

CLINICAL PAPER

The benefits of pelvic floor muscle training in people with multiple sclerosis and lower urinary tract dysfunction

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Abstract

The aim of this study was to determine whether pelvic floor muscle (PFM) training (PFMT) improves lower urinary tract function in people with multiple sclerosis (MS). Thirty-seven subjects (11 males and 26 females) with a definite diagnosis of MS were recruited from neurological outpatient departments and MS charities throughout Northern Ireland. The participants received individualized PFMT combined with electromyography (EMG) biofeedback for 9 weeks. These individuals served as the control group in a double-blind randomized controlled trial (RCT) of the effects of neuromuscular electrical stimulation on bladder dysfunction in people with MS. The outcome measures included: digital and EMG biofeedback assessment of the PFMs; the number of leakage episodes (bladder diary); the amount of leakage (pad test); uroflowmetry; the International Prostate Symptom Score; and a Visual Analogue Scale relating to the problems associated with the symptoms. The results of the RCT demonstrated that improvement in the strength and endurance of these muscles was possible, and a significant reduction in symptoms was evident. A 9-week PFMT programme improved the function of the PFMs, reduced the symptoms associated with lower urinary tract dysfunction and increased quality of life in people with MS.

Keywords: lower urinary tract dysfunction, multiple sclerosis, pelvic floor muscle training.

Introduction

Lower urinary tract dysfunction can affect up to 84% of people with multiple sclerosis (MS), the symptoms being dependent on the site, extent and evolution of the lesions (Hadjimichael 2002). Unlike the non-neurogenic population, incontinence within a neurological population may be a result of dysfunction of the detrusor, dysfunction of the sphincter or a combination of these factors; therefore, storage problems,

leading to incontinence, may be associated with emptying problems, and both must be considered at the same time.

Pelvic floor muscle (PFM) training (PFMT) is defined as repetitive selective voluntary contraction and relaxation of specific muscles (Abrams *et al.* 2002), and aims to make changes in a non-optimally functioning pelvic floor by improving the force generation, incorrect timing or coordination of the PFMs (Bø & Sherburn 2005). The latter authors also stated that, because the PFMs are untrained in most people, an appropriate training programme should produce a change in PFM function or force,

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even in the presence of tissue pathology (e.g. neuropathy).

Fowler (2004) stated that there is experimental evidence from patients with detrusor overactivity that points to an inhibitory effect on the detrusor resulting from contraction of the PFMs and urethral sphincter (de Groat *et al.* 2001). Pelvic floor muscle contraction results in an increase in outlet pressure as well as a reduction in the pressure within the bladder, and also a reduction in the sensation of urgency.

Fowler (2004) proposed to term this phenomenon the 'procontinence' reaction. If this concept of a 'procontinence' reaction, which involves the contraction of the pelvic floor or urethral sphincter, leading to an inhibitory effect on the detrusor, is correct, then the enhancement of this inhibitory reflex would lead to improved voluntary control of micturition. This is also called the perineal-detrusor inhibitory reflex (Mahoney *et al.* 1997; Shafik & Shafik 2003). Retraining of the voluntary external urethral sphincter and PFMs, and educating the patient when to apply the technique, would possibly lead to the development of an automatic response. Although this may be a segmental reflex, it can be initiated by voluntary output, and it is probably via this mechanism that pelvic floor therapy has an effect in treating urge incontinence (Fowler 2004). For this reason, it can be postulated that, by increasing the strength and endurance of these muscles, detrusor overactivity could be brought under control.

Whether it is possible to improve the strength, endurance or coordination of partially denervated muscle, or to inhibit neurogenic detrusor overactivity by contraction of the neurologically impaired PFMs, has not been definitively established; however, according to Laycock (2002) PFMT should benefit those patients with weak musculature and will probably work better for patients with mild to moderate neurological symptoms.

A review, undertaken by the present authors, of the literature on the use of PFMT within the neurogenic population identified few high-quality research articles. However, one paper reported possible benefits in patients who had suffered a stroke (Tibaek *et al.* 2004), and two small studies reported possible benefits in people with MS (Klarskov *et al.* 1994; Fried *et al.* 1995). Several other publications reported some benefits following the use of PFMT and electrical stimulation (Primus 1992; Primus & Kramer 1996; Vahtera *et al.* 1997; De Ridder *et al.*

1999). More recently, a report from the 3rd International Consultation on Incontinence (Wyndaele *et al.* 2005), which was the only review found that pertained to neurologic urinary and faecal incontinence, concluded that behavioural techniques, which incorporate PFM exercises to control urgency, would seem to be beneficial for 'most neurological patients in one way or another', but there was no consensus on either a definition of the technique or the population that can benefit from such interventions.

Therefore, the objective of the present study was to assess if it was possible to improve PFM function in people with MS, and to report associated improvements in bladder dysfunction and quality of life.

Subjects and methods

Participants

To be eligible for the present study, the participants had to have a diagnosis of MS with the disease stabilized for the previous 3 months, be over 18 years of age, be able to transfer independently (Expanded Disability Status Scale <7.5; Kurtzke 1983), and have sufficient dexterity to enable completion of assessments and treatment protocols. Individuals were included if they presented with at least one of the following: any involuntary leakage of urine; a voiding frequency of >8 per 24 h (Stöhrer *et al.* 1999); nocturia; and/or reported voiding dysfunction, such as hesitancy, straining, poor stream and incomplete emptying, demonstrated during uroflowmetry, with measurement of post-void residual urine volume. Participants were excluded if they had suffered a MS relapse necessitating hospitalization 3 months prior to, or during, the study. The other exclusions were symptomatic prolapse, previous or current treatment for prostatic hyperplasia, the presence of an urinary tract infection, current or recent diagnosis of a serious medical condition (other than MS), and severe cognitive impairment.

Recruitment was by self-referral in response to advertising via MS charities and hospital outpatient departments. Treatment was conducted in 12 healthcare facilities throughout Northern Ireland. Ethical approval was granted by the University of Ulster's Research Ethical Committee. All subjects ($n=37$; 11 males, 26 females) were provided with written and verbal information about the trial, and gave written

informed consent. Thirty-six participants completed the study.

Procedures

The intervention period was for 9 weeks, with participants attending weekly clinics and performing daily PFM exercises at home.

At week 1, PFM function was assessed during a vaginal/anal assessment and graded according to the Modified Oxford Scale (MOS; Laycock & Jerwood 2001). Electromyography (EMG) biofeedback was also performed using a Periform (female) or Anuform (male) electrode (Neen Healthcare, Oldham, UK), Aquagel lubricating couplant (Adams, Leeds, UK) and a NeuroTrac[™] ETS unit (Verity Medical Ltd, Stockbridge, Hampshire, UK). During subsequent weekly visits to the clinic, EMG biofeedback was undertaken with participants in the half-lying supine position and one pillow under their knees. The monitor was positioned to facilitate viewing of the graphical feedback; an audio feedback system was set to sound when a certain level was attained and verbal encouragement with an overall focus on building endurance at submaximal strength was provided. Excessive use of strength was discouraged because this tended to induce fatigue and difficulty with isolating the PFM.

Based on the initial vaginal assessment, participants were instructed to perform daily PFM exercises at home, and were provided with a written regimen and a record card to record compliance. The exercise regimen was reviewed weekly. A typical programme would have commenced with a holding time of 3 s, with 5 s rest, repeated five times, five times a day. This would have been gradually increased according to the feedback, to holding submaximally for 10 s, with a 5-s rest, five times, five times a day.

The recruitment and progress of participants are shown in Fig. 1. Demographic details are provided in Table 1.

Outcome measures

The outcome measures were recorded blind by an independent researcher at baseline, and at weeks 9, 16 and 24; these included:

- (1) digital assessment of the strength and endurance by the MOS, as verified by Laycock & Jerwood (2001);
- (2) EMG biofeedback, which measures the electrical correlate of the muscle contraction, and can provide an overview of the

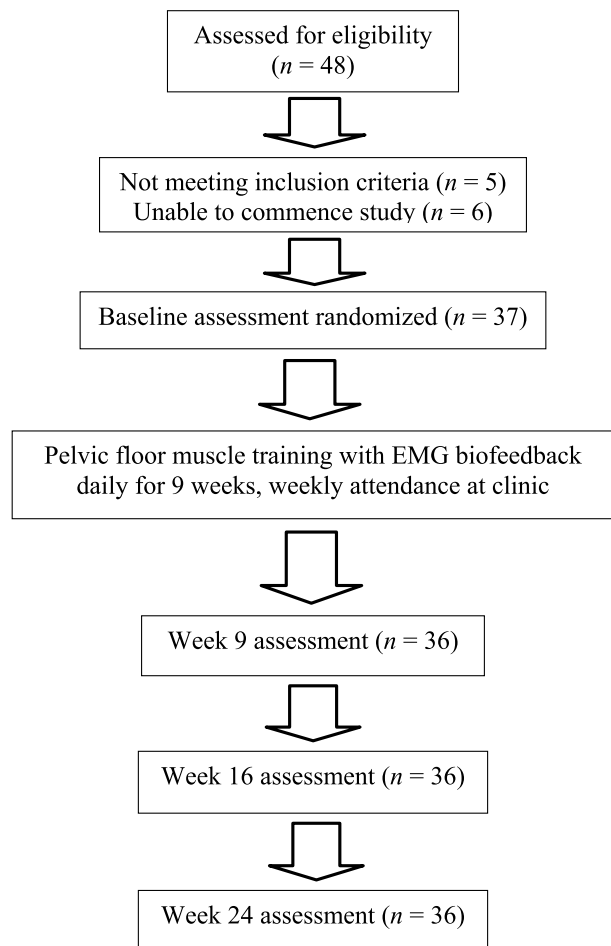


Figure 1. Recruitment and progress of participants: (EMG) electromyography.

relaxation and contraction phases of PFM activity (Haslam 2002);

- (3) symptomatic relief, which was measured using a 3-day bladder diary that recorded the number of leakage episodes (Schäfer *et al.* 2002), a 24-h pad test (Siltberg *et al.* 1997) and uroflowmetry with measurement of post-void residual urine volume; and
- (4) patient perspective and quality of life, which were measured using the International Prostate Symptom Score (IPSS; Barry *et al.* 1992) and a Visual Analogue Score (VAS) relating to problems associated with the symptoms.

A full description of these outcome measures has been previously published (McClurg *et al.* 2008).

Data analysis

Data were analysed using the SPSS, Version 11, statistical package (SPSS Inc. Chicago, IL, USA). The analysis was by intention to treat. Week 0 data were compared using a one-way analysis of variance. All within-group data

Table 1. Demographic details

Variable	Value
Subjects (<i>n</i>):	
female	26
male	11
total	37
Age (years):	
mean ± SD	52.0 ± 8.8
range	27–72
Body Mass Index (kg/m ²):	
mean ± SD	23.3 ± 8.9
range	15–23
Expanded Standard Disability Status Scale score:	
mean ± SD	4.9 ± 1.4
range	3.5–7.5
Time since diagnosis (years):	
mean ± SD	11.0 ± 7.6
range	1–32
Type of multiple sclerosis (<i>n</i>):	
relapsing remitting	13
primary progressive	8
secondary progressive	16
Smoking status (<i>n</i>):	
non-smokers	28
smokers	9
Intermittent self-catheterization routinely used (<i>n</i>)	8
Use of anticholinergic medication (<i>n</i>)	11

were analysed using a paired sample *t*-test. The primary analysis was conducted on week 9 data using a paired sample *t*-test and a significance level of 0.05 was set.

Results

Digital assessment

The initial digital assessment (Fig. 2) of the subjects demonstrated that seven females ($n=26$) could not perform a PFM contraction, while all the males could ($n=11$). At baseline, the average grade was 1 on the MOS (a flicker or pulsing under the examining finger – a very weak contraction) and the average endurance was 2 s. Following digital, audio and visual feedback, the results showed that five women were still unable to voluntarily contract their PFM. However, the average increase for the total population was one grade (MOS), and there was an increase in endurance of 4.5 s, as measured by digital examination. These increases were both statistically significant ($P=0.001$) and were largely maintained at follow-up (at weeks 16 and 24).

Electromyography biofeedback

Details of the EMG biofeedback results are shown in Fig. 3.

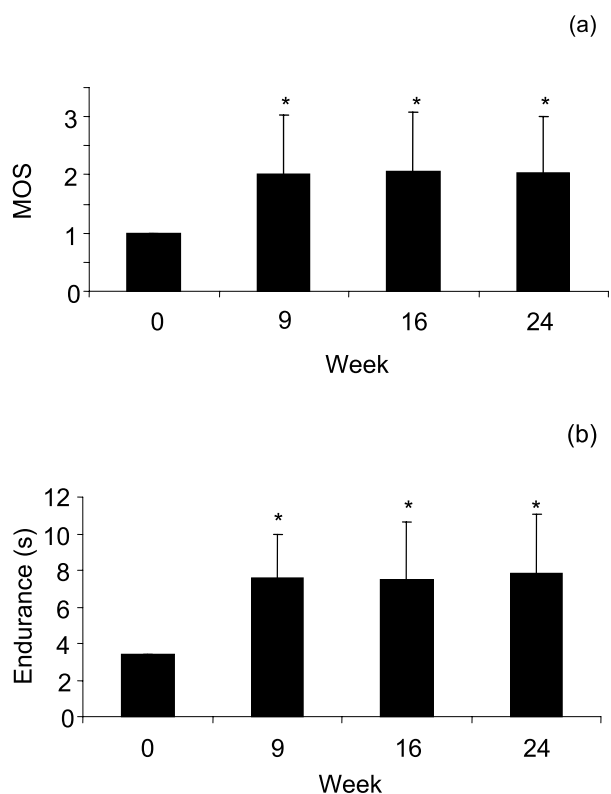


Figure 2. Digital assessment of pelvic floor muscle assessment: (a) power; and (b) endurance. Key: (MOS) Modified Oxford Scale; and (*) statistically significant change from baseline ($P=0.001$).

Contraction (work). There was a slight, non-significant improvement in the contraction phase of the EMG biofeedback that was maintained throughout the study.

Relaxation (rest). A slight, non-significant reduction in EMG biofeedback was evident throughout the study.

Endurance. The time for which a 50% maximum contraction could be held was also measured. At the end of the treatment phase, a significant ($P=0.001$) increase in endurance was demonstrated and this was maintained at follow-up.

Bladder diary

Daily leakage episodes. Results for the number of episodes of leakage per 24 h, as recorded in the 3-day bladder diary, demonstrated a reduction of 47% ($P=0.001$). This significant improvement was maintained at follow-up (Fig. 4).

Frequency. Following the 9-week intervention period, an 18% reduction in frequency ($P=0.001$) was demonstrated and this was largely maintained throughout the study (an average reduction of from nine to seven voids).

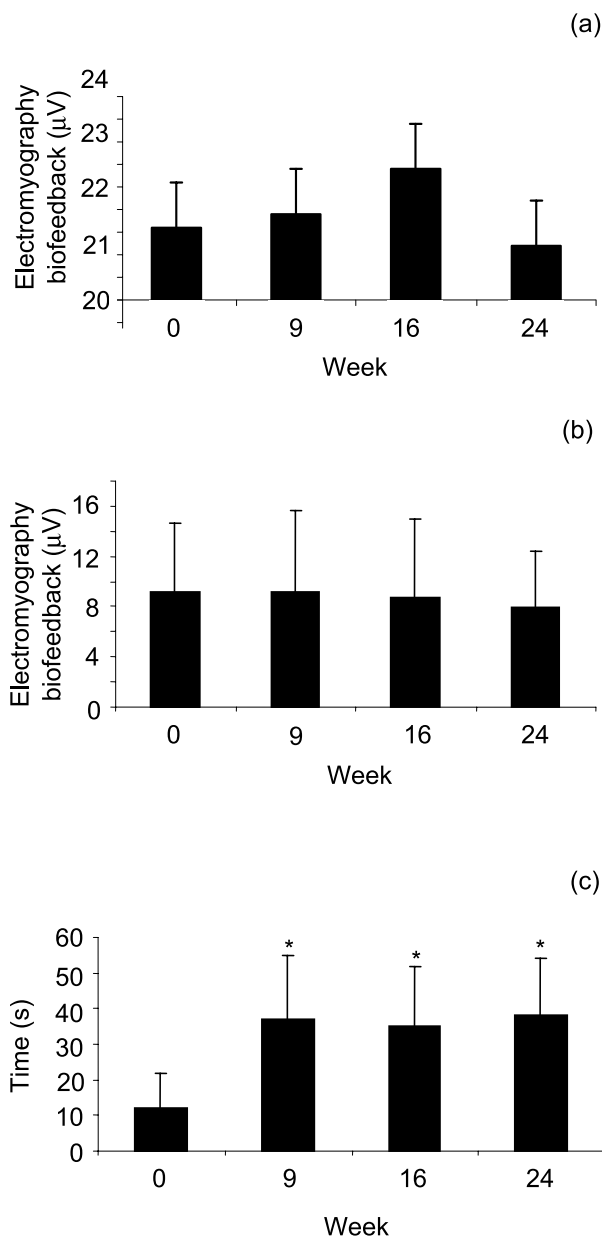


Figure 3. Electromyography biofeedback: (a) contraction; (b) relaxation; and (c) endurance. Key: (*) statistically significant change from baseline ($P=0.001$).

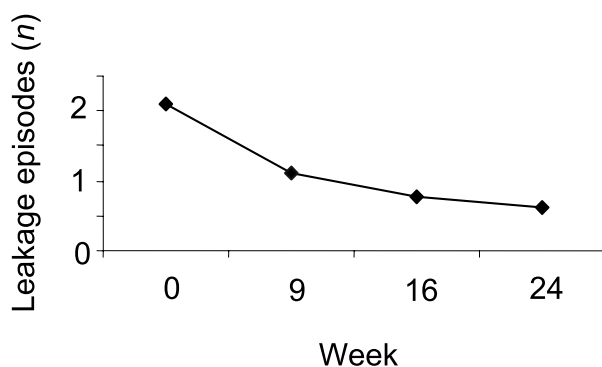


Figure 4. Number of leakage episodes: statistically significant reduction at all time points ($P=0.001$).

Nocturia. By week 9, a 53% reduction in night voids ($P=0.001$) was demonstrated and this was maintained at follow-up (an average reduction of from 1.5 to 0.5 voids).

Twenty-four-hour pad test

Results for the pad test demonstrated a 41% reduction ($P=0.001$) in the amount of leakage at the end of the treatment period and this was again largely maintained throughout the study.

Uroflowmetry

By week 9, the uroflowmetry results demonstrated an improvement in bladder emptying. Non-significant improvements in maximum flow rate (Q_{max}) and post-void residual urine volumes were noted ($P>0.05$), and a significant improvement in volume voided was evident ($P<0.05$). These improvements in voiding ability were maintained at follow-up.

International Prostate Symptom Score

By week 9, a statistically significant reduction in the IPSS score was demonstrated ($P=0.001$) and this was maintained at the end of the study period.

Visual Analogue Scale

A significant reduction in the problems related to bladder dysfunction was demonstrated throughout the study ($P=0.001$).

Summary

It was evident from the results that the endurance of the PFM's could be significantly improved with exercise, and these changes had a positive effect with an associated reduction in leakage and an improvement in quality of life.

Discussion

The aim of the present study was to determine if it is beneficial to patients with MS and bladder dysfunction to undertake a course of PFMT. To the authors' knowledge, this has not been definitively established in previous studies.

The function of the PFM's has been shown to be impaired in MS (Jameson *et al.* 1994; De Ridder *et al.* 1998, 1999), and it has been suggested that this impairment is an important factor in the pathogenesis of urinary and faecal problems in this population (De Ridder *et al.* 1998). In the present study, the EMG biofeed-

back activity recorded at baseline appeared to agree with previous findings on palpation, whereby a weakness of contraction in nearly all the participants has been demonstrated, together with poor endurance and exhaustibility of muscle. It was also apparent that those subjects with severe leakage had poorer contraction strength and endurance, while those with no leaks demonstrated a slightly higher resting tone on EMG biofeedback, perhaps indicating poor pelvic floor relaxation.

The present results demonstrate that the function of PFM of people with MS can be improved with an appropriate training programme. Vaginal palpation is used to ensure correct technique, and measure strength and endurance. According to Bø & Sherburn (2005), vaginal palpation is currently the technique used by most physiotherapists to evaluate correct PFM contraction, and such measurements, taken before and after training, can determine whether the intervention has caused changes. The above authors also stated that, even in the presence of tissue pathology (e.g. neuropathy), if there is no change in PFM function or force development after a training programme commensurate with that pathology, then training has been insufficient, or the participants have failed to adhere to the programme. In the present study, the strength and endurance of the PFMs, as measured by vaginal palpation, improved significantly ($P=0.001$). Fried *et al.* (1995) also reported a statistically significant association between increased PFM contraction duration and a reduction in incontinence episodes in a neurogenic population.

Electromyography biofeedback also improved, with a significant increase in endurance ($P<0.05$) being evident at 50% of maximum voluntary contraction. It was noted that the increase in strength, as measured by digital assessment, was significant, whereas the increase in EMG biofeedback was not. This may be because EMG biofeedback records the bioelectrical activity of the muscle; it does not measure the muscle contractility itself, but the electrical correlate of the muscle contraction. It is an electrical and not a kinetic measurement, and as such, is an indicator of the physiological activity and not the actual activity itself. Pelvic floor muscle training aims to improve the synchronicity of motor unit activity; thus, a patient will not necessarily increase their microvolt output, but may improve functionality by gaining better control of the coordination and timing, and EMG bio-

feedback enables the patient to visualize the changes in their PFM contraction (Haslam 2007).

Relief of the distressing symptoms of neurogenic detrusor overactivity was evident. Incontinent episodes and pad test weight were both reduced by over 40% ($P=0.001$) following the 9 weeks of intensive training; furthermore, these reductions were maintained at 6 months. Frequency and nocturia were also reduced significantly ($P=0.001$). Interestingly, there also seemed to be an improvement in voiding ability, with a significant reduction in the post-void residual urine volumes ($P<0.05$), and non-significant increases in Q_{\max} and voided volume ($P>0.05$), as recorded at uroflowmetry.

From assessments at baseline, it was evident that the symptoms of male and female patients were slightly different within this population sample. Males tended to have less leakage, similar frequency and urgency, but more voiding dysfunction. Following the treatment period, however, there was an improvement in these symptoms, as demonstrated by the results of the uroflowmetry. This improvement in bladder emptying may be a result of several factors, such as a better relaxation of the PFMs, improved voiding positioning and the use of the double void technique.

From anecdotal reports from the participants and the significant reduction in the IPSS ($P=0.001$) and VAS scores ($P<0.05$), it was evident that the decrease in symptoms translated into a better quality of life.

Conclusion

Fifty per cent of people with MS will develop bladder dysfunction within 3–5 years of their diagnosis (Nortvedt *et al.* 2007) and PFM training may help to reduce the devastating symptoms of this condition. It would seem practicable to include some form of PFMT as standard in a rehabilitative programme and, if necessary, direct referral to a specialist continence physiotherapist should be offered.

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