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MAJOR DEFECTS OF THE PUBOVISCERAL MUSCLE, LEVATOR HIATUS DIMENSIONS AND PELVIC FLOOR FUNCTION, A THREE AND FOUR DIMENSIONAL TRANSPERINEAL STUDY.

Hypothesis / aims of study

The relationship between pelvic organ prolapse (POP) and vaginal deliveries has long been known. Using MRI, and more recently 3D/ 4D ultrasound, it is possible to identify defects in the pelvic floor muscles (PFM) and specifically the pubovisceral (PV) muscle in women who have delivered vaginally. The link between PV muscle defects and POP is not completely understood. The aims of the present study were to investigate the relationship between major pubovisceral muscle defects, changes in levator hiatus dimensions during contraction and Valsalva, and pelvic floor muscle strength and endurance.

Study design, materials and methods

In this cross-sectional study women were recruited between January 2006 and April 2008. They were originally invited to participate in a RCT investigating the effects of pelvic floor training on POP and/or as controls in a parallel case-control study investigating risk factors for POP(1)(2). 3D/4D transperineal ultrasound examination at rest, maximal contraction and maximal Valsalva were performed using the GE Kretz Voluson E_8 system (GE Medical Systems Zipf, Austria). The ultrasound volumes were analyzed in the axial plane at the level of minimal dimensions of the levator hiatus (LH) using the 4D View (v 5.0).The measurements assessed were; area (LHarea), anterior-posterior (LHap) and transverse diameter (LHrl) of levator hiatus. For the identification and grading of major PV muscle defects, tomographic ultrasound imaging was performed on volumes obtained at maximal pelvic floor contraction. PV muscle defect (PVD) was diagnosed when persistently present in three slices; at the level of minimal hiatal dimensions, 2.5 mm and 5 mm cranial to this plane (3). Muscle strength and endurance were registered with a vaginal balloon catheter (balloon size 6.7 x 1.7cm) connected to a high precision pressure transducer (Camtech AS), while observing an inward movement of the perineum/catheter The narrowing and widening of LH during contraction and Valsalva were calculated as percent change from resting values to assess the relative ability for the PV muscle to constrict and distend. Descriptive statistics were used; the results are given as frequencies with percentage and means, with range and 95% confidence intervals (CI). Analysis of variance (ANOVA) was used to compare levator hiatus and pressure measurements between groups. The level of significance was set at 0.05.

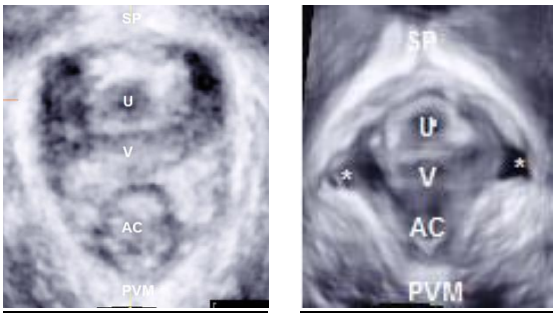

Figure 1
Levator hiatus at the level of minimal hiatal dimensions.
A) Women with intact PV muscle.
B) Women with bilateral defect of the PV muscle.

Defect is marked by *.

Table 1. Major Pubovisceral muscle defects and dimensions of the levator hiatus at rest and contraction. Values are shown as mean with its 95% CI. (N= 144). *Significant at the level of 5%. ap; anterior-posterior diameter, rl, right-left transverse diameter.

	No injury N=95	Unilateral defects N=25	Bilateral defects N=24	ANOVA P-values
LHarea (rest), cm^2	21.6(20.6; 22.6)	23.9 (21.9; 25.8)	24.1(21.7; 26.4)	.027*
LHrl (rest), cm	4.7(4.6; 4.8)	4.9 (4.6; 5.1)	5.1(4.8; 5.4)	.013*
LHap (rest), cm	6.2 (6.1; 6.3)	6.4 (6.2; 6.6)	7.0 (6.6; 7.4)	.000*
LHarea(contration), cm^2	17.5(16.6; 18.4)	19.6 (17.6; 21.6)	21.6 (18.8; 4.4)	.001*
LHrl (contration), cm	3.8(3.7-3.9)	4.9 (4.5; 5.2)	5.5 (5.2; 5.7)	.000*
LHap(contration), cm	5.4 (5.2; 5.5)	5.9 (5.4; 6.5)	5.8 (5.4, 6.3)	.000*
LHarea %decrease	18.3(15.3; 21.2)	18.1(13.5; 22.7)	9.2 (1.5; 16.8)	.025*
LHrl %decrease	17.0(13.6; 2.4)	-0.9 (-6,83; 4,97)	-7.0 (14.8; 0.8)	.000*
LHap% decrease	12.4(9,8; 15.0)	8.1 (0,1; 15,7)	10,4 (6,5; 14,3)	.300

Results

One hundred and fifty-seven women were included in the study. Assessment of PVD was possible in 144 women. Mean age 49.7 years (range 27-70), mean BMI 25.8 (range18.5-36.6), parity 2.3 (range1-6), mean number of vaginal deliveries 2.3 (range1-4) and mean operative deliveries 0.24 (range 0-1). 68% of women had a clinically significant prolapse (stage ≥ 2). Twenty-five (17.4%) women had a unilateral and 24 (16,7%) bilateral major PVD. There was a significant difference in mean values of the area, transverse and anterior-posterior diameter of levator hiatus at rest and contraction in women with out PVD, unilateral PVD and bilateral PVD (Table 1). During PFM contraction the constriction of LHarea and LHap was reduced in women with unilateral and bilateral major PVD compared to women with no defects. There was no significant difference in hiatal dimensions on Valsalva between women without PVD, unilateral PVD and bilateral PVD. Divided into two groups as women without PVD and women with unilateral and bilateral PVD, women without PVD had higher relative increase in all hiatal dimensions than women with any PVD,(LH area 39.1%95%CI (32.4-45.7); 25.9%, 95% CI(16.1-35.3) (P=0.025),(LHap 19.5% with 95%CI (16.1-22.9); 13.0% 95%CI(8.6-17.3) (P=0.013) and LHrl 16.0% with 95% CI (12.6-19.4); 8.2% 95%CI(2.6-13.7) (P=0.026). Women with PVD had lower mean resting vaginal pressure and pelvic floor muscle strength and endurance measurements as compared to women without PVD but differences were not statistically significant.

Interpretation of results

Having unilateral and bilateral major pubovisceral muscle defects has implications for function of the PFM and can be one of the explanations for the development of pelvic organ prolapse. The levator hiatus dimensions at rest and contraction were larger in women with than without major PVD. This may lead to less support both during normal daily activity and during physical activities further increasing intra- abdominal pressure. Contradictory to our expectations, women with PVD had less relative increase of the LHarea during Valsalva compared to women without.PVD. This difference however was statistically significant only when the women were divided into two groups. Further research with larger sample size is needed to elaborate these results. One hypothesis might be that injured muscles have less elasticity. As vaginal pressure values and pelvic floor muscle strength and endurance were not significantly different in women with and without PVD, PVD may not be the only factor influencing the pelvic floor muscle function. Other parts of the PFM may compensate for injuries in one of the muscles. More research is needed to investigate the role of compression and neurogenic injuries.

Concluding message

Women with unilateral and bilateral major pubovisceral defects have reduced ability to constrict and expand hiatal dimensions. Further studies with larger sample size are needed to investigate the link between PVD and PFM strength.

References

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Is this a clinical trial?	**Yes**
Is this study registered in a public clinical trials registry?	**No**
Is this a Randomised Controlled Trial (RCT)?	**No**
What were the subjects in the study?	**HUMAN**
Was this study approved by an ethics committee?	**Yes**
Specify Name of Ethics Committee	**The study was approved by the Regional Medical Ethics Committee (212-06078 1.2006.291), and the Norwegian Social science Data Service (2008-16703 JE/RF).**
Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**