

# High efficacy of biofeedback therapy for treatment of dysfunctional voiding in children

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## KEY WORDS

dysfunctional voiding ► incontinence ►  
biofeedback ► children

## ABSTRACT

**Introduction.** Dysfunctional voiding is a frequent condition in children associated with symptoms of incontinence. The aim of this study was to present the efficacy of biofeedback treatment on the resolution of clinical symptoms in a large cohort of children with urodynamically confirmed dysfunctional voiding.

**Material and methods.** 81 children (75 girls and 6 boys) aged 6–18 years (mean: 10.32 ± 3.17 yrs.) with a dysfunctional voiding pattern are presented. 74/81 (92.6%) of children were unresponsive to standard urotherapy and prior pharmacotherapy. Symptoms of bladder dysfunction were evaluated by questionnaire, bladder diary and an urodynamic study according to definitions and standards set by ICCS. The biofeedback training was planned for 2 months. Each session consisted of about 30 repeats of 5 s contraction and 30 s relaxation of pelvic floor muscles and external urethral sphincter. Biofeedback was performed together with standard urotherapy.

**Results.** 67 (82.72%) of the 81 children declared wetting during the day and 41 (50, 62%) – wetting during the night. 32/81 (39.5 %) children had increased voiding frequency and 43 (53.08%) had decreased bladder capacity. Following 2 months of biofeedback therapy daytime incontinence resolved in 34/67 (50.7%) children and nighttime incontinence in 22/41 (53.65%). A further 40.3% declared partial improvement in daytime and 26.7% in nighttime wetting.

**Conclusions.** Biofeedback treatment is an effective therapeutic option for children with dysfunctional voiding. Pelvic floor therapy with biofeedback should be offered to children with dysfunctional voiding resistant to standard urotherapy.

In the past "dysfunctional voiding" was used to describe all types of voiding dysfunctions connected to both the filling and voiding phases. Today according to the Standardization Committee of the International Children's Continence Society (ICCS) dysfunctional voiding is a term used for the "habitual contraction of the urethral sphincter specifically during the voiding phase only" [3]. The term "dysfunctional voiding" can be applied when sphincter contractions are present during the voiding phase on urodynamic study [2, 4]. This term is used to describe only neurologically normal children [5].

According to ICCS terminology overactivity of the pelvic floor muscles during micturition is the common denominator in several patterns of dysfunctional voiding. Though there are no clear data on the causes of dysfunctional voiding, several theories exist on its possible pathogenesis: persistent infantile voiding pattern, developmental delay of proper detrusor-sphincter synergy, habitual behavior, or a secondary reaction to bladder overactivity. In children with poor or lacking coordination between detrusor contraction and sphincter relaxation there can be similarities with detrusor-sphincter dyssynergia typically seen in children with neurological problems [2].

ICCS has classified symptoms according to their relation to the voiding or storage phase of bladder function [2]. The main voiding symptoms are *straining* (a child applies abdominal pressure to initiate voiding), *intermittency* (a fractioned stream during voiding), *holding maneuvers* (crossing legs, squatting), *LUT pain* and *feeling of incomplete emptying* [2].

Dysfunctional voiding is a condition that is often overlooked by parents [6]. Incomplete bladder emptying and abnormal urethral sphincter function can lead to symptoms of dysfunctional voiding such as wetting, urge incontinence, overflow incontinence, or recurrent UTI. Symptoms of incontinence or urgency are distressing for both the children and their parents. They need to be treated not only as medical conditions, but also because children with incontinence become outsiders and develop low self-esteem, which may lead to serious psychological complications [7].

Treatment of dysfunctional voiding consists of standard urotherapy and pharmacotherapy. The aim of standard urotherapy is education on the anatomy and physiology of the urinary tract, modification of voiding and drinking habits, correction of the toilet posture, treatment of constipation, and positive motivation of the child and parents [1, 2, 7, 8]. The aim of pharmacotherapy is to improve bladder emptying. In children without detrusor disorders bladder emptying can be promoted by targeting the bladder outlet with alpha-adrenergic antagonists (alpha-blockers). If dysfunctional voiding is connected with an overactive bladder the treatment should include bladder relaxants and anticholinergic therapies that facilitate storage by relaxing the detrusor smooth muscle [6]. The results of therapy need to be monitored with uroflowmetry and regular voiding charts [6]. A significant number of children are resistant to the above therapy and are still wet during the day and/or night in spite of improvement of bladder capacity.

## INTRODUCTION

Dysfunctional voiding is a frequent condition related to abnormal bladder function in school-age children. Symptoms related to dysfunctional voiding include incontinence, urgency, intermittency, recurrent urinary tract infections, and a feeling of incomplete emptying. It was previously believed that daytime and nighttime wetting was related to psychological trauma, psychiatric disorders or family problems [1]. Today it is recognized that the symptoms are a consequence of abnormal bladder and urethral sphincter function [1, 2].

**Table 1.** Clinical response to 2-month biofeedback therapy for dysfunctional voiding in 81 children

| Clinical symptom                   | No. of children (%) Before biofeedback treatment | No. of children (%) After biofeedback treatment | [p]      |
|------------------------------------|--|---|----------|
| Daytime incontinence               | 67/81 (82.72%)                                   | 34/81 (58.6%)                                   | p <0.001 |
| Nighttime incontinence             | 41/81 (50.62%)                                   | 19/81 (23.45%)                                  | p =0.001 |
| Urgency                            | 62/81 (76.54%)                                   | 42/81 (51.85%)                                  | p <0.001 |
| „Holding maneuvers“                | 55/81 (67.9%)                                    | 27/81 (32.1%)                                   | p <0.001 |
| Intermittency                      | 62/81(76.54%)                                    | 29/81 (35.80%)                                  | p <0.001 |
| Straining                          | 30/81(37.04%)                                    | 13/81 (16.05%)                                  | p <0.001 |
| Feeling of incomplete micturition  | 44/81(54.32%)                                    | 15/81 (18.52%)                                  | p <0.001 |
| Wetting before reaching the toilet | 38/49 (77.55%)                                   | 11/49 (22.45%)                                  | p <0.001 |
| Mental discomfort                  | 50/81 (61.73%)                                   | 25/81 (30.84%)                                  | p <0.001 |
| Abnormal bladder capacity          | 52/81 (64.2%)                                    | 7/81 (8.54%)                                    | p <0.001 |
| Incorrect voiding frequency        | 41/81 (50.62%)                                   | 19/81 (23.46%)                                  | p <0.001 |

Pelvic floor and external urethral sphincter relaxation therapy has been applied for children with dysfunctional voiding and experience is cumulating on the positive effect of using biofeedback therapy [3]. Biofeedback is used for the treatment of different acquired behavior dysfunctions. The method enables the visualization of physiological processes that can be measured and recorded. Biofeedback therapy for dysfunctional voiding involves EMG tracing of pelvic floor muscle contraction and relaxation in the form of an animation with a soundtrack tailored for children. There are few publications on the results of such treatment in the pediatric age group and the groups presented are frequently diagnosed clinically [3,9]. The aim of this prospective study was to present the effect of biofeedback treatment on the resolution of clinical symptoms of a large cohort of children with urodynamically confirmed dysfunctional voiding.

## MATERIAL AND METHODS

Eighty-one children (75 girls and 6 boys) aged 6-18 years (mean: 10.3 ±3.1 yrs.) with a dysfunctional voiding pattern are presented. 74/81 (92.6%) children were unresponsive to prior standard urotherapy and pharmacotherapy. The inclusion criteria for the study group was age (6-18 yrs.), the recording of external urethral sphincter contractions during voiding on urodynamic study, the presence of any of the following voiding disorders: daytime incontinence, nighttime incontinence, urgency, straining, intermittency, dysuria, holding maneuvers, feeling of incom-

plete emptying, and abnormal bladder capacity or frequency. Exclusion criteria included the following: age <6 yrs, presence of anatomical abnormalities, mental deficiency, behavior disorders and neurological diseases.

Symptoms of bladder dysfunction were evaluated by questionnaire, bladder diary and an urodynamic study according to definitions and standards set by ICCS [2, 10]. These included the following definitions of success: *full response* – 100% decrease of symptoms, *response* – >90% decrease of symptoms, *partial response* 50-89% decrease of symptoms, and *nonresponse*: 0-49% decrease of symptoms.

Evaluation of bladder dysfunction was made prior to and after 2 months of treatment. The pelvic floor muscle and external sphincter training was planned for 2 months. At onset the children had a 1-hour session daily with an urotherapist for 5 days followed by sessions once a week. Each session consisted of about 30 repeats of 5 sec contraction and 30 sec relaxation of pelvic floor muscles and external urethral sphincter [11]. During the training the abdominal muscles were monitored to be relaxed.

Visualization of pelvic floor muscle activity was performed by a rectal electrode and abdominal muscles by skin electrodes. Biofeedback was performed together with classical urotherapy.

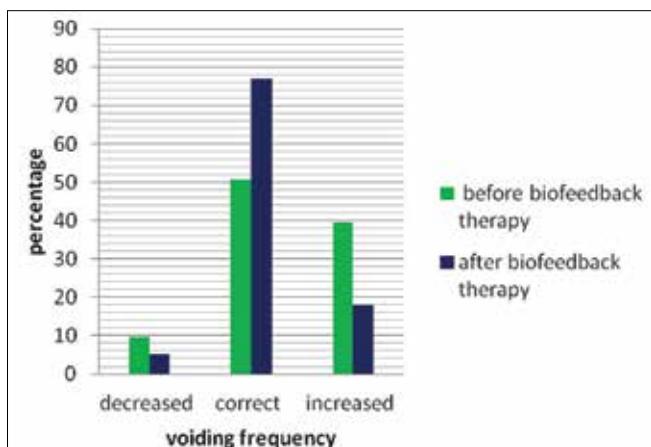
The study obtained approval from the local Ethics Committee.

## Statistical methods

All statistical calculations were made in statistical software SPSS no.17.0 for Windows. For the statistical evaluation of quantitative parameters nonparametric tests were used – Mann-Whitney test for independent variables, Wilcoxon and Mc Nemar's test for dependent variables; for quality parameters the exact Fischer test was used. Values are considered significant when p <0.05.

## RESULTS

Sixty-seven (82.72%) among 81 children aged 6-18 years with dysfunctional voiding declared wetting during the day and 41 (50.62 %) – wetting during the night (Table 1). 32/81 (39.5 %) children had increased voiding frequency and 43 (53.08%) had decreased bladder capacity (Figs. 1 and 2). Urgency was declared by 76.54% children, „holding maneuvers“ by 67.9%, intermittency – 76.54%, straining – 37.04%, wetting before reaching the toilet – 77.55%, and feeling of incomplete emptying by 54.32% children (Table 1).



**Fig. 1.** Voiding frequency in children with dysfunctional voiding before and after biofeedback therapy.

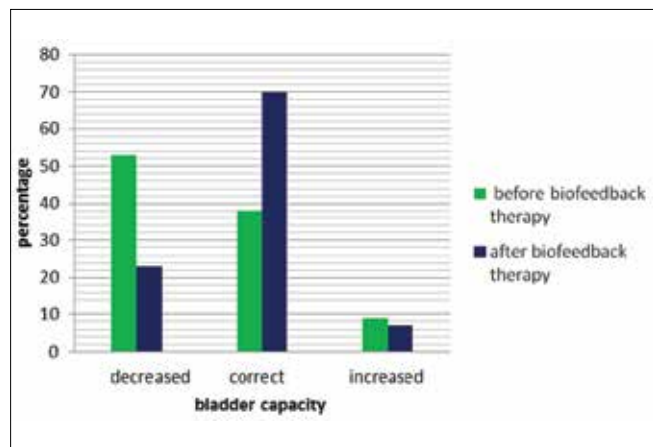


Fig. 2. Bladder capacity in children with dysfunctional voiding before and after biofeedback therapy according to 'voiding diary'.

Following 2 months of biofeedback therapy daytime incontinence resolved in 34 /67 (50.7%) children and nighttime incontinence in 22/41 (53.65%). A further 40.3% declared partial improvement in daytime and 26.7% in nighttime wetting. Only 6/67 (8.9%) children with daytime incontinence and 8/41 (19.5%) with nighttime incontinence remained unresponsive to therapy (Table 2). 76% of children had a normal bladder capacity and 70% normal voiding frequency (Figs.1 and 2). A statistically significant decrease in the proportion of children reporting symptoms of urgency (51.85%), „holding maneuvers” (32.1%), intermittency (35.80%), straining (16.05%), wetting before reaching the toilet (22.45%), and feeling of incomplete emptying (18.52%) was also observed after 2 months of therapy (Table 1).

## DISCUSSION

Daytime incontinence, nighttime incontinence, urgency, abnormal bladder capacity, and voiding frequency belong to the main clinical symptoms of dysfunctional voiding [1, 6, 12]. In the presented cohort of 81 children, 82.72% of children declared daytime incontinence, 50.62% nighttime incontinence, and 76.5% urgency. About 50% of children demonstrated problems with frequency of micturition and fluid intake. Bladder capacity and abnormal frequency of micturition can be normalized with standard urotherapy; however symptoms associated with the inability to relax the external urethral sphincter during voiding remain a problem [1, 12, 13]. Biofeedback enabled the children to visualize their pelvic floor muscle contraction and relaxation in the form of an animation with a soundtrack on a computer monitor [11, 15-18]. This allowed them to achieve control of external urethral sphincter relaxation and contraction. After 2 months of training all of the clinical symptoms of dysfunctional voiding had improved. The resolution of symptoms following therapy reached high statistical significance. Only a minority of children remained unresponsive to biofeedback treatment. Some of the nonresponders were uncooperative during the training sessions or noncompliant to classical urotherapy, which has been shown to be a cause of treatment failure [2]. In individual children the duration of treatment was probably too short to reverse the acquired behavior dysfunction of habitual sphincter

contraction. The results of the presented study confirm previous reports on the importance of implementing biofeedback training in order to achieve higher efficacy of classical urotherapy [5, 11, 18, 19, 20]. The treatment regimens for dysfunctional voiding vary between different centers and are therefore difficult to compare. There are no randomized trials that demonstrate the superiority of any treatment schedule though many studies have shown the high efficacy of non-pharmacological treatment of voiding disorders [2, 3, 11, 21].

The excellent results achieved with biofeedback treatment of dysfunctional voiding in the presented cohort of children enable us to conclude that this form of therapy is effective and useful. We suggest that it should be offered to every patient with dysfunctional voiding who is unresponsive to standard urotherapy. The limitation of this method is the need to have a dedicated urotherapist who is trained in cooperating with children.

## CONCLUSIONS

Biofeedback treatment is an effective method of treating dysfunctional voiding in children with over 50% achieving resolution of symptoms.

Pelvic floor therapy with biofeedback should be offered to all children with dysfunctional voiding resistant to classical urotherapy.

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Table 2. Resolution of incontinence following biofeedback therapy in 67 children with dysfunctional voiding

| SYMPTOM                | FULL RESPONSE  | RESPONSE       | PARTIAL RESPONSE | NO RESPONSE   |
|------------------------|----------------|----------------|------------------|---------------|
| Daytime incontinence   | 34/67 (50.75%) | 23/67 (34.33%) | 4/67 (5.97%)     | 6/67 (8.95%)  |
| Nighttime incontinence | 22/41 (53.65%) | 5/41 (12.19%)  | 6/41(14.65%)     | 8/41 (19.51%) |

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