Efficacy of combination of biofeedback therapy and pelvic floor muscle training in dyssynergic defecation

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Abstract

Background: **It is now known that with appropriate exercises, the functions of the muscles in the body ameliorate and increase in strength. We applied pelvic floor muscle relaxation training and exercises that strengthen the abdominal and pelvic muscles in combination with biofeedback therapy (BFT) to patients with dyssynergic defecation (DD).**

Methods: **Patients who met the criteria for DD and had no underlying organic cause were included in this study. The electromyography (EMG) technique was used for BFT therapy. Patients had received at least six sessions of BFT. BFT was considered successful in patients when the DD pattern in anorectal manometry (ARM) disappeared and/or adequate anal relaxation was obtained following BFT and in patients who had full clinical recovery.**

Results: **Data of 104 patients (58 females [55.8%] and 46 males [44.2%]) was evaluated. Abdominal and rectal symptoms disappeared in 71 (68.26%) patients. Of the patients who achieved symptomatic improvement, 58 (55.76%) saw a disappearance of the dyssynergic defecation pattern.**

When the differences between anal sphincter pressures before and after treatment were compared in patients who responded to BFT and those who did not, no significant differences were observed, but significant changes were found in anal squeezing pressures. It was found that those who had high squeezing pressures before BFT, those who increased their squeezing pressures after BFT, and those who decreased their resting pressure responded better to BFT.

Conclusions: **In this study, BFT was found to be more effective in those with a high squeezing pressure and those that increased squeezing pressure after BFT. These findings will influence the treatment of patients with dyssynergic defecation who do not respond to treatment. A combination of abdominal and pelvic floor muscle exercises and BFT increases patient response.** (Acta gastroenterol. belg., **2021,** 84**, 577-583**).

Keywords: dyssynergic defecation, biofeedback therapy, pelvic floor muscle training, anorectal diseases.

Introduction

Chronic constipation is a common condition that significantly impairs quality of life, occurring in an estimated 14-18% of society. Constipation also contributes to the use of health services and direct and indirect economic costs. DD is one of the main causes of chronic constipation and comprises one third of patients who have chronic constipation. This acquired behavioral problem arises from the impaired coordination of the abdominal and pelvic floor muscles during the evacuation of feces (1,2).

Conservative treatment options (lifestyle changes, diet, medical treatments, etc.) are often insufficient for these patients, and many patients continue to experience problems due to symptoms (3,4). Biofeedback therapy (BFT) is an inexpensive, non-invasive, and easy-to-apply treatment that has been proven to be one of the most effective treatments for DD. BFT can provide both symptomatic healing and can help eliminate the DD pattern. For this reason, BFT is recommended by the American Neurogastroenterology and Motility Society (ANMS) and the European Society of Neurogastroenterology and Motility (ESNM) (5,6) as first-line therapy for DD.

Although the etiology of DD is unknown, the underlying pathophysiological mechanisms are proposed as follows: 1) malfunction in pushing the stool forward in the rectum, 2) inadequate relaxation in the anal sphincter, or 3) paradoxical anal contractions. In BFT, the objective is to regain abdominal-pelvic coordination ability, and there are many randomized and non-randomized studies that demonstrate the efficacy of BFT (7-13).

Disrupted abdominal-pelvic coordination and dyssynergy of the abdominal and pelvic muscles are responsible for DD. It is now known that with appropriate exercises, the functions of the muscles in the body ameliorate and increase in strength. In our clinic (a tertiary healthcare center), we applied pelvic floor muscle relaxation training and exercises that strengthen the abdominal and pelvic muscles in combination with BFT to patients with DD. In this study, we present the outcomes of 104 patients.

Materials and methods

Patients

Study protocol was reviewed and approved by the Local Ethics Committee (protocol number: 29620911-929), and patient data was collected.

The data of patients with DD, who underwent biofeedback therapy from January 2014 to February 2019, was collected retrospectively. The data was collected from the medical records of our motility laboratory digital database.

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Of the patients who presented to our clinic with a complaint of constipation, those between 18-75 years of age, who had experienced symptoms for more than 12 months, in whom organic and metabolic causes leading to chronic constipation were excluded by colonoscopy and laboratory examinations, and who fully met the DD criteria Rome III (13) were included in the study. Patients excluded from the study comprised those younger than 18 years old, who had experienced symptoms for fewer than 12 months, who could not cooperate with BFT procedure, were pregnant, had active bowel disease and active fissure, had severe heart disease, had impaired cognition (Mini-Mental State score <15), had neurological diseases (such as multiple sclerosis, stroke, or complete spinal cord injury [SCI]), and those who had organic pathologies (descent, rectocele, or intussusception) in MRI defecography.

The diagnosis of DD was made by evaluating the results of anorectal manometry (ARM) and magnetic resonance (MR) defecography. The demographic and characteristic features of the patients, patient history, baseline and post-BFT manometry results, and symptomatic responses to treatment were evaluated.

BFT was considered successful in patients where the DD pattern in ARM disappeared and/or adequate anal relaxation was obtained (>20% sphincter relaxation) (13) after BFT and in patients who experienced full clinical recovery. Even when improvement in bowel and defecation symptoms was observed, BFT was considered unsuccessful in patients who continued to experience a DD pattern following an ARM.

Anorectal manometry tests

ARM was performed using an eight-channel (Dent-sleeve International) water perfusion system. A catheter was connected to calibrated pressure transducers, and data produced by them was recorded digitally (14-15). All standard procedures were performed by an experienced nurse. Anal resting pressure, maximum squeezing pressure, pressure during cough, concomitant relaxation or paradoxical contraction during defecation, and rectoanal inhibitor reflex were recorded. Then, the rectal sensation was evaluated by inflating the rectal balloon and measuring first sensation, desire to defecate, and maximum tolerable volumes.

Biofeedback therapy

Patients were given advice on bowel habits, exercise, laxatives, dietary fiber and fluid intake, and timed toilet training. A team (gastroenterologist, nurse, and physiotherapist), who were experienced on motility, gave patients training on normal defecation anatomy, advice on correct toilet positioning, and how they could improve pushing efforts using postural and diaphragmatic breathing techniques. Patients were then asked to apply these maneuvers at home at least twice a day for 15 minutes. All were recommended to quit digital maneuvers. Exercises that relax the pelvic floor muscles, strengthen the abdominal and pelvic muscles, and provide abdominal-pelvic coordination were explained to patients visually and verbally by the physiotherapist. In addition, visual and written documents were provided to enable the patients to exercise at home. In each BFT session, the BFT nurse would question patients as to whether they were exercising at home, encourage them, and repeatedly emphasize the importance of exercise.

The electromyography (EMG) technique was used for the BFT (16). While a patient lay in the left lateral decubitus position, surface EMG probes were placed around the anal canal. Patients watched the manometric tracings from surface EMG probes around the bilateral anal canal on a computer monitor. Patients were taught to fulfill the commands given by the nurse to control the sphincter and pelvic floor muscles and improve abdominal-pelvic coordination with visual and verbal feedback. Patients received at least six sessions of BFT, applied under the supervision of a motility nurse. BFT was terminated after the sixth session in patients who did not show any improvement in clinical symptoms and who continued to have paradoxical anal contraction in an ARM. The treatment was extended to 10 to 15 sessions in patients who responded to the first six. Each BFT session was applied between 30 to 45 minutes. After the final BFT session, clinical and manometric reevaluations were performed.

The technique of MR defecography

MR defecography was performed by a 1.5 Tesla MR machine with a phase array body coil. Patients were placed in the supine position inside to the machine. Rectal distention was achieved by using rectal ultrasound gel before the examination. To begin, a three-plane T2weighted image was obtained to evaluate the shape and position of the anal canal, rectum, and other pelvic organs. Once the midline sagittal plane had been achieved through these three sequences, the dynamic series was obtained. Each dynamic series took 40-50 seconds and was included in the resting, squeezing, straining, defecation, and post-defecation phase. If the patient was unable to evacuate the gel by defecation, the dynamic series was repeated at least twice.

Evaluation of MR defecography

Initially, pelvic organs were assessed, followed by an evaluation of the dynamic series. PCL (the distance between the inferior pubic ramus and the last sacrococcygeal joint) was drawn on the midline sagittal image. Rectal descensus was accepted if the distance between the puborectalis indentationand the PCL was greater than 4cm. The anorectal angle (ARA) was measured during the resting and defecation/straining phases.DD was diagnosed if the ARA was not enlarged

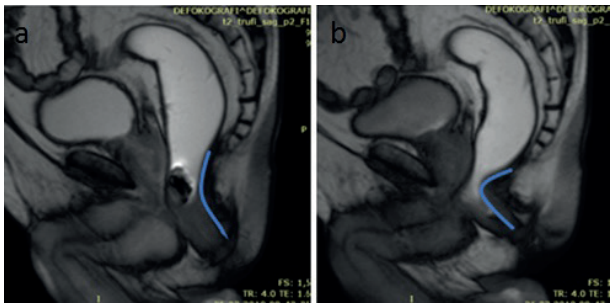

Figure 1. — The rest (a), the defecation (b) phase of DD patient. ARA (blue line) was narrow during defecation phase instead of enlarged according to the rest phase.

enough (>10^0) during defecation or the straining phase (Figure 1).

Statistical analysis

To compare the benefit and non-benefit groups according to continuous clinical variables, a t-test or Mann-Whitney U test was used according to the distribution of data. Therefore, mean-standard deviation or median-minimum and maximum values were calculated to describe the data.

To test the relationship between the benefit groups and categorical variables, a chi-square test statistic was used. Univariate logistic regression models were created for each variable significant in univariate analyses.

To achieve the optimal cut-off and accuracy of "squeeze pressure before biofeedback", and to distinguish the benefit and non-benefit groups, the area under the receiver operating characteristic curve (ROC curve) was used. Youden's Index was used to calculate the sensitivity and specificity of optimal cut-off. The type I error rate was taken as 0.05 to test statistical hypotheses. SPSS 20.0 was used to run statistical analyses (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.).

Results

A total of 104 patients who did not respond to conservative treatments (e.g., diet, treatments that increase stool volume, or laxatives) and who met the inclusion criteria were included in the study. The data of 104 patients (58 females [55.8%] and 46 males [44.2%]) was evaluated.

The mean age of the patients was *47.07±16.11,* and the mean duration of complaints was 72 (12-420) months. Seventy (67.3%) patients suffered from constipation, and 34 (32.7%) suffered from difficulty in the evacuation of feces. Nine patients had a history of DM, nine had a history of incomplete neurological injury, 18 had a

Table 1. — **Outcomes of biofeedback therapy**

	Value (n) n: 104	**Responder n:58**	**Non-responders n:46**	**p**
Demographics • Age, (years,mean±std.dev)	 47.07±16.11	 45.14±13.97	 49.52±18.35	 0.169*
Gender • Male • Female	 46(44.2%) 58 (55.8%)	 24 34	 22 24	 0.511**
• Duration of constipation or difficulty evacuation, (month, median (min-max))	72 (12-420)	72 (17-300)	72 (12-420)	0.945***
• Constipation • Difficulty evacuation	70 34	42 16	28 18	 0.213**
Medical history • Diabetes mellitus • Previous spinal cord injury	 9 9	 5 4	 4 5	 0.989** 0.504**
• History of previous anorectal surgey Etiology of anorectal surgey • Hemorrhoidectomy • Anal fisür • Anal fistül or abse • Rectal prolabsus	18 7 4 3 4	6 2 2 1 1	12 5 2 2 3	**0.035****
• Number of women who vaginal delivery, (n)	46	29 (1-7)	17 (1-6)	0.82***
External sphincter tear rate • 0-25 % , (n) • 25-50 %, (n)	 4 1	 1 0	 3 1	
Biofeedback number of sessions (median (min-max))		12(10-15)	8.5 (6-15)	<0.001***
Anorectal manometry findings • Normal • Anormal	 76 28	 46 12	 30 16	 0.124**
Rectal capacity • Normal • Decreased • İncreased	 59 25 20	 37 10 11	 22 15 9	 0.159**

*Independent sample t-test result **Pearson chi-square test result ***Mann-Whitney-U test result

Table 2. — **Comparison of anorectal manometry findings between patients with responder and non-responders results before and after training**

	Responders	Non-responders	p
Resting Pressure before BFT (mmHg, mean)	75.83±25.13	68.98±27.2	0.186*
Squeeze Pressure before BFT (mmHg, mean)	147.4±44.75	126.93±40.60	**0.018***
Resting Pressure after BFT (mmHg, mean)	67.4±15.7	60.85±18.43	**0.053***
Squeeze Pressure after BFT (mmHg, mean)	180.69±41.37	142.89±42.99	**<0.001***

*Independent sample t-test result.

Table 3. — **Comparison of median anal sphincter pressure changes according to biofeedback therapy response**

	Non-responders	Responder	p
Δ Resting Pressure mmHg, (median, min-max)	2 (-27/65)	5 (-30/65)	0.997*
Δ Squeeze Pressure, mmHg, (median ,min-max)	-10 (-100/30)	-30 (-100/30)	**<0.001***

*Independent sample t-test result.

Table 4. — **Univariate binary logistic regression analysis to predict independent factors for BFT response**

					95% C.I.for OR	
	B	**S.E.**	**p**	**OR**	**Lower**	**Upper**
Squeeze pressure after BFT	0.021	0.005	**<0.001**	1.021	1.011	1.032
Squeeze pressure before BFT	0.011	0.005	**0.021**	1.011	1.002	1.021
History of previous anorectal surgey	1.118	0.546	**0.041**	3.059	1.048	8.927

history of anal surgery, and 46 had a history of vaginal delivery (Table 1).

After BFT, dyssynergic defecation in ARM, as well as abdominal and rectal symptoms, disappeared in 58 (55.76%) of 104 patients. Abdominal and rectal symptoms disappeared in 71 (68.26%) of the patients. Of the patients who experienced symptomatic improvement, 58 observed a disappearance of the DD pattern, but 13 retained the DD pattern in follow-up ARMs despite the symptomatic improvement after BFT.

It was found that age, gender, the presence of diabetes, type of delivery, pregnancy, and a history of neurological injury (e.g., an incomplete SCI) did not affect BFT success. However, while those who underwent anorectal surgery benefited less from BFT, it was found that patients who had high squeezing pressures before BFT, who increased their squeezing pressures after BFT, and who decreased their resting pressure responded better to BFT (Table 2).

When a rectal balloon was inflated and the rectal capacity was evaluated, normal rectal sensation was observed in 59 patients, rectal hyposensitivity in 25 patients, and rectal hypersensitivity in 20 patients. Again, no differences in terms of the benefits of BFT were found between those who had normal rectal sensation before BFT and those with increased or decreased rectal sensation after it.

ROC analysis was performed with patients who had benefited from BFT to determine the cut-off value of squeezing pressure before BFT, and a cut-off value of 161 mmHg was obtained – with a sensitivity of 40% and a specificity of 80% (p=0.029, 95% CI:0.518-0.732) (Figure 2).

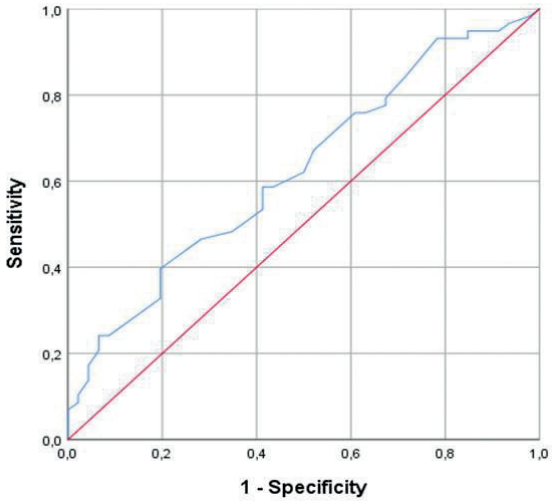

Figure 2. — Receiver-operating characteristic (ROC) curve analysis to identify the cut-off value of squeeze pressures before biofeedback for those with successful BFT.

When the differences between anal sphincter pressures before and after treatment were compared in patients who responded to BFT and those who did not, there were no significant differences in anal resting pressures, but significant changes were found in anal squeezing pressures (Table 3).

Univariate logistic analysis was performed on patients who benefited from BFT. This analysis revealed that

squeezing pressure before BFT, squeezing pressure after it, and a history of anal surgery were independent risk factors for the success of BFT (Table 4).

Discussion

The present study showed that with BFT, the DD pattern disappeared in more than half of the patients, and most experienced a disappearance of symptoms. In addition, those with a high squeezing pressure before BFT and those who could increase their squeezing pressure after it benefited more from BFT. A combination of abdominal and pelvic floor muscle exercises and BFT increased patient response.

Different types of studies in the literature report varying success rates of BFT in patients with DD. In previous uncontrolled studies, response rates to BFT treatment have varied between 11% and 93% (7,8). However, more consistent results have been reported in recent randomized trials that have compared BFT with placebo or standard conservative treatments (laxatives, diazepam, placebo, etc.), and response rates have been between 70% and 80% (9-12). In the present study, both the DD pattern and abdominal and rectal symptoms disappeared in 55.7% of patients. Abdominal and rectal symptoms disappeared in 71 (68.2%) patients, but the dyssynergic pattern was still present in 12.5%.

Consistent with other studies (10,11,17), an improvement in symptoms was observed in the present study, but the number of patients in which the dyssynergic pattern disappeared was lower compared to recent reports in the literature. These variations in treatment success may be due to the BFT methods applied to patients (manometry-based biofeedback, EMG biofeedback, balloon defecation training, and home-based training biofeedback (10,11,18,19) and differences between patient groups.

With BFT, improvements are observed in the toning of the anal sphincter at rest, functioning of the anal sphincter and puborectalis muscles, abdominopelvic coordination during defecation, and rectal sensation functions (3,4,12). In a previous study, Patcharatrakul et al. (3) saw a decrease in the resting pressures of patients, an improvement in the initial sensations of the patients, and a slight increase in the compression pressures after BFT, but none of these factors had a predictive effect on BFT success. BFT was more successful only in cases where digital maneuvers were used before treatment and in patients who had a lower baseline bowel satisfaction score, and these were determined as independent factors that affected BFT treatment.

In another study, in the BFT group, weekly bowel movements increased from 1.9 to 4.85, anal resting pressure decreased from 81 mmHg to 32 mmHg, and the defecation index increased from 0.4 to 1.9 (17). In contrast, Lee et al. (4) did not observe a significant change in the anal resting and squeezing pressures of patients after BFT. While anal resting pressure decreased significantly after BFT in the present study, a significant increase was observed in anal squeezing pressure. These changes were more prominent in the group who benefited from BFT.

We also found that patients with an anal squeezing pressure above 161 mmHg showed a better response rate to BFT. In addition, while there were no significant differences in the anal resting pressures of those who responded to BFT, we found significant changes in anal squeezing pressures. We attribute this to the exercises that correct and strengthen the functions of the abdominal and pelvic muscles applied in combination with BFT that provides abdominal-pelvic coordination and pelvic relaxation training.

Patients with DD may also have fecal incontinence. In a study by Jodorkovsky et al. (12), fecal incontinence (FI) was evident in 6% of patients with DD. This supports our hypothesis. For this reason, for patients with DD, BFT should be combined with exercises, which will ensure coordinated functioning of the pelvic and abdominal muscles as well as exercises that strengthen those muscles.

DD may also be accompanied by 50-60% impaired rectal sensation (20,21). In a study by Satish SC Rao et al. (17), first sensation decreased from an average of 49 cc to 18 cc. In contrast, Lee et al. (4) found no change in the rectal sensitivities of patients following BFT. In addition, the success rate of BFT was 56% in constipated patients with rectal hyposensitivity, and this hypersensitivity improved in these patients (22). In the present study, the rectal sensations of patients were not evaluated following BFT, but it was found that normal, hyposensitive, and hypersensitive rectal sensation before BFT did not affect BFT success.

Sphincter dysfunction occurring after anorectal surgery, radical hysterectomy, prostatectomy, or vaginal delivery may cause DD or FI (23-25). In the present study, two-thirds of patients who had a history of anorectal surgery did not respond to BFT, and those without a history of anorectal surgery benefited from BFT three times more than those with a history of such.

Damage to the autonomic, motor, and sensory nerves of the anorectal region and intestines may occur after medulla spinalis injury. The severity of symptoms and response rates to BFT vary according to the severity of the damage. Neurogenic bowel dysfunction (NBD), especially constipation and fecal incontinence (due to the lack of a bowel and bladder autonomy system), is highly prevalent in patients with an SCI, with estimates of up to 75% in various studies (26,27). Although NBD is more likely to develop in patients with a complete SCI, it is also highly prevalent in those with an incomplete SCI. The efficacy of BFT has been demonstrated in patients with incomplete SCIs, who do not respond to conservative treatments (28). In their study, Mazor et al. (29) found a 40% improvement on the constipation score with BF in patients who had incomplete SCIs. In the present study, five of the nine patients who had a history of incomplete

SCI did not respond to BFT, while the other four did respond.

The prevalence of DD generally increases with age and is more common in middle-aged women (30,31). Patcharatrakul et al. (3) reported that age, gender, onset of constipation, or symptoms such as incomplete bowel movements have no effect on BFT success. Other studies also found no difference in BFT success with respect to age and gender (4,12). In the present study, the mean age was 47.07±16.11, and 55.8% of the patients were female. Like other studies, we found no differences in terms of age or gender.

The ANMS and ESNM recommend six sessions of BFT (60 minutes per week) for patients with DD (5,6). In the present study, we performed at least six sessions with patients who did not respond to BFT and averaged 11.5 sessions with patients who did benefit; however, the sessions were 45 minutes long, not 60. We thought that face-to-face interviews in the hospital and an increased number of sessions could improve patient motivation and affect the success of the treatment. Compared to other studies in the literature, we did not see an increase in treatment response; therefore, we believe that increasing the number of sessions does not change the response rates.

This study was limited in certain aspects. Retrospective study design, non-homogeneous patient group, a lack of investigation into the abdominal and rectal symptom scores before and after BFT, and a lack of evaluation into rectal sensation after BFT can be listed as the limitations of this study.

Conclusion

BFT is non-invasive, inexpensive, easy-to-apply, has a high response rate to treatment, and has no side effects. Applying pelvic floor relaxation training and exercises that strengthen and improve the functions of abdominal and pelvic muscles in addition to BFT will increase response to BFT and improve symptoms.

For this reason, we recommend that pelvic floor muscle relaxation training and exercises that strengthen abdominal and pelvic muscles should be applied in combination with BFT to patients with DD.

Authors contribution

YO and OO contributed in designing the study and performed critical revision of the manuscript.

SP analyzed and interpreted the statistical results

IT, FB and DA collected data

SUR evaluated MR defecography

ZMY reviewed the manuscript

Conflict of interest

We declare that there is no conflict of interests for all authors, and no financial support from any establishment.

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