Behavioral Medicine Treatment in Chronic Constipation with Paradoxical Anal Sphincter Contraction

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Nine women and five children with severe chronic constipation received behavioral medicine therapy. Before treatment, all patients had a paradoxical contraction of the external anal sphincter at defecation attempts as demonstrated with electromyography and/or anorectal manometry. An electromyographic biofeedback device connected to an anal probe was used for the training that was performed on a regular toilet seat during five 1-hour sessions. Thirteen of the patients improved considerably and could learn to defecate spontaneously, and the use of laxatives ceased or diminished. Simultaneously with improvement, the paradoxical anal contraction disappeared. The results remained after 6 months, although two of the patients had received booster sessions of biofeedback training during follow-up. [Key words: Behavioral medicine; Constipation; EMG biofeedback; Anorectal manometry; Paradoxical contraction of external anal sphincter]

Dahl J, Lindquist BL, Tysk C, Leissner P, Philipson L, Järnerot G. Behavioral medicine treatment in chronic constipation with paradoxical anal sphincter contraction. Dis Colon Rectum 1991;34:769–776.

Constipation is a common medical problem. Although some respond to medical treatment or a high-fiber diet, others with persistent severe constipation do not respond to any form of treatment.

The pathophysiology of severe chronic idiopathic constipation is not known, but previous studies have shown an abnormally high sphincter pressure,[1] impaired rectal sensitivity,[2] failure of relaxation or paradoxical contraction of the external sphincter,[3] or reduced colonic propulsion.[4, 5] Abnormalities of the colonic myenteric plexus,[6] impaired motilin release,[7] and reduced amounts of vasoactive intestinal peptide (VIP) and peptide histidine-methionine (PHM) in the colonic circular smooth muscle have been described.[8] The concept of paradoxical contraction of the external anal sphincter causing chronic constipation in young women has been outlined earlier, although some have disputed its exact pathophysiologic importance.[3] Medical therapy often fails, and surgical procedures such as anorectal myotomy,[9] posterior division of the puborectal muscle,[10] colectomy with ileorectal anastomosis,[11] and proctocolectomy with a pelvic pouch[12] have been attempted with varying and unpredictable results.

In the past decade, behavioral techniques have been developed for gastrointestinal disorders[13–15] and have been successful in fecal incontinence[16, 17] and in some cases of chronic constipation.[18–20] Although these are different disorders, the functional basis may be the same, *i.e.*, learning/relearning how to control the external anal sphincter upon appropriate signals.

The aim of the present study was to evaluate such treatment using electromyographic (EMG) biofeedback in patients with chronic constipation and a paradoxical contraction of the puborectal muscle.

PATIENTS AND METHODS

Patients

Nine women (age range, 22–60 years) and five children (four boys and one girl; age range, 6–14 years) with chronic constipation resistant to traditional treatment participated in the study. The mean duration of constipation symptoms in the adults was 18 (range, 4–40) years, and that in the children was 8 (range, 4–12) years.

This study was supported financially by the Örebro County Research Committee.
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The boys had life-long constipation, never having experienced regular toilet evacuation. The girl (11 years old) was born with high anal atresia and received colostomy in the neonatal period; a Duhamel operation was performed later. She was continent but suffered for many years from disabling, painful defecation problems.

Pretreatment Diagnostic Procedures

Diagnostic procedures consisted of gastroenterologic examinations including barium enema, sigmoidoscopy, intestinal radiopaque marker transit time, anorectal manometry, defecography (adults), EMG of the external sphincter muscle, and the balloon expulsion test. A behavioral assessment included home recordings of "defecation behavior" and situational context, ratings of relevant psychologic factors such as stress, pain, cognitions, and consequences of this problem, and recordings of all exercise, diet, and laxative-type medicine during the 2 weeks prior to intervention.

Manometric Techniques

Anorectal manometry was performed as described by others[21] with minor modifications. The cuff of a Mallinckrodt No. 6 endotracheal tube (Mallinckrodt Laboratories, Athione, Ireland) was used to record the pressures at the internal and external sphincters. The cuff was filled with air and connected *via* a polyethylene tube to the recording unit, consisting of a pressure transducer, amplifier, and recorder. Rectal distention was achieved *via* a latex balloon (3–4 cm in length, deflated) made of the fingertip of a surgical glove. The balloon was connected to a polyethylene tube and sealed with glue and silk thread. The tube was passed through the Mallinckrodt tube to the recording unit.

All patients were examined in the left-side position with hips and knees in flexion. No enemas or other preparations were given 12 hours prior to examination.

Rectal sensitivity was estimated by recording the threshold volume and maximal tolerated rectal volume. The threshold volume of rectal distention was the smallest volume that the patient could perceive. The recorded value was the mean value of three consecutive recordings.

Internal anal sphincter activity was documented as the rectoanal inhibitory reflex recorded as a transient reproducible involuntary relaxation of the internal anal sphincter upon rectal distention.

External anal sphincter activity was recorded during squeezing and straining with the cuff at the external anal orifice and the rectal balloon distended to the threshold volume.

Strain Index

The strain index was defined as the proportion between the maximal activities at strain and at squeeze recorded with EMG and anorectal manometry. Paradoxical contraction of the external anal sphincter was defined as a strain index of 0.5 or higher at manometry and/or EMG.

Balloon Expulsion Test

The balloon expulsion test[3] was performed with the patient sitting on a toilet and the rectal balloon filled with 50 ml (adults) or 25 ml (children) of air.

EMG Measurements

The EMG signal from the rectal sphincter muscle was detected in the children by means of a commercially available (Dantec, Copenhagen, Denmark) hourglass-shaped plastic probe featuring two circular electrodes (Fig. 1). The relationship between isometric muscular tension and its EMG signal is well documented, demonstrating that the average rectified surface-recorded EMG and the exerted force of the same muscle are close to linear.[22–27] Thus, it was assumed in the present study that the average rectified EMG from the anal sphincter was correlated to the exerted pressure from the sphincter muscle.

The probe was gently introduced into the anal canal and located at the estimated level of the external sphincter. The EMG signal was amplified and recorded using standard portable equipment

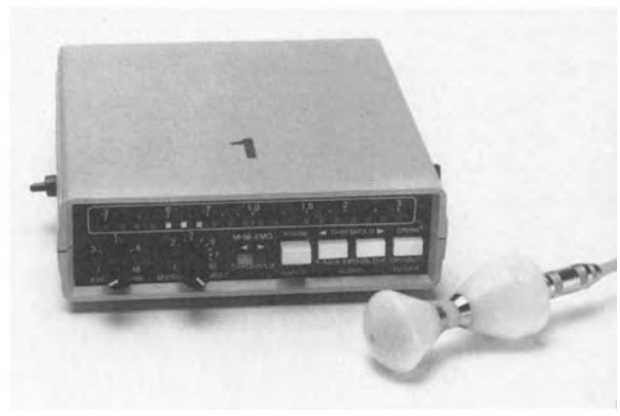

Figure 1. Anal probe for EMG registration.

allowing visual and/or acoustic documentation. Recordings were performed at rest, squeeze, and strain before and after treatment. The rectified EMG pattern was documented in average arbitrary units. In the adults, the EMG was performed as a traditional needle EMG of the external anal sphincter muscle.

Behavioral Assessment

Continuous daily measurements of the defecation urge and responses, as well as laxative drugs consumed, plus diet and physical exercise, were recorded by the patient, before, during, and after treatment, on registration cards and were handed in weekly. Time of "straining" in defecation attempts each day was recorded, as was a self-rating of emotional state and degree of tension in these situations.

Experimental Design

An experimental analysis A–B design entailing a baseline, intervention, and follow-up, where each patient served as his/her own control, was used as described by Hersen and Barlow.[28]

Treatment

The goal of the behavioral treatment was to increase sensitivity to normal amounts of rectal distention and to shape the external sphincter response to allow normal defecation. An EMG biofeedback apparatus connected to an anal probe and a rectal balloon was used. Training took place on a normal toilet seat in a natural position, for 1 hour on five different occasions. The training program was provided by one of the authors, a behavioral psychologist (J. D.).

Treatment consisted of four consecutive parts: 1) sensory awareness training of rectal sensation, 2) shaping of the correct sphincter response, 3) weaning of the patient from the apparatus, and 4) generalization and application of new responses in the home environment.

Sensory awareness training consisted of distending the rectum with the threshold volume of air sensed by the patient and progressively decreasing the distention to levels which normally elicit the defecation response (30–40 ml). Subsequently, the amounts of air were increased and decreased at random, and the patient was required to estimate the rectal distention.

A forced-choice technique[29] was used to overcome selection bias, whereby the patient received both true and false inflations at random, and the patient was required to choose which of two distentions were "real." When the patient correctly identified a rectal distention of 20–30 ml five times in a row, Part 2 of training began.

Part 2 consisted of training to correct the sphincter response in three steps. First, the patient was shown a normal pattern of correct response necessary for adequate defecation. Instructions were provided prompting the patient to imitate squeeze and strain responses by increasing and decreasing the muscle activity as displayed on the EMG apparatus in the forms of auditory and visual signals. Second, subsequent to exhibiting correct sphincter responses, the patients were trained in initiating these same responses to successively lower levels of rectal distention using a rectal balloon. The final step was the use of applied relaxation in the defecation situation, generally with the purpose of lowering the muscular tone during rest and aiding in the patient's concentration on controlling the sphincter muscle.

Part 3 of treatment consisted of a program of successively weaning the patient from the EMG apparatus. The rectal balloon was first removed followed by successive removal of visual and then auditory signals. Following each training session, patients remained in the toilet room with no apparatus and tried to apply new responses in real defecation attempts.

The fourth part of treatment consisted of applying learned techniques in natural situations at home or work. An applied-relaxation, home-training program was given using instructional tapes for the defecation situation. Applied relaxation was also used in situations which patients judged as stressful. Sphincter exercise training programs, which entailed exercising the sphincter muscle upon certain frequent daily activities, were also given to patients.

One-week booster sessions 3 months following treatment were provided if needed.

RESULTS

Pretreatment Findings

All patients suffered from severe chronic idiopathic constipation with disabling defecation problems, distress, and pain. Eleven patients used laxatives and enemas frequently, and the other three had stopped, as they had received no benefit.

There was no sign of neurogenic lesion as evidenced by careful clinical evaluation. The defecation rate varied considerably. With laxative and enemas, the patients evacuated their bowel approximately once a week or every other week. All children showed considerable emotional distress at attempts to defecate.

The intestinal transit time using the marker technique is considered delayed if more than four markers remain on day 5.[30] Accordingly, 10/14 patients had a slow transit time, with the markers in the left colon in all cases (Table 1).

At anorectal manometry, three patients (Patients 1, 4, and 5) had rectal threshold volumes of 60–70 ml, all the others having 10–40 ml at the beginning of treatment. Thirteen of the patients could tolerate 250 ml or more when testing the maximal tolerated volume at manometry, indicating a normal or low rectal sensitivity. However, the girl who had been operated on because of anal atresia had a low tolerance of 35 ml.

In spite of suffering from severe defecation problems, all patients except one (Patient 9) could expel the balloon at the expulsion test.

The rectoanal inhibitory reflex was demonstrated in all patients, indicating normal internal anal sphincter function.

Before treatment, all patients exhibited paradoxical contraction, defined as a contraction of the external anal sphincter during straining in rectal evacuation and documented as a strain index of 0.5 or higher at EMG and manometry. In five of the nine women, defecography demonstrated absence of relaxation of the puborectalis muscle at straining.

Results of the Effects of Treatment

Table 2 shows the main results of the study from a 3-week baseline to a 2-month and 6-month follow-up.

Following EMG biofeedback, 12/14 patients were improved considerably after 2 months. They could defecate more frequently, and the need for laxatives was reduced. Six patients ceased, three diminished, and four did not change the use of laxatives during the observation period.

A striking general improvement of the patients with great relief was apparent when they learned to handle the defecation.

An effect was seen in all cases after two to four training sessions. In the youngest patients (Patients 13 and 14), the improvement was linked to a reduction of the number of defecation accidents with soiling. Before training, there were three to five such accidents, and, after training, there were zero to one accident per 14 days.

One patient (Patient 4) showed no improvement at the 2-month follow-up and refused further therapy.

At the 6-month follow-up, the results were maintained, although two of the patients (Patients 5 and 8) received booster sessions with biofeedback after 2 months, as their symptoms and paradoxical con-

Table 1.
Clinical Data of 14 Patients with Chronic Constipation and Paradoxical Contraction of the External Anal Sphincter Before Behavior Treatment

Patient	Sex	Age (yr)	Duration (yr)	ITT	TV (ml)	Defecography
1	F	50	40	20	60	PSC
2	F	44	4	1	40	N
3	F	37	7	2	30	N
4	F	60	12	20	70	N
5	F	40	10	10	70	PSC
6	F	26	15	3	30	N
7	F	22	10	16	30	PSC
8	F	40	34	1	40	PSC
9	F	50	30	18	30	PSC
10	M	11	10	20	25	n.d.
11	M	11	10	18	25	n.d.
12	F	14	12	15	10	n.d.
13	M	6	4	20	30	n.d.
14	M	8	6	20	35	n.d.

ITT = intestinal transit time: number of remaining markers 5 days after intake of 20 markers. TV = threshold volume. n.d. = not done. N = normal. PSC = paradoxical sphincter contraction.

Table 2.
Effects of Behavioral Training in Chronic Constipation

Month Patient	Defecation Rate			Laxatives			EMG			Manometry		
	0	2	6	0	2	6	0	2	6	0	2	6
1	4	2	2	2	1	1	0.6	0.3	n.d.	0.9	0.3	0
2	4	3	1	2	2	1	0.5	0.2	n.d.	0.5	0	0
3	3	3	2	3	2	2	0.5	0.1	n.d.	0.3	0.3	0.1
4	3	3	*	3	3	*	1.2	1.0	*	1.0	1.0	*
5	4	3	2	3	3	3	0.9	0.5	0.1	1.0	0.5	0
6	4	2	1	3	1	1	0.7	0.5	n.d.	0.8	0	n.d.
7	4	3	3	1	1	1	1.0	n.d.	0.1	1.0	0.6	0.3
8	4	4	2	1	1	1	1.0	0.3	0.2	0.8	0.8	0
9	4	2	1	3	1	1	0.8	0.5	n.d.	0.7	0.4	0
10	5	2	2	4	1	3	0.7	n.d.	0.4	0.6	0.2	0.5
11	4	2	2	4	1	2	0.6	n.d.	0.3	0.7	0.2	0.2
12	4	1	3	4	2	2	0.7	n.d.	0.2	0.7	0.4	0.3
13	4	1	1	4	1	1	0.7	0.4	0.3	0.7	0.2	0.1
14	4	1	2	1	1	1	0.7	0.4	0.3	0.8	0.3	0.2

Defecation rate: 1 = daily; 2 = every 2–3 days; 3 = every 4–6 days; 4 = every 7–14 days; 5 = never.
Use of laxatives: 1 = never; 2 = 1–3 times/2 weeks; 3 = 1–5 times/week; 4 = daily.
EMG (strain index—EMG): average rectified EMG (arbitrary units) at strain divided by EMG at squeeze.
Manometry (strain index—manometry): peak level of pressure recording of the external anal sphincter at strain divided by pressure at squeeze.
n.d. = not done.
* Dropout.

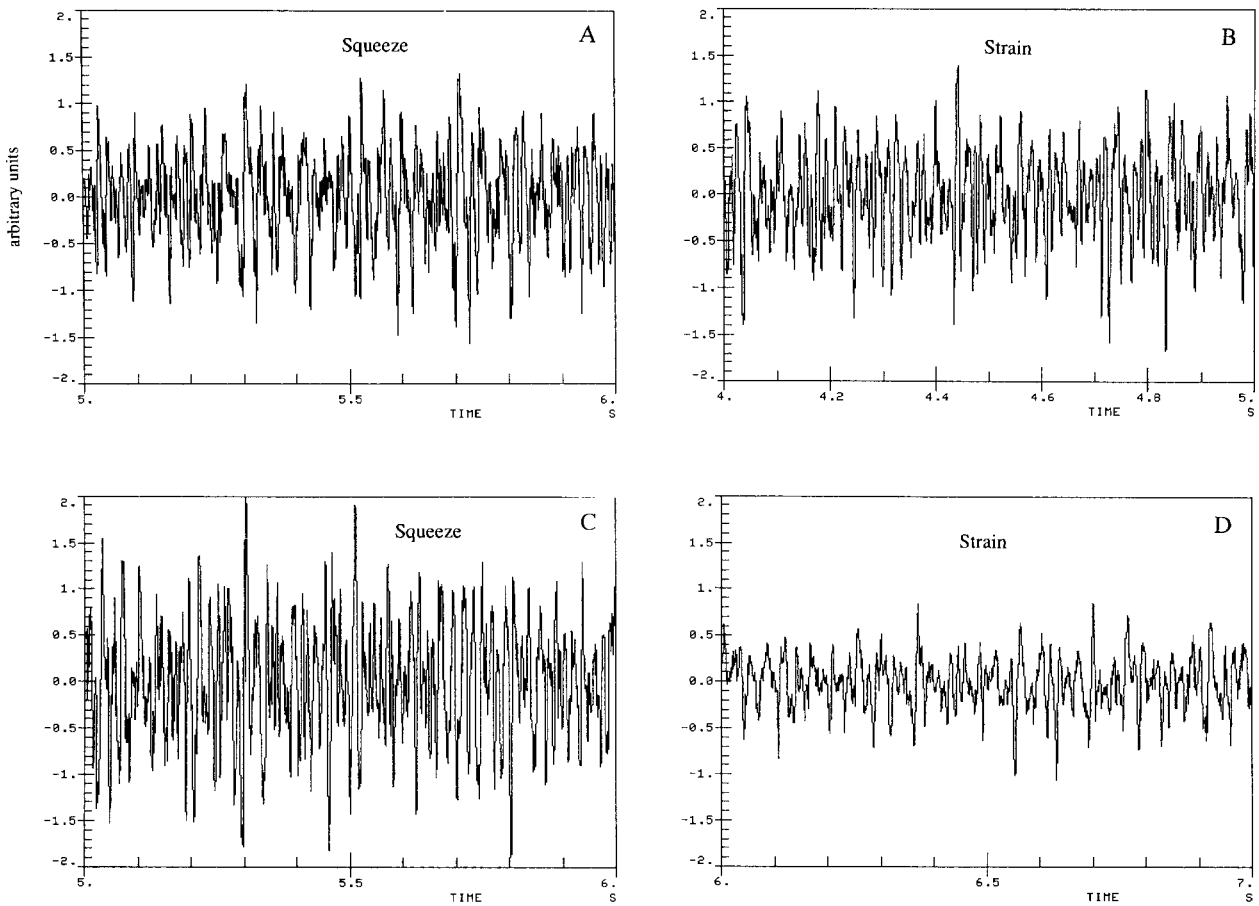

Figure 2. Surface EMG recorded for 1 second at the external anal sphincter level during squeeze and strain in a constipated patient (Patient 5) before behavioral training (A, B) with strain index 0.9, and at 2 months follow-up (C, D) with strain index 0.5.

traction persisted. In the other patients, the clinical improvement was followed by a reduced strain index at EMG and/or manometry (Figs. 2 and 3). The woman who could not expel the balloon before treatment could do so easily after behavioral therapy.

A very good correlation was found between strain index as recorded with manometry or EMG. On 32 occasions, both methods were used with a correlation coefficient of 0.83 ($P < 0.001$).

DISCUSSION

The present study demonstrates that selected children and adults with severe chronic constipation and paradoxical contraction of the external anal sphincter can learn to defecate appropriately. The patients could learn to reestablish an appreciation for normal rectal distention and use this as a signal to voluntarily initiate control over the external sphincter after a relatively short behavioral treatment program.

The study also shows that some of the patients with a very long duration of constipation could stop using laxative drugs and still defecate spontaneously. Clinical improvement was apparent in 13 of the 14 patients at analysis of symptoms and clinical signs and was documented by EMG and anorectal manometric techniques.

Findings in the present study are in accordance with earlier studies using behavioral biofeedback

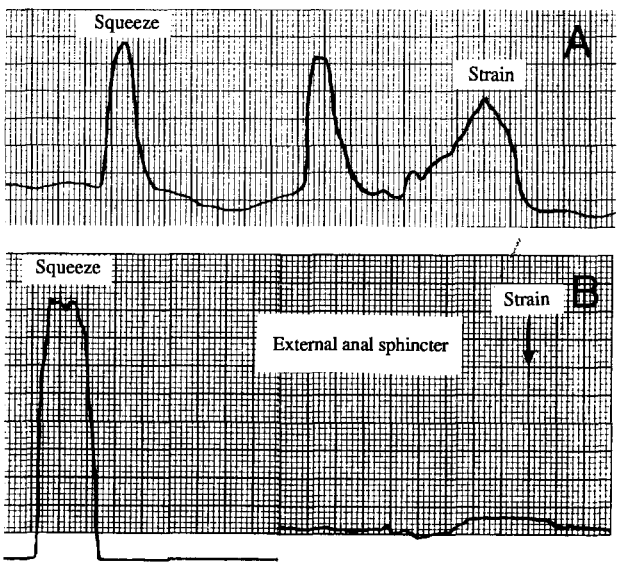

Figure 3. Manometric tracings in a constipated patient (Patient 13) during squeeze and strain before treatment (A) with strain index 0.7, and at 6 months follow-up (B) with strain index 0.1.

treatment of constipation.[18–20] In the present study and the one by Bleijenberg and Kuijpers,[20] subjects with paradoxical contraction of the external sphincter were treated using the EMG biofeedback technique to relax the spastic pelvic floor. However, Weber *et al.*[19] included patients with anal hypertonia and ultraslow waves or with a decreased rectoanal inhibitory reflex and used manometric registrations on a screen to condition the patient to relax the anal sphincter. In our study, all training sessions took place in a normal toilet room with the patient sitting on a normal toilet seat and monitoring the defecation response on the portable EMG. The patients also took this equipment home for a period as a part of their home training. A simplified biofeedback procedure of this kind reduces many of the problems of generalization from the laboratory to the natural environment.

The present study also demonstrated that the balloon expulsion test was normal in most patients with chronic constipation and paradoxical contraction. This contrasts with the observations made by Keren *et al.*[18] in a study of patients with constipation and paradoxical contraction of the external anal sphincter. They successfully used a simple technique for anal sphincter conditioning by teaching the patients to relax the anal sphincter and expel a rectal balloon distended with different volumes. In the present study, all patients except one could expel the balloon before treatment, *i.e.*, in spite of the presence of paradoxical contraction. According to our results, the balloon expulsion test is not a useful physiologic marker of paradoxical contraction. The intestinal transit time is usually increased in chronic constipation of the outlet type.[1, 30] However, in the present study, 4 of 14 patients had a normal transit time, which may indicate that these patients suffer mainly from constipation of the outlet type with evacuation problems rather than a disturbance of colonic motility.

Careful diagnostic examinations in the form of gastroenterologic, neurophysiologic, and behavioral assessments are crucial for selecting patients with constipation who show paradoxical contractions. To standardize this procedure, a strain index was defined which provided reproducible results and was convenient for diagnostic work as well as for follow-up documentation with EMG and manometry. During improvement, the strain index decreased to below 0.5 but increased in two patients who deteriorated during follow-up and subsequently received booster sessions of biofeedback

training. We suggest that a strain index be used for clinical evaluation of paradoxical contraction of the anal external sphincter.

The present study also indicates that paradoxical contraction of the external anal sphincter is important for the clinical symptoms in selected constipated patients, although the pathogenesis in other patients is more complicated and multifactorial.[3]

Conventional needle EMG was used for adults and surface EMG was used for children in the present study. It was found that both methods can be used for documentation of paradoxical contraction when compared with manometry. Surface EMG causes less discomfort, can easily be repeated, and is preferred for use in children. In addition, it is convenient to use the same device for diagnostic evaluation and treatment. In the future, we will use only surface EMG for these particular clinical situations provided that there is no need for more detailed diagnostic evaluation requiring invasive investigation. For clinical routine use, the good correlation between strain index recorded with manometry and with EMG indicates that manometric investigation alone may be sufficient if neurophysiologic equipment is lacking.

The present study, with a follow-up time of 6 months, should be regarded as a pilot study that focused on designing a methodology for clinical evaluation. Longer follow-up periods will be required before any conclusions can be drawn as to long-term effects of treatment. Regular booster sessions at preprogrammed intervals may also be required to maintain the effects of treatment.

However, results of the present study were promising, as this group of patients with extremely severe constipation was relieved of the symptoms which previously have been resistant to all other therapeutic modalities.

In conclusion, this study demonstrates that behavioral medicine treatment may be beneficial in selected adults and children with chronic constipation and paradoxical contraction of the external sphincter. The long-term effects remain to be studied, as well as evaluation of possible nonspecific effects of biofeedback treatment and professional attention.

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