Endoluminal Ultrasound is Preferable to Electromyography in Mapping Anal Sphincteric Defects

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Assessment of complex sphincteric defects in patients with fecal incontinence by digital rectal examination and intraoperative dissection can be difficult in the presence of excessive scarring. Adjunctive investigation such as endoluminal ultrasound (ELUS) and needle electromyography (EMG) may provide objective evidence of the nature and extent of the sphincteric defects. In a series of 11 patients, ELUS of the anal canal with a 10-MHz transducer (focal zone of 1–4 cm) accurately detected defects in the external anal sphincter (EAS) in seven of seven patients, defects in the internal anal sphincter (IAS) in eight of eight patients, and integrity of both sphincters in two patients. These findings were confirmed by needle EMG of the EAS alone in five patients, by operative findings at a perineal sphincteroplasty operation in six patients, and by both in two patients. ELUS was associated with less pain than was needle EMG (pain score 4 *vs.* 10, 10 being most painful) and provided high-resolution radial images of both the EAS and the IAS. Thus, ELUS seems preferable to EMG in mapping anal sphincteric defects and can be a useful anatomic adjunct to physiologic studies of anorectal function in patients with fecal incontinence. [Key words: Ultrasound; Imaging; Electromyography; Anus; Anal sphincters]

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Detection of localized anal sphincteric defects is important in the evaluation of fecal incontinence since these defects may be amenable to surgical repair.[1] Clinical assessment by digital examination may not always accurately detect the presence and extent of such defects because of excessive scarring. Anal manometry and needle electromyography (EMG) are often used for mapping the external anal sphincter (EAS) prior to sphincteric repairs.[1] However, needle EMG can be a rather painful procedure. Endoluminal ultrasound (ELUS) of the anal canal is a simple examination that enables accurate visualization of both the EAS and the internal anal sphincter (IAS).[2, 3] Accurate delineation of perianal fistulous tracts has also been reported.[4] Much of the work on anal sonography has originated from a single center in the United Kingdom.[2, 4, 5]

The aims of this prospective comparative study were to compare the accuracy and comfort of ELUS and EMG in the mapping of anal sphincteric defects.

PATIENTS AND METHODS

Eleven patients with fecal incontinence were examined (Table 1). Symptoms of daytime and nighttime incontinence were specifically documented. There were nine females and two males. All had a history of traumatic vaginal childbirth (n = 7) and/or previous anorectal surgery (n = 5). The age ranged from 22 to 86 years (median, 47 years). All patients had an ELUS examination performed by one of two authors (J.J.T. or J.W.M.); seven patients had anal manometry with EMG mapping on the same day as well. The results of the tests were kept separately until both tests had been performed. Operative confirmation was available in all six patients who underwent sphincteroplasty (Table 1). All patients were asked to grade the discomfort level associated with ELUS and needle EMG (if performed) using a visual analog scale (1–10, 10 being most painful).

ELUS

The procedure was performed with the patient in the left lateral position. The ultrasound equipment used was a Bruel & Kjaer (Naerum, Denmark) scanner, Type 1846, with a rotating hand-held endoprobe (Type 1850). The 10-MHz transducer (focal zone of 1–4 cm) was used because it has previously been shown[3] that it gives a better resolution

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Table 1.
Summary of ELUS, EMG, and Operative Findings

Patient	ELUS	EMG	Defect by ELUS ± EMG		Perineal Sphincteroplasty	Operative Confirmation
			EAS	IAS		
1	D	D	Yes	Yes	ND	—
2	D	D	Yes	Yes	ND	—
3	D	D	No	No	ND	—
4	D	D	Yes	Yes	ND	—
5	D	D	Yes	Yes	D	Yes
6	D	D	No	No	ND	—
7	D	D	Yes	Yes	D	Yes
8	D	ND	Yes	Yes	D	Yes
9	D	ND	Yes	Yes	D	Yes
10	D	ND	No	No	D	Yes
11	D	ND	No	Yes	D	Yes

D = done; ND = not done.

of the anal sphincters than does the 7-MHz transducer (focal zone of 2–5 cm). A lubricated latex balloon that covered the transducer was inflated with degassed water to provide protection for the probe and effective acoustic coupling within the anal canal. Any defect within the muscle was recorded in terms of quadrants and "hours" deficiency, using the standard clock face with 12 o'clock as the anterior midline point.

EMG

Single-fiber needle EMG was used to record resting activity in the EAS. A Dantec 2000 Neuromatic™ (Dantec, Copenhagen, Denmark) EMG apparatus was used to display the results. One needle insertion was made in each quadrant equidistant from the anal canal to examine the integrity of the EAS. Through the same insertions, the needle was advanced in various directions to sample separate motor units. Any sphincteric defect was recorded in terms of anterior, posterior, right, and left quadrants.

RESULTS

All seven patients reported that needle insertions associated with EMG mapping were painful, and, using a visual analog scale, the pain score ranged from 9 to 10 (median score, 10). Three patients refused to have further EMG testing. By contrast, ELUS was usually well tolerated by the patients (median pain score, 4; range, 1–9). Proctoscopy accounted for the significant discomfort (pain score, 9) associated with ELUS in one patient. All patients stated that they would readily undergo any further ELUS examinations.

The sonographic appearances of the EAS have been described previously and confirmed in a cadaver study.[3] The EAS appears as a broad (1.0–1.2 cm) band of mixed echogenicity comprising a series of concentric white and gray lines (Fig. 1). It could be traced from the puborectalis muscle down to the subcutaneous level in the lower anal canal. The IAS appears as a 2-mm to 3-mm-thick hypoechoic (dark) circular band just deep to the brighter submucosa (Fig. 1).

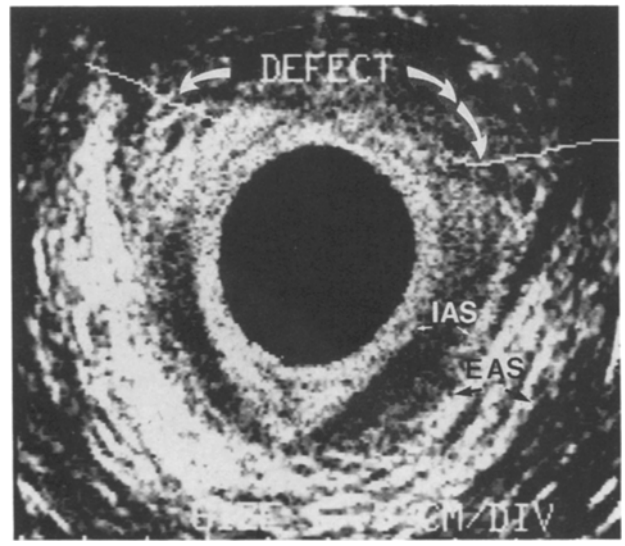

Figure 1. Sonographic image of the anal canal in a patient with an anterior sphincteric defect using a 10-MHz probe. EAS = normal external anal sphincter (black arrows); IAS = normal internal anal sphincter (small white arrows). Anterior defect affecting both the EAS and the IAS is demonstrated (large white arrows).

ELUS detects the presence of sphincteric defects because fibrous scar tissue in the region of the defects has a different acoustic texture with a loss of the characteristic mixed echogenic pattern of the EAS and the hypoechoic pattern of the IAS (Figs. 1 and 2). The defects appear as amorphous areas of varying echogenicity and are visualized as a loss in the continuity of the muscle ring. When the defects are incomplete, relative thinning (Fig. 3) rather than actual loss of the continuity of the muscle ring is seen. Sphincteric defects are demonstrated in EMG by a complete loss or marked reduction of normal electrical activity. Increased fiber density may be present and reflects denervation-reinnervation injury.

Five patients were found to have defects in the EAS on both the ELUS and EMG mapping. Two of these patients underwent sphincteroplasty operations, and, in these, the findings were confirmed (Table 1). The defect was also localized to the same quadrant of the anal canal by both techniques. Because of the painful nature of the procedure, only one needle insertion in each quadrant was performed using EMG. By contrast, ELUS provided high-resolution radial images of the entire circumference of the anal canal (Fig. 3). As a result, a better display of the extent of sphincteric defects is possible with ELUS.

In four patients (Table 1), ELUS only was performed. The findings as to the presence (n = 3) or absence (n = 1) and the extent of the sphincteric defects were confirmed at sphincteroplasty operations. In eight patients, defects in the IAS and EAS were detected by ELUS. Five of these patients had subsequent sphincter repair, and the findings were confirmed.

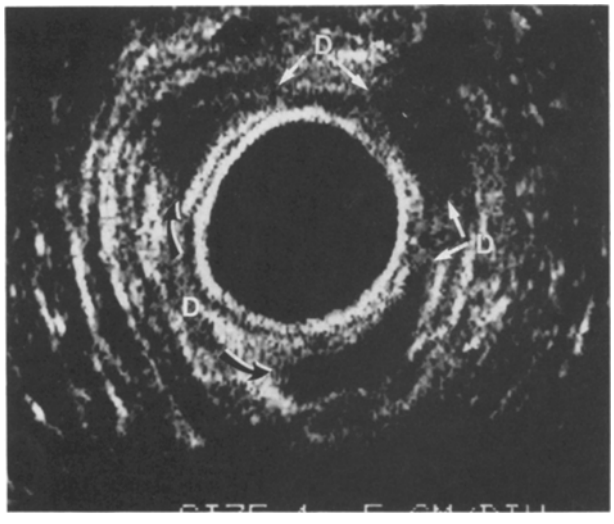

Figure 2. Sonographic image of the anal canal with defects (D) of primarily the IAS at three sites.

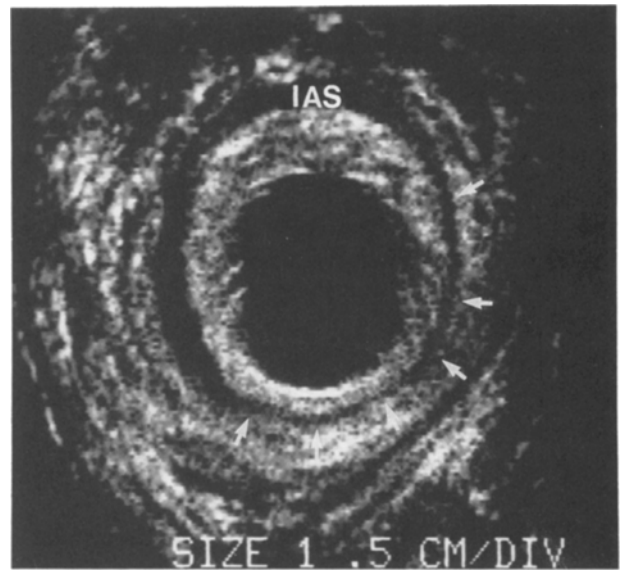

Figure 3. Sonographic image of the anal canal showing thinning of the IAS (arrows).

DISCUSSION

This is a pilot study on the use of ELUS in the evaluation of anal sphincteric defects. It also provides a direct comparative study on the accuracy and patient discomfort between ELUS and EMG, with operative confirmation in some cases. Both techniques accurately detected the presence or absence of defects, although ELUS was less painful and provided a good visual display of the extent of the gaps in relation to the remaining anal sphincters. Similar results were noted in a previous study using a 7-MHz transducer.[2]

EMG has an important role in the evaluation of fecal incontinence to detect neurogenic dysfunction.[6] The striated anal sphincters, namely the EAS and puborectalis muscle, display continuous tonic EMG activity. However, needle EMG may be associated with significant discomfort during needle insertions. As a result, mapping of the extent of a defect may be restricted since most patients will only tolerate a limited number of needle insertions. In addition, defects in the IAS can be readily detected by ELUS but not by EMG because accurate needle placement into the IAS can be tedious and inaccurate.[7] This is of importance since up to 85 percent of the resting manometric tone is attributed to the action of the IAS,[8] and unconscious fecal soiling may be associated with a low anal canal

resting pressure. Repair of a disrupted IAS may be important if surgical treatment of the fecal incontinence is considered.

Many surgeons in treating sphincteric injuries use clinical assessment alone with or without anal manometry. The addition of ELUS and needle EMG may be superfluous for experienced surgeons evaluating patients with clear-cut physical findings. However, this added testing with ELUS and/or needle EMG provides useful confirmatory information and objective evidence of the nature and extent of the sphincteric defects.[5] Additionally, assessment of complex sphincteric defects by preoperative digital rectal examination and intraoperative dissection can be difficult in the presence of excessive scarring or a previously failed repair. Adjunctive investigation with ELUS and/or needle EMG can provide an objective record of the status of the anal sphincters.

Our results indicate that ELUS is highly accurate in the detection and mapping of the extent of anal sphincteric defects and is the only method available to easily assess the integrity of the IAS. Because of the significant discomfort associated with needle EMG, we feel that it should not be used as the primary method for mapping anal sphincteric defects if ELUS is available. Thus, ELUS of the anal canal can be a useful anatomic adjunct to physiologic studies of anorectal function in patients with fecal incontinence.

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