

Original – Voiding dysfunction

The anatomical-functional characteristics of the pelvic floor and quality of life of women with stress urinary incontinence subjected to perineal exercises

E.F. Carneiro^a, N. dos S. Araujo^{a,*}, L. Beuttenmüll^a, P.C. Vieira^a, S.A. Cader^{b,c}, M. Rett^{b,c}, S.F. de Oliveira^b, M. do S. Mouta Oliveira^c, and E.H.M. Dantas^{d,e}

^aCiencia de la Motricidad Humana en la Universidad Castelo Branco/RJ, Rio de Janeiro, Brazil

^bUniversidad Nuestra Señora de la Asunción, Asunción, Paraguay

^cFundación Santa Casa de Misericórdia do Pará

^dPrograma de Postgrado Strictu Sensu en Ciencia de la Motricidad Humana de la UCB-PROCIMH-UCB/RJ, Brazil

^eLaboratorio de Biociencias de la Motricidad Humana, LABIMH, Rio de Janeiro, Brazil

ARTICLE INFORMATION

Article history:

Received 9 February, 2010

Accepted 13 May, 2010

Keywords:

Pelvic floor

Stress urinary incontinence

Quality of life

A B S T R A C T

Objective: To determine the effects of exercise in anatomic abnormalities of the pelvic floor (PF) and the quality of life (QoL) of women with stress urinary incontinence (SUI).

Method: An experimental study with 50 women with SUI, distributed randomly into two groups, experimental (EG, 49.24±7.37 years) and control group (CG; 45.25±5.60 years). The groups performed ultrasound evaluation of the PF, evidence of pelvic floor muscle strength by palpation bidigital, surface EMG motor activity and replied to the QoL before and after treatment. The EG had 16 sessions of pelvic floor exercises twice a week for 30 min.

Results: Comparison between the EG and CG revealed significant differences in favor of EG, namely: mobility of the bladder neck ($\Delta=-0.79$ mm, $p=0.00$), thickness of pelvic floor muscle ($\Delta=-0.04$ mm, $p=0.00$), EMG ($\Delta=0.05$ μ V, $p=0.00$), muscle strength by the AFA ($\Delta=0.05$ level, $p=0.00$), DOMI1 ($\Delta\%=5.67\%$, $p=0.00$), DOMI2 ($\Delta\%=18.00\%$, $p=0.00$), DOMI3 ($\Delta\%=18.22\%$, $p=0.00$), DOMI4 ($\Delta\%=4.45\%$, $p=0.00$), DOMI5 ($\Delta\%=0.22\%$, $p=0.00$), DOMI6 ($\Delta\%=2.00\%$, $p=0.00$), DOMI7 ($\Delta\%=3.78\%$, $p=0.00$), DOMI8 ($\Delta\%=6.33\%$, $p=0.00$), DOMI9 ($\Delta\%=4.03\%$, $p=0.00$).

Conclusion: The anatomic features of the pelvic floor of women from the EG was modified and improved through perineal exercises, which will positively influence the QoL of these women.

© 2010 AEU. Published by Elsevier España, S.L. All rights reserved.

*Corresponding author.

E-mail: nazetearaujo@hotmail.com (N.d. Araujo).

Las características anatomofuncionales del suelo pélvico y la calidad de vida de mujeres con incontinencia urinaria de esfuerzo sometidas a ejercicios perineales

R E S U M E N

Palabras clave:

Suelo Pélvico
Incontinencia Urinaria por Estrés
Calidad de Vida

Objetivo: Verificar el efecto de los ejercicios en las alteraciones anatomofuncionales del suelo pélvico (SP) y en la calidad de vida (CV) de mujeres con incontinencia urinaria de esfuerzo (IUE).

Método: Estudio experimental realizado con 50 mujeres con IUE, distribuidas de forma aleatoria en: grupo experimental (GE; 49,24 ± 7,37 años) y grupo control (GC; 45,25 ± 5,60 años). Los grupos realizaron evaluación ecográfica del SP, prueba de fuerza muscular del suelo pélvico por medio de la palpación bidigital, actividad motora electromiográfica de superficie y contestaron al cuestionario CV antes y después del tratamiento. El GE hizo 16 sesiones de ejercicios para el suelo pélvico, dos veces a la semana, durante 30 min. **Resultados:** La comparación entre el GE y el GC reveló diferencias significativas a favor del GE, a saber: movilidad del cuello vesical ($\Delta = -0,79$ mm, $p = 0,00$), espesor de los músculos del suelo pélvico ($\Delta = -0,04$ mm, $p = 0,00$), EMG ($\Delta = 0,05$ μ V, $p = 0,00$), fuerza muscular por el AFA ($\Delta = 0,05$ grado, $p = 0,00$), DOMI1 ($\Delta\% = 5,67\%$, $p = 0,00$), DOMI2 ($\Delta\% = 18,00\%$, $p = 0,00$), DOMI3 ($\Delta\% = 18,22\%$, $p = 0,00$), DOMI4 ($\Delta\% = 4,45\%$, $p = 0,00$), DOMI5 ($\Delta\% = 0,22\%$, $p = 0,00$), DOMI6 ($\Delta\% = 2,00\%$, $p = 0,00$), DOMI7 ($\Delta\% = 3,78\%$, $p = 0,00$), DOMI8 ($\Delta\% = 6,33\%$, $p = 0,00$), DOMI9 ($\Delta\% = 4,03\%$, $p = 0,00$).

Conclusión: Se modificaron y se mejoraron las características anatomofuncionales del suelo pélvico de las mujeres del GE a través de ejercicios perineales, lo que influyó de forma positiva en la CV de esas mujeres.

© 2010 AEU. Publicado por Elsevier España, S.L. Todos los derechos reservados.

Introduction

Stress urinary incontinence (SUI) is defined as a complaint of involuntary urine loss concomitant with stress, sneezing, or cough.¹ SUI is the most prevalent incontinence in the general population, affecting 12%-56% of patients depending on the population studied and the diagnostic criteria used.^{2,3}

In Brazil, SUI prevalence ranges from 26.4% and 35%, as compared to the 37% prevalence of mixed urinary incontinence.³ This condition is however underdiagnosed because some women do not report the urine loss for shame or even because they consider it a natural process.⁴

Women with SUI complain of limitations in physical activities such as sport and lifting objects. Changes in social, occupational, or household activities have a negative impact on emotional status and sex life. They may also cause social and hygienic discomfort because of fear of losing urine, urine smell, the need for using (absorbent) panty liners, and more frequent change of clothes, which has a direct impact on quality of life (QoL).⁵

The World Health Organization (WHO) considers physical therapy as the first choice treatment for mild to moderate incontinence, and also for first degree simple prolapse.^{6,7} Physical therapy exercises for strengthening the pelvic floor, vaginal cones, kinesitherapy, and intravaginal electrical

stimulation have been shown to significantly improve urinary incontinence (UI) symptoms in up to 85% of cases.^{5,8}

The aim of physical therapy is to restore perineal reflex to stress, promote awareness of contraction of pelvic floor muscles, and reprogram the nervous system through techniques that may be used separately or combined.⁹

In perineal exercises, techniques intended to improve the strength and resistance of pelvic floor muscles (PFMs) are used to increase urethral closure strength under given conditions, such as a sudden increase in abdominal pressure. Various studies have shown that perineal exercises are an effective treatment, and that patient motivation is a significant factor for a successful treatment.^{8,10}

The purpose of this study was therefore to verify the effects of perineal exercises on anatomical and functional pelvic floor changes and on the QoL of women with SUI.

Methods

This study strictly followed the guidelines on ethical precautions in research appearing in decision 196/96, of 10/10/1996, of the National Health Council (Brazil, 1996) and the Declaration of Helsinki (WMA, 2008). The project was previously approved by the Ethics Committee for Research in Humans of UCB with protocol number 0047/08.

After approval, all individuals participating in the research signed the informed consent and were treated at the CAFISIO physical therapy clinic, located at the city of Belém, state of Pará, from October 2008 to May 2009.

The research consisted of a randomized clinical study to which women aged 30-55 years complaining of SUI, all of them referred by urologists and gynecologists who requested and performed urine sediment analyses and quantitative urine cultures, the urodynamic study, and transvaginal ultrasound were recruited.

Urine analyses were performed to rule out potential urinary tract infections. Urodynamic studies were used to diagnose the type of UI and pressure drop under stress (PDS). Ultrasound examinations, performed with Toshiba equipment (Nomio, Japan), were used to measure urethral mobility (in millimeters) and thickness of the levator ani muscle (in millimeters). A 6.5 MHz convex endocavity probe was used in transvaginal examination to measure urethral mobility, and a 3.5 MHz transducer was used in the transabdominal technique to measure thickness of the levator ani muscle. This examination was performed on a bladder containing a maximum of 50 mL of urine.¹¹

Once tests were performed, women were selected based on the inclusion criteria, consisting of a urodynamic diagnosis of SUI due to bladder neck hypermobility or PDS of 90 cm H₂O or higher, and on exclusion criteria, including SUI due to intrinsic insufficiency (PDS less than 60 cm H₂O), prior surgical correction of SUI, and genital prolapse of any grade in physical examination. The sample consisted of 50 women randomized into two groups using simple random sampling (as when tossing a coin) as follows: experimental group (EG, n=25) and control group (CG, n=25). Table 1 shows their most relevant characteristics.

All participants underwent a physical therapy assessment consisting of a clinical history and physical examination. At physical examination, PFM strength was measured using bidigital palpation, and electromyographic motor activity (EMG-test) was measured in microvolts (μ V) using a model USB-4 Phenix equipment (Vivaltis, Paris, France). For this last measurement, subject was placed in a decubitus position, with legs flexed and feet resting on the examination couch, and a vaginal probe 5 cm long and 5.5 cm in diameter, moistened with K-Y Jelly gel (Johnson), was introduced. Women were then asked to perform three maximal contractions of PFMs. The highest contraction recorded was selected as the starting point for treatment and was transmitted to the computer through a visual signal.

In order to assess SUI interference with QoL of participants, groups completed a quality of life questionnaire, the King's Health Questionnaire (KHQ).¹² This instrument assesses both the presence of UI symptoms and their relative impact. The questionnaire consists of 30 questions distributed into nine domains: health perception, impact of incontinence, limitations for carrying out tasks, physical limitation, social limitation, social relationship, emotions, sleep/energy, and severity measures.¹² It also includes a symptom scale: increased urinary frequency, nocturia, urgency, bladder hyperreflexia, SUI, nocturnal enuresis, incontinence during intercourse, urinary tract infections, and bladder pain. This

questionnaire is scored in each of its domains, and there is no overall score. Scores range from 0 to 100, and the higher the score, the worse the quality of life related to the domain.¹²

The EG participated in a perineal exercise program that started with verbal information about PFM function and visualization of pelvic floor components using anatomical figures. Members of the EG then performed a series of perineal exercises for 30 min twice weekly during 8 (eight) consecutive weeks.¹³⁻¹⁵ Maximum contraction was verified by initial assessment, individual for each woman.¹⁶ The control group carried out no activity during the 8 weeks, as they were on a waiting list.

To start perineal exercises, the participant remained 5 min on the 75-cm diameter therapeutic ball and was asked to make lateral movements of the pelvis, pelvic anteversion movements, short jumps, and figure of 8 movements with the pelvis for proprioception.¹⁷ Participants then performed a series of 8-12 repetitions of 5 perineal exercises in the recumbent, sitting, and standing positions, with contractions sustained for 6 to 10 seconds.⁶

At the end of the 8 weeks, ultrasound examination, surface electromyography, and the test of muscle strength of pelvic floor were again performed in both the EG and CG. Both groups also answered the KHQ again.

Descriptive statistics were used including mean, median, standard error, standard deviation, minimum, maximum (Δ) and percent ($\Delta\%$) absolute delta. Normality of the sample was assessed using a Shapiro-Wilk test, and homogeneity of variance using a Levene test. To analyze the response variables, a paired Student's t test or a Wilcoxon test was used in the within-group analysis, provided it was adequate (homogeneous or heterogeneous data distribution respectively). A two-way ANOVA test, followed by a Scheffe's post hoc test, was used for between-group analysis of the pelvic floor variable. A Kruskal-Wallis test was used for comparisons between groups, followed by the Mann-Whitney test. A Bonferroni correction was used to identify the potential differences after the test. A value of $p < 0.05$ was considered statistically significant. Excel software and the SPSS 14.0 statistical package were used to assess the results.

Table 1 – Descriptive baseline characteristics of the EG (n=25) and CG (n=25)

	EG	CG	p value
	Mean \pm SD	Mean \pm SD	
Age	49.24 \pm 7.37	45.25 \pm 5.60	0.598
Vaginal deliveries	4.00 \pm 3.77	3.70 \pm 2.20	0.844
Cesarean deliveries	0.92 \pm 0.95	1.00 \pm 1.03	0.594
Time with SUI	1.36 \pm 1.50	0.75 \pm 0.85	0.067

Age (years); time with SUI: stress urinary incontinence (years); EG: experimental group; CG: control group.

Table 2 – Comparative analysis (mean ± standard deviation) of morphological and functional characteristics of pelvic floor in the EG and CG at baseline and at study end

	EG			CG		
	Baseline mean±SD	Final mean±SD	SW p value	Baseline mean±SD	Final mean±SD	SW p value
Mobility	16.74±4.53	17.53±4.33	0.607	15.60±4.27	12.63±4.35	0.964
Thickness	10.70±1.88	10.74±2.26	0.104	10.13±0.98	12.87±1.02	0.342
EMG-test	8.30±5.03	8.25±5.70	0.007	9.28±5.29	13.56±5.41	0.059
Strength	2.55±1.23	2.50±0.76	0.006	2.48±1.10	3.20±1.05	0.019

EMG: electromyography; SW: Shapiro-Wilk; SD: standard deviation; EG: experimental group; CG: control group; measurement units used were as follows: urethral mobility (mm), thickness (mm), EMG-test (μ v), muscle strength (grade).

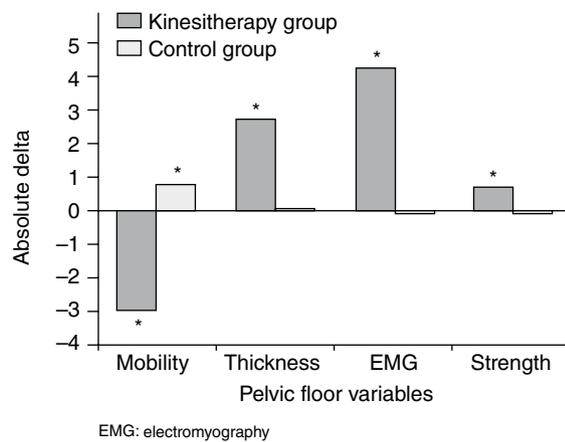


Figure 1 – Comparative analysis of the morphological and functional characteristics of pelvic floor of the groups by absolute delta.

Results

Table 1 shows the characteristics of sample groups.

Table 2 includes a comparative analysis of anatomical and functional pelvic floor parameters in the EG and CG.

As shown, a heterogeneous result ($p < 0.05$) was only found in the sample for the strength and EMG-test variables in the EG and for the strength variable in the CG.

Figure 1 refers to the within-group comparative analysis of anatomical and functional PF variables by absolute delta of sample groups.

Within-group results in the EG revealed a significant improvement in all anatomical and functional pelvic floor variables. No satisfactory improvement in variables was achieved by the control group, which also showed a significant and unsatisfactory increase in the neck variable.

Table 3 shows a comparative analysis (mean ± standard deviation) of the KHQ domains before and after the test of EG and CG.

An analysis of table 3 shows that significant differences ($p < 0.05$) occurred in the EG in the domains of limitations in daily life and impact of incontinence. No significant differences were seen in the CG for any of the KHQ scores.

Discussion

Perineal kinesitherapy is routinely used for treatment of SUI. Perineal exercises increase the strength of PFMs because they promote strengthening of urethral resistance and improvement in the elements supporting pelvic organs.¹⁸

Conflicting results of the efficacy of ultrasound to assess bladder neck descent in SUI diagnosis continue to be reported, and responses are unclear. However, regardless of SUI factors, current consensus recommends definition of the presence or absence of bladder neck hypermobility.^{19–21}

This study also found a statistically significant reduction in bladder neck mobility. These results support the Potrick study,²² where transvaginal electrical stimulation of PFMs achieved a significant decrease in urine loss frequency in most patients. A non-significant effect was seen on pressure drop under stress and bladder neck mobility.

Rett et al⁵ reported a decreased strength and thickness of PFMs in incontinent women, suggesting neuromuscular damage. Priority should therefore be given to treatments to strengthen and reeducate such muscles. This research showed a significant increase in PFM thickness (table 2) in the EG, but not in the CG, after treatment with exercises.

Pelvic floor is one of the structures responsible for urethral support and is involved in the mechanism of continence. It may be assessed by palpation and perineometry. Pelvic floor consists of type I (slow or tonic contraction) and type II (rapid or phasic contraction) skeletal, striated muscle fibers, and may therefore be also assessed through surface electromyography (EMG).²³

A reduction in surface electromyographic activity was shown in women with SUI and mixed incontinence as compared to healthy women, which suggests an impaired neuromuscular function in those women.²⁴

Table 3 – Comparative analysis (mean ± standard deviation) of QoL at baseline and at the end of treatment in the EG (n=25) and CG (n=25), as assessed by the KHQ

	EG			CG		
	Baseline (mean±SD)	Final (mean±SD)	p value	Baseline (mean±SD)	Final (mean±SD)	p value
DOM1	28.33±13.18	34.00±14.22	0.086	28.75±14.68	28.75±14.68	1.000
DOM2	34.66±24.96	52.66±28.74	0.007	55.41±28.13	55.41±28.13	1.000
DOM3	14.00±18.43	32.22±32.98	0.002	26.63±23.76	26.63±23.76	1.000
DOM4	16.66±19.84	21.11±26.64	0.440	31.66±29.07	29.16±28.03	0.317
DOM5	12.89±23.11	13.11±23.45	0.875	18.83±25.74	18.83±25.74	1.000
DOM6	11.99±23.32	13.99±24.37	0.513	27.50±35.57	27.50±35.57	1.000
DOM7	15.99±22.92	19.78±28.87	0.469	30.52±26.84	30.52±26.84	1.000
DOM8	15.33±21.47	21.66±23.11	0.170	25.55±20.02	25.55±20.02	1.000
DOM9	22.64±24.31	26.66±26.74	0.517	34.61±23.91	34.61±23.91	1.000

DOM1: Overall health; DOM2: Impact of incontinence; DOM3: limitations in daily activities; DOM4: physical limitations; DOM5: social limitations; DOM6: personal relations; DOM7: emotions; DOM8: sleep/mood; DOM9: severity measures; SD: standard deviation; EG: experimental group; CG: control group.

In this study, significantly increased electromyographic activity values were found in the EG (table 2), which may suggest that pelvic floor exercises may restore neuromuscular function of this muscle group.

Moreira²⁵ conducted research on 101 women distributed into two groups, consisting of continent and incontinent women respectively. The study objective was to compare the value of objective and subjective propedeutic evaluation in UI diagnosis. Muscle strength and perception of pelvic floor were significantly deficient in incontinent as compared to continent women

This research showed significant increase in muscle strength (table 2) after PFM exercises. Bo et al,²⁶ in a study on a sample of 52 women aged 24-64 years (mean, 45.4 years) with SUI, reported a positive correlation between an increased PFM strength and urine loss with stress.

As regards KHQ, which was the subjective parameter used in that study to assess the impact of perineal exercises on the QoL of study women, significant differences were only seen in the EG in the domains of limitations in daily life and impact of incontinence (table 3). However, non-significant differences related to an improved quality of life were seen in all other scores (overall health, physical limitations, social limitations, personal relations, emotions, sleep, energy, and severity measures). This may be related to the individual perception of the problem by each woman.⁵

Oliveira et al²⁷ also studied QoL and correlated urinary symptoms of 34 women with UI. They also reported their socioeconomic, gynecological, and obstetric profiles. Authors concluded that women studied experienced urinary symptoms often associated to the complaint of urine loss with stress. Most women complaining of SUI and urge incontinence reported that their QoL was at least somewhat impaired. While UI did not limit their daily physical and social activities, most women stated that it affected perception of their health and had a negative impact on this, and particularly impaired sleep and mood. When interference of urinary symptoms with life was considered, enuresis was found to impair sleep

and mood, and urgency triggered a worsening in emotional state.

Wang et al²⁸ used biofeedback, electrical stimulation, and kinesitherapy for detrusor overactivity in women of different ages and found with the KHQ decreases in symptoms and in the domains of physical limitations, social limitations, and personal relations.

Conclusion

In this study, anatomical and functional characteristics of the pelvic floor could be modified and improved in women in the kinesitherapy group through perineal exercises which, in the final analysis, had a positive impact on the QoL of those women.

Conflict of interest

The authors declare no conflict of interest.

REFERENCES

1. Feldner Júnior PC, Sartori MGF, Lima GR, Baracat EC, Girão MJBC. Diagnóstico clínico e subsidiário da incontinência urinária. *Rev Bras Ginecol Obstet.* 2006;28:54-62.
2. Figueiredo EM, Lara JO, Cruz MC, Quintão DMG, Monteiro MVC. Perfil sócio-demográfico e clínico de usuários de Serviço de Fisioterapia Uroginecológica da rede pública. *Rev bras fisioter.* 2008;12:136-42.
3. Guarasi T, Neto AMP, Oassis MJ, Pedro AO, Paiva LHC, Faundes A. Urinary incontinence among climacteric Brazilian women: household survey. *Rev Saude Pública.* 2001;35:428-35.
4. Dumoulin C, Hay-Smith J. Pelvic floor muscle training versus no treatment for urinary incontinence in women. *A Cochrane systematic review.* *Eur J Phys Rehabil Med Italy.* 2008;44: 47-63.

5. Rett MT, Simões JA, Herrmann V, Pinto CL, Marques AA, Morais SS. Management of estress urinary incontinence with surface electromyography-assisted biofeedback in women of reproductive age. *Phys Ther*. 2007;87:136-42.
6. Amaro JL, Haddad JM, Trindade JCS, Ribeiro RM. Reabilitação do assoalho pélvico nas disfunções urinárias e anorretais. São Paulo: Segmentofarma. 1st Ed., 2005.
7. Oliveira IM, Carvalho VCP. Pelvic organ prolapse: etiology, diagnising and conservative treatment. *Femina*. 2007;35:285-93.
8. Bernardes NO, Peres FR, Souza ELBL, Souza OL. Métodos de tratamentos utilizados na incontinência urinária de esforço genuína: um estudo comparativo entre cinesioterapia e eletroestimulação endovaginal. *Rev Bras Ginecol Obstet*. 2000;22:49-54.
9. Guarda RI, Gariba M, Nohana P, Amaral VF. Conservative treatment of urinary stress incontinence. *Femina*. 2007;35:219-27.
10. Baracho E, Moreno AL. Fisioterapia Aplicada à obstetrícia, uroginecologia e aspectos de mastologia. Rio de Janeiro: Guanabara Koogan. 2007;430-42.
11. Cammu H, Van NM, Amy JJA. 10-year follow-up after Kegel pelvic floor muscle exercises for genuine stress incontinence. *BJU Int*. 2000;85:655-8.
12. Tamanini JTN, D'Ancona CAL, Botega NJ, Netto Júnior NR. Validación al portugués del «Internacional Consultation on Incontinence Questionnaire-Short Form» (ICIQ-SF). *Rev Saúde Pública*. 2004;38.
13. Lorenzo MF, Silva AJM, García CFJ, Geanini YA, Urrutia AM. Tratamiento de la incontinencia urinaria de esfuerzo con Biofeedback perineal con electrodos de superficie. *Actas Urol Esp*. 2008;32:629-36.
14. Ortiz J, Robalo L. Modelo teórico de ensino dos exercícios para o pavimento pélvico-Método de Delphi. *EssFisiOnline*. 2006;2:3-23.
15. Hermann V, Potrick BA, Palma PCR, Zanetini CL, Marques AA, Júnior NRN. Eletroestimulação transvaginal do assoalho pélvico no tratamento da incontinência urinária de esforço: avaliações clínica e ultra-sonográfica. *Rev Assoc Méd Bras*. 2003;49:401-5.
16. Bergmans B, Bø K, Bernardes N. Clinical practice guidelines for the physical therapy of patients with urinary incontinence. *Rev Urodinâmica & Uroginecologia*. 2003;6:1-28. jan./mar.
17. Pesqueira ALO. O uso da bola suíça na cinesioterapia laboral com um grupo de trabalhadores da biblioteca de uma universidade. Trabalho de conclusão do curso de Engenharia de Produção, Universidade Federal do Rio Grande do Sul, Porto Alegre. 2004.
18. Wroclawski ER, Borelli Júnior M, Borelli M. Tratamento não-cirúrgico da Incontinência Urinária de Esforço. En: Rubinstein I., editors. *Urologia Feminina*. São Paulo: BYK; 1999. p. 189-201.
19. Otcenasek M, Halaska M, Krcmar M, Maresova D, Halaska MG. New approach to the urogynecological ultrasound examination. *Eur J Obstet Gynecol Reprod Biol*. 2002;103:72-4.
20. Rovner ES, Wein AJ. Evaluation of lower urinary tract symptoms in females. *Curr Opin Urol*. 2003;13:273-8.
21. Brandt FT, Albuquerque CDC, Arraes AF. Influência do volume vesical na avaliação ultra-sonográfica da junção uretrovesical e uretro proximal. *Radiol Bras*. 2005;38:33-6.
22. Potrick BA. Eletroestimulação transvaginal do assoalho pélvico no tratamento da incontinência urinária de esforço: avaliação clínica, urodinâmica e ultra-sonográfica. 2002. Dissertação (Mestrado em Cirurgia) Faculdade de Ciências Médicas-Universidade Estadual de Campinas, Campinas.
23. Matheus LM, Mazzari CF, Mesquite RA, Oliveira J. Influência dos exercícios perineais e dos cones vaginais, associados à correção postural, no tratamento da incontinência urinária feminina. *Rev bras fisioter*. 2006;10:387-92. São Carlos.
24. Gunarsson M, Mattiasson A. Female stress, urge and mixed urinary incontinence are associated with a chronic and preogressive pelvic floor/vaginal neuromuscular disorder: an investigation of 317 health and incontinent women using vaginal surface electromyography. *Neurourol Urodyn*. 1999;18:613-21. São Carlos.
25. Moreira SFS. Mobilidade do colo vesical e avaliação funcional do assoalho pélvico em mulheres continentas e com incontinência urinária de esforço, consoante o estado hormonal. 60 f. Dissertação (Mestrado em ginecologia)-Escola Paulista de Medicina, São Paulo, 2000.
26. Bo K. Pelvic floor muscle strength and response to pelvic training for stress urinary incontinence. *Neurourol Urodyn*. 2003;22:654-8.
27. Oliveira JMS, Salgado LBG, Schmitt ACB, Da Rosa LCL. Correlação entre sintomas urinários e qualidade de vida em mulheres com incontinência urinária. *Fisioter Pesqui*. 2007;14:12-17. sep./dec.
28. Wang AC, Wang YY, Chen MC. Single-blind, randomized trial of pelvic floor muscle training, biofeedback-assisted pelvic floor muscle training, and electrical stimulation in the management of overactive bladder. *Urology*. 2004;63:61-6.