Review article: dyssynergic defaecation and biofeedback therapy in the pathophysiology and management of functional constipation

G. R. Skardoon1 | A. J. Khera2 | A. V. Emmanuel3 | R. E. Burgell4

Summary

**Background:** Functional constipation is a common clinical presentation in primary care. Functional defaecation disorders are defined as the paradoxical contraction or inadequate relaxation of the pelvic floor muscles during attempted defaecation (dyssynergic defaecation) and/or inadequate propulsive forces during attempted defaecation. Prompt diagnosis and management of dyssynergic defaecation is hindered by uncertainty regarding nomenclature, diagnostic criteria, pathophysiology and efficacy of management options such as biofeedback therapy.

**Aim:** To review the evidence pertaining to the pathophysiology of functional defaecation disorders and the efficacy of biofeedback therapy in the management of patients with dyssynergic defaecation and functional constipation.

**Methods:** Relevant articles addressing functional defaecation disorders and the efficacy of biofeedback therapy in the management of dyssynergic defaecation and functional constipation were identified from a search of Pubmed, MEDLINE Ovid and the Cochrane Library.

**Results:** The prevalence of dyssynergic defaecation in patients investigated for chronic constipation is as many as 40%. Randomised controlled trials have demonstrated major symptom improvement in 70%-80% of patients undergoing biofeedback therapy for chronic constipation resistant to standard medical therapy and have determined it to be superior to polyethylene glycol laxatives, diazepam or sham therapy. Long-term studies have shown 55%-82% of patients maintain symptom improvement.

**Conclusions:** Dyssynergic defaecation is a common clinical condition in patients with chronic constipation not responding to conservative management. Biofeedback therapy appears to be a safe, successful treatment with sustained results for patients with dyssynergic defaecation. Further studies are required to standardise the diagnosis of dyssynergic defaecation in addition to employing systematic protocols for biofeedback therapy.
1 INTRODUCTION

1.1 Functional constipation

Functional constipation is a common clinical concern, representing approximately eight percent of patient presentations in a primary care setting. The Rome IV Criteria define functional constipation as at least two of six symptoms: need for straining, lumpy or hard stools, sensation of incomplete evacuation, sensation of anorectal obstruction and need for manual manoeuvres to facilitate defeacation more than one-fourth of defeacations or less than three defeacations per week for the last 3 months with symptom onset being at least 6 months prior to diagnosis (Table 1) and who do not already meet the criteria for constipation predominant irritable bowel syndrome.

1.2 Functional constipation subtypes

The true prevalence of subtypes of functional constipation is poorly defined as the studies in this area have generally been undertaken in tertiary or quaternary centers. As a result, the data are difficult to extrapolate to the general population as the majority of patients in the community are not investigated to a similar extent. Nevertheless, functional constipation subtypes are considered to include: (1) functional defaecatory disorders (diagnosed in 12%-24% of patients describing constipation), (2) slow transit constipation (5%-42%), (3) a combination of slow transit constipation and functional defaecatory disorder (2%-25%) and (4) constipation predominant irritable bowel syndrome (IBS), characterised by abdominal pain associated with defeacation, (20%) or normal transit constipation (20%-60%) depending on diagnostic definition and investigative modality. The Rome IV criteria further divides functional defaecatory disorders into those due to paradoxical contraction or inadequate relaxation of the pelvic floor muscles during attempted defeacation (dyssynergic defeacation) and/or inadequate defaecatory propulsion. The prevalence of dyssynergic defeacation in patients investigated for chronic constipation is thought to be as many as 40%, however, evidence from the literature ranges from 13% to 81% depending on patient population and definition. The epidemiological inaccuracy is in large part relating to historical controversy regarding the diagnostic definition of dyssynergic defeacation as well as lack of standardised investigative techniques.

1.3 Biofeedback therapy

Biofeedback was first introduced as a treatment for dyssynergic defeacation in 1987. Since then, biofeedback therapy has demonstrated clinical efficacy in uncontrolled trials and a small number of randomised controlled trials (RCT). Biofeedback is based on “operant conditioning” techniques and uses instruments such as electromyography (EMG) sensors, balloons or manometry to guide the patient to increase intraabdominal pressure effectively and to coordinate relaxation of the pelvic floor and the anal sphincter musculature during defeacation.

TABLE 1 Rome IV criteria for functional constipation, functional defeacation disorder including dyssynergic defeacation

<table>
<thead>
<tr>
<th>Functional constipation</th>
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<tbody>
<tr>
<td>Patients with functional constipation should not meet irritable bowel syndrome criteria. Criteria fulfilled for the last 3 months with symptom onset at least 6 months prior to diagnosis</td>
</tr>
<tr>
<td>1. Must include 2 or more of the following</td>
</tr>
<tr>
<td>a. Straining during more than one-fourth (25%) of defeacations</td>
</tr>
<tr>
<td>b. Lumpy or hard stools (BSFS 1-2) more than one-fourth (25%) of defeacations</td>
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<tr>
<td>c. Sensation of incomplete evacuation more than one-fourth (25%) of defeacations</td>
</tr>
<tr>
<td>d. Sensation of anorectal obstruction/blockage more than one-fourth (25%) of defeacations</td>
</tr>
<tr>
<td>e. Manual manoeuvres to facilitate more than one-fourth (25%) of defeacations (eg, Digital evacuation, support of the pelvic floor)</td>
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<tr>
<td>f. Fewer than 3 spontaneous bowel movements per week</td>
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<table>
<thead>
<tr>
<th>Functional Defaecation Disorder</th>
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<tbody>
<tr>
<td>Criteria fulfilled for the last 3 months with symptom onset at least 6 months before diagnosis</td>
</tr>
<tr>
<td>1. The patient must satisfy diagnostic criteria for functional constipation and/or irritable bowel syndrome with constipation</td>
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<tr>
<td>2. During repeated attempts to defecate, there must be features of impaired evacuation as demonstrated by two of the following three tests:</td>
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<tr>
<td>a. Abnormal balloon expulsion test</td>
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<tr>
<td>b. Abnormal anorectal evacuation pattern with manometry or anal surface EMG</td>
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<td>c. Impaired rectal evacuation by imaging</td>
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<tr>
<th>Dyssynergic defeacation</th>
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<tr>
<td>Inappropriate contraction of the pelvic floor as measured with anal surface EMG or manometry with adequate propulsive forces during attempted defeacation</td>
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<tr>
<th>Inadequate defaecatory propulsion</th>
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<tr>
<td>Inadequate propulsive forces as measured with manometry with or without inappropriate contraction of anal sphincter and/or pelvic floor muscles</td>
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This review summarises the current evidence regarding (1) the pathophysiology of dyssynergic defeacation, (2) diagnosis of dyssynergic defeacation in chronic constipation and (3) efficacy of managing dyssynergic defeacation with biofeedback therapy.

2 NORMAL DEFAECATION

Normal defeacation is complex. It requires the coordination of increased intraabdominal pressure in combination with concurrent pelvic floor muscle and anal sphincter relaxation, and intact rectal sensation and perception. The three muscular components that influence continence are the pelvic floor muscles (levator ani), internal anal sphincter (IAS) and external anal sphincter (EAS) (Figure 1). The levator ani is a broad muscular dome comprising of four muscles: puborectalis, iliococcygeus, ischiococcygeus and pubococcygeus which have voluntary and reflexive functions. The latter three
Pelvic Floor Muscles

Pubococygeus

Puborectalis

Iliococygeus

Ischiococygeus

FIGURE 1  Levator Ani musculature

muscles function to provide physical support, acting as a dome shaped "diaphragm," for the pelvic viscera. The puborectalis, in contrast, is a U-shaped muscle which forms a sling around the upper anal canal and interdigitates its muscular fibres with the EAS (located caudally) before attaching anteriorly on the pubis. Puborectalis contraction pulls the anorectal junction anteriorly to form the anorectal angle. This angulation of approximately 90° is maintained by tonic activity (postural reflex); creating a mechanical barrier which aids continence (Figure 2). The internal and external sphincters also form a physical barrier to defaecation by maintaining a higher anal pressure than rectal pressure.

An increase in rectal distension mediates the initiation of rectal evacuation. If it is a socially appropriate time, a voluntary increase in intraabdominal pressure is coupled with puborectalis relaxation which widens the anorectal angle and straightens the passage of stool from the rectum to the anus (Figure 2). This is followed by anal sphincter relaxation and stool evacuation.

3 | PATHOPHYSIOLOGY OF DYSSYNERGIC DEFAECATION

Dyssynergic defaecation refers to the paradoxical contraction or inadequate relaxation of the pelvic floor muscles during attempted defaecation. This impedes the passage of stool leading to incomplete or unsuccessful evacuation and symptoms of constipation. Contraction of the pelvic floor muscles decreases the anorectal angle thereby causing a physical obstruction to defaecation (Figure 2). Inadequate defaecatory propulsion may also cause constipation due to an insufficient increase in intrarectal pressure despite relaxation of the anal sphincter.

The aetiology of dyssynergic defaecation is unclear. A prospective survey of 100 patients with dyssynergia suggested that symptoms began during childhood in 31%, after a physical event such as pregnancy, trauma or back injury in 29% and with no cause identified in 40% of patients. In addition, a central component has been suggested as patients with dyssynergic defaecation have demonstrated a significant bi-directional brain-gut dysfunction that may have treatment implications.

4 | FOCUSED EXAMINATION TO IDENTIFY DYSSYNERGIA

As symptoms are not necessarily reliable predictors of underlying pathophysiology, it is recommended that dyssynergia should be considered in all patients with chronic constipation unresponsive to standard therapy and appropriate investigations undertaken. A skilled digital rectal examination is the most accessible and economical clinical tool available. A digital rectal examination to evaluate for dyssynergia includes assessment of perineal sensation, ano-rectal reflexes, anal resting tone and squeeze pressures, abdominal push effort during simulated defaecation with associated evaluation of perineal descent and sphincter/puborectalis relaxation. Increased resting tension, restricted movement and/or tenderness on palpation of puborectalis are markers of pelvic floor muscle dysfunction. When undertaken by an experienced clinician, a digital rectal examination has a high sensitivity and positive predictive value for detecting dyssynergia as diagnosed by high resolution anal manometry and balloon expulsion test. Given this, there is controversy as to whether further testing is required to confirm Rome IV criteria.
dyssynergic defaecation prior to commencing treatment. Unfortunately, the specificity of a digital rectal examination (58.7%-87%) is poor. Furthermore, many clinicians are inadequately trained to perform a sufficiently comprehensive examination. Therefore, the current Rome criteria recommends the use of specialised diagnostic modalities for the formal diagnosis of dyssynergia.

5 | INITIAL APPROACH FOR DYSSYNERGIC DEFAECATION

In patients who do not respond to conservative treatment measures for chronic constipation, further testing may be initiated. Given the diagnosis of functional constipation depends on symptom based criteria, the most important outcome of investigations is to predict response to treatment and aid stratification of patients to a specific therapy. Frustratingly, however there is no gold standard diagnostic modality for confirming dyssynergic defaecation in patients with chronic constipation. There is also evidence of disparity in results when evaluating between modalities and with each in isolation.

Given this, a diagnosis of dyssynergia requires two dynamic tests to be positive including impaired evacuation on balloon expulsion test or defaecography, inappropriate contraction of the pelvic floor muscles or incomplete relaxation of the anal sphincter on anorectal manometry, anal surface electromyography or imaging studies (Figure 3).

**FIGURE 3** Diagnostic and treatment algorithm for dyssynergic defaecation
5.1 | Balloon expulsion test

The balloon expulsion test is a simple, clinical procedure. A balloon tipped catheter is inserted in to the rectum and inflated with water to 50 mL. The patient is asked to evacuate the balloon while timed. A normal test result is the expulsion of the balloon under one to two minutes, whereas, dyssynergia is suspected if the patient is unable to expel the balloon in under two minutes.33 The balloon expulsion test has an 80%-90% specificity and sensitivity ranges from 33% to 94% for dyssynergia as defined by anorectal manometry.

5.2 | Anorectal manometry

Anorectal manometry indirectly assesses anorectal function by measuring recto-anal pressures and motor coordination.31 It evaluates:

1. anal sphincter function (2) recto-anal reflex activity and (3) changes in anal and rectal pressures during simulated defaecation.38 Furthermore, the current configuration of catheters allows integrated measurement of rectal sensation, rectal compliance and performance of a balloon expulsion test.38 The original studies, that established the role of anorectal manometry for predicting response to biofeedback, employed the use of low-resolution anorectal manometry.39 Recent technical advancements in anorectal manometry allow high-definition assessment of anorectal function, however, a blinded multiobserver study in 170 participants by Grossi et al., demonstrated that nearly 90% of healthy volunteers have a pattern regarded as “abnormal” based on traditional low-resolution manometric criteria during anorectal manometry performed in the left lateral position with an empty rectum.35

The high false positive rate for manometry may be due to a number of factors. Firstly, anorectal testing is best undertaken in private due to subject anxiety in the laboratory setting.35 Secondly, position is a key component as demonstrated in a study by Rao et al. of 25 healthy volunteers that found an increase in dyssynergia in the left lateral position (36%) compared with the seated position (20%) (P<.05).40 Manometric data from this study demonstrated lower intrarectal pressure, anal resting and residual pressures in the left lateral position due to positional effects on sphincter tone and the effect of weight from the intraabdominal viscera.40 This will intuitively result in an underestimation of rectal propulsive pressure. In addition, as anorectal function has a significant voluntary component, effective instruction and verbal feedback has been demonstrated to effect the manometric diagnosis.41 Therefore, the findings from high resolution anorectal manometry need to be interpreted in context with supporting modalities, as in isolation, it has limited application.31,35 More studies are needed to determine if alternative metrics for high resolution/definition manometry improve its sensitivity and specificity.

5.3 | Electromyography

Electromyography assesses the activity of the external anal sphincter by detecting paradoxical muscular contraction via recording the number of motor units firing at a certain time point. Surface EMG is most commonly utilised, with electrodes placed on the anal skin over the external anal sphincter. A sustained increase in surface EMG activity (>50% increase from baseline) on attempted defaecation is defined as inappropriate contraction.20,42 EMG has been shown to correlate with balloon expulsion in 82% of patients.43,44

5.4 | Defaecating proctography

Defaecating proctography involves the insertion of barium paste into the rectum followed by videofluoroscopy at rest and during rectal evacuation.10,45,46 Defaecating proctography is a cost-effective procedure which mimics normal defaecation. A lack of perineal descent and an evacuation time longer than 30 seconds has been shown to be highly predictive of dyssynergia,47,48 although a recent study suggested evacuation may still be normal if as little as 35% of the rectum is emptied in two and a half minutes.49 Unfortunately, defaecating proctography can be difficult to access outside of tertiary centers, may be uncomfortable as it is undertaken in a semi-public setting and involves exposure to low-dose ionising radiation (average dose 4.9 mSv).50 As a result, defaecating proctogram is often reserved as a second line investigation for those who have not responded to biofeedback or in those in which there is a high index of suspicion of structural abnormalities.

Following confirmation of dysynergia on diagnostic testing using two modalities, further management using a behavioural therapy such as biofeedback therapy can be commenced.

6 | BIOFEEDBACK THERAPY

6.1 | Definition of biofeedback therapy

Biofeedback is a behavioural therapy which incorporates exercise repetition and simulation of defaecation to correctly coordinate abdominal and pelvic floor muscle contraction.10 It is a form of operant (Skinnerian) conditioning utilising visual or auditory feedback as a means of modifying the occurrence or type of behaviour. All patients with confirmed dyssynergic defaecation should be considered for biofeedback therapy (Figure 3).11,51 Biofeedback therapy is optimally combined with a holistic behavioural and general pharmacological treatment plan tailored to the individual patient. It includes the use of objective measures of function including EMG, anorectal manometry, ultrasound or digital palpation to “feedback” to the patient what is normal or abnormal with the aim to modify patterns of defaecation. Exercises are repeated and corrected until the patient can perform the correct action independently. This can be coupled...
with habit training about toileting patterns and psycho-social aspects of toilet use.

### 6.2 Procedure, duration and frequency of training

Fundamental to all behavioural therapies including that of biofeedback therapy is the instruction and training by the therapist. Their role is to correct and improve muscle control which translates into actual function. Biofeedback therapy is optimally undertaken in the correct defaecation position (seated, leaning forward at 45 degree angle, legs apart) with the biofeedback instrument in situ.\(^\text{10,52}\) The key components of a biofeedback session includes instruction on: (1) diaphragmatic breathing, (2) increase in intraabdominal pressure associated with push effort, (3) coordinated pelvic floor relaxation, (4) simulated defaecation and may also incorporate (5) rectal sensory retraining in patients with altered visceral sensitivity.\(^\text{10,52}\) Biofeedback protocols vary between specialist centers and require instruction by an experienced practitioner (physician, physiotherapist or nurse). Biofeedback training optimally requires 5-6 training sessions at regular intervals on a fortnightly basis, each lasting 30-60 minutes but should be individualised based on patient requirements.\(^\text{53}\) Contraindications to biofeedback therapy include; pregnancy, active infection or inflammation, active anal fissures, significant cognitive impairment or dementia with an inability to learn or acute post-operative patients. Poor compliance and pessimism, while not absolute contraindications, may be considered relative contraindications and a reason to cease ongoing biofeedback therapy if no response has been demonstrated as their presence predict poor response to therapy.

### 6.3 Mechanism of action

Dyssynergic defaecation is thought to be primarily an acquired condition, therefore, the aim of biofeedback is to relearn a normal pattern of defaecation.\(^\text{52}\) The mechanism by which biofeedback improves constipation symptoms and bowel function remains incompletely understood. Studies suggest that biofeedback acts locally and improves constipation by removing the mechanical barrier (acute anorectal angle) caused by paradoxical pelvic floor contraction. Appropriate relaxation of the pelvic floor muscles allow stool to be propelled forward more readily and may eliminate retrograde peristalsis caused by pelvic floor contraction during defaecation.\(^\text{52,54,55}\) Biofeedback may also have a role in neumodulation of the gut.\(^\text{42}\) At least one study has shown that patients with a positive response to biofeedback therapy, demonstrate enhanced gut microcirculation resulting in a decreased stool transit time suggesting potential modification of autonomic pathways.\(^\text{52}\)

### 6.4 Instrument modalities

Instruments used for biofeedback may include a manometry system, electromyography (EMG), rectal balloon, ultrasound (intrarectal, intravaginal, perineal), digital guidance or visual feedback techniques.\(^\text{56,57}\)

The solid state manometry system includes a probe with microtransducers connected to a display unit for interpretation of pressure activity and a balloon for simulated defaecation and sensory training.\(^\text{52}\) EMG biofeedback systems commonly include a surface electrode attached to an anal probe or a sensor, placed on the surface of the external anal sphincter, connected to a display unit to provide real time visual and auditory feedback.\(^\text{52}\)

Balloon biofeedback may be undertaken with the patient in the left lateral position or seated on a commode. A catheter with a balloon attached is inserted 10 cm into the rectum. Fifty millilitres (mL) of water or air is injected into the balloon to provide sensory awareness, the patient is instructed to generate increased intraabdominal pressure using the diaphragm and abdominal muscles while simultaneously relaxing the pelvic floor and anal sphincter muscles to release the balloon without straining. The therapist holds the end of the balloon catheter to assess balloon movement (propulsion) and may apply gentle traction to the balloon catheter to assist initially. If the patient is unable to evacuate a 50 mL balloon then water or air can be sequentially removed until the patient is able to expel the balloon.\(^\text{58}\) In patients with altered rectal sensitivity, balloon biofeedback can be undertaken by serially inflating a balloon with incrementally smaller or larger volumes; enabling the patient to appreciate rectal filling and to attempt evacuation at an appropriate threshold.

The use of ultrasound imaging can also be used for biofeedback. Ultrasound can provide real time information about the direction of pelvic floor movement during pelvic floor muscle contraction and relaxation to assist teaching a patient to relax the muscles during defaecation.\(^\text{59}\)

Head-to-head trials between biofeedback treatment techniques are limited and significant disparity between treatment protocols comparing different techniques makes it challenging to identify the most efficacious procedure (Table 2).\(^\text{9}\) Despite these limitations, Koh et al., undertook a meta-analysis comparing EMG biofeedback with non-EMG biofeedback and found a OR of 6.738 (95% CI, 2.914-15.580, P<.001) favouring EMG.\(^\text{9}\) A recent Cochrane Review, while unable to make a clear conclusion of the most efficacious biofeedback modality, also indicated EMG biofeedback demonstrated a slightly superior response compared with balloon biofeedback and manometry, however, the findings were not statistically significant.\(^\text{60}\)

### 6.5 Review criteria and methodology regarding efficacy of biofeedback for dyssynergic defaecation

Online databases searched included Pub Med, MEDLINE Ovid and the Cochrane Central Trials Registry. All original research studies, reviews and systematic reviews published in English from January 1950 onwards were considered. The following key words were used alone or in combination; “constipation and levator ani,” “constipation and pelvic floor muscle,” “constipation and biofeedback,” “dyssynergic defaecation pathophysiology,” “dyssynergic defaecation and biofeedback,” “pelvic floor muscle and constipation review,” “anismus and biofeedback”, “obstructive defaecation and biofeedback” and “dyssynergia and biofeedback”. Articles were excluded if they...
incorporated paediatric patients, non-human studies, or did not have an abstract available in English.

6.6 Efficacy of biofeedback in dyssynergic defaecation

Biofeedback is practitioner dependent and often individualised to a particular patient’s needs. This variability makes intra- and inter-centre comparisons challenging and leads to inherent difficulties in designing and interpreting studies. This was recognised in a recent Cochrane Review which concluded that the efficacy and safety of biofeedback could not be determined due to inadequacies in study methodology and bias. Nevertheless, despite the limitations highlighted in the Cochrane Review, the randomised controlled trials in Table 3 demonstrate evidence for the utilisation of biofeedback therapy for patients with dyssynergic defaecation. Biofeedback therapy for dyssynergic defaecation has response rates of up to 80% improvement in symptoms with sustained results at 44 months. Symptom improvement in patients with good compliance can be demonstrated within 4-6 sessions and periodic reinforcements may provide additional benefit.

Of note are the following landmark studies. Chiarioni et al., randomised 104 patients with dyssynergia to PEG laxatives or EMG biofeedback and assessed their response at 6 and 12 months. Eighty per cent of patients who underwent biofeedback reported a major improvement in symptoms compared with 22% of patients in
TABLE 3 Comparison between randomised controlled trials of biofeedback vs nonbiofeedback therapy for dyssynergic defaecation

<table>
<thead>
<tr>
<th>Authors (date)</th>
<th>Study description</th>
<th>Outcome measures</th>
<th>Results</th>
<th>P-value</th>
<th>Limitations/Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koutsomanis et al.</td>
<td>60 patients unresponsive to standard treatment</td>
<td>Patient symptom diary, whole gut transit, surface EMG, simulated defaecation.</td>
<td>1. Improved symptoms in 14/31 visual biofeedback vs 12/28 muscle training, 2. Changes in bowel frequency, duration of abdominal pain and improvement in anismus index were similar in both groups</td>
<td>P&lt;.01</td>
<td>Not blinded</td>
</tr>
<tr>
<td>Chang et al.</td>
<td>22 patients n=12 Electrical stimulation therapy (EST) vs n=10 EMG biofeedback.</td>
<td>Symptom questionnaire, anorectal manometry before and after, balloon distension</td>
<td>1. Global improvement in symptoms in both groups (48.3% bowel satisfaction in electrical stimulation group and 59% in biofeedback patients) 2. No significant difference in mean anal resting pressure, maximal anal squeezing pressure or rectal pressures between before and after therapy in either group 3. No significant difference in rectal sensation for biofeedback group. EST group demonstrated significant reduction in threshold volume for desire to defaecate, urge to defaecate and maximal tolerated volume.</td>
<td>P&lt;.05, P&lt;.05</td>
<td>Not blinded</td>
</tr>
<tr>
<td>Chiarioni et al.</td>
<td>104 patients n=54 EMG biofeedback vs n=55 polyethylene glycol (PEG) 14.6 g.</td>
<td>Global improvement of symptoms Physiological variables: change in anal canal pressure, pelvic floor EMG when straining and balloon expulsion</td>
<td>1. Major improvement in symptoms at 6 months in biofeedback group (80%) compared with laxative treated (22%). 2. Biofeedback benefit sustained at 24 months. 3. Biofeedback demonstrated greater reduction in straining, sensations of incomplete evacuation and anorectal blockage, use of suppositories and abdominal pain. 4. All biofeedback patients who reported major improvement demonstrated decreases in anal canal pressure, pelvic floor EMG when straining. Threshold volume for urge to defaecate lower in biofeedback group</td>
<td>P&lt;.001, P&lt;.01</td>
<td>Not blinded</td>
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percentage of patients reported improvement in global bowel satisfaction in the biofeedback group (86%) compared with sham (48%) but not standard care post-intervention. Heymen et al., compared two control conditions, placebo or diazepam against EMG biofeedback. The trial involved three phases including a run in which involved enhanced standard care including diet, lifestyle measures, stool softeners and scheduled evacuations. Of the 117 patients who commenced the trial, 18 reported adequate relief at the end of run in and were excluded. The remaining 84 patients were randomised to placebo, diazepam and biofeedback. At the 3 month follow-up 70% of the biofeedback group reported adequate relief compared with 30% of the diazepam treated ($P<.001$) and 38% of placebo

<table>
<thead>
<tr>
<th>Authors (date)</th>
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<tbody>
<tr>
<td>Heymen et al.64</td>
<td>84 patients 24 placebo vs 30 diazepam vs 30 biofeedback</td>
<td>Global symptom relief</td>
<td>1. Relief of constipation: biofeedback (70%) vs diazepam (30%) 2. Relief of constipation: biofeedback superior to placebo (38%) 3. Biofeedback had significantly more unassisted bowel movements at follow-up compared with placebo 4. Biofeedback patients reduced pelvic floor EMG during straining more than diazepam patients</td>
<td>1. $P&lt;.001$ 2. $P=.017$ 3. $P=.005$ 4. $P&lt;.001$</td>
<td>Inadequate blinding</td>
</tr>
<tr>
<td>Rao et al.91</td>
<td>44 patients eligible, 26 participated in long-term study n=13 Manometric biofeedback vs n=13 conventional medical therapy Followed up for 12 months.</td>
<td>Number of CSBM/week Secondary outcomes: global bowel satisfaction, stool frequency, stool consistency, straining effort, digital assistance and laxative consumption score per week.</td>
<td>Sustained improvement at 12 months. 1. Increased CSBM/week in biofeedback group but not standard 2. Normalisation of dyssynergic muscle pattern in biofeedback group compared with standard 3. Normalisation of colonic transit in biofeedback compared with standard 4. Improvement in balloon expulsion in biofeedback group compared with standard 5. Defaecation index increased in biofeedback group compared with standard</td>
<td>1. $P&lt;.001$ 2. $P&lt;.001$ 3. $P=.01$ 4. $P=.0009$ 5. $P&lt;.001$</td>
<td>Not blinded</td>
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(Continues)
treated patients \((P=.017)\). A meta-analysis by Koh et al., demonstrated the overall effectiveness of biofeedback with an OR of 5.861 (95% CI, 2.175-15.794, \(P<.001\)) in favour of biofeedback compared with nonbiofeedback treatment.9

6.7 Efficacy of biofeedback in slow transit constipation

In the current classification, slow transit constipation as diagnosed by colonic transit studies (radio-opaque marker study, scintigraphy or wireless motility capsule) can exist alone or with dyssynergic defaecation.

Studies of biofeedback therapy in patients with slow transit constipation and dyssynergia have demonstrated a beneficial response rate of approximately 50%,10,39,65 Emmanuel and Kamm demonstrated that gut directed biofeedback is an effective behavioural treatment for chronic idiopathic constipation, with 59% of patients reporting subjective improvement.\(^{42}\) In addition, 59% of patients with slow transit constipation normalised their transit time at the end of treatment.\(^{42}\) It has been postulated that patients with rectal evacuatory dysfunction and slow transit may have secondary colonic dysmotility, as improvement in dyssynergia is associated with improvement of colonic transit.\(^{66}\) However, evacuatory dysfunction is not associated with an identifiable specific pattern of transit delay.\(^{67}\)
Contestation also remains as to whether biofeedback improves symptoms in slow transit constipation without dyssynergia.39,42 Chiotakakou-Faliakou et al., in a retrospective study found that response was equal following biofeedback in patients with slow transit alone, dyssynergic defaecation alone and combined slow transit and dyssynergic defaecation.68 In contrast, Chiarioni et al., in their study of 52 patients demonstrated that 71% of patients with combined slow transit constipation and pelvic floor dyssynergia improved following biofeedback training compared with 8% in the slow transit only group.39

6.8 | Efficacy of biofeedback in IBS-C

Patients with constipation predominant IBS with symptoms of pelvic floor dyssynergia may demonstrate overall pelvic floor dyssynergic physiology similar to that of patients with functional constipation.69 Studies have shown that the presence of IBS symptoms in dyssynergic defaecation did not affect the outcome of biofeedback therapy,70 in addition, utilising biofeedback therapy in patients with IBS improved both constipation and IBS symptoms.69 Therefore, there may be a role for biofeedback therapy in patients with IBS-C in the presence of dyssynergia.

6.9 | Clinical predictors of success

Biofeedback is a labour intensive therapy predominantly performed in specialised tertiary centers which limits patient access.71 The majority of biofeedback studies specifically selected patients with a functional defaecation disorder although a smaller number of studies have shown possible benefit in all patients with constipation.52,72 Clinical predictors of success for biofeedback therapy may aid in resource allocation. Clinical predictors that have demonstrated an increased likelihood of beneficial effect include: harder stool consistency, shorter duration of laxative use and willingness to comply with treatment protocols.71 Physiological parameters on anorectal manometry that correlate with clinical improvement with biofeedback are a high straining rectal pressure and a prolonged balloon expulsion time.71

Risk factors for a poor response to biofeedback include a long history of constipation,73 an eating disorder or poor compliance.68 Manometric findings of inability to evacuate an intrarectal balloon and increased anorectal angle during squeeze have been independently associated with a lack of response to biofeedback.74 However, despite negative predictors patients may still have a reasonable response to therapy.73 The vast majority of biofeedback trials have only included patients diagnosed with a functional defaecation disorder on anorectal manometry or balloon expulsion. Hence, it seems reasonable to use similar criteria to select patients for biofeedback therapy. Symptomatic improvement is also known to correlate with correction of anorectal manometric abnormalities and at least one trial has shown poor response of biofeedback in constipated patients without dyssynergic defaecation, although, there is evidence that there may be a role for biofeedback therapy in all constipated patients.59,42,72

7 | ADDITIONAL INVESTIGATIONS AND MANAGEMENT FOR DYSSYNERGIC DEFAECATION

7.1 | Structural and functional investigations

If symptoms persist following biofeedback therapy, the use of defaecating proctogram (if not already undertaken) magnetic resonance imaging (MRI), ultrasound or colonic transit studies may aid in diagnosing a structural or functional abnormality in these patients (Figure 3). The scope of this manuscript does not extend to a detailed discussion of these investigations, which have been reviewed in Ahmad et al.75

7.2 | Botulinum toxin injection

Botulinum toxin injection into nonrelaxing puborectalis has shown variable response in patients with dyssynergic defaecation and is not widely utilised.76-78 Based on small uncontrolled studies, Botulinum toxin has demonstrated an inconsistent improvement in symptoms but its effect decreases within 3 months post-injection. In one study, Botulinum toxin injection was found to be superior to biofeedback therapy, however, the success rates of biofeedback in this study were significantly inferior to other published studies.34,77 Overall, the recent AGA technical review on constipation has concluded that Botulinum toxin injection, a more invasive therapy, is not superior to biofeedback as first line therapy in patients with dyssynergic defaecation.11

7.3 | Surgery

Due to the functional nature of dyssynergic defaecation, only those patients refractory to nonsurgical measures with a severe impact on their quality of life should be considered for a surgical procedure such as a diverting colostomy. Other surgical procedures including partial surgical division of the puborectalis muscle have been associated with unacceptable risks such as faecal incontinence.79 It is also important to note that at least two studies have found that patients with dyssynergia who underwent stapled transanal rectal resection (STARR) for rectocele or intussuception were found to have worse clinical outcomes post-surgery with addition unfavourable surgical complications (bleeding, infection, pain and incontinence).80,81

8 | FURTHER AREAS OF INTEREST

It has been found that a significant number of patients with inflammatory bowel disease who have evacuatory dysfunction may also have concomitant pelvic floor dyssynergia.82 Biofeedback therapy
in this cohort has demonstrated encouraging results with up to 80% of patients reporting improvement in symptoms. Biofeedback has also been utilised with success in patients with multiple sclerosis, spinal cord and neurogenic bowel dysfunction. In addition, for practical purposes, home biofeedback may enable patients in rural or regional settings to access treatment using an EMG home trainer or silicone probe device and has demonstrated encouraging results.

Despite an increase in evidence based research into pelvic floor dyssynergia in chronic constipation and its management, there are a number of areas which require further study. Head-to-head trials of biofeedback modalities need to be undertaken to determine a gold standard therapy. Studies evaluating the economic benefit and impact of biofeedback therapy on reducing primary care visits, medical therapies and expensive testing may allow increased funding for this treatment technique.

9 CONCLUSIONS

Dyssynergic defaecation is an under-recognised, potentially reversible cause for chronic constipation. There is no gold standard diagnostic modality for dyssynergic defaecation and further research is required in this area. In patients diagnosed with dyssynergic defaecation, biofeedback therapy is the most efficacious and safe treatment available. Further research into biofeedback therapy with standardised protocols and patient centred outcomes is required to expand its utility in clinical practice.

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AUTHORSHIP

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