Fecal Incontinence: Etiology, Evaluation, and Treatment

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ABSTRACT

Fecal incontinence is a debilitating problem facing ~2.2% of the U.S. general population over 65 years of age. Etiologic factors include traumatic, neurologic, congenital, and iatrogenic. Most commonly, obstetric trauma causes fecal incontinence as well as poorly performed anorectal surgery or pelvic radiation. Several severity scores and quality of life indexes have been developed to quantify incontinent symptoms. There are several nonsurgical and surgical options for the treatment of fecal incontinence. Biofeedback is among the most successful nonoperative strategies. Depending on the cause, anal sphincter repair, artificial bowel sphincter, and sacral nerve stimulation are used to treat fecal incontinence with some success. Unfortunately, fecal incontinence is an extremely difficult problem to manage: there has not been one, single treatment option that has proven to be both safe and effective in long-term studies.

KEYWORDS: Fecal incontinence, anal sphincter repair, sacral nerve stimulation, artificial bowel sphincter, biofeedback

Objectives: On completion of this article, the reader should be able to summarize the causes and treatment options of fecal incontinence, including both surgical and nonoperative.

BACKGROUND

Fecal incontinence (FI) is a debilitating and embarrassing problem facing ~2.2% of the U.S. general population over 65 years old.[1] This disorder is more prevalent in the elderly population and is one of the most common reasons for nursing home placement.[2,3] The etiology of FI is multifactorial and can be due to several factors including neuropathic, traumatic, congenital, and obstetric trauma, as well as iatrogenic injuries due to injudicious fistula surgery, hemorrhoidectomy, and lateral internal sphincterotomy among several others. FI symptoms can range from mild to severe and the work-up and treatments of this disorder are just as varied. Patients may complain of incontinence to flatus, liquid or solid stools. In some patients, just the concern that an accident may happen adversely affects their daily quality of life and limits their ability to interact socially due to fear and embarrassment. Several scoring systems have been created and validated to help patients and their medical practitioners quantify the severity of symptoms and the effects of FI on their daily life. These scores are used by physicians to plan treatment strategies and by researchers to study the outcomes of FI treatments. Unfortunately, numerous treatments have been developed for FI, but not one option has been shown to have consistent, long-term effectiveness with low rates of complications, making FI extremely difficult to manage.

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Table 1 Cleveland Clinic Incontinence Score*

Type of Incontinence	Frequency				
	Never	Rarely	Sometimes	Usually	Always
Solid	0	1	2	3	4
Liquid	0	1	2	3	4
Gas	0	1	2	3	4
Wears pad	0	1	2	3	4
Lifestyle alteration	0	1	2	3	4

0, perfect continence; 20, complete incontinence.
Never, 0 (never); rarely, <1/month; sometimes, <1/week and >1/month; usually, <1/day and >1/week; always, >1/day.
*Jorge J, Wexner S. Etiology and management of fecal incontinence. Dis Colon Recum 1993;36:77-97. Reprinted with permission of Cleveland Clinic Florida.

The mechanism of fecal continence is extremely complex despite the simplicity that physicians often ascribe to it. The sphincter mechanism requires the ability to discriminate between solid, liquid, and gas; voluntarily allowing for the passage of one while holding the other components. Treating fecal incontinence requires an understanding of this complex pelvic floor musculature, innervation, and function, as well as what mechanisms must be present to ensure continence. The internal and external sphincters and the puborectalis muscle comprise the sphincter mechanism. The internal anal sphincter is a continuation of the circular, smooth, involuntary muscle of the rectum that accounts for the resting tone of the anus. The rectoanal inhibitory reflex allows the internal sphincter to relax in response to rectal distension, preparing the anal canal for defecation.[4] The external anal sphincter provides voluntary control over defecation and provides the squeezing pressure measured by anal manometry. The puborectalis is a U-shaped muscle that controls the rectoanal angle that increases during defecation. Both parasympathetic and sympathetic nerves provide the innervation of this sphincter complex. The pudendal nerve innervates both the puborectalis and external anal sphincters and when neurogenic incontinence is present, latency of this nerve can be detected.

Because of the embarrassing nature of FI, symptoms are often hidden by patients and thus are underreported and undertreated. Once these symptoms are voiced, it is important to obtain a detailed account of the incontinence. Descriptions of partial incontinence to only gas or liquid stools occasionally or complete involuntary passage of solid stools should be provided to assess severity. Episodes of soiling or leakage and use of protective pads for undergarments are important, as well as the thorough assessment of general bowel habits. Does the patient have chronic diarrhea? Any medical comorbidities that affect bowel function? Does the patient have urgency? Does the patient take medications that result in constipation or diarrhea such as laxatives? A careful history of anorectal surgery, colorectal disease, anal intercourse, obstetric trauma, rectal prolapse, and neurologic disorders should be taken.

Details of the patient's stool frequency, consistency, or frequency of incontinent episodes should be obtained to assess the severity FI symptoms. There have been several score indices created to quantify symptoms, for example, the Fecal Incontinence Severity Index (FISI) or the Cleveland Clinic Incontinence Score (Table 1) that combines the loss of flatus, liquid, and solid stools as well as impact of quality of life to assess the severity of FI. Other scoring systems specifically address the effects of FI on quality of life, as in Fecal Incontinence Quality of Life Questionnaire (FIQL) published by the American Society of Colon and Rectal Surgeons.[3,4] The clinician can use these tools to assess the severity of symptoms and thus recommend a strategy for evaluation and treatment.

ETIOLOGY

Fecal incontinence may be attributed to a disturbance of any of the mechanisms that are required to produce continence: sphincter function, rectal sensation, adequate rectal capacity and compliance, colonic transit time, stool consistency, and cognitive and neurologic factors.[4] The etiology of FI includes the following: congenital, obstetric, surgical, accidental and iatrogenic trauma, colorectal disease, neurologic diseases (cerebral, spinal, peripheral) or other causes such as diarrhea, laxative abuse, or fecal impaction[5,6] (see Table 2). Congenital incontinence is suffered by patients with anorectal anomalies such as imperforate anus or Hirschsprung disease or other congenital anomalies including spina bifida, meningocele, or myelomeningocele. The disorder itself or a history of surgery for any of these disorders increases the risk of incontinence during childhood as well as later in life.[5] Patients with low forms of anorectal agenesis appear to do well with surgical repair as children; however, those with high defects affecting the pelvic floor, rectum, and urogenital tract are likely to have incontinence as adults.[3]

Table 2 Causes of Fecal Incontinence

Trauma
Obstetric (vaginal delivery, forceps, mediolateral episiotomy, pudendal nerve damage)
Accidental/nonaccidental (penetrating, impalement, sexual abuse)
Iatrogenic
Surgical (anorectal surgery, lateral internal sphincterotomy, hemorrhoidectomy, fistulotomy, colorectal surgery, low anterior resection)
Radiation (pelvic radiation)
Neurogenic
Multiple sclerosis, diabetes mellitus
Congenital
Spinal cord (spina bifida, meningomyelocele, lumbar sacral spinal defects)
Anorectal malformations/anomalies (imperforate anus, Hirschsprung disease)
Ano- and colorectal diseases
Rectal prolapse, large hemorrhoids, inflammatory bowel disease, cancer, infectious, chronic anorectal inflammation, colitis, proctitis
Other
Aging, dementia, laxative abuse, constipation/fecal impaction

Obstetric trauma comprises the largest proportion of FI causes in women. Vaginal delivery can damage the pelvic floor and sphincters resulting in FI. Direct mechanical tears of the sphincter occur ~0.6–9% of vaginal deliveries and risk factors associated obstetric tears include use of forceps, mediolateral episiotomy, and primiparity.[3] Another contributing factor to FI is pudendal nerve damage, which occurs during lengthy vaginal deliveries or when forceps are used.[3] Other trauma can also lead to FI including accidental penetrating trauma, perineal lacerations, pelvic fractures, spinal injuries, or foreign body insertion. There is often disruption of the sphincter complex and damage to the innervation of the pelvic floor.[3]

Anorectal disease is a significant risk factor for incontinence, including hemorrhoids, fissure or fistulae even without surgical intervention. Mucosal or full rectal prolapse may stent the anal canal open and stretch the sphincters, leading to their dysfunction.[5] Other colorectal conditions may be associated with FI such as inflammatory bowel disease, malignancies, or infectious diseases. Along with anorectal conditions, surgery for these disorders is a common causative factor of FI. A high incidence of soiling has been historically noted after internal sphincterotomy and fistulotomy (35–45%).[3] The incidence of FI after these operations is due to numerous factors; however, if a well-planned, properly performed surgical procedure is done for the appropriately selected patient, the outcomes are much better with less resultant incontinence. FI can also result from hemorrhoidectomy, transanal advancement flaps or from internal sphincter dilation with a retractor.[3] FI from hemorrhoidectomy is due to a poorly performed procedure with injury to the internal and possibly the external sphincters. Transanal excision with planned dilation of the anal sphincter can lead to uncontrolled, multiple tears of the sphincter mechanism. Other surgeries that place patients at higher risk for FI include low anterior resections (LAR), especially after radiation. Incontinence after LAR results from the loss of the rectal reservoir leading to a decrease in the capacity of the neorectum to hold the appropriate amount of stool. However, the increasing incidence of colonic pouch creation has resulted in improved functional outcomes.[3]

Pelvic radiation results in significant morbidity including severe FI. It can lead to incontinence through radiation proctosigmoiditis, small bowel injury, fistula, reduced rectal capacity, decreased sphincter function, rectal mucosal sensitivity, and neuropathy; surgical options are limited so most radiation-induced FI is treated nonoperatively or with fecal diversion.[3,5] If postoperative radiation therapy has been used, redo-proctectomy with excision of the radiated tissue and creation of a non-radiated reservoir can improve FI symptoms. Other causes of FI include neurologic (central, spinal, peripheral), diarrhea, fecal impaction, or laxative abuse.

EVALUATION

After taking a thorough history of incontinent symptoms, medical and surgical history, medications and quality of life, physical examination is one of the most important aspects of evaluation of FI. Careful anorectal examination should be performed, first addressing the perineum for presence of skin irritation, moisture, fecal soilage, previous scars, deformities, anal stenosis, hemorrhoids, fistula, or abscess.[4] Noting whether the anal canal is open or closed at rest and the sphincter action while squeezing should be observed and documented. Digital rectal exam will evaluate the presence of sphincter defect, resting tone, stricture, anal or rectal masses, squeezing pressure, and the presence of mucosal or rectal prolapse.[4] Perineal descent should also be investigated as a sign of pelvic floor weakness. Vaginal exam should be performed to evaluate for presence of rectoceles, cystoceles, enteroceles or vaginal prolapse. The puborectalis sling and anterior body should be palpated for evidence of paradoxical contraction or sequelae of obstetric trauma and anterior sphincter defects.

Anal manometry is a useful adjunct to the digital rectal exam to quantify the pressures of the sphincter complex. Manometry specifically evaluates the anal resting pressure, anal squeeze pressure, rectoanal inhibitory reflex, compliance of the rectum and sensory thresholds in response to balloon distension.[3] Although the manometric results are reliable quantitative measures of

sphincter function, the findings are confounded by the patient's compensation for any deficiencies. Patients with FI may have decreased resting and squeeze pressures when compared with continent patients; however, several studies including one by Zutshi et al, have indicated that anal manometry results do not correlate with symptom severity and do not help to predict postoperative success of surgical treatment of FI.[1] Anal manometry is indicated to exclude impaired sphincter function as the cause of FI as well as to assess effects of surgery on sphincter function postoperatively, as some patients have normal sphincter function, but still have clinical incontinence.[3]

Defecography provides a radiographic picture of the act of defecation allowing visualization of the action of the pelvic floor. The anorectal angle during defecation, presence of rectocele or intussusception, extent of perineal descent, and completion of rectal emptying can be assessed. This tool identifies anatomic and mechanical contributers to obstructed defecation, but interobserver variation is great which is limiting. The usefulness of this test is also limited by the inability of incontinent patients to hold the contrast, leading to premature evacuation and an inadequate study. Defecography is indicated in those patients with suspected overflow incontinence.

The most important adjunct for FI evaluation is anal endosonography. This study visualizes the internal and external sphincters, assesses their length and width and any scar tissue or defects that may be present. This tool should be used to evaluate FI in female patients with a history of vaginal delivery or suspicion of obstetric trauma or any patient with the possibility of a sphincter defect.[3]

Pudendal nerve terminal motor latency is a test to evaluate the contribution of pudendal neuropathy to fecal incontinence. This nerve is most commonly damaged in obstetric trauma and is affected by general neuropathy that may be seen in diabetes or multiple sclerosis.[7] This tool measures the time it takes for stimulation of the pudendal nerve, from the ischial tuberosity to the anal canal, to elicit contraction of the pelvic floor muscles. Delayed response is associated with pudendal neuropathy, which can contribute to FI. This adjunct has also been used to predict the success of sphincteroplasty repairs; however, there is wide interobserver variability and the test may be difficult to perform. A recent study by Brouwer et al showed no correlation between pudendal nerve latency testing with success after sacral nerve stimulation for FI treatment.[7]

Other anal physiologic testing includes sensation testing, magnetic resonance imaging (MRI), and endoscopy. Anorectal sensation testing refers to electrical stimulation of the distal anus as well as urge sensitivity of the rectum with balloon inflation. This test identifies the minimal volume that is first sensed, the first urge sensation, and the maximal volume that is tolerated.[3] MRI of the pelvis can be performed with an endocoil that increases visualization of the sphincter complex. This imaging can identify sphincter atrophy or defects and visualize any anatomical abnormalities that may contribute to incontinence.[3] Endoscopy may be used to evaluate the rectum and colon for any infectious or inflammatory cause of abnormal bowel patterns that may lead to FI, such as infectious diarrhea, polyps, or solitary rectal ulcer.

TREATMENT: NONOPERATIVE

The initial management of FI is conservative, concentrating on dietary, medical, and psychological modifications to attempt to improve continence and quality of life. Patients should be educated about incontinence. Practitioners should instruct patients on the necessity of improving bowel habits by (1) changing the consistency and frequency of stools by stopping laxatives, (2) starting or increasing stool bulking agents, (3) changing dietary habits, and (4) starting antimotility agents. Loperamide has been extensively studied and has been shown to effectively decrease stool frequency and improve diarrhea-associated FI.[8]

The attempt to establish a regular, predictable bowel pattern is an important aspect of education and bowel "retraining." Patients should work to have bulkier, more solid stools that they may evacuate completely; this is accomplished through patient education, dietary, pharmacologic and lifestyle changes, including increasing fiber and water intake, and the use of enemas or rectal irrigation to empty the rectum. The best prevention of fecal incontinence is an empty rectum, well demonstrated by the reduction of soiling in 78% of children with myelomeningocele who used rectal irrigation.[3]

These modifications may be combined with biofeedback treatment, a re-training program that provides strength, sensory, and coordination training for incontinent patients to help them relearn how to defecate completely, regularly, and effectively. This physiologic training incorporates varying instruments and technology: pneumatic and perfusion manometry, surface electromyography, and transanal ultrasound.[8] Therapists work to improve the threshold of rectal sensitivity and coordinate pelvic floor muscle contraction with distension of the rectum.[3] Several studies have shown the effectiveness of biofeedback with success rates between 50 to 90%; however, most of these studies are small or lack control groups.[9] Boselli et al found a 55% improvement in symptoms after biofeedback training; although sphincter function was not affected, general effect of conservative therapy, and possible increased rectal sensitivity may account for the positive findings.[9] Certain patients do not respond to biofeedback: those with complete denervation of the pelvic floor or those with

decreased rectal capacity from surgery.[3] Biofeedback is time-consuming, labor-intensive, but safe and can be effective in patients who have mild to moderate neuropathic incontinence or incomplete sphincter defects. Patients should be motivated and clearly understand the training with the help of an enthusiastic therapist. The mechanism of clinical effectiveness is not clear; however, FI symptoms and quality of life scores have shown improvement in certain patients. Tools used in addition to biofeedback are balloon training to help reduce the sensitivity threshold of first urge sensation. Electrostimulation is also employed by physiotherapists. This tool has been shown to improve external sphincter muscle function; however, studies have not proven its clinical effectiveness.[3]

TREATMENT: OPERATIVE

There are two primary methods of surgical management of fecal incontinence: direct repair of the sphincter defect or augmentation of the sphincter (see Table 3). Direct sphincter repair is best suited for patients with sphincter defects secondary to obstetric trauma or iatrogenic injury. There are three main approaches to direct sphincter repair: apposition, overlapping, and plication or reefing.[5] If there is adequate sphincter present, overlapping is the preferred method of repair. Plication repair of the external sphincter or puborectalis has been employed for vaginal repair of rectoceles as well. This procedure can be performed anteriorly or posteriorly. The muscle is plicated toward the midline to narrow the anal orifice.[5] There are no studies that demonstrate one repair is superior to the others; overall success rates of anterior sphincteroplasty have been reported as high as 80% during a 12-month follow-up period.[4] However, there a very few studies that looked at long-term outcomes of direct sphincter repair. In a 2009 study by Zutshi et al, patients were given FISI and FIQL questionnaires 10 years after their sphincteroplasty, and the results were compared with their 5-year status. This group noted that no one patient was completely continent to stool or flatus at 10 years. It was reported that patients had overall higher fecal incontinence severity scores; however, this increase did not necessarily correlate with their quality of life scores. This study also noted that women with two or more vaginal deliveries and those patients who were older at the time of surgery had higher FISI scores at 10 years.[10] It appears that long-term outcomes after sphincteroplasty are disappointing, but the symptoms may have less of an impact on quality of life for these patients. A recent study by Zufferey et al in 2009 shows that perineal ultrasound measuring puborectalis contraction to >8 mm predicts the success of sphincter repair in patients after obstetric trauma.[11] If this extent of voluntary contraction is not achieved, then pudendal neuropathy may be present and other surgical treatments would be more appropriate.

Table 3 Surgical Management of Fecal Incontinence

Direct repair of anal sphincter
Anterior anal sphincter repair: overlapping, plicating, appositional
Postanal repair: plication of pubococcygeus and puborectalis, external sphincter repair
Augmentation of anal sphincter
Sacral nerve stimulation
Dynamic graciloplasty, gluteus maximus muscle transfer
Artificial bowel sphincter
Injection of sphincter complex (bioproducts, bulking agents, myoblasts)
Thiersch procedure (no longer used)
Other
Fecal diversion (colostomy, ileostomy)
MACE (Malone antegrade continent enema)

In 1975, Sir Alan Parks developed the postanal repair, emphasizing the importance of levator plication to re-establish the anorectal angle and lengthen the anal canal, both which contribute to continence.[5] This procedure is recommended for patients with FI and rectal prolapse or descending perineum syndrome and pelvic floor denervation. To be successful, adequate muscle mass needs to be present. After dissecting in between the internal and external sphincters, Waldeyer fascia is divided to enter the pelvis and plicate the pubococcygeus and the puborectalis muscles. Several early studies indicated that this repair results in short-term symptom improvement in 60 to 80% of patients; however, more recent studies indicate a much lower success rate and long-term improvement of FI appears to diminish.[5] The postanal repair is not appropriate for patients with sphincter defects from trauma or obstetric injury.

For patients with neurogenic incontinence, intact anal sphincters, or a failed sphincter repair, sacral nerve stimulation (SNS) is indicated for FI treatment. This procedure is modeled after sacral neuromodulation that was used to treat urinary incontinence due to neurogenic bladder.[12] SNS electrodes are placed through the foramen of S3 while the patient is placed in prone position until electrical stimulation results in contraction of the anus and pelvic floor.[3] The first electrodes are temporary and placed for a test period of $\sim$3 weeks to establish if the patient has improvement of incontinence. If there is improvement, a stimulator and permanent electrode are implanted. These devices may stay in place for a median duration of 8 years if no complications occur. Several studies of SNS indicate excellent results with low morbidity; improvements were seen in number of incontinent episodes per week, urgency, ability to defer defecation and a few studies reported achievement of total continence for some patients.[2] The mechanism of action is still not completely understood; however, Malouf et al suggested that the electrodes might affect

rectal and internal sphincter smooth muscle and facilitate the external sphincter striated muscle function.[12] Several studies have shown 80% improvement in incontinence during the follow-up period, as did this group in both symptoms and quality of life scores; however, changes in anal physiologic testing did not correlate.[12] Although several small studies have shown high success rate and low morbidity, these studies have been very small. A more recent study by Wexner et al (2010) looked at a larger population to evaluate the efficacy and safety of SNS. In 120 patients who qualified for permanent electrode placement, 40% had perfect continence during the 12-month follow-up and another 30% had over 75% improvement of symptoms.[2] The success rate defined as greater than 50% reduction in the number of incontinent episodes was 85% at 12 months and 2 years and 87% at 3 years.[2] This group found improvements in all measures of the FIQL and FISI over 12 months. They also showed that patients with sphincter defects did benefit from SNS. Approximately 5% of patients experienced adverse effects from the implant; 11% of these complications were infection, and only 7 required surgical intervention.[2] Thus, in a larger study population, sacral nerve stimulation appears to be a safe and effective option for FI treatment; unfortunately, this technique is not FDA-approved and thus, only available outside the United States.

There are several treatment options for FI that aim to augment sphincter function. Gracilis muscle transposition is a procedure that was developed in 1952 by Pickrell to create a neosphincter by dividing the insertion site of the distal end of the gracilis muscle and tunneling the muscle subcutaneously to the perineum to then encircle the anal canal.[3] Although some continence was achieved by tightening the anal canal to cause an outlet obstruction, results improved once dynamic graciloplasty was introduced. Researchers implanted electrodes and a pulse generator to deliver sustained contraction to the gracilis to change the short-acting, easily-fatigable fast-twitch fibers to long-acting, slow-twitch fibers that are much more appropriate for sphincter function.[13] The operation is technically difficult and success depends on patient selection and surgeon experience. The success rate varies from 40 to 80%; however, the complication rate is high. Indications for dynamic graciloplasty include severe FI with large sphincter defects that cannot be repaired primarily or a failed sphincter repair. This operation is appropriate for young patients with FI secondary to trauma or a congenital defect.[5] It should be avoided in patients with chronic diarrhea, irritable bowel syndrome, intractable constipation, anal disease, radiated perineum or radiation proctitis, impaired wound healing, or in the elderly; these patients will have poor outcomes.[5] A similar procedure is performed using the gluteus maximus to encircle the anal canal; one study by Devesa et al showed 67% improvement of FI in 20 patients.[4] The stimulated graciloplasty is no longer available in the United States.

Another operation that augments the sphincter complex is artificial bowel sphincter (ABS). This procedure implants a fluid-filled, silicon cuff that encircles the anal canal and is regulated by a control pump and pressure-regulating balloon. The cuff is constantly inflated to create a continent sphincter; once the fluid is manually pumped from the cuff to the balloon, stool is allowed to pass. Indications for artificial bowel sphincter include patients with severe incontinence and those who were not amenable to standard therapy or have failed previous surgical treatments.[5] ABS should be avoided in patients with impaired healing, local anal disease, diarrhea, or intractable constipation.[5] Several studies have reported excellent results in those patients in which the ABS remained implanted, up to 85% improvement in FI.[4] However, a large proportion of patients require explantation secondary to infection or erosion. Wexner et al (2009) investigated factors to predict failure of ABS; only history of perineal infection and faster time to first bowel movement were significant.[6] ABS is associated with high rates of adverse effects, with infection and erosion being the most important.[14] Studies indicate that complications range from 20 to 100% and many of these patients require explantations or revisions.[6]

Although fecal diversion may be considered a failure of FI treatment, it is an effective, safe, and appropriate operation for certain patients with severe incontinence. Indications of colostomy or ileostomy include severe neurogenic incontinence, complete pelvic floor denervation, severe perianal trauma, severe radiation-induced FI, or those patients who are incapacitated physically or mentally without any bowel control resulting in poor quality of life.[4]

There are several procedures that are no longer being performed or performed often and some novel therapies currently under investigation for treatment of FI. Those include the encirclement operations (Thiersch) that tighten mesh around the sphincter complex. The Malone antegrade continent enema creates an appendicoumbilical stoma through which a patient will irrigate the colon to empty the rectum, preventing FI. Novel procedures include injection of bulking agents into the sphincter complex for augmentation and now researchers are investigating the injection of autogenous bioproducts, such as myoblasts, to enhance muscle cell growth and function without the risk of infection or rejection of foreign material. Studies show promising results with improvement in FI symptoms and low complication rates.[15]

In conclusion, fecal incontinence is an overlooked, underreported debilitating condition; medical practitioners must be comfortable with its evaluation and management. The most important aspect of the initial workup is obtaining a thorough history. Physicians must

appreciate the details of incontinent symptoms and the impact of FI on the patients' quality of life. Indices and questionnaires are helpful for patients to explain their symptoms and for physicians to quantify their severity. Anal physiologic tests are useful adjuncts to the physical examination, and are especially helpful in defining anatomic defects. Biofeedback in conjunction with dietary, pharmacologic, and lifestyle changes has been shown to improve FI symptoms and quality of life measures. However, if symptoms, sphincter injury, or neuropathy are severe, surgery can be an effective choice in the appropriately selected patient. Although there are several operations available, some show initial success that deteriorates over time and some have intolerable rates of complications. There are no perfect surgical solutions for FI; however, studies are ongoing to find safer and more effective treatment options for fecal incontinence.

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