THE ASSESSMENT OF KINESIS-THERAPEUTIC TREATMENT USING NUMERICAL EVALUATION OF PELVIC FLOOR MUSCLE FORCES

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PROCENA KINEZITERAPIJSKOG TRETMANA KROZ NUMERIČKU EVALUACIJU SILA PODA KARLICE

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ABSTRACT

Introduction: Numerous factors lead to the dysfunction of pelvic floor muscle in women, resulting in various disturbances, of which urinary incontinence is the most significant. In addition to surgery, treatment of stress urinary incontinence may include, for instance, exercises for strengthening the pelvic floor muscle.

Aim: The aim of the current study was to use a vaginal dynamometer, a device for measuring pelvic floor muscle force, to compare the pelvic floor muscle force before and after a kinesitherapy program for women who suffer from stress urinary incontinence.

Method: This pilot study included 50 women, aged 30-58, who suffered from urinary stress incontinence. Patients were selected using the method of controlled sample, which excluded pregnant women, patients with inflammatory processes, and malignant and respiratory illnesses. Pelvic floor muscles were strengthened by performing Kegel exercises and the Proprioceptive Neural Fascilitation Spiral-dynamic technique. Pelvic floor muscle strength was measured using a vaginal dynamometer before and after the exercise. Exercise efficiency was measured by a vaginal dynamometer before and after the exercise. Exercise efficiency was statistically significant (p=0.000).

Results: The difference between pelvic floor muscle force measured by a vaginal dynamometer before and after the exercise was statistically significant (p=0.000).

Conclusion: The results confirm that the vaginal dynamometer provides reliable measurements. They also suggest the superiority of the newly designed device over the previously applied conventional methods of measuring pelvic floor muscle strength.

Key words: pelvic floor, urinary incontinence, dynamometer

SAŽETAK

Uvod: Brojni cinioci štetnim delovanjem dovode do dis-funkcije mišića poda male karlice kod žena, što ima brojne posledice, od kojih je najznačajnija urinarne inkontinencije. Pored hirurškog lečenja kod stres inkontinencije primenjuje se i konzervativno lečenje odnosno vežbe za jačanje mišića poda karlice.

Cilj Cilj rada je da se uz pomoć uređaja za međeši mišić sile mišića poda karlice kod žena, koja su izrađene u periodu glavne inkontinencije.

Metod: U pilot studiji 50 žena starosne dobi od 30-58 god. koje pate od stres urinarne inkontinencije su metodom kontrolisanog uzorka iz koga su isključene trudnice, osobe sa malignim ili zapaljenskim bolestima, kao i one sa ozbiljnim kardiovaskularnim ili respiratornim bolestima izabrane da vežbaju mišiće poda karlice pomoću Kegelovih vežbi i PNF Spiraldinamik tehnike. Snaga mišića poda karlice je merena vaginalnim dinamometrom pre i posle vežbi. Na osnovu usmeno dobijenih podataka o inkontinenciji (izvestaj o gubitku urina i kvalitetu zivota) i na osnovu dobijenih numeričkih vrednosti izmerenih vaginalnim dinamometrom utvrđena je efikasnost vežbi.

Rezultati: Razlika izmedju vrednosti mišićne sile merene vaginalnim dinamometrom pre i posle vežbi je statistički značajna (p=0.000).

Zaključak: Ova studija na osnovu dobijenih rezultata ukazuje na to da vaginalni dinamometar obezbedjuje pouzdana merenja. Iz tog razloga i da novo konstruisan vaginalni dinamometar ima idejnih i mernih prednosti u odnosu na dosad korišćene konvencionalne metode merenja snage mišića poda karlice kod žena.

Ključne reči: pod karlice, urinarne inkontinencije, dinamometar


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INTRODUCTION

Stress urinary incontinence (SUI) in women is defined as an involuntary loss of urine in cases of strain, sneezing or coughing (1). It is a very frequent disorder, increasingly affected by age and number of deliveries (2). It is a serious social and hygiene problem (3,4,5). Numerous factors contribute to SUI, and many solutions to the problem have been proposed (6). Conservative, non-surgical treatments that have been suggested include kinesis therapy, such as exercises for strengthening the pelvic floor muscle (PFM), bio-feedback, electric stimulation and vaginal cones (7,8,9). In order to decrease SUI, traditional exercises for strengthening PFM are mostly limited to Kegel exercises. They consist of static contractions of the PFM. In addition to Kegel exercises, the PNF Spiral-dynamic technique, i.e., proprioceptive neural stimulation that follows the principle of body diagonals and spiral three-dimensionality of movements, is also applied (10,11,12). Since the aim of physical therapy is to strengthen the PFM, a reliable direct measurement of muscle strength is essential for the evaluating the effects of such treatment.

So far, PFM strength has been measured using digital assessment (13,14,15) and indirect methods, such as perineometry measurement, perineal ultrasound and surface electromyography (16,17,18).

An attempt to develop a dynamometer for measuring isometric PFM force has been reported (Doumulin 2003) (19,20).

Recognising the importance of direct measurements of PFM strength in the evaluation of SUI, and the application of kinesis therapy as treatment, we decided to construct a new device that can reliably and numerically display the measured PFM strength before and after the exercises.

The aim of this paper is to describe the design of a new dynamometer that provides unique data in comparison with the previously employed measurement techniques. The device’s clinical application in persons who suffer from SUI will also be discussed.

MATERIALS AND METHODS

The study was approved by Ethics Committee and carried out at the Centre for Physical Therapy and Rehabilitation, Clinical Centre in Kragujevac during 2007–2008.

The study included 50 patients aged 30–58. The experimental group included women who had 1–3 deliveries and suffered from SUI (based on reported loss of urine and quality of life). Patients were randomly selected for measurements of PFM force using the vaginal dynamometer. After the measurements, they were exposed to exercises for PFM strengthening through the PNF Spiral-dynamic technique method and Kegel exercises. After 3 months, the control measurements were performed using the vaginal dynamometer. Pregnant women or those who suffered from inflammatory or malignant diseases of pelvic organs, or who had serious cardiology or respiratory diseases, were not included in the study.

All women were interviewed about the extent of their SUI (i.e., a small level of discomfort, a small problem, a great problem, or a huge problem). Subsequently, PFM strength was measured using the newly constructed dynamometer.

Precise, numerical and reliable determination of PFM force expressed in daN (decaNewtons) is possible with the application of a vaginal dynamometer. It was designed at the Faculty of Mechanical Engineering in Kragujevac, in collaboration with professors of the Medical and Mechanical Engineering Faculties.

The dynamometer consists of:
1. An instrument for measuring the PFM contraction forces with a cable (Position 1)
2. A measuring device with a display unit and analogue output for monitoring (Position 2)

Figure 1. Instrument for measuring the contraction forces of the pelvic floor muscles - vaginal dynamometer

The body of the instrument consists of a redesigned speculum, which is used in gynaecology, with a sensor for force measurement. The newly designed dynamometer employs the principle of measuring bands and the Winston Bridge. The force is physically transferred to the dynamometer and then transformed into an electrical signal that is proportional to the magnitude of the force.

Measurements are made in the following way: First, the methodology of applying the new device is explained to each patient. Then, the patient takes the necessary position on the gynaecological table. The instrument is inserted with closed
branches up to stopper G, and the wheel T is turned to separate the branches until contact pressure between the vaginal wall and the instrument is established. When the instrument is placed, the patient initiates a static contraction, straining the PFMs for 6 seconds, and PFM force (Fpk) is applied to the branches of the instrument. Thus, physical application of PFM force (Fpk) is transmitted to the dynamometer as the force Fd and turned into an electric voltage signal with a value proportional to the strength of the force (Fpk). After a 12 second pause, the procedure is repeated 5 times in order to calculate a mean value. The numerical value of the measured force is read from the display of the instrument.

Calibration is performed with a known unit of pressure (Fpk = 1 daN) that is exerted in the middle of contact zone Zk.

After the measurement of PFM force using the vaginal dynamometer and obtaining the data, the patients were either trained to exercise using the PNF Spiral-dynamic technique or taught how to perform Kegel exercises at the Centre for Physical Therapy and Rehabilitation. After the training, the patients practiced at home. They visited a physiatrist or a physical therapist at the Centre monthly to report on the regularity of practice.

After 3 months of exercise, PFM strength was measured again with the vaginal dynamometer.

**RESULTS**

Table 1 shows the values of PFM force (in daN) measured using the vaginal dynamometer before and after exercise.

<table>
<thead>
<tr>
<th>ordinal number r</th>
<th>age</th>
<th>number of deliveries</th>
<th>incontinent</th>
<th>PFM forces before exercise</th>
<th>PFM forces after exercise</th>
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<tbody>
<tr>
<td>1</td>
<td>43</td>
<td>1</td>
<td>yes</td>
<td>0.429</td>
<td>0.442</td>
</tr>
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</tr>
<tr>
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<td>0.547</td>
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<tr>
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<tr>
<td>18</td>
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<td>0.672</td>
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</table>

Table 2. The analysis of PFM force values in women before and after exercise revealed a significant difference (p = 0.000).

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
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<tr>
<td>Pair 1</td>
<td>.6909</td>
<td>49</td>
<td>.2141</td>
<td>3.059E-02</td>
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<tr>
<td>VAR00006</td>
<td>.8139</td>
<td>49</td>
<td>.2599</td>
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</table>
Figure 3. Values of PFM force in women measured by a vaginal dynamometer before and after exercise

**DISCUSSION**

This study showed that, in addition to surgical treatment of stress urinary incontinence, a kinesis program of pelvic floor muscle strengthening may play an important role (7,8,9). Measuring women's pelvic floor strength by using the vaginal dynamometer before and after a 3-month kinesis program revealed an increase in muscle force. Kinesis therapy is not only one form of primary prevention but also an inseparable part of treating pelvic weakness. The best known therapy is Kegel exercises, pelvic floor muscle strength and the necessity of supplementary methods for control of correct contraction Neurourology 2005; 9(5):479-87


