

## HOW COMMON IS PELVIC FLOOR MUSCLE ATROPHY AFTER VAGINAL CHILDBIRTH?

### Hypothesis / aims of study

The aim of this study was to determine whether there is any significant reduction in the thickness of the levator ani muscle 3-6 months after a first vaginal delivery compared to values obtained in the late third trimester, using ultrasound volume data obtained in the context of two perinatal trials investigating pelvic floor structure and function before and after childbirth.

### Study design, materials and methods

This study was carried out as a retrospective observational cohort study using translabial ultrasound volume datasets obtained with Voluson type ultrasound systems, analyzed with the software 4D View v 10.0 (GE Kretz Ultrasound, Zipf, Austria). We measured bladder neck elevation in the midsagittal plane and reduction of the anteroposterior diameter of the levator hiatus in the axial plane as previously described[1] during a pelvic floor muscle contraction (PFMC) as measures of pelvic floor muscle function, as well as muscle thickness in four locations (right paravaginal, right anorectal, left paravaginal, left anorectal) as a measure of muscle bulk. Muscle thickness was measured within 1cm of the plane of minimal hiatal dimension as identified in the midsagittal plane on PFMC, i.e., where the puborectalis/ pubovisceralis muscle shows maximum thickness. These measurements were taken from volumes obtained at 36-38 weeks' gestation, and again 3-6 months following delivery. A total of 202 women were assessed during the study period (November 2006- March 2008). Power calculations were omitted due to an absence of pilot data. Data collection occurred blinded against delivery related information, and analysis of ultrasound volume data sets was undertaken blinded against all other data. 4D volumes for pelvic floor muscle thickness (n=202) and bladder neck lift on PFMC were analyzed. Pairwise comparisons were employed to identify peripartum changes.

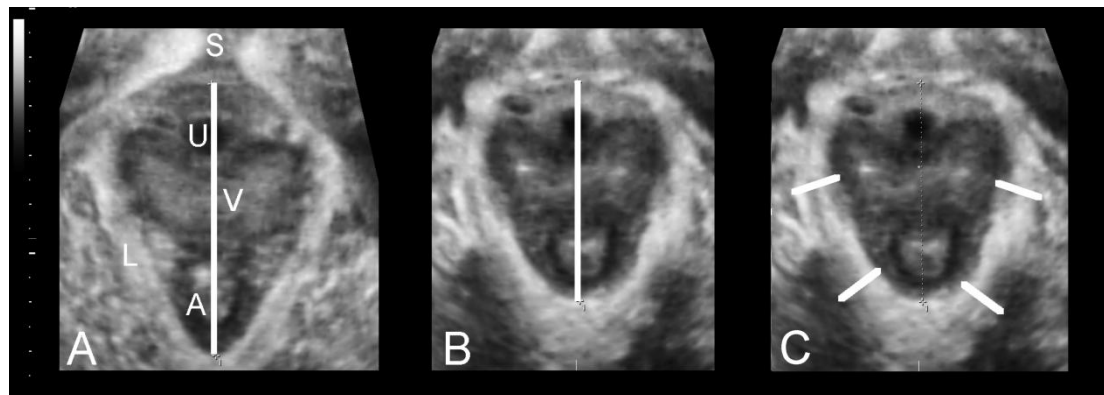


Figure 1: The anteroposterior hiatal diameter (vertical line) at rest (image A) is shortened at PFMC (image B). Muscle thickness was measured at the four locations (horizontal lines) indicated in C, that is, lateral to vagina and anorectum. S=symphysis pubis, U=urethra, V=vagina, A=anal canal, L=levator ani.

### Results

Repeatability of all measured ultrasound parameters was tested using Intraclass Correlation Coefficients (single measures, absolute agreement definition) after confirming no or minimal systematic bias by comparing means. The repeatability of bladder neck position and hiatal diameters was excellent for both rest and PFMC (n=21, ICC between 0.92 [CI 0.83- 0.98] and 0.969 [0.91- 0.99]). For muscle thickness (n=84), repeatability was 0.65 (0.29- 0.81), signifying substantial agreement. During the study period, 202 participants were enlisted. They were seen between 36+0 and 39+0 (mean gestation 37+1). Of those, 165 (82%) returned for their postnatal follow-up appointment at a median of 124 days after their birth (SD 47 days, range 82- 368 days). Of the 37 patients who did not attend, 26 were lost to follow-up, 7 cancelled participation in the study, 3 moved locations and one had fallen pregnant again. In 7 cases ultrasound volume data sets could not be retrieved due to technical or clerical errors, leaving 165 - 7 = 158 patients. All further analysis pertains to this number.

Of those 158 women, 12 had a prelabour Caesarean Section (CS), 29 a CS in first stage, 8 a CS in second stage, 88 a normal vaginal delivery (NVD), 13 a Vacuum Extraction and 8 a Forceps, at an average gestation of 40 weeks (range, 36+6 to 42+4).

On ultrasound postprocessing analysis, the average bladder neck elevation on pelvic floor muscle contraction was measured at 3.3 mm (SD 3.2) at the antepartum (AP) assessment and 2.3 mm (SD 2.2) after childbirth (p= 0.001). This reduction of one mm on average was not associated with delivery mode. As regards reduction in hiatal diameters on PFMC, this was also less pronounced at the postpartum (PP) visit (AP -8.6 mm [SD 4.6] vs PP -7.8 [SD 4.5] mm; P=0.03). This change was associated with delivery mode (peripartum change in hiatal reduction was -0.5 mm [SD 4.3] in CS vs 1.4 mm [SD 4.5] in the vaginal delivery group; P=0.013).

However, on analysing muscle thickness we found no evidence of significant peripartum change. Mean measurements at both time points was 10.1 mm (P=0.76), without side differences. Muscle thickness was not associated with delivery mode (peripartum change in mean muscle thickness after CS was -0.4 (SD 2.5) mm vs. +0.1 (SD 1.9) mm after vaginal delivery; n.s.). There were no significant differences even if elective CS was analysed separately.

### Interpretation of results

The levator ani muscle endures great stress during vaginal childbirth, especially the puborectalis component of this muscle. In a substantial minority of women this results in macroscopic trauma ('avulsion injury') and/ or traumatic overdistension, and this is associated with female pelvic organ prolapse, especially of the anterior and central compartment[2]. There also is substantial evidence for delivery- related impairment of pelvic floor innervation[3], but it is not clear as to whether such neuropathic changes affect the levator ani. If there was any significant denervation of this muscle one would expect atrophic changes, ie., a reduction in muscle mass.

Our findings revealed a reduction in bladder neck displacement and hiatal diameters at PFMC postpartum, confirming previously published evidence of a reduction of the effectiveness of pelvic floor muscle contractions after childbirth. The observed reduction in hiatal diameters on PFMC was associated with delivery mode, with women after vaginal delivery demonstrating lower measurements compared to CS. However, on analysing muscle thickness we found no evidence of significant peripartum change, regardless of delivery mode.

### Concluding message

While we have confirmed previously published evidence of a reduction of the effectiveness of pelvic floor muscle contractions after childbirth, our data does not support muscle atrophy as a significant factor in the pathophysiology of delivery- related alterations in pelvic floor morphology and function. Atrophy of the puborectalis muscle seems to be uncommon after childbirth, regardless of delivery mode. This finding is consistent with a recently demonstrated low likelihood of muscle atrophy in women after severely obstructed labour and vesicovaginal/ rectovaginal fistula. Abnormal morphology of the levator ani seems to be much more likely to be due to direct trauma.

### References

1. Dietz HP (2011) Pelvic Floor ultrasound in incontinence: What's in it for the surgeon? . Int Urogynecol J 22:1085-1097
2. Dietz HP (2011) Pelvic Floor ultrasound in prolapse: what's in it for the surgeon? Int Urogynecol J 22:1221-1232
3. Snooks SJ, Swash M, Mathers SE, Henry MM (1990) Effect of vaginal delivery on the pelvic floor: a 5-year follow- up. BrJSurg 77 (12):1358-1360

### Disclosures

**Funding:** None. **Clinical Trial:** No **Subjects:** HUMAN **Ethics Committee:** Sydney West Area Health Service Human Research Ethics Committee (SWAHS HREC) **Helsinki:** Yes **Informed Consent:** Yes