ICS 2013 Barcelona

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Affiliations to disclose:

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Funding for speaker to attend:

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[ ] Self-funded

[x] Institution (non-industry) funded

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Virtual Reality Rehabilitation for older women with urinary incontinence: The Montreal Experience



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Outline

1. Prevalence and impact of UI in elderly women
2. Physical and cognitive deficiencies related to MUI in older women: The Montreal studies
3. Virtual reality rehabilitation (VRR): The advantages
4. Pelvic floor exercise classes with VRR: The Montreal experience
5. From theory to practice…

Urinary incontinence in elderly women: Prevalence and impact

In women 60 and over:

- 40-55% suffer from UI
- MUI > SUI > UUI
- 20 to 25% suffer from severe symptoms (>10 episodes/week) (Nygaard, 1996)

Urinary incontinence can:

- Be onerously expensive
- Negatively impact QoL
- Result in isolation, decline in ADL
- Increase the risk of falls and nursing home admissions (Resnick, 1989, Nygaard, 1996; Johnson, 1998, Wilson, 2005).

Montreal study 1: The lower-limb strength and balance dysfunction project

Neurourology & Urodynamics;2009:28(7):923.

Dumoulin C.[1,2], Chiva-Razavi S.[2], Elliott V.[1,2], Corriveau H.[3]

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3. School of Rehabilitation, Faculty of Medicine, University of Sherbrooke and Research Center of the Institut Universitaire de Gériatrie de Sherbrooke

Context

- Mixed urinary incontinence has been independently associated with increased falls among aging community-dwelling women.

Aim & Method

Aim: to explore possible relationships between balance or lower-extremity strength and the impact and/or severity of mixed UI in aging community-dwelling women.

Subjects:
- 110 MUI women aged 60 and over

Method:
- Cohort study

Assessment:
- Urogenital Distress Inventory
- Incontinence Impact questionnaire
- Timed Unipedal Stance Test
- Sit-to-Stand Test

Results

Correlation of the UDI, IIQ, UPST dominant, UPST non-dominant and STS in 110 mixed UI women

	UPST dominant	UPST non-dominant	STS
UDI	-0.076 (0.432)	-0.110 (0.256)	-0.196 (0.041)*
IIQ	-0.033 (0.731)	-0.115 (0.230)	-0.186 (0.052)

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.001 level (2-tailed).

Results

Correlation of the UDI, IIQ, UPST dominant, UPST non-dominant and STS in 41 mixed UI women 70 years and older

	UPST dominant	UPST non-dominant	STS
UDI	-0.062 (0.699	-0.026 (0.873)	-0.472 (0.001)**
IIQ	-0.087 (0.589)	-0.108 (0.500)	-0.203 (0.204)

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Conclusion

Poorer leg strength is associated with a greater severity of symptoms in MUI women; especially those 70 years and older.

Special attention should be given to leg strength evaluations and training in older MUI women, particularly those with more severe UI symptoms.

Montreal study 2: Impaired executive function is associated with MUI in older women

Neurourology & Urodynamics; 2010 29(6): 30. Journal of Clinical and Experimental Neuropsychology, May 2013

Dumoulin C.[1,2], Lussier M.[2,3], Corriveau H.[4] Renaud M.[2,3], Bherer L.[2,3]

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Context

- In relatively healthy community-dwelling women, the association between UI and cognition remains ambiguous - some studies support a relationship while others do not.
- However, if there is an association between cognition and UI, it may not be homogeneous among the different types of UI.

Aim & methods

Aim
To study the associations between cognition and the presence of mixed UI.

Method
Design: Cohort study
Subject: 32 continent / 83 MUI

Cognitive assessment

- General Mental Status (MMSE)
- Verbal Intelligence (Similarities WAIS-III)
- Short Term Memory (Empan *forward*)
- Working Memory (Empan *backward*)
- Processing Speed (Digit Symbol test)
- Executive function (Stroop test, Trail A and B)
- Divided attention (Computerized dual-task performance)

Results

			P value
MMSE	28.76 (1.07)	29.06 (1.08)	p > 0.05
Similarity (WAIS-III) (score)	21.64 (5.65)	4.13 (5.60)	p > 0.05
Digit span forward (score)	9.49 (2.30)	9.03 (2.24)	p > 0.05
Digit span backward (score)	6.31 (2.34)	6.25 (1.69)	p > 0.05
Digit coding (score)	62.59 (17.2)	62.91 (11.57)	p > 0.05
Stroop-flexibility (ms)	144.33 (34.03)	126.04 (22.84)	p < 0.01
Stroop-flexibility (errors)	4.98 (4.94)	2.63 (2.15)	p < 0.05
Trail B (ms)	97.35 (39.48)	81.22 (25.96)	p < 0.01
Dual-mixed trials (ms)	1944.16 (505.98)	1744.74 (315.49)	p < 0.05
Dual-mixed trials (% Acc)	95.81 (2.82)	97.46 (2.78)	p < 0.05

Conclusion

MUI women demonstrated poorer cognitive performance on:
- executive function tests
- divided attention tests

Suggesting difficulties in:
- disengaging attention from one task to perform another
- coping with interference

Physiotherapists should consider these dysfunctions when teaching and practicing PFM exercises with older women.

Virtual reality rehabilitation (VRR)

- Virtual reality: Involves real-time simulation of an environment, scenario or activity that allows user to interact via a computer interface such as Nintendo Wii, Sony Playstation, Dance Dance Revolution, or Microsoft Xbox.

Stepmania : dance game

Dance mat

Arrow sequence: beginner level

Participants dancing

Arrow sequence: expert level

Virtual reality rehabilitation (VRR)

Advantages:
1. Has the potential to influence both physical and cognitive abilities in adults
2. Interactive nature
3. Game aspect
4. Enhances motivation
5. Enhances sense of engagement
6. Carry-over to real life (learned behaviour)

Montreal study 3: Virtual reality as a treatment approach for older women with mixed urinary incontinence: a feasibility study

Neurourology & Urodynamics; 2012 31(6): 940-41.

Elliott V. [1], de Bruin E.D. [2], Dumoulin C. [1]

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2.Research Institute of Human Movement Sciences and Sport, ETH, Zurich

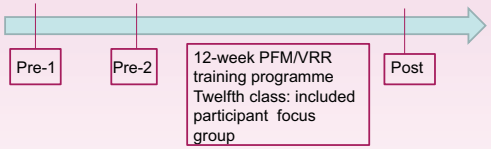
Fonds de la recherche en santé Québec

Aim

- The **primary** objective was to evaluate the feasibility of using VRR to treat mixed urinary incontinence (UI) in women 65 years and older.
- The **second** objective was to evaluate the impact of the VRR pelvic floor muscle (PFM) training program on MUI symptoms, QoL and PFM function.
- Since it was a new intervention, we also wanted to gather qualitative and quantitative information regarding patient satisfaction with the PFM/VRR training programme

Methods

- **Study Design:** quasi-experimental, pre-test, post-test design.



- **Intervention**

Intervention: PFM/VRR training programme

12 consecutive 60-minute weekly exercise class; each class session comprised :

- 10-minute education period on UI
- 30-minute session of static PFM training in different positions
- 20-minute VRR training session using a free open-source software dance game, StepMania.

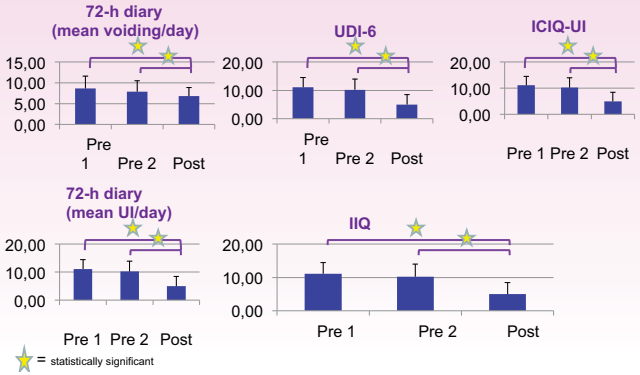
Outcomes

Feasibility	Effectiveness on UI symptoms	Effectiveness on PFM function	Satisfaction
Participation rate for the 12-week PFM/VRR programme	72-h bladder diary	Laycock's PERFECT 6-point scale (0-5).	Satisfaction visual analogue scale (VAS)
Completion rate for the 12-week PFM/VRR programme	UDI-6		Satisfaction & willingness to seek another treatment question
Participation rate for the home exercise program	IIQ		Focus group
	ICIQ-UI		
	1 hour pad test		

Results: feasibility

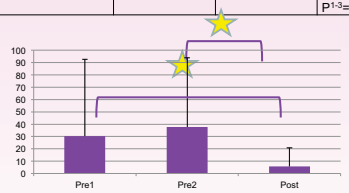
- Participation rate for the weekly treatment sessions: **91%**
- Participation rate for the home exercise program : **92%**
- Completion of the 12-week PFM/VRR programme **96%**

Results: Effectiveness on UI symptoms



Results : effectiveness on UI symptoms

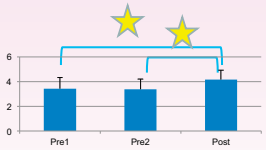
Outcomes	Pre1[1] Mean and SD	Pre2[2] Mean and SD	Post[3] Mean and SD	p-value
One hour pad test	30.42 ± 62.19	37.69 ± 56.23	5,76 ± 14.93	$P^{1\text{-}2}$=0.313 $P^{2\text{-}3}$=0.005* $P^{1\text{-}3}$=0.008*



- Applying a p<0.017 Bonferroni adjustment, the modified one hour pad test changed significantly between pre-1 and post (p=0.008) and pre-2 and post (p=0.005), but not between pre-1 and pre-2 (p=0.313).

Results : effectiveness on PFM function

Outcomes	Pre1[1] Mean and SD	Pre2[2] Mean and SD	Post[3] Mean and SD	p-value
Power	3.41 ± 0.91	3.38 ± 0.82	4.15 ± 0.77	$P^{1\text{-}2}$=0.739 $P^{2\text{-}3}$=0.000* $P^{1\text{-}3}$=0.000*

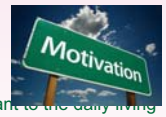


Power

- Applying a p<0.017 Bonferroni adjustment, the P (power of the PERFECT score changed significantly between pre1-post (p=0.000) and pre2-post (p=0.000), but not between pre1-pre2 (p=0.739).

Results: Participant Satisfaction

- Satisfaction visual analogue scale (VAS) (VRR component): **9.8** (±0.5)
- Satisfaction & willingness to seek another treatment question: **91%**



Focus group

"pleasant activity "

"reward at the end of the class "

"the dance game was a dynamic exercise, relevant to the daily living activities "

'I feel more confident that I can contract while walking or dansing''

Conclusion

- This feasibility study demonstrated that:
  - women, aged 65 and over, with mixed UI are capable of complying with PFM/VRR training program demands.
  - the PFM/VRR programme was effective in:
    - reducing UI symptoms, enhancing QoL
    - improving PFM strength
  - the addition of a VRR component may also improve adherence to PFM rehabilitation.

Therefore, a combined PFM/VRR is an acceptable functional training approach for older women with mixed UI.

Montreal study 4: The effect of virtual reality rehabilitation on the gait parameters of older women with mixed urinary incontinence: a feasibility study

Neurourology & Urodynamics; 2012 31(6): 883-84.

Elliott V. [1], Fraser S.[1,2], Chaumillon J. [1], de Bruin E.D. [3], Bherer L. [1,2] Dumoulin C. [1]

1. Research Center of the Institut Universitaire de Gériatrie de Montréal
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3. Research Center, Institute of Human Movement Sciences and Sport, ETH, Zurich

Aim & method

Aim:
To assess whether pelvic floor muscle (PFM) training using VRR affected the gait parameters under a dual task situation for older women with mixed UI.

Method:
Design: quasi-experimental pre-test, post-test design
Subject: 24 women aged 65 and over with mixed UI

Gait assessment:

- **gait velocity:** total distance walked divided by the time it took
- **cadence**: number of steps in one minute, measured by a pedometer
- **step time:** time between the heel strike of one foot to that of the opposite foot; analysed on videotape
- **stride time:** time between the heel strike of two consecutive footfalls of the same foot; analysed on videotape

Aim & method

A 5-meter segment located in the middle of a walking path was videotaped and used to calculate, with Cyberlink PowerDVD™ software, the stride and step times for each participant.

Intervention: PFM/VRR training programme

12 consecutive 60-minute weekly exercise class; each class session comprised :

- 10-minute education period on UI
- 30-minute session of static PFM training in different positions
- 20-minute VRR training session using a free open-source software dance game, StepMania.

Results

Gait parameter outcomes for pre and post PFM/VRR training programme evaluations using paired t-tests

Gait parameters	Pre Mean ± SD	Post Mean ± SD	p-value
Velocity (m/s) Cadence (step/minute)	1.45 ± 0.14 124.20 ± 17.09	1.46 ± 0.15 125.50 ± 12.14	P = 0.929 P = 0.840
Stride time (s)	**0.97 ± 0.02**	**0.95 ± 0.02**	**P = 0.047***
Step time (s)	**0.49 ± 0.02**	**0.48 ± 0.02**	**P = 0.029***
Standard deviation of stride time (s)	**0.05 ± 0.03**	**0.01 ± 0.02**	**P = 0.024***
SD of step time (s)	0.03 ± 0.02	0.02 ± 0.01	P = 0.320

Conclusion

The PFM/VRR training programme is effective in reducing gait variability.

A combined PFM/VRR training programme that addresses LE function could improve gait performance in walking for older women with mixed UI, thereby, reducing the risk of falls in this population.

Montreal study 5: Virtual reality rehabilitation improves dual-task walking ability in older women with mixed urinary incontinence

Neurourology & Urodynamics; 2012 31(6): 973-74.

Fraser S.[1,2], Elliott V. [1], de Bruin E.D. [3], Bherer L. [1,2] Dumoulin C. [1]

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Aim & methods

Aim:

To evaluate the effect of pelvic floor muscle (PFM) training, employing a virtual reality rehabilitation (VRR) component, on the ability of older women with mixed urinary incontinence (UI) to perform a cognitive task while walking.

Method:

Design: quasi-experimental pre-test, post-test design

Subject: 24 women aged 65 and over with mixed UI

Assessment:

- Three assessment times: pre-1, pre-2 and post-treatment
- 2-back task in the sitting position (ST: SINGLE TASK)
- 2-back task while walking (DT: DUAL TASK)

Intervention

Results

The means and standard deviations (SD) of the 2-back DTCs, prior to and after the PFM/VRR programme

	Pre1 Mean ± SD	Pre2 Mean ± SD	Post Mean ± SD	P-value
2-back error DTC	-0.62 ± 1.64	-1.07 ± 1.22	0.30 ± 1.88	P^{1-2}=0.14 P^{2-3}=0.022*

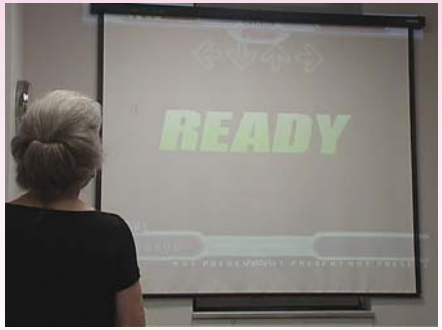
**Note*: A negative DTC indicates that more errors were made in the dual task than in the single task.

The 2-back error DTC diminished significantly over time for the entire sample [F (2, 21) = 3.667; p = 0.034; η^2 = 0.14].

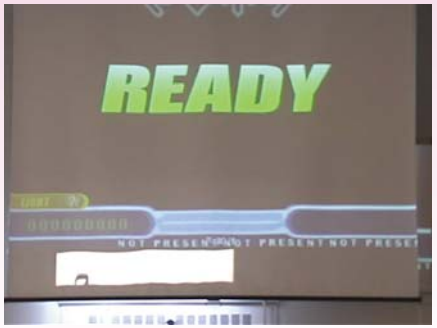
Conclusion

A combined, more dynamic, PFM/VRR training programme that addresses cognitive functions and physical rehabilitation could improve cognitive performance while walking in older women with mixed UI.

Let's dance …



Let's dance …Beginners



Let’s dance …Advanced

And now for your questions …