

## DIAGNOSIS OF LEVATOR AVULSION: IS IT NECESSARY TO PERFORM TOMOGRAPHIC IMAGING ON PELVIC FLOOR MUSCLE CONTRACTION?

### Hypothesis / aims of study

Avulsion of the levator ani muscle is a form of pelvic floor muscle trauma that occurs at the time of vaginal delivery. It is a known risk factor for female pelvic organ prolapse (FPOP) and for recurrence after surgical treatment. [1] This condition can be diagnosed by translabial ultrasound, preferably through the use of tomographic ultrasound imaging (TUI) during pelvic floor muscle contraction (PFMC). A PFMC increases muscle bulk and results in a more acute angle between pubic ramus and muscle, making resulting images visually easier to assess. A small minority of patients, however, are unable to achieve a PFMC despite teaching, and in these cases published methodology suggests that avulsion be assessed at rest. There is currently no evidence to support this practice. The aim of our study is to validate the diagnosis of levator avulsion by means of imaging at rest relative to imaging on PFMC.

### Study design, materials and methods

This study is based on the analysis of data obtained in routine clinical practice in a tertiary urogynaecological unit between January and July 2013. All subjects underwent a standardised interview, multichannel urodynamic testing, ICS POP-Q examination and 4D translabial pelvic floor ultrasound (US), supine and after voiding. The latter was used to generate volume data sets at rest, on maximal PFMC, and on Valsalva. US post-processing was performed by the first author, using proprietary software (4D View v 10.7), blinded against all clinical data. Avulsion of the puborectalis muscle was defined as an abnormal levator ani insertion visible on at least three consecutive axial plane slices at and above the level of minimal hiatal dimensions, obtained at an interslice interval of 2.5 mm. [2] Significant FPOP was determined clinically as ICS POPQ stage II or higher, and on translabial US relative to the symphysis pubis [3].

We used TUI to diagnose avulsion in archived volume data sets and examined the correlation between this diagnosis obtained at rest and on PFMC. We also tested each method's association with significant FPOP on clinical examination, significant organ descent on US [3], and hiatal ballooning, after excluding patients who had previously undergone surgery for FPOP. We did not perform power calculations due to the absence of pilot data in the literature.

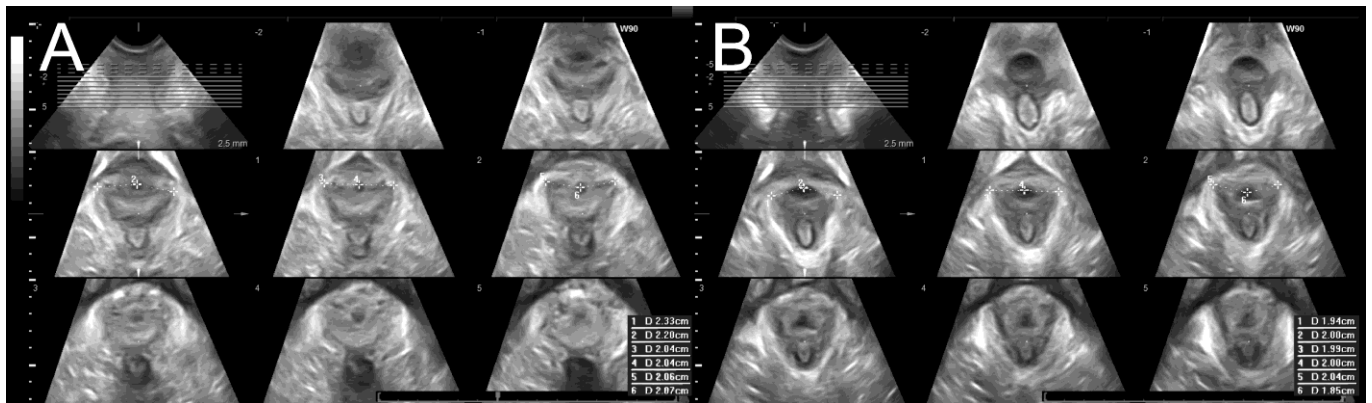


Figure: Tomographic assessment of the puborectalis component of the levator ani at rest (A) and on PFMC (B) in the same patient. It is evident that the image appears clearer on PFMC, but diagnostic accuracy does not seem to be affected.

### Results

Between January and July 2013, 233 patients were seen for assessment. Due to lack of equipment on four days, volume datasets of US imaging were available for 204 patients. Two more patients were unable to produce a PFMC on demand and were excluded from the study. The final data set comprises 202 patients. All reported data relates to this population.

Mean age was  $53.9 \pm 14.5$  years. Mean BMI was  $28.9 \pm 6.6$  kg/m<sup>2</sup>. Patients had a mean parity of  $2.5 \pm 1.4$ . 84.6% of patients had at least one vaginal delivery, and 20.8% a forceps. Thirty percent of patients had a previous hysterectomy, and 15.8% previous surgery for FPOP. Fifty-three percent of patients presented with symptoms of FPOP, 71.7% of patients had a history of stress urine incontinence (SUI), and 68.2% of urge incontinence (UII). On clinical examination, 73.8% of patients had FPOP ICS POP-Q stage 2 or higher.

Using traditional methodology, i.e. assessing for avulsion on PFMC, 16.3% of patients had a right-sided avulsion and 12.9% had a left sided avulsion. A bilateral avulsion was diagnosed in 7.4% of patients. In all, 21.4% of patients had a full avulsion diagnosed on TUI. When using volumes obtained at rest, 23.3% of patients had a right sided avulsion and 22.8% a left sided avulsion. Fifteen percent of patients had a bilateral avulsion and 30.7% of all patients had an avulsion of any kind. This is significantly higher than when using PFMC volumes (OR 1.64 (CI 10.2- 2.63),  $P = 0.041$  on Fisher's exact test). The Cohen's kappa for diagnosis of avulsion for volumes at rest compared to volumes on PFMC was 0.583 (95% CI 0.484-0.683), suggesting moderate correlation only. Agreement for defects on single slices was also moderate, with a kappa of 0.556 (95% CI 0.52-0.591).

For validation of avulsion diagnosis on PFMC and at rest, thirty two patients were excluded from further analysis due to a history of FPOP surgery, The remaining 170 patients were used to determine the association of both methods with significant FPOP. We considered a test as positive if it met criteria for avulsion on either side.

	TUI on PFMC		TUI at rest	
	OR (95% CI)	P value	OR (95% CI)	P value
Significant POP (Stage II or higher)	4.7 (1.4-16.2)	0.008	11.6 (2.7-50.4)	<0.0001
Significant organ descent on US	3.9 (1.5-10)	0.003	3.6 (1.6-8.1)	0.001
Ballooning (Hiatal area $\geq$ 25 cm <sup>2</sup> )	5.2 (1.9-14.4)	0.001	6.9 (2.7-17.5)	<0.0001

Table 1: Odds ratio of significant outcomes for diagnosing avulsion on PFMC and at rest (n= 202).

#### Interpretation of results

Our findings suggest that when assessing levator ani anatomy at rest, there is only moderate agreement regarding the diagnosis of avulsion with the original methodology using volume data obtained on PFMC. However, the assessment at rest did not perform less well in predicting significant FPOP or hiatal ballooning, suggesting that assessment of tomographic slices for avulsion at rest can be equally valid compared to assessment on PFMC.

#### Concluding message

Levator avulsion may be assessed at rest if necessary, as this does not appear to be inferior to the assessment of tomographic slices obtained on PFMC. However, measurement at rest is more likely to result in a diagnosis of avulsion. Hence, any reporting should specify whether avulsion was diagnosed at rest or on PFMC.

#### References

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#### Disclosures

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