CME

ACG Clinical Guidelines: Management of Benign Anorectal Disorders

Arnold Wald, MD, MACG[1], Adil E. Bharucha, MBBS, MD[2], Berkeley Limketkai, MD, PhD, FACG[3], Allison Malcolm, MBBS, FRACP[4], Jose M. Remes-Troche, MD, MsC[5], William E. Whitehead, PhD[6] and Massarat Zutshi, MD[7,8]

Benign anorectal disorders of structure and function are common in clinical practice. These guidelines summarize the preferred approach to the evaluation and management of defecation disorders, proctalgia syndromes, hemorrhoids, anal fissures, and fecal incontinence in adults and represent the official practice recommendations of the American College of Gastroenterology. The scientific evidence for these guidelines was assessed using the Grading of Recommendations Assessment, Development and Evaluation process. When the evidence was not appropriate for Grading of Recommendations Assessment, Development and Evaluation, we used expert consensus to develop key concept statements. These guidelines should be considered as preferred but are not the only approaches to these conditions.

Am J Gastroenterol 2021;116:1987–2008. https://doi.org/10.14309/ajg.0000000000001507; published online

INTRODUCTION

Similar to the previous ACG Clinical Guidelines, these updated guidelines summarize the definitions, diagnostic criteria, evaluation, and management of a group of benign disorders of anorectal function and/or structure. Disorders of defecation, proctalgia syndromes, and fecal incontinence (FI) are primarily regarded as disorders of function; some patients also have structural abnormalities. The structural disorders include acute and chronic anal fissures and hemorrhoids. The guidelines consist of individual sections that cover the definitions, epidemiology and/or pathophysiology, diagnostic testing, and treatment recommendations. These reflect a comprehensive search of relevant topics of pertinent English language articles in PubMed, Ovid MEDLINE, and the National Library of Medicine updated to June 2020 using appropriate terms for each subject. As with the earlier guidelines, recommendations for anal fissures, hemorrhoids and surgical interventions for FI also rely on adaptation from the American Society of Colon and Rectal Surgeons Practice parameters from the most recently published guidelines in 2018. We used systematic reviews and meta-analyses when available. The National Library of Medicine was searched for terms that were cross-referenced to the terms that have been used to describe dyssynergic defecation: disordered defecation, pelvic floor dyssynergia, anismus, obstructed defecation, and functional outlet obstruction.

Each section contains key concepts, recommendations, and summaries of the available evidence. Each recommendation statement includes an assessment of the quality of evidence based on the Grading of Recommendations Assessment, Development and Evaluation (GRADE) process (1). High-quality evidence indicates that further research is unlikely to change the authors confidence in the estimate of the effect; moderate-quality evidence is defined as moderate confidence in the estimate of effect, although future studies would be likely to impact our confidence of the estimate; low-quality evidence indicates that further study would likely have an important impact on the confidence in the estimate of the effect and would likely change the estimate. Very-low-quality evidence indicates very little confidence in the effect estimate and that the true effect is likely to be substantially different than the estimate of effect.

Largely but not entirely based on the evidence, a strong recommendation is made when the authors agree that the benefits clearly outweigh the negatives and/or the result of no action. A conditional recommendation indicates that some uncertainty remains about the balance of benefits and potential harms. In these guidelines, many treatments have little or no potential for harm and may result in a strong recommendation with low quality of evidence. In contrast, treatments associated with potential for harm may result in a conditional recommendation with similar quality of evidence. Key concepts are statements that are not amenable to the GRADE process either because of the structure of the statement or because of the available evidence. In some instances, key concepts are based on extrapolation of evidence and/or expert opinion.

Each of the key concepts and recommendations were assessed by the 6 authors based on a five-point Likert scale:

[1]Division of Gastroenterology and Hepatology, University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin, USA; [2]Division of Gastroenterology and Hepatology, Mayo Clinic, Rochester, Minnesota, USA; [3]Division of Digestive Diseases, David Geffen School of Medicine at UCLA, Los Angeles, California, USA; [4]Neurogastroenterology Unit, Royal North Shore Hospital and University of Sydney, St Leonards, NSW, Australia; [5]Medical Biologic Research Institute, Universidad Veracruzana, Xalapa, Veracruz, Mexico; [6]Center for Functional GI and Motility Disorders, University of North Carolina, Chapel Hill, North Carolina, USA; [7]Lerner College of Medicine of Case Western Reserve University, Cleveland, Ohio, USA; [8]Department of Colorectal Surgery, Digestive and Surgical Institute, Cleveland Clinic, Cleveland, Ohio, USA. **Correspondence:** Arnold Wald, MD, MACG. E-mail: axw@medicine.wisc.edu.
Received November 5, 2020; accepted August 9, 2021

(1) Strongly disagree
(2) Disagree
(3) Neither agree nor disagree
(4) Agree
(5) Strongly agree

Consensus agreement was defined as a composite score of ≥ 25 (maximum of 30).

These guidelines are established to support clinical practice and suggest preferable approaches to a typical patient with a particular medical problem based on the currently-available published literature. When exercising clinical judgment, particularly when treatments pose significant risks, health-care providers should incorporate this guideline in addition to patient-specific medical comorbidities, health status, and preferences to arrive at a patient-centered care approach.

DEFECATION DISORDERS

A systematic review of diagnostic tests for constipation was recently reported as part of a comprehensive guideline concerning the management of constipation (2). These guidelines focus on studies that examined the concordance of the most commonly used diagnostic tests to each other or to an external standard where one is available. The diagnostic tests assessed include symptoms, digital rectal examination, anorectal manometry (ARM) with or without electromyography (EMG) of the pelvic floor, the balloon expulsion test (BET), barium defecography, and MRI of the pelvic floor.

Definition and epidemiology

Defecation disorders (DDs) are defined as difficulty in evacuating stool from the rectum in patients with chronic or recurring symptoms of constipation (2–4). The diagnosis requires both symptoms of constipation and anorectal tests suggestive of impaired rectal evacuation. With the increasing availability of anorectal tests, DDs are increasingly recognized in clinical practice. In the community, the incidence of diagnosis of DD is more common in women than in men and is 3-fold more common than Crohn's disease (5). In women, the incidence is greatest between the ages of 20 and 29 years and then declines with a second peak between the ages of 80 and 89 years. In men, the incidence of DD increases with age until the age of 80–89 years.

Pathophysiology

Maladaptive learning of sphincter contraction, possibly initiated by avoidance of anorectal pain or trauma or neglecting the call to defecate, is thought to underlie the development of DD (6,7). In one-third of children with constipation, severe symptoms persist beyond puberty (8). Evacuation may be impaired because of inadequate rectal propulsive forces and/or increased outlet resistance, resulting from impaired relaxation or paradoxical contraction of the external anal sphincter and/or puborectalis muscle (3,4,9–14). Other abnormalities such as reduced rectal sensation and structural deformities (e.g., rectoceles and excessive perineal descent) may coexist and be primary or secondary to constipation (15–20). Decreased rectal sensation may also reduce the desire to defecate and contribute to DD (16,17). Up to 50% of patients with DD also have delayed colonic transit, which may represent coexistent colonic motor dysfunction or arise secondary to pelvic floor dysfunction (10,21,22). Over time, excessive straining can weaken the pelvic floor, leading to excessive perineal descent, rectal intussusception, solitary rectal ulcer syndrome, and pudendal neuropathy (23–26).

However, several important questions remain. Some asymptomatic people exhibit a dyssynergic pattern when tested, perhaps because it is a challenge to simulate defecation in the laboratory; hence, the extent to which dyssynergia is responsible for impaired evacuation is uncertain (27–29). Among patients who also have structural abnormalities (e.g., a large rectocele), their relative contribution to the symptoms is unclear. Stool form may influence the expression of pelvic floor dysfunction; similar to healthy people, patients with DD strain more to evacuate hard than soft stools (30,31).

Associated conditions. In case series, DDs often begin in childhood; many patients have irritable bowel syndrome (IBS), anxiety, and/or depression (5,32–34). Other associated conditions and possible risk factors include surgery, hospitalization, eating disorders, trauma, and physical or sexual abuse (5,32,35,36). In contrast to FI, obstetric trauma is not associated with DD (37). Secondary causes of DD include Parkinson disease and inflammatory bowel disease before or after ileal pouch–anal anastomosis (5,38–41).

Clinical features. The symptoms of DD include infrequent defecation, hard stools, excessive straining during defecation, sense of anorectal blockage during defecation, use of manual maneuvers to facilitate evacuation, and a sense of incomplete evacuation after defecation (3,4,14,32,42,43). However, these symptoms, including a sense of anal blockage during defecation or anal digitation, do not discriminate between DD and other causes of constipation (42,44–47).

A digital rectal examination (DRE) can identify structural abnormalities (e.g., anal fissures, hemorrhoids, fecal impaction, descending perineum syndrome, or anorectal cancer) and also assess anal sphincter functions that are involved with defecation. A DRE includes perianal inspection followed by digital assessment to assess stool in the rectum, anal tone at rest, during voluntary contraction of the sphincter (squeeze) and simulated evacuation. During the latter, the anal sphincter should relax. Failure to relax with simulated defecation or contraction around the finger may suggest a DD or reflect the challenges of simulating evacuation in healthy people. The examining finger is then inserted more deeply to palpate the puborectalis muscle; the patient is again asked to simulate defecate and the normal response is for the muscle to relax, thus widening the anorectal angle. Regrettably, many health care providers do not perform a DRE in patients with constipation (48). Assessments of anal tone at rest, during squeeze and evacuation, and perineal descent during evacuation with a meticulous DRE are significantly correlated with objective assessments by experienced examiners (15,49,50). Compared with manometry, a DRE was 75% sensitive and 87% specific for identifying dyssynergia in 1 study from a tertiary care center (50). Compared with a rectal BET, which is arguably the most useful diagnostic test for DD, the sensitivity and specificity were 80% and 56%, respectively. Some persons with normal pelvic floor function may find it awkward to simulate defecation during a DRE, which might explain the lower specificity of DRE compared with a BET. Although a normal DRE is probably more useful than an abnormal result (50), all patients with constipation with symptoms refractory to standard therapy should be referred for anorectal testing to exclude the presence of a DD.

Diagnostic tests. Anorectal tests are necessary because symptoms alone do not discriminate between DD and other causes of constipation. The diagnostic tests assess rectal sensation and

anorectal pressures (manometry), rectal balloon expulsion (BET), external anal sphincter and pelvic floor muscle activity (EMG), or rectal evacuation (barium or MRI defecography) (19,46,51,52).

All diagnostic tests have strengths and limitations, and there is no single gold standard. In the United States and several other countries, ARM and a BET are performed in conjunction, followed by defecography if there is a discrepancy between the clinical features and the initial tests, and/or a discrepancy between the manometry and BET, and/or in patients with clinically suspected pelvic organ prolapse (e.g., cystocele, rectocele, and rectal intussusception) (2). ARM and BET are more readily available, less cumbersome, and avoid the radiation exposure associated with barium defecography. At some centers, defecography is more readily available and used before a BET (53). The test results should be interpreted together with the clinical features because false-positive and false-negative results are not uncommon (2). The Rome IV criteria also propose that a diagnosis of DD be confirmed by at least 2 abnormal tests (4).

Overall, the results of anorectal high-resolution anorectal manometry (HRM), BET, and MRI defecography are concordant with levels of agreement >70% (54), which substantiates the criterion validity of these tests (20). This is so despite the fact that these tests are performed in different positions and with or without rectal filling. However, different tests may not agree in individual patients (19,20,51).

Rectal BET. The BET measures the time required to evacuate a balloon filled with 50 mL of warm water in the seated position (54–56). Using a party or commercial balloon (Mui Scientific, Toronto, Canada), which are the most widely used and preferred approaches, the upper limit of normal is 1 minute (55–57). When using a Foley catheter inflated to 50 mL (which is above the manufacturer-recommended limit of 30 mL), the upper limit of normal is 2 minutes (54). Even with the 2-minute cutoff, 25% of healthy people would be misclassified as abnormal using a Foley catheter because they require more than 2 minutes to expel the balloon (57). For this reason, we discourage the use of Foley catheter balloons in favor of commercially available ones or locally constructed ones based on those centers that have reported normative data. The techniques are described in detail by Mazor et al. (57). In a series of 106 patients with functional constipation and 24 patients with DD, the BET identified those with DD, as documented with defecography, with a sensitivity and specificity of approximately 88%; positive and negative predictive values were 64% and 97%, respectively, for a diagnosis of DD (46). Normal values for defecography were based on historical data. Patients with secondary (such as medication-induced) chronic constipation were excluded. Rather than a fixed volume, the rectal balloon was inflated until patients experienced the desire to defecate, averaging 183 mL, which may compensate for reduced rectal sensation identified in some patients with DD (46).

Anorectal manometry. Manometry measures rectal sensation and anorectal pressures at rest, during anal and pelvic floor contraction (squeeze), evacuation, and a cough or Valsalva maneuver (58). Conventional catheters have water-perfused, air-charged, or solid-state sensors (27,59–61). High-resolution manometry and high-definition manometry catheters have more closely spaced sensors that straddle the entire anal canal, provide better spatial resolution, and allow pressures to be assessed without a pull-through maneuver (62,63). Measurements with conventional and HRM catheters are comparable (64). However, values are greater with HRM or high-definition manometry than with conventional catheters. Therefore, pressures must be compared with reference values measured with the same technique. Unfortunately, reference values have been characterized in relatively few individuals, more so in women than in men; the largest cohort comprises 96 women studied with the Medtronic high-resolution manometry device (28).

Evacuation studies are summarized by rectal and anal pressures, anal relaxation, and the rectoanal gradient. Intuitively, it would seem that normal evacuation requires a positive rectoanal gradient, that is, rectal pressure is greater than anal pressure. However, many healthy people exhibit a negative rectoanal gradient (27,28,65); indeed, in women younger than 50 years, the 10th percentile reference value measured with the Manoscan high resolution manometry catheter (Medtronic TM) is −70 mm Hg (28)! Similar considerations apply to other features suggestive of DD such as decreased rectal pressures or paradoxical anal contraction or high anal pressure during evacuation or high anal resting pressure (42). For example, 37% of asymptomatic women fail to relax or paradoxically contract their pelvic floor muscles during evacuation (56). Recent studies suggest that seated manometry may be more useful than left lateral manometry for discriminating between healthy people and patients with DD (66). Further confirmatory studies are awaited, but if feasible, performance of manometry might be considered in the seated position.

Barium and magnetic resonance defecography. Defecography is performed by injecting barium contrast mixed with psyllium or another thickening agent into the rectum (barium defecography) or gel (magnetic resonance [MR] defecography) and taking lateral images of the anorectum at rest, during pelvic floor contraction, and defecation (67). The angle between the axes of the rectum and the anal canal provides an indirect measure of whether the puborectalis muscle relaxes (normal response) or contracts (indicative of DD) during simulated defecation. Abnormalities include inadequate (such as a spastic disorder) or excessive (such as in descending perineum syndrome) widening of the anorectal angle and/or perineal descent during defecation. Internal intussusception, solitary rectal ulcers, rectoceles, and rectal prolapse may also be identified (67). Enteroceles, bladder, and uterovaginal prolapse can be visualized when the vagina and small intestine are opacified.

Older studies noted several limitations of barium defecography such as limited reproducibility of anorectal angle measurements (68), which can be overcome with standardized techniques (19,51,69). Although barium defecography is performed in the seated position, MR defecography is performed in the supine position. In contrast to barium defecography, MRI avoids radiation exposure, provides more precise assessments of pelvic organ prolapse and pelvic floor motion (15,70–72), and is especially useful for uncovering pelvic floor dysfunction in patients who have clinical features of DD with a normal BET; this group includes more than 90% of patients with a large rectocele, enterocele, and/or peritoneocele (15,20). However, MR defecography is less widely available and more expensive.

Anal EMG. Average anal EMG activity is recorded by electrodes mounted on an acrylic anal plug or taped to the perianal skin. It

Table 1. Biofeedback treatment of defecation disorders in adults: summary of clinical trials

Author	Sample size	Study type	Comparison made	Outcome
Pourmomeny et al. (82)	65	RCT	Balloon defecation training vs BF	BF superior
Hart et al. (83)	21	RCT	EMG-based BF vs sham BF	BF superior
Chiarioni et al. (11)	99	RCT	PEG vs BF	BF superior
Heymen et al. (73)	84	RCT	BF vs diazepam vs placebo	BF superior to diazepam and placebo
Rao et al. (12)	77	RCT	BF vs sham vs medical care	BF superior to sham and medical care
Rao et al. (13)	26	RCT	BF vs usual medical care	BF superior
Simon and Bueno (84)	30	RCT	EMG-based BF vs control	BF superior
Simon and Bueno (85)	20	RCT	EMG-based BF vs control	BF superior

BF, biofeedback; EMG, electromyography; PEG, polyethylene glycol; RCT, randomized controlled trial.

may be used to identify dyssynergia (68) and to provide biofeedback training for DD (11,73). Although a reduction of 20% or more in anal EMG activity during evacuation is considered to be normal, data are limited. Less than 20% reduction during evacuation, however, has been correlated with dyssynergic defecation, as identified by manometry and abnormal BET (54).

Colon transit. Colonic transit should only be evaluated in patients who do not respond after biofeedback therapy or who exhibit normal anorectal function during testing; this can be performed with radiopaque markers, colon scintigraphy, or the wireless motility capsule after (optimally) discontinuing medications that can affect colonic transit. Radio-opaque marker studies (Sitz-Mark; Konsyl Pharmaceuticals, Ft Worth, TX) are inexpensive, easily available, easy to perform, and entail modest radiation exposure (74). Although up to 50% of patients with DD exhibit slow colonic transit if tested, such patients should be treated initially with pelvic biofeedback therapy because slow transit often normalizes with successful biofeedback to correct pelvic floor abnormalities. Assessments of colonic transit are reproducible in patients with simple constipation (74) but less so in patients with DD or slow transit constipation (75). Contrary to older studies, a recent multicenter study concluded that the distribution of markers in the rectosigmoid colon is not associated with DD (76). Radionuclide gamma scintigraphy (77,78) or a wireless pH-pressure capsule may be used when it is also desirable to measure gastric emptying and small intestinal transit (79). If patients can only discontinue medications for a few days, scintigraphy is preferred.

Differential diagnosis. DDs may be associated with IBS (47) and conditions that are associated with rectal bleeding (e.g., hemorrhoids or solitary rectal ulcer). Abdominal imaging and/or a colonoscopy should be considered when clinically indicated. Some patients with severe symptoms have anxiety, depression, or generalized somatoform disorders that need to be addressed concurrently (5,32). In patients with DD and excessive perineal descent, with or without pelvic organs prolapse, it can be challenging to determine the contributions of structural and functional disturbances to DD. Slow transit constipation may occur in isolation or coexist with DD (2). In up to two-thirds of patients with the latter, slow colonic transit is probably secondary to outlet dysfunction rather than an independent, comorbid condition (80).

Treatment

Conservative treatment. Anorectal biofeedback therapy is the cornerstone for managing DD. Other conservative measures are also helpful, especially because anorectal biofeedback therapy is not widely available or may not benefit all patients (81). Potential options include eliminating medications that cause or exacerbate constipation, use of soluble fiber (e.g., psyllium and *Sterculia*) or laxatives for patients with hard stools, insoluble fiber for patients with loose stools, or regular toileting (2). Consideration should be given for the use of a footstool to enhance defecation, which has little if any risk, although studies are needed to evaluate this technique. Patients should be advised to consume meals of 500 Kcal or more to induce the gastrocolonic response, to heed the call to defecate, and to avoid straining and spending excessive time during defecation. Anorectal conditions (e.g., anal fissure or symptomatic hemorrhoids) should be treated concurrently.

If these measures are insufficient, oral osmotic or stimulant laxatives, secretory agents, or serotonin $5HT_4$ agonists may be considered (2). Administered on an as-needed basis (e.g., if patients do not have a bowel movement for 2 days), enemas and suppositories provide some predictability over bowel habits. In contrast to biofeedback therapy, pelvic floor therapy does not provide feedback from pelvic floor muscles, is not specific for disorders of defecation, and is not effective for managing DD.

Anorectal biofeedback therapy. The aim is to improve symptoms by teaching patients to appropriately coordinate abdominal and pelvic floor muscles during defecation. Through 1 or more techniques (ARM, abdominal and anal EMG, assessment of rectal sensation, and ability to expel a rectal balloon), patients

Table 2. Summary of treatment recommendations for DD

1	We recommend that instrumented anorectal biofeedback therapy should be used to manage symptoms in DD (strong recommendation; minimal risk of harm; quality of evidence: moderate). Consensus score: 29
2	We suggest that full-thickness rectal prolapse often requires surgical treatment with abdominal rectopexy or in selected cases a perineal procedure (conditional recommendation; moderate risk of harm; quality of evidence: very low). Consensus score: 30

DD, defecation disorder.

Table 3. Suggested treatment protocol for anorectal biofeedback

Component	Details
Education	Use diagrams to teach anatomy, explain what dyssynergia is, and explain rectoanal gradient
Correct toileting position and behavior	Use of foot stool with knees higher than hips, lean forward, consider limiting time spent in the toilet per visit, and number of visits
Abdominal breathing technique	Detail and teach this, patients to practice at home
Manometric-based BF guiding how to generate sufficient rectal pressure	During biofeedback, rectal pressure on push recorded with the rectal port and shown to patients; patients taught to tighten abdominal muscles and lower diaphragm to increase pressure appropriately
Manometric-based BF guiding anal relaxation—and make it simultaneous with rectal pressure rise (rectoanal coordination)—initially anal sphincter pressure relax	Patients receive visual feedback of anal manometry or EMG on performing push maneuver to teach the skill to relax, rather than paradoxically contract the anal sphincter and pelvic floor muscles. Subsequently, patients view rectal and anal tracing and are taught to simultaneously increase rectal pressure and reduce anal pressure on command.
Balloon expulsion retraining	Practice of simulated defecation using a rectal balloon during sessions
Sensory retraining	When hyposensitivity is present, the rectal balloon is inflated, and patients are informed of the volume in milliliters and are encouraged to be able to detect smaller volumes of inflation

BF, biofeedback; EMG, electromyography.

Table 4. Summary of key concepts in DD

1. Symptoms suggestive of DD include excessive straining during defecation, sense of anorectal blockage during defecation, use of manual maneuvers to facilitate evacuation, and a sense of incomplete evacuation after defecation.
2. We strongly recommend DRE as part of the assessment to identify structural abnormalities (i.e., anal fissures, hemorrhoids, fecal impaction, descending perineum syndrome, or anorectal cancer) and assess anal sphincter function.
3. DD may result from inadequate rectal propulsive forces and/or impaired relaxation or paradoxical contraction of the external anal sphincter and/or puborectalis muscle.
4. ARM and balloon expulsion are required to diagnose DD.
5. Important initial approaches include normalizing of stool form, advice on toileting position, and behavior.
6. Biofeedback should involve 4–6 sessions with well-trained therapists aimed at normalizing rectoanal coordination, ensuring good rectal pressure on strain, sensory retraining, and balloon expulsion retraining.
7. Baseline ARM and balloon expulsion is useful to predict the outcome and guide biofeedback therapy.
8. Defecography (MR or barium) may be indicated in patients with DD who fail conservative therapy and biofeedback.
9. The decision to treat a structural abnormality with surgery should be based on overall clinical assessment including symptoms, ancillary testing, and psychological assessment where appropriate.
10. Most patients with structural abnormalities do not need surgical therapy given the high prevalence of these findings in asymptomatic patients, the low-level evidence of efficacy for and the moderate risks of surgery.
11. Patients with DD should be carefully counseled on benefits vs risk before any surgery for defecatory disorders, as often potential risks outweigh the potential benefits.
12. Selection of patients for surgery for rectocele repair should depend on symptoms. Size and degree of nonemptying of the rectocele and/or a vaginal bulge or prolapse in conjunction with defecatory symptoms is a stronger indication than for symptoms alone
13. The evidence to support use of botulinum toxin for patients with DD is poor; in addition, results are short lived, and the procedure is unlikely to be a practical long-term solution.

ARM, anorectal manometry; DD, defecation disorder; DRE, digital rectal examination; MR, magnetic resonance.

receive visual and verbal feedback of their anorectal disturbances and are taught corrective approaches. With additional practice at home, the appropriate behaviors can be learned and maintained.

Biofeedback therapy includes (i) teaching patients abdominal breathing and a method to generate adequate propulsive force during defecation; (ii) teaching patients to relax the anal sphincter and synchronize this with increased rectal pressure, which reflects intra-abdominal pressure; (iii) rectal sensory retraining to enhance rectal perception in patients with hyposensitivity, when required; and (iv) balloon expulsion retraining to shorten the time to balloon expulsion (Table 1). Four to 6 sessions, each several weeks apart, are recommended (86).

Several randomized controlled trials (RCTs) suggest that anorectal biofeedback therapy improves symptoms in DD (Tables 2 and 3) (11–13,73,82–85). Comparators have included diet, exercise, and laxatives, polyethylene glycol, diazepam, or placebo, balloon defecation training, and sham biofeedback therapy. Most studies show efficacy for short-term outcomes, although evidence for longer-term efficacy is of low quality (11,13,87–89). Patients with solitary rectal ulcer syndrome may also respond to biofeedback therapy if there is evidence of DD on manometry (90).

Anorectal biofeedback therapy is very safe but is labor intensive, involves considerable specialized expertise, and is not widely available. Baseline ARM and balloon expulsion and a history suggestive of abnormal toileting behavior such as digitation may possibly predict response to biofeedback; however, further studies are required (91,92). Strategies to better triage patients according to their likelihood of success or modifying the treatment such as using home-based therapies or abbreviating the

Table 5. Surgical options for DD with associated structural abnormality

Structural disorder	Category of procedure	Specific procedural options	Outcomes		Harm
			Effect on constipation	Global improvement/QOL	
Rectal prolapse	Rectal suspension procedures	Open or laparoscopic posterior or ventral rectopexy	Variable, often not measured, up to 86% from ventral mesh rectopexy (97)	73%–91% "some benefit" (97)	5%–15% serious: 0%–4% mesh erosion 2%–7% anatomic recurrence (97)
	Perineal procedures	E.g., Altemeier	Not reported	"All reported improvement in QOL" (98)	26.7% recurrence 9.1% early complication rate (98)
Rectocele	Rectovaginal reinforcement	Posterior vaginal repair and perineal or transanal repair	30%–50% improvement (99)	67%–78% satisfactory or good global outcome (99)	7%–17% occ serious (e.g., rectovaginal fistula); 17% anatomic recurrence (99)
	Rectal excision procedure	STARR; first-generation and second-generation staplers (better outcome)	68%–76% moderate reduction in obstructed defecation syndrome (100)	73%–80% "good or satisfactory outcome" (100)	4% recurrence, overall morbidity 16.9% −23%, especially urgency; rarely serious complications: bleeding, perforation, and stenosis (100,101)
Sigmoidocele/ enterocele	Sacrocolpopexy		75% recurrence of DD (102)	Not reported (102)	9% minor complications; 23% recurrent pelvic discomfort; 9% recurrence rate (102)
No significant structural abnormality	Minimally invasive procedures	Botulinum toxin A injection	Not reliably assessed (103)	29.2%–100% (104)	14.2% (104)
		SNS	Shown to be not efficacious in RCT	Shown to be not efficacious in RCT	61% device-related adverse outcome at 60 mo (105)

DD, defecation disorder; RCT, randomized controlled trial; QOL, quality of life; SNS, sacral nerve stimulation; STARR, stapled transanal rectal resection.

program are needed (93–95). If conservative management and biofeedback fail, further investigations and consideration of surgery or minimally invasive procedures may be considered (Table 4).

Surgery and minimally invasive procedures. Conservative measures and biofeedback therapy for defecatory disorders may not always provide adequate relief of symptoms. In such patients, it may be appropriate to perform investigations such as MR or barium defecography to look for structural disorders to explain symptoms. However, structural abnormalities of the pelvic floor occur commonly in asymptomatic subjects and usually do not require surgical correction (18,96). Accordingly, surgical restoration of structure to the pelvic floor often does not result in restoration of function. Exceptions include overt rectal prolapse and a sizeable, nonemptying rectocele when defecatory symptoms are associated with typical symptoms of vaginal bulge or prolapse (Table 5) (103,106). The utility of repairing enteroceles or sigmoidoceles is unclear (107).

Rectal prolapse. Patients who present with overt full-thickness rectal prolapse, with or without defecatory symptoms and/or progressive FI, should be considered for surgical correction given the effectiveness of surgery in relieving symptoms and improving continence (107). Although the evidence is only of low level, the alternative of leaving overt rectal prolapse untreated leads to very significant morbidity. If prolapse is suspected, but not demonstrated on rectal examination in the left lateral position, the examination should be repeated with the patient squatting or sitting on a toilet or commode to potentially demonstrate the prolapse. Full-thickness rectal prolapse should be distinguished from mucosal prolapse or internal intussusception, which have a more benign course and may be found in asymptomatic patients. For most patients with full-thickness prolapse, a laparoscopic rectopexy (either posterior or ventral) is the most appropriate operation as it is associated with a substantially lower recurrence rate than perineal procedures such as the Altemeier procedure (27% recurrence rate) (98,108). Perineal procedures such as the Altemeier or Delorme procedure are, however, a reasonable option for patients who are elderly or frail (109). The effect of these procedures on constipation is variable but is best substantiated with ventral mesh rectopexy, which leads to 66%–86% improvement in preoperative constipation (97,110). Perioperative complication rates for rectal suspension procedures are generally in the order of 5%–15% and are occasionally severe (103). There should be added caution in the following groups who have worse outcomes: psychiatric disorders, chronic pain or IBS, morbid obesity, joint hypermobility, connective tissue disorders, women who are planning pregnancy or those at high risk for pelvic surgery due to previous surgery, infection, or radiotherapy (103). Surgery (e.g., laparoscopic ventral mesh rectopexy) may also be considered when biofeedback and behavioral interventions are not effective in patients with solitary

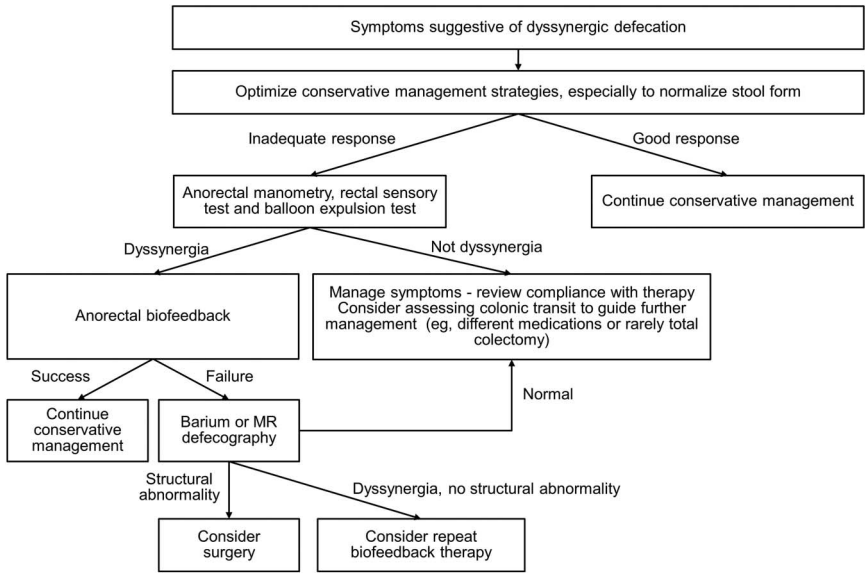

Figure 1. Suggested evaluation of patient with chronic constipation and symptoms suggestive of dyssynergic defecation. IBS, irritable bowel syndrome.

rectal ulcer syndrome, especially in patients with ulceration at the lead point of an internal rectal intussusception. In 2 articles with 75 patients, the ulcer healed in 78% of cases (97).

Rectocele. Rectoceles are often identified on clinical examination or defecography in asymptomatic women and usually do not require surgery (18,96). Rectocele surgery should be considered for patients with bothersome gynecological symptoms such as bulging in the perineum or protrusion through the vaginal introitus (103,106). In the absence of these symptoms, women who present with defecatory dysfunction and a coexistent rectocele should be initially managed conservatively, including biofeedback therapy (111). When patients do not respond to these measures, determining whether to proceed with surgery can be challenging. Two features that have been suggested to be useful to select patients for surgery include (i) significant size of rectocele based on clinical assessment and/or imaging (e.g., >5 cm) and (ii) evidence of trapping or nonemptying on dynamic assessment such as defecography (103,112). However, others have suggested that size alone is not a criterion for surgery (113). Rectocele surgery mainly involves reinforcement of the rectovaginal wall and may be performed vaginally or transanally. The vaginal approach seems more favorable for treatment of pelvic organ prolapse syndromes (114), and a recent small RCT showed that it might be more favorable to treat constipation (115). Transvaginal repairs using native tissue are preferred (116), and the use of a vaginal mesh repair has been discontinued by the US Food and Drug Administration (117). Short-term success rates for surgery are reported to be in the order of 73% (103); however, most studies to date have lacked uniform validated outcome measures, particularly for the symptom of constipation, and it is difficult to separate patients presenting with defecatory disorders alone from those presenting with coexistent gynecological symptoms. In addition, many series report only short-term follow-up, and symptoms often progressively deteriorate over time with longer follow-up (112), again emphasizing that a significant degree of caution should be given when selecting patients for rectocele surgery.

An alternative approach to rectovaginal reinforcement surgery for rectocele is the stapled transanal rectal resection procedure that is predominantly performed in Europe (Italy). Small RCTs (118,119), a large observational study (120), and a systematic review (121) have shown efficacy for treating constipation, but others have expressed concerns about these reports and the outcomes of this procedure. For example, in 1 study (118), characterization of a defecatory disorder at baseline was insufficient, as BET was not performed and anal pressures were not reported. In addition, the quality of biofeedback performed as a comparator was inadequate according to current guidelines (86). Newer versions of the stapling device might ameliorate concerns about reported complications (100,122). Currently, the procedure is not widely performed in other countries (e.g., never in Australia and seldom in the United States) (103).

Sigmoidocele and enterocele. Sigmoidoceles and enteroceles are components of pelvic organ prolapse that often include uterine/vaginal vault prolapse, cystoceles, and rectoceles (123,124). When thought to be symptomatic, enteroceles and sigmoidoceles may be treated with surgical repair (e.g., sacrocolpopexy) after careful radiological testing using MRI, defecating proctogram, and/or transperineal ultrasound (107,125,126). This procedure is usually performed by urogynecologists with concurrent treatment of the associated pelvic organ prolapse, although a multidisciplinary approach is clearly required. Sacrocolpopexy seems to result in acceptable reduction of the anatomical defect (102) but has a very high recurrence of defecatory symptoms (75% of patients in the long term [85 months] (102,127)) and 23% have recurrent pelvic discomfort.

Surgical approaches for defecatory disorders in the absence of a structural abnormality. In patients who have failed medical management and biofeedback and have proven dyssynergia due to dysfunction of the puborectalis muscle, injections of botulinum toxin A into the anal sphincter complex have been used. Botulinum toxin A has a reversible paralytic effect on the nerve endings of muscles with growth of new nerve fibrils in 2–3 months (128). A recent systematic review of botulinum toxin A was based on 3 small RCTs and 8 small uncontrolled studies. Study design, techniques for administering botulinum toxin, and outcome

Table 6. Key concepts of proctalgia syndromes

1	Chronic proctalgia syndrome is characterized by a history of recurring episodes of anorectal pain lasting at least 20 min and the exclusion of other causes of pain by history and diagnostic testing. The diagnosis is strengthened by the finding of tenderness on palpation of the levator ani muscles.
2	The duration rather the frequency of proctalgia episodes is used to diagnose chronic proctalgia in the general population.
3	The presence of levator tenderness and the absence of other potential causes are sufficient for the diagnosis of levator syndrome in a patient with chronic proctalgia
4	The absence of levator tenderness in a patient with chronic proctalgia defines idiopathic chronic proctalgia syndrome.
5	ARM and BET should be performed in patients with levator syndrome to identify patients eligible for biofeedback therapy.
6	The clinical history and a normal DRE alone is sufficient to diagnose PF.
7	The presence of prolapsed hemorrhoids, chronic anal fissure, or other anorectal pathology does not invalidate a diagnosis of PF.
8	The preferred approach to patients with PF is an explanation of the disorder and reassurance.
9	Given the brevity of episodes of PF, there is no evidence to support treatment intervention or to prevent attacks.

ARM, anorectal manometry; BET, balloon expulsion test; DRE, digital rectal examination; PF, proctalgia fugax.

Table 7. Treatment recommendations for proctalgia syndromes

1	We recommend biofeedback to teach pelvic floor muscle reconditioning for levator syndrome with abnormal ARM (strong recommendation; quality of evidence: very low). Consensus score: 26
2	We suggest that electrical (galvanic) stimulation may be attempted to manage levator syndrome with abnormal ARM if biofeedback is not available (conditional recommendation; quality of evidence: very low). Consensus score: 25
3	There is no evidence to support the use of Botox or digital massage in chronic proctalgia syndromes. Consensus score: 28

ARM, anorectal manometry.

assessments varied considerably between studies. Only 3 studies used validated constipation questionnaires in their assessment (104). The authors concluded that "the evidence to support using BTX for DD is poor." Combined adverse effects in this review were 14.2% and included flatus and FI and occasionally, more serious side effects (104).

Sacral nerve stimulation (SNS) involves peripheral nerve stimulation of the S3 or S4 nerve roots in the sacral foramina and is most often used to treat FI. Three RCTs (129–131) have shown no benefit of SNS in constipation (regardless of type). In addition, the long-term complication rate is considerable, with 61% reporting device-related adverse events in a long-term (60 months) follow-up study (105). Therefore, this procedure cannot be recommended in patients with constipation of any type. Figure 1 illustrates a suggested algorithm for the evaluation and management of DDs.

PROCTALGIA SYNDROMES

Proctalgia syndromes may be defined as a history of recurrent episodes of anorectal pain in the absence of other known causes of pain on the basis of history and diagnostic testing. They are divided into chronic and acute syndromes based on the duration of painful episodes (Table 6).

Chronic proctalgia

Chronic proctalgia syndrome is characterized by a history of recurring episodes of anorectal pain lasting at least 20 minutes (often hours or even days) and the exclusion of other causes of anorectal pain by history and diagnostic testing (132). The most common theory rests on the assumption that there is excessive tension of the pelvic floor muscles, specifically the puborectalis or levator ani muscles. This is reinforced by the demonstration of tenderness of the levator ani muscle on DRE, most often on one side or the other. In such cases, the diagnosis of levator ani syndrome, levator syndrome, or puborectalis syndrome may be applied. In the absence of such a finding, the term chronic idiopathic proctalgia syndrome should be used. This is potentially important in terms of treatment (see below).

There is often an overlap of symptoms between chronic proctalgia and other conditions centered in the pelvic area such as chronic prostatitis in men and chronic pelvic pain syndrome in women. We continue to endorse excluding such conditions with appropriate testing before proceeding with a trial of conservative treatment (133).

In the previous guidelines, we advocated performing ARM and balloon expulsion testing in patients with levator syndrome but not idiopathic chronic proctalgia syndrome to identify patients who might benefit from biofeedback therapy. This recommendation was based on a single well-designed study that demonstrated that failure to evacuate a 50 mL water filled balloon and manometric demonstration of inability to relax pelvic floor muscles during simulated defecation in patients with levator tenderness were often improved with biofeedback to normalize the defecation response vs conservative therapy (134). We continue to strongly recommend this despite a GRADE rating of low evidence strength and the fact that there has been no independent confirmation of this finding since its publication 10 years ago. Our reasoning is that biofeedback has no significant risks, and there are no effective alternative therapies. This is also the reasoning behind our recommendation for electrogalvanic stimulation, which was less effective than biofeedback but was superior to conservative treatment. These recommendations are based on availability of either treatment with biofeedback remaining as a preferred option. As previously concluded, there is no evidence to support the use of botulinum toxin or digital rectal massage to treat either levator syndrome or chronic idiopathic proctalgia syndrome (135,136).

Proctalgia fugax

Proctalgia fugax (PF) is characterized by intense sensations of rectal or anal pain lasting only a few seconds to less than 20 minutes (132). Although there are many causes of chronic proctalgia, these do not apply to PF, which is a diagnosis based on a characteristic history and a normal DRE. The presence of anorectal conditions such as prolapsed hemorrhoids, chronic

Table 8. Current concepts for chronic anal fissures

1	Chronic anal fissures are defined as lasting more than 8–12 wk and are characterized by edema and fibrosis.
2	Chronic anal fissures persist as nonhealing ulcers by anal sphincter spasm and consequent ischemia. Treatment is typically directed toward softening stool and reducing spasm to improve perfusion to this area.

Table 9. Treatment recommendations for chronic anal fissures

1	We recommend that local application of a calcium channel blocker should be the initial medical treatment of chronic anal fissure (**strong recommendation; quality of evidence: low). Consensus score: 27**
2	We suggest that botulinum toxin A injections may be attempted in patients in whom CCB fails or as an alternative option to CCB (**conditional recommendation; quality of evidence: low). Consensus score: 27**
3	We recommend that LIS is the surgical treatment of choice for chronic anal fissures that do not heal with nonsurgical measures (**strong recommendation; quality of evidence: high). Consensus score: 29**

CCB, calcium channel blocker; LIS, lateral internal sphincterotomy.

anal fissure, or other conditions does not invalidate the diagnosis of PF.

The pathophysiology of the disorder remains unknown, and no trigger events are consistently identified. A rare congenital form of this disorder has been identified as have patients with thickening of the internal anal sphincter associated with elevated resting pressure.

The recommended approach to patients with PF is an explanation of the disorder and reassurance. Given the brevity of episodes of PF, there is no evidence to support treatment intervention or to prevent attacks. The potential efficacy of salbutamol inhalation is based on a study published 25 years ago, was effective only in patients in whom the duration of pain was greater than 20 minutes, and has not been duplicated (137). Therefore, we do not endorse treatment of any kind (Table 7).

ANAL FISSURES

Definition

An anal fissure is an ulcer-like longitudinal tear in the midline of the anal canal, distal to the dentate line. In almost 90% of cases, an idiopathic fissure is located in the posterior midline (138), but it can also occur in the anterior midline (132). Fissures in lateral positions should raise suspicion for disease processes such as Crohn's disease (137), tuberculosis (133), syphilis, human immunodeficiency virus/acquired immunodeficiency syndrome, dermatologic conditions (e.g., psoriasis), and anal carcinoma (Table 8).

Pathophysiology

Often, there is the history of a tearing sensation during passage of a hard stool or diarrhea. Rectal bleeding is frequent and occurs during or after defecation and is usually limited to minimal bright red blood on toilet tissue (134). Chronicity of an anal fissure results in a nonhealing ulcer due to spasm of the internal anal sphincter muscle and consequent ischemia (Table 9).

Clinical features

An acute anal fissure looks like a simple tear in the endoderm. A chronic fissure is a nonhealing anal fissure and is defined as lasting more than 8–12 weeks. It is further characterized by overhanging edges, edema, and fibrosis with fibers of the internal anal sphincter, which may be visible in the floor of the fissure (134). Typical accompanying features of chronic fissures include a sentinel pile (skin tag) at the distal fissure margin and a hypertrophied anal papilla in the anal canal proximal to the fissure. The former is often described by patients as a painful hemorrhoid, and the latter may be seen on anoscopy or endoscopic retroflexion. The clinical hallmark of an anal fissure is pain during defecation and often persisting after defecation. Rectal bleeding is frequent and occurs during or after defecation and is usually limited to minimal bright red blood on toilet tissue (134).

Medical management

Almost half of all patients with acute anal fissure will heal with sitz baths (135) and fiber supplements such a psyllium as the first step in therapy, with or without the addition of topical anesthetics or anti-inflammatory ointments. In addition to fissure healing, symptomatic relief of pain and bleeding can be achieved with virtually no side effects (Table 10).

A chronic anal fissure is often treated with topical pharmacologic agents such as calcium channel blockers or nitrates. Treatment with topical nitrates is marginally superior to placebo in healing of a chronic anal fissure with a short-term decrease in anal pressures (136). In a study using 3 doses of topical nitroglycerine vs placebo, 0.1%, 0.2%, and 0.4% nitroglycerin ointments were applied twice daily for 8 weeks. Healing was reported in 50%, 36%, and 57% of patients, respectively, compared with 26% in the placebo group. The most common side effect was headache, which was dose related (140). However, extending treatment for a longer time is not associated with increased healing rates (139). A Cochrane review of medical treatment of chronic anal fissure concluded that topical nitroglycerin remains only marginally better 48.9% vs 35.5% than placebo in healing chronic anal fissures (149).

Chronic anal fissures may also be treated with topical calcium channel blockers such as nifedipine. There are few studies reporting calcium channel blockers and none reporting a dose escalation. The healing rate reported with a topical calcium channel blocker approximates 67% (141) to 90% (150), with long-term healing reported in 70% of patients; side effects consisted mainly of headache in 20%, and about 10% of patients stopped treatment due to this side effect in an uncontrolled study (151). Although impressive, the absence of a placebo control makes it impossible to compare to the controlled trials of topical nitrates. Another study reported a healing rate of 91.7% with topical diltiazem (2%) vs 60% with topical nitroglycerine (0.2%). The incidence of headache was lower with topical diltiazem (0%) than with nitroglycerine (100%) (152). The absence of any side effects with diltiazem seems implausible, but the study does suggest the efficacy of both agents. There are very few studies comparing topical nitroglycerine and nifedipine. One compared nifedipine with topical nitrate medications. This showed a healing rate of 80% with nifedipine, 73% with 0.2% nitroglycerine, and 33% with

Table 10. Summary of treatment options for chronic anal fissures

Management	References	Efficacy	Adverse effects
Nitroglycerine	Gagliardi et al. (139)	58%	Not reported
	Scholefield et al. (140)	50% with 0.1% GTN group, 36% with 0.2% group, and 57% with 0.4% GTN group	Headaches 6%–20%
Diltiazem	Nash et al. (141)	68%	Mild headache in 20%
Botulinum toxin A	Arroyo et al. (142) 25 units	Recurrence 2 mo 12% 6 mo 16% 1 yr 24% 2 yr 1% 3 yr 0%	Incontinence at 2 mo 6%
	Pilkington et al. (143)	Healing 53%	3% hematoma and fistula
	Barnes et al. (144)	Healing 67%	Temporary incontinence 7%
	Gandomkar et al. (145)	Healing 65%	Ecchymosis and itching
	Barbeiro et al. (146)	47%	None reported
Lateral internal sphincterotomy	Liang and Church (147)	Healing 98%	Minor incontinence 4%
	Gandomkar et al. (145)	Healing 94%	Urinary retention 44% Incontinence 16%
	Gupta et al. (148)	Healing 96%	Delayed wound healing 4%

GTN, glyceryl trinitrate.

placebo, with recurrence rates of 12%, 32%, and 50% with nifedipine, nitroglycerine, and placebo, respectively (153).

Overall, because of the paucity of RCTs, there are insufficient data to conclude whether calcium channel blockers are superior to placebo in healing anal fissures. Side effects such as headache occur less frequently than with topical nitrates.

Oral calcium channel blockers may be as efficacious as topical calcium channel blockers, suggesting that it is the drug rather than the route of administration that is important; healing rates were 90% for topical vs 76% for oral. Side effects included headache most frequently and ankle edema (154) and were not significantly increased with the oral route. However, there are no long-term studies to suggest low recurrence rates (149). Another report evaluated 4 studies with oral and topical nifedipine and found no difference in recurrence rates, slightly better healing rates with topical use and fewer side effects (150). Few studies have trialed different formulations of nifedipine. One small study of 27 patients tested nifedipine 0.5% and reported 85% healing with a recurrence rate of 16% and a 7.4% occurrence of moderate headaches (155); another study reported 83% healing and better compliance when compared with nitroglycerine (156). Topical diltiazem 2% had a lower incidence of adverse effects than did topical nitroglycerin and was preferred to nitroglycerin (152,157).

Minimally invasive procedures

Botulinum toxin A injection for chronic anal fissures in doses of 5–100 units (158) has been reported to have superior healing rates compared with placebo, although with the disadvantage of requiring a needle injection in a sensitive area. There is no consensus on dosage, precise site of administration, number of injections, or efficacy (159). In 1 study, injection of botulinum toxin into the internal anal sphincter reported healing in 60%–80% of fissures and at a higher rate than placebo (160). The most common side effect is temporary incontinence of flatus in up to 18% and of stool in 5% (161). Recurrence may occur in up to 42%, but patients may be retreated with similar results to initial treatment (162). There is little evidence that efficacy is dose related or of any relationship of dose to the incidence of FI (161). On the other hand, a Cochrane review concluded that botulinum toxin A has only marginal improvement over placebo (10).

Topical nitrate medications may potentiate the effects of botulinum toxin in patients with refractory anal fissure (163). Predictors of efficacy may include female sex, satisfaction with the first procedure, and a lower body mass index (164). Patients in whom medical treatment or botulinum toxin A injection fail should be recommended for lateral internal sphincterotomy (LIS) (165). On the basis of available evidence and despite the limitations of the quality of reports, our consensus is that noninvasive treatment with topical calcium channel blockers should be first-line therapy for chronic anal fissures, whereas the role of more invasive botulinum A toxin remains uncertain, perhaps as an attempt to avoid sphincterotomy if CCFB fails.

Surgical interventions

LIS is a procedure that involves cutting fibers of the internal anal sphincter muscle up to the apex of the fissure or the dentate line (158); it may be performed under general, spinal, or local anesthesia. It remains the surgical treatment of choice for chronic anal fissures that are refractory to medical treatment (166,167). Healing rates have been reported between 94% and 98% (147,148,168) and are clearly superior to uncontrolled manual anal dilation, with better healing rates and less incontinence (167). It is also more efficacious than any topical (169) or injectable treatment (170). There is no outcome difference between open and closed sphincterotomy, and thus, a minimal-incision approach is probably preferred (148,168,171). However, there is a low but real incidence of FI from LIS (172), and hence, surgeons continue to explore alternative interventions (173,174).

Controlled pneumatic balloon dilation has shown promise as an alternative to LIS in 1 small series (175), suggesting that an interested gastroenterologist, using the tools at their disposal, may treat even medically refractory anal fissures without resort to surgical consultation. However, surgical referral remains prudent for most cases of medical treatment failure in chronic anal fissure because LIS is a safe and effective operation. LIS should be used with caution in patients when anal pressures are not high, but these determinations are usually made by digital examination

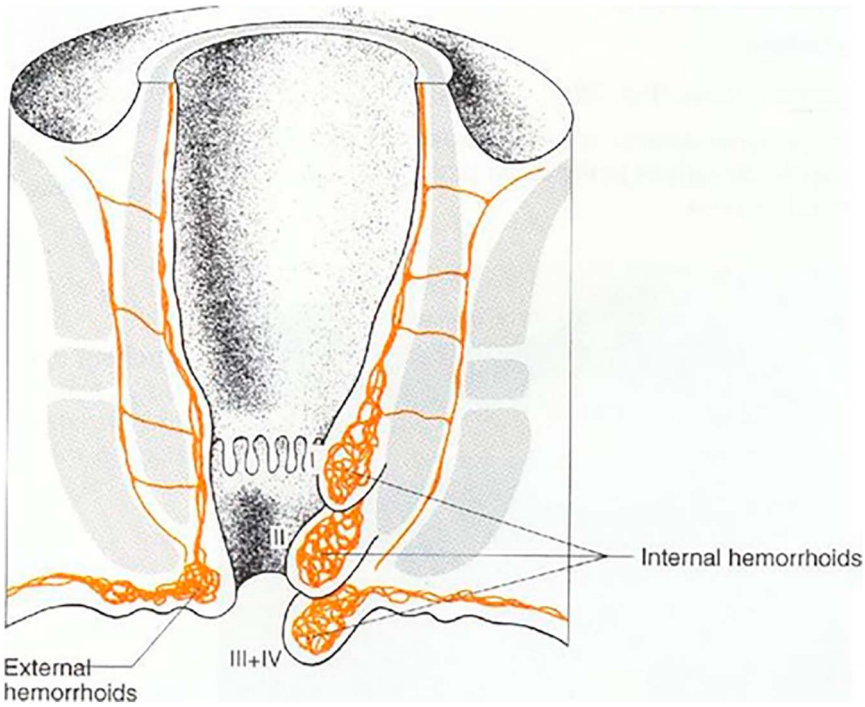

Figure 2. Illustration of the origins and location of internal and external hemorrhoids.

only. In such cases, anal advancement flap repair (176) or a V-Y plasty (158) would be recommended.

In patients with Crohn's disease, medical management is recommended (177,178), and LIS should be used with great caution (179). Refractory chronic anal fissures should be treated first with calcium channel blocker; the role of botulinum toxin A is uncertain. LIS may be considered in patients with rectal sparing disease with good resting and squeeze pressures.

HEMORRHOIDS

Definitions

Vascular tissue covered with anal mucosa is normally present in the anal canal and is termed anal cushions and is an integral part of the mechanism for anal sensation and preservation of continence. These anal cushions are termed internal hemorrhoids when they bleed or enlarge and protrude into the anal canal from above the dentate line. Symptomatic hemorrhoids cause painless bleeding or protrude through the anal verge during or after the process of defecation. Internal hemorrhoids are graded based on the degree of protrusion (Figure 2). Grade 1 hemorrhoids are not associated with prolapse, Grade 2 hemorrhoids prolapse with straining and spontaneously reduce after a bowel movement, Grade 3 hemorrhoids prolapse and need manual reduction, and Grade 4 hemorrhoids prolapse and are not manually reducible. External hemorrhoids are located distal to the dentate line and are covered by squamous epithelium. They are painful only when they develop an acute thrombosis but are otherwise painless (Figure 2; Table 11).

Pathophysiology

Internal hemorrhoids are thought to occur because of loss of connective tissue support and prolapse making them more susceptible to trauma from straining and/or the passage of hard stools. Thus, constipation and sitting on the toilet for long periods of time are thought to predispose to their development and symptoms.

Clinical features

The cardinal signs of internal hemorrhoids are hemorrhoid-pattern bleeding—defined as painless bleeding with bowel movements—and intermittent, reducible protrusion. It is often the role of the gastroenterologist to provide the diagnosis of exclusion of symptomatic internal hemorrhoids by ruling out other sources of bleeding and protrusion. External hemorrhoids present with painful swelling. Anal skin tags represent residual redundant skin from previous episodes of inflammation and thrombosis and are painless.

Medical management

Symptomatic internal hemorrhoids may be treated with conservative management that include bowel management with advice on increasing fluid (6–8 glasses of fluids daily) and dietary fiber intake (20–30 g daily), discouraging sitting on the toilet for a prolonged time, which includes reading and use of cell phone. For patients unable to increase their dietary fiber, polyethylene glycol 3,350 or docusate may be given. The evidence for conservative management is moderate (180–182), but the recommendation is strong based on correction of the presumed pathogenesis and minimal risk of complications when compared with office procedures (183).

Symptomatic first- and second-degree hemorrhoids not responding to conservative management may be treated in the office with rubber band ligation. Rubber band ligation (banding) is the most popular and effective office treatment for internal hemorrhoids. The evidence is low due to the paucity of data on Grade 1 hemorrhoids (184,185); however, the recommendation is strong as the procedure is relatively simple, the complications are low, and it may be easily repeated if symptoms recur (186).

Table 11. Current concepts of hemorrhoids

1	The cardinal signs of internal hemorrhoids are painless bleeding and intermittent protrusion. The diagnosis generally requires the exclusion of other conditions that can produce similar symptoms.
2	Internal hemorrhoids are assigned a functional grade based on their history: First-degree hemorrhoids do not prolapse; second-degree hemorrhoids prolapse but spontaneously reduce; third-degree hemorrhoids prolapse and require manual reduction; and fourth-degree hemorrhoids protrude and cannot be reduced.
3	External hemorrhoids may become thrombosed by developing a clot in a vein under the squamous epithelium of the anal verge.

Table 12. Treatment recommendations for hemorrhoids

1	We recommend that dietary modification consisting of adequate fluid and fiber intake and counseling to minimize straining at defecation should be first-line therapy for symptomatic hemorrhoids (strong recommendation; quality of evidence: moderate). Consensus score: 29
2	We recommend that patients with acutely thrombosed external hemorrhoids may benefit from either surgical excision or incision and evacuation of the thrombus when seen within the first 4 d (strong recommendation; quality of evidence: low). Consensus score: 30
3	We recommend that symptomatic grade 1 and 2 internal hemorrhoids that fail medical therapy can be effectively treated with office-based procedures such as a rubber band ligation. Alternative procedures include infrared coagulation, sclerotherapy, and bipolar coagulation (strong recommendation; quality of evidence: moderate[a]). Consensus score: 28
4	We suggest that Doppler-guided procedures such as hemorrhoidal artery ligations have similar outcomes to hemorrhoidectomy for symptomatic grade 3 hemorrhoids (conditional recommendation; quality of evidence: very low). Consensus score: 29

[a]Moderate on the basis of grade II hemorrhoids; no evidence for grade I hemorrhoids.

Ligation of hemorrhoids can be accomplished through a rigid anoscope or using a retroflexed flexible endoscope with a ligation attachment. In a meta-analysis of 18 randomized prospective studies of office treatments, banding had a lower need for repeated treatment, compared with injection sclerotherapy and infrared coagulation, in the treatment of first- to third-degree hemorrhoids (150). The most common complications of banding are anorectal pain, bleeding, thrombosis of external hemorrhoids, and vasovagal symptoms that occur in 1%–3% of patients (156). Life-threatening septic complications have been reported, but are vanishingly rare. Rubber band ligation should be used with caution in patients on anticoagulant therapy.

Other treatment options are infrared coagulation (187), sclerotherapy, or bipolar coagulation (185). Sclerotherapy is successful in treating 75%–90% of patients with first- to third-degree hemorrhoids (188) Recurrence is frequent, but retreatment is considered safe, with complications similar to ligation. Rarely, serious complications have resulted from erroneous injection of the sclerosant or systemic effects (153,154). Sclerotherapy has been found to be effective in patients with acute bleeding who are on anticoagulants (189) or are immunocompromised (190). Infrared coagulation involves the contact application of infrared heat via a device inserted under vision through an anoscope, essentially cauterizing around the base of the hemorrhoid. This is most commonly used for first- and second-degree hemorrhoids. Randomized trials have demonstrated outcomes similar to banding (155). Both infrared coagulation and sclerotherapy can treat bleeding hemorrhoids that are too small to ligate.

Symptomatic grade 3 hemorrhoids may be treated with Doppler-guided hemorrhoidal ligation with a hemorrhoidopexy, mucopexy, or a stapled hemorrhoidectomy. The recommendation for the Doppler-guided hemorrhoidal ligation is moderate, although the quality of evidence is low, as it is relatively noninvasive. However, it may not successfully treat the external component of fourth-degree hemorrhoids as does the stapled hemorrhoidectomy. Doppler-assisted hemorrhoidal artery ligation uses a Doppler-equipped anoscope to identify and ligate the arteries supplying internal hemorrhoids. This is followed by a hemorrhoidopexy or a rectoanal repair. A potential benefit is that no tissue is excised. Stapled hemorrhoidectomy has been shown to have higher complication and long-term recurrence rates; it has been less frequently used as a treatment alternative in recent years.

When compared with office procedures, traditional hemorrhoidectomy was more effective for grade III hemorrhoids, but more painful, and had a higher complication rate in 1 study (150). Standard hemorrhoidectomy leaves open or closed wounds (157) and may be performed with a variety of surgical devices, none of which displays a clear advantage over the others (159). Traditional hemorrhoidectomy remains the recommended treatment for Grade 4 hemorrhoids (191).

External hemorrhoids that develop a clot are termed thrombosed external hemorrhoids. They present with sudden onset of pain and swelling that may be external to the anal verge or just inside the anal verge. They may be treated surgically if seen within 4 days (188). The procedure is excision of the clot with removal of overlying skin to prevent recurrence. The recommendation is strong for this based on small cohort of studies; however, the level of evidence is low for the same reason. Conservative treatment involves softening the stool with docusate, sitz baths, and pain control, which is effective but may be associated with longer time taken for symptom relief and a higher recurrence rate (188) (Table 12).

FECAL INCONTINENCE

Definition and pathophysiology

FI is the involuntary loss of solid or liquid feces (Table 13). The more general term, anal incontinence, also includes involuntary loss of flatus (4,192). Although incontinence for flatus can be embarrassing, a threshold to discriminate inadvertent expulsion of gas from incontinence is not available (193). One survey suggests that some patients prefer accidental bowel leakage or other terms to fecal incontinence (194).

The prevalence of FI in the community increases with age and varies from 2.2% to 25% (192,195). In community surveys, the age-adjusted prevalence is approximately 9% in the United States (196) but lower in global surveys (197). Prevalence rates are related to the frequency of FI that is required for case definition: in a survey of the United States, Canada, and England, the overall prevalence of FI in the last 3 months was 16%, but in only 2.1% of

Table 13. Summary of key concepts in FI

Clinical features
FI is the involuntary loss of solid or liquid feces including staining of underwear.
Diagnosis
The clinical assessment should identify conditions that predispose to FI and gauge symptom severity by asking patients about the type, frequency, and amount of leakage and the presence of urgency to defecate. The severity of FI predicts the need for consultation with a clinician.
Diagnostic tests provide useful functional and structural information that can guide the treatment. There is no single test that can be considered as a gold standard. Functional (ARM, balloon evacuation testing, and sensory evaluation) tests and imaging tests (endoanal ultrasound and MRI) are complimentary.
Treatment
Conservative measures (i.e., education, measures to prevent diarrhea, and pelvic floor exercises) are safe, inexpensive, and often effective.
Children and older patients who have FI associated with constipation may benefit from laxatives but the evidence in younger adults is insufficient.
For some invasive procedures (e.g., SphinKeeper™), the safety and efficacy data are insufficient.

ARM, anorectal manometry; FI, fecal incontinence.

these cases did it occur twice a month and last at least 6 months (198). FI often consisted of staining under clothes.

FI impacts daily quality of life (199) and may predispose to institutionalization (200): up to 50% of nursing home residents in 1 survey had FI (201). Despite these potentially devastating consequences, only a small proportion of incontinent patients discuss the symptom with a physician (202–204). Therefore, physicians should ask patients with predisposing risk factors when they have FI.

In community-based epidemiological studies, older age, diarrhea (frequent stools or loose stools), rectal urgency, constipation (infrequent stools, hard stools), and urinary incontinence are associated with FI (205–210). Women are more likely than men to report FI, but the differences are small (1%–2%). Obstetric anal sphincter injury during child birth may cause FI, although more typically, FI begins 2-3 decades after vaginal delivery (204,211). Other medical disorders that cause changes in stool consistency and/or anorectal weakness also predispose to FI (212). Specific diseases of the central nervous system (dementia and stroke), peripheral nervous system (diabetic peripheral neuropathy, spinal cord injury, and pelvic anomalies), and inflammatory bowel disease are associated with FI.

Diagnostic assessment

There is no biomarker for FI. There are multiple demographic, physiological, medical, and psychiatric comorbidities that are strongly associated with FI (195,213,214), but there is no single factor that is always present in a patient with FI (if there was a primary factor, the other factors could be seen as moderator variables). The data suggest that the higher the number of risk factors present, the greater the likelihood that FI will occur. These risk factors interact so that treatment of 1 risk factor may lower the overall prevalence of FI and restore continence. For example, a weak external anal sphincter may increase the likelihood of FI, but if combined with hard stools, no FI may occur. The aim of diagnostic assessment is to identify all factors that contribute to FI and to order them in terms of which ones are easiest to modify.

The Bristol Stool Form Scale is a validated set of pictures of bowel movements (74,215,216). Pictorial representations of stool form (e.g., by the Bristol Stool Form Scale) and bowel diaries are efficient and reliable methods to characterize bowel habits and are better predictors of colonic transit than self-reported stool frequency (74,215).

Bowel diaries may provide additional information on stool frequency, although they are not standardized. Specific questions about the frequency, amount (i.e., small, medium, or large amount), type of leakage, and presence of urgency can be added to provide an index of symptom severity, which strongly correlates with the impact of FI on quality of life (199,204) and medical consultation. Semiformed or liquid stools pose a greater threat to pelvic floor continence mechanisms than do hard stools.

An awareness of the desire to defecate before defecation provides a clue to pathophysiology. Patients with urge incontinence experience the desire to defecate, but cannot reach the toilet in time. Patients with passive incontinence are not aware of the need to defecate before the incontinent episode. Patients with urge incontinence generally have reduced squeeze pressures (217), squeeze duration (218), or reduced rectal capacity with rectal hypersensitivity (204). Squeeze pressure usually is a manifestation of external anal sphincter function, whereas resting pressure is largely a manifestation of the internal anal sphincter. Patients with passive incontinence have lower resting pressures (217). Incontinence during sleep is uncommon; it occurs in patients with diabetes mellitus, isolated internal anal sphincter weakness, or scleroderma.

Physical examination

The physical examination should exclude diseases in which FI is secondary. A meticulous anorectal examination is mandatory in every patient with FI, not only to identify rectal masses but also to gauge anal sphincter tone and pelvic floor motion at rest, during voluntary contraction of the anal sphincter and pelvic floor muscles, and during simulated evacuation (219). Digital examination should be performed before referral for ARM.

Perianal pinprick sensation and the anal wink reflex evaluate the integrity of the sacral lower motor neuron reflex arc. For experienced observers, there is good agreement between digital assessment of anal sphincter function when at rest and during squeeze (49,50). Other abnormalities in patients with FI include abnormal (i.e., increased or reduced) pelvic floor motion during evacuation, impacted stool in the rectal vault, and perianal soiling with feces. Reduced anal resting tone or weak squeeze responses are common features in FI.

Table 14. Summary of treatment recommendations in fecal incontinence

1	We recommend antidiarrheal drugs (e.g., loperamide, diphenoxylate with atropine, bile salt binding agents, anticholinergic agents, and clonidine) when FI is accompanied by diarrhea (strong recommendation; quality of evidence: low). Consensus score: 30
2	We recommend that patients with FI who do not respond to education and conservative measures should undergo biofeedback (i.e., pelvic floor rehabilitative techniques with visual or auditory feedback) (strong recommendation; quality of evidence: moderate). Consensus score: 30
3	We suggest that anal plugs, vaginal balloons, and other devices to impede defecation be considered in selected patients who do not respond to conservative measures and biofeedback (conditional recommendation; quality of evidence: very low). Consensus score: 26
4	We suggest injecting bulking agents such as dextranomer sodium in selected patients with FI who do not respond to conservative therapy or biofeedback (conditional recommendation; quality of evidence: low). Consensus score: 26
5	We recommend SNS for patients with moderate to severe FI who have failed conservative measures, biofeedback, and other low-cost, low-risk techniques (strong recommendation; quality of evidence: low). Consensus score: 29
6	We suggest anal sphincteroplasty for acute injuries to the anal sphincters (conditional recommendation; quality of evidence: low). Consensus score: 30
7	We suggest offering an end stoma to patients with severe FI who have not responded to other treatments (conditional recommendation; quality of evidence: low). Consensus score: 30

FI, fecal incontinence; SNS, sacral nerve stimulation.

The next steps are guided by the clinical assessment. For patients with mild symptoms, conservative measures may suffice (220) (see beginning of the Therapy section). If symptoms improve and there are no features to suggest an organic disorder, further testing may not be necessary. If symptoms do not improve, diagnostic testing can guide management (221,222).

Diagnostic tests

These tests are tailored to the patient's age, probable etiological factors, symptom severity, impact on quality of life, response to conservative medical management, and availability of tests. ARM, rectal BET, and rectal sensation should be performed in patients who fail to respond to conservative measures. Additional diagnostic tests such as pelvic floor and anal canal imaging and anal EMG should be considered for patients with anal weakness.

Although widely available, diagnostic tests should be performed optimally by laboratories with more training and experience. Testing should begin with an ARM. In ARM, anal sphincter resting and squeeze pressures are the key parameters. Because anal sphincter pressures decline with age and are lower in women, age and sex should be taken into consideration when interpreting anal canal pressure (28). The anal cough reflex is also useful, in a qualitative sense, for evaluating the integrity of the lower motor neuron innervation of the external anal sphincter. Rectal sensation in FI may be normal, increased, or decreased (204). Rectal sensory and rectal evacuation dynamics may change with biofeedback therapy.

Further testing is guided by the results of initial tests and therapy. Anal imaging with endoanal ultrasound or MRI should be considered in patients with weak pressures especially if surgery is being considered. Although the findings of endoanal ultrasound and MRI are generally congruent, each of these modalities has unique strengths (204). The internal sphincter is visualized clearly by endoanal ultrasound, whereas MRI is superior for discriminating between an external anal sphincter tear or a scar and for identifying external sphincter atrophy. Internal sphincter defects probably reflect more severe anorectal injury than do external sphincter injuries alone (223,224). Interpreting the clinical significance of anal sphincter injury is challenging even for experienced radiologists. Moreover, even asymptomatic women can have postpartum sphincter defects. A 2D ultrasound identifies anal sphincter defects after vaginal delivery in up to one-third of women (225), but with 3D ultrasound or MRI, the prevalence is approximately 10% (210,226).

Further testing (e.g., assessment of rectal compliance and sensation with a barostat, needle EMG of the anal sphincter, and assessment of pelvic floor motion by dynamic MRI or barium proctography) may be considered for patients who have refractory symptoms, especially if surgery is being considered. However, these tests are not widely available. Needle EMG of the anal sphincter should be considered in patients with clinically suspected neurogenic sphincter weakness, particularly if there are features suggestive of proximal (i.e., sacral root) involvement (227). Although pudendal nerve terminal motor latency may be significantly prolonged in some patients with idiopathic FI, this test has low clinical significance because of its low reliability.

Treatment of fecal incontinence

FI impairs quality of life (198). However, most individuals have it less than once a month or it consists only of staining of underclothes. These individuals might benefit from less costly interventions. Choices of therapy depend on the severity of the FI and the presence of other comorbid conditions such as dementia that may moderate other treatments such as biofeedback (228).

Conservative treatment for FI is relatively low in cost and has few adverse events. Most conservative treatments include 3 components: (i) educating the patient about diarrhea and constipation as causes of FI; (ii) use of drugs such as loperamide or diphenoxylate for diarrhea and fiber supplements and/or laxatives for constipation and (iii) daily pelvic floor exercises to strengthen pelvic floor muscles. A bowel diary may be added to monitor progress. These simple measures are often inconsistently implemented. However, when properly taught and followed up by a health care professional, up to 20% of patients may not need further treatment (229).

In a controlled trial (230), 171 patients with FI were randomly allocated to 4 groups: standard medical/nursing care (i.e., advice only), advice plus verbal instruction on sphincter exercises, hospital-based computer-assisted sphincter pressure biofeedback, or hospital biofeedback plus use of a home EMG biofeedback device. Symptoms improved in 55% and resolved in 5% with no differences between treatment groups, and improvement was sustained at 1 year. In another RCT of 108 patients (73,229), 22% reported adequate relief of FI after 4 weeks of conservative therapy. However, instructions to defecate at specific times were not effective for FI (231–233) (Table 14).

FI with diarrhea

Several drugs to manage diarrhea (e.g., loperamide, diphenoxylate with atropine, bile salt binding agents such as cholestyramine and colesevelam, anticholinergic agents, and clonidine) are available. A Cochrane review identified 13 randomized studies with 473 participants (234). Nine trials included only persons with FI related to liquid stool, and 7 tested antidiarrheal drugs (loperamide, diphenoxylate plus atropine, and codeine). In 4 trials, symptoms were better with active treatment compared with placebo, with improved and/or restored fecal continence (235–238), improved fecal urgency (236), more formed stools (236,238), and reduced use of pads (237). In 2 of these 4 trials, more persons reported adverse effects such as constipation, abdominal pain, diarrhea, headache, and nausea (236,238). There were no adverse effects in either arm in 1 trial (237), and adverse effects were not reported in another (235). Among women with FI, clonidine did not improve fecal continence in all comers, but tended to improve continence in women with diarrhea (239).

Diet education and advice on the relationship between foods containing incompletely digested sugars (e.g., fructose and lactose) and caffeine for loose stools and urgency may also be helpful, but the evidence is limited. For example, 65% of 65 patients reported improved improved fecal continence on a low FODMAP diet in an uncontrolled, retrospective audit of patients seen in clinical practice (240). However, prospective RCTs are required to determine the efficacy of such diets for patients with FI.

Fecal incontinence with constipation

Laxative regimens sometimes benefit children (241) and older patients with FI associated with constipation (242), but the benefits in younger adults are not supported by objective evidence.

Anorectal biofeedback for FI. Biofeedback training was previously described for the treatment of dyssynergic defecation and is also appropriate for FI, but with minor differences in focus. FI is often accompanied by diarrhea and constipation and weakness of the external anal sphincter. Biofeedback therapy for FI seeks to increase the strength and coordination of the external anal sphincter without contracting the abdominal wall muscles and to improve rectal sensation where necessary. In those patients with hypersensitivity to rectal distention who cannot delay defecation, biofeedback seeks to reduce rectal sensation so that patients can postpone defecation until more stool fills the rectum. Hence, biofeedback for FI should be tailored to the symptoms and specific anorectal dysfunctions (244) (Table 3).

There are known limitations to the use of biofeedback training (1). It is much less effective in patients who have short-term memory loss related to dementia (228) or depression. Biofeedback training requires a motivated patient and reinforcement over time. (243–246). Patients with central nervous system etiologies for their FI such as spinal cord injury or head injury may be less amenable to biofeedback training. The skill of the therapist may also influence the outcome.

In a controlled study, biofeedback therapy was more effective than attention control therapy; both groups were also treated with other conservative approaches (247). However, biofeedback therapy was not superior to conservative measures or pelvic floor exercises alone (230) or to education (244). Also, biofeedback plus loperamide was not more effective than biofeedback plus placebo (244). One possible explanation is that the patients in these trials were not initially treated with other conservative measures for FI before they received biofeedback therapy. Indeed, among patients who did not adequately respond to medications, education, and behavioral therapy, 76% of patients treated with treated with biofeedback versus 41% with pelvic floor exercises alone reported adequate relief at 3 months (229). In summary, biofeedback therapy benefits many patients and does not cause harm. Hence, biofeedback is regarded by many as a mainstay of treatment for FI (228).

Anal plugs

Anal plugs are mechanical barrier devices. Renew is a silicone anal insert that is disposable. In 1 study of 30 patients with FI, 20% disliked the device, 23% showed no change, and 12% reported worse symptoms of FI; however, 57% of patients wished to continue using the device (248). In a second study, the Renew device was used in 15 patients with an ileoanal pouch (249): 8 of 15 (53%) found the Renew device to be acceptable, and 6 of 15 (40%) reported it to be effective. The Peristeen anal plug is available in Europe. One review (250) concluded that plugs are difficult to tolerate but may be useful in a select group of patients and may be used as an adjunct to other treatments.

The Eclipse vaginal bowel control device (251) is a balloon that is inserted into the vagina and acts as a mechanical barrier, compressing the anterior wall of the rectum. The correct-sized balloon has to be selected for each patient, and manual dexterity is required to deflate, inflate, insert, and remove the device. Two case series were published: In the first series, 61 patients were evaluated for 1 month (252). A 50% reduction in FI was reported by 86%, and quality of life improved. Adverse events such as cramping and abdominal pain were reported during the fitting period. Another study showed reductions in urgency, frequency, and incomplete evacuations in more than 50% of the patients (253).

Patients with passive incontinence for small amounts of stool may benefit from perianal cotton plugs to absorb moisture and to reduce the uncontrolled passage of gas. However, there are no formal studies with this intervention.

Injectable bulking agents

Injectable bulking agents, which are used to augment the urethral sphincter and treat urinary incontinence, were approved by the US Food and Drug Administration for managing FI (254,255). In a multicenter, placebo-controlled randomized trial of a perianal bulking agent (dextranomer in stabilized hyaluronic acid [NASHA Dx]) in 206 patients with FI (254), a $\geq$50% reduction in incontinence episodes was reported more frequently for NASHA Dx (52% patients) than placebo (31% patients). The number of patients who became completely continent was not provided. Two serious adverse events occurred (i.e., rectal abscess and prostatic abscess), but most adverse events were minor. Treatment did not affect embarrassment scores related to FI. Anorectal physiological tests and imaging were not performed; hence, patient characteristics and mechanisms of action were unknown.

A prospective multicenter trial in 136 FI patients found that fecal continence improved in 52% of patients in 6 months, and this was sustained after 36 months (255). Further studies to compare the effects of bulking agents to biofeedback therapy in FI are ongoing (256).

Radiofrequency stimulation (SECCA procedure)

The SECCA procedure involves radiofrequency stimulation of the muscles in the anal canal to increase muscle connective tissue ratio and scarring (257) via a probe with needles in the anal canal performed under local anesthesia and sedation. Despite initial positive studies including a multi-center trial from 2003 (258), more recent reports suggest poor long-term results (259).

Sacral nerve electrical stimulation. SNS is approved for treating FI in Europe and the United States. Patients whose symptoms respond to temporary SNS for 2–3 weeks have the device implanted in their abdomen. Between 2002 and 2008, the pivotal North American multicenter controlled study enrolled 133 patients with FI characterized as having more than 2 incontinent episodes per week for more than 6 months or for more than 12 months after childbirth and who had failed or were not candidates for conservative therapy (260,261). Patients with chronic diarrhea, large sphincter defects, chronic inflammatory bowel disease, visible sequelae of pelvic radiation, active anal inflammation, and neurologic diseases such as clinically significant peripheral neuropathy or complete spinal cord injury were excluded. The success rate for temporary SNS was 90%. At follow-up 3 years later, 86% of those with an implanted device achieved a ≥50% reduction in the number of incontinent episodes per week (therapeutic success), and 40% achieved complete continence. Incontinent episodes decreased from a mean of 9.4 per week at baseline to 1.7 at 12 months. There was significant improvement in all 4 scales of the FI Quality of Life instrument at 12, 24, and 36 months of follow-up. The most common device-related adverse events were implant site pain (28%), paresthesias (15%), change in the sensation of stimulation (12%), and infection (10%). Despite marked improvement in symptoms in this uncontrolled study, SNS has had no significant effects on measured anorectal functions (262). Based on these and other studies, SNS is recommended for patients with FI whose symptoms are refractory to medical therapy.

Less invasive methods have also been investigated including percutaneous tibial nerve stimulation (PTNS) and transcutaneous tibial nerve stimulation (TTNS). PTNS stimulates the tibial nerve through a needle inserted above the ankle of 1 leg, and TTNS stimulates between pads attached to the sole of 1 foot. Both approaches reduced the frequency of FI in uncontrolled case series (263). A small study comparing PTNS with TTNS and sham stimulation showed PTNS to be more effective than TTNS or sham (82%, 48%, and 13% for reducing the frequency of FI by at least 50%; $P = 0.035$). In contrast, a large multicenter European study (264) compared 12 weekly sessions of PTNS to sham stimulation. There were over 100 patients per arm. Outcomes at the end of treatment showed no significant difference between the 2 techniques (38% for PTNS and 31% for sham). However, patients with urge-related FI did better than those with passive FI (265). Future studies are needed to resolve the efficacy of PTNS in subpopulations of patients with FI.

Anal sphincteroplasty

Sphincteroplasty is a surgical repair of a separated internal and/or external anal sphincter. The separated end of the sphincter are brought together or overlapped and sutured together for healing. Although short-term improvements in FI occur in up to 85% of patients, continence deteriorates thereafter and averages 50% after 40–60 months (266). As a result, anal sphincteroplasty is recommended for patients in whom FI and anal sphincter injury are recognized shortly after vaginal delivery or other injury, with symptoms persisting despite adequate therapy of coexisting bowel disturbances. It may also be reserved when medical, noninvasive therapies and SNS have failed or a device is not recommended.

Dynamic graciloplasty

This procedure involved bringing a segment of gracilis muscle up to the anal canal to wrap around the anal sphincter, often with electrical stimulation. There was significant associated morbidity and even mortality with only modest benefits (267–270). Because of this, the procedure is not currently recommended.

Miscellaneous devices

Numerous attempts have been made to artificially enhance the anal sphincter to improve continence. Most of these devices have shown unacceptable complication rates or explant rates (271–273) and are not currently available. The newest of these devices, which is a thin expandable prosthesis that is implanted in the intersphincteric space, has only been evaluated in very few patients (274).

Colostomy or ileostomy with an end stoma

An end stoma (i.e., end ileostomy or colostomy) is considered a last resort in the algorithm of treatment for FI. During the evaluation and management of patients with severe FI, this option should be discussed early so that patients are aware of the same. Even in very frail patients, the post-procedure morbidity is low. The procedure may markedly improve the quality of life. In 1 study, the median score (scale of 0–10) for ability to live with a stoma was 8, and satisfaction with the stoma was rated as a median of 9 (275). Most (83%) felt that the stoma restricted their life a little or not at all, which was significantly improved from the perceived former restriction due to incontinence. Eighty-four percent would probably or definitely choose to have the stoma again. Quality of life (36-Item Short Form Health Survey) was poor, but neither depression nor anxiety was a prominent feature. An end stoma may also be an option for patients with a spinal cord injury (276). Patients have a wide variety of reactions to the prospect of an end stoma, viewing it as anything from a welcome necessity to an unacceptable option. Understanding the patient's informed views toward the possibility of an end stoma helps the gastroenterologist to navigate the various options.

CONFLICTS OF INTEREST

Guarantor of the article: Arnold Wald, MD, MACG.

Specific author contributions: All authors participated in planning, researching, meeting, interpreting data, drafting, and editing the manuscript.

Financial support: None.

Potential competing interests: A.W., B.L., A.M., M.Z.: None. A.E.B.: Patents and royalties: Medspira, Minnesota Medical Technologies. Patients: Medtronic. Research support to Mayo Clinic: Cairn Diagnostics. NIH NIDDK Grant: RO1 DK 78924. J.M.R.-T.: Advisory Boards-Takeda, Asofarma, Biocodex, Speakers bureaus-Takeda, Asofarma, Medtronic, Carnot, Alfasigma, W.E.W.: NIH U01 DK115575 research grant; Medspira, Palette Life Sciences research support.

REFERENCES

1. Guyatt G, Oxman AD, Akl EA, et al. GRADE guidelines: 1. Introduction-GRADE evidence profiles and summary of findings tables. J Clin Epidemiol 2011;64:383–94.
2. Bharucha AE, Lacy BE. Chronic constipation: Mechanisms, evaluation and management. Gastroenterology 2020;158:1232–49.e3.

3. Wald A, Bharucha AE, Cosman BC, et al. ACG clinical guidelines: management of benign anorectal disorders. Am J Gastroenterol 2014; 109:1141–57.
4. Rao S, Bharucha AE, Chiarioni G, et al. Functional anorectal disorders. Gastroenterology 2016;150:1430–42.
5. Noelting J, Eaton J, Choung RS, et al. The incidence rate and characteristics of clinically diagnosed defecatory disorders in the community. Neurogastroenterol Motil 2016;28:1690–7.
6. Whitehead WE, di Lorenzo C, Leroi AM, et al. Conservative and behavioural management of constipation. Neurogastroenterol Motil 2009;21(Suppl 2):55–61.
7. Palit S, Lunniss PJ, Scott SM. The physiology of human defecation. Dig Dis Sci 2012;57:1445–64.
8. van Ginkel R, Reitsma JB, Buller HA, et al. Childhood constipation: Longitudinal follow-up beyond puberty. Gastroenterology 2003;125: 357–63.
9. Rao SS, Welcher KD, Pelsang RE. Effects of biofeedback therapy on anorectal function in obstructive defecation. Dig Dis Sci 1997;42: 2197–205.
10. Rao SS, Welcher KD, Leistikow JS. Obstructive defecation: A failure of rectoanal coordination. Am J Gastroenterol 1998;93:1042–50.
11. Chiarioni G, Whitehead WE, Pezza V, et al. Biofeedback is superior to laxatives for normal transit constipation due to pelvic floor dyssynergia. Gastroenterology 2006;130:657–64.
12. Rao SSC, Seaton K, Miller M, et al. Randomized controlled trial of biofeedback, sham feedback, and standard therapy for dyssynergic defecation. Clin Gastroenterol Hepatol 2007;5:331–8.
13. Rao SSC, Valestin J, Brown CK, et al. Long-term efficacy of biofeedback therapy for dyssynergic defecation: Randomized controlled trial. Am J Gastroenterol 2010;105:890–6.
14. Bharucha AE, Locke GR, Pemberton JH. AGA practice guideline on constipation: Technical review. Gastroenterology 2013;144:218–38.
15. Bharucha AE, Fletcher JG, Seide B, et al. Phenotypic variation in functional disorders of defecation. Gastroenterology 2005;128: 1199–210.
16. Gladman MA, Lunniss PJ, Scott SM, et al. Rectal hyposensitivity. Am J Gastroenterol 2006;101:1140–51.
17. Burgell RE, Lelic D, Carrington EV, et al. Assessment of rectal afferent neuronal function and brain activity in patients with constipation and rectal hyposensitivity. Neurogastroenterology Motil 2013;25:260–7, e167–8.
18. Palit S, Bhan C, Lunniss PJ, et al. Evacuation proctography: A reappraisal of normal variability. Colorectal Dis 2014;16:538–46.
19. Palit S, Thin N, Knowles CH, et al. Diagnostic disagreement between tests of evacuatory function: A prospective study of 100 constipated patients. Neurogastroenterol Motil 2016;28(10):1589–98.
20. Prichard DO, Lee T, Parthasarathy G, et al. High-resolution anorectal manometry for identifying defecatory disorders and rectal structural abnormalities in women. Clin Gastroenterol Hepatol 2017;15:412–20.
21. Preston DM, Lennard-Jones JE. Severe chronic constipation of young women: "Idiopathic slow transit constipation". Gut 1986;27:41–8.
22. Ravi K, Bharucha AE, Camilleri M, et al. Phenotypic variation of colonic motor functions in chronic constipation. Gastroenterology 2010;138: 89–97.
23. Schweiger M, Alexander-Williams J. Solitary-ulcer syndrome of the rectum: Its association with occult rectal prolapse. Lancet 1977;309: 170–1.
24. Parks AG, Swash M, Urich H. Sphincter denervation in anorectal incontinence and rectal prolapse. Gut 1977;18:656–65.
25. Henry MM, Parks AG, Swash M. The pelvic floor musculature in the descending perineum syndrome. Br J Surg 1982;69:470–2.
26. Bartram CI, Turnbull GK, Lennard-Jones JE. Evacuation proctography: An investigation of rectal expulsion in 20 subjects without defecatory disturbance. Gastrointest Radiol 1988;13:72–80.
27. Lee TH, Bharucha AE. How to perform and interpret a high-resolution anorectal manometry test. J Neurogastroenterol Motil 2016;22:46–59.
28. Oblizajek NR, Gandhi S, Sharma M, et al. Anorectal pressures measured with high-resolution manometry in healthy people-Normal values and asymptomatic pelvic floor dysfunction. Neurogastroenterol Motil 2019; 31:e13597.
29. Rao SSC, Kavlock R, Rao S. Influence of body position and stool characteristics on defecation in humans. Am J Gastroenterol 2006;101: 2790–6.
30. Bharucha AE, Seide BM, Zinsmeister AR, et al. Insights into normal and disordered bowel habits from bowel diaries. Am J Gastroenterol 2008; 103:692–8.
31. Chakraborty S, Feuerhak K, Muthyala A, et al. Effects of alfuzosin, an alpha-1 alphadrenergic antagonist on anal pressures and bowel habits, in women with and without defecatory disorders. Clin Gastroenterol Hepatol 2019;17:1138–47.e3.
32. Rao SS, Tuteja AK, Vellema T, et al. Dyssynergic defecation: Demographics, symptoms, stool patterns, and quality of life. J Clin Gastroenterol 2004;38:680–5.
33. Suttor VP, Prott GM, Hansen RD, et al. Evidence for pelvic floor dyssynergia in patients with irritable bowel syndrome. Dis Colon Rectum 2010;53:156–60.
34. Patcharatrakul T, Gonlachanvit S. Outcome of biofeedback therapy in dyssynergic defecation patients with and without irritable bowel syndrome. J Clin Gastroenterol 2011;45:593–8.
35. Nehra V, Bruce BK, Rath-Harvey DM, et al. Psychological disorders in patients with evacuation disorders and constipation in a tertiary practice. Am J Gastroenterol 2000;95:1755–8.
36. Philips EM, Peeters B, Teeuw AH, et al. Stressful life events in children with functional defecation disorders. J Pediatr Gastroenterol Nutr 2015; 61:384–92.
37. Klingele CJ, Bharucha AE, Fletcher JG, et al. Pelvic organ prolapse in defecatory disorders. Obstet Gynecol 2005;106:315–20.
38. Khanna R, Li Y, Schroeder T, et al. Manometric evaluation of evacuatory difficulty (dyschezia) in ileal pouch patients. Inflamm Bowel Dis 2013; 19:569–75.
39. Perera LP, Ananthakrishnan AN, Guilday C, et al. Dyssynergic defecation: A treatable cause of persistent symptoms when inflammatory bowel disease is in remission. Dig Dis Sci 2013;58:3600–5.
40. Bondurri A, Maffioli A, Danelli P. Pelvic floor dysfunction in inflammatory bowel disease. Minerva Gastroenterol Dietol 2015;61: 249–59.
41. Quinn KP, Tse CS, Lightner AL, et al. Nonrelaxing pelvic floor dysfunction is an underestimated complication of ileal pouch-anal anastomosis. Clin Gastroenterol Hepatol 2017;15:1242–7.
42. Ratuapli S, Bharucha AE, Noelting J, et al. Phenotypic identification and classification of functional defecatory disorders using high resolution anorectal manometry. Gastroenterol 2013;144:314–22.e2.
43. Vasant DH, Solanki K, Radhakrishnan NV. Rectal digital maneuvers may predict outcomes and help customize treatment intensity of biofeedback in chronic constipation and dyssynergic defecation. Dis Colon Rectum 2017;60:e2.
44. Grotz RL, Pemberton JH, Talley NJ, et al. Discriminant value of psychological distress, symptom profiles, and segmental colonic dysfunction in outpatients with severe idiopathic constipation. Gut 1994;35:798–802.
45. Glia A, Lindberg G, Nilsson LH, et al. Clinical value of symptom assessment in patients with constipation. Dis Colon Rectum 1999;42: 1401–8; discussion 1408–10.
46. Minguez M, Herreros B, Sanchiz V, et al. Predictive value of the balloon expulsion test for excluding the diagnosis of pelvic floor dyssynergia in constipation. Gastroenterology 2004;126:57–62.
47. Prott G, Shim L, Hansen R, et al. Relationships between pelvic floor symptoms and function in irritable bowel syndrome. Neurogastroenterol Motil 2010;22:764–9.
48. Wong RK, Drossman DA, Bharucha AE, et al. The digital rectal examination: A multicenter survey of physicians' and students' perceptions and practice patterns. Am J Gastroenterol 2012;107: 1157–63.
49. Orkin BA, Sinykin SB, Lloyd PC. The digital rectal examination scoring system (DRESS). Dis Colon Rectum 2010;53:1656–60.
50. Tantiphlachiva K, Rao P, Attaluri A, et al. Digital rectal examination is a useful tool for identifying patients with dyssynergia. Clin Gastroenterol Hepatol 2010;8:955–60.
51. Bordeianou L, Savitt L, Dursun A. Measurements of pelvic floor dyssynergia: Which test result matters? Dis Colon Rectum 2011;54:60–5.
52. Neshatian L. The assessment and management of defecatory dysfunction: A critical appraisal. Curr Opin Gastroenterol 2018;34:31–7.
53. Grossi U, Di Tanna GL, Heinrich H, et al. Systematic review with meta-analysis: Defecography should be a first-line diagnostic modality in patients with refractory constipation. Aliment Pharmacol Ther 2018;48: 1186–201.

54. Chiarioni G, Kim SM, Vantini I, et al. Validation of the balloon evacuation test: Reproducibility and agreement with findings from anorectal manometry and electromyography. Clin Gastroenterol Hepatol 2014;12:2049–54.
55. Rao SS, Hatfield R, Soffer E, et al. Manometric tests of anorectal function in healthy adults. Am J Gastroenterol 1999;94:773–83.
56. Ratuapli S, Bharucha AE, Harvey D, et al. Comparison of rectal balloon expulsion test in seated and left lateral positions. Neurogastroenterol Motil 2013;25:e813–20.
57. Mazor Y, Prott G, Jones M, et al. Anorectal physiology in health: A randomized trial to determine the optimum catheter for the balloon expulsion test. Neurogastroenterol Motil 2019;31:e13552.
58. Carrington EV, Heinrich H, Knowles CH, et al. The international anorectal physiology working group (IAPWG) recommendations: Standardized testing protocol and the London classification for disorders of anorectal function. Neurogastroenterol Motil 2020;32: e13679.
59. Bharucha AE, Stroetz R, Feuerhak K, et al. A novel technique for bedside anorectal manometry in humans. Neurogastroenterol Motil 2015;27: 1504–8.
60. Basilisco G, Bharucha AE. High-resolution anorectal manometry: An expensive hobby or worth every penny? Neurogastroenterol Motil 2017; 29.
61. Sharma M, Lowry AC, Rao S, et al. A multicenter study of anorectal pressures and rectal sensation measured with portable manometry in healthy women and men. Neurogastroenterol Motil 2020;33(6):e14067.
62. Prott G, Hansen R, Badcock C, et al. What is the optimum methodology for the clinical measurement of resting anal sphincter pressure? Neurogastroenterol Motil 2005;17:595–9.
63. Chakraborty S, Feuerhak KJ, Zinsmeister AR, et al. Reproducibility of high-definition (3D) manometry and its agreement with high-resolution (2D) manometry in women with fecal incontinence. Neurogastroenterol Motil 2017;29.
64. Gosling J, Plumb A, Taylor SA, et al. High-resolution anal manometry: Repeatability, validation, and comparison with conventional manometry. Neurogastroenterol Motil 2019;31:e13591.
65. Grossi U, Carrington EV, Bharucha AE, et al. Diagnostic accuracy study of anorectal manometry for diagnosis of dyssynergic defecation. Gut 2016;65:447–55.
66. Sharma M, Muthyala A, Feuerhak K, et al. Improving the utility of high-resolution manometry for the diagnosis of defecatory disorders in women with chronic constipation. Neurogastroenterol Motil. 2020; e13910.
67. Agachan F, Pfeifer J, Wexner SD. Defecography and proctography: Results of 744 patients. Dis Colon Rectum 1996;39:899–905.
68. Diamant NE, Kamm MA, Wald A, et al. AGA technical review on anorectal testing techniques. Gastroenterology 1999;116:735–60.
69. Noelting J, Bharucha AE, Lake DS, et al. Semi-automated vectorial analysis of anorectal motion by magnetic resonance defecography in healthy subjects and fecal incontinence. Neurogastroenterol Motil 2012; 24:e467–75.
70. Reiner CS, Tutuian R, Solopova AE, et al. MR defecography in patients with dyssynergic defecation: Spectrum of imaging findings and diagnostic value. Br J Radiol 2011;84:136–44.
71. Tirumanisetty P, Prichard D, Fletcher JG, et al. Normal values for assessment of anal sphincter morphology, anorectal motion, and pelvic organ prolapse with MRI in healthy women. Neurogastroenterol Motil 2018;30:e13314.
72. Puthanmadhom Narayanan S, Sharma M, Fletcher JG, et al. Comparison of changes in rectal area and volume during MR evacuation proctography in healthy and constipated adults. Neurogastroenterol Motil 2019;31:e13608.
73. Heymen S, Scarlett Y, Jones K, et al. Randomized, controlled trial shows biofeedback to be superior to alternative treatments for patients with pelvic floor dyssynergia-type constipation. Dis Colon Rectum 2007;50: 428–41.
74. Degen LP, Phillips SF. How well does stool form reflect colonic transit? Gut 1996;39:109–13.
75. Nam YS, Pikarsky AJ, Wexner SD, et al. Reproducibility of colonic transit study in patients with chronic constipation. Dis Colon Rectum 2001;44:86–92.
76. Staller K, Barshop K, Ananthakrishnan AN, et al. Rectosigmoid localization of radiopaque markers does not correlate with prolonged balloon expulsion in chronic constipation: Results from a multicenter cohort. Am J Gastroenterol 2015;110:1049–55.
77. Burton DD, Camilleri M, Mullan BP, et al. Colonic transit scintigraphy labeled activated charcoal compared with ion exchange pellets. J Nucl Med 1997;38:1807–10.
78. Manabe N, Wong BS, Camilleri M, et al. Lower functional gastrointestinal disorders: Evidence of abnormal colonic transit in a 287 patient cohort. Neurogastroenterol Motil 2010;22:293-e82.
79. Hasler WL, Saad RJ, Rao SS, et al. Heightened colon motor activity measured by a wireless capsule in patients with constipation: Relation to colon transit and IBS. Am J Physiol Gastrointest Liver Physiol 2009;297: G1107–14.
80. Chiarioni G, Salandini L, Whitehead WE. Biofeedback benefits only patients with outlet dysfunction, not patients with isolated slow transit constipation. Gastroenterology 2005;129:86–97.
81. Mazor Y, Kellow J, Prott G, et al. Comparison of an abbreviated versus a standard protocol for anorectal biofeedback. Gastroenterology 2016;1: S539.
82. Pourmomeny AA, Emami MH, Amooshahi M, et al. Comparing the efficacy of biofeedback and balloon-assisted training in the treatment of dyssynergic defecation. Can J Gastroenterol 2011;25:89–92.
83. Hart SL, Lee JW, Berian J, et al. A randomized controlled trial of anorectal biofeedback for constipation. Int J Colorectal Dis 2012;27: 459–66.
84. Simon MA, Bueno AM. Behavioural treatment of the dyssynergic defecation in chronically constipated elderly patients: A randomized controlled trial. Appl Psychophysiol Biofeedback 2009;34:273–7.
85. Simon MA, Bueno AM. Efficacy of biofeedback therapy in the treatment of dyssynergic defecation in community-dwelling elderly women. J Clin Gastroenterol 2017;51:e90–4.
86. Rao SS, Benninga MA, Bharucha AE, et al. ANMS-ESNM position paper and consensus guidelines on biofeedback therapy for anorectal disorders. Neurogastroenterol Motil 2015;27:594–609.
87. Wang J, Luo MH, Qi QH, et al. Prospective study of biofeedback retraining in patients with chronic idiopathic functional constipation. World J Gastroenterol 2003;9:2109–13.
88. Battaglia E, Serra AM, Buonafede G, et al. Long-term study on the effects of visual biofeedback and muscle training as a therapeutic modality in pelvic floor dyssynergia and slow-transit constipation. Dis Colon Rectum 2004;47:90–5.
89. Lee HJ, Boo SJ, Jung KW, et al. Long-term efficacy of biofeedback therapy in patients with dyssynergic defecation: Results of a median 44 months follow-up. Neurogastroenterol Motil 2015;27:787–95.
90. Rao SS, Ozturk R, De Ocampo S, et al. Pathophysiology and role of biofeedback therapy in solitary rectal ulcer syndrome. Am J Gastroenterol 2006;101:613–8.
91. Shim L, Jones M, Prott GM, et al. Predictors of outcome of biofeedback therapy in patients with constipation. Gastroenterology 2010;1:S543.
92. Patcharatrakul T, Valestin J, Schmeltz A, et al. Factors associated with response to biofeedback therapy for dyssynergic defecation. Clin Gastroenterol Hepatol 2018;16:715–21.
93. Shim LS, Jones M, Prott GM, et al. Predictors of outcome of anorectal biofeedback therapy in patients with constipation. Aliment Pharmacol Ther 2011;33:1245–51.
94. Mazor Y, Kellow JE, Prott GM, et al. Anorectal biofeedback: An effective therapy, but can we shorten the course to improve access to treatment? Ther Adv Gastroenterol 2019;12:1756284819836072.
95. Rao SSC, Go JT, Valestin J, et al. Home biofeedback for the treatment of dyssynergic defecation: Does it improve quality of life and is it cost-effective? Am J Gastroenterol 2019;114:938–44.
96. Shorvon PJ, McHugh S, Diamant NE, et al. Defecography in normal volunteers: Results and implications. Gut 1989;30:1737–49.
97. Grossi U, Knowles CH, Mason J, et al. Surgery for constipation: Systematic review and practice recommendations: Results II: Hitching procedures for the rectum (rectal suspension). Colorectal Dis 2017;19: 37–48.
98. Pinheiro LV, Leal RF, Coy CS, et al. Long-term outcome of perineal rectosigmoidectomy for rectal prolapse. Int J Surg 2016;32:78–82.
99. Grossi U, Horrocks EJ, Mason J, et al. Surgery for constipation: Systematic review and practice recommendations: Results IV: Recto-vaginal reinforcement procedures. Colorectal Dis 2017;19(Suppl 3): 73–91.
100. Mercer-Jones M, Grossi U, Pares D, et al. Surgery for constipation: Systematic review and practice recommendations: Results III: Rectal

wall excisional procedures (rectal excision). Colorectal Dis 2017; 19(Suppl 3):49–72.
101. Giarratano G, Toscana C, Toscana E, et al. Stapled transanal rectal resection for the treatment of rectocele associated with obstructed defecation syndrome: A large series of 262 consecutive patients. Tech Coloproctol 2019;23:231–7.
102. Oom DM, van Dijl VR, Gosselink MP, et al. Enterocele repair by abdominal obliteration of the pelvic inlet: Long-term outcome on obstructed defaecation and symptoms of pelvic discomfort. Colorectal Dis 2007;9:845–50.
103. Knowles CH, Grossi U, Horrocks EJ, et al. Surgery for constipation: Systematic review and practice recommendations: Graded practice and future research recommendations. Colorectal Dis 2017;19(Suppl 3): 101–13.
104. Chaichanavichkij PV PF; Scott SM; Knowles CH. Botulinum toxin type A for the treatment of dyssynergic defaecation in adults: A systematic review. Colorectal Dis 2020;22(12):1832–41.
105. Maeda Y, Kamm MA, Vaizey CJ, et al. Long-term outcome of sacral neuromodulation for chronic refractory constipation. Tech Coloproctol 2017;21:277–86.
106. Mowat A, Maher D, Baessler K, et al. Surgery for women with posterior compartment prolapse. Cochrane Database Syst Rev 2018:3:CD012975.
107. Oom DM, Gosselink MP, Schouten WR. Enterocele—Diagnosis and treatment. Gastroenterol Clin Biol 2009;33:135–7.
108. Emile SH, Elbanna H, Youssef M, et al. Laparoscopic ventral mesh rectopexy vs Delorme's operation in management of complete rectal prolapse: A prospective randomized study. Colorectal Dis 2017;19:50–7.
109. Lee A, Kin C, Syan R, et al. Surgical decision-making for rectal prolapse: One size does not fit all. Postgrad Med 2020;132:256–62.
110. Emile SH, Elfeki H, Shalaby M, et al. Outcome of laparoscopic ventral mesh rectopexy for full-thickness external rectal prolapse: A systematic review, meta-analysis, and meta-regression analysis of the predictors for recurrence. Surg Endosc 2019;33:2444–55.
111. Schey R, Cromwell J, Rao SS. Medical and surgical management of pelvic floor disorders affecting defecation. Am J Gastroenterol 2012;107: 1624–33; quiz 1634.
112. Chung CS, Yu SH, Lee JE, et al. Comparison of long-term clinical outcomes according to the change in the rectocele depth between transanal and transvaginal repairs for a symptomatic rectocele. J Korean Soc Coloproctol 2012;28:140–4.
113. Carter D, Gabel MB. Rectocele—Does the size matter? Int J Colorectal Dis 2012;27:975–80.
114. Grimes C, Schimpf M, Wieslander C, et al. Surgical interventions for posterior compartment prolapse and obstructed defecation symptoms: A systematic review with clinical practice recommendations. Int Urogynecol J 2019;30:1433–54.
115. Balata M, Elgendy H, Emile SH, et al. Functional outcome and sexual-related quality of life after transperineal versus transvaginal repair of anterior rectocele: A randomized clinical trial. Dis Colon Rectum 2020; 63:527–37.
116. Marks BK, Goldman HB. What is the gold standard for posterior vaginal wall prolapse repair: Mesh or native tissue? Curr Urol Rep 2012;13: 216–21.
117. American College of Obstetricians and Gynecologists and the American Urogynecologic Society. Pelvic organ prolapse. Female Pelvic Med Reconstr Surg 2019;25:397–408.
118. Lehur PA, Stuto A, Fantoli M, et al. Outcomes of stapled transanal rectal resection vs. biofeedback for the treatment of outlet obstruction associated with rectal intussusception and rectocele: A multicenter, randomized, controlled trial. Dis Colon Rectum 2008;51:1611–8.
119. Renzi A, Brillantino A, Di Sarno G, et al. Evaluating the surgeons' perception of difficulties of two techniques to perform STARR for obstructed defecation syndrome: A multicenter randomized trial. Surg Innov 2016;23:563–71.
120. Stuto A, Renzi A, Carriero A, et al. Stapled trans-anal rectal resection (STARR) in the surgical treatment of the obstructed defecation syndrome: Results of STARR Italian Registry. Surg Innov 2011;18: 248–53.
121. Van Geluwe B, Stuto A, Da Pozzo F, et al. Relief of obstructed defecation syndrome after stapled transanal rectal resection (STARR): A meta-analysis. Acta Chir Belg 2014;114:189–97.
122. Grossi U, Mercer-Jones M, Di Tanna GL, et al. Recalled stapler device, high complication rate, nonvalidated scoring system and misquote from the STARR surgeons. Tech Coloproctol 2019;23:1017–8.
123. Herbst A, Mishell D, Stenchever M, et al. Disorders of the Abdominal Wall and Pelvic Support. In: MA Stenchever (ed). Comprehensive Gynecology, 2nd edn. Mosby Year Book: Philadelphia, PA, 1992, pp 594–612.
124. Samuelsson EC, Victor FT, Tibblin G, et al. Signs of genital prolapse in a Swedish population of women 20 to 59 years of age and possible related factors. Am J Obstet Gynecol 1999;180:299–305.
125. Lienemann A, Anthuber C, Baron A, et al. Diagnosing enteroceles using dynamic magnetic resonance imaging. Dis Colon Rectum 2000;43: 205–12; discussion 212–3.
126. Karaus M, Neuhaus P, Wiedenmann TB. Diagnosis of enteroceles by dynamic anorectal endosonography. Dis Colon Rectum 2000;43: 1683–8.
127. Jean F, Tanneau Y, Le Blanc-Louvry I, et al. Treatment of enterocele by abdominal colporectosacropexy—Efficacy on pelvic pressure. Colorectal Dis 2002;4:321–5.
128. Maria G, Sganga G, Civello IM, et al. Botulinum neurotoxin and other treatments for fissure-in-ano and pelvic floor disorders. Br J Surg 2002; 89:950–61.
129. Dinning PG, Hunt L, Patton V, et al. Treatment efficacy of sacral nerve stimulation in slow transit constipation: A two-phase, double-blind randomized controlled crossover study. Am J Gastroenterol 2015;110: 733–40.
130. Zerbib F, Siproudhis L, Lehur PA, et al. Randomized clinical trial of sacral nerve stimulation for refractory constipation. Br J Surg 2017;104: 205–13.
131. Knowles CH, Thin N, Gill K, et al. Prospective randomized double-blind study of temporary sacral nerve stimulation in patients with rectal evacuatory dysfunction and rectal hyposensitivity. Ann Surg 2012;255: 643–9.
132. Hananel N, Gordon PH. Re-examination of clinical manifestations and response to therapy of fissure-in-ano. Dis Colon Rectum 1997;40: 229–33.
133. Myers SR. Tuberculous fissure-in ano. J R Soc Med 1994;87:46.
134. Nelson RL. Chronic anal fissures. Am Fam Physician 2016;93:498–9.
135. Gupta PJ. Effects of warm water sitz bath on symptoms in post-anal sphincterotomy in chronic anal fissure—A randomized and controlled study. World J Surg 2007;31:1480–4.
136. Jonas M, Amin S, Wright JW, et al. Topical 0.2 percent glyceryl trinitrate ointment has a short-lived effect on resting anal pressure. Dis Colon Rectum 2001;44:1640–3.
137. Vermeire S, Van Assche G, Rutgeerts P. Perianal Crohn's disease: Classification and clinical evaluation. Dig Liver Dis 2007;39:959–62.
138. Stewart DB Sr, Gaertner W, Glasgow S, et al. Clinical practice guideline for the management of anal fissures. Dis Colon Rectum 2017;60:7–14.
139. Gagliardi G, Pascariello A, Altomare DF, et al. Optimal treatment duration of glyceryl trinitrate for chronic anal fissure: Results of a prospective randomized multicenter trial. Tech Coloproctol 2010;14: 241–8.
140. Scholefield JH, Bock JU, Marla B, et al. A dose finding study with 0.1%, 0.2%, and 0.4% glyceryl trinitrate ointment in patients with chronic anal fissures. Gut 2003;52:264–9.
141. Nash GF, Kapoor K, Saeb-Parsy K, et al. The long-term results of diltiazem treatment for anal fissure. Int J Clin Pract 2006;60:1411–3.
142. Arroyo A, Perez F, Serrano P, et al. Surgical versus chemical (botulinum toxin) sphincterotomy for chronic anal fissure: Long-term results of a prospective randomized clinical and manometric study. Am J Surg 2005; 189:429–34.
143. Pilkington SA, Bhome R, Welch RE, et al. Bilateral versus unilateral botulinum toxin injections for chronic anal fissure: A randomised trial. Tech Coloproctol 2018;22:545–51.
144. Barnes TG, Zafrani Z, Abdelrazeq AS. Fissurectomy combined with high-dose botulinum toxin is a safe and effective treatment for chronic anal fissure and a promising alternative to surgical sphincterotomy. Dis Colon Rectum 2015;58:967–73.
145. Gandomkar H, Zeinoddini A, Heidari R, et al. Partial lateral internal sphincterotomy versus combined botulinum toxin A injection and topical diltiazem in the treatment of chronic anal fissure: A randomized clinical trial. Dis Colon Rectum 2015;58:228–34.
146. Barbeiro S, Atalaia-Martins C, Marcos P, et al. Long-term outcomes of botulinum toxin in the treatment of chronic anal fissure: 5 years of follow-up. United European Gastroenterol J 2017;5:293–7.
147. Liang J, Church JM. Lateral internal sphincterotomy for surgically recurrent chronic anal fissure. Am J Surg 2015;210:715–9.

148. Gupta V, Rodrigues G, Prabhu R, et al. Open versus closed lateral internal anal sphincterotomy in the management of chronic anal fissures: A prospective randomized study. Asian J Surg 2014;37:178–83.
149. Nelson RL, Thomas K, Morgan J, et al. Non surgical therapy for anal fissure. Cochrane Database Syst Rev 2012;2012:CD003431.
150. Sahebally SM, Ahmed K, Cerneveciute R, et al. Oral versus topical calcium channel blockers for chronic anal fissure-a systematic review and meta-analysis of randomized controlled trials. Int J Surg 2017;44: 87–93.
151. Shrivastava UK, Jain BK, Kumar P, et al. A comparison of the effects of diltiazem and glyceryl trinitrate ointment in the treatment of chronic anal fissure: A randomized clinical trial. Surg Today 2007;37:482–5.
152. Ala S, Saeedi M, Hadianamrei R, et al. Topical diltiazem vs. topical glyceryl trinitrate in the treatment of chronic anal fissure: A prospective, randomized, double-blind trial. Acta Gastroenterol Belg 2012;75: 438–42.
153. Sanei B, Mahmoodieh M, Masoudpour H. Comparison of topical glyceryl trinitrate with diltiazem ointment for treatment of chronic anal fissure. A randomized clinical trial. Ann Ital Chir 2009;80:379–83.
154. Agrawal V, Kaushal G, Gupta R. Randomized controlled pilot trial of nifedipine as oral therapy vs. topical application in the treatment of fissure-in-ano. Am J Surg 2013;206:748–51.
155. Katsinelos P, Kountouras J, Paroutoglou G, et al. Aggressive treatment of acute anal fissure with 0.5% nifedipine ointment prevents its evolution to chronicity. World J Gastroenterol 2006;12:6203–6.
156. Shrestha SK, Thapa PB, Maharjan DK, et al. Effectiveness of 0.2% glyceryl trinitrate and 0.5% nifedipine in the treatment of chronic anal fissure. JNMA J Nepal Med Assoc 2017;56:149–52.
157. Sajid MS, Whitehouse PA, Sains P, et al. Systematic review of the use of topical diltiazem compared with glyceryl trinitrate for the nonoperative management of chronic anal fissure. Colorectal Dis 2013;15:19–26.
158. Mentes BB, Ege B, Leventoglu S, et al. Extent of lateral internal sphincterotomy: Up to the dentate line or up to the fissure apex? Dis Colon Rectum 2005;48:365–70.
159. Yiannakopoulou E. Botulinum toxin and anal fissure: Efficacy and safety systematic review. Int J Colorectal Dis 2012;27:1–9.
160. Arroyo A, Perez F, Serrano P, et al. Long-term results of botulinum toxin for the treatment of chronic anal fissure: Prospective clinical and manometric study. Int J Colorectal Dis 2005;20:267–71.
161. Bobkiewicz A, Francuzik W, Krokowicz L, et al. Botulinum toxin injection for treatment of chronic anal fissure: Is there any dose-dependent efficiency? A meta-analysis. World J Surg 2016;40:3064–72.
162. Lindsey I, Smilgin-Humphreys MM, Cunningham C, et al. A randomized, controlled trial of fibrin glue vs. conventional treatment for anal fistula. Dis Colon Rectum 2002;45:1608–15.
163. Lysy J, Israelit-Yatzkan Y, Sestiery-Ittah M, et al. Topical nitrates potentiate the effect of botulinum toxin in the treatment of patients with refractory anal fissure. Gut 2001;48:221–4.
164. Kyriakakis R, Kelly-Schuette K, Hoedema R, et al. What predicts successful nonoperative management with botulinum toxin for anal fissure? Am J Surg 2020;219:442–4.
165. Shao WJ, Li GC, Zhang ZK. Systematic review and meta-analysis of randomized controlled trials comparing botulinum toxin injection with lateral internal sphincterotomy for chronic anal fissure. Int J Colorectal Dis 2009;24:995–1000.
166. de Rosa M, Cestaro G, Vitiello C, et al. Conservative versus surgical treatment for chronic anal idiopathic fissure: A prospective randomized trial. Updates Surg 2013;65:197–200.
167. Nelson RL, Chattopadhyay A, Brooks W, et al. Operative procedures for fissure in ano. Cochrane Database Syst Rev 2011;2011:CD002199.
168. Kortbeek JB, Langevin JM, Khoo RE, et al. Chronic fissure-in-ano: A randomized study comparing open and subcutaneous lateral internal sphincterotomy. Dis Colon Rectum 1992;35:835–7.
169. Brown CJ, Dubreuil D, Santoro L, et al. Lateral internal sphincterotomy is superior to topical nitroglycerin for healing chronic anal fissure and does not compromise long-term fecal continence: Six-year follow-up of a multicenter, randomized, controlled trial. Dis Colon Rectum 2007;50: 442–8.
170. Iswariah H, Stephens J, Rieger N, et al. Randomized prospective controlled trial of lateral internal sphincterotomy versus injection of botulinum toxin for the treatment of idiopathic fissure in ano. ANZ J Surg 2005;75:553–5.
171. Boulos PB, Araujo JG. Adequate internal sphincterotomy for chronic anal fissure: Subcutaneous or open technique? Br J Surg 1984;71:360–2.
172. Casillas S, Hull TL, Zutshi M, et al. Incontinence after a lateral internal sphincterotomy: Are we underestimating it? Dis Colon Rectum 2005;48: 1193–9.
173. Singh M, Sharma A, Gardiner A, et al. Early results of a rotational flap to treat chronic anal fissures. Int J Colorectal Dis 2005;20:339–42.
174. Pelta AE, Davis KG, Armstrong DN. Subcutaneous fissurotomy: A novel procedure for chronic fissure-in-ano. A review of 109 cases. Dis Colon Rectum 2007;50:1662–7.
175. Renzi A, Izzo D, Di Sarno G, et al. Clinical, manometric, and ultrasonographic results of pneumatic balloon dilatation vs. lateral internal sphincterotomy for chronic anal fissure: A prospective, randomized, controlled trial. Dis Colon Rectum 2008;51:121–7.
176. Giordano P, Gravante G, Grondona P, et al. Simple cutaneous advancement flap anoplasty for resistant chronic anal fissure: A prospective study. World J Surg 2009;33:1058–63.
177. Sweeney JL, Ritchie JK, Nicholls RJ. Anal fissure in Crohn's disease. Br J Surg 1988;75:56–7.
178. D'Ugo S, Franceschilli L, Cadeddu F, et al. Medical and surgical treatment of haemorrhoids and anal fissure in Crohn's disease: A critical appraisal. BMC Gastroenterol 2013;13:47.
179. Fleshner PR, Schoetz DJ Jr, Roberts PL, et al. Anal fissure in Crohn's disease: A plea for aggressive management. Dis Colon Rectum 1995;38: 1137–43.
180. Alonso-Coello P, Guyatt G, Heels-Ansdell D, et al. Laxatives for the treatment of hemorrhoids. Cochrane Database Syst Rev 2005: CD004649.
181. Garg P. Hemorrhoid treatment needs a relook: More room for conservative management even in advanced grades of hemorrhoids. Indian J Surg 2017;79:578–9.
182. Garg P, Singh P. Adequate dietary fiber supplement and TONE can help avoid surgery in most patients with advanced hemorrhoids. Minerva Gastroenterol Dietol 2017;63:92–6.
183. Porrett TR, Lunniss PJ. A prospective randomized trial of consultant-led injection sclerotherapy compared with nurse practitioner-led noninvasive interventions in the management of patients with first and second degree haemorrhoids. Colorectal Dis 2001;3:227–31.
184. Brown SR, Tiernan JP, Watson AJM, et al. Haemorrhoidal artery ligation versus rubber band ligation for the management of symptomatic second-degree and third-degree haemorrhoids (HubBLe): A multicentre, open-label, randomised controlled trial. Lancet 2016;388: 356–64.
185. Filgate R, Dalzell A, Hulme-Moir M, et al. Haemorrhoid energy therapy versus rubber band ligation for the management of grade I and II haemorrhoids: A randomized trial. ANZ J Surg 2019;89:1466–9.
186. MacRae HM, McLeod RS. Comparison of hemorrhoidal treatment modalities. A meta-analysis. Dis Colon Rectum 1995;38:687–94.
187. Marques CF, Nahas SC, Nahas CS, et al. Early results of the treatment of internal hemorrhoid disease by infrared coagulation and elastic banding: A prospective randomized cross-over trial. Tech Coloproctol 2006;10: 312–7.
188. Greenspon J, Williams SB, Young HA, et al. Thrombosed external hemorrhoids: Outcome after conservative or surgical management. Dis Colon Rectum 2004;47:1493–8.
189. Yano T, Nogaki T, Asano M, et al. Outcomes of case-matched injection sclerotherapy with a new agent for hemorrhoids in patients treated with or without blood thinners. Surg Today 2013;43:854–8.
190. Scaglia M, Delaini GG, Destefano I, et al. Injection treatment of hemorrhoids in patients with acquired immunodeficiency syndrome. Dis Colon Rectum 2001;44:401–4.
191. Maloku H, Gashi Z, Lazovic R, et al. Laser hemorrhoidoplasty procedure vs open surgical hemorrhoidectomy: A trial comparing 2 treatments for hemorrhoids of third and fourth degree. Acta Inform Med 2014;22: 365–7.
192. Bharucha AE, Dunivan G, Goode PS, et al. Epidemiology, pathophysiology, and classification of fecal incontinence: State of the science summary for the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) workshop. Am J Gastroenterol 2015;110: 127–36.
193. Heymen S, Palsson O, Simren M, et al. Patient preferences for endpoints in fecal incontinence treatment studies. Neurogastroenterol Motil 2017; 29:e13032.
194. Brown HW, Wexner SD, Segall MM, et al. Accidental bowel leakage in the mature women's health study: prevalence and predictors. International Journal of Clinical Practice 2012;66:1101–8.

195. Menees SB, Almario CV, Spiegel BMR, et al. Prevalence of and factors associated with fecal incontinence: Results from a population-based survey. Gastroenterology 2018;154:1672–81.e3.
196. Whitehead WE, Borrud L, Goode PS, et al. Fecal incontinence in US adults: Epidemiology and risk factors. Gastroenterology 2009;137: 512–7.
197. Sperber AD, Bangdiwala SI, Drossman DA, et al. Worldwide prevalence and burden of functional gastrointestinal disorders, results of Rome foundation global study. Gastroenterology 2021;160:99–114.e3.
198. Whitehead WE, Simren M, Busby-Whitehead J, et al. Fecal incontinence diagnosed by the Rome IV criteria in the United States, Canada, and the United Kingdom. Clin Gastroenterol Hepatol 2020;18:385–91.
199. Bharucha AE, Zinsmeister AR, Locke GR, et al. Symptoms and quality of life in community women with fecal incontinence. Clin Gastroenterol Hepatol 2006;4:1004–9.
200. Grover M, Whitehead WE. Is fecal incontinence a risk factor for institutionalization in the elderly? Am J Gastroenterol 2011;106:366–7.
201. Nelson R, Furner S, Jesudason V. Fecal incontinence in Wisconsin nursing homes: Prevalence and associations. Dis Colon Rectum 1998;41: 1226–9.
202. Drossman DA, Li Z, Andruzzi E, et al. U.S. householder survey of functional gastrointestinal disorders. Prevalence, sociodemography, and health impact. Dig Dis Sci 1993;38:1569–80.
203. Leigh RJ, Turnberg LA. Faecal incontinence: The unvoiced symptom. Lancet 1982;1:1349–51.
204. Bharucha AE, Fletcher JG, Harper CM, et al. Relationship between symptoms and disordered continence mechanisms in women with idiopathic fecal incontinence. Gut 2005;54:546–55.
205. Quander CR, Morris MC, Melson J, et al. Prevalence of and factors associated with fecal incontinence in a large community study of older individuals. Am J Gastroenterol 2005;100:905–9.
206. Kalantar JS, Howell S, Talley NJ. Prevalence of faecal incontinence and associated risk factors; an underdiagnosed problem in the Australian community? Med J Aust 2002;176:54–7.
207. Bharucha AE, Zinsmeister AR, Locke GR, et al. Risk factors for fecal incontinence: A population-based study in women. Am J Gastroenterol 2006;101:1305–12.
208. Bharucha AE, Seide BM, Zinsmeister AR, et al. Relation of bowel habits to fecal incontinence in women. Am J Gastroenterol 2008;103:1470–5.
209. Bharucha AE, Zinsmeister AR, Schleck CD, et al. Bowel disturbances are the most important risk factors for late onset fecal incontinence: A population-based case-control study in women. Gastroenterology 2010; 139:1559–66.
210. Bharucha AE, Fletcher JG, Melton LJ III, et al. Obstetric trauma, pelvic floor injury and fecal incontinence: A population-based case-control study. Am J Gastroenterol 2012;107:902–11.
211. Bharucha AE, Zinsmeister AR, Locke GR, et al. Prevalence and burden of fecal incontinence: A population based study in women. Gastroenterology 2005;129:42–9.
212. Andrews CN, Bharucha AE. The etiology, assessment, and treatment of fecal incontinence. Nat Clin Pract Gastroenterol Hepatol 2005;2:516–25.
213. Ditah I, Devaki P, Luma HN, et al. Prevalence, trends, and risk factors for fecal incontinence in United States adults, 2005-2010. Clin Gastroenterol Hepatol 2014;12:636–43.e1–2.
214. Goode PS, Burgio KL, Halli AD, et al. Prevalence and correlates of fecal incontinence in community-dwelling older adults. J Am Geriatr Soc 2005;53:629–35.
215. Saad RJ, Rao SS, Koch KL, et al. Do stool form and frequency correlate with whole-gut and colonic transit? Results from a multicenter study in constipated individuals and healthy controls. Am J Gastroenterol 2010; 105:403–11.
216. Probert CJ, Emmett PM, Heaton KW. Intestinal transit time in the population calculated from self made observations of defecation. J Epidemiol Community Health 1993;47:331–3.
217. Engel AF, Kamm MA, Bartram CI, et al. Relationship of symptoms in faecal incontinence to specific sphincter abnormalities. Int J Colorectal Dis 1995;10:152–5.
218. Chiarioni G, Scattolini C, Bonfante F, et al. Liquid stool incontinence with severe urgency: Anorectal function and effective biofeedback treatment. Gut 1993;34:1576–80.
219. Bharucha AE, Wald A. Anorectal disorders. Am J Gastroenterol 2010; 105:786–94.
220. Wald A. Clinical practice. Fecal incontinence in adults. N Engl J Med 2007;356:1648–55.
221. Bharucha AE. Pro: Anorectal testing is useful in fecal incontinence. Am J Gastroenterol 2006;101:2679–81.
222. Wald A. Con: Anorectal manometry and imaging are not necessary in patients with fecal incontinence. Am J Gastroenterol 2006;101:2681–3.
223. Richter HE, Fielding JR, Bradley CS, et al. Endoanal ultrasound findings and fecal incontinence symptoms in women with and without recognized anal sphincter tears. Obstet Gynecol 2006;108:1394–401.
224. Bradley CS, Richter HE, Gutman RE, et al. Risk factors for sonographic internal anal sphincter gaps 6-12 months after delivery complicated by anal sphincter tear. Am J Obstet Gynecol 2007;197:310.e1–5.
225. Bharucha AE. Fecal incontinence. Gastroenterology 2003;124:1672–85.
226. Williams AB, Bartram CI, Halligan S, et al. Alteration of anal sphincter morphology following vaginal delivery revealed by multiplanar anal endosonography. BJOG 2002;109:942–6.
227. Bharucha AE, Daube J, Litchy W, et al. Anal sphincteric neurogenic injury in asymptomatic nulliparous women and fecal incontinence. Am J Physiol Gastrointest Liver Physiol 2012;303:G256–62.
228. Whitehead WE, Rao SS, Lowry A, et al. Treatment of fecal incontinence: State of the science summary for the national institute of diabetes and digestive and Kidney diseases workshop. Am J Gastroenterol 2015;110: 138–46; quiz 147.
229. Heymen S, Scarlett Y, Jones K, et al. Randomized controlled trial shows biofeedback to be superior to alternative treatments for fecal incontinence. Dis Colon Rectum 2009;52:1730–7.
230. Norton C, Chelvanayagam S, Wilson-Barnett J, et al. Randomized controlled trial of biofeedback for fecal incontinence. Gastroenterology 2003;125:1320–9.
231. Ouslander JG, Simmons S, Schnelle J, et al. Effects of prompted voiding on fecal continence among nursing home residents. J Am Geriatr Soc 1996;44:424–8.
232. Schnelle JF, Leung FW, Rao SS, et al. A controlled trial of an intervention to improve urinary and fecal incontinence and constipation. J Am Geriatr Soc 2010;58:1504–11.
233. Simmons SF, Schnelle JF. Effects of an exercise and scheduled-toileting intervention on appetite and constipation in nursing home residents. J Nutr Health Aging 2004;8:116–21.
234. Cheetham M, Brazzelli M, Norton C, et al. Drug treatment for faecal incontinence in adults. Cochrane Database Syst Rev 2003:CD002116.
235. Harford WV, Krejs GJ, Santa Ana CA, et al. Acute effect of diphenoxylate with atropine (Lomotil) in patients with chronic diarrhea and fecal incontinence. Gastroenterology 1980;78:440–3.
236. Read M, Read NW, Barber DC, et al. Effects of loperamide on anal sphincter function in patients complaining of chronic diarrhea with fecal incontinence and urgency. Dig Dis Sci 1982;27:807–14.
237. Hallgren T, Fasth S, Delbro DS, et al. Loperamide improves anal sphincter function and continence after restorative proctocolectomy. Dig Dis Sci 1994;39:2612–8.
238. Sun WM, Read NW, Verlinden M. Effects of loperamide oxide on gastrointestinal transit time and anorectal function in patients with chronic diarrhoea and faecal incontinence. Scand J Gastroenterol 1997; 32:34–8.
239. Bharucha AE, Fletcher JG, Camilleri M, et al. Effects of clonidine in women with fecal incontinence. Clin Gastroenterol Hepatol 2014;12: 843–51.e2; quiz e44.
240. Menees SB, Chandhrasekhar D, Liew EL, et al. A low FODMAP diet may reduce symptoms in patients with fecal incontinence. Clin Transl Gastroenterol 2019;10:e00060.
241. van Dijk M, Bongers ME, de Vries GJ, et al. Behavioral therapy for childhood constipation: A randomized, controlled trial. Pediatrics 2008; 121:e1334–41.
242. Chassagne P, Jego A, Gloc P, et al. Does treatment of constipation improve faecal incontinence in institutionalized elderly patients? Age Ageing 2000;29:159–64.
243. Markland AD, Jelovsek JE, Whitehead WE, et al. Improving biofeedback for the treatment of fecal incontinence in women: Implementation of a standardized multi-site manometric biofeedback protocol. Neurogastroenterol Motil 2017;29.
244. Jelovsek JE, Markland AD, Whitehead WE, et al. Controlling faecal incontinence in women by performing anal exercises with biofeedback or loperamide: A randomised clinical trial. Lancet Gastroenterol Hepatol 2019;4:698–710.
245. Mazor Y, Prott G, Jones M, et al. Factors Associated With Response to Anorectal Biofeedback Therapy in Patients With Fecal Incontinence. Clin Gastroenterol Hepatol 2020;19:492–502.e5.

246. Ozturk R, Niazi S, Stessman M, et al. Long-term outcome and objective changes of anorectal function after biofeedback therapy for faecal incontinence. Aliment Pharmacol Ther 2004;20:667–74.
247. Ussing A, Dahn I, Due U, et al. Efficacy of supervised pelvic floor muscle training and biofeedback vs attention-control treatment in adults with fecal incontinence. Clin Gastroenterol Hepatol 2019;17:2253–61.e4.
248. Leo CA, Thomas GP, Hodgkinson JD, et al. The Renew® anal insert for passive faecal incontinence: A retrospective audit of our use of a novel device. Colorectal Dis 2019;21:684–8.
249. Segal JP, Leo CA, Hodgkinson JD, et al. Acceptability, effectiveness and safety of a Renew((R)) anal insert in patients who have undergone restorative proctocolectomy with ileal pouch-anal anastomosis. Colorectal Dis 2019;21:73–8.
250. Deutekom M, Dobben AC. Plugs for containing faecal incontinence. Cochrane Database Syst Rev 2015:CD005086.
251. Sokol ER. Management of fecal incontinence—Focus on a vaginal insert for bowel control. Med Devices (Auckl) 2016;9:85–91.
252. Richter HE, Matthews CA, Muir T, et al. A vaginal bowel-control system for the treatment of fecal incontinence. Obstet Gynecol 2015;125:540–7.
253. Varma MG, Matthews CA, Muir T, et al. Impact of a novel vaginal bowel control system on bowel function. Dis Colon Rectum 2016;59:127–31.
254. Graf W, Mellgren A, Matzel KE, et al. Efficacy of dextranomer in stabilised hyaluronic acid for treatment of faecal incontinence: a randomised, sham-controlled trial. The Lancet 2011;377:997–1003.
255. Mellgren A, Matzel KE, Pollack J, et al. Long-term efficacy of NASHA Dx injection therapy for treatment of fecal incontinence. Neurogastroenterol Motil 2014;26:1087–94.
256. Bharucha AE, Gantz MG, Rao SS, et al. Comparative effectiveness of biofeedback and injectable bulking agents for treatment of fecal incontinence: Design and methods. Contemporary Clinical Trials 2021;107:106464.
257. Herman RM, Berho M, Murawski M, et al. Defining the histopathological changes induced by nonablative radiofrequency treatment of faecal incontinence—A blinded assessment in an animal model. Colorectal Dis 2015;17:433–40.
258. Efron JE, Corman ML, Fleshman J, et al. Safety and effectiveness of temperature-controlled radio-frequency energy delivery to the anal canal (Secca procedure) for the treatment of fecal incontinence. Dis Colon Rectum 2003;46:1606–16; discussion 1616–8.
259. Lam TJ, Visscher AP, Meurs-Szojda MM, et al. Clinical response and sustainability of treatment with temperature-controlled radiofrequency energy (Secca) in patients with faecal incontinence: 3 years follow-up. Int J Colorectal Dis 2014;29:755–61.
260. Wexner SD, Coller JA, Devroede G, et al. Sacral nerve stimulation for fecal incontinence: Results of a 120-patient prospective multicenter study. Ann Surg 2010;251:441–9.
261. Mellgren A, Wexner SD, Coller JA, et al. Long-term efficacy and safety of sacral nerve stimulation for fecal incontinence. Dis Colon Rectum 2011;54:1065–75.
262. Michelsen HB, Worsoe J, Krogh K, et al. Rectal motility after sacral nerve stimulation for faecal incontinence. Neurogastroenterol Motil 2010;22:36–41.
263. Horrocks EJ, Thin N, Thaha MA, et al. Systematic review of tibial nerve stimulation to treat faecal incontinence. Br J Surg 2014;101:457–68.
264. Horrocks EJ, Bremner SA, Stevens N, et al. Double-blind randomised controlled trial of percutaneous tibial nerve stimulation versus sham electrical stimulation in the treatment of faecal incontinence: CONtrol of Faecal Incontinence using Distal NeuromodulaTion (the CONFIDeNT trial). Health Technol Assess 2015;19:1–164.
265. Horrocks EJ, Chadi SA, Stevens NJ, et al. Factors associated with efficacy of percutaneous tibial nerve stimulation for fecal incontinence, based on post-hoc analysis of data from a randomized trial. Clin Gastroenterol Hepatol 2017;15:1915–21.e2.
266. Altomare DF, De Fazio M, Giuliani RT, et al. Sphincteroplasty for fecal incontinence in the era of sacral nerve modulation. World J Gastroenterol 2010;16:5267–71.
267. Matzel KE, Madoff RD, LaFontaine LJ, et al. Complications of dynamic graciloplasty: Incidence, management, and impact on outcome. Dis Colon Rectum 2001;44:1427–35.
268. Thornton MJ, Kennedy ML, Lubowski DZ, et al. Long-term follow-up of dynamic graciloplasty for faecal incontinence. Colorectal Dis 2004;6:470–6.
269. Rongen MJ, Uludag O, El Naggar K, et al. Long-term follow-up of dynamic graciloplasty for fecal incontinence. Dis Colon Rectum 2003;46:716–21.
270. Koch SM, Uludaq O, El Naggar K, et al. Colonic irrigation for defecation disorders after dynamic graciloplasty. Int J Colorectal Dis 2008;23:195–200.
271. Goos M, Baumgartner U, Lohnert M, et al. Experience with a new prosthetic anal sphincter in three coloproctological centres. BMC Surg 2013;13:45.
272. Hong KD, Dasilva G, Kalaskar SN, et al. Long-term outcomes of artificial bowel sphincter for fecal incontinence: A systematic review and meta-analysis. J Am Coll Surg 2013;217:718–25.
273. Michot F, Costaglioli B, Leroi AM, et al. Artificial anal sphincter in severe fecal incontinence: Outcome of prospective experience with 37 patients in one institution. Ann Surg 2003;237:52–6.
274. La Torre M, Lisi G, Milito G, Campanelli M, Clementi I. Sphinkeeper TM for faecal incontinence: a preliminary report. Colorectal Disease. 22(1):80–85, 2020 01.
275. Norton C, Burch J, Kamm MA. Patients' views of a colostomy for fecal incontinence. Dis Colon Rectum 2005;48:1062–9.
276. Branagan G, Tromans A, Finnis D. Effect of stoma formation on bowel care and quality of life in patients with spinal cord injury. Spinal Cord 2003;41:680–3.