

# The Role of Biofeedback Treatment in Children with Lower Urinary Tract Dysfunction

## Alt Üriner Sistem Disfonksiyonu Olan Çocuklarda Biyofeedback Tedavisinin Etkinliği

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### ABSTRACT

**Objective:** Lower urinary tract dysfunction is a wide clinical spectrum and according to the International Children's Continence Society, lower urinary tract dysfunction contains overactive bladder, voiding postponement, underactive bladder, infrequent voiding, extraordinary daytime only urinary frequency, vaginal reflux, bladder neck dysfunction, and giggle incontinence.

Biofeedback is a non-invasive therapy that can be applied easily and aims to activate relevant pelvic wall muscles for normal bowel and bladder functions. This study aimed to evaluate the efficacy of biofeedback treatment in children with lower urinary tract dysfunction.

**Material and Methods:** Twenty-nine patients who were diagnosed with lower urinary tract dysfunction and did not respond to standard therapy were included in the study. Biofeedback therapy was applied to these patients for 8 weeks.

**Results:** After animation biofeedback treatment, daytime symptoms improved in 13 patients (44.8%), and nighttime enuresis improved in two (6.8%) patients. Although 5 patients with constipation completely improved, there was no improvement in patients with encopresis. There was a decrease but not a complete improvement in complaints of six patients (20.7%). Mean urinary incontinence symptom score which was 16.19±7.69 before biofeedback treatment decreased to 9.52±6.4 after the treatment, with a statistically significant difference (p<0.001).

**Conclusion:** It was suggested that biofeedback treatment can be considered as a suitable alternative in children with dysfunctional urination who do not respond to standard treatment.

**Key Words:** Biofeedback treatment, Lower urinary tract dysfunction, Standard urotherapy

### ÖZ

**Amaç:** Alt üriner sistem disfonksiyonu geniş spektrumlu bir tanıdır ve Uluslararası Çocuk İşeme Topluluğuna göre aşırı aktif mesane, işemeyi erteleme, az aktif mesane, seyrek işeme, vajinal reflü, mesane boynu disfonksiyonu ve kıkırdama inkontinansını içerir.

Biyofeedback kolay uygulanabilen, girişimsel olmayan ve normal mesane ve barsak fonksiyonlarının sağlanmasında pelvik duvar kaslarını aktive etmek için kullanılan bir tedavi yöntemidir. Bu çalışmada alt üriner sistem disfonksiyonu olan çocuklarda biyofeedback tedavisinin etkinliğinin değerlendirilmesi amaçlanmıştır.



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**Gereç ve Yöntemler:** Çalışmaya alt üriner sistem disfonksiyonu tanısı alan ve standart tedaviye yanıt vermeyen 29 hasta dahil edildi. Bu hastalara 8 hafta süre ile biyofeedback tedavisi uygulandı

**Bulgular:** Animasyon biofeedback tedavisinden sonra 13 hastada (%44.8) gündüz, iki (%6.8) hastada gece kaçırma şikayetleri düzeldi. Kabızlığı olan 5 hastada tamamen düzelme olmasına rağmen enkoprezisi olan hastalarda düzelme olmadı. Altı hastanın (% 20.7) şikayetlerinde azalma oldu ancak tam düzelme olmadı. Biofeedback tedavisi öncesi  $16.19 \pm 7.69$  olan ortalama işeme bozuklukları semptom skoru, tedavi sonrası  $9.52 \pm 6.4$ 'e geriledi ve istatistiksel olarak anlamlı bir fark ( $p < 0.001$ ) saptandı.

**Sonuç:** Çalışmamızdan elde ettiğimiz sonuçlara ve literatür taramalarına göre standart tedaviden fayda görmeyen alt üriner sistem disfonksiyonu olan çocuklarda biyofeedback tedavisi faydalı olabilir.

**Anahtar Sözcükler:** Biyofeedback tedavisi, Alt üriner sistem disfonksiyonu, Standart tedavi

## INTRODUCTION

Normal development of voluntary bladder-sphincter function is an essential step for the regular lower urinary system function. This maturation is generally completed by the age of five years. When lower urinary tract symptoms (LUTS) continue beyond that age, the condition is referred to as lower urinary tract dysfunction (LUTD). Lower urinary tract dysfunction is a wide clinical spectrum and according to the International Children's Continence Society (ICCS), LUTD contains overactive bladder, voiding postponement, underactive bladder, infrequent voiding, extraordinary daytime only urinary frequency, vaginal reflux, bladder neck dysfunction, and giggle incontinence. All these conditions frequently intertwine with each other.

Diagnosis of LUTD is essentially based on clinical history, investigation of bladder storage, voiding symptoms (urinary frequency, daytime incontinence, enuresis, urgency), and constipation. There are many causes of LUTD, which are typically categorized into anatomic, neurogenic, and non-neurogenic. Most lower urinary tract symptoms in children have a functional origin, and few children have anatomical or neurological malformations (1-3). Children may be often referred to LUTD related urinary tract infections (UTIs) and vesicoureteral reflux (VUR).

Lower urinary tract dysfunction may also lead to emotional stress. Children with urinary incontinence have an increased risk of being refused by their peers and alienated by their teachers. Moreover, the probability of being exposed to violence by their family is also high (3).

According to the ICCS, non-invasive conventional urotherapy is used in the treatment of lower urinary tract dysfunction. There are five components of standard therapy, i.e. providing information on dysfunction and recognizing it, recommending lifestyle changes to the patient, determining a way to resolve dysfunction, training the patient on urination diary, helping the parents for supporting and encouraging the child. In addition to the components mentioned above, when standard therapy fails, retraining of pelvic wall, behavioral therapy, and psychotherapy may be added to standard treatment (1-3).

In the training of pelvic wall dysfunction in children, biofeedback is a non-invasive therapy that can be applied easily. Biofeedback, which is used as physical therapy, aims to activate relevant

pelvic wall muscles for normal bowel and bladder functions. There are two types of biofeedback, that is electromyography and uroflow, employed by therapists against bowel and bladder dysfunction. The treatment method of biofeedback is training the child with video-like games in order that contracted sphincters can relax during urination (4-6).

The aim of the present study was to evaluate the efficacy of biofeedback treatment in children with urinary dysfunction.

## MATERIAL and METHOD

Twenty-nine patients who were diagnosed with lower urinary tract dysfunction and did not respond to standard therapy were enrolled in the study. After standard therapy, biofeedback therapy was applied to these patients for 8 weeks. The study was approved by the local Ethics Committee (approval number-date: GO 20/1177-15.12.2020). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Diet, urination, and defecation habits of all patients and their structural urological anomalies were evaluated with a thorough history.

In physical examination, a complete system examination and detailed neurological, vertebral, genital, and rectal examinations were carried out. For each patient, BUN, creatinine, glucose, ALT, AST, and full automatic urinalysis and urine culture were ordered. A fluid input-output chart indicating urinary frequency and urination volume for two days was completed in all patients. Residual urine volume was measured with urinary system ultrasonography (USG). Urinary incontinence symptom scores (UISS) and uroflowmetry were evaluated before and after biofeedback treatment (7). In addition to the clinical history of urination-defecation and findings of physical examination; fluid input-output chart, UISS, and uroflowmetry results were used for the diagnosis of LUTD. Uroflowmetry is a crucial test for children with LUTD. It is simple to perform, non-invasive, and fast. Uroflowmetry supplies appropriate information on lower urinary tract function and the possible etiology of LUTD. The type of curve pattern identified at uroflowmetry may suggest specific conditions. Voided volume, voiding time, maximum flow, curve pattern, and rate of flow may be obtained from uroflowmetry. A bell-shaped curve is considered physiological. Conversely, a staccato-shaped pattern suggests dysfunctional voiding or

bladder and bladder neck dysfunction, while a tower-shaped curve is indicative of overactive bladder, a plateau is suggestive of a lower urinary tract obstruction and an interrupted curve is typical of an underactive bladder (1). In this study, uroflowmetry results were evaluated by two pediatric nephrologists.

The patients who had genitourinary anatomic abnormalities, neuropathic bladder, or a history of prior urinary tract surgery were excluded from the study.

As standard urotherapy, we recommended appropriate dietary and fluid intake, timed voiding, double voiding, spread leg voiding, management of constipation, and general urinary hygiene.

After two months of standard urotherapy; patients who had no response to the therapy underwent biofeedback therapy with an animation over eight weeks once weekly for 20 minutes. Biofeedback is a training system with a computer animation. In this study, EMG superficial electrodes were placed on the 3 and 9 o'clock positions of each patient's anus and they were instructed to contract and relax the muscles of the pelvic floor. When they contracted muscles (with the command to hold their urine), fish in computer animation moved upwards and when they relaxed muscles (with the command to let their urine go), it moved downwards. Before and after biofeedback treatment, daily frequency of voiding, the number of enuresis during the daytime, urination disorders, symptom score, and uroflowmetry results were evaluated to assess the efficacy of biofeedback treatment.

### Statistics

Descriptive statistics were calculated with data obtained (mean, standard deviation, median, percentage, etc.). The normality distribution of the quantitative data was evaluated with a histogram and Kolmogorov Smirnov test. The Paired Samples t-Test was used for the normally distributed mean values and the Wilcoxon sign test was used for the non-normally distributed mean values. A p-value less than 0.05 was considered statistically significant. SPSS version 23.0 was used in the evaluation of data.

## RESULTS

Twenty-nine patients who were diagnosed with LUTD were included in this study. 14 patients were girls, 15 were boys (48.3, 51.7 %), and the mean age of the patients was  $6.51 \pm 1.33$  (minimum-maximum, 5-10).

Six patients had urge incontinence before biofeedback treatment, and 4 patients had after biofeedback treatment; 8 patients had daytime enuresis with holding maneuvers before biofeedback treatment, 5 patients had after biofeedback treatment. Moreover, 8 patients had daytime enuresis without urgency or holding maneuvers before biofeedback treatment,

**Table I: Distribution of patients according to clinical symptoms and signs.**

	Before Biofeedback Treatment	After Biofeedback Treatment	p
Urge incontinence	6	4	
Daytime enuresis with holding	8	5	
Daytime enuresis without urgency or holding	9	5	
Day and night enuresis	6	2	
UISS	16.19±7.69	9.52±6.4	<0.001

**Table II: Uroflowmetry results of patients.**

Uroflowmetry pattern	Number of patients	
	Before biofeedback	After biofeedback
Staccato-shaped	14	8
Tower-shaped	2	3
Interrupted-shaped	4	3
Bell-shaped (normal)	9	15

5 patients had after biofeedback treatment; finally, 6 patients had day and night enuresis before biofeedback treatment, 2 patients had after biofeedback treatment. Clinical signs and findings are outlined in Table I.

None of the patients had abnormal physical examination findings. Also, liver and kidney function tests of all patients were normal.

Fifteen patients (51.7%) had urinary tract infections, seven of these (24.1%) had vesicoureteral reflux. Prophylactic antibiotic treatment was initiated in eight of the patients. Except for these eight patients, none of the patients received additional medical treatment. In addition, 15 patients had (51.7%) constipation and 4 patients (13.8%) encopresis. Thickening in the bladder wall was detected in the USG examination of 10 patients (34.4 %) and hydronephrosis in 5 (17.2%) patients.

All patients underwent a uroflowmetry investigation before and after biofeedback therapy. Before biofeedback treatment, staccato-shaped patterns in 14 patients, tower-shaped patterns in 4 patients, interrupted-shaped patterns in 2 patients, and bell-shaped patterns in 9 patients were detected in uroflowmetry tests. Although a statistically significant difference was not found; the number of patients with a bell-shaped pattern increased to 15 and the staccato-shaped pattern decreased to 8 after treatment. Uroflowmetry results of patients were summarized before and after biofeedback treatment in Table II.

After animation biofeedback treatment, daytime symptoms improved in 13 patients (44.8%) and nighttime enuresis improved in two (6.8%) patients. Although 5 patients with constipation completely improved, there was no improvement in patients with encopresis. There was a decrease but not a

complete improvement in complaints of six patients (20.7%). UISS score which was  $16.19 \pm 7.69$  before biofeedback treatment decreased to  $9.52 \pm 6.4$  after the treatment, with a statistically significant difference ( $p < 0.001$ ).

## DISCUSSION

Biofeedback is a non-invasive treatment technique that can be readily applied in pelvic wall dysfunction in children. It was originally described by Mc Kenna et al. (8) as an animated computer game. Although the evidence level is limited, biofeedback treatment was beneficial especially in 4 to 6-years-old children with dysfunctional voiding (4,8,9). In the study of Zeng et al. (10), six patients receiving pharmacological treatment were compared with 16 patients receiving biofeedback treatment and it was reported that all patients recovered in the latter group. Similarly, in the study of Desantis et al. (11), it was stated that approximately 80% of children benefitted from biofeedback treatment and emphasized that this treatment is non-invasive and efficient. Likewise, in this study, after animation biofeedback treatment, daytime symptoms improved in 13 patients (44.8 %), nighttime enuresis improved in two (6.8 %) patients, and five patients with constipation completely improved. In the study of Ladi-Seyedran et al. (12), the mean of the UISS score was found  $9.5 \pm 4.7$  before biofeedback treatment, while it was found  $4.02 \pm 3.4$  at the sixth month of treatment, with a statistically significant difference ( $p:0.003$ ). We also found a statistically significant difference in the UISS score after the treatment ( $16.19 \pm 7.69$  before treatment,  $9.52 \pm 6.4$  after treatment,  $p < 0.001$ ).

In conclusion, biofeedback was underlined as a useful treatment method for dysfunctional voiding in the literature and further studies with larger patient series should be carried out to draw definitive conclusions about its effects.

In this study, it was suggested that biofeedback treatment can be considered as a suitable alternative for children with lower urinary tract symptoms who do not respond to standard treatment.

Being a retrospective study with a limited number of patients, no USG examinations and records of the rates of UTIs after biofeedback treatment can be stated as the limitations of this study.

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