

The optimal number of sessions for biofeedback therapy in children: A retrospective study

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ABSTRACT

OBJECTIVE: Biofeedback electromyography (EMG) involves the transmission of pelvic and abdominal muscle activity to the patient via visual and sometimes auditory feedback, with the ultimate goal of learning to contract and relax the pelvic muscles at the appropriate times through real-time analysis and feedback. To determine the optimal number of biofeedback therapy sessions required for a therapeutic response in the treatment functional voiding dysfunction.

METHODS: The retrospective data of 779 patients who underwent biofeedback therapy at a tertiary pediatric hospital between 2017 and 2023 were analyzed. The study included patients referred for urinary symptoms and uroflow/EMG findings who did not respond to standard urotherapy and behavioral therapy and completed at least 8 biofeedback sessions. During treatment, methods such as EMG biofeedback, pelvic muscle training, and keeping symptom diaries were utilized. Statistical analyses were performed using the Mann-Whitney U test and Chi-Square test.

RESULTS: Of the patients, 62.4% were female, 37.6% were male, and the mean age was 9.05 ± 3.05 years. The most common urinary symptoms were daytime urinary incontinence (59.4%) and nocturnal enuresis (54%). The average number of sessions required for a therapeutic response was 6 ± 1.3 . Female patients showed an earlier response to treatment compared to males ($p < 0.01$). Younger patients demonstrated faster recovery and better response to therapy ($p < 0.05$). Patients who did not respond to therapy had a higher mean age and required more sessions ($p < 0.05$). The higher mean number of sessions in non-responders compared to responders was found to be statistically significant ($p = 0.001$; $p < 0.05$).

CONCLUSION: Biofeedback is an effective and non-invasive treatment method for children with functional voiding dysfunction. Most patients show symptomatic improvement within 1.5–2 months (2–8 sessions - average 6). Male patients may require longer treatment durations, while younger children respond better to therapy. Future studies focusing on factors influencing biofeedback success may contribute to optimizing this treatment.

Keywords: Biofeedback; children; enuresis; incontinence; session; urotherapy.

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Urinary incontinence significantly impacts children and their families, causing both physical and psychosocial challenges. While its exact prevalence is difficult to determine, it is estimated to account for approximately 40% of all pediatric urology consultations [1]. In recent years, we have seen in our own practice that

this rate has increased up to 60%. In a similar study, the prevalence of stress, urgency, and nocturnal enuresis was reported as 22.95%, 19.34%, and 93.93%, respectively [1]. Gender shows a significant association with stress and urgency-type incontinence, while age is significantly associated with nocturnal enuresis [2].

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The first-line treatment for bladder dysfunction is urotherapy, which includes specific behavioral modifications such as scheduled toilet visits, limiting fluid intake in the evening, adopting proper voiding and defecation postures, and managing constipation [3]. When urotherapy alone is insufficient, clinicians explore other treatment options. Biofeedback (BF) therapy is a second-line treatment in selected patients with functional voiding dysfunction [4]. The goal of biofeedback electromyography (EMG) is to retrain pelvic muscles and the bladder-brain connection, teaching proper voiding and defecation habits.

The ultimate aim is for the patient to learn to contract and relax pelvic muscles at appropriate times through real-time analysis and feedback. While biofeedback's effectiveness has been demonstrated in many studies, the optimal duration of therapy required for maximum benefit remains unclear. This treatment is a time- and education-intensive process for patients, families, and health-care systems.

This study aims to determine the optimal number of biofeedback therapy sessions required for a therapeutic response in the treatment of functional voiding dysfunction.

MATERIALS AND METHODS

Data from all patients undergoing biofeedback therapy at a tertiary pediatric hospital between 2017 and 2023 were retrospectively collected. A total of 779 patients who completed at least 8 sessions of biofeedback therapy were included in the study. Patients with urinary incontinence complaints and voiding symptoms were included in the study. Patients with neurogenic and/or anatomical issues, as well as those who underwent BF therapy solely for constipation/encopresis complaints, were excluded from the study. Patients with urinary symptoms unresponsive to standard urotherapy [3] (information, clarification, lifestyle advice, recommendations, behavior modification, recording, and support) were referred for BF sessions. Standard urotherapy was applied for a duration of 6–8 weeks. An initial plan of 8 sessions was outlined for all patients. All sessions were conducted by a single urotherapy nurse. The therapist was a urotherapy and urodynamics unit nurse, trained and experienced in BF therapy, uroflowmetry, and standard urotherapy. Sessions were scheduled weekly, and the decision to extend the number of sessions was made with the consent of the physician, patient, and family.

Highlight key points

- Biofeedback therapy is an effective treatment for functional voiding dysfunction in children.
- It has been shown that results in Biofeedback therapy treatment can be achieved in optimally 6 sessions.
- Factors related to biofeedback success depend on the patient, the family, and the education nurse, and cooperation between them is very important.

The first session consisted of a 10-minute evaluation and a 20-minute biofeedback training segment. Evaluation was performed using the DVISS (Dysfunctional Voiding and Incontinence Symptoms Score) [5]. Subsequent sessions focused on the 20-minute BF training segment. Before starting the BF sessions, anatomical and functional principles related to voiding were explained to the children and their parents with illustrated and figured explanations. Medical Measurement System (MMS) was used in the BF sessions. In the second part, two electromyography (EMG) electrodes were placed at 3 and 9 o'clock on the pelvic floor, and the reference electrode was placed on the anterior aspect of the thigh. Patients were made aware of the function of their pelvic floor muscles using animated figures and were taught how to contract their external urethral sphincter during the sessions. Patients were asked to do these exercises at home. It is recommended to apply it once a day at home until the next session. During the first part of each session, patients were assessed, home progress and biofeedback diaries were reviewed, and education on elimination programs was reinforced. Family-provided BF diaries documented urinary frequency, incontinence, constipation-encopresis, and adherence to therapy. Symptom improvement was documented in a written summary by the BF nurse based on the diary and patient-family interviews. The number of sessions in which improvement was detected was recorded. Improvement was noted as either 'response present' or 'no response.' According to ICCS (International Children's Continence Society: ICCS) recommendations, the results were classified into two categories:

1. No response: Less than 50% reduction in symptoms.
2. Response: Partial response (50–99% reduction in symptoms) and complete response (100% resolution of symptoms) [6].

Urinary symptoms were categorized into seven thematic groups: Incontinence (daytime urinary leakage), enuresis (nocturnal enuresis), urgency, frequency, uri-

TABLE 1. Comparison of age and session count according to response status

	n	Mean±SD	Min–Max (median)	p
Age				
No response	227	9.26±2.8	5–17 (9)	0.044*
Response	552	8.96±3.1	5–17 (8)	
Improvement session				
No response	227	6.79±0.98	3–8 (7)	0.001**
Response	552	6±1.3	2–8 (6)	

SD: Standard deviation; Min: Minimum; Max: Maximum; Mann-Whitney U Test; *: $P<0.05$; **: $P<0.01$.

nary retention, giggle incontinence, constipation-encopresis. Bowel dysfunction was recorded in BF diaries based on reports of Bristol Type 1 stool or encopresis (fecal leakage, staining, or soiling). Treatment outcomes were evaluated based on the BF session at which urinary symptoms improved. Improvement was defined as the regression of the patient's initial complaints. Nurse observations were conducted during each session. Physician assessments were performed during the initial examination and after the BF therapy. The final physician assessment was conducted after the last session, incorporating the nurse's report and a face-to-face interview with the family. Health Sciences University Umraniye Training and Research Hospital Ethics Committee reviewed and approved the study design (date: 23.11.2023 decision no: B.10.1.TKH.4.34.H.GP.0.01/452). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical Analysis

For statistical tests, data were evaluated as response/no response to treatment. Statistical analyses were performed using the NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) software. Descriptive statistical methods (mean, standard deviation, median, frequency, percentage, minimum, and maximum) were used to evaluate study data. Data distribution was assessed using the Shapiro-Wilk Test. The Mann-Whitney U Test was used for comparisons of quantitative data between two groups, while the Chi-square analysis assessed relationships between qualitative data. Significance was evaluated at $p<0.01$ and $p<0.05$ levels.

RESULTS

Of the patients, 62.4% ($n=486$) were female, and 37.6% ($n=293$) were male. The mean age of all patients was 9.05 ± 3.05 years.

The mean age of patients responding to BF treatment was 8.96 ± 3.1 , which was younger than those who did not respond. Age and session outcomes are summarized in Table 1. Daytime incontinence ($n=463$) and nocturnal enuresis ($n=421$) were the most prevalent urinary symptoms.

The response of the patients to BF treatment was found to be higher in girls with 360 (65.2%) girls and 192 (34.8%) boys. The highest response rate to treatment was observed in the patient group with incontinence (daytime urinary incontinence) with 58.9% ($n=325$). Findings on urinary symptoms and biofeedback therapy responses are detailed in Table 2.

Patients who responded to treatment were younger on average than non-responders ($p=0.043$; $p<0.05$). Additionally, responders required fewer sessions to achieve improvement than non-responders ($p=0.001$; $p<0.01$).

Given the stable use of anticholinergics and desmopressin during biofeedback therapy (47.8% of patients [451/799] initiated or discontinued usage), medication status was also included in the analysis. It was found that the response to treatment was more effective (56.2%) in patients receiving medication (Table 3).

DISCUSSION

Functional voiding dysfunction has significant psychosocial impacts on children and their families. Biofeedback is a crucial tool for treating this condition; however, retraining voiding mechanics takes time. Understanding the timeframe for clinical improvement can guide clinicians, patients, and families in setting realistic expectations.

Our aim in this study was to determine the optimally number of biofeedback sessions that patients should receive before considering other treatments. We reported symptom improvement by session.

The regression of the patient's complaint after the first session was evaluated as a response to treatment and the average number of sessions was determined as 6 ± 1.3 . In addition, the fact that the average age of those who did not respond to treatment was higher than those who did was found to be statistically significant ($p=0.043$; $p<0.05$). As we observed in the clinic, we saw that in rela-

TABLE 2. Relationship between urinary symptoms and response to biofeedback therapy

	No response	Response	Total	p
Gender				0.011*
Female	126 (55.5%)	360 (65.2%)	486 (62.4%)	
Male	101 (44.5%)	192 (34.8%)	293 (37.6%)	
Incontinence				0.501
Yes	138 (56.3%)	325 (58.9%)	463 (58.1%)	
Enuresis				0.497
Yes	125 (51%)	296 (53.6%)	421 (52.8%)	
Urgency				0.210
Yes	9 (3.7%)	32 (5.8%)	41 (5.1%)	
Frequency				0.144
Yes	11 (4.5%)	14 (2.5%)	25 (3.1%)	
Urinary retention				0.942
Yes	6 (2.4%)	14 (2.5%)	20 (2.5%)	
Giggle				0.459
Yes	2 (0.8%)	8 (1.4%)	10 (1.3%)	
Constipation-encopresis				0.403
Yes	2 (0.8%)	2 (0.4%)	4 (0.5%)	

Chi-Square Test; *: P<0.05.

TABLE 3. Relationship between medication use and response to biofeedback therapy

	No response	Response	Total	p
Medication use				0.715
No	104 (42.4%)	242 (43.8%)	346 (43.4%)	
Yes	141 (57.6%)	310 (56.2%)	451 (56.6%)	

tively younger patients, education and information about urination in the family and child contributed quickly to the treatment. We can explain the positive effect of the relatively younger age group in the BF treatment as the fact that the game was with visual animations and their motivation was higher. This situation also ensures that they come to therapy sessions willingly.

In one study, it was stated that in most cases, improvement was evident in approximately 3 months [7]. They stated that more than one third of the patients in their series continued with a pause and progress after 9 months. Possible reasons for this lack of progress were selection of patients with severe voiding disorders, pa-

tient non-compliance, or decreased clinical benefit due to the increase in session intervals to 3-4 months after the 8th session. Our session duration was determined as 8 weeks. The duration can be extended to once a week depending on the clinical condition and the motivation of the child and the family. However, we believe that the response to treatment may be delayed and delayed in patients who have a very long duration and long session intervals. A statistically significant relationship was found between gender and treatment response ($p=0.011$; $p<0.05$). The higher proportion of females compared to males among those who responded to treatment was also found to be statistically significant ($p=0.001$; $p<0.01$)."

Combs et al [8] found that the average number of biofeedback sessions required to achieve a consistent urodynamic response in a series of 21 patients was approximately 3.7 (approximately 1–3 months after the initial visit). The authors also noted that clinical response required more sessions. In our study, we reported an average of 6 sessions. The earliest response was 2 and the latest was 8 sessions. Another study showed that patients who achieved success with biofeedback underwent an average of 4.1 sessions (3–6 months after the initial visit) [9]. Our results are consistent with these studies, but we suggest that symptomatic improvement is best achieved in 1.5 months.

When we evaluate the response to biofeedback treatment according to the urinary symptoms at presentation, we see that the only significant data is the gender difference. No statistical significance was found in terms of other symptoms and response status. Our data show that boys may have a slower recovery rate than girls and may need biofeedback therapy for a longer period. In another study that reached similar results to ours, the authors found that the maximum recovery time in urinary symptoms was 10 sessions in girls and 22 sessions in boys [7]. It was observed that male patients were less willing to report the latest status of their complaints and their views on the treatment in the feedback interview conducted in the last biofeedback sessions. This finding suggests that we need to do more work on this subject. While gender-based responses to biofeedback have not been previously defined, a similar finding was mentioned in a study conducted in recent years [7]. However, it is known that female patients are included in a higher rate in biofeedback studies. In our series, the rate of female patients was 62.4% of the patients.

Future research will be aimed at understanding patients who do not respond to BF and maximizing BF success. Factors related to biofeedback success affect both the patient, the family, and the education nurse, and cooperation between them is very important. A study on behavioral therapy has shown that behavioral therapy provides 60–80% improvement in children with voiding disorders [10, 11]. Another study reported a 59% success rate with behavioral therapy in patients 4 years of age and older diagnosed with lower urinary tract dysfunction and urinary tract infection [12]. Similarly, in another series, 54% of patients had a voiding disorder symptom score of ≤ 8.5 after an average of 6 months of behavioral therapy. It was observed that there was a 68% improvement in diurnal enuresis (partial response), 58% in nocturnal enuresis (partial response), 84% in intermittent urination (partial response), and 91% improvement in the complaint of

needing to urinate again shortly after urinating (complete response) [13]. In addition to these studies, a systematic review of standard urotherapy indicated that a possible explanation for the low efficacy rates of urotherapy in nocturnal enuresis is the large heterogeneity of the study populations and interventions. They also believe that the duration of intervention and the intensity of the intervention may have an effect on the outcome [14]. We would like to emphasize by mentioning all these studies the importance of family, child and nurse harmony and togetherness. The observation of the nurse applying biofeedback treatment is one of the most effective conditions in the physician's taking the right path for the patient in this process. The attitude of the family and the child's willingness are other factors that support success. Our observational data is that effective success is achieved in a short time in children who regularly apply the nurse's recommendations for voiding training at home. Some of the technical difficulties during the application are that it is difficult to stick the electrode in children with high body weight and the adhesive constantly separates due to sweating. There have been patients who have described leg pain at the end of the session due to incorrect application of biofeedback treatment in relatively older children. This is also a situation that should be kept in mind by the practitioner.

A recent meta-analysis reported no benefit from biofeedback therapy in children with non-neuropathic voiding disorders [15], but a prospective study found that biofeedback therapy helped patients gain control of their voiding function [16]. It has also been shown that children with dysfunctional voiding can be successfully treated with biofeedback therapy with or without animation. Our procedure is animated. It has been observed that presenting several animated visual options to the child allows the child to perceive the treatment as a game and has a positive motivational effect.

Our study has some limitations. It is a single-center, retrospective study, which may introduce observer bias, patient selection bias and limit the validity of our results to other centers. Another limitation is how urinary symptoms were measured. Patients' symptoms were recorded as dichotomous (present/absent), but symptoms are a continuous variable, especially in cases of functional voiding dysfunction. The use of dichotomous outcomes may limit closer analyses of symptom improvement. Adherence to biofeedback treatment is an important aspect of biofeedback and requires compliance from both the patient and the family. This is difficult to measure and therefore cannot be reported.

In conclusion, biofeedback is a simple, effective and noninvasive treatment method for children with functional voiding dysfunction. It improves voiding disorders, voiding patterns and also has a significant impact on the quality of life of both children and their families. This study is one of the large patient sample studies evaluating the treatment process of biofeedback in the management of voiding dysfunction. As we mentioned at the beginning of the discussion in our study, we reported an average of 6 sessions. The earliest response was 2 and the latest was 8 sessions. Our data suggest that most patients who will benefit from biofeedback will improve within the first 1.5-2 months and that other patients may continue to improve over the following periods. Clinical improvement may be slow or ineffective for some patients. In this case, re-evaluation or other treatment options should be considered. Female patients may benefit from biofeedback earlier than male patients and are more likely to receive feedback on progress. The success rate of biofeedback on quality of life may be more effective in children and their families who suffer less from functional voiding dysfunction. This can help physicians guide patients and families about what to expect from treatment biofeedback therapy. We would like to emphasize that the 70.8% treatment response rate observed in our study should be interpreted with caution to avoid overgeneralization and to strengthen directions for future research.

Conclusion

Our study demonstrates that biofeedback therapy is an effective treatment for functional voiding dysfunction in children, with optimal results achieved within 6 sessions. Further research is needed to understand the factors influencing therapy outcomes and to maximize the effectiveness of biofeedback.

Ethics Committee Approval: The Health Sciences University Umraniye Training and Research Hospital Clinical Research Ethics Committee granted approval for this study (date: 23.11.2023, number: B.10.1.TKH.4.34.H.GP.0.01/452).

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