

# Combined Pelvic Floor Muscle Training and Electrical Stimulation in Managing Sexual Dysfunction

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**Abstract** While restoring sexual function is critical for women with neurological disorders, its evaluation is often neglected. **Methods:** The study assessed 133 women aged 18–74 with neurological disorders, evaluating the effectiveness of biofeedback, transcutaneous tibial nerve stimulation (TTNS), and Kegel device therapy, through a three-step questionnaire process. **Results:** Target group showed significant reductions in FSDS-R scores, with increases in Modified Oxford Scale and SQoL-F scores indicating improved pelvic floor muscle strength and enhanced sexual quality of life. The control group's improvements were less pronounced. **Conclusion:** The findings revealed enhancements in sexual function and overall quality of life among the participants following the therapeutic interventions.

**Keywords** FSDS-R, SQoL-F, Female sexual dysfunction, Modified oxford scale, Biofeedback, Kegel device, Transcutaneous tibial nerve stimulation

## 1. Introduction

Investigations into women with neurological disorders such as stroke, multiple sclerosis (MS), and traumatic brain injury (TBI) have grown, demonstrating sexual challenges are widespread and demand comprehensive appraisal and intervention to elevate the quality of life for these demographics. Despite this progress, current research points to persistent unmet needs related to sexuality among these neurological groups, highlighting the potential for healthcare providers to enhance their evaluation and response to these concerns more proficiently [1]. Urinary incontinence, spasticity and pain can disrupt sexual function and significantly impact the willingness to engage in sexual activities, although desire, arousal, and orgasm are attainable, women have reported experiencing additional complications [2-5]. On the other hand, some studies have observed occurrences of increased sexual desire in women who have suffered from a stroke [6]. The interplay of neurological impairments and the intimate nature of sexual function creates a unique set of challenges for these patients. Traditional treatment modalities often fail to address the multifaceted nature of sexual dysfunction and recent findings in the field of neurorehabilitation and sexual health have emphasized the need to integrate various therapeutic strategies to address these issues effectively [7,8].

The concept of pelvic floor physiotherapy from its historical development to its contemporary applications, empowers healthcare professionals to implement the therapy effectively with their patients. It underscores that various pelvic floor therapy strategies are in use, yet a clear understanding is lacking among professionals, occasionally resulting in more harm than benefits [9].

The findings from research indicate that both transcutaneous tibial nerve stimulation (TTNS) and pelvic floor muscle training (PFMT) effectively improved symptoms in female multiple sclerosis patients [10,11].

Patients enhance their awareness of positive physiological sensations by using mindfulness strategies while improving voluntary control over pelvic muscles through biofeedback. Moreover, the Sexual Wellness Enhancement and Enrichment Training Model, a group therapy method, is fundamentally structured around the combination of biofeedback and mindfulness [12-13]. Biofeedback therapy is effective in alleviating sexual pain in women, though it has not been shown to be superior to other treatments [14].

The Revised Female Sexual Distress Scale (FSDS-R) for assessing sexual distress in women with hypoactive sexual desire disorder (HSDD). Have been used with findings revealed that the FSDS-R, along with its item 13, demonstrated strong discriminant validity, high test-retest reliability, and consistent internal consistency in differentiating women with HSDD or other female sexual dysfunctions from those without, confirming the scale's effectiveness in measuring sexually related personal distress [15-16].

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The effectiveness of supervised and unsupervised PFMT was assessed in managing stress urinary incontinence (SUI) among women. The study utilized the Oxford Grading Scale to measure pelvic floor muscle strength, finding significant enhancements in muscle strength, overall quality of life, and reductions in urine loss for both training modalities [17]. There were successfully validated the Sexual Quality of Life-Female (SQOL-F) questionnaire with analysis confirmed the questionnaire's robust four-factor structure, making it a reliable tool for assessing female sexual quality of life in reproductive health care [18].

The aim of the study is to assess the efficacy of a comprehensive treatment approach, which includes TTNS, biofeedback therapy, and the use of a Kegel device, in treating sexual dysfunction in women with neurological disorders.

## 2. Methods

The research took place at the 1st governmental hospital's clinic and Jacksoft MDS clinics, located in Tashkent, Uzbekistan. Participants were recruited and underwent testing from January 2022 through December 2024.

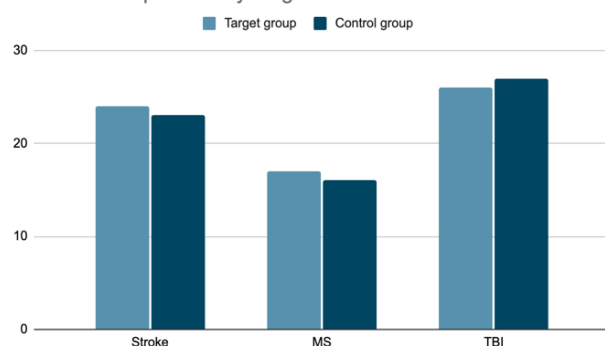
This study included 133 women, ranging in age (Table 1) from 25 to 66 ( $45.0 \pm 11.6$ ), with diagnosed neurological conditions.

**Table 1.** Age

Age	
Difference	0,165
Standard error	2,12
95% CI	-4.0294 to 4.3594
t-statistic	0,078
DF	131
Significance level	P = 0.9381

The patients were divided into two groups with established diagnoses: TBI in 53 women (39.8%), with 26 women in the target group and 27 women in the control group; MS in 33 women (24.8%), with 17 women in the target group and 16 women in the control group; and stroke in 47 women (35.3%), with 24 women in the target group and 23 women in the control group (Figure 1).

Distribution of patients by diagnosis



**Figure 1.** Distribution of patients by diagnosis

The overall sample was divided into two groups: a target group comprising 67 women (50.3%) who received an integrated treatment regimen including biofeedback techniques, TTNS, and Kegel device therapy in addition to pharmacological treatment, and a control group of 66 women (49.7%) who received a standard treatment protocol with the Kegel device.

The study included patients who met the following criteria: sexual dysfunctions occurring in the context of clinical manifestations of neurological disorders, symptoms of sexual dysfunction present for at least 3 months, and the absence of organic disorders in systems responsible for sexual functioning (gynecological and endocrine), as verified by laboratory and instrumental research methods.

Patients were excluded from the study if they had acute cerebrovascular accidents, open traumatic brain injuries, closed traumatic brain injuries within the first 2 months, pregnancy, infectious and inflammatory diseases of the genitourinary system, or oncological diseases.

Instructions for performing Kegel exercises at home were provided to patients through both verbal and written formats. They needed to engage in these exercises for 10 minutes, three times a day. The exercise routine included a mix of quick maximal and extended sustained squeezes.

Both groups underwent initial evaluations to establish baseline sexual function, which included assessments using the FSDS-R, Modified Oxford Scale, and SQoL-F questionnaire. These tools were chosen for their ability to comprehensively assess different dimensions of sexual dysfunction and distress, pelvic muscle function, and overall sexual quality of life, respectively [15-18].

Following the baseline assessment, the treatment interventions were applied according to group assignment. The target group's therapy regimen included daily sessions of biofeedback, which helps patients gain awareness and control of physiological functions to improve sexual response; weekly sessions of TTNS, aimed at enhancing pelvic floor muscle response via nerve stimulation; and regular use of Kegel devices, designed to strengthen pelvic floor muscles and improve sexual function. The control group, meanwhile, continued with their existing management plans, which did not include the integrated approach used with the target group.

A specialized rehabilitation program has been developed for patients with sexual dysfunctions, customized according to their specific diagnosis, clinical symptoms, and initial questionnaire responses. For patients with multiple sclerosis, the program consists of 15 sessions held every other day, each lasting 45 minutes. Stroke patients undergo 12-13 sessions every other day, with each session lasting 35 minutes. Patients with traumatic brain injuries participate in 10 sessions every other day, each 30 minutes long. The effectiveness of this therapy is assessed at the 10th session, as the benefits usually start to manifest by the 3rd or 4th session and are well-established by the 10th session.

The frequency and duration of the sessions are tailored based on the evaluation of pelvic floor muscle strength and their adaptation to regular partial loads. For multiple

sclerosis patients, the positive effects of biofeedback therapy are noticeable by the 13th or 14th session. Stroke patients typically experience benefits by the 11th or 12th session, while those with mild traumatic brain injuries see improvements by the 8th or 9th session.

These findings have informed the creation of a comprehensive rehabilitation program for patients with neurological disorders accompanied by sexual dysfunctions. The data suggest that achieving significant clinical benefits from biofeedback therapy necessitates consistent training with appropriate intervals and loads. We recommend sessions every other day, as breaks longer than two days impair the pelvic floor muscles' ability to swiftly adapt to physical exertion, thereby diminishing the overall effectiveness of the treatment.

The treatment period has ended and all participants were re-evaluated using the same set of questionnaires to measure changes in sexual function, distress, and quality of life. Statistical analysis was employed to compare the pre- and post-treatment scores within each group and between the two groups, to determine the effectiveness of the treatment regimens. The analysis focused on identifying significant improvements in the scores, which would indicate a reduction in sexual distress and dysfunction, and an enhancement in the overall sexual quality of life. This comprehensive methodological approach was designed to provide a clear comparison between a more innovative, integrative treatment strategy and conventional therapy, thereby offering insights into the potential benefits of combining biofeedback, TTNS, and Kegel exercises in the treatment regimen for women with neurological-induced sexual dysfunction.

During the program, patients from the target group underwent TTNS using the TENS and EMS modes from the NMS60 device. Its frequency was maintained at 10 Hz, 200 microseconds pulse duration, and adjustable from 0 to 100 mA intensity level. To optimize placement, four electrodes were positioned strategically; one was located around 4-5 cm above the inner ankle bone, and another by the heel. Initially, intensity was escalated to prompt a movement in the big toe, either flexion or abduction, indicating the motor response threshold had been reached. Following this, while keeping the frequency constant at 10 Hz, the intensity was lowered to a level that continued to elicit a sensory response but remained within a comfortable range for participants [19].

Statistical analyses were executed on a Mac personal computer, utilizing both Microsoft Office Excel version

16.13.1 and the Prism 7 software, which offers built-in statistical processing features. Advanced mathematical analyses were carried out using GraphPad Prism 7 for Mac. The t-test was employed to compare two data sets that conformed to a normal distribution. Quantitative data that adhered to this distribution were represented as  $M \pm SD$ , where M indicates the mean and SD signifies the standard deviation. Differences were considered statistically significant when the p-value was less than 0.0001.

### 3. Results

The results for the target group in this study demonstrate more significant improvements compared to the control group in sexual function following the intervention. According to the FSDS-R, there were marked improvements across these neurological conditions. Before the intervention, mean scores for TBI patients were 31.38, which improved to 7.46 post-treatment. Similarly, stroke patients showed an improvement from an initial mean of 41.29 to 7.88, and MS patients improved from 44.88 to 12.06. The standard deviations also decreased, indicating a convergence of scores towards the mean improvement. Statistically, these results were highly significant with p-values less than 0.0001 across all conditions. The t-statistics were -41.723 for TBI, -40.896 for stroke, and -62.802 for MS, with confidence intervals strongly excluding zero, further substantiating the effectiveness of the treatment (Table 2).

This substantial reduction in the FSDS-R scores reflects a significant alleviation of sexual distress among participants, pointing towards a robust efficacy of the therapeutic intervention in enhancing sexual health and quality of life for women with these specific neurological disorders. Before treatment, the control group's FSDS-R scores showed minimal initial differences, with values like 31.33 for TBI, 40.70 for stroke, and 44.38 for MS, reflecting a high level of sexual distress. Post-treatment scores improved significantly across all conditions—19.04 for TBI, 24.17 for stroke, and 23.19 for MS—indicating notable reductions in sexual distress. Statistically, these changes were highly significant, with p-values less than 0.0001 for each condition, demonstrating the effectiveness of the treatment. The t-statistics, ranging from -15.756 for TBI to -27.727 for MS, alongside substantial improvements in the 95% CI, highlight the robust effect of the treatment in reducing sexual distress within the control group (Table 3).

**Table 2.** FSDS-R Values of the Target Group

FSDS-R							
Disorders	Pre		Post		95% CI	t statistic	p-value
	M	SD	M	SD			
TBI	31,38	3,99	7,46	2,47	-25.0540 to -22.7860	-41,723	P < 0.0001
Stroke	41,29	5,55	7,88	3,73	-35.0260 to -31.7940	-40,896	P < 0.0001
MS	44,88	3,35	12,06	2,66	-33.8537 to -31.7863	-62,802	P < 0.0001

**Table 3.** FSDS-R Values of the Control Group

FSDS-R							
Disorders	Pre		Post		95% CI	t statistic	p-value
	M	SD	M	SD			
TBI	31,33	5,36	19,04	3,38	-13.8331 to -10.7469	-15,756	P < 0.0001
Stroke	40,70	5,98	24,17	3,35	-18.1992 to -14.8608	-19,592	P < 0.0001
MS	44,38	4,91	23,19	3,80	-22.7020 to -19.6780	-27,727	P < 0.0001

Improvements in pelvic floor muscle strength, as assessed by the Modified Oxford Scale, were observed, especially in the target group. Initially, the target group had a mean score of 2.94 with a SD of 0.86. After undergoing the treatment, which included biofeedback techniques, TTNS, and Kegel device therapy, their mean score significantly increased to 4.71, with a reduced SD of 0.54. This change was statistically significant ( $p < 0.0001$ ), with a 95% CI ranging from 1.5246 to 2.0154, and a t statistic of 14.267, indicating a substantial enhancement in pelvic floor muscle function (Table 4).

**Table 4.** Modified Oxford Scale Values of the Target Group

Modified Oxford Scale		
	Pre	Post
Mean	2,94	4,71
SD	0,86	0,54
95% CI	1.5246 to 2.0154	
t-statistic	14,267	
Significance level	P < 0.0001	

Conversely, the control group, which continued with standard treatment protocols without the integrated approach, also showed improvements but to a lesser degree. Their mean score increased from 3.01 (SD = 0.85) before treatment to 3.98 (SD = 1.015) afterward. This improvement was significant ( $p < 0.0001$ ), with a 95% CI of 0.6085 to 1.2515 and a t statistic of 5.723. These results underscore the efficacy of the comprehensive treatment approach in significantly enhancing pelvic floor muscle strength, particularly in the target group (Table 5).

**Table 5.** Modified Oxford Scale Values of the Control Group

Modified Oxford Scale		
	Pre	Post
Mean	3,01	3,98
SD	0,85	1,01
95% CI	0.6085 to 1.2515	
t-statistic	5,723	
Significance level	P < 0.0001	

Changes in sexual quality of life among participants was assessed by SQoL-F questionnaire. The target group experienced a remarkable improvement, as indicated by the significant decrease in their SQoL-F scores. Initially, the target group's mean score was 88.61 with a SD of 12.35. Following the

treatment, mean score dropped to 43.95 (SD = 6.16). This drastic reduction was statistically significant ( $p < 0.0002$ ), with a 95% CI ranging from -47.9952 to -41.3248, and a t statistic of -26.488. Conversely, the control group, following standard treatment protocols without the integrated approach, showed notable improvements but not as profound as those in the target group. Their mean SQoL-F score decreased from 88.31 (SD = 13.58) before treatment to 52.50 (SD = 8.14) afterward. This change was significant ( $p < 0.0001$ ), with a 95% CI of -39.6556 to -31.9444 and a t statistic of -18.37. These findings underscore the efficacy of the integrated treatment strategy in significantly improving the sexual quality of life for women with neurological disorders, particularly in the target group, highlighting the added benefits of biofeedback and TTNS to Kegel exercises (Table 6).

**Table 6.** SQoL-F Values

Outcomes	Target Group		Control Group	
	Pre	Post	Pre	Post
Mean $\pm$ SD	88,61 $\pm$ 12,35	43,95 $\pm$ 6,16	88,31 $\pm$ 13,58	52,50 $\pm$ 8,14
95% CI	-47.9952 to -41.3248		-39.6556 to -31.9444	
t-statistic	-26,488		-18,37	
Significance level	P < 0.0002		P < 0.0001	

The study's results clearly demonstrate the superior efficacy of combining Kegel exercises with TTNS and biofeedback techniques over using Kegel exercises alone in treating sexual dysfunction in women with neurological disorders. While both treatment groups showed significant improvements, the outcomes were more dramatic in the target group. For instance, the FSDS-R scores in the plummeted from 38.3 to 8.7, compared to the control group's reduction from 37.7 to 21.8. Similarly, the Modified Oxford Scale showed greater enhancement in the target group, with scores rising from 2.9 to 4.7, in contrast to the control group's increase from 3.1 to 3.9. Most notably, the SQoL-F scores in the target group dropped from 88.6 to 43.9, more than halving the baseline score, while the control group saw a decrease from 88.3 to 52.5. These improvements were statistically significant, with the target group not only achieving substantial clinical severity reductions and quality of life enhancements but also doing so with greater magnitude, as indicated by the more profound changes in all measured outcomes (Table 7).

**Table 7.** Effects of the Treatments on Clinical Severity and Quality of Life

Outcomes	Kegel			Kegel + TTNS & biofeedback techniques		
	Pre	Post	P value	Pre	Post	P value
FSDS-R	37,7 ± 7,7	21,8 ± 4,1	P < 0.0001	38,3 ± 7,2	8,7 ± 3,5	P < 0.0001
Modified Oxford Scale	3,1 ± 0,8	3,9 ± 1,1	P < 0.0001	2,9 ± 0,8	4,7 ± 0,5	P < 0.0001
SQoL-F	88,3 ± 13,5	52,5 ± 8,1	P < 0.0001	88,6 ± 12,3	43,9 ± 6,1	P < 0.0002

Scores are expressed as mean ± SD.

## 4. Discussion

In many regions, especially for women, cultural and societal constraints severely limit the ability to openly address sexual concerns, despite the well-documented fact that neurological disorders frequently lead to considerable instances of sexual dysfunction [20-23].

The remarkable improvements observed in the target group, as demonstrated by the substantial changes in both the Modified Oxford Scale and the SQoL-F questionnaire scores, highlight the efficacy of integrating biofeedback techniques, TTNS, and Kegel device therapy into the treatment plan. Previous investigations have sought to determine the therapeutic effectiveness of individual treatments in comparison to control groups, resulting in varied outcomes. Nevertheless, as far as we are aware, no study has yet explored the comparative efficacy of these four therapies and their influence on the extensive array of anorectal physiological aspects [24-29].

The results of the study demonstrate that PFMT, either as a standalone treatment or when integrated with intravaginal neuromuscular electrical stimulation (NMES) or TTNS, is effective in managing symptoms related to sexual dysfunction, often associated with urinary tract issues in women diagnosed with MS. Notably, the synergistic approach of combining PFMT with NMES exhibited superior efficacy in diminishing pelvic floor muscle tone and symptoms associated with an overactive bladder [30,31].

Neurological impairments can lead to a range of issues including sensory deficits, motor function loss, and emotional disturbances, all of which can severely impact sexual function [32,33]. Traditional treatment modalities often fail to address these multifaceted challenges. However, comprehensive treatment approach that includes TTNS, biofeedback, and Kegel exercises can effectively target these diverse aspects [34-36]. The use of TTNS in the target group is notable for its role in enhancing neural function and facilitating the recovery of pelvic floor muscle control [37]. By stimulating the tibial nerve, TTNS can influence the neural pathways that are essential for maintaining pelvic floor strength and sexual function [38-41].

Biofeedback therapy, on the other hand, helps patients gain awareness and control over their physiological responses, enhancing their ability to manage and improve sexual function consciously [42]. Finally, the regular use of Kegel devices strengthens the pelvic floor muscles, which is vital for sexual health and urinary continence [43]. This integrative approach not only improves physical aspects of sexual function but also addresses the psychological and

emotional dimensions [44].

The significant improvement in SQoL-F scores indicates that participants experienced not only physical benefits but also an enhanced perception of their sexual life, contributing to a better overall quality of life [45,46].

## 5. Conclusions

This study underscores the importance of a comprehensive and integrative approach to managing sexual dysfunction in women with neurological disorders. The combination of TTNS, biofeedback techniques, and Kegel device therapy demonstrated efficacy, particularly in enhancing pelvic floor muscle strength and sexual quality of life. These improvements in the target group not only mitigate physical symptoms but also significantly boost the emotional and psychological well-being of the patients, thus elevating their overall quality of life. By laying a solid foundation for future research, this study emphasizes the critical need for all-encompassing treatment strategies to address the complexities of sexual dysfunction in individuals with neurological conditions effectively.

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