Measurement of pelvic floor muscle function with manometry and surface EMG

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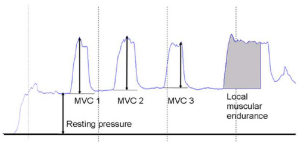
Introduction

Measurement of pelvic floor muscle (PFM) function using validated measurement tools is important for clinicians and researchers involved in the conservative treatment of pelvic floor disorders. Electromyography (EMG) and manometry can provide important information about PFM function such as: resting values, maximum contraction and endurance/ mean hold. EMG measures muscle activation whereas manometry measures changes in vaginal pressure which is considered the gold standard for measurement of PFM strength (1). The overall purpose of the study was to evaluate if the less expensive, newer and easier available method, surface EMG (sEMG,) can be used instead of manometry. We aimed to validate the sEMG by exploring the relationship between the two devices, analyze the test-retest reliability of sEMG, and evaluate the ability of both measurement devices to detect changes in PFM function.

Methods and Materials

These cross-sectional and longitudinal studies included women seeking treatment by a Women's Health Physical Therapist. Participants answered a questionnaire including symptoms of pelvic organ prolapse, urinary- and fecal incontinence, and bowel- and sexual function. Ability to perform a PFM contraction was assessed by visual observation of an inward lift of the perineum and confirmed by vaginal palpation (1). PFM function (resting value, maximum voluntary contraction and endurance) was assessed by manometry first, and on one occasion only (Camtech AS) (Fig 1). Two testing sessions with vaginal sEMG followed (MyoPlusPro) (Fig 2). Participants who returned for follow-up appointments after supervised pelvic floor muscle training (PFMT) were tested with both devices. The physical therapist who performed all tests was blinded to background variables and to the results of the first examination during the follow-up visit.

Statistical analyses were performed using SPSS 25. Results are given as frequencies and percentages, and means with standard deviation (SD) or 95% confidence intervals (CI). The relationship between manometry and sEMG was investigated using Spearman's rho due to the data not being normally distributed. We considered a correlation > 0.5 as large (2). Intra-rater reliability of the sEMG was analyzed using the intra-class correlation coefficient (ICC $_{2,1}$) using a two-way mixed model for absolute agreement with 95% CI. ICC values under 0.20 were considered poor, 0.21– 0.40 fair, 0.41–0.60 moderate, 0.61–0.80 good, and 0.81–1.00 very good (3). A paired-samples t-test was conducted to evaluate the change in PFM function between test 1 and 2



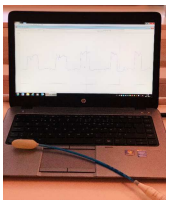


Figure 1. Manometry. Camtech AS with a balloon catheter. Maximum voluntary contraction (MVC)

Table 1. Pelvic floor muscle function measured as resting value, maximum voluntary contraction (MVC) and endurance hold using manometry (cmH_2O) and sEMG (µV) at test day 1 (n=66) and at follow-up visit (n=29). Values are given as mean with SD.

	Test day 1 Manometry	Test day 1 sEMG_1	Test day 1 sEMG_2	Follow-up visit Manometry	Follow-up visit sEMG
Resting value	29.4 ± 8.6	7.2 ± 3.7	6.8 ± 3.5	30.7 ± 8.1	5.9 ± 3.2
MVC	23.2 ± 16.4	91.7 ± 68.1	85.3 ± 51.3	28.2 ± 17.0	102.0 ± 68.3
Endurance	165 ± 129	31.6 ± 19.9	32.6 ± 21.1	228 ± 157	30.8 ± 18.9

Results

Sixty-six women, mean age 45 years (range 24-84) and mean parity of 2.2 (range 0-10) participated in the studies. Urinary incontinence was reported by 59 women with a mean score of 11.5 (SD 4.8) on the International Consultation on Incontinence Questionnaire -Urinary Incontinence Short Form (ICIQ-UI SF). Stress urinary incontinence was reported by 56 (85%), urgency urinary incontinence by 26 (39%), pelvic organ prolapse symptoms (vaginal bulging) by 34 (52%), bowel urgency by 33 (50%), fecal incontinence by 3 (4.5%), and sexual dysfunction by 53 (80%).

The measurement values for manometry and sEMG at test day 1 and at follow-up visit are presented in Table1. The relationship between manometry and sEMG was strong for maximum contraction (r=0.66, n=66, p>.001) and for endurance/ mean hold (r = 0.67, n=66, p>.001). For the resting value it was moderate (r = 0.42, n=66, p<.001).

57 were tested twice with sEMG on test day 1 (Table 2). Very good test-retest reliability was found for all sEMG measurements (resting sEMG value ICC= 0.90, 95%CI 0.84-0.94; sEMG max contraction ICC=0.86, 96%CI 0.78-9.2; sEMG mean hold ICC=0.99, 95%CI 0.99-1.00).

After performing supervised PFMT 29 women were retested (Table 1). The time difference between the tests was 4 to 42 weeks (mean 16.4 ± 9.7). There was no statistically significant correlation between changes in PFM function measured with manometry compared to sEMG (p=0.09-0.87). A significant increase in PFM strength (7.0 cmH_2O, 95%CI 4.9 – 9.2, p<.001) and endurance (74 cmH_2Osec, 95% CI 48 – 99, p<.001) measured with manometry was found from test 1 to the follow-up visit, but this could not be confirmed by sEMG. A decrease in the resting value measured with sEMG (1.5 µV, 95%CI 0.25 – 2.7, p=.02) was found, but not with manometry.

Table 2. Test-retest reliability for sEMG measurements of PFM function showing results, smallest detectable change (SDC) and standard error of measurement (SEM). Numbers are gives as mean with standard deviation (SD) and 95% confidence interval (CI). N=57

Test day 1	sEMG 1 (µV)	sEMG 2 (µV)	Difference (95%CI)	SD diff	p-value	SEM (µV)	SDC (µV)
Resting value	7.1 ± 3.8	6.8 ± 3.5	0.3 (-0.9 – 0.7)	1.60	0.125	1.12	3.11
MVC	89.9 ± 62.8	85.3 ± 51.3	4.6 (-3.3 – 12.6)	29.98	0.250	21.20	58.76
Endurance	32.6 ± 20.9	32.6 ± 21.1	0.007 (-0.9 – 0.9)	3.43	0.988	2.43	5.44

Discussion

Surface EMG can assist teaching women with pelvic floor disorders how to contract and relax the PFM. The method is easy available, reliable and correlates well with manometry. However, sEMG is not as responsive as manometry for changes in PFM strength and endurance.

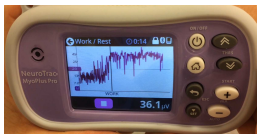


Figure 2 Surface EMG. NeuroTrac MyoPlusPro with Periform vaginal elecrode.

Conclusions

Manometry is the superior measurement tool for clinicians and researchers to use given its ability to measure change in PFM function. Surface EMG is user friendly and reliable and can be used to assess muscle activity. However, sEMG cannot replace manometry.

References

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