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Dynamic transperineal ultrasound vs. defecography in patients with evacuatory difficulty: a pilot study

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Abstract *Background and aims:* Defecating proctography has been traditionally used to assess patients with evacuatory dysfunction. More recently, dynamic transperineal ultrasound has been described, defining the interaction between the infralevator viscera and the pelvic floor at rest and during straining. This study compared qualitative diagnosis and quantitative measurement obtained by defecography and dynamic transperineal ultrasonography in patients with evacuatory difficulty. *Patients and methods:* Thirty-three women were examined using both techniques with both examiners blinded to the results of the other method. Quantitative measurement was made of rectocele depth, anorectal angle (at rest and during maximal straining) and anorectal junction position at rest and movement during straining. *Results:* There was good agreement for the diagnoses of rectocele, rectoanal intususseption, and rectal prolapse. Dynamic transperineal ultrasound was more likely than defecography to make multiple diagnoses or to diagnose an enterocele when a rectocele was present. There was no difference noted between the two techniques for the measurement of anorectal angle at rest, anorectal junction position at rest, or anorectal junction movement during straining. The mean anorectal angle during straining was 123.3±4.3° as measured by defecography and 116.4±3.3° as measured by dynamic transperineal ultrasound, nearly reaching statistical significance. *Conclusion:* Dynamic transperineal ultrasound is a simple and accurate technique for assessment of the pelvic floor and soft-tissues in patients with evacuatory dysfunction.

Keywords Transperineal ultrasound · Defecography · Rectocele · Enterocele

Introduction

Defecography has been the imaging technique of choice for patients with evacuatory difficulty [1]. In recent years it has become clear that such patients often have a multiplicity of visceral and pelvic floor disorders and that clinical examination of these cases is often inaccurate [2, 3]. The selective need during proctography for opacification of the small bowel, bladder, vagina (and even in some cases the, peritoneal cavity) has resulted in a complex and at times poorly tolerated “extended technique” of defecography which has given way (where available) to dynamic magnetic resonance imaging (MRI) [4, 5]. Recent studies have shown that dynamic MRI has the advantages of demonstrating all compartments of the pelvis as well as their interaction during straining and evacuation, and that there is good qualitative and quantitative correlation for different anorectal disorders and for specific anorectal measurements [6, 7]. MRI is expensive and is not often allocated in institutions for the assessment of functional anorectal disorders. Moreover, comparison with seated defecography is difficult unless there is access to an open-architecture magnet [8]. Recently the use of transperineal ultrasonography in normal individuals [9, 10] and dynamic transperineal ultrasound (DTP-US) in those with functional anorectal disorders [11, 12] has been described, providing a simple means of assessment of all compartments of the lower pelvis and perineum and their interaction at rest during straining and defecation.

The purpose of this study was to assess the level of agreement between evacuation proctography and DTP-US in diagnosing pathology in an unselected group of patients who presented to our pelvic floor clinic with evacuatory difficulty and to compare measurements of anorectal configuration using both the techniques.

Methods and materials

Patients and methods

Thirty-three women (mean age 58 years, range 32–77) who presented with long-standing difficulty in evacuation were examined with both proctography and DTP-US. Each patient had a long-standing reported history of constipation (mean 3 years duration, range 2 –26). Only patients defined as constipated were included in the study, whereby their history of evacuatory difficulty exceeded 6months, if there was at most one bowel movement every 4 days (or longer), and/or if more than 25% of these movements were accompanied by excessive straining [13, 14]. This group of patients was heterogeneous, and no attempt was made in this pilot study to distinguish those cases of pure outlet obstruction from those with delayed colonic or rectal transit. All patients provided informed consent for both procedures, and the study was approved by the local hospital ethics committee.

Of these selected patients 14 (42.4%) complained of daily straining at stool, with 8 (24.2%) reporting only one stool on average per week. Fifteen patients (46%) complained of repeatedly unsatisfied defecation, with 7 (21.2%) reporting hard stools for more than 50% of evacuation attempts. Sixteen patients (48.5%) used daily stimulant laxatives, with 4 (12.1%) utilizing daily enemas and a further 4 admitting to daily rectal digitations to assist evacuation. Eight patients (24.2%) confirmed that toileting exceeded 60 min duration on average. Twelve patients in the group (36.4%) had previously undergone a hysterectomy, 6 (18.2%) a hemorrhoidectomy, and 3 (9.1%) lateral internal anal sphincterotomy, with a further 3 patients (9.1%) having a confirmed solitary rectal ulcer.

Proctographic technique

Evacuation proctography was performed without prior bowel preparation with 120 ml barium paste (55% wt/wt barium sulfate) instilled into the rectum using conventional video-fluoroscopy in the lateral sitting position at rest and during evacuation in accordance with the basic technique described by Shorvon et al. [15] Quantitative measurements were made during defecography for comparison with the new technique. The anorectal angle (ARA) was measured from the proctographic film at the junction of the axis of the anal canal and the rectal ampulla. Movement of the anorectal junction (ARJ) was assessed in relation to a horizontal line drawn across the most inferior point of the ischial tuberosities visible on lateral films. A rectocele was defined as any outpouching of the anterior rectal wall occurring during evacuation or straining and its depth (when present) was measured perpendicular to the expected contour of the anterior rectal wall in projected lateral films. Rectoanal intussusception when identified was graded in accordance with the lowest point of the intussusception apex on maximal straining in relation to its position in the rectum or anal canal. This grading was modified from that described by Shorvon et al. [15] where grade 1 is minimal infolding of part of the rectal wall or circumferential infolding which remains entirely intrarectal. Grade 2 is recorded when the leading edge of the intussusception extends into the orifice of the anal canal, and grade 3 when the leading edge extends intra-anally. The small bowel was opacified following ingestion of 200 ml dilute oral diatrizoate meglumine (Gastrografin, Schering UK) 60 min prior to the examination. All proctographic examinations and measurements were made by the same examiner (A.P.Z.) who was blinded to the results of DTP-US.

DTP-US imaging technique

All procedures were videotaped for orthograde and retrograde scrolling of dynamic images and static representative images were used for clinical measurement. DTP-US was performed using curvilinear transducers (C 4-7 and C 8-12) and a linear-array transducer (L 5-10 ATL, HDI 3000, Advanced Technology Laboratories, Bothell, Wash., USA). The transperineal approach has been previously described by our group [12]. Briefly, before commencement of the procedure the patient's rectum was filled with 50 ml ultrasonographic coupling gel (Ultra-Gel, Aquarius 101, Medilab USA) using a standard Luer syringe and a soft-end catheter. A similar volume of acoustic gel was instilled into the vagina and gel was liberally applied to the perineum. Patients were advised to avoid micturition for a minimum of 2 h prior to the procedure. Gastrografin (50 ml) diluted 1:1 with tap water was ingested by the patient 1 h prior to each procedure. The perineum of the patient was examined in the left-lateral position. Images of the infralevator viscera and soft tissues and the pelvic floor musculature were obtained at rest and during maximal straining for routine visualization of the pubis, urethra, bladder, vagina, anus, distal rectum, and puborectalis muscle, all of which were registered by the examiner. All examinations were performed by the same clinician (M.B.G.) who was blinded to the results of defecography.

Axial images of the anal sphincter were identified with the probe placed in a sagittal plane and then rotated through 180° whereas coronal images of the anal canal and sphincter musculature were made by holding the transducer head in a transverse plane near (but not in) the introitus. Sagittal examination of the anterior perineum showed the distal vagina, bladder, and urethra and was used to identify contrast-filled enteric loops (if present) between the rectal and vaginal walls in the territory of the rectovaginal septum. Towards the end of the procedure patients were encouraged to evacuate as much of the intrarectal gel as possible.

Specific quantitative measurements were made as outlined previously [12] and shown in Fig. 1, where the ARA is calculated at the confluence of a line forming the longitudinal axis of the anal canal with that of the posterior border of the rectal wall at rest and during evacuation of rectal gel. The movement of the ARJ was measured in a coordinate system defined by an axis which lies perpendicular to a line which touches the posterior aspect of the ARJ, and which joins a horizontal axis passing through the midpoint between the superior and inferior borders of the pubic symphysis. The vertical distance between the ARJ and this horizontal axis can be seen to vary during maximal straining, permitting the determination of ARJ displacement. The resting position of the anorectal junction and its measured movement on straining was compared with those values obtained during defecography. The depth of a rectocele (when demonstrated by DTP-US) was also measured. This measurement is made by constructing two axes, one drawn perpendicular to the horizontal axis which passes through the projected contrast line of the anterior aspect of the

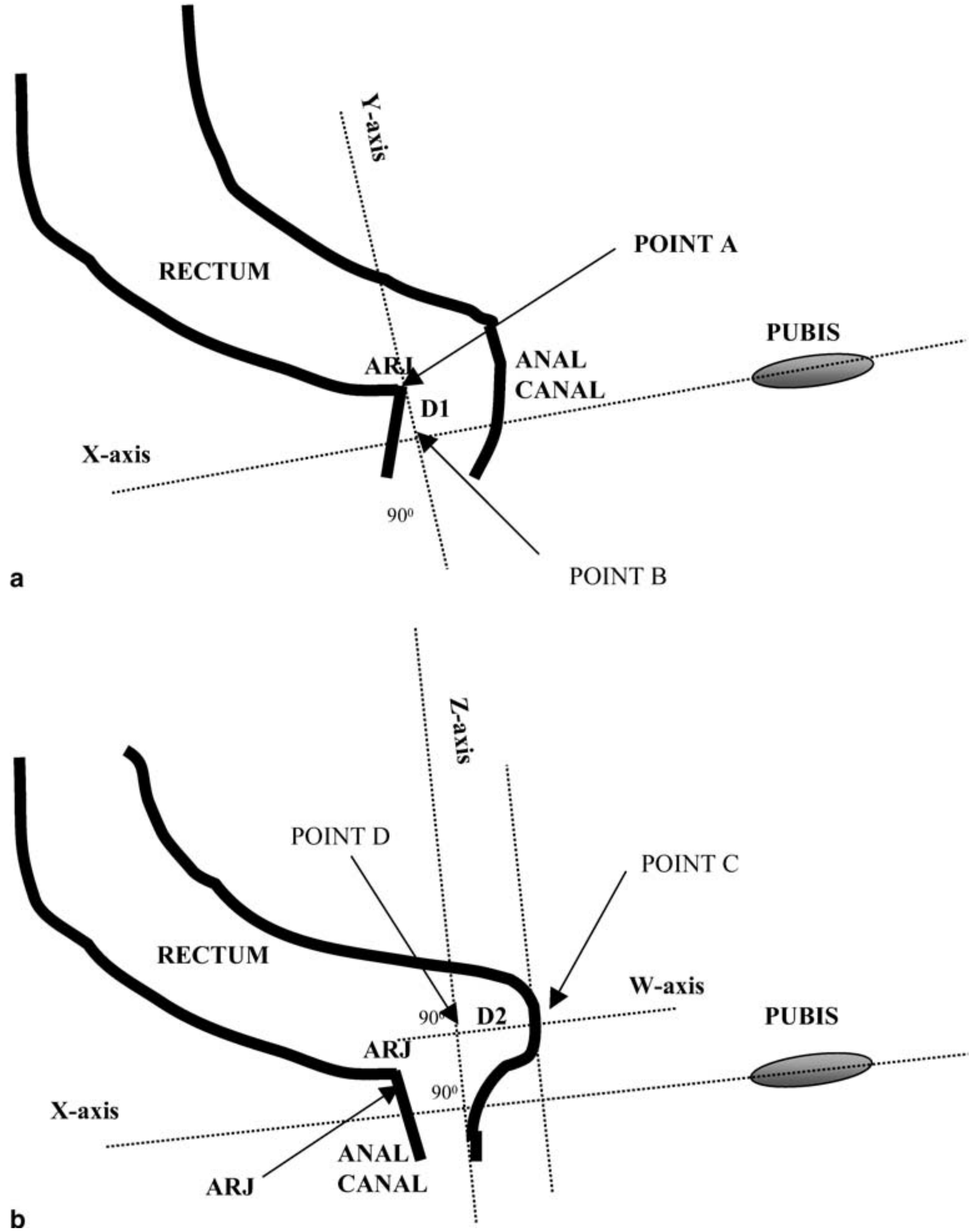

Fig. 1 **a** Schematic representation of the posterior pelvic floor during sagittal dynamic transperineal ultrasonography. The X-axis passes through the central portion of the symphysis pubis, and the Y-axis passes perpendicularly to the X-axis abutting the posterior aspect of the anorectal junction (*ARJ*). The anorectal angle (*ARA*) is clearly definable on DTP-US. The distance between points *A* and *B* represents ARJ displacement (distance *D1*) between the resting position and following maximal straining. **b** Schematic representation of the measurement of rectocele depth. The Z-axis passes through the projected anterior aspect of the anal canal perpendicular to the X-axis. The W-axis passes at right angles to the Z-axis through the most anterior point of the rectocele. The distance between points *C* and *D* represents the depth of the rectocele (distance *D2*)

anal canal, and the other parallel to the horizontal axis passing through the most anterior part of the rectocele. The distance between the two lines represents the measured depth of the rectocele.

Statistics

The means of the two methods for quantitative measurement of the ARA and ARJ position and movement were compared on the differences per patient between the two techniques, namely the value obtained by DTP-US subtracted from the value obtained by defecography. The paired *t* test was employed accompanied by a 95% confidence interval (CI) for the difference in means. Pearson's correlation coefficient was used to show correlation between the ARJ position at rest and during straining as well as the measured depth of a rectocele (when present) using the two techniques. The χ^2 test was used to determine whether there was a significant association between the technique chosen and the number of pathologies found, and Fisher's exact test was used in patients with rectocele to determine whether there was a significant association between the technique chosen and the frequency of diagnosed enteroceles.

Results

Real-time DTP-US imaging routinely showed the dynamic movement of the posterior perineum and infralevator visceral elements and their relationship to the pelvic floor

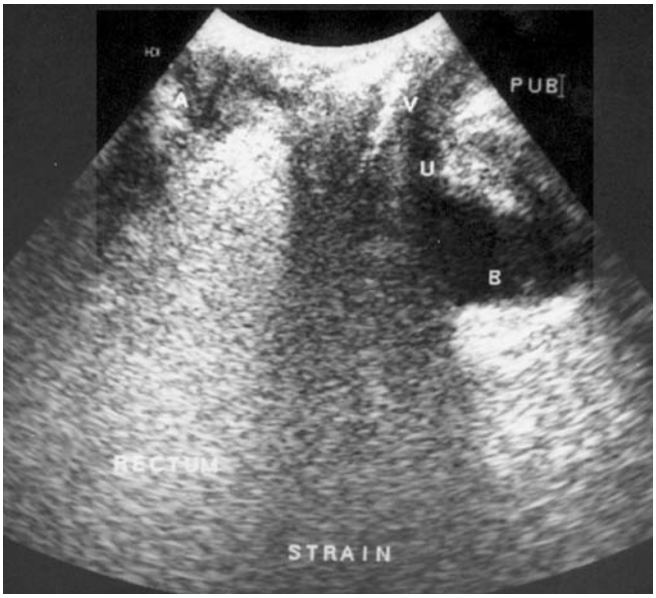

Fig. 2 An example of a rectocele as shown on sagittal imaging by the dynamic transperineal ultrasound technique

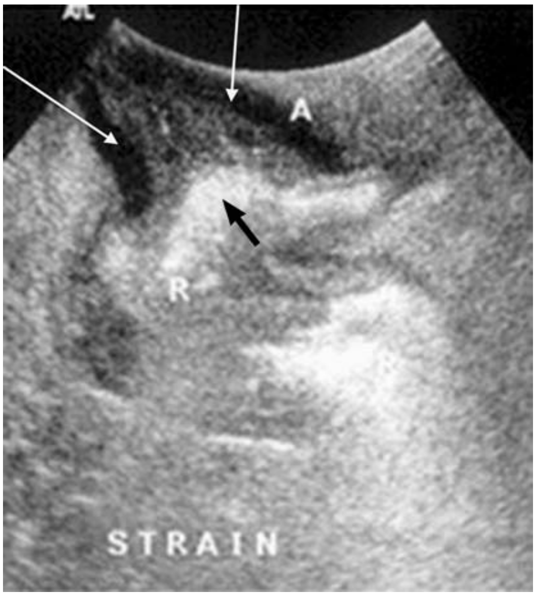

Fig. 3 A case of rectoanal intussusception diagnosed by DTP-US showing acoustic contrast gel in the rectum trapped between the intussuscepting segment and the outer rectal wall

during evacuation. During defecation there was a characteristic widening of the posterior ARA which is comparable with that seen on defecography. In cases of proctographically confirmed anismus the ARA failed to open during straining. Distinct clinical entities such as a rectocele, rectoanal intussusception, peritoneocele, and enterocele were well demonstrated by DTP-US. An example of a rectocele demonstrated on sagittal imaging is shown in

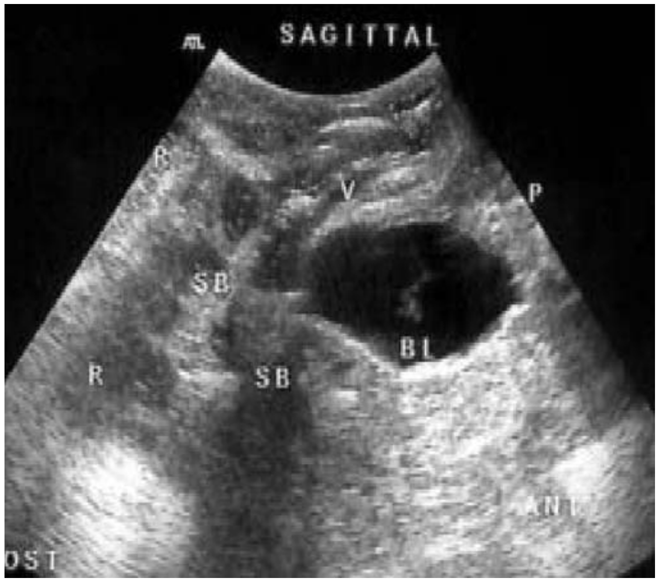

Fig. 4 Straining sagittal DTP-US. Small bowel loops (*SB*) containing water-soluble contrast are seen moving towards the perineum and displacing the vagina (*v*) anteriorly. The area between the rectum (*R*) and the vagina represents a very attenuated rectovaginal septum. *BL* Bladder, *P* pubis

Table 1 Comparison between DTP-US and defecography for the diagnosis of specific disorders in 33 consecutive patients presenting with evacuatory difficulty (rectoanal intussusception: *grade 1* minimal infolding of the rectal wall or circumferential intussusception which remains intrarectal,*grade 2* intussusception where the leading edge of infolding enters the internal anal orifice, *grade 3* intra-anal intussusception or external prolapse of the leading edge of the intussusception)

	Defecography	DTP-US
Rectocele	18	16
Enterocele	7	11
Peritoneocele	0	1
Intususseption	19	17
Grade 1	2	0
Grade 2	7	10
Grade 3	10	7
Prolapse	5	5

Fig. 2. Rectoanal intussusception was readily identified during straining with contrast visible in the rectum and trapped between the intussuscepting segment and the outer rectal wall (Fig. 3). Figure 4 shows a straining sagittal DTP-US of a patient with a large enterocele. Here small bowel loops containing Gastrografin are seen descending through an attenuated rectovaginal septum.

There were no consistent imaging diagnoses using either technique for specific symptoms of evacuatory difficulty (data not shown). The overall diagnostic comparison between DTP-US and defecography is shown in Table 1. In general there was good agreement between

Table 2 Measurements of the anorectal angle (*ARA*) at rest and during maximal straining and the position at rest and movement during maximal straining of the anorectal junction (*ARJ*) as calculated using defecography and DTP-US (*mean difference*value obtained by DTP-US subtracted from the value measured at defecography, CI 95% confidence interval)

	Mean ±SEM	Mean difference	95% CI	*P*
ARA at rest				0.92
Defecography	102.9±3.75	−0.39	−8.29 to +7.5	
DTP-US	103.3±2.86		–	
ARA during straining				0.09
Defecography	123.3±4.32	+6.91	−0.75 to +14.57	
DTP-US	116.4±3.32		–	
ARJ position at rest (mm)				0.72
Defecography	14.17±4.9	1.23	−5.89 to +8.35	
DTP-US	12.94±3.4		–	
ARJ movement during straining (mm)				0.49
Defecography	34.73±10.6	2.78	−5.63 to +11.19	
DTP-US	31.94±5.14		–	

the techniques for specific diagnoses. Two rectoceles were missed by DTP-US as shown on defecography. Both of these rectoceles were estimated at 1.5 cm in maximal width and both completely emptied during defecation on defecography. More enteroceles were diagnosed by DTP-US, and one case of peritoneocele (as defined by an enlarged rectovaginal septum not containing bowel loops) was diagnosed using the ultrasound technique although not confirmed by combined defecoperitoneography. Two cases of rectoanal intussusception were not detected by DTP-US, both of which were designated as grade 1. In 9 of 17 cases (52.9%) there was agreement between the two techniques concerning the grade of rectoanal intussusception, with all cases of complete rectal prolapse being diagnosed correctly by DTP-US (Table 1).

In comparable cases DTP-US diagnosed one major pathology (out of rectocele, rectoanal intussusception, enterocele, or peritoneocele) in 6 (18.2%) patients as compared with the defecographic diagnosis of one major pathology in 12 (36.4%) cases. Two or three pathologies were diagnosed by DTP-US in 19 (57.6%) and 6 (18.2%) patients, respectively, compared with equivalent diagnoses by defecography in 15 (45.4%) and 3 (9.1%) patients, respectively. No pathology was diagnosed by DTP-US in 2 patients (6%) and by defecography in 3 patients (9.1%). There was no significant association between the method of examination chosen and the number of pathologies found (*P*=0.3). DTP-US was more likely to diagnose the presence of an additional enterocele when the primary diagnosis of rectocele was made (4/18 cases, 22.2% by defecography vs. 8/17 cases, 47.1%, by DTP-US) although this too did not reach statistical significance (*P*=0.15). Where defecography was used as a gold standard for the diagnosis of rectocele, the sensitivity and specificity for diagnosis by DTP-US was 88.9% and 100%, respectively. The sensitivity and specificity for the diagnosis of rectoanal intussusception of any grade by DTP-US using defecography as a gold standard was 89.5% and 100%, respectively.

The mean (±SEM) depth of rectoceles as diagnosed by defecography was 2.69± 0.19 cm and by DTP-US was 3.0±0.36 cm. This measurement had a low correlation coefficient and was not found to be significant (*r*=0.29, *P*=0.39). Table 2 shows the measured ARA (at rest and during straining), resting ARJ position, and ARJ displacement during straining as calculated by defecography and DTP-US. The mean ARA at rest obtained by defecography was 102.9±3.75° and by DTP-US 103.3±2.86°. The mean difference between techniques was −0.39°, with a 95% CI of −8.29° to +7.5°. This was not statistically significantly different from zero (*P*=0.92). The mean ARA during straining obtained by defecography was 123.3±4.32° as compared with 116.4±3.32° as measured by DTP-US. The average difference between the 2 techniques was +6.91^0 (CI=−0.75° to +14.57°) nearly reaching statistical significance (*P*=0.09). Comparison of the two techniques showed significant outliers with much higher defecographic than ultrasonographic values of ARA during straining. The mean resting position of the ARJ recorded by proctography in relation to the ischial tuberosities was 14.17±4.9 mm with a value of 12.94±3.4 mm for DTP-US in relation to the transsymphyseal line. The mean difference between the two techniques in ARJ position at rest was +1.23 mm, although there was a wide scatter, with a 95% CI of −5.89 to +8.35 mm. This mean difference was found not to be significant (*P*=0.72). During maximal straining the ARJ movement recorded on proctograms was 34.73±10.6 mm compared with 31.94± 5.14 mm as measured by DTP-US. The difference between the two techniques in ARJ movement on straining was +2.78 mm with a 95% CI of −5.63 to +11.19 mm (P=0.49).

Discussion

DTP-US provides a comprehensive static and dynamic visualization of the interaction of the pelvic floor and viscera in patients who present with evacuatory dysfunction and appears to provide more information than standard defecography. In this study there was a good diagnostic comparison between defecography and DTP-US for the diagnoses of rectocele, rectoanal intussusception, and rectal prolapse with a high sensitivity and specificity for each diagnosis. Static transperineal ultrasound imaging of the anal region has recently been reported in normal patients [16], perirectal sepsis [9], and selected cases of fecal incontinence [17]. More recently, transperineal ultrasound has been used to provide dynamic real-time images defining the interrelationship between the infralevator pelvic viscera and during provocative maneuvers in a range of pelvic floor disorders [11, 12]. The transperineal technique as described in this study is less invasive than defecography and less likely to distort the perineal and pelvic soft tissues than transintroital or endoanal sonography.

In qualitative diagnosis in this study the two rectoceles missed by DTP-US were both small and completely emptied on evacuation proctography. It has previously been suggested that seated defecography is too sensitive a test for the diagnosis of clinically insignificant rectoceles, particularly in the asymptomatic patient [15]. Two cases of rectoanal intussusception were also missed by DTP-US, both of small grade. Given that these procedures were carried out at different times, diagnostic differences may result from a variation in the ability of the patient to fully strain during DTP-US, perhaps due to patient reticence because of the perineal proximity of the probe.

In general, DTP-US is more likely to diagnose multiple pelvic floor and visceral pathology than defecography, although this did not reach statistical significance. This is in keeping with the reported incidence of a multiplicity of recognizable anomalies in patients who ultimately come to surgery presenting with evacuatory difficulty to specialized pelvic floor clinics [18]. Enterocele in particular was more frequently diagnosed in patients with recognizable rectoceles using the new technique, although this too did not reach statistical significance. This phenomenon has particularly been reported in the posthysterectomy patient [19] and is of clinical importance in the preoperative diagnosis if recurrence following rectocele surgery is to be avoided. Moreover, DTP-US may obviate the occasional need for cumbersome techniques in order to diagnose a coincident enterocele or peritoneocele. There is at present no uniform classification for what represents a pathological peritoneocele or enterocele (particularly in the postoperative patient), and the literature abounds with confusing terminology. Using defecoperitoneography, Bremmer et al. [20] defined a peritoneocele as an extension of the pouch of Douglas below the upper one-third of the vagina, which could contain liquid, bowel, or rarely omentum, and whose contents could differ at different times in the same patient or during different examinations. There does not appear to be, however, any clear association between clinical classifications of pelvic organ prolapse and the radiological interpretations of what represents a peritoneocele and/or an enterocele [7].

The quantitative measurements afforded by DTP-US, included assessment of rectocele depth, measurement of the ARA (at rest and during straining) and ARJ displacement from a resting position during maximal straining. Although we clearly recognize that such measurements are of no clinical significance, they were analyzed in this study in an attempt to validate the new technique quantitatively against a traditional gold standard examination. There was only a poor correlation between the techniques for rectocele depth measurement. There was no significant difference noted between the two techniques when measurements were made for ARA at rest, ARJ position at rest, and ARJ movement during straining. The difference between the techniques nearly reached significance for ARA measurement during straining, with markedly greater widening of the ARA noted during defecography. Although it is recognized that there was a wide scatter of results, the mean difference between the techniques for ARA at rest and ARJ (at rest and during straining) was also not significant.

Although the two imaging modalities were correlated for these measurements, these differences are most likely to be a result of the positional variation between the techniques [21, 22] as well as probable reticence by the patients to evacuate in the presence of the examiner during DTP-US. It is accepted that the left lateral position for the performance of DTP-US is nonphysiological. In this regard we report in this pilot study similar comparisons as those between defecography and conventional dynamic MRI for patients with pelvic floor dysfunction [6, 23].

It is accepted that the position adopted for examination using DTP-US is not equivalent to that normally used during evacuation, and it is likely to lead to a higher resting ARJ position and less descent of the ARJ on straining. Moreover, for some conditions only readily diagnosed at the end of evacuation (most notably full-thickness rectal prolapse and rectoanal intussusception), DTP-US may be suboptimal. In this regard merely stressing the patient as opposed to using true evacuation has the potential for underdiagnosis. DTP-US may also be criticized as a technique since in some cases maintaining probe contact with the perineum particularly during provocative maneuvers may result in limitations in overall pelvic floor movement.

We fully accept that conclusions concerning the efficacy of DTP-US in the diagnosis of specific pelvic floor disorders must at this stage be drawn with caution. Our study was not based on individual symptoms or symptom scoring of difficult evacuation [24], and there is no clearly definable relationship between specific symptoms of constipation and DTP-US findings. Further, it is essential to compare the findings of this pilot study with those obtained in a control age-matched population of women without defecatory difficulty, a study which is at present underway in our institution. It must also be stated that the two techniques used in this study are not strictly comparable, since different volumes are instilled into the rectum and DTP-US instills fluid into the vagina (albeit small amounts). We have experimented with smaller volumes of gel instillation into the rectum and vagina without any appreciable effect on qualitative diagnoses in individual cases. DTP-US offers the facility to assess the vaginal vault after gel instillation, and no patient showed evidence of vaginal vault distension or alteration in vaginal conformation during conduct of the examination. As no attempt was made actually to distend these organs, there was less distortion with the new technique than that imposed by a tampon (as traditionally used in defecography), suggesting that the reported phenomenon of "crowded pelvis syndrome" was unlikely to have been significant in our patients [25, 26].

Conclusions

DTP-US represents a simple and relatively noninvasive assessment of pelvic floor dysfunction. It is well tolerated by patients and dynamically assesses the complex interaction of the pelvic floor and viscera in a multiplanar capacity during evacuation, minimizing the luminal and soft-tissue distortion normally imposed by endoanal and endovaginal probes. It avoids pelvic irradiation, which is of importance in the younger patient presenting with evacuatory dysfunction, and unlike MRI there is no need for an interpretative inference of the relationship between the pelvic viscera and the levator floor. For us there has been a substantial learning curve in the use of DTP-US. We have now performed over 300 studies since 1997. At the start the average examination took about 45 min since we were establishing the presence and appearance of landmarks. Currently DTP-US takes approximately 20 min to perform, and we have been able to standardize the most optimal orientations for probe use. The wide availability of DTP-US, its relative ease of training, and its minimal cost (being about one-half the cost of standard defecography in our unit) suggest a place for further prospective evaluation of this new technique in specific patient subgroups with pelvic floor dysfunction.

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