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DIAGNOSIS OF LEVATOR AVULSION INJURY: A COMPARISON OF THREE METHODS

Hypothesis / aims of study

Levator avulsion injury is a form of maternal birth trauma that is known to be common after vaginal delivery. Several different diagnostic methods have been developed to define this injury. Vaginal palpation (1) is simple with moderate validity and reproducibility but requires substantial teaching. 3D ultrasound imaging is probably more valid and reproducible but requires expensive equipment. Two methods using ultrasound have been proposed. One utilises rendered volumes placed at the level of the plane of minimal hiatal dimensions (2), the other employs tomographic imaging (3). We undertook this study to determine the relative merits of those methods.

Study design, materials and methods

We retrospectively analysed randomy identified datasets of 266 women who presented for urodynamic testing in a tertiary urogynaecological unit between March 2006 and November 2008. Each patient underwent an interview, a vaginal examination, multichannel urodynamic testing and translabial ultrasound (Voluson 730 expert system, GE Kretz Ultrasound, Zipf, Austria). During vaginal examination, prolapse was graded using the ICS POP-Q grading, and levator strength and integrity were also assessed by palpation at the time of the original examination. Ultrasound imaging analysis was performed offline months to years later using proprietary software (Kretz 4D View V 5.0) on a PC, with the operator blinded against all clinical data.

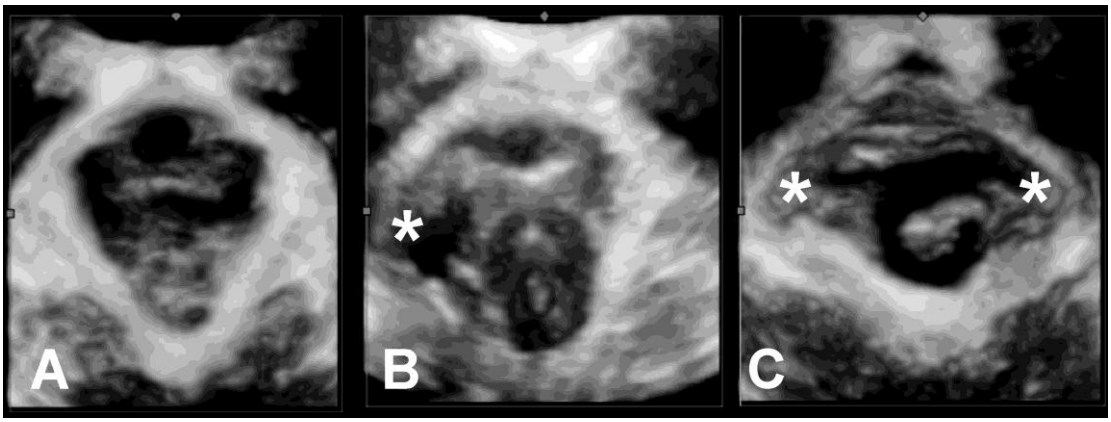

Figure: 3D pelvic floor ultrasound rendered volumes in the axial plane showing (A) intact puborectalis muscle, (B) right-sided avulsion injury (indicated by *) and (C), bilateral avulsion.

Tomographic imaging (TUI) produced a set of eight slices in the axial plane at intervals of 2.5 mm, from 5 mm caudad to 12.5 mm cephalad of the plane of minimal hiatal dimensions. An avulsion was rated as present if the plane of minimal dimensions as well as the two slices cephalad to that plane showed abnormal insertions. Rendered volumes were set at a thickness of about 2 cm, with the inferior margin of the rendered volume close to the plane of minimal dimensions, and with the rendering direction set from caudally to cranially. The standard rendering setting was surface/ minimum 80/20, with transparency set at 50. An avulsion was diagnosed on analysis of rendered volumes if the insertion of the puborectalis muscle on the inferior pubic ramus was clearly abnormal. This did not require a complete discontinuity between sidewall and muscle. Figure shows typical findings in patients with an intact muscle (A), a unilateral right-sided avulsion (B) and a bilateral avulsion (C). An interobserver repeatability series performed by the first and second authors in 43 patients yielded a Cohen's Kappa of 0.57 (CI 0.32-0.76).

Results

Of 266 datasets identified for this study, 7 were irretrievable due to clerical error, leaving 259. Mean age was 56 years (range, 22-88). They presented with stress incontinence (n=211, 79%), urge incontinence (n=188, 71%), frequency (n=106, 40%), nocturia (n=137, 52%), symptoms of voiding dysfunction (n=70, 28%) and symptoms of prolapse (n=119, 45%). Most (n=247, 93%) were vaginally parous, 101 had had a hysterectomy (38%), and 58 an incontinence or prolapse procedure (22%). 156 patients (59%) had a significant prolapse on examination. On urodynamic testing, 186 patients (71%) were diagnosed with urodynamic stress incontinence, 66 (25%) and 77 (29%) patients with detrusor overactivity and voiding dysfunction respectively. Mean bladder neck descent was 30 mm (, 0-67). Mean hiatal area on Valsalva was 29 (12-63) cm^2.

On palpation, 54 patients had a complete avulsion (20%), 47 on the right (18%), 25 on the left (9%). On rendered volume imaging, 65 patients were diagnosed with avulsion (25%), 43 on the right (17%) and 31 on the left (12%). On TUI, 79 women (30%) were found to have an avulsion, with 70 right-sided and 50 left-sided defects. Table 1 shows agreement between methods; Table 2 shows results of validating the diagnosis of avulsion against symptoms and signs of prolapse as well as against sonographic findings. Almost identical results were obtained on analysing a subset of women without previous anti-incontinence and prolapse surgery (n= 201).

Methods	Agreement	Cohen's kappa (95% CI)

Palpation versus rendered volume	86%	0.43 (0.32- 0.53)
Rendered volume versus TUI	80%	0.35 (0.26-0.44)
Palpation versus TUI	87%	0.56 (0.48-0.62)

Table 1: Agreement between methods used to diagnose levator avulsion.

Method	Symptoms of prolapse	Significant prolapse (POP-Q stage 2+)	Maximum bladder descent on US	Maximum hiatal area on Valsalva
Palpation	X2= 39.8, P< 0.001#	X2= 91.1 P< 0.001#	t= 4.22 P< 0.001	t=-6.92 P< 0.001*
Rendered volume	X2= 25.8 P< 0.001*	X2= 64.3 P< 0.001*	t= 2.73 P= 0.007*	t=-3.46 P< 0.001**
Tomographic ultrasound	X2= 13.8 P< 0.001	X2= 58.3 P< 0.001	t=3.78 P< 0.001	t=-7.04 P< 0.001*

*Table 2: Validation of the diagnosis of avulsion against symptoms and signs of prolapse as well as against sonographic findings associated with prolapse. N= 266 except for *n=259 and **n=252. All findings were blinded against each other, except for those marked with #.*

Interpretation of results

The three methods used for the diagnosis of levator avulsion in this study all seem to be moderately repeatable, they correlate moderately well with each other, and findings for all three methods are significantly associated with symptoms, signs and ultrasound findings of female pelvic organ prolapse (P= 0.007 to P< 0.001). Tomographic ultrasound seems to yield the highest number of avulsions, and it is not clear as to whether this represents over-diagnosis or higher sensitivity. From own experience it seems likely that palpation may identify small remnants of puborectalis muscle that are not visible on tomographic imaging. This may also explain as to why palpation performed surprisingly well in the validation phase of the study; however, this may partly be due to the fact that palpation could not be consistently blinded against symptoms and clinical examination.

Concluding message

Depending on the availability of local expertise and equipment, any of the three methods tested in this study may be used to document avulsion of the puborectalis muscle.

References

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Was this study approved by an ethics committee?	**Yes**
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Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**No**