

4D ULTRASOUND TO MEASURE CLOSURE OF THE LEVATOR HIATUS DURING PELVIC FLOOR AND TRANSVERSUS ABDOMINIS MUSCLE CONTRACTION

Hypothesis / aims of study

During pelvic floor muscle (PFM) contraction there is closure of the pelvic openings, a lift of the pelvic organs, and stabilizing and prevention of descent during rise in intra-abdominal pressure (1). Recently, a theoretical model involving training of the deep abdominal muscles, in particular the transversus abdominis (TrA) has been introduced to restore pelvic floor function (2). It has also been suggested that TrA contraction can facilitate co-contraction of the PFM in women not able to contract the PFM. The TrA, due to its anatomical location, can have no direct effect on the continence mechanism and a possible contribution must go via a co-contraction of the PFM. Recently, the dimensions of the levator hiatus (LH) have achieved increasing interest in understanding pathophysiology and mechanism of incontinence and pelvic organ prolapse (POP) in women. Reduction of the LH can be used to measure the effectiveness of a voluntary or automatic PFM contraction. The aim of the present study was to compare the effect of instruction of PFM and TrA contraction on closure of the levator hiatus, using 4D ultrasound.

Study design, materials and methods

Women with stage 1-3 POP assessed by POP-Q were included in the study. Correct PFM and TrA contraction was ensured with digital palpation and ultrasonography. A Voluson E8 Volume Ultrasound machine with 4-8 MHz curved array 3D/4D transducer (RAB 4-7l/obstetric) was used. The field of view angle was set to its maximum of 70° in the sagittal plane and volume acquisition angle to 85° in the coronar plane (frame rate 3Hz). After instruction of correct PFM and TrA contraction the participants contracted the two different muscle groups in standing position with the ultrasound probe on the perineum. Analyses of 4D real time volumes were conducted offline on a laptop, using the software "4D View v 6.2". Measurements were performed in the axial plane of minimal hiatal dimensions. The area of LH was measured as the area bordered by the pubovisceral muscle, symphysis pubis and inferior pubic ramus. Hiatal dimensions from left to right side (transverse) and the anterior- posterior distance were measured in addition to muscle length. Muscle length was calculated as circumference of the LH minus the suprapubic arch (3).

Power calculation was based on data from 17 healthy volunteers showing a reduction of the levator hiatus of 25% (95% CI:18-32) during PFM contraction. We suggested that 50% less closure of the levator hiatus during TrA contraction compared to each women's PFM contraction may be a clinical relevant co-contraction. With alfa 0.05 and power, 0.8, 13 women was the minimum sample size. Results are presented as mean differences with 95% confidence intervals (CI) in constriction of hiatal area between PFM and TrA contraction. P-value is set to <.05.

Results

Thirteen women, mean age 46.5 years (SD 7.2), body mass index 24.7 (SD 3.6) and parity 2.6 (SD 0.8) participated in the study. During PFM and TrA contraction the mean hiatal area reduction was 24% (SD 12.5) and 9.5% (SD 10.9), respectively. The mean difference in constriction of the hiatal area between PFM and TrA contraction was 3.30 cm² (95% CI: 1.35-5.25), p=0.003. The mean difference in constriction of the transverse and anterior-posterior dimensions of the levator hiatus were 0.23 cm (95% CI: 0.05-0.40) and 0.54 cm (95% CI: 0.23-0.86), p=0.016 and p= 0.003, respectively. Mean difference in reduction of muscle length was 1.07 cm (95% CI: 0.20-1.95), p=0.022. All participants had reduction of the LH during PFM contraction. During TrA contraction two women increased the LH area with 0.4 and 9.8%, respectively.

Interpretation of results

The results of the present study showed that in women with POP the closure of the LH was significantly larger during instruction of PFM contraction than during instruction of TrA contraction. In two women there was an opening of the LH instead of closure during TrA contraction. The studies supporting the theory that PFM can be trained via instruction of the TrA, are small (numbers ranging from 1-7) and have included women without pelvic floor dysfunctions (2). Recommendations for effective strength training is to contract as close to maximal contraction as possible. Whether contractions with 50% of a maximum contraction can change PFM morphology and automatic function must be evaluated in a randomized controlled trial. A co-contraction of the PFM with TrA contraction (or other muscle groups as well), is expected in women with a well functioning pelvic floor. However, the present study showed that such co-contraction may be absent or weak in some women with pelvic floor dysfunction.

Concluding message

Instruction of PFM contraction is significantly more effective in reducing the levator hiatus than instruction of TrA contraction in women with POP. In some women with symptoms of pelvic floor dysfunction contraction of the TrA may open up the hiatus instead of closing it. A significant co- contraction of the PFM can not be expected during TrA contraction in all women with pelvic floor dysfunction. In clinical practice indirect training via TrA without confirming that there is a simultaneous and efficient co-contraction of the PFM is therefore not recommended.

References

1. Ann NY Acad Sci (2007), 1101: 266-296.
2. MT (2004), 9: 3-12.
3. Ultrasound Obstet Gynecol (2008), 31: 201-205.

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Is this a clinical trial?	No
What were the subjects in the study?	HUMAN
Was this study approved by an ethics committee?	Yes
Specify Name of Ethics Committee	Regional Committe for Medical Research in Norway
Was the Declaration of Helsinki followed?	Yes

Was informed consent obtained from the patients?

Yes
