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PRACE ORYGINALNE

Magdaléna Hagovská, Peter Takáč

EMG biofeedback as a diagnostic and therapeutic method in the treatment and prevention of women's urinary incontinence

Physiatry, Balneology and Medical Rehabilitation Clinic,
LF UPJŠ and L. Pasteur Faculty Hospital, Rastislavova 43, Košice, Slovakia
In cooperation with Lučky Spa Centre (Liptovské liečebné kúpele Lúčky,a.s.)

In our research we have tried to objectivise pelvic floor muscle contractions in its maximal and average values and patient's ability of muscle relaxation with the aid of EMG biofeedback and also the Perfect Scheme objectivisation with the above in the form of a resultant electromyogram. We have also objectivised the relaxation of m.rectus abdominis during training exercises. We have compared the monitored parameters in women with and without urinary incontinence and have tried to reduce the urinary incontinence symptoms by a complex physiotherapeutic treatment.

Patient group: *The group consisted of 66 patients out of which number there were 46 incontinent women and 20 women without urinary incontinence (UI). Patients were after vaginal and abdominal hysterectomy.*

Methods used: *Surface electromyography (EMG) for the evaluation of pelvic-floor functionality according to Perfect Scheme (performance, endurance and repetitions of contractions, fast contractions, every contraction timed). For the quantification of urine leakage one hour pad weight test has been used. Contlife questionnaire covered the quality of life of stress urinary incontinence patients.*

Rehabilitation methods: *Exercises for stretching, strengthening and relaxing pelvic floor (PF) muscles by means of repeated selected willful contraction or relaxation of PF muscles carried out two times a day with duration time 15 minutes. Group exercises for stretching and relaxing PF muscles two times a week, duration time 30 minutes.*

Results: *After the complex rehabilitation treatment a statistically significant retreat of urinary incontinence has been achieved. Statistically significant relation (r = -0,32) between the strength of PF muscles in (μV) and urinary incontinence in grams (g) has been confirmed the weaker the PF muscles, the more expressive urinary incontinence symptoms and vica versa. Objectively assessed by biofeedback, statistically significant pelvic floor muscles strength increase and improvement of monitored parameters according to Perfect Scheme after the treatment have been proven. We have found that women without urinary incontinence were able to contract pelvic floor muscles without observed muscles fatigue. In the ability to relax abdominal muscles during exercises there were no significant differences recorded between these two groups.*

Key words: *biofeedback method, stress urinary incontinence, pelvic floor, abdominal muscles*

EMG biofeedback jako metoda diagnostyczna i terapeutyczna w zapobieganiu i leczeniu nietrzymania moczu u kobiet

W badaniach starano się zobiektywizować kurczliwość mięśni dna miednicy w ich maksymalnych i przeciętnych wartościach, a także umiejętności pacjentek w zakresie rozluźniania mięśni za pomocą biologicznego sprzężenia zwrotnego (EMG biofeedback) oraz metody Perfect Scheme w formie elektromiogramu. Ponadto pomiary dotyczyły rozluźniania mięśnia prostego brzucha podczas odpowiednich ćwiczeń. Porównaliśmy monitorowane parametry u kobiet zdrowych z pacjentkami cierpiącymi na nietrzymanie moczu, próbując złagodzić objawy przy pomocy kompleksowej fizjoterapii.

Osoby badane: *Grupa składała się z 66 pacjentek, z których 46 cierpiało na nietrzymanie moczu, zaś u 20 zaburzenie to nie występowało. Pacjentki wcześniej przebyły zabiegi pochwowego i brzusznego usunięcia macicy.*

Metoda: *Zastosowano powierzchniową elektromiografię (EMG) w celu oceny funkcjonowania dna miednicy zgodnie z procedurą Perfect Scheme (występowanie, czas trwania oraz częstotliwość skurczów). Dokonywano pomiaru przeciekania moczu w ciągu godziny. Jakość życia pacjentek była oceniana przy pomocy kwestionariusza Contlife.*

Metody rehabilitacji: *Zastosowano 15-minutowe ćwiczenia, powtarzane 2 razy dziennie, których celem było rozciągnięcie, wzmocnienie i rozluźnienie mięśni dna miednicy. Ponadto stosowano ćwiczenia grupowe trwające 30 minut, z częstotliwością 2 razy tygodniowo.*

Wyniki: *Po zastosowaniu rehabilitacji kompleksowej stwierdzono statystycznie istotne wycofywanie się objawów nietrzymania moczu. Wyraża to zależność (r = -0,32) pomiędzy siłą mięśni dna miednicy (w μV) a nietrzymaniem moczu (w gramach). Oznacza to, że w miarę osłabiania siły mięśni dna miednicy nasilają się objawy nietrzymania moczu i odwrotnie. Stwierdzono również, że kobiety niewykazujące objawów nietrzymania moczu mogły kurczyć mięśnie dna miednicy bez oznak zmęczenia. W trakcie ćwiczeń stwierdzono, że w zakresie umiejętności rozluźniania mięśni brzucha brak było istotnych różnic pomiędzy porównywanymi grupami kobiet.*

Słowa kluczowe: *metoda biologicznego sprzężenia zwrotnego (biofeedback), stres, nietrzymanie moczu, dno miednicy, mięśnie brzucha*

INTRODUCTION

The International Continence Society defines urinary incontinence (UI) as the complaint of any involuntary leakage of urine [1]. Though UI does not pose a threat to life, it has, due to its unwanted occurrence, an impact on the quality of life and causes high curative costs which makes it a serious medical, psycho-social and economical problem. The occurrence of UI in women in Slovakia was published by Švihra et al. [19]. The lowest occurrence of UI was in the age group from 30 to 39 years (23,3%), the highest occurrence was in the age group above 80 years (55,6%). Epidemiological studies that evaluated the occurrence of UI and were conducted in recent years in Europe and USA have shown that its prevalence in women is (on average) around 27% and in half of all cases it is classified as stress urine incontinency [13]. Every other woman, including young women, develops in the course of her life urinary incontinence. Around half of all forms of UI present stress urinary incontinence cases. We have focused our attention to conservative treatment of stress urinary incontinence. Our rehabilitation treatment has been concentrated on the symptom alleviation of stress UI by utilizing EMG biofeedback module and PF muscles training.

STATE OF THE ART OF PROBLEM OVERVIEW OF PREVIOUS RESEARCH

Bo and Sherbun [4] have found that in the majority of people these muscles are not well trained and there is a great potential in strengthening them. Training of these muscles may compensate for further factors associated with UI. By this training urine leakage could be reduced or completely eliminated. Many studies have disclosed that more than 30% of women are not capable to properly contract PF muscles after the first instruction (consultation). To get the desired effect one should be aware of the very important factors in the treatment of UI, such as patient's good cooperation with qualified personnel and proper conducting of exercises, intact nerves and muscle system unharmed.

Dannecker [7] observed the effect of the biofeedback assisted training of PF muscles to enhance the stress and mixed UI therapy. In his study he presented his seven years experiences with 390

women patients. The aim of this study was to point out to short and long term effect of EMG-biofeedback assisted training of PF muscles in the treatment of stress and mixed UI therapy. From the viewpoint of short term improvement a statistically significant improvement in provoked cough test has been confirmed. Also a significant improvement has been confirmed in Oxford Score and 95% patients experienced subjective improvement. EMG electric potential has been raised (11,3 – 20,5 μV). Also in this study statistically significant effect of intensive training of PF muscles, supplemented with EMG-biofeedback, has been proven.

Bo [5] points out that incontinent patient do not know how to contract and relax PF muscles. These patients do not feel the difference between relaxing of the mentioned muscles group and their contraction. PF muscles can be weakened to a various degree and their feedback may be inadequate. Also various degree of functional insufficiency may be present. Muscular coordination activity may also be disturbed. Fear of possible urine leakage increases muscle static tension, sometimes in all muscle groups in body.

The American Academy of Neurology proposed recommendation degrees for EMG utilization. Scientific research results have confirmed that surface EMG method is considered an acceptable tool for evaluation of objectification of PF muscles contraction [18].

RESEARCH PROJECT

The aim of our research has been the improvement of PF muscles contractions scanned by a vaginal probe according to Perfect Scheme with the aid of biofeedback and comparison of the given parameters between the groups of incontinent and continent women patients. Then we have conducted the correlation of the values of maximal contractions measured in μV units with the amount of leaked urine in grams and also assessed the ability to relax m.rectus abdominis during the performance of targeted exercises in both groups to achieve the best possible results.

RESEARCH SAMPLE

A research sample consisted of 66 women patients after vaginal and abdominal hysterectomy. The patients were randomly allocated to the research by a simple stratified selection. The criterion for the selection was hysterectomy for uterus myomatosus. Exclusion criteria were hysterectomy due to carcinoma and hysterectomy due to drop of PF. The first group consists of 46 women – incontinent patients with average age of 50,39 years. The second group contained 20 women patients without incontinence with average age of 49,3 years. The patients were, as mentioned before, after vaginal and abdominal hysterectomy, examined by gynecologist and recommended for a complex rehabilitation therapy and training for UI. The respondents came from various parts of Slovakia. From the viewpoint of stated diagnosis, one part of patients had suffered from first degree stress urinary incontinence (SUI). In the given case of incontinence type urodynamic examination is not indicated. In the given period the patients were not treated for any other serious disease. Both types of operations were carried out in January – March 2009.

METHODS

The questionnaire, which we have used, has been selected from the Medline data base. It is a specific questionnaire and its validity has been verified by statistical studies [23].

a) The Questionnaire evaluating quality of life in patients with UI.

CONTLIFE – a questionnaire designed for women with stress UI [3]. Includes daily and physical activities, personality and emotional consequences , sexual life and quality of life.

b) Surface electromyography (EMG)

Name of apparatus: Biofeedback 2000 x-pert

Manufacturer: SCHUHFRIED GmbH, Austria

Form of the training: neuro-muscular rehabilitation

Data processed statistically on apparatus information panel (screen)

Maximum value: highest value of contraction during monitored period of time

Minimum value – the lowest value of contraction during monitored period of time **(**ability to relax PF muscles)

Difference: recorded difference between maximum and minimum values of PF muscles contraction

Average: arithmetic mean of recorded PF muscles contraction

Length of one session: 10 minutes – a recording evaluated according to PERFECT scheme

PERFECT scheme according to Laycock, Sherbun [11].

PERFECT scheme supplies information on PF-functional status and evaluates the important parameters given below. It has been used as a form of a palpable examination and we have objectivised it by the surface EMG.

P – Performance – strength. A four degree scale is used (no contraction, weak contraction, normal contraction, strong contraction) 0 – 4.

E – Endurance. The patient is requested to produce maximum PF voluntary contraction. The time of contraction weakening is measured. It is given in seconds, maximum 10 seconds.

R – Repetitions. The patient is requested to produce repeated maximum contractions lasting for 3 seconds. The number of contractions until fatigue or the contractions quality decrease is recorded (up to 10 contractions).

F – Fast contractions. The patient is requested to produce repeated maximum PF contractions lasting for maximum 1 second. The number of contractions until fatigue or contractions quality declines are recorded (up to 10 contractions).

Every **C**ontraction **T**imed: The patient is requested to voluntarily cough. The presence or absence of simultaneous reflex contraction of PF muscles is assessed by palpitation.

c) One Hour Pad Test according to Mayne [12]. Activities performed during the pad-weighing test: Pre-weighed pads are placed into leak-proof panties. During 15 minutes the patient drinks 500 ml liquid, then she walks for 30 minutes, including walking up and down the stairs. After that she gets up ten times from the sitting position, ten times she coughs, then she runs for one minute on the spot; five times she bents to lift an object from the floor. After that she washes her hands under running water for one minute. Remaining incontinence: 1. No, if the pad weighs less than 2g/hour. 2. Mild, if the pad weighs up to 10g/hour. 3. Moderate, if the pad weighs up to 10 –50 g/hour. 4. Severe, if the pad weighs more than 50 g/hour.

REHABILITATION METHODS

PF muscles training (gymnastics) – PF muscles training has been defined as repeated, selected, willful contraction or relaxation of certain PF muscles. This training requires knowledge on the use of a proper muscle and exclusion of unwanted contraction of connected muscle groups /10/. Individual exercises were carried out two times daily for 15 minutes, group exercises were carried out two times a week for 30 minutes.

Biofeedback – Patients carried out exercises with biofeedback according to PERFECT scheme. They were individually instructed by skilled health personnel with regard to the exclusion of unwanted muscles groups (m. rectus abdominis, m. adductores) during training. The program of the training consisted of stretching of PF muscles. The recording was conducted in supine position.

Vaginal electrode has been used for sensing PF muscle contraction. The recording is shown in the form of electromyogram on a computer screen. A special, targeted training utilizing contraction and relaxation elements has led to gradual strengthening of weakened muscles of PF and to the reduction of UI symptoms.

Placing of 3 self adhesive electrodes on the lower abdomen over the insertion m. rectus abdominis. The objective of the training was to obtain maximal relaxation of m. rectus abdominis during maximal contraction of PF muscle. Recomended length of one exercises: 10 minutes.

RESEARCH

The research was carried out in the Spa Center facilities „Liptovské liečebné kúpele a.s., Lúčky", in the time span June-August 2009. The study was approved by the Ethics Committee and the patients gave their informed consent. They had been selected randomly for this research. A dependent variable was the occurrence of UI, independent variables were – biofeedback and training (exercises) on UI. Rehabilitation examination, biofeedback and questionnaire method were carried out at the beginning of the spa treatment and at the end of this treatment. The instructions were supplemented with regard to proper conducting of exercises in UI and biofeedback. During the rehabilitation treatment patients continued with indicated pharmacotherapy which did not affect the symptoms of UI. After the completion of three weeks long spa treatment we have gained information on the effect of the rehabilitation treatment based on a thorough physiotherapeutic examination of patients and by EMG biofeedback, pad weight test and the questionnaire method.

HYPOTHESES

H1: We have assumed a significant reduction of symptoms of UI in patients with stress incontinence after the completion of complex rehabilitation treatment, which was to be evaluated with pad test and questionnaire method.

TABLE 1. Contlife questionnaire score comparison before and after treatment by Wilcoxon test

Contlife before and after treatment	n	$\bar{x}$ -before treatment	SD	$\bar{x}$ after treatment	SD	p
Daily activities	46	12,63	4,99	11,00	4,68	**p<0,01**
Physical activities	46	8,65	3,65	7,26	3,49	**p<0,01**
Personality	46	8,13	2,82	7,45	2,58	**p<0,01**
Emotional consequences	46	13,26	5,9	11,93	5,47	**p<0,01**
Sexual life	46	2,84	2,26	2,76	2,04	0,20
Quality of life	46	2,15	1,13	1,86	0,83	**p<0,02**
Total score	46	47,65	15,12	42,28	13,73	**p<0,01**

N – number, $\bar{x}$ – average score , SD – standard deviation, p – significance level

TABLE 2. Pad test in grams compared before and after the treatment by Wilcoxon test

PW v g	n	$\bar{x}$	SD	p
Before treatment	46	5,24	4,01	
After treatment	46	3,55	3,13	**p<0,01**

N – number, $\bar{x}$ – average score, SD – standard deviation, p – significance level

TABLE 3. Correlation between PF muscles strength – (μV) and UI (g)

PW (g)	n	r
Maximum values of muscle strength	46	-0,32

N – Number, r – Spearman correlation coefficient, p – significance level , PW – One Hour Pad Test

TABLE 4. PF muscles functionality status monitored by surface EMG in incontinent patients compared by Wilcoxon test (paired)

SI Comparison of the strength of PF muscles before and after treatment	N	T	Z	$\bar{x}$ before	$\bar{x}$ after	SD before	SD after	p
Maximum values of muscle strength PF-performance v(μV)	46	70	4,5	31,28	39,02	15,31	17,21	**p<0,01**
Duration of maximum voluntary contraction	46	97,5	2,40	2,84	3,76	2,17	3,07	**p<0,01**
Repeating of maximum contractions	46	49,5	3,88	6,63	8,47	2,79	2,04	**p<0,01**
Fast repeated maximum contractions	46	20,5	4,25	6,02	7,93	2,81	2,35	**p<0,01**
Minimum values of MS PF v(μV)	46	337	2,03	2,10	2,81	1,43	2,39	**p<0,04**
Average values of MS PF v(μV)	46	154	4,1	13,93	16,83	9,18	9,11	**p<0,02**

N – number, T – score, Z – score, $\bar{x}$ – average score, SD – standard deviation, p – significance level MS – muscle strength, PF – PF, SI – incontinent patients

TABLE 5. PF muscles functionality status monitored by surface EMG in patients without UI compared by Wilcoxon test (paired)

WI comparison of PF MS before and after treatment	N	T	Z	$\bar{x}$ before	$\bar{x}$ after	SD before	SD after	p
Maximal values of PF MS PF-performance v(μV)	19	31,0	2,37	29,88	38,26	14,13	15,11	**p<0,01**
Duration of maximal voluntary PF muscles contraction PF-endurance v (s)	19	13	2,27	3,65	4,78	3,63	5,11	**p<0,02**
Repetition of PF muscles contractions	19	8	1,4	8,5	9,15	2,52	1,70	1,61
Fast repeated maximal contraction	19	16,5	1,12	8,25	8,52	1,86	1,74	0,26
Minimal values of PF MS PF v(μV)	19	63	1,28	2,04	2,86	1,72	2,47	0,19
Average values of PF MS PF v(μV)	19	41	2,17	12,50	16,66	7,44	8,58	**p<0,02**

N – number, T – score, Z-score, $\bar{x}$ – average score , SD – standard deviation, p – significance level MS – muscle strength, PF – PF, WI – without incontinence

TABLE 6. Average values of m.rectus abdominis activation in μV, before and after the treatment in incontinent and continent patients

Average values of muscles strength in (μV) of - RA-m.rectus abdominis	$\bar{x}$ SI	$\bar{x}$ WI	SD SI	SD WI	N SI	N WI	p
Before treatment	5,63	6,03	3,67	4,18	46	20	0,70
after treatment	5,73	7,48	4,32	5,29	46	20	0,17

n – number, $\bar{x}$ – average score , SD – standard deviation, p – significance level PF – PF, SI – incontinent patients, WI – without incontinence

H2: We have assumed significant differences between the groups of incontinent and continent patients in the functional status of PF and the objectivisation has been carried out by EMG biofeedback according to PERFECT scheme.

H3: We have assumed that in incontinent women a statistically significant higher activation of m.rectus abdominis before and after the treatment will be recorded than in continent women.

RESEARCH RESULTS

The obtained data from patients have been processed statistically with the aid of the statistical software package STATISTICA using the following methods: **unpaired t-test, Wilcoxon test (paired)-**non-parametric comparison of two variables, **Correlation** (Spearman´s correlation coefficient) is the measurement of mutual relation of two or several variables. The research results are given in the sequence identical with formulated hypotheses.

After the physiotherapeutic treatment completion a significant urine leakage decrease was experienced in situations such as daily activities, physical activities, personal wellbeing, emotional consequences, quality of life, as well as in total score in the given questionnaire; in sexual life the improvement was not significant. The stay in spa resort meant a significant change in the patients´ life and family stereotypes and that is why we assume the sexual life quality issue has not yet been completely relevant at that time.

We have compared the incontinence symptoms evaluated with pad test in grams before and after the treatment. After completion of physiotherapeutic treatment a statistically significant decrease in urine leakage followed in grams on the significance level of $p < 0,01$.

The amount of leaked urine in grams has been correlated with maximum PF muscles strength in micro volts (μV). The obtained negative value of Spearman correlation coefficient r=-0,32 means that the statistical significance in relation between PF muscles strength and UI has been confirmed – e.g. the weaker the PF muscles, the higher the UI symptoms and vice versa. **H1 we have accepted.**

URINE INCONTINENT PATIENTS

In all monitored parameters statistically significant differences after the completion of treatment were confirmed. The maximum strength of muscles, the length of duration of maximal contraction, number of maximal contractions and number of fast contractions were increased. The value of minimal activation points out to the ability of PF muscles relaxation. The values of minimal activation were statistically significantly increased, which however was not necessary. It points out to the incontinent patients´ effort to increase the strength of PF muscles and their lower ability to relax the PF muscles.

PATIENTS WITHOUT URINARY INCONTINENCE

Statistically significant difference in PF maximal muscle strength, as well as in the duration length of voluntary contraction has been confirmed. The minimal activation of PF muscles assessed their ability to relax. Contrary to the group of patients with incontinence, the patients without incontinence maintained a better ability to relax PF muscles. Statistically significant differences in the increased number of repeated maximal contractions, as well as in the increased number of fast contractions have not been confirmed. The increase of maximal muscle strength (MS) and duration length of voluntary contractions have been obtained by applying the training exercises (gymnastics) to PF muscles; the increase in number of maximal and fast contractions remained unchanged however, but their number was also optimal before the treatment.

MUTUAL COMPARISON OF INCONTINENT AND CONTINENT PATIENTS

The continent patients had a statistically significantly higher number of repetitions of maximal and fast contractions without an objective muscle fatigue before the commencement of the

treatment compared to the incontinent patients. In other monitored parameters no statistically significant differences have been confirmed. The same assessment we have conducted in both groups after the treatment. In the monitored parameters no significant differences have been confirmed.

Comparison of the activation of m.rectus abdominis while carrying out PF muscle contraction before and after the treatment.

The objective of the training was also achieve the maximal relaxation of m. rectus abdominis during maximal contraction of PF muscle.

Before commencing the treatment no statistically significant differences in the activation of m.rectus abdominis during exercise performance between incontinent and continent patients were confirmed. After the treatment also no statistically significant differences in the ability to relax the mentioned muscle were confirmed. Higher mean values were recorded in the group of continent patients. It suggests the assumption that the incontinent women put more effort to carry out the exercises more precisely.

H 3 we cannot accept.

DISCUSSION

It has been known that patients at the beginning of treatment are not able to perform separated (isolated) contraction of PF muscles. After the biofeedback treatment they were able to better understand this kind of technique and their self-control in training has been improved [4].

In our research we have tried to alleviate of UI symptoms and to improve PF functionality status by means of Biofeedback Method. Also the patients have been individually instructed and trained how to properly conduct these exercises with the reduction of the activity of m.rectus abdominis during the contraction of PF-muscles. This kind of exercises is recommended for the risk groups within the framework of UI-prevention in risk groups such as our control group of continent women after hysterectomy.

DISCUSSION REGARDING THE REHABILITATION TREATMENT

Our expectation was a significant decline of UI symptoms in patients with stress incontinency. After the completion of the complex physiotherapeutic treatment we have evaluated the results by the pad test and the questionnaire.

We have compared urine incontinency symptoms evaluated by pad test in grams before and after the treatment. After completion of the spa treatment there was statistically significant symptoms retreat of urine leakage in grams evident.

Also significantly reduced urine leakage in such situation as daily activities, physical activities, the effect of the reduced urine leakage on the personality of the patients, on their personal feelings, their quality of life in the overall score of the given questionnaire has been confirmed. The improvement in sexual life cannot be assessed as significant, however. The stay in the spa rehabilitation centre meant a significant change for the patients with regard to their life and family stereotypes and that is why we have assumed that the improvement of the quality of their sexual life has not been fully relevant yet. We do believe that the training of PF muscles with biofeedback and exercises for strengthening of PF muscles in good cooperation of patients with personnel have significantly contributed to urine incontinence symptom retreat.

We have correlated the amount of urine leaked in grams with the maximal muscles strength of PF in micro volts (μV).The obtained negative value of Spearman's correlation coefficient r=-0,32 which means that the statistical significance of the relation between PF muscles strength and incontinency has been confirmed i.e. the weaker the PF muscles, the stronger the UI symptoms , and vica versa.

These findings confirm the Hypothesis 1 and are also in conformity with the research results publicized in foreign literature [8, 21].

The strength of muscles of PF has been evaluated and the comparison of individual parameters according to PERFECT scheme has been carried out.

When comparing incontinent and continent women groups before and after the treatment following findings were obtained: women without incontinence achieved a higher number of repetitions of maximal and fast contractions without muscle fatigue occurrence as against incontinent patients. These findings illustrate the fact that there are differences between these groups with regard to greater endurance of PF muscles in continent women than in incontinent women.

In incontinent patients the strength of PF muscles has been significantly increased after the therapy**.** The values of minimal activation have been statistically significantly increased, which however was not needed. It shows the effort of the incontinent patients to concentrate on the increasing PF muscles strength and lowering the ability to relax these muscles. We assume that a longer

period of time would be required to train PF muscles relaxation. Also increased was the length of duration of maximal contraction and the number of fast contractions. We believe that the training of PF muscles with biofeedback and exercises to strengthen these muscles exerted strong effect on the improvement of the functional status of PF and on the PF muscles strength increase. Similar findings were reported by other authors [2, 9, 7, 15, 16, 22].

Patients without UI: In monitored items statistically significant difference after the completion of the physiotherapeutic treatment has been confirmed, with the exception of minimal value of PF muscles strength, which was not desired, however. Contrary to the group of urine incontinent patients, the patients without UI retained a better ability to relax PF muscles. A statistically significant difference in the increase in number of repeated maximal contractions and also in number of fast contractions has not been confirmed, but their number was also optimal before the treatment. Maximal muscles strength increase and duration length of voluntary contractions have been achieved due to the effect of the PF muscles training.

An important finding is that some patients without incontinence can have weakend PF muscles. It can be asumed that in these patients there is a higher risk of developing UI. For this reason it seems to be advisable to carry out excercises for strengthening PF muscles as a prevention to develop UI.

PF muscle training using biofeedback method and exercises for strengthening PF muscles contributed to muscle strength increase, which is achieved by muscle inneravtion changes, higher excitation frequency and by engaging new motor units into contraction. These changes occur during the first weeks of training. Muscle strength can thus be increased up to 100% [17]. Also hypertrophy is developing, this process, however, is much slower.

We have compared the activation of m.rectus abdominis during carrying out PF muscle contraction before and after the treatment between the two groups.

No significant differences in the assessment of mean values of m.rectus abdominis before and after the treatment have been recorded. Higher mean values were recorded in the group of continent patients. It underlines the effort of incontinent women to carry out the exercises more precisely**.** We assume that lowering the activation of m.rectus abdominis during training would require a longer period of time than the length of the administered training during the treatment.

Pelvic floor muscle exercises and concurrent abdominal muscle relaxation was examined by Neumann P.Gill [14]. His results indicate, that it is not possible to contract PF muscles effectively, while maintaining relaxation of the deep abdominal muscles. Our observation was similar though we have assumed that it could be attempted by further training.

CONCLUSION

PF- muscles activity measurement is a developing method that is dynamically changing after making use of available new technologies.

1. From the diagnostic point of view: the most important contribution of this research is the possibility of objectivation of PF muscles contractions. It makes possible the evaluation of maximum and average contraction – monitoring the length of maximal contraction, number of repeated maximal and fast contractions, ability to relax PF muscles. Activation of m.rectus abdominis during training can be objectives too, eventually in further undesired muscle groups.
2. From the therapeutic point of view: current check of biofeedback treatment result enhances patient's motivation and induces a more favorable mental status especially in long-lasting training.
3. During the biofeedback method training the patient has optimal condition to perform the exercises in a correct way. The patient shall effectively learn to carry out isolated contractions of PF- muscles, excluding unwanted contractions of associated muscle groups if possible.

The problems with the UI in women regardless of age, present today current problems. A complex rehabilitation treatment can be used in case of light forms of UI, and also within the framework of its prevention and in case of worsening its clinical picture. The rehabilitation treatment results can be considered as prognostically favorable providing responsible and complex approach is used in treatment of the given disease.

RECOMMENDATION FOR FURTHER RESEARCH

Comparison of maximal strength of PF muscles – evaluated by EMG biofeedback with dynamometry and with maximal urethral closing pressure, and correlation with ultrasound investigation of symmetric contraction of the monitored muscles. Comparison of the given parameter with

further women risk groups (heavy smokers, obesity, heavy vaginal delivery).

REFERENCES

1. Abrams P., Cardozo L., Fall M., Griffiths D., Rosier P., Ulmsten U., van Kerrerbroecker P., Victor A., Wein: *The standardization of terminology of lower urinary tract function. Report from the Standardization Sub – committee of the The International Continence society.* Am J Obset Gynecol, 2002, 187, 116–126.
2. Aksac B., Aki S., Karan A., Yalcin O., Isikoglu M., Eskiyurt N.: *Biofeedback and PF exercises for the rehabilitation of urinary stress incontinence.* Gynecol Obstet Invest. 2003; 56: 23–27.
3. Amarenco G., Arnould, B., Carita P. et. al.: *European psychometric validation of Contlife: a quality – of – life questionnaire for urinary incontinence.* Eur. Urol. 2003, 43, 391–404.
4. Bo K., Sherburn M.: *Evaluation of female pelvic – floor muscle function and strength*. Phys Ther, vol. 85, no. 3, march 2005, pp. 269–282.
5. Bø K., Larsen S., Oseid S. et al.: *Knowledge about and ability to correct pf muscle exercises in women with urinary stress incontinence*. Neurourol urodyn. 1988; 7: 261–262.
6. Dumoulin C., Lemieux M.C., Bourbonnais D., Gravel D., Bravo G., Morin M.: *Physiotherapy for persistent postnatal stress urinary incontinence: A randomised controlled trial.* Obstet Gynecol. 2004; 104: 504–510.
7. Dannecker Ch., Wolf V., Raab R., Hepp H., Anthuber Ch.: *EMG – biofeedback assisted PF muscle training is an effective therapy of stress or mixed urinary incontinence: a 7 year experience with 390 patients*. A. Gynecol Obset, 2005.
8. Goode P.S., Burgio K.L., Locher J.L., Roth D.L., Umlauf M.G., Richter H.E., Varner R.E., Lloyd L.K.: *Effect of Behavioral training With or Without PF Electrical Stimulation on Stress Incontinence in Women.*, JAMA, July 16, 2003, Vol 290, No. 3, p. 345–352.
9. Johnson V.Y.: *Effects of submaximal exercise protocol to recondition the PF musculature.* Nursing Research. 2001; 50: 33–41.
10. Kolařík D.: *Konzervatívní léčba v urogynekologii, (Conservative treatment in Urogynecology)* In: HalaškaM. a kol.: Urogynekologie, Galén, Praha, 2004, ISBN 8072622722, p. 75–80.
11. Laycock J., Jerwood D.: *PF – asssessment: the P.E.R.F.E.C.T. scheme.* Physiotherapy, 87, 2001, 87, p. 631.
12. Mayne C.J., Hilton P.: *Short apd test: method and comparison with one – hour test.* Neurourol. Urodyn., 1988, 7, 5, p. 443–445.
13. Minassian V.A., Drutz H.P., AI – Badr A.: *Urinary incontinence as a worldwide problem.* Int J Gynaecol Obset 2003, 82, 327–338.
14. Neumann P., Gill V.: *PF and abdominal muscle interaction: EMG activity and intra-abdominal pressure.* Int Urogynecol J PF Dysfunct. 2002; 13: 125–132.
15. Neumann P.B., Grimmer K.A., Deenadayalan Y.: *PF muscle training and adjunctive therapies for the treatment of stress urinary incontinence in women: a systematic review.* BMC Women's Health, 2006, 6, 11.
16. Parkkinen A., Karjalainen E., Vartiainen M., Penttinen J.: *Physiotherapy for female stress urinary incontinence: Individual therapy at the outpatient clinic versus home-based PF training: A 5 year follow-up study.* Neurourol Urodyn. 2004; 23: 643–648.
17. Pollock M., Gaesser G., Butcher J., et. al.: *The recommended quantity and quality of exercise for developing and maintaing cardiorespiratory and muscular fitness and flexibility in healthy adults.* Med. Sci. Sports. Exerc., 1989, 30, 6, p. 975–991.
18. Pullman S.L., MD, FRCP(C); D.S. Goodin, MD; A.I. Marquinez, MD; S. Tabbal, MD, M. Rubin, MD, FRCP(C): *Clinical utility of surface EMG Report of the Therapeutics and Technology Assessment, Subcommittee of the American Academy of Neurology*, Neurology 2000; 55: 171–177.
19. Švihra J., Baška T., Mona M., Bushnell D., Kliment J., Lachváč Ľ., Valanský L., Ľupták J., Sopilko I., Dušenka, M.: *Prevalencia ženskej močovej inkontinencie v Slovenskej republike (Prevalence of women UI in the Slovak Republic)*. Urológia 2001, 7, 2, p. 29–34.
20. Halaška M., Otčenášek M.: *Fyziologie funkce dolního močového ústrojí(Physiology of the function of lower urine tract)* In: Halaška, M., Urogynekologie, Galén, Praha, ISBN 8072622722, 2004, p. 18–20.
21. Thompson J., O´Sullivan P., Briffa K., Neumann P.: *Correct performance of PF muscle exercises counts*, Physiotherapy Research Update, 2007.
22. Wong K.S., Fung K.Y., Fung S.M., Fung C.W., Tang C.H.: *Biofeedback of PF muscles in the management of genuine stress incontinence in Chinese women.* Physiotherapy. 2001; 87: 644–648.
23. Zachoval R., Krhut J., Zámečník L., Hanuš T., Čelko A.M.: *Dotazníky hodnotící kvalitu života u pacientu s inkontinencí moči a hyperaktivním měchýřem. (Questionnaires assessing LF of patients with UI and hyperactive bladder)* Urolog.pro praxi, 2006, 6, 286–296.

PhDr. Magdalena Hagovska Ph.D.
Physiatry, Balneology and Medical Rehabilitation Clinic,
LF UPJŠ and L. Pasteur Faculty Hospital,
Rastislavova 43,
Košice, 04001, Slovakia
Tel.: 00421944400846, 055 6152090
E-mail: lehag@centrum.sk