The effects of training by virtual reality or gym ball on pelvic floor muscle strength in postmenopausal women: a randomized controlled trial

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Introduction: Evidence suggests pelvic floor muscle training (PFMT) should be offered as a first-line conservative therapy for people with urinary incontinence (stress, urge, or mixed). A previously developed exercise protocol by Marques et al. stimulates repeated PFM maximal contractions. Alternatively, virtual reality has been used in clinical practice to explore the game environment while receiving treatment, adding innovation and interactivity to the physical therapy routine.

Aim/Primary Aim: To evaluate the effectiveness of abdominopelvic training by virtual reality compared to pelvic floor muscle training (PFMT) using a gym ball on postmenopausal women's PFM strength.

Study Design/Study Format:
- Prospective randomized controlled trial
  - Oxford Centre for Evidence grading scale: Level Ib
- Subjects:
  - 60 postmenopausal women originally recruited
  - Randomly assigned into two training groups through a simple randomization schedule using computerized random numbers.
    - 47 completed the protocols: 27 from the Virtual reality (APT_VR) group and 20 from the therapy gym ball (PFMT_GB) group.
  - Groups were considered similar at start of trial in demographics, level of activity, parity, delivery mode, hormone replacement, and incontinence type.
  - Exclusion criteria: urinary tract infection, myopathy, neurological abnormalities, diseases which alter collagen, cognitive and physical disorders that would hinder participation, any pelvic organ prolapse greater than or equal to three on the POP-Q scale, PFM strength grade of zero, and previous PFMT supervised by health professionals.

Methods:
- Outcome measures:
  - PFM strength and endurance via digital palpation and dynamometry
- Blinding:
  - Subjects: No
  - Treating Therapists: No
  - Assessors: Unclear
- Methods: Both training sessions were individually supervised by the same physical therapist, and lasted 30 minutes each, twice a week for five consecutive weeks, totaling 10 sessions.
  - Virtual Reality: The virtual reality group (APT_VR) used a *Wii*TM console with a *Wii Fit Plus*TM CD game. The participants sat on the *Wii Balance Board*TM. While the games

were carried out, no verbal commands for direct PFM contractions were given by the researcher.

- Subgames used: *Lotus Focus*[TM], *Penguin Slide*[TM], *Table Tilt*[TM], and *Balance Bubble*[TM]. Games were performed 5 mins each, with 90 second break between games.
- For Lotus Focus you sit on balance board with legs folded, and your back upright. On the screen is a candle with a flame which your body controls. You must keep your body still to keep the flame on the candle from blowing out.
  - https://www.youtube.com/watch?v=_-jpAVmKXvc
- In Penguin Slide there is an image of an iceberg with a penguin balancing on top. You must shift body left and right to catch fish which jump up on to the iceberg (which moves like a see-saw).
  - https://www.youtube.com/watch?v=bb8q9R_1uP0
- In Table Tilt you control a marble on variously shaped tables. You use your hips to tilt in rotational movements.
  - https://www.youtube.com/watch?v=Dnx_ZUMnrCo
- For Balance Bubble your character is in a bubble which you use to run on water. Abdominopelvic action in rotational patterns allow you to navigate a river
  - https://www.youtube.com/watch?v=Se44IPPXh0o
- o Therapy Ball: Utilized pelvic mobility, stretching, strengthening, and relaxation exercises performed in all sessions in five different positions (see additional resources in this outline).
  - Each exercise was repeated five times, alternating with PFM contractions which consisted of four series of 10 fast contractions together with four series of 10 sustained contractions, lasting eight seconds each then followed by a 16-second rest interval, maintaining the same positions.

Results:
- Both groups showed significant improvement in PFM strength when assessed by digital palpation ($p<0.05$)
  - o The APT_VR group showed a significant increase in the "average strength" and "endurance" parameters.
  - o The PFMT_GB group showed an increase in the "maximum strength" parameter, which could refer to the power and ability to perform fast contractions.
- Dropout rate:
  - o PFMT_GB lost 33%, APT_VR lost 11%
    - The dropout rate from the PFMT_GB group being >20% and the differential between groups being >15% make this unacceptable and gives the potential for bias
  - o The lower APT_VR dropout rate may suggest that entertainment exercises are better at facilitating adherence, and motivating the continuation of training.

Discussion:
- Only the endurance parameter showed a significant difference between groups. The APT_VR group had a significant improvement after training, while the PFMT_GB group had a significant decrease in the same parameter after training.
- Limitations:

- Limited number of training sessions: 10 training sessions are not enough to develop muscular hypertrophy, hence longer periods of intervention should be encouraged.
- Loss of follow up: In the PFMT_GB group (approximately 33%, n=10). The authors used the intention-to-treat analysis to minimize the bias that this loss caused to the study protocol as well as for the estimation of training effect.
- Vaginal dynamometer equipment: Only measures anteroposterior unidirectional compressive strength. Also, some participants did not undergo PFM assessment by vaginal dynamometry due to their inability to perform the test due to pain/ discomfort when the sensor was introduced.

Conclusion/Summary: Both training protocols improved the overall PFM contraction.

Clinical Application:
- What are the advantages of using a seated program vs standing?
- What are the advantages and limitations of using virtual reality vs the gym ball?
- Is there an investment payoff to administering training with virtual reality?

Other References:

Marques J, Botelho S, Pereira LC, et al. Pelvic floor muscle training program increases muscular contractility during first pregnancy and postpartum: electromyographic study. Neurourol Urodyn. 2013;32(7):998-1003.

1. Inhale through your nose and exhale through the mouth, to trigger the abdominal muscles.

2. Exhale and stretch one leg to the limit. Inhale and return to starting position. Repeat with opposite leg. Time: 3 sets of 10 seconds on each side.
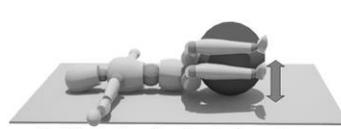
3. Exhale, keeping the body resting on mat, legs turn to the opposite side. Inspire maintaining the position and then exhale the body back to starting position. (Repeat for other side). Time: 5 times on each side..

4. In initial position with flexed hips and legs supported on the ball in the frog position, exhale and make the pelvic dissociation slowly, holding the contraction of the abdomen. Time: 5 times on each side.

5. Exhale and extend hips and legs, moving the ball. Inhale, hold the position, exhale and contraction of the abdomen and PF after return to starting position. Time: 5 times..

6. Exhale, lift your hips up to form a bridge. Inhale and hold the movement. Exhale and return to the ground directing the hip.. Time: 5 times.

7. Exhale and flex the spine, starting the movement for head and rolling the ball with his left hand toward the right foot. Rotate the right arm and extend it back. Exhale and return to starting position. Time: 5 times on each side.
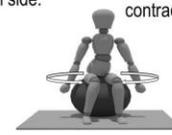
8. Patient in squatting position must perform sustained contraction of PF (contract and release). Time:: 4 series of 10 last contractions.
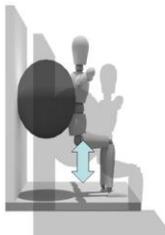
9. Lateral movements, taking the hips from side to side.. Time: 5 times on each side..

10. The patient must make moves with the tailbone back and forth. Time: 5 times in each direction.

11. The patient should rotate your hips clockwise and counterclockwise. Time: 5 times on each side.

12. Standing, the patient should prepare inspirare movement. After it expires, and bend your knees, keeping your feet flat on the ground. Inhale, exhale and extend your knees back to starting position. Time: 1 serie of 8 repetitions.

13. Patient standing, should do pelvic anteversion and retroversion, with recruitment of pelvic floor support. Time: 1 serie of 8 repetitions.
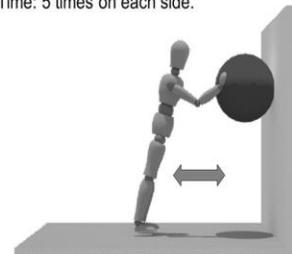
14. Patient with feet hip-width apart with your arms straight, inhale and prepare the motion. Exhale and bend your elbows, moving your body forward and squeeze your toes. Keep the abdominals tight. Time: 5 times.

*Pelvic mobility exercises, stretching, strengthening and relaxation were performed in every session in five different positions (supine, followed by sitting on the floor, then on the Gym Ball, squat and standing position), along with the PFM contractions, which were carried out consisting of four series of ten fast contractions together with four series of ten sustained contractions, lasting eight seconds followed by a sixteen second relaxation, maintaining the same positions .