



Full length article



The impact of short-term pelvic floor muscle training on the biomechanical parameters of the pelvic floor among patients with stress urinary incontinence: A pilot study

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ABSTRACT

Objective: Our study aimed to improve the understanding of the biomechanical changes occurring in the pelvic floor due to pelvic floor muscle training (PFMT), which is responsible for improving stress urinary incontinence (SUI) symptoms.

Study design: In this prospective cohort study, we examined the impact of a six-week PFMT program in women with stress or stress-predominant urinary incontinence on the biomechanical parameters of the pelvic floor. Fifty-two biomechanical parameters were measured by Vaginal Tactile Imager (VTI) at baseline and at a six-week follow-up. In addition, we have assessed the Urinary Distress Inventory (UDI-6), Incontinence Impact Questionnaire (IIQ-7), and Patient's Global Impression of Severity (PGI-S) scores at enrolment and at six-week follow-up. We have divided our cohort into two groups, Improved Group (IG) and Not-improved Group (NIG), based on the change in UDI-6 score after six weeks and compared the biomechanical changes within and between the two groups.

Results: The overall cohort included twenty women with stress or stress-predominant SUI based on MESA questionnaire [MESA SUI index (mean $\pm$ SD) 63.3 % $\pm$ 24.0 %, MESA UII index (mean $\pm$ SD) 13.3 % $\pm$ 15.3 %, $p < 0.01$]. Nine of the 52 VTI parameters have changed significantly after six weeks of PFMT in the entire cohort. Eleven women (IG) achieved the minimum 11-point change in the UDI-6 scaled score. In IG, we found that three VTI parameters differed significantly: Parameter 1: the maximum value of force measured during the VTI probe insertion [(N, mean $\pm$ SD) 0.55 $\pm$ 0.18 vs. 0.78 $\pm$ 0.31, $p < 0.049$], parameter 18: the maximum gradient at the upper third of the vagina (posterior) [(kPa/mm, mean $\pm$ SD) 0.16 $\pm$ 0.05 vs. 0.36 $\pm$ 0.28, $p < 0.048$], and parameter 47: integral force change in the anterior compartment at reflex pelvic muscle contraction (cough) [(N, mean $\pm$ SD) 1.61 $\pm$ 0.85 vs. 1.97 $\pm$ 0.71, $p < 0.045$].

Conclusion: Our study revealed a significant association between the improvement of strength in targeted muscle groups and a reduction in urinary incontinence symptoms. Identifying specific muscles changing PFMT provides valuable insights for specific interventions. Our findings may help to create personalized and targeted interventions to improve the quality of life of women affected by SUI.

Abbreviations: UI, urinary incontinence; SUI, stress urinary incontinence; MUI, mixed urinary incontinence; UII, urge urinary incontinence; ISD, intrinsic sphincteric deficiency; PFMT, pelvic floor muscle training; PFM, pelvic floor muscle; IG, Improved Group; NIG, Not-improved Group; MCID, minimal clinically important difference; BMI, body mass index; UDI-6, Urinary Distress Inventory; MESA, Medical, Epidemiologic, and Social Aspects of Aging; IIQ-7, Impact Questionnaire; PGI-S, Patient's Global Impression of Severity; PGI-I, Patient's Global Impression of Improvement; VTI, Vaginal Tactile Imager; BI-score, Biomechanical Integrity score.

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Introduction

Urinary incontinence (UI) is a prevalent and distressing medical condition [1]; approximately 50 % of women experience involuntary loss of urine at some point in their lives [2]. UI contributes to a significant financial burden and significantly diminishes the quality of life [3]. The major subtypes of UI include stress, urge, and mixed UI [4,5]. The prevalence of SUI at 12.6 % surpasses that of mixed urinary incontinence (MUI) at 9.1 % and urgency urinary incontinence (UUI) at 5.3 % [6]. The International Urogynecological Association (IUGA) and International Continence Society (ICS) joint report define SUI as a „complaint of involuntary loss of urine on effort or physical exertion” [5]. The pathophysiology of SUI involves anatomical, physiological, and functional aspects. Deficient urethral support is associated with loss of connective tissue and/or muscular strength due to chronic pressure or trauma. Another pathophysiology behind the SUI is intrinsic sphincteric deficiency (ISD). This type of SUI results from loss of urethral integrity; the sphincter cannot effectively close and create sufficient resistance to keep urine within the bladder [7].

The first-line treatments of UI are lifestyle modifications and pelvic floor muscle training (PFMT) [8,9]. Previous publications have described the rationale for appropriate PFMT, an effective, cost-effective, non-invasive first-line treatment that improves pelvic floor muscle strength, endurance, power, relaxation, or a combination of these parameters [10,11]. Despite considerable research, the exact mechanism of action of PFMT in SUI is unknown. While various potential mechanisms are known, they lack strong supporting evidence. Without this understanding, it is challenging to identify appropriate indications for PFMT, leading to inquiries into the best timing and methods for its introduction to maximize effectiveness. It is unclear whether understanding PFMT can be effectively translated into practical application.

Vaginal Tactile Imaging (VTI) is a novel technology that constructs a visual representation of the biomechanical properties of the female pelvic floor. This visualization is based on an analysis of 52 parameters [12]. Subsequently, the system generates the Biomechanical Integrity (BI) Score, a quantitative characterization of the pelvic floor's biomechanical state [13].

Our study aimed to understand better the biomechanical process occurring with PFMT. We hypothesized that PFMT results in significant changes in the biomechanical properties of the pelvic floor in women with SUI assessed by VTI.

Materials and methods

This prospective cohort study recruited a cohort of 20 women aged 18 years and older with stress-predominant urinary incontinence at the Urogynecology Outpatient Unit of the University of Debrecen, Hungary. Our study was approved by the Scientific and Research Ethics Committee of Hungary: 2876-13/2022/EÜIG. Inclusion criteria encompassed women exhibiting stress or stress-predominant urinary incontinence as determined by the Medical, Epidemiologic, and Social Aspects of Aging (MESA) questionnaire [14,15]. Exclusion criteria included pregnancy or a postpartum period of less than 12 months, self-reported symptoms of pelvic organ prolapse or a POP-Q stage > 2, a history of more than three vaginal deliveries or any prior operative delivery, a history of supervised PFMT within the past 12 months, current use of medications for urinary incontinence or surgical treatment for urinary incontinence, and the presence of collagen or connective tissue diseases.

Following enrolment, participants were asked to complete the Urinary Distress Inventory (UDI-6) and Incontinence Impact Questionnaire (IIQ-7) [16,17]. After a standardized pelvic examination, the biomechanical properties of the pelvic floor were assessed, along with voluntary and involuntary contractions, using Vaginal Tactile Imager. Patients received detailed pelvic floor muscle exercise instruction and

training with the aid of the perineometer. Study participants were instructed to perform daily pelvic floor muscle exercises at an intensity of at least 65–75 % of one repetition maximum of 45 pelvic floor muscle (PFM) contractions per day (15 PFM contractions performed three times per day) for six weeks as per previous protocols [11]. At the six-week follow-up visit, participants underwent a reassessment involving examination of pelvic floor biomechanical parameters with VTI, completing UDI-6 and IIQ-7 questionnaires, and following pelvic examinations.

Vaginal tactile imager [18]

The VTI provides a high-resolution pressure distribution map of vaginal conditions, as well as a real-time assessment of pelvic floor muscle strength and functionality. The VTI testing protocol consists of eight steps: Tests 1 and 3 provide data to assess the elasticity of the vaginal tissue, and test 2 provides parameters to characterize the strength of the pelvic support. Tests 4–8 provide dynamic pressure patterns for functional characterization. The VTI software automatically calculated 52 parameters, contributing to the BI-score, as a single value.

Questionnaires

Medical, epidemiologic, and social aspects of aging (MESA) questionnaire [14]

The MESA questionnaire is a reliable tool for identifying the stress or urge-dominant component of MUI and assessing symptom severity. It consists of two sections, with a maximum total score of 27 for SUI and 18 for UUI. The stress index, obtained by dividing actual scores by the maximum possible total score, helps discern SUI or stress-dominant MUI from UUI or urge-dominant MUI. SUI severity is categorized as mild (scores 1 to 9), moderate (scores 10 to 18), or severe (scores 13 to 18) based on the total stress score (maximum = 27).

Urogenital Distress Inventory (UDI-6) and incontinence impact questionnaire (IIQ-7) [16]

The UDI-6 consists of six items that assess the severity of urinary symptoms on a 4-point scale. Scores are calculated by multiplying the mean score of answered items within each component by 25, resulting in a scale of 0 to 100. Higher scores indicate greater disability. Conversely, the IIQ-7, tailored as a psychometric questionnaire for urinary incontinence, gauges its psychosocial impact on women. Higher scores reflect a more pronounced effect on overall well-being.

Patient global impression of severity and improvement question (PGI-S and PGI-I) [19]

The PGI-S rates condition severity from 0 (no symptoms) to 4 (severe symptoms), with a minimal clinically important difference (MCID) set at 1. The PGI-I assesses changes in urinary tract condition compared to pre-treatment status on a seven-point scale.

Statistics

For statistical calculations, we used IBM SPSS Statistics for Windows Version 25.0 statistical software (IBM Corp., Armonk, NY, USA). Descriptive statistics were computed for all variables of interest. The continuous outcomes were summarized using means and standard deviations. A D'Agostino-Pearson test was used to assess the normality of data. The Students' *t*-test was used to compare mean values between the two groups. Statistical significance was defined as a two-tailed test with a *p*-value threshold of <0.05.

Results

Twenty women with stress or stress-predominant urinary incontinence participated in our study. Table 1. describes the demographic and

Table 1
Demographics and clinical characteristics of the study group.

	Study Group (N = 20)
Age (years, mean ± SD)	50 ± 13
Gravida (median, range)	2.5 (1–4)
Parity (median, range)	2 (1–3)
BMI (kg/m2, mean ± SD)	27.4 ± 6.2
History of vaginal delivery (n, %)	18 (90)
Postmenopausal (n, %)	9 (45)
PGI-S (mean ± SD)	3 ± 0.8
The severity of SUI according to PGI-S	
Mild (n, %)	4 (20)
Severe (n, %)	16 (80)
MESA SUI index (% , mean ± SD)	63 ± 24
MESA UII index (% , mean ± SD)	13 ± 16
MESA SUI score (mean ± SD)	17.1 ± 6.5
The severity of SUI, according to MESA	
Mild (n, %)	3 (15)
Moderate (n, %)	8 (40)
Severe (n, %)	9 (45)
MESA UII score (mean ± SD)	2.4 ± 2.8

BMI: Body mass index, PGI-S: Patient Global Impression of Severity and Improvement question, Stress urinary incontinence severity category according to PGI-S scores 1 to 2 is assigned as mild, and 3 to 4 as severe. SUI: stress urinary incontinence, UII: urge urinary incontinence, MESA: Medical, epidemiologic, and social aspects of aging urinary incontinence questionnaire, Stress urinary incontinence severity category according to MESA: scores of 1 to 9 is assigned as mild, 10 to 18 as moderate, and 19 to 27 as severe.

clinical characteristics of enrolled women. All participants performed the appropriate daily exercise as instructed based on self-reporting and returned for a follow-up examination. The MESA questionnaire completed at enrolment demonstrated that only patients with stress or stress-predominant urinary incontinence were included in the study, as in all cases, the MESA SUI Index was higher than the MESA UII Index. Accordingly, the overall cohort mean showed a strong stress dominance (MESA SUI index 63.3 % ± 24.0 %, MESA UII index 13.3 % ± 15.3 %, $p < 0.001$).

First, we investigated whether the six-week PFMT significantly reduced urinary symptoms, as assessed by the UDI-6 questionnaire [(mean ± SD) 9.85 ± 3.84 vs. 7.15 ± 4.48, $p = 0.06$]. We also investigated which of the 52 VTI parameters tested changed significantly after six weeks of PFMT. In the whole cohort, the following parameters changed significantly: parameter 1: the maximum value of force measured during the VTI probe insertion [(N, mean ± SD) 0.61 ± 0.40 vs. 0.76 ± 0.37, $p = 0.047$], parameter 3: the maximum value of anterior gradient (change of pressure per anterior wall displacement in the orthogonal direction to the vaginal channel) [(mJ, mean ± SD) 0.84 ± 0.68 vs. 1.25 ± 0.98, $p = 0.01$], parameter 10: maximum pressure at the perineal body [(kPa, mean ± SD) 6.53 ± 4.61 vs. 7.93 ± 5.06, $p < 0.01$], parameter 30: displacement of the maximum pressure peak in the posterior compartment [(mm, mean ± SD) 0.22 ± 4.78 vs. 4.63 ± 4.12, $p < 0.01$], parameter 31: integral force change in the anterior compartment at voluntary muscle contraction [(N, mean ± SD) 1.14 ± 0.88 vs. 1.46 ± 0.90, $p = 0.03$] parameter 32: maximum pressure change in the anterior compartment at voluntary muscle contraction [(kPa, mean ± SD) 15.29 ± 16.04 vs. 21.39 ± 17.90, $p = 0.02$], parameter 34: integral force change in the posterior compartment at voluntary muscle contraction [(N, mean ± SD) 1.17 ± 0.83 vs. 1.70 ± 0.94, $p < 0.01$], parameter 40: integral force change in the left side at voluntary muscle contraction [(N, mean ± SD) 0.59 ± 0.39 vs. 0.81 ± 0.56, $p = 0.04$], parameter 47: integral force change in the anterior compartment at reflex pelvic muscle contraction [(N, mean ± SD) 1.62 ± 0.97 vs. 1.93 ± 0.90, $p = 0.04$] (Table 2).

We have divided our cohort into two groups based on improvement in incontinence symptoms after six weeks. Women with a change in UDI-6 score that reached the previously reported MCID score (11 points) were placed in one group (Improved Group, IG), and those women with

Table 2
The result of the examination of 52 VTI parameters before and after six weeks of PFMT Only the significantly different parameters are presented.

No.	Description	Interpretation	Units	before PFMT	after 6 weeks PFMT	p-value
1	The maximum value of force measured during the VTI probe insertion	Maximum resistance of anterior vs. posterior widening; tissue elasticity at a specified location (capability to resist applied deformation)	N	0.61 ± 0.40	0.76 ± 0.37	0.047
3	The maximum value of anterior gradient (change of pressure per anterior wall displacement in the orthogonal direction to the vaginal channel)	The maximum value of tissue elasticity in the anterior compartment behind the vaginal at a specified location	mJ	0.84 ± 0.68	1.25 ± 0.98	0.01
10	Maximum pressure at the perineal body (posterior)	Pressure feedback of Level III support	kPa	6.53 ± 4.61	7.93 ± 5.06	<0.01
30	Displacement of the maximum pressure peak in the posterior compartment	Mobility of posterior structures Valsalva maneuver	mm	0.22 ± 4.78	4.63 ± 4.12	<0.01
31	Integral force change in the anterior compartment at voluntary muscle contraction	Integral contraction strength of pelvic muscles along the vagina	N	1.14 ± 0.88	1.46 ± 0.90	0.025
32	Maximum pressure change in the anterior compartment at voluntary muscle contraction	Contraction strength of specified pelvic muscles	kPa	15.29 ± 16.04	21.39 ± 17.90	0.023
34	Integral force change in the posterior compartment at voluntary muscle contraction	Integral contraction strength of pelvic muscles along the vagina	N	1.17 ± 0.83	1.70 ± 0.94	<0.01
40	Integral force change in the left side at voluntary muscle contraction	Integral contraction strength of pelvic muscles along the vagina	N	0.59 ± 0.39	0.81 ± 0.56	0.045
47	Integral force change in the anterior compartment at reflex pelvic muscle contraction (cough)	Integral pelvic function at reflex muscle contraction	N	1.62 ± 0.97	1.93 ± 0.90	0.04

a score change of fewer than 11 points were placed into the other group (Not-improved Group, NIG). Eleven women achieved the minimum 11-point change in the UDI-6 scaled score, and nine did not. There was no significant difference in demographic and clinical data between the IG and NIG. In addition, there were no differences in the VTI values of the two groups at the beginning of the study. We compared the changes within the two groups after the six weeks of PFMT in VTI data. In IG, we found that the three parameters differ significantly. Parameter 1: the maximum value of force measured during the VTI probe insertion [(N, mean $\pm$ SD) 0.55 ± 0.18 vs. 0.78 ± 0.31 , $p < 0.049$], parameter 18: the maximum gradient at the upper third of the vagina (posterior) [(kPa/mm, mean $\pm$ SD) 0.16 ± 0.05 vs. 0.36 ± 0.28 , $p < 0.048$], parameter 47: integral force change in the anterior compartment at reflex pelvic muscle contraction (cough) [(N, mean $\pm$ SD) 1.61 ± 0.85 vs. 1.97 ± 0.71 , $p < 0.045$] showed significant difference (Table 3).

Among NIG patients, we found that seven parameters differ significantly. Parameter 3: the maximum value of anterior gradient change of pressure per anterior wall displacement in the orthogonal direction to the vaginal channel [(kPa/mm, mean $\pm$ SD) 0.88 ± 0.40 vs. 1.30 ± 0.73 , $p = 0.043$], parameter 9: maximum pressure at the cervix area [(kPa, mean $\pm$ SD) 3.68 ± 1.59 vs. 5.87 ± 1.71 , $p = 0.01$], parameter 10: maximum pressure at the perineal body [(kPa, mean $\pm$ SD) 6.84 ± 3.64 vs. 8.29 ± 3.92 , $p = 0.01$], parameter 30: displacement of the maximum pressure peak in the posterior compartment [(mm, mean $\pm$ SD) -1.79 ± 2.32 vs. 4.13 ± 3.30 , $p = 0.001$], parameter 32: maximum pressure change in the anterior compartment at voluntary muscle contraction [(kPa, mean $\pm$ SD) 13.99 ± 11.63 vs. 26.00 ± 18.13 , $p = 0.022$], parameter 34: integral force change in the posterior compartment at voluntary muscle contraction [(N, mean $\pm$ SD) 0.85 ± 0.57 vs. 1.56 ± 0.87 , $p = 0.036$], parameter 35: maximum pressure change in the posterior compartment at voluntary muscle contraction [(kPa, mean $\pm$ SD) 7.92 ± 5.40 vs. 11.76 ± 7.11 , $p = 0.022$] showed significant difference (Table 4).

Discussion

To our knowledge, we are the first to investigate the biomechanical parameters of the pelvic floor after six weeks of PFMT and its connection to clinical improvement, highlighting the main changes in the musculoskeletal system of the pelvic floor. There was a significant difference in the strength of the muscles in the anterior compartment between women with and without significant clinical improvement in SUI symptoms. However, in patients whose subjective SUI symptoms had already improved after six weeks, in addition to a significant change in the anterior compartment, we also measured a significant increase in the strength of the posterior part of the upper third of the vagina (corresponding to Level I vaginal support) and the strength of the entire vagina.

The PFMT approach in our study resembled that of the ESTEEM study [11]. Most PFMT studies have emphasized clinical outcomes, but the mechanisms underlying PFMT are still not fully understood. Proposed mechanisms include strengthening pelvic floor muscles, increased

awareness of timing, and strengthening core muscles [20]. The conclusions drawn from the literature are troubling, indicating an almost complete lack of evidence in current scientific knowledge to either support or challenge the three proposed mechanisms by which PFMT interventions are thought to work [21].

We believe that through our study, we can better understand the mechanism of action of PFMT in improving SUI symptoms. The VTI parameters showing significant differences after six weeks of PFMT indicate that PFMT increases vaginal wall elasticity, pelvic floor muscle strength, and overall pelvic muscle function. Although the studies mentioned above have also shown an increase in pelvic muscle strength, they have not shown an explicit correlation between an increase in muscle strength and a clear association with an improvement in SUI. Of the patients included in the study, 11 had clinically significant improvement in incontinence symptoms at six weeks as measured by the UDI-6. The biomechanical parameters were examined within the IG after six weeks of PFMT. Three parameters changed significantly. These include an increase in muscle strength in the area of the frontal vaginal wall, which of course, is not surprising as it increases the support of the urethra. However, our results suggest that the muscular strength of the entire vaginal wall, and in particular the upper third of the vagina, which may correspond to Level I support, may play a more significant role than previously suspected in maintaining the continent state.

Currently, PFMT is usually not individualized [22]. We believe that with VTI, we may be able to identify the cause of the symptoms individually, thus designing a personalized exercise program and monitoring the changes resulting from the exercise [23]. The decreasing adherence to PFMT over time underscores the significance of effective modifications within a shorter timeframe. Hence, we elected a 6-week duration for our study to optimize the attainment of meaningful outcomes [24].

Besides its prospective nature, our study's strength is that, according to our knowledge, this is the first study to investigate the clinically significant mechanism of action of PFMT in improving SUI symptoms by measuring pelvic biomechanical properties objectively with VTI, complemented by subjective and validated questionnaires. A notable strength of the study was that participants self-reported full adherence to daily PFMT. The study's weaknesses included not performing urodynamic testing to assess urinary incontinence. Another limitation was the relatively short length of PFMT, the homogeneity of the study population, and the relatively small number of women included.

Conclusion

In conclusion, our study has revealed how pelvic floor muscle training positively affects stress urinary incontinence symptoms through several complex mechanisms in addition to those previously known. This study contributes to the expanding knowledge base regarding the biomechanics of pelvic floor muscle training and its potential therapeutic benefits for individuals dealing with stress urinary incontinence. Further research and clinical applications based on these findings may build the way for more personalized and targeted interventions to

Table 3

Comparison of VTI data within the Improved Group before and after six weeks of PFMT. Only the significantly different parameters are presented.

No.	Description	Interpretation	Units	before 6 weeks PFMT	with subjective improvement after 6 weeks PFMT	P
1	The maximum value of force measured during the VTI probe insertion	Maximum resistance of anterior vs. posterior widening; tissue elasticity at a specified location (capability to resist applied deformation)	N	0.55 ± 0.18	0.78 ± 0.31	0.049
18	The maximum gradient at the upper third of the vagina (posterior)	Strength of Level I support (tissue deformation up to 45 mm)	kPa/mm	0.16 ± 0.05	0.36 ± 0.28	0.048
47	Integral force change in the anterior compartment at reflex pelvic muscle contraction (cough)	Integral pelvic function at reflex muscle contraction	N	1.61 ± 0.85	1.97 ± 0.71	0.045

Table 4
Comparison of VTI data within the Not Improved Group before and after six weeks of PFMT. Only the significantly different parameters are presented.

No.	Description	Interpretation	Units	before 6 weeks PFMT	without subjective improvement after 6 weeks PFMT	P
3	The maximum value of anterior gradient (change of pressure per anterior wall displacement in the orthogonal direction to the vaginal channel)	The maximum value of tissue elasticity in the anterior compartment behind the vaginal at a specified location	kPa/mm	0.88 ± 0.40	1.30 ± 0.73	0.043
9	Maximum pressure at the cervix area (anterior)	Mobility of the uterus and conditions of uterosacral and cardinal ligaments	kPa	3.68 ± 1.59	5.87 ± 1.71	0.014
10	Maximum pressure at the perineal body (posterior)	Pressure feedback of Level III support	kPa	6.84 ± 3.64	8.29 ± 3.92	0.018
30	Displacement of the maximum pressure peak in the posterior compartment	Mobility of posterior structures Valsalva maneuver	mm	−1.79 ± 2.32	4.13 ± 3.30	0.001
32	Maximum pressure change in the anterior compartment at voluntary muscle contraction	Contraction strength of specified pelvic muscles	kPa	13.99 ± 11.63	26.00 ± 18.13	0.022
34	Integral force change in the posterior compartment at voluntary muscle contraction	Integral contraction strength of pelvic muscles along the vagina	N	0.85 ± 0.57	1.56 ± 0.87	0.036
35	Maximum pressure change in the posterior compartment at voluntary muscle contraction	Contraction strength of pelvic muscles at a specified location	kPa	7.92 ± 5.40	11.76 ± 7.11	0.022

improve the quality of life for those affected by this common condition.

CRediT authorship contribution statement

Dávid Rátonyi: Writing – original draft, Software, Resources, Project administration, Investigation, Formal analysis, Data curation, Conceptualization. **Erzsébet Koroknai:** Investigation. **Krisztina Pákozdy:** Investigation. **Attila G. Sipos:** Investigation. **Peter Takacs:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Zoárd Tibor Krasznai:** Writing – review & editing. **Bence Kozma:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: The following authors have no conflict of interest to declare: Rátonyi, Koroknai, Pákozdy, Sipos, Krasznai, Kozma. Takacs is a paid consultant for Fempharma LLC. IRB Approval: 2876-13/2022/EÜIG.

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