Bladder base displacement during abdominal and pelvic floor exercises assessed by transperineal ultrasound imaging

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Introduction

Childbirth causes significant alterations of pelvic organ support, pelvic floor muscles (PFM) function and abdominal wall (1,2). However, there is a lack of consensus on which are the most appropriate PFM and AM (abdominal muscles) exercises in postpartum programs. The aim of this study was to investigate the immediate effect of three PFM and AM exercises on the displacement of bladder base (BB), differentiating between parous and nulliparous women using transperineal ultrasound (TPU). We hypothesized that there will be a disparate effect of the PFM and AM exercises on the displacement of the BB by type of exercise, and by group.

Methods and Materials

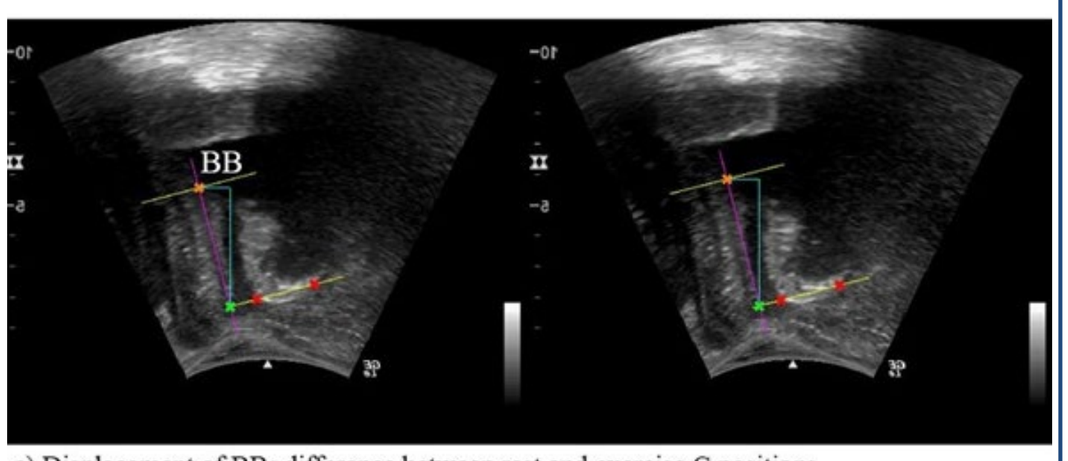
A convenience sample of 18 nulliparous women and 13 postpartum women participated in this cross-sectional study. The vertical and horizontal displacements of BB were assessed with TPU during three randomly ordered exercises recruiting PFM and AM. The protocol involved three exercises: A) submaximal PFM + Deep AM exercise, B) submaximal PFM + Deep AM + axial spine elongation exercise, and C) semi-curl-up exercise (Figure 1). Two-dimensional TPU was performed by placing a 3.5 MHz curved linear probe on the perineum in the sagittal plane. The vertical and horizontal displacements of BB were assessed using the standardized method described by Henemann et al 2014 (3) placing the BB mark 1 cm apart from bladder neck. A Graphical User Interface on MATLA8 software has been developed for aiding in measurement process (Figure 2). A repeated measures multi-factor ANOVA using 8onferroni adjustments to multiple comparisons was used to compare the differences of the displacement of BB among exercises, and between groups. Means with 95% CI are reported.

Figure 1. Exercises A (submaximal PFM + Deep AM contraction); Exercise B (submaximal PFM + Deep AM + axial spine elongation exercise); Exercise C (semi-curl-up).

Results

The BB was elevated during exercise A (submaximal PFM + deep AM) and exercise B (PFM + AM+ self-elongation), while descended during exercise C (semi-curl-up) (Figure 3), showing statistical differences among elevating and descending exercises of the BB in both groups ($P<0.01$). Submaximal PFM + deep AM exercise (exercise A) displaced significantly more cranially BB in postpartum comparing to nulliparous women (Figure 3). BB was displaced significantly backwards during curl-up exercise comparing to submaximal PFM + deep AM in both groups. No statistical differences were found in the horizontal displacement of BB between groups (Figure 3).

Figure 2. A MATLAB algorithm was developed to measure the BB displacement from rest (left image) to the position during the exercise B (right image). Blue line: vertical displacement (cm); Pink line: horizontal displacement of BB (cm).



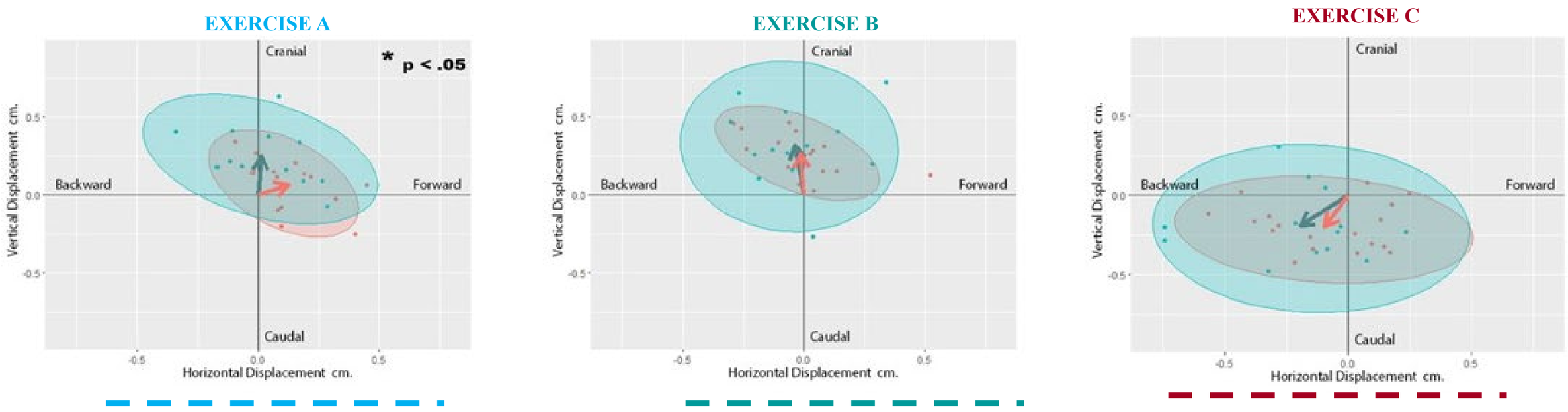
c) Displacement of BB: difference between rest and exercise $\hat{B}$ positions.

Rest position
Vertical distance = 3.8333 [cm]
Horizontal distance = 1.0147 [cm]

Exercise $\hat{B}$
Vertical distance = 4.0912 [cm]
Horizontal distance = 1.052 [cm]

BB displacement
Vertical distance = 0.25784 [cm]
Horizontal distance = -0.03731 [cm]

•Figure 3. Scatterplot representing the immediate effect (vertical and horizontal displacement) of exercises A-C on the bladder base (BB) by groups. Arrows depict mean vertical and horizontal displacements. Ellipses represent the 95% confidence intervals of a multivariate t-distribution for postpartum and nulliparous women. Significant intergroup differences are highlighted with an asterisk ($p < .05$). Significant differences in displacements between groups (nulliparous vs postpartum) are marked (*).



Discussion

Findings demonstrated which exercises were descending BB in postpartum women comparing to nulliparous one, and which one elevated BB in postpartum. Further research is required to determine the long-term effect of those exercises in the position of BB.

Conclusions

Findings demonstrated which exercises were descending BB in postpartum women comparing to nulliparous one, and which one elevated BB in postpartum. Further research is required to determine the long-term effect of those exercises in the position of BB.

References

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