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Prevalence of anal sphincter defects and association with anal incontinence in women scheduled for pelvic organ prolapse surgery

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Abstract

Aims: Some women with pelvic organ prolapse (POP) have concomitant symptoms of anal incontinence. Our aim was to assess the prevalence of anal sphincter defects and the association with incontinence in women undergoing POP surgery.

Methods: Cross-sectional study of 200 women scheduled for POP surgery. They answered yes/no and graded any symptoms of fecal and flatal incontinence on a visual analog scale (0–100). 3D/4D transperineal ultrasound was used to assess internal (IAS) and external anal sphincter (EAS) defects. A defect of ≥30° in ≥4 of 6 slices on tomographic imaging was regarded significant. The association between incontinence and sphincter defects was tested with multivariable logistic regression analysis.

Results: The prevalence of any sphincter defect was 50/200 (25%). Combined IAS/EAS defect was found in 19/200 (9.5%) women, 8/200 (4.0%) had isolated IAS, and 23/200 (11.5%) had isolated EAS defects. In women with defect and intact IAS, 37% and 11% reported fecal incontinence, respectively, adjusted odds ratio (aOR) 2.3 (95% confidence interval [CI], 0.7–7.0), $p = .147$ and in women with defect versus intact EAS, 36% and 9% had fecal incontinence, aOR 4.0 (95% CI, 1.5–10.8), $p = .005$. In women with defect and intact IAS, 85% versus 43% reported flatal incontinence, aOR 5.2 (95% CI, 1.6–17.2), $p = .007$ and in women with defect versus intact EAS, 71% versus 43% had flatal incontinence, aOR 1.9 (95% CI, 0.8–4.5), $p = .131$.

Conclusions: One of four women scheduled for POP surgery had an anal sphincter defect. EAS defects were associated with fecal incontinence and IAS defects were strongly associated with flatal incontinence.

KEYWORDS
anal sphincter, fecal incontinence, flatulence, pelvic organ prolapse, ultrasound imaging

1 | INTRODUCTION

Anal incontinence (AI) is defined as involuntary leakage of flatus or feces, and has a significant impact on the quality of life in affected individuals.[1,2] The prevalence of AI varies from 1.4% to 19% in various studies, and increases with age.[1,3]

Obstetric anal sphincter injury (OASI) is an important risk factor for AI.[4,5] Previous studies report incidences of 11%–22% in primiparous women diagnosed with ultrasound, whereas clinical studies state the incidence to be between 3.9% and 11%.[4–7] OASI may be underestimated, and ultrasound can diagnose injuries undetected at the time of delivery, thus rendering higher estimates of the prevalence.[7,8] In a general population of parous women, the incidence of external (EAS) and internal sphincter (IAS) defects were reported to be 15% and 3%, respectively.[8] Up to 50% of women with OASI may develop AI and even after primary repair one-half of women still exhibit mild symptoms.[5,6,9] Undiagnosed and unrepaired tears may carry an even higher risk of AI.[8]

One important risk factor for pelvic organ prolapse (POP) is levator ani muscle (LAM) injury occurring due to obstetric trauma.[10] Patients with POP may have a higher prevalence of OASI and AI than the general population.[11,12] Common risk factors during delivery, such as instrumental delivery and high infant birthweight may cause both anal sphincter and LAM injury.[10–14] The prevalence of AI in urogynecological settings is reported to be between 14% and 29%, which is higher than the prevalence in the general female population.[2,11,12,14] However, the prevalence of anal sphincter defects and AI among women with more advanced POP scheduled for surgery has not been extensively studied.[12]

Our aim was to assess the prevalence of IAS and EAS defects and to study a possible association with incontinence in women with advanced prolapse scheduled for POP surgery, who could benefit from further diagnostic workup to optimize treatment.

2 | MATERIALS AND METHODS

This was a cross-sectional study of women scheduled for POP surgery at a university hospital between 1 January 2017 and 29 June 2018. This study is a secondary analysis of women included in a randomized controlled trial (registered in ClinicalTrials.gov) designed to examine the effect of pelvic floor exercise on prolapse symptoms and LAM function in women with symptomatic POP scheduled for surgery.[15] The study was approved by the Regional Committee for Medical and Health Research Ethics (REK 2015/1751/midt). Sample size calculation was performed for the parent study.[15] Women were recruited from the outpatient urogynecological clinic at surgical referral and examined at a preoperative consultation. Inclusion criteria were indication for POP surgery (POP stage ≥2), ≥18 years, and fluent in Norwegian or English language. Women who needed immediate surgery or had cognitive impairments were excluded. Written informed consent was obtained from all study participants.

Age, parity, delivery mode, height, and weight were registered. Women answered yes/no to questions regarding frequent involuntary leakage of stool or flatus and, if yes, marked bother on a visual analog scale (VAS) from 0 to 100, where 100 is the most bothersome. The proportion of women with any fecal and flatal incontinence (VAS > 0) was registered.

All study participants met with empty bowel and bladder; this was confirmed during the ultrasound examination. They underwent an examination in the supine position in a gynecological examination chair, with knees and hips semiflexed and abducted. We used the pelvic organ prolapse quantification system (POP-Q) for assessment of POP at maximal Valsalva, and the proportion of women with POP stage ≥ 2 in each compartment was registered.[16] 3D/4D transperineal ultrasound of the anal sphincter muscles were acquired with a GE Voluson S8 or E10 device (GE Medical Systems) using a RAB 4-8-RS abdominal 3D probe at an 85° acquisition angle, held horizontally and angled slightly caudally toward the anus. Three volumes were acquired, one at rest and two at pelvic floor muscle contraction, where the anal sphincter was clearly visualized.[12] The LAM was also assessed using 3D probe placed transperineally in the transverse plane and volumes were acquired at maximum pelvic floor contraction.[17]

Offline analysis of the ultrasound volumes was performed using 4Dview Version 14 Ext.0 (GE Healthcare) software, blinded to all clinical data. Two examiners (S. M. and R. A. G. R.) assessed all anal sphincter volumes. In the case of discordant diagnosis, the volumes were reanalyzed by a third examiner (M. Ø. N.). We used the best of the three volumes acquired at the preoperative examination. Tomographic imaging was used for the assessment of IAS and EAS defects. Interslice space was regulated according to the length of the EAS to obtain eight slices; from one slice cranial to EAS and the last slice caudal to the IAS enabling the evaluation of the entire length of the EAS on six slices. The IAS was depicted on six slices by placing the first slice cranial to the IAS and the last slice at the level of the subcutaneous portion of the EAS.[7,12] A defect of the EAS or IAS of ≥30° in at least four of six slices on tomographic ultrasound

imaging was considered a significant defect,[7,8,12] see Figures 1 and 2. The proportion of women with any defect (either EAS or IAS or both) was noted. Then, tomographic ultrasound imaging was used to identify significant LAM injury at pelvic floor muscle contraction. Offline analysis was carried out by a single examiner (M. Ø. N.). A significant LAM injury was diagnosed and registered if all three central slices; the slice in the plane of minimal hiatal dimensions and the slices 2.5 and 5.0 mm cranial to this, showed abnormal muscle insertion on one or both sides as outlined in previous studies.[13,17]

2.1 | Statistical analyses

We used IBM SPSS Statistics version 25 (SPSS Inc.) to perform statistical analyses, and a $p < .05$ was considered statistically significant. Agreement between the two examiners (S. M. and R. A. G. R.) was calculated using Cohen's kappa and the following cut-offs were used: 0.00, no agreement; 0.01–0.20, slight agreement; 0.21–0.40, fair agreement; 0.41–0.60, moderate agreement; 0.61–0.80, good agreement; and 0.81–1.00, strong agreement. A possible association between incontinence and sphincter defects was tested with multivariable logistic regression analyses to calculate adjusted odds ratios (aORs) for fecal and/or flatal incontinence in the presence of either EAS or IAS defects, adjusting for age, parity, and body mass index (BMI). These possible confounders were selected based on clinical experience and previous studies.[1,2,8] In addition, IAS was entered as a confounder when testing the association between EAS and the outcome and vice versa. Mann–Whitney *U* test was used to assess differences in VAS scores for fecal and flatal incontinence between women with and without EAS or IAS defect. χ^2 test was performed to determine any influence of LAM injury on sphincter defects or AI.

3 | RESULTS

In all, 272 women were referred for POP surgery during the study period. Thirty-six women declined participation, four were missed for recruitment, and 32 did not meet the eligibility criteria (one woman was excluded based on language criterion), resulting in 200 women eligible for examination. Background characteristics and anatomical findings are outlined in Table 1. All women had POP stage ≥2 in the most prominent compartment and 122 (61%) had POP stage ≥3.

Cohen's kappa between the two main examiners (S. M. and R. A. G. R.) was 0.77 for EAS defect and 0.87 for IAS defect, suggesting good to strong agreement between the two main examiners. Twenty EAS volumes and 11 volumes of IAS were discordant and evaluated by the third examiner (M. Ø. N.). The prevalence of LAM injury, EAS, and IAS defects is shown in Table 1. Anal sphincter defect was present in 50/200 (25%) and LAM injury in 100/200 (50%) women. Any AI was reported by 107 (54%) women. In a subgroup analysis of women with posterior wall POP stage ≥2, the prevalence of any anal sphincter defect and AI was similar (16/65 [25%] and 35/65 [54%], respectively). Among the 18 primiparous women, only 3 had any sphincter defect.

The distribution of incontinence and VAS scores for women with intact and defect sphincters is presented in

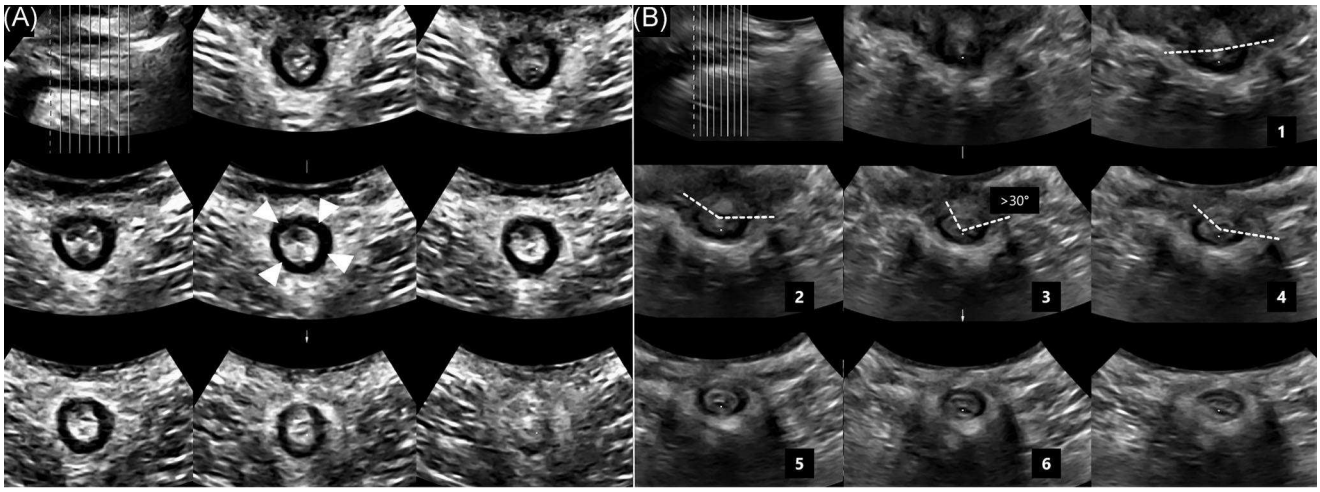

FIGURE 1 Three-dimensional transperineal ultrasound with tomographic ultrasound imaging showing (A) intact internal anal sphincter (IAS) seen as a hypoechogenic ring (white triangles) and (B) IAS defect shown as a break in echogenicity between the dotted lines involving >30° of the circumference in four of six images

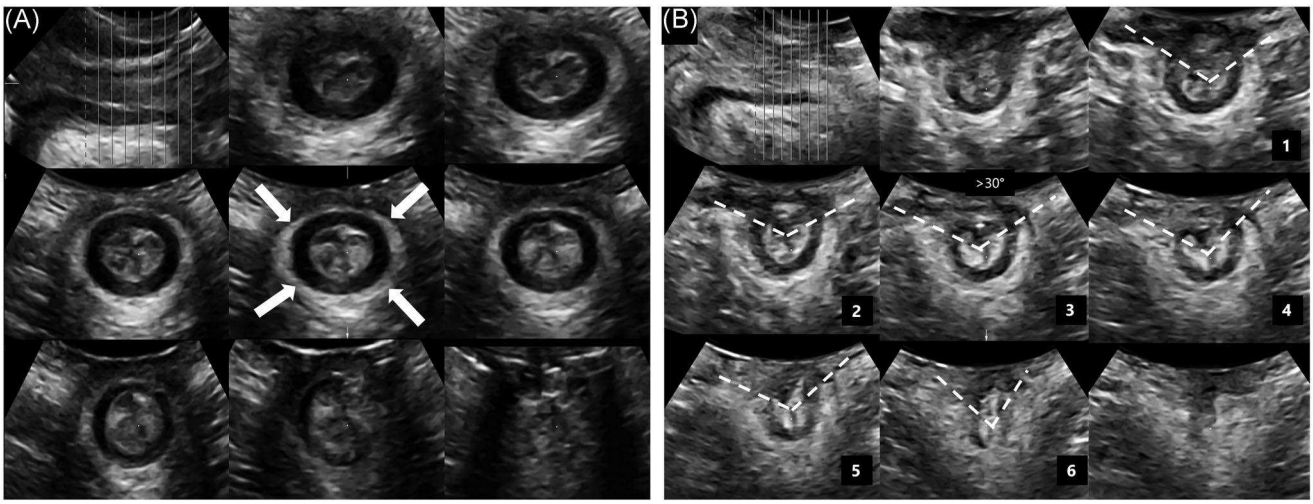

FIGURE 2 Three-dimensional transperineal ultrasound with tomographic ultrasound imaging showing (A) intact external anal sphincter (EAS) as a continuous hyperechogenic ring (white arrows) and (B) EAS defect, with the latter two showing a break (between dotted lines) in the echogenicity of involving >30° of the circumference in six of six images

Table 2. In addition, associations between EAS/IAS defects and fecal and flatal incontinence are shown in Table 2. Age, BMI, and parity were not associated with the outcome. Women with a defect EAS had aOR 4.0 (95% confidence interval [CI], 1.5–10.8) for fecal incontinence regardless of whether they had any IAS defect. After adjusting for EAS defects, women with IAS defects had aOR 5.2 (95% CI, 1.6–17.2) for flatal incontinence. Table 2 shows highly significant differences in VAS scores for women with and without EAS or IAS defects.

Any sphincter defect was present in 26/100 (26%) women with LAM injury and in 24/100 (24%) women without a LAM injury ($p = 0.74$). Any AI was found in 59/100 (59%) versus 48/100 (48%) in women with and without a LAM injury ($p = 0.12$). Eighteen (9%) women had LAM injury, anal sphincter defect, and any AI. Figure 3 illustrates the distribution of anal sphincter defects, AI, and LAM injury in a Venn diagram.

4 | DISCUSSION

The prevalence of anal sphincter defects in women scheduled for POP surgery was 25%. An EAS defect was associated with a fourfold increased risk of fecal incontinence, and a defect in the IAS increased the risk of flatal incontinence by five times. Both EAS and IAS defects correlated with higher VAS scores for fecal and flatal incontinence.

We found a higher prevalence of EAS and IAS defects (21% and 13.5%) compared with previous reports from a general population of parous women (15% and 3%).[8] A study from a urogynecological population found EAS and IAS defects in 18% and 12%, respectively, which is comparable to our findings.[12] Eight women had isolated IAS defects. This can be attributed to a missed diagnosis of IAS tear during the primary repair of the EAS. In addition, some women may still show a defect even after primary repair, due to interrupted healing as demonstrated by some studies.[6,8]

Fecal incontinence was found in 15%, which is in agreement with a previous study from a similar population.[12] Flatal incontinence was found in 48%, which is lower than some studies from a general population reporting up to 60% flatal leakage.[3] One-third of that study population was over 65 years, therefore, age and chronic diseases may have influenced this finding.[2,3] In another urogynecological setting, the prevalence of fecal and flatal incontinence was 41% and 58% respectively, which correlates well with our study.[14] Any AI of 54% is higher than reported in similar studies, but can be explained because this cohort consists of patients with severe POP.[11,12] Advanced prolapse of the posterior vaginal wall may cause rectal distension and incomplete defecation resulting in reduced reservoir function which in time may cause overflow incontinence.[18] However, the prevalence of AI was similar for women with posterior wall POP in our study. A follow-up study of the population after surgical correction may shed light on any improvement in symptoms of AI. As subsequent births may aggravate symptoms, another reason for the high prevalence of AI might be the increased share of multiparous women in this study.[1,8]

Our findings of increased risk of incontinence associated with sphincter defects coincide well with results from a recent study reporting a 50% increased risk of

TABLE 1 Population characteristics, anatomical findings, and prevalence of internal (IAS), external anal sphincter (EAS) and combined defects among 200 women

Background characteristics	Mean (*SD*)	Median (range)
Age	61.7 (11.4)	63 (31.0–83.0)
Body mass index	26.1 (4.0)	25.8 (19.6–43.0)
Parity	2.5 (0.9)	3 (0–6)
	Number (%)	
Nullipara	2 (1.0)	
Primipara	18 (9.0)	
Multipara	180 (90.0)	
Normal vaginal delivery	145 (72.5)	
Operative vaginal delivery	40 (20.0)	
Vaginal breech or twin delivery	11 (5.5)	
Only cesarean section	2 (1.0)	
Anatomical findings		
Pelvic organ prolapse stage ≥2 in		
Anterior wall	163 (81.5)	
Posterior wall	65 (32.5)	
Mid compartment	72 (36.0)	
Any levator ani muscle injury	100 (50.0)	
Bilateral levator ani muscle injury	48 (24.0)	
Any sphincter defect	50 (25.0)	
Isolated EAS defect	23 (11.5)	
Isolated IAS defect	8 (4.0)	
Combined defect	19 (9.5)	

fecal incontinence for women with defect EAS.[8] EAS is a voluntary muscle and injury affects function and may cause incontinence.[19] We found no association between EAS defects and flatal incontinence. This is plausible, as it is the IAS that contributes to the mean anal basal pressure, and IAS injury, therefore, affects flatal incontinence as shown in this study.[19] In addition, IAS involvement may suggest a more severe injury resulting in a higher risk of incontinence.

Previous studies have found an association between anal sphincter defects and AI. Our findings emphasize this association between sphincter defects and AI in women with the most advanced POP scheduled for surgery and adds new knowledge to the association between IAS defects and flatal incontinence in women with severe POP.

One strength of this study was the use of transperineal ultrasound to assess anal sphincter defects. Transperineal ultrasound has shown good correlation to

TABLE 2 Prevalence of fecal and flatal incontinence among women with intact and defect internal anal sphincter (IAS) and external anal sphincter (EAS) with adjusted odds ratio (aOR)[a] and visual analog scale (VAS) scores

	Fecal incontinence (*n* = 29/199)		Flatal incontinence (*n* = 97/199)		Fecal incontinence VAS scores (*n* = 198)		Flatal incontinence VAS scores (*n* = 198)	
	Number (%)	aOR[a] (95% CI); *p*	Number (%)	aOR[a] (95% CI); *p*	Mean score (*SD*); median (range)	Mann–Whitney *U* (*p*)	Mean score (*SD*); median (range)	Mann–Whitney *U* (*p*)
IAS								
Intact (*n* = 173/200)	19 (10.9)	2.3	74 (43.0)	5.2	5.6 (14.3); 0.0 (0–95)	<0.001	18.8 (29.2); 0.0 (0–100)	<0.001
Defect (*n* = 27/200)[b]	10 (37.0)	(0.7–7.0); 0.147	23 (85.2)	(1.6–17.2); 0.007	12.5 (24.6); 0.0 (0–82.3)		39.1 (34.9); 32.6 (0–100)	
EAS								
Intact (*n* = 158/200)	14 (8.9)	4.0	67 (42.7)	1.9	2.8 (13.5); 0.0 (0–95)	<0.001	19.6 (29.8); 0.0 (0–100)	0.006
Defect (*n* = 42/200)[b]	15 (35.7)	(1.5–10.8); 0.005	30 (71.4)	(0.8–4.5); 0.131	12.2 (22.7); 0.0 (0–82.3)		28.8 (33.6); 10.9 (0–100)	

[a]Potential confounders adjusted for include the presence of either EAS or IAS defects, age, parity, and body mass index.

[b]Isolated IAS defect in 8/200 (4%) and isolated EAS defects in 23/200 (13%) were found.

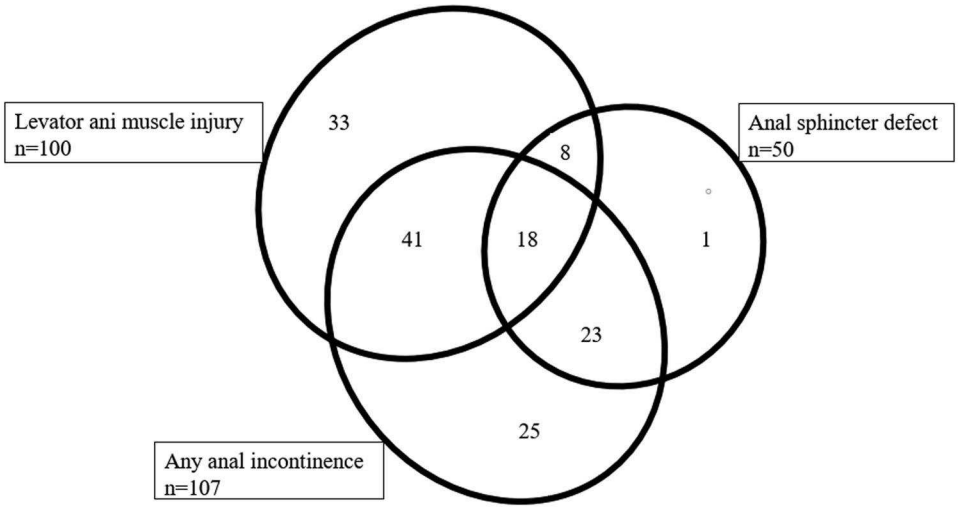

FIGURE 3 Venn diagram illustrating the distribution of anal sphincter defects, anal incontinence, and levator ani muscle injury among 200 women

symptoms, creates the least discomfort to patients and is readily available in most gynecological practices.[20,21] Another strength was that all volumes were assessed by two examiners, blinded to each other and to the patient characteristics and symptoms, and we found a good to strong agreement between the two main examiners. A third examiner evaluated all discordant findings, adding to the strength. We included women with prolapse in all compartments, therefore, the results should be representative for women with severe POP in a urogynecological practice.[8,12] Another strength was that we tested any association between LAM injury, AI, EAS, and IAS defect. We found no association between LAM injury and AI, which is in accordance with another study.[13]

A limitation of this study was that we had no information about OASI recorded at delivery and subsequent repairs. The participants were part of a larger study evaluating the LAM anatomy using a transperineal ultrasound, and the same approach was used to assess the anal sphincters. One study comparing transperineal and introital to endoanal ultrasound suggested that the endoanal ultrasound is the most accurate diagnostic imaging modality, but the transperineal approach was well tolerated and had high negative predictive value in rendering it suitable for preliminary diagnostics.[22] Another limitation was that a yes/no answer to leakage of stool or flatus does not give a nuanced picture of all aspects of AI. Still, it can be a useful screening aid in a busy clinical setting, and we used VAS score to further quantify symptoms. A study by Ulrich et al.[23] showed that a VAS is a valid tool in a urogynecological setting of POP patients. Standardized questionnaires could have improved the estimate of AI, as the questions asked in this study did not differentiate between leakage of loose or solid stool. Our study population included women who gave birth at a time where forceps deliveries were common in Norway, and the rate of undiagnosed anal injuries may have been higher than today. The etiology for AI is multifactorial and not solely dependent on muscle damage. Neurological impairment, estrogen deficiency, degenerative processes, chronic diseases, and positional instability of the pelvic structures possibly play a role in the development of AI.[19] We did not register background information regarding any previous anorectal surgery or diseases with possible impact on AI. Data concerning the 72 excluded women were not collected, which can also be considered a limitation. Symptomatic women are more eager to participate in studies than nonsymptomatic women introducing a bias in this study.

In a urogynecological population, the likelihood of sphincter defects and AI may be high and should be addressed.[2,12] Transperineal ultrasound has a high negative predictive value and can be utilized as a tool to assess symptomatic women who may benefit from extended investigation and treatment.[20–22] Further anophysiological investigation by a colorectal surgeon might be required to evaluate ideal treatment options. Symptomatic women with sphincter defects on transperineal ultrasound may also benefit referral to physiotherapy, biofeedback, bulking agents or sacral nerve stimulation.[24,25] Patients with POP and sphincter defects have usually sustained vaginal trauma during childbirth. Studies report that 25%–30% of women with OASI had concomitant LAM injury underlining the common risk factors.[7,13] Further follow-up studies are needed to determine whether prolapse surgery may alleviate the

symptoms of AI, particularly in patients with a posterior compartment prolapse. The high prevalence of AI in this population necessitates careful discussion of patient expectations regarding the alleviation of AI postoperatively and offers proper investigation and treatment options in case of persistent symptoms.

5 | CONCLUSION

One of four women with severe POP scheduled for surgery have anal sphincter defects. In symptomatic patients scheduled for POP surgery, we suggest examining for anal sphincter defects to diagnose any major defect. This should prompt further diagnostic testing to facilitate optimal treatment for this debilitating condition.

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CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

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