A novel device for assessing pelvic floor muscle function in

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women



Background

- Urinary Incontinence
 - Young women: <5 to 30%
 - Highly active young women: ≤35%
 - Middle-age women: 30-40%
 - Post-menopausal women: 30-50%
- Prolapse
 - ≈50% of women over age 50
 - 11-19% of women will require surgery
 - 1/3 will have at least one re-operation
- PFM exercise: First line treatment







Data source: 1996/97 National Population Health Survey, cross-sectional sample, Health file † Estimated as difference in mean Health Utilities Index (HUI3) score between those with and without condition, adjusted for age and all other conditions ($p \le 0.05$). ‡ Respondents aged 12 to 19 with "not applicable" code were assigned to "no" group.

Health Reports, Vol. 14, No. 4, August 2003

Statistics Canada, Catalogue 82-003





Research Problem

- Urinary incontinence is a motor control problem
- Limitations of current devices







Purpose

 To test the feasibility and reliability of a novel device for recording PFM EMG and vaginal pressures simultaneously.





Methods - Design

- Self retaining & comfortable
- 3 pairs of EMG electrodes
 - Centred at 3, 12 & 9 o'clock
 - Coupled with Delsys miniTrigno[™] electrodes
- 2 pressure sensors
 - Proximal & distal at 6 o'clock
 - Freescale Semiconductor MPX2300DT pressure transducers





• Interfaced with Trigno[™] load cell adaptors.



Methods – Reliability Testing

- Subjects: Female pelvic floor physiotherapists
- Test-Retest design
 - 2 one-hour testing sessions, 1 week apart
- Tasks: PFM MVC & Coughing
 - Supine & Standing, 3 trials each





Methods – Data Processing & Analyses

- Pressure and EMG recorded simultaneously at 2000 Hz
- EMG: RMS 200ms sliding window, 199 ms overlap
- Peak values extracted

- Channel independence
 - Pressure: cross-correlation
 - ANOVA, nMAD
- Between trial reliability
 - ANOVA, coefficients of variation
- Between day reliability
 - ANOVA, Spearman's rho, nMAD



Results: Participants

- 8 women
- Mean age 42
- 4 nulliparous
- 4 parous

median 3 (2-5) births

4 urinary incontinence

3 stress predominant

Device was comfortable and stayed in place



Results: Data Quality





Results: Channel Independence

- Pressure:
 - PFM MVC PFM>IAP,
 - Standing cough IAP>PFP
 - No time lag IAP vs.
 PFP

- EMG:
 - R>L
 - nMAD

Supine MVC	28.67%			
Standing MVC	41.31%			

- Supine Cough 40.75%
- Standing Cough 48.50%





Results: Between Trial

 No between trial differences in either EMG or pressure for either task or position

Task	Μ	IVC	Co	Cough	
Position	Supine	Standing	Supine	Standing	
Channel					
IAP day 1	31.16%		21.32%	19.37%	
IAP day 2	27.83%	19.36%	22.38%		
PFP day 1	56.34%	61.20%	51.08%	41.86%	
PFP day 2	69.03%	59.61%	67.63%	47.89%	
PFM_R	37.5%	18.75%	45.16%	28.57%	
PFM_L	72.0%	94.12%	41.66%	53.33%	



Results: Between Day

- EMG no between day differences
- Pressure

PFP day 1 < day 2

IAP – Supine only, MVC day 1 < day 2, Cough day 1 > day 2

Task	M	VC	Со	ugh	MVC		Cough	
Position	Supine	Standing	Supine	Standing	Supine	Standing	Supine	Standing
Channel	Spearman's Rho				nMAD			
IAP	0.43	0.79	0.89	0.82	20%	10.45%	10.80%	8.34%
PFP	0.82	0.86	0.82	0.71	32.29%	18.77%	29.97%	25.55%
PFM_R	1.00	0.97	0.50	0.53	16.03%	3.09%	21.41%	13.48%
PFM_L	0.72	0.83	0.61	0.37	32.54%	46.76%	52.85%	29.17%



Conclusions

- Pressure sensors and EMG channels clearly independent
- Between trial repeatability is acceptable
- Between day repeatability is acceptable
 - No difference in PFM EMG amplitudes
 - Pressure differences suggest learning or functional adaptation
- Standing seems to be more reliable than supine



Where next?

- Lifting
- Jumping
- Running









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THANK YOU

Angelica Lang, School of Rehabilitation Science, College of Medicine; Gordon Sarty, Biomedical Engineering, College of Arts and Science;

Bob Wilson, College of Engineering, Mechanical Engineering Shops