90%	87.10%	100%
	% within Int. Open-US Accuracy	57.10%	50.90%	51.70%
	% of Total	6.70%	45%	51.70%
	<i>Accurate:</i>			
	Count	3	26	29
	% within Int.Open-MRI Accuracy	10.30%	89.70%	100%
	% within Int.Open-US Accuracy	42.90%	49.10%	48.30%
	% of total	5%	43.30%	48.30%
<i>Total:</i>				
Count	7	53	60	
% within Int. Open-MRI Accuracy	11.70%	88.30%	100%	
% within Int. Open-US Accuracy	100%	100%	100%	
% of Total	11.70%	88.30%	100%	
Symmetric measures value		Asymp. Std. Error (a)	Approx. T (b)	p-value
Measure of agreement	<i>Kappa:</i> 0.025	0.081	0.308	0.758
N of valid cases	60			

a: Not assuming the null hypothesis.

b: Using the asymptotic standard error assuming the null hypothesis.

### Discussion

Factors predictive of developing a postoperative recurrence following fistula surgery include the inability to locate the internal opening and mismanagement of the fistula tract [13,14]. Approximately 32 to 52% of all recurrences occur in those cases in which an internal opening is not identified [13,15,16]. Therefore, preoperative accurate assess-

ment of the fistula is crucial to the success of fistula surgery and should include localization of the internal opening, course of the primary tract, beside the presence of any associated pathology (secondary tracts, abscesses).

A variety of imaging modalities have been employed to assist in the pre-operative assessment of anal fistulas including fistulography, computerized

tomography (CT), magnetic resonance imaging (MRI) and endoanal ultrasonography. Fistulography has been found to be inaccurate and unreliable in most reports [16-18].

Computerized tomography (CT) has also proven to be suboptimal in assessing anal fistulas. Gillaumin et al., [19] have demonstrated the relatively poor resolution of the levator and anal sphincter muscles by CT and, therefore, the difficulty in identifying fistulas in relation to these structures.

Currently, the main techniques used are endoanal ultrasonography (EUS) and magnetic resonance imaging (MRI). EUS is a safe and economical technique that can also be used in patients who cannot undergo MRI because of claustrophobia, obesity, or metallic implants (such as pacemakers). Conventional EUS has limited value in visualizing fistula tracts. EUS combined with hydrogen peroxide (HPUS) as a contrast medium improves visualization and provides an accurate preoperative assessment of fistulas [20-22].

A new technique is three-dimensional (3D) EUS. 3D EUS enables axial images of the anal canal to be reconstructed in the coronal and sagittal planes. The use of 3D images provides more information on the anatomy of anorectal disorders [23].

Like our study, several studies have compared EUS to MRI, with some reporting better results with EUS and others with MRI; and several other studies had shown the role of either endosonography (with or without H<sub>2</sub>O<sub>2</sub> enhancement) or MR imaging, as a single diagnostic modality in preoperative assessment of perianal fistula. EAUS was inferior to MRI in earlier studies and it was inferior or equivalent in subsequent studies. A conventional 2D-EAUS was used in most of these comparative studies. In the only prospective comparative study evaluating 3D-EAUS and MRI, both modalities were shown to be accurate [24].

In (2009); Yung and Young published their study in the world journal of gastroenterology in which 61 patients were included in this prospective study to evaluate the effectiveness of three-dimensional endoanal ultrasound (3D-EAUS) in the assessment of anal fistulae with and without H<sub>2</sub>O<sub>2</sub> enhancement, the obtained results were-like our study-compared to the operative findings as the reference standard. The results of our study seems to agree with the results in this study to a large extent. In this study, the accuracy of 3D-EAUS in localization of the internal opening was 84.2% (in our study it is 88.3%) [1].

In harmony with our results, Ratto and colleagues conducted a prospective study of 102 patients with primary cryptogenic anal fistula and demonstrated an overall intra operative concordance rate (with respect to preoperative EAUS) Of 91 percent for internal opening (88.3% in our study) [25].

Again, our results is very much in concordance with the results of Gustafsson et al., study published in June 2001. Similar to our study design, 23 patients underwent preoperative 0.5 T body coil M.R.I and 1 0Mhz EAUS which included propping in 6 patients. The results of both techniques were compared against surgical findings as a reference method [5].

Concerning the localization of the internal opening by EAUS the corresponding figures were 17 cases (74%) “in our study it is (88%)” and by M.R.I 10 cases (43%) “in our study it is (48.3%)”.

A further study carried out by Shwartz et al., showed agreement with our study. In his prospective study, Shwartz made a comparison between Endosonography performed with a 7-MHz rigid linear endoanal probe and body coil phased array MR imaging and examination under anesthesia (EUA) in 34 patients with suspected Chron's disease perianal fistula which were classified according to park's classification, with a consensus gold standard determined for each patient, unlike most studies in which only surgery is used as a gold standard.

The overall accuracy of all 3 modalities was >or =85%: Endoanal ultasonography accuracy was 91% (78.3% in our study), MRI accuracy was 87% (68.3% in our study) and examination under anesthesia accuracy was 91 % (not performed in our study). Accuracy was 100% when any 2 modalities were combined [26].

On the contrary of our study results, many studies have been published; in which MR imaging was superior and more accurate than endosonography.

Buchanan et al., published a study included 104 patients in which they prospectively evaluate the relative accuracy of digital examination, 1 0Mhz anal endosonography, and body-coil magnetic resonance (MR) imaging for preoperative assessment of fistula in ano by comparison to an outcome-derived reference standard which was based on a combination of subsequent surgical and MRI findings and clinical outcome after surgery; unlike our

study, which relies only on the intraoperative findings as a reference standard [10].

In this study, endosonography correctly identify the internal opening in (91%) of cases versus (97%) with MRI.

(In our study, these figures correspond to 88.3% with endosonography and 48.3% with MRI).

By the end of this study, Buchanan GN. et al., concluded that endosonography with a high frequency transducer is superior to digital examination for preoperative classification of perianal fistula and stated that while MR imaging is superior in all respects, endosonography can be used as an alternative for identification of the internal opening.

Another prospective, non randomized study published in Maier et al., Austria, in which patients with perianal fistulae and sepsis were investigated with either endosonography or magnetic resonance imaging with both results compared with surgical findings, stated that MRI appears to be more specific and sensitive in the preoperative assessment of perianal sepsis [27].

Level of expertise of a person performing endosonography not mentioned in this study, this could have biased the results for favour of MRI.

Lunniss et al., conducted a prospective study on 35 patients with clinical diagnosis of fistula-in-ano, in which body-coil MR imaging was compared with the independently documented operative findings. MRI was also compared with anal endosonography (7-MHz radial endoanal probe was used) in 20 patients [28].

They reported that magnetic resonance imaging is accurate and is superior to endoanalsonography (Neither hydrogen peroxide H<sub>2</sub>O<sub>2</sub> nor 3D sonography was used in the study), also they concluded that MRI is advocated as the method of choice when imaging is required for anal fistula as it can demonstrate pathology missed at surgery by experienced coloproctologists [28].

Both modalities showed equal results in the prospective study published by West RL., Zimmerman DD. et al., in (2003), comparing hydrogen peroxide-enhanced three-dimensional endoanal ultrasonography (H<sub>2</sub>O<sub>2</sub> 3D-EAUS) and endoanal MRI in preoperative assessment of perianal fistula in 21 patients [24].

Agreement with the surgical findings, for the location of an internal opening was 86% for H<sub>2</sub>O<sub>2</sub> enhanced 3D-EAUS and 86% for endoanal MRI.

This corresponds to 88.3% & 48.3%, respectively, in our study in 2013-2014.

Finally, and as any research or study done before, we acknowledge that our study may have some limitations and shortage. It didn't include as much complex fistulae; due to low prevalence of high type fistulae or fistulae due to Chron's disease, this made it difficult to draw clear conclusions as to how adequate EAUS was in detecting high type or complex fistula, also there was multiple variations in our study which may not guarantee the overall accuracy of our results, from this, is the presence of more than Endosonography operator, who may have different experiences and learning curves with the sonar.

Again, this problem was encountered with MR imaging which was done in many centers with different protocols and different interpretations of MR images, beside that some radiologists may bypass many important findings, due to lack of the knowledge about what the surgeon requires from MRI films.

Another limitation in our study, was the presence of more than one colorectal surgeon, involved in the surgeries of fistula; with different levels of experience and technical approaches thus, influencing the results of the present study.

The lack of data on clinical outcomes and the use of surgical findings as the gold standard in this study might in part biased our results. Most previous reports, like our study, have regarded surgical results as the reference standard. However, surgery as a gold standard has been questioned, as studies have shown that EAUS and MRI are able to detect fistula tracts that are not seen on surgical exploration [24].

Buchanan et al., suggested using the clinical outcomes rather than surgical findings as a reference standard because missed occult infection is possible during surgical exploration [10].

In our study, we didn't use H<sub>2</sub>O<sub>2</sub> (as an enhancing agent in endosonography) in all cases due to technical difficulties or patient intolerance, so this may have biased our results to some extent.

#### *Conclusion:*

EUS combined with hydrogen peroxide and 3D technique shows an advance over MRI in localization of the fistula internal opening and offers extra visualization of perianal fistulas. So, we can warrant the EUS to be considered the preferred examination technique in the study of anal fistulas especially,



that Endoanal Ultrasonography (EAUS) is more economic and can be used for patients who cannot undergo MRI as in obese patients or patients having metallic implants like pacemaker, or patients known to be claustrophobic.

Other advantages that make the EAUS the modality of choice is its quickness (takes <10 minutes), and portability (can be performed in the operating room). Also no radiation hazards are encountered with EAUS, like those in C.T or conventional fistulography.

EAUS has also a good reputation in showing the topography of the sphincter complex which allows detection of any sphincteric defects that have no clinical manifestations, thus aid in the planning of fistula surgery according to the obtained findings. Our data demonstrate that EUS (2D/3D) with selective hydrogen peroxide image enhancement is an excellent modality for elucidating the anatomy of fistula-in-ano with a high positive predictive value and sensitivity.

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## الملخص العربي

الهدف: تعتبر جراحة الناسور الشرجي من الجراحات الشائعة. وتعد معرفة وتحديد مكان الفتحة الداخلية للناسور من الاشياء اللازمة والضرورية لضمان عدم ارتجاع الناسور الشرجي بعد الجراحة. في هذه الدراسة تمت مقارنة دقة التشخيص للفتحة الداخلية للناسور الشرجي لكلا من السونار الشرجي والرنين المغناطيسي الخارجى عن طريق مطابقة ما تم التوصل اليه بكلا الفحصين مع ما تم اكتشافه اثناء الجراحة كمعيار مرجعى.

الطريقة: تضمنت الدراسة ٦٠ (ستون) مريضاً من كلا الجنسين، تتراوح اعمارهم ما بين ١٨ و ٦٥ عاماً (متوسط الأعمار ٣٩ عاماً) يعانون من ناسور شرجي منخفض أو عال، متعاود أو غير متعاود، أجروا الفحوصات المعملية المعتادة وقاموا بعمل سونار شرجي ثنائى وثلاثى الأبعاد باستخدام أو عدم استخدام ماء الأكسجين كصبغة موضحة، كما قاموا ايضا بعمل رنين مغناطيسى خارجى على القناة الشرجية لتقييم الناسور.

تم تقييم الفتحة الداخلية للناسور - بكلا الطريقتين - مع عدم معرفة القائمين بالجراحه على نتائج اى من الفحصين.

تم مقارنة النتائج التى تم الحصول عليها من كلا الفحصين (السونار والرنين المغناطيسى) بما تم التوصل اليه اثناء العملية الجراحية للناسور والتي اعتبرت كمرجع قياسى للمقارنة، لبيان مدى دقة كل طريقة فى تشخيص الناسور الشرجي قبل اجراء الجراحة، كما تم مقارنة نتائج كلا الطريقتين ببعضهما البعض لتحديد الي اى مدى تصل درجة التوافق بين الطريقتين.

النتائج: السونار الشرجي أدق وأعلى من الرنين المغناطيسى فى تحديد ومعرفة أماكن الفتحة الداخلية للناسور الشرجي حيث تم التشخيص بدقة فى ٥٥ حالة من اصل ٦٠ (٨٨,٣٪) بينما تم التشخيص بدقة ل ٢٩ حالة فقط بالرنين المغناطيسى بنسبة (٤٨,٣٪).

الاستنتاج: تظهر الدراسة أن السونار الشرجي لديه دقة كبيرة تقارن بل وتتفوق على الرنين المغناطيسى فى تقييم وتشخيص حالات الناسور الشرجي قبل الجراحة، مما يؤهله لأن يصبح بديلاً مناسباً وربما الخيار الأول فى تشخيص حالات الناسور الشرجي وذلك لما يتمتع به من مميزات تفوق الرنين المغناطيسى مثل سهولة الاستخدام والتعلم، سرعة اجراء الفحص وامكانية نقل جهاز السونار الشرجي، مما يمكن من اجراء الفحص داخل غرفة العمليات بالإضافة الى عدم التعرض الى مخاطر اشعاعية وقلة تكاليف اجراء الفحص بالنسبة للمريض.