Pelvic Floor Muscle Resting Tone in Children With Dysfunctional Voiding Symptomology Following Simple Gross Motor Exercises

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Purpose: The study aimed to understand the effects of a set of simple gross motor exercises on pelvic floor muscle (PFM) resting tone (RT) in children with dysfunctional voiding symptomology.

Methods: The study compared PFM RT for a single-sample before and after 2 protocols: exercise versus relaxation (metric standard).

Results: Participants included 27 children ages 5.00 to 10.92 years. Preintervention PFM RT was similar between the interventions: 63% (exercise) and 78% (relaxation) of children decreased PFM RT following intervention. Between-intervention post-minus-prechanges in PFM RT were compared. Between-intervention differences were similar.

Conclusions: Exercise and relaxation protocols were comparable in lowering PFM RT in children with voiding dysfunction. Findings are clinically worthy in that either exercises or relaxation prior to toileting may assist with more complete emptying in children with symptoms. (Pediatr Phys Ther 2021;000:1–8)

Key words: children, exercise, incontinence

INTRODUCTION AND PURPOSE

Childhood incontinence is a relatively common occurrence, with daytime incontinence experienced by 15% of 4.5-year-olds and 5% of all 9.5-year-olds.[1] Nocturnal enuresis is reported in 15.5% of 7.5-year-olds.[2] Pediatric voiding dysfunctions are organic in nature, with underlying neurogenic or non-neuropathic causes and with or without anatomical/structural anomalies. Dysfunctional voiding is characterized by a staccato uroflow pattern. In these cases, incomplete relaxation of the pelvic floor muscles (PFMs) and sphincters while emptying the bladder results in incomplete bladder and/or bowel emptying.[3]

Voiding dysfunctions may also be referred to as dysfunctional elimination syndrome or bladder and bowel dysfunction.[4] Active bowel dysfunction, especially functional constipation with or without encopresis, is strongly associated with dysfunctional voiding.[5] Among the health risks associated with voiding dysfunctions is recurrent urinary tract infections (UTI), which can manifest as kidney problems in the long term.

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Pelvic Floor Muscle Function

The muscles of the pelvic floor span the underlying surface of the pelvis. These muscles form a thick muscle sheath spanning from the pubis to the coccyx. The urethra, anal canal, and, in females, the vagina pass through this muscle sheath. Pelvic floor muscles are especially important for the following functions: supporting organ systems within the pelvis and lower abdomen; closing the urethra and anal canal for continence; signaling the bladder, rectum, and colon when either voiding or defecating is to take place; and opening the urethra and anal canal by relaxing PFMs.[6]

Pelvic floor muscles are under voluntary control, unlike the smooth muscles of the bladder, colon, and rectum. A feature of these muscles is their ability to inhibit smooth muscle involuntary contraction through voluntary muscle control. Coordination of these muscle functions is essential to proper bowel and bladder functioning. Too much PFM tone (or tension) can lead to dysfunction such as constipation, incomplete fecal evacuation, and straining with defecation.[6] Too little PFM tone can result in symptoms such as increased voiding frequency,[7] voiding hesitancy,[6] holding maneuvers,[5,7] interrupted stream,[6] vesicoureteral reflux,[7] painful urination,[6] UTIs,[7] and urinary urge.[6,7]

Diaphragmatic Breathing and Pelvic Floor Relaxation

Pelvic floor muscles form an aspect of the abdominal capsule that includes the thoracic diaphragm and abdominal muscles. The relaxation of lower abdominal muscles is important, since these muscles act synergistically with the PFMs during voiding and defecation.[8] It is known that diaphragmatic motion is altered by PFM contraction.[9] Conversely, diaphragmatic breathing can stimulate PFM contraction.[10] With inspiration, the thoracic diaphragm contracts and lowers. To maintain the pressure system in the core, the pelvic diaphragm lowers through relaxation in coordinated fashion. Optimal respiratory function, abdominal strength, and pelvic floor control are essential components of voiding function as well as postural control and movement. Evidence supports the benefits of diaphragmatic breathing and pelvic floor retraining as an effective approach to managing dysfunctional voiding.[11,12] Diaphragmatic breathing has been chosen as a standard comparator for the current study because of the technique's success in lowering PFM tone.

Exercise and Pelvic Floor Control

The contract-relax patterns of the PFM when voiding or defecating are overlearned to the extent that they become automatic. However, strategies that support pelvic control and awareness have successfully remediated pelvic floor dysfunction, and exercise has been used as an adjunct treatment to biofeedback for treating dysfunctional voiding and issues related to constipation. A 9-week gross motor exercise program including walking in a semisquat position beginning with 5 and progressing to 15 minutes daily resulted in observable improvements in child-reported stool frequency, diameter, and consistency, although the program was limited in that no significant changes were observed in stool withholding or fecal impaction.[13] A regimen of combined functional PFM exercises with a Swiss ball and urotherapy showed improvements in abnormal voiding patterns, electromyography (EMG) activity during voiding, urgency, episodes of daytime wetting, and reduced postvoid residual.[7] A case series demonstrated changes in urinary incontinence among school-aged children who are developing typically following a PFM training (ie, biofeedback; breathing training) and gross motor strengthening program.[14]

Given the evidence that specifically designed exercise protocols ameliorate symptoms associated with dysfunctional voiding, this study set out to measure the short-term, immediate changes in PFM resting tone associated with a set of specific exercises. As such, the purpose of this study was to understand the effects of a set of simple gross motor exercises on PFM resting tone in children with dysfunctional voiding symptomology.

METHODS

The cross-sectional study compared PFM resting tone before and after 2 exercises designed to lower PFM resting tone in a sample population of children with symptomatic dysfunctional voiding with or without constipation. A relaxation protocol was used as a comparator.

Participants

Child participants were recruited through advertisement and by urologist referral. English-speaking children between 4.99 and 10.99 years old, with the ability to hop, jump, or perform physical exercises and with symptoms suggestive of high PFM tone (eg, daytime incontinence, high frequency or urgency of voiding or holding all day, possible nocturnal enuresis, and constipation) met inclusion criteria. Children with neurogenic bladders were excluded.

Procedure

The study entailed a participant commitment of 2 sessions—each session devoted to a different intervention (exercise or relaxation). After each of the 2 intervention sessions, children received a small monetary incentive as well as choice of a small prize, both of which were found acceptable by a human subjects Institutional Review Board. Parents/guardians were informed that specific consultation would be held until the end of the second session to ensure parent education did not influence behaviors between the 2 sessions. All parents/guardians were agreeable to these terms.

Two clinic sites approximately 350 miles (563 km) apart recruited participants from their respective geographical areas. Children were recruited through social media advertisement and by referral from local cooperating primary care physicians and urologists. Interested parents contacted the study's principal investigator and were screened for inclusion criteria. If the child met inclusion criteria, a clinic scheduler established 2 appointment sessions (no more than 14 days apart), each session assessing a different intervention approach.

Intervention assignment within each scheduled session was randomized by coin toss during the first session by the treatment physical therapists who directed the intervention sessions at each site. To strengthen the study, the assessment physical therapists from both sites were blinded to the intervention type. The child was seen first by the respective site's assessment physical therapist, who had expertise in the management of pediatric urinary incontinence. Appropriate written consent and assent were obtained from parent/guardian and child.

Pregelled adhesive surface electrodes were placed directly on the skin by the trained assessment physical therapist at 4:00 and 10:00 around the anus, with the third ground electrode placed over the ischial tuberosity on either side.[15] The child's clothing was pulled over the electrodes after placement for the remainder of the testing. A protocol that included a measure of average PFM resting muscle activity (millivoltage [μV]) over 1 minute and an average of muscle activity over 5 maximum contractions was taken while the child was lying in the supine position.

After baseline measurements were recorded, the child was escorted by the assessment physical therapist to the treatment room with the electrodes left in place. The child was greeted by the treatment physical therapist, who guided the child through 1 of 2 interventions, depending on a coin toss at the first session. Following the intervention, the child returned to the private clinic room, where the assessment physical therapist reassessed resting tone and maximal contraction strength using the electrodes, which had been previously placed. During the second session, the protocol was repeated, with the child receiving the alternate intervention.

EMG Measures of PFM Tone. Percent maximum voluntary isometric contraction (%MVIC) was calculated in an effort to normalize PFM resting tone data across subjects and time and provide an indicator of the neural drive delivered by the central nervous system to the PFM. Given the pediatric participants of this study and the intimacy and invasiveness required of vaginal or anal probes, the current study relied upon surface EMG to collect both resting tone and maximum contraction data. The findings of a study by Auchincloss and McLean[16] call into question the reliable use of surface EMG for between-subject comparisons or for use as between-day outcome measure. However, Oleksy and colleagues[17] demonstrated good (intraclass correlation coefficient ≥ 0.80) between-trial and between-day reliability for average mean and peak amplitude PFM resting tone with 2 different protocols. Participants in both of these studies were adult women with assumedly better motor control ability to isolate PFMs during maximal contractions than children.

Exercise Protocol. This intervention required the child to perform repetitive wide-legged squats (Figure 1A) to fatigue and then maintain child's pose (also known as, Balasana; Figure 1B) for 2 minutes. The wide-legged position for repetitive squats was selected as a part of the protocol, as it replicates wide-legged walking shown to improve functional constipation[13] and is similar to the squat, lunge, and side-step programming used with successful outcomes in managing urinary incontinence.[14] The squat rise and descent invokes internal perturbations and calls on the engagement of PFMs in anticipation of postural shifts created by hip and trunk prime movers.[18-20] Choice of an activity with dynamic perturbations drew upon this role, and the directive to squat to fatigue worked the PFM, theoretically, to fatigue, with prospects of reducing PFM muscle tone. Sustained child's pose was chosen as a posture that enhances PFM awareness and excursion during breathing[21] and places gluteus maximus on stretch.

Fig. 1. Protocol exercises included (A) repetitive, deep, wide-legged squats to fatigue, followed by (B) 2-minute sustained child's pose. This figure is available in color online (www.pedpt.com).

A case series[14] revealed many children with voiding dysfunction demonstrate compensatory strategies (eg, locking knees and using spinal segment flexion) when asked to pick an object up from the floor or sustain a squat with neutral knee-over-foot position. To aid proper form, a script with photographs was used. The script ensured prompts provided to the child were reliably consistent between intervention therapists at the 2 separate facilities.

Relaxation Protocol. A second intervention, meant to serve as a metric standard, required the child to lie in the supine position for 5 minutes of guided relaxation with verbal cues to encourage diaphragmatic breathing. The protocol was selected based on the known relationship between thoracic and pelvic diaphragm synchronization in the management of intraabdominal pressure.[19] To minimize variability between the 2 testing sites, treatment therapists used photographs and a standard script as a relaxation instruction guide.

Controlling for Symptomology Over Time. During each intervention session, the child's parent completed the Dysfunctional Voiding Scoring System (DVSS)[22] to determine symptom severity and, to account for time and maturation, ensure the child's symptoms were not largely different between intervention events. The validated version of the DVSS[23] comprises 13 quantitative age-appropriate questions related to urinary incontinence symptomology and a final question about quality of life. The first 4 questions are specific to symptom frequencies and are scored, depending upon item, 0 to 4 or 0 to 5.[23] Questions 5 to 13 are dichotomous "no" (0 point) or "yes" (1 or 2, question dependent) response questions. The scale's maximum score is 35 points.[23] The DVSS has been validated for children ages 4 to 10 years. A score of 8.5 is the threshold determinant of clinically significant wetting and functional voiding symptoms (90% sensitivity and 90% specificity).[23]

Data Analysis

Descriptive statistics were used to profile the sample. Data were explored to determine whether assumptions of normality (to include examinations of skew, kurtosis, and outliers) were met. Paired *t* tests with α established at 0.05 were used to analyze continuous data from related groups when assumptions were met, and a related-samples Wilcoxon signed rank test was used for comparisons when assumptions were not met ($z = \pm1.96$; $\alpha = 0.05$). Pelvic floor resting tone change was calculated by subtracting preintervention resting tone from that of postintervention. These change scores were used to conduct a related-samples Wilcoxon signed rank test to understand between-intervention differences.

RESULTS

Twenty-nine children with symptoms were recruited for the study; however, 1 child did not return for a second assessment. One participating child was reported to have a diagnosis of attention-deficit hyperactivity disorder with neurodevelopmental delay; the remaining participants were described by parents/guardians as developing typically. Twenty-eight children with reported dysfunctional voiding completed both exercise and relaxation intervention protocols. Time between first and second sessions ranged between 3 and 14 days (mean = 8.81, SD = 3.63). At analysis, a child's parent/guardian reported DVSS scores of 6 (exercise) and 7 (relaxation), which did not meet the threshold for clinically symptomatic wetting and functional voiding symptoms. Data collected from this participant were eliminated, leaving a remaining 27 participating children included in the analysis. Remaining participants (51.9% male; mean age = 7.45, SD = 1.89 years with range 5.00-10.92 years) had urinary and/or fecal incontinence (mean number of urinary "accidents" per week [including nocturnal enuresis] = 8.22, SD = 4.83, range = 1.50-21.50; mean number of fecal "accidents" per week = 1.32, SD = 1.72, range = 0.00-5.50; Bristol Stool Scale mean = 3.32, SD = 1.06, range = 1.50-7.00). Mean number of squats during the exercise intervention was 26.88 (SD = 19.53; range = 6-100).

Symptoms

DVSS scores (mean [exercise] = 17.59, SD = 5.58; mean [relaxation] = 18.26, SD = 5.22) were explored for assumptions of normality (including skew and kurtosis) and met expectations. Using data from the DVSS quality of life question responses from the relaxation session, approximately 96% of children's parents/guardians reported their child's symptoms affected family, social, or school life at least "sometimes." Almost 30% of parents/guardians reported that symptoms "seriously affected" aspects of their children's lives.

A paired-samples t test was used to assess between-session differences in DVSS scores. The paired symptom scores were strongly correlated ($r = 0.838$, $P < .001$), and there was no significant between-session difference in symptoms ($P = .272$; $t = -1.122$; Cohen's $d = -0.216$, 95% CI = -0.596 to 0.168). Frequencies of reported scores for each intervention are in Figure 2.

Surface EMG

An immediate challenge to using normalized %MVIC was recognized by assessment physical therapists when children naïve to the assessment protocol showed difficulty isolating PFM contraction from accessory muscles such as gluteus maximus during repeated maximum contractions. Given these challenges, the maximum contraction data were questionable, and a decision was made to rely on mean PFM resting tone data to draw conclusions about changes in PFM resting tone. Because there are no existing pediatric norms for PFM resting tone, the study used Glazer's[24] resting tone threshold, which establishes resting tone of 2 μV or more as overactive.

Pelvic floor muscle resting tone data were explored for assumptions of normality, and violations of normality were revealed, such that nonparametric statistics were used.[25] The related-samples Wilcoxon signed rank test revealed no significant between-session differences in preintervention PFM resting tone ($z = -1.817$; $P = .069$), providing a level of confidence that when children returned to participate in the second event their baseline PFM resting tone was statistically similar to that of the first event. Both exercise and relaxation groups showed a reduction in mean PFM resting tone between pre- and postinterventions (Table 1). However, this change in resting tone was statistically significant for the relaxation group ($z = -3.01$; $P < 0.01$) but not for the exercise group ($z = -1.40$; $P = .162$; Table 1). Pelvic floor resting tone was reduced under both intervention conditions for 11 of 27 (40.7%) children (Figure 3).

Seventeen children (63.0%) reduced their mean PFM resting tone levels pre- to post-exercise (ie, positive ranks). Twelve symptomatic children presented with pre-exercise protocol PFM resting tone of less than 2.0 μV, lower than the

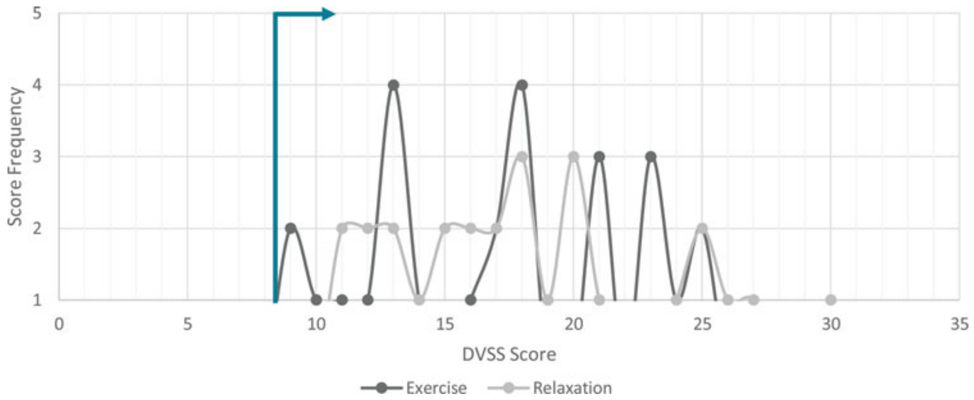

Fig. 2. Preintervention parent-reported DVSS score frequencies (ie, number of children with DVSS score) by intervention. Scores of more than 8.5 are considered symptomatic. DVSS indicates Dysfunctional Voiding Scoring System. This figure is available in color online (www.pedpt.com).

TABLE 1

Comparison of Pre- and Postintervention Pelvic Floor Resting Tone (N = 27)[a]

	Exercise					Relaxation				
	Preintervention Mean (SD) = 2.57 (2.08) μV Postintervention Mean (SD) = 2.09 (2.08) μV					Preintervention Mean (SD) = 4.14 (4.18) μV Postintervention Mean (SD) = 2.02 (1.88) μV				
	n	Mean Rank	Sum of Ranks	z	P	n	Mean Rank	Sum of Ranks	z	P
Negative ranks	9	13.39	120.50			5	11.40	57.00		
Positive ranks[c]	17	13.56	230.50	− 1.398	.162	21	14.00	294.00	− 3.011	.003[b]
Ties	1					1				

[a] Related sample Wilcoxon signed rank test.

[b] $P < .01$.

[c] Postintervention < preintervention.

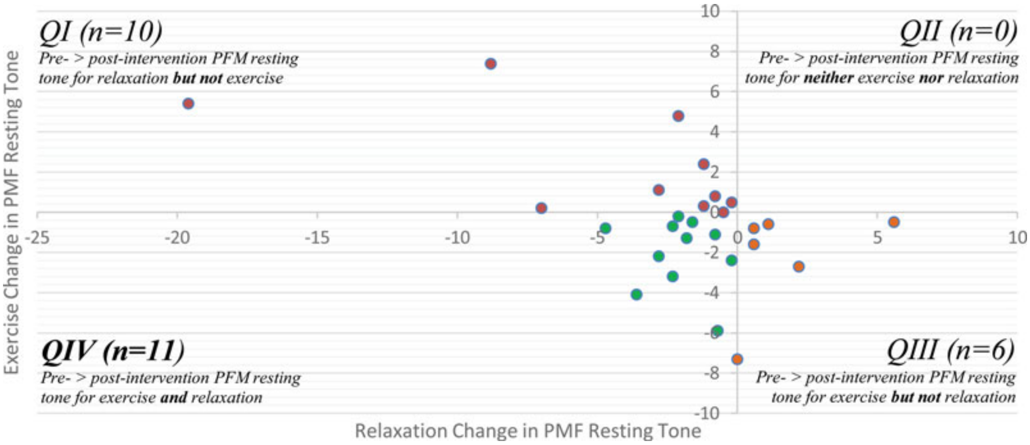

Fig. 3. Scatterplot depiction of post-minus-pre-PFM resting tone for each intervention for each participant. Participants situated in quadrant I (QI) reduced PFM resting tone for relaxation condition but not following exercise. Participants situated in QIII reduced resting tone following exercise but not under the relaxation condition. Participants in QIV reduced resting tone following both exercise and relaxation. PFM indicates pelvic floor muscle. This figure is available in color online (www.pedpt.com).

threshold for overactive resting tone (Table 2).[24] In contrast, 21 children (78%) reduced their mean PFM resting tone following relaxation (Table 1); 10 of these children presented with pre-relaxation protocol resting tone of less than 2.0 μV (Table 2). The higher percentage of participants with low pre-exercise PFM resting tone may have impacted the range potential for lowering PFM resting tone post-exercise and may, in part, explain rank score differences between the 2 interventions.

An observable trend seen with both interventions showed successful reduction in PFM resting tone for most children following both exercise (63.0%) and relaxation (77.8%), regardless of initial resting tone. Children with categorically overactive resting tone successfully lowered PFM resting tone to a standard baseline range (<2 μV) under both exercise (10 of 15, 66.7%) and relaxation (11 of 17, 64.7%) intervention conditions (Table 2).

Pre- to postintervention changes were calculated for each intervention by subtracting preintervention PFM resting tone from postintervention PFM resting tone measures. Change scores for the 2 interventions were compared using a related-samples Wilcoxon signed rank test. Exercise lowered PFM resting tone equally as well as a relaxation protocol ($z = -0.889$; $P = .374$; Table 3). Using categorical, rather than continuous data for outcome (clinical improvement defined as pre-PFM

TABLE 2

Comparison of Post-Minus-Prechange in Pelvic Floor Resting Tone by Intervention Protocol (N = 27)[a]

	Ranks = n	Mean Rank	Sum of Ranks	z	P
Exercise	Negative ranks = 16	14.13	226.00	−0.889	.374
Mean (SD) change = −0.48 (3.10) μV	Positive ranks[b] = 11	13.83	152.00		
Relaxation	Ties = 0				
Mean (SD) change = −2.11 (4.43) μV					

[a] Related sample Wilcoxon signed rank rest with change in PFM resting tone calculated as post-minus-prechange.

[b] Exercise change < relaxation change.

TABLE 3

Pre-/Postfrequencies by Pelvic Floor Muscle Resting Tone Classification (N = 27)[a]

	Exercise Protocol			**Relaxation Protocol**		
	Postfrequencies			**Postfrequencies**		
Prefrequencies	**RT < 2.0 μV, n (%)**	**RT ≥ 2.0 μV, n (%)**	**Total, n (%)**	**RT < 2.0 μV, n (%)**	**RT ≥ 2.0 μV, n (%)**	**Total, n (%)**
RT < 2.0 μV	8 (29.6)	4 (14.8)	12 (44.4)	8 (29.6)	2 (7.4)	10 (37.0)
RT ≥ 2.0 μV	10 (37.0)	5 (18.5)	15 (55.6)	11 (40.7)	6 (22.2)	17 (63.0)
	18 (66.7)	9 (33.3)	27 (100)	19 (70.4)	8 (29.6)	27 (100)

Abbreviations: PFM, pelvic floor muscle; RT, resting tone.

[a] RT = PFM resting tone; PFM resting tone > 2.0 μV = overactive.

resting tone < post *and* post-PFM resting tone < 2.0; no clinical improvement defined as pre-PFM resting tone ≥ post *or* post-PFM resting tone ≥ 2.0) by intervention (exercise vs relaxation), an odds ratio contingency table (Table 4) showed the odds of improvement following an exercise protocol were 0.63 times lower (95% CI = 0.21 to 1.88; $z = 0.824$, $P = .410$) than the odds of improvement following relaxation.

DISCUSSION

The International Children's Continence Society has given careful consideration to the standardization of guidelines for the management of urinary incontinence in children.[26] While urotherapy, with its aim at normalizing bladder emptying and storage, is the treatment of choice for dysfunctional voiding,[3] pelvic floor relaxation instruction is among the most widely available preferred treatments used to normalize emptying. The current study aimed to understand whether a pair of exercises would immediately lower PFM resting tone in children with dysfunctional voiding symptoms as well as a comparator relaxation protocol.

The current study specifically examined the treatment needs of children with voiding dysfunction symptoms. Theoretically, a lowered PFM resting muscle tone allows children with generally higher resting tone to void more fully. The identification of a set of exercises that successfully lowers PFM tone has useful implication for therapists and physicians who do not specialize in gastrointestinal/genitourinary dysfunction but who readily identify symptoms associated with increased PFM resting tone and who can easily implement these exercises as a treatment approach to ameliorating dysfunction for these children.

TABLE 4

Odds Ratio Contingency Table, Successful Outcomes by Intervention

	Exercise Protocol	**Relaxation Protocol**	**Odds Ratio (95% CI)**
Clinical improvement[a]	14	17	0.63 (0.21 to 1.88)
No clinical improvement[b]	13	10	

Abbreviations: CI, confidence interval; PFM, pelvic floor muscle; RT, resting tone.

[a] Clinical improvement = pre-PFM RT < post-PFM RT *and* post-PFM RT < 2.0 μV.

[b] No clinical improvement = pre-PFM RT ≥ post-PFM RT *or* post-PFM RT ≥ 2.0 μV.

Evidence supports the role of the pelvic floor in synergistic control of postural strategies.[18] Pelvic floor muscles are synergistically activated during a range of lower extremity tasks and postural control strategies. Synergistic patterns involving anticipatory PFM activation demonstrate the connectivity of even remote parts of the body, joined by common cortical and spinal circuitries. For instance, it has been shown that voluntary activation of the flexor hallucis longus is synergistically paired with activation of the anal sphincter.[27] The pelvic floor reliably activates as a synergist in advance of gluteus maximus during lower extremity tasks such as squatting or hopping.[28] The current study's findings theorize that driving lower extremity muscles to fatigue during the squat task also had the effect of fatiguing the PFM, resulting in a state of lowered resting tone.

Results of the current study support use of a simple pair of exercises, including repetitive wide-legged squats to fatigue and 2 minutes of the child's pose, as a treatment option to reduce PFM tone within a short time span. The protocol showed efficacy in lowering PFM tone when compared with 5 minutes of supine relaxation and guided diaphragmatic breathing. For children experiencing voiding dysfunction, the exercise protocol can be used to lower PFM resting tone in advance of toileting and in conjunction with recommended toileting postures as a means of assisting better elimination.

Future Directions

A greater proportion of children presented with resting tone of less than 2.0 μV at pre-exercise than at prerelaxation. This may explain why the analyses showed improved reduction in postrelaxation PFM resting tone not observed with postexercise, while still showing similar reduction in PFM resting tone when exercise and relaxation PFM resting tone were compared with one another. These findings warrant replicated study and future investigation using a larger sample to confirm the present results. Further, the study set out to understand the immediate effects of 2 interventions on PFM resting tone. A longitudinal study investigating the long-term effects of programming incorporating these interventions would be beneficial.

Limitations

The use of surface EMGs poses issues. Electrode shifts relative to muscle fibers or altered impedance between electrode and source may interfere with the reliability of within-session readings. It is acknowledged that the inability to rely upon a %MVIC normalization method of comparison for PFM resting tone is a limitation. Normalization methods remove the effects of outside influential factors that might affect signal capture,[29] and have the added benefit of allowing the comparison of different muscles and individuals. It is an advantage of this study that a standardized EMG electrode placement protocol was used, a single muscle group tested, and the same sample group used for comparison between the 2 interventions. These intentional efforts may help mitigate variability between testing and sessions.

History and maturation may have posed threats to internal validity; however, efforts were made to minimize the passage of time between first and second session events, limiting this time to no more than 14 days. Threats to testing or instrumentation were minimized by the nature of the surface EMG instrument, which cannot be "learned." While repeated testing may have posed a threat to external validity through multiple treatment interference, interventions were randomized in time for all subjects, lending likelihood that each intervention had the same probability of being executed during the first (and subsequent) session.

Finally, it is not possible to control for a child's state of arousal or anxiety, which may have been altered by the unfamiliar clinic environment and/or the child's naïvety, as it relates to EMG testing. The small sample size and geographical isolation to 2 Midwest US areas may limit broader generalizability.

Clinical Implications

Clinicians without access to more sophisticated biofeedback equipment, especially, may recommend these exercises immediately prior to toileting as a means of approaching treatment for dysfunctional voiding symptomology. Parents may find this more active alternative especially helpful for children who have difficulty with relaxation techniques in advance of voiding.

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