

THE IMPACT OF LEVATOR TRAUMA ON PELVIC FLOOR MUSCLE FUNCTION

Hypothesis / aims of study

Levator trauma is common after vaginal delivery, either as “macrotrauma”, i.e. levator avulsion, or “microtrauma”, i.e. irreversible overdistension of the levator hiatus. The latter affects up to 30% of women after vaginal delivery (1). If microtrauma was the result of neuropathy, then one would expect an association with reduced contractile function. The same would be expected if overdistension had an effect on ultrastructure. Damage to the sarcomeres may be expected if muscle fibre is stretched to 150% of original length or more (2), which routinely occurs in labour. In this study we tested the hypothesis: Irreversible overdistension of the levator hiatus is associated with a reduction in contractile function of the levator ani muscle.

Study design, materials and methods

This is a retrospective analysis of the ultrasound volume datasets of women seen before and after childbirth in two prospective perinatal imaging studies. They were assessed with a standardised questionnaire, clinical examination (modified Oxford grading (MOS) optional) and translabial 4D ultrasound. Volumes were acquired at rest, on Valsalva and pelvic floor muscle contraction (PFMC). Volume data sets were later analysed on a desktop computer using proprietary software by an operator blinded against all other data. Irreversible overdistension (microtrauma) was defined as an increase over 20% in hiatal area on Valsalva comparing ante-natal and postpartum volume datasets (1). Complete and partial avulsion were diagnosed on tomographic ultrasound imaging (TUI) (3). To assess for changes in pelvic floor muscle function we measured the following ultrasound indices before and after childbirth (see Fig. 1): bladder neck elevation (A,B), reduction in anteroposterior hiatal diameter (C,D), change in levator plate angle (E,F), and reduction in hiatal area on PFMC (G,H). We also analysed pre- and postnatal modified Oxford grading (MOS).

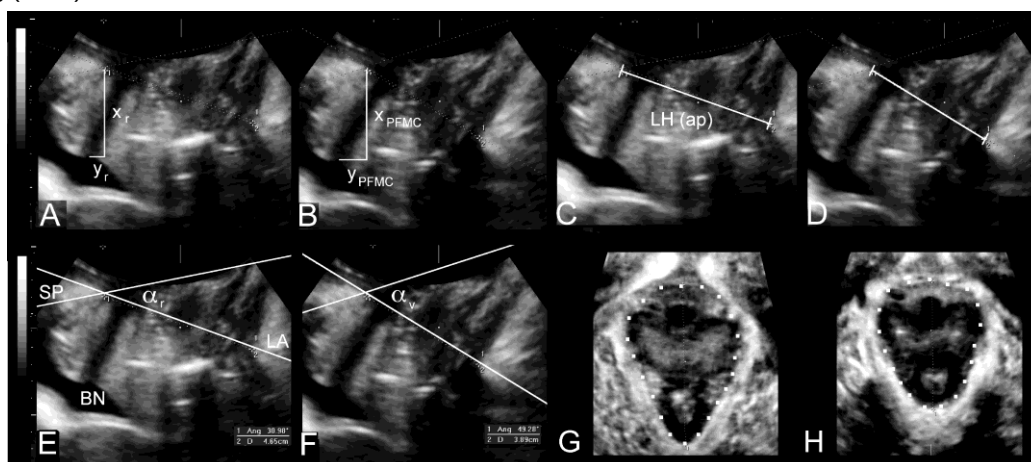


Figure: Assessment of pelvic floor muscle function by translabial ultrasound. A,B: Determination of bladder neck lift in the midsagittal plane; C,D: Shortening of midsagittal hiatal diameter; E,F: Change in levator plate angle; G,H: reduction in hiatal area on PFMC.

The study was a retrospective subanalysis of two prospective perinatal imaging studies approved by the local institutional Human Research Ethics Committee. Statistical analysis was undertaken using the software Minitab v13 for PC (Mintab Inc., State College, PA, USA) and SAS v9.2 (SAS Institute Inc., Cary, NC, USA.). All quantitative data were found to be normally distributed on Kolmogoror-Smirnov testing.

Results:

A test retest of 20 ultrasound volume datasets showed good to excellent repeatability of ultrasound indices of pelvic floor function (ICC between 0.67 and 0.94). Of 560 participants seen at a mean gestation of 36.4 weeks (33.2-38.3), 79% (n=446) returned on average 5 months (2.3-22.4) after childbirth. Thirteen were excluded (missing data n=5, poor acquisition n=4, pregnant at assessment n=3, another delivery in the interim n=1), leaving 433 datasets for analysis. Mean age was 29.2 years (18-45), BMI was 29.7 (SD 5.3) and 86% were Caucasians. 320 women (74%) had a vaginal delivery (NVD 54%; vacuum 14%; forceps 7%), and 113 (26%) a caesarean section (prelabour 5%; 1st stage 15%; 2nd stage 5.5%).

Postnatally, 26% complained of stress incontinence, 8.5% urge incontinence, 24% frequency, 7.9% nocturia and 4% symptoms of prolapse. There was a significant reduction in all measures of pelvic floor function except for Oxford Grading, Table 1. However, it was only the change in Oxford grading that was associated with delivery mode (ANOVA, P= 0.006).

Parameters	Antepartum	Postpartum	P value
Bladder neck elevation (mm)	8.9 (4.1)	6.5 (3.7)	<0.001
Reduction in AP Diameter (cm)	0.97 (0.5)	0.83(0.5)	<0.001
Change in levator angle (deg.)	11.81(5.04)	10.43(4.92)	<0.001
Reduction in hiatal area (cm ²)	3.2 (2.1)	2.6(1.8)	<0.001
Modified Oxford Grading	2.94(0.85)	2.87(0.91)	0.172

Table 1: Change in PFM function in women after a first delivery (n=433 for all parameters except Oxford Grading n=332)

47 (15% of vaginally parous women) were diagnosed with levator avulsion. Avulsion was associated with a reduction in PFM contractility peripartum on sonographic parameters and MOS. However, only clinical assessment reached statistical significance (Table 2).

Parameters Change	No Avulsion N=386	Avulsion N=47	P Value
Bladder neck elevation (mm)	-2.31 (4.39)	-3.11(3.66)	NS
Reduction in AP Diameter (cm)	-0.13(0.52)	-0.19 (0.55)	NS
Change in levator angle (deg.)	-1.19(5.86)	-2.99(6.34)	NS
Reduction in hiatal area (cm ²)	-0.59(2.51)	-0.98(2.38)	NS
Modified Oxford Grading	-0.011(0.912)*	-0.56(0.928)**	0.002

Table 2: Comparison between women with avulsion or no avulsion in postpartum change on PFM function parameters. *n=297 **n=35

After excluding women with avulsion or partial trauma, 65/312 (21%) of women were diagnosed with microtrauma. We found no evidence of impairment in levator muscle contractility on ultrasound. In fact, some measures (hiatal diameter and hiatal area reduction on PFMC) seemed 'improved'. However, there was a statistically significant reduction in Oxford Grading (Table 3).

Parameters Change	No Microtrauma N=247	Microtrauma N=65	P Value
Bladder neck elevation (mm)	-2.38 (4.37)	-1.29 (4.7)	NS
Reduction in AP Diameter (cm)	-0.179(5.12)	0.1(0.53)	<0.001
Change in levator angle (deg.)	-1.21(5.89)	0.19(5.35)	NS
Reduction in hiatal area (cm ²)	-0.80(2.47)	0.63(2.42)	<0.001
Modified Oxford Grading	0.102(0.89)*	-0.366 (0.85)**	0.001

Table 3: Comparison between women with or without microtrauma, excluding avulsion and partial trauma. *n=181 **n=56

Conclusion

Both levator avulsion (macrotrauma) and irreversible overdistension (microtrauma) of the levator hiatus are associated with reduced contractile function. This effect is more easily detected by palpation than by ultrasound, likely due to the fact that organ displacement on PFMC will depend at least as much on tissue compliance, which is generally increased after childbirth, as on actual contractility.

References

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Disclosures

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