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PRACTICE GUIDELINES

Diagnosis and Management of Fecal Incontinence

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DEFINITION

Fecal incontinence is defined as either the involuntary passage or the inability to control the discharge of fecal matter through the anus. Clinically there are three subtypes (a) passive incontinence—the involuntary discharge of stool or gas without awareness; (b) urge incontinence—the discharge of fecal matter in spite of active attempts to retain bowel contents, and (c) fecal seepage—the leakage of stool following otherwise normal evacuation. The severity of incontinence can range from the unintentional elimination of flatus to the seepage of liquid fecal matter or sometimes the complete evacuation of bowel contents. Not surprisingly, these events cause considerable embarrassment, which in turn can lead to a loss of self-esteem, social isolation, and a diminished quality of life (1).

EPIDEMIOLOGY

Although fecal incontinence affects people of all ages, its prevalence is disproportionally higher in women, in the elderly, and in nursing home residents. Estimates of its prevalence vary greatly and depend on the clinical setting, the influence of social stigma, the definition of incontinence, and the frequency of occurrence.

In the U.S. householder survey, frequent leakage of stool or fecal staining for more than 1 month was reported by 7.1% and 0.7% of the population, respectively (2). In contrast, two or more episodes of fecal incontinence per month were reported by 0.8% of patients presenting to primary care clinics in the UK (3). In an elderly (>65 yr) self-caring population, fecal incontinence occurred at least once a week in 3.7% of subjects and in more men than women (men:women = 1.5:1) (4). In contrast, 25–35% of institutionalized patients (5) and 10–25% of hospitalized geriatric patients (6) suffer from fecal incontinence. In the United States, fecal incontinence is the second leading cause for placement in nursing homes (6).

In a survey of 2,570 households, comprising 6,959 individuals, the prevalence of at least one episode of incontinence during the previous year was 2.2%; among these 63% were women, 30% were >65 yr of age, 36% were incontinent of solid stool, 54% of liquid stool, and 60% of flatus (7). Furthermore, in another prospective survey of patients attending either a gastroenterology or a primary care clinic, over 18% reported fecal incontinence at least once a week (8). Only one third had ever discussed the problem with a physician (8). When stratified for the frequency of episodes, 2.7% of patients reported daily incontinence, 4.5% weekly, and 7.1% once per month (8). In another survey, fecal incontinence was associated with urinary incontinence in 26% of women attending a Uro/Gyn Clinic (9). A higher incidence of mixed fecal and urinary incontinence was also reported in nursing home residents (10, 11).

The cost of health care related to fecal incontinence includes items that can be measured such as the evaluation, diagnosis and treatment of incontinence, medications, the use of disposable pads and other ancillary devices, skin care, and nursing care. Approximately $400 million/year were spent for adult diapers (8, 12) and between $1.5 and $7 billion/year were spent on care for incontinence among institutionalized elderly patients (6, 13). In a long-term facility, the annual cost for a patient with both mixed fecal and urinary incontinence was $9,711 (14). In the outpatient setting, the average cost per patient (including evaluation) was estimated at $17,166 (15). Additionally, there are other costs that cannot be measured such as the impaired quality of life and social dysfunction (1).

SUMMARY. The prevalence of fecal incontinence ranges between 1% and 7.4% in otherwise healthy people and up to 25% in those who are institutionalized. Both the embarrassment and the social stigma attached to this disorder, often delay presentation as well as treatment for several years. Fecal incontinence not only causes significant morbidity in the community but it also consumes substantial health care resources.

PATHOPHYSIOLOGY

Functional Anatomy and Physiology of the Anorectum

The neuromuscular integrity of the rectum, anus, and the adjoining pelvic floor musculature helps to maintain normal fecal continence. The rectum is a muscular tube composed of a continuous layer of longitudinal muscle that interlaces with the underlying circular muscle. This unique muscle arrangement enables the rectum to serve both as a reservoir for stool and as a pump for emptying stool. The anus is a muscular tube 2–4 cm. long, which at rest forms an angle with the axis of the rectum. At rest, the anorectal angle is approximately

90 degrees, with voluntary squeeze it becomes more acute, approximately 70 degrees, and during defecation it becomes more obtuse, about 110–130 degrees.

The anal sphincter consists of the internal anal sphincter, which is a 0.3–0.5 cm thick expansion of the circular smooth muscle layer of the rectum, and the external anal sphincter which is a 0.6–1 cm thick expansion of the striated levator ani muscles. Morphologically, both sphincters are separate and heterogeneous (16). The anus is normally closed by the tonic activity of the internal anal sphincter and this barrier is reinforced by the external anal sphincter during voluntary squeeze. The anal mucosal folds together with the expansile anal vascular cushions provide a tight seal. These mechanical barriers are augmented by the puborectalis muscle, which forms a flap-like valve that creates a forward pull and reinforces the anorectal angle to prevent incontinence (16).

The anorectum is innervated by sensory, motor, and autonomic parasympathetic nerves as well as by the enteric nervous system. The principal nerve is the pudendal nerve, which arises from the second, third, and fourth sacral nerves and innervates the external anal sphincter, the anal mucosa, and the anorectal wall. This is a mixed nerve and subserves both sensory and motor function (17). Its course through the pelvic floor makes it vulnerable to stretch injury, particularly during vaginal delivery.

It is likely that rectal contents are periodically sensed by the process of “ano rectal sampling” (18, 19). This process may be facilitated by transient relaxations of the internal anal sphincter that allows the movement of stool or flatus from the rectum into the upper anal canal where they may come into contact with specialized sensory end organs such as the numerous Krause end-bulbs, Golgi–Mazzoni bodies and genital corpuscles and the relatively sparse Meissner’s corpuscles and Pacinian corpuscles (20). Specialized afferent nerves for touch, cold, tension, and friction subserve these organized nerve endings. An intact “sampling reflex” allows the individual to choose whether to discharge or retain their rectal contents, whereas an impaired “sampling reflex” may predispose to incontinence (19, 20).

In contrast, the rectal epithilium shows no organized nerve endings (21). Myelinated and unmyelinated nerve fibers are present adjacent to the rectal mucosa, the submucosa and the myenteric plexus. These subserve the sensation of distention and stretch and mediate the viscero-visceral, the rectoanal inhibitory, and contractile responses (22). The sensation of rectal distention travels along the parasympathetic system to S_2, S_3, and S_4 (21). Thus, the sacral nerves are intimately involved with the sensory, motor, and autonomic function of the anorectum and in maintaining continence.

Pathogenic Mechanisms and Etiology

Incontinence occurs when one or more mechanisms that maintain continence are disrupted to an extent that other mechanisms are unable to compensate. Thus, the cause of fecal incontinence is often multifactorial (23–25). In a prospective study, 80% of patients had more than one pathogenic abnormality (23). In adult women, obstetric trauma is a major predisposing factor (26). This injury may involve either the external anal sphincter, the internal anal sphincter, or the pudendal nerves or all three structures. In prospective studies, nearly 35% of primiparous women (normal *ante partum*) showed evidence of sphincter disruption following vaginal delivery (26–28). Other important risk factors include forceps delivery, prolonged second stage of labor, large birth weight, and occipito-posterior presentation (29–31). Perineal tears, even when carefully repaired, can be associated with incontinence, and patients may either present immediately or several years following delivery (27). Other causes of anatomic disruption include iatrogenic factors such as anorectal surgery for hemorrhoids, fistulas, or fissures. Anal dilatation or lateral sphincterotomy may result in permanent incontinence due to fragmentation of the internal anal sphincter (32, 33). The internal anal sphincter is occasionally and inadvertently damaged during hemorrhoidectomy (34). Accidental perineal trauma or a pelvic fracture may also cause direct sphincter trauma leading to incontinence (35). In the absence of structural defects, internal anal sphincter dysfunction may occur because of a myopathy (36, 37), or internal sphincter degeneration (37), or a complication of radiotherapy (38, 39).

Neurological diseases can affect continence by interfering with either sensory perception or motor function, or both. In the central nervous system, multiple sclerosis, dementia, stroke, brain tumors, sedation, dorsal and spinal cord lesion may each cause incontinence (40–43). In the peripheral nervous system, cauda equina lesions, diabetic neuropathy (41, 44, 45), toxic neuropathy from alcohol, or traumatic neuropathy in the *post partum* setting may all lead to fecal incontinence. Up to 30% of patients with multiple sclerosis are incontinent (41).

Skeletal muscle disorders such as muscular dystrophy, myasthenia gravis, and other myopathies can affect external anal sphincter and puborectalis function. Reconstructive procedures such as ileoanal (46) or coloanal pouches (47) can increase anorectal capacity and may improve continence. However, up to 40% of patients with an ileoanal pouch experience periodic, often nocturnal fecal incontinence, possibly related to uncoordinated pouch contractions (48). Similarly, rectal prolapse may be associated with fecal incontinence in up to 88% of cases (49–51). This is most likely due to prolonged inhibition of anal tone from intussusception of the rectum into the upper anal canal.

Conditions that decrease rectal compliance and accommodation may also cause fecal incontinence (52). Etiologies include radiation-induced inflammation and fibrosis, rectal inflammation secondary to ulcerative colitis (53, 54), or Crohn’s disease and infiltration of the rectum by tumor, ischemia, or following radical hysterectomy (39). Rarely other causes include high intrarectal pressures generated in some patients with ulcerative colitis (53), or with severe voluminous diarrhea (55).

In many patients fecal seepage or staining of undergarments is due to the incomplete evacuation of stool. A majority of these patients show obstructive or dyssynergic defecation (56). In these patients, anal sphincter and pudendal nerve function are intact but the ability to evacuate stool is impaired (56). Many also exhibit impaired rectal sensation (56, 57). Similarly, in the elderly and in children with functional incontinence, the prolonged retention of stool in the rectum leads to fecal impaction. Fecal impaction causes prolonged relaxation of the internal anal sphincter tone that allows liquid stool to flow around impacted stool and to escape through the anal canal (58).

SUMMARY. Anal sphincter disruption or weakness, pudendal neuropathy, impaired anorectal sensation, impaired rectal accommodation, or incomplete evacuation may all contribute to the pathogenesis of fecal incontinence. These changes may be a consequence of local, anatomical, or systemic disorders. Thus, the origin of fecal incontinence is often multifactorial.

CLINICAL ASSESSMENT OF FECAL INCONTINENCE

Recommendation: Patients with fecal incontinence may be categorized into passive or urge incontinence or fecal seepage and their severity can be graded based on a prospective stool diary and clinical features.

The evaluation of a patient with fecal incontinence involves a detailed clinical assessment together with the appropriate physiological and imaging tests of the anorectum. These three sources of information are complementary and should provide useful data regarding the severity of the problem, the underlying etiological factors, and the impact of the problem on the quality of life. Equipped with this knowledge, it is possible to design appropriate treatment strategies that could lead to clinical improvement.

Clinical Features

Many patients who suffer with fecal incontinence or soiling, take refuge under the term “diarrhea” or “urgency” (59). Thus, the first step in the evaluation is to establish a rapport with the patient and to confirm the existence of fecal incontinence. Thereafter, further characterization is desirable. This can include an assessment of its duration, its progression, its nature, *i.e.*, incontinence of flatus, liquid stool, or solid stool, and its impact on the quality of life (Table 1). The use of pads or other devices and the ability to discriminate between formed or unformed stool and gas should be enquired. A detailed inquiry should also include obstetric history, a history of coexisting conditions such as diabetes mellitus, pelvic radiation, neurological problems or spinal cord injury, dietary history, and a history of coexisting urinary incontinence. Also, during clinical assessment, it is useful to ask if a patient can differentiate between formed and unformed stool or flatus, *i.e.*, the presence of rectoanal agnosia. A prospective stool diary may also be very useful (Fig. 1).

The circumstances under which incontinence occurs should also be determined. Such a detailed inquiry may facilitate the identification of the following possible scenarios:

Table 1. A List of Important Information That Should be Elicited When Taking a History in a Patient with Suspected Fecal Incontinence

• Onset and precipitating event(s)
• Duration, severity and timing
• Stool consistency and urgency
• Coexisting problems/surgery/urinary incontinence/back injury
• Obstetric Hx-forceps, tears, presentation, repair
• Drugs, caffeine, diet
• Clinical subtypes—Passive or urge incontinence or fecal seepage
• Clinical grading of severity
• History of fecal impaction

1. *Passive incontinence*—which is the involuntary discharge of fecal matter or flatus without any awareness. This suggests a loss of perception and/or impaired rectoanal reflexes either with or without sphincter dysfunction.
2. *Urge incontinence*—which is the discharge of fecal matter or flatus in spite of active attempts to retain these contents. Here, there is a predominant disruption of the sphincter function or the rectal capacity to retain stool.
3. *Fecal seepage*—which is the undesired leakage of stool, often after a bowel movement with otherwise normal continence and evacuation. This condition is mostly due to incomplete evacuation of stool and/or impaired rectal sensation (56, 58). The sphincter function and pudendal nerve function are mostly intact (56, 57).

Although there is an overlap between these three groups, by making a clinical distinction, it is possible to assess the underlying etiology and to guide investigations and management. Symptom assessment can also provide useful insights regarding the underlying mechanism(s), but may not correlate well with manometric findings. In one study, leakage had a sensitivity of 98.9%, a specificity of 11%, and a positive predictive value of 51% for detecting low resting anal sphincter pressures (31). The positive predictive value for detecting a low squeeze pressure was 80% (31). Thus, for an individual patient with incontinence, history and clinical features alone are insufficient to define the pathophysiology and therefore objective testing is essential.

Nevertheless, based on the clinical features, several grading systems have been proposed. Recently, a modification of the Cleveland Clinic grading system (60) has been validated by the St. Mark’s investigators (61). This system can provide an objective method of quantifying the degree of incontinence. It can also be useful for assessing the efficacy of therapy. This grading system is based on seven parameters that include whether the anal discharge is either solid, liquid or flatus, and whether the problem causes alterations in lifestyle, (scores: Never = 0, Always = 5); the need to wear a pad or the need to take antidiarrheal medication, and the ability to defer defecation (scores: No—0, yes—2). The score ranges from 0 (continent) to 24 (severe incontinence). Clinical features alone are, however, insufficient to define the pathophysiology. The use of validated questionnaires such as

Stool Diary

PLEASE RECORD YOUR STOOL HABIT FOR ONE WEEK: **Name:** **Hosp #:**

Date	**Time of Bowel Movement**	**Incontinence** Yes / No	**Stool Seepage or Staining** Yes/No	**Stool Consistency** (Type 1 – 7) See Below	**Urgency** – unable to postpone BM for more than 15 Minutes Yes / No	**Use of Pads** Yes / No	**Medications**	**Comments**

Use the following descriptors for describing stool consistency:

Type 1: **Separate hard lumps**. Type 2: **Sausage shaped but lumpy.** Type 3: **Like a sausage but with cracks on its surface.** Type 4: **Like a sausage or snake, smooth and soft.** Type 5: **Soft blobs with clear-cut edges (passed easily).** Type 6: **Fluffy pieces with ragged edges, a mushy stool.** Type 7: **Watery.**

Figure 1. A sample stool diary for assessing patients with fecal incontinence. Use the following descriptors for describing stool consistency: Type 1: Separate hard lumps. Type 2: Sausage shaped but lumpy. Type 3: Like a sausage but with cracks on its surface. Type 4: Like a sausage or snake, smooth and soft. Type 5: Soft blobs with clear-cut edges (passed easily). Type 6: Fluffy pieces with ragged edges, a mushy stool. Type 7: Watery.

the SCL-90^{R} SF-36 may provide additional information regarding the psychosocial issues and impact on the quality of or life.

Physical Examination

This should include a detailed physical and neurological examination of the back and the lower limbs, because incontinence may be secondary to a systemic or a neurological disorder. The perineal inspection and digital rectal examination is best performed with the patient lying in the left lateral position and with good illumination. Upon inspection, the presence of fecal matter, prolapsed hemorrhoids, dermatitis, scars, skin excoriation, the absence of perianal creases, or a gaping anus may be noted. These features suggest either sphincter weakness or chronic skin irritation and provide clues regarding the underlying etiology. Excessive perineal descent or rectal prolapse can be demonstrated by asking the patient to attempt defecation. An outward bulge that exceeds 3 cm is usually defined as excessive perineal descent (62).

The perianal sensation should also be checked. The anocutaneous reflex examines the integrity of the connection between the sensory nerves and the skin, the intermediate neurons in the spinal cord segments S_2, S_3, and S_4, and the motor innervation of the external anal sphincter. This can be assessed by gently stroking the perianal skin with a cotton bud in each of the perianal quadrants. The normal response consists of a brisk contraction of the external anal sphincter. Impaired or absent anocutaneous reflex suggests either afferent or efferent neuronal injury (63).

Digital Rectal Examination

Recommendation: Digital rectal examination can identify patients with fecal impaction and overflow. It is not accurate enough for diagnosing sphincter dysfunction or for initiating therapy.

After inserting a lubricated, gloved index finger, one should assess the resting sphincter tone, the length of the anal canal, the integrity of the puborectalis sling, the acuteness of the anorectal angle, the strength of the anal muscle, and the elevation of the perineum during voluntary squeeze. Also, the presence of a rectocele or impacted stools may be noted. Unlike the examination of other organs, one should exercise considerable sensitivity and allay any fears when performing a digital rectal examination.

The accuracy of digital rectal examination—as an objective test for evaluating anal sphincter function—has been assessed in several studies. In one study of 66 patients, digital examination by an experienced surgeon was somewhat correlated with resting sphincter pressure ($r = 0.56$; $p < 0.001$) or maximum squeeze pressure ($r = 0.72$: $p < 0.001$) (64). In another study of 280 patients with several anorectal disorders, a reasonable correlation was reported between digital palpation and manometry (65). However, the sensitivity, the specificity, and the positive predictive value of the digital exam were very low (65). By the digital exam, the positive

Table 2. Treatment of Fecal Incontinence

Treat underlying cause
Supportive therapy
• Education/counseling/habit training
• Diet (fiber, lactose, fructose)
• Reduce caffeine intake
• Anal hygiene/skin care
Specific therapy
• Pharmacologic
Loperamide
Diphenoxylate/atropine (Lomotil®)
Codeine*
Cholestyramine/colestipol*
Estrogens*
Phenylephrine*
Sodium valproate*
Amitriptyline*
• Biofeedback therapy (neuromuscular conditioning)
Anal sphincter muscle strengthening
Rectal sensory conditioning
Rectoanal coordination training
• Biofeedback therapy for dyssynergic defecation (neuromuscular conditioning)
• Others
Anal plugs*
Sphincter bulking*
- Collagen*, gax*, silicone
Anal electrical stimulation*
• Surgery
Sphincteroplasty
Anterior repair
Gracilis muscle transposition ± stimulation
Artificial bowel sphincter
Sacral nerve stimulation
Colostomy

Uncontrolled study/anecdotal*.

predictive value of detecting a low sphincter tone was 66.7% and a low squeeze tone was 81% (31). In another study of 64 patients, the agreement between digital examination and resting anal canal pressure or squeeze pressure was 0.41 and 0.52, respectively (66). These data suggest that digital examination is only an approximation, which is influenced by many factors including the size of the examiner's finger, the technique, and the cooperation of the patient. Thus, it is not very reliable and is prone to interobserver differences.

INVESTIGATIONS OF FECAL INCONTINENCE

Recommendation: Endoscopic evaluation of the rectosigmoid region is appropriate for detecting mucosal disease or neoplasia that may contribute to fecal incontinence.

At the outset it is important to distinguish whether the incontinence is either secondary to diarrhea or independent of stool consistency. If there is coexisting diarrhea, a flexible sigmoidoscopy or colonoscopy should be performed to exclude colonic mucosal inflammation, a rectal mass, or stricture. Stool studies, including stool screening for infection, stool volume, stool osmolality and electrolytes may be performed. Similarly, biochemical tests may reveal thyroid dysfunction, diabetes and other metabolic disorders. Breath tests may reveal lactose or fructose intolerance or bacterial overgrowth (24).

Several specific tests are available for defining the underlying mechanisms of fecal incontinence (23, 52, 63, 67). These tests are often complementary (23, 52, 63, 67). The most useful tests are anorectal manometry, anal endosonography, balloon expulsion test and pudendal nerve terminal motor latency (23, 52, 63, 67). A description of these tests and others that are commonly used for the evaluation of fecal incontinence and their clinical significance has been discussed in detail by Diamant *et al*. (67). Hence, a brief description of these tests and their clinical relevance is presented here with particular emphasis on recent literature and contentious issues.

Anorectal Manometry and Sensory Testing

Recommendation**:** Anorectal manometry with rectal sensory testing is the preferred method for defining the functional weakness of the external or internal anal sphincter and for detecting abnormal rectal sensation. Measurement of rectal compliance (reservoir function) may be helpful in some patients. These tests may also facilitate biofeedback training.

Anorectal manometry provides an objective assessment of anal sphincter pressures together with an assessment of rectal sensation, rectoanal reflexes, and rectal compliance. Currently, several types of probes and pressure-recording devices are available. Each system has distinct advantages and drawbacks (63, 68, 69). A water-perfused probe with multiple closely spaced sensors is commonly used (63, 69). Alternatively, a solid-state probe with micro-transducers may be used (63, 69). Although more expensive and fragile, they do not require perfusion equipment, are easier to calibrate, and are possibly more accurate (63, 68).

The anal sphincter pressures can be measured by stationary, station pull-through, or rapid pull-through techniques, but the former two are probably more accurate (63, 67, 68). A rapid pull-through technique can give falsely high sphincter pressures (67, 70). The resting anal sphincter pressure predominantly represents the internal anal sphincter function and the voluntary squeeze anal pressure predominantly measures the external anal sphincter function.

Patients with incontinence have been shown to have low resting and low squeeze sphincter pressures (65, 71, 72). The duration of the sustained squeeze pressure provides an index of sphincter muscle fatigue. The ability of the external anal sphincter to contract in a reflex manner can also be assessed during abrupt increases of intraabdominal pressure such as when coughing (25, 63, 68, 69). This reflex response causes the anal sphincter pressure to rise above that of the rectal pressure to preserve continence. The response may be triggered by receptors on the pelvic floor and mediated through a spinal reflex arc. In patients with spinal cord lesions above the conus medullaris, this reflex response is present but the voluntary squeeze may be absent, whereas in patients with lesions of the cauda equina or sacral plexus both the reflex response and the voluntary squeeze response are absent (63, 73, 75). The response may be triggered by receptors on the pelvic floor and mediated through a spinal reflex arc.

Sensory Testing

Rectal balloon distention with either air or water can be used for the assessment of both the sensory responses and the compliance of the rectal wall. By distending a balloon in the rectum with incremental volumes, it is possible to assess the thresholds for first perception, a first desire or an urgent desire to defecate (25, 52, 63, 68, 69). A higher threshold for sensory perception suggests impaired rectal sensation (23, 25, 41, 52, 71). Also, the balloon volume required for partial or complete inhibition of anal sphincter tone can be assessed. It has been shown that the volume required to induce reflex anal relaxation was lower in incontinent patients than controls (71, 74).

Because sampling of rectal contents by the anal mucosa may play an important role in maintaining continence (18, 19), quantitative assessment of anal perception using either electrical (22) or thermal (22, 76) stimulation has been advocated. In one study, anal mucosal sensation was assessed by recording perception threshold for electrical stimulation of the mid anal canal using a ring electrode (77). A combined sensory and motor defect was seen in patients with incontinence (77). In another study, although anal canal perception was impaired immediately after a vaginal delivery, there was no difference at 6 months (78). The role of thermosensitivity appears controversial (22). In one study, the ability of healthy anal mucosa to differentiate between small changes in temperature has been questioned (79). Hence, under normal conditions it is not possible to appreciate the temperature of fecal matter passing from the rectum to the anal canal during sampling (79). Whether patients have a pure sensory defect of anus without coexisting sphincter dysfunction or rectal sensory impairment has not been shown. In contrast, a combined sensory and motor defect has been reported in many studies (77, 78, 80).

Rectal compliance can be calculated by assessing the changes in rectal pressure during balloon distention with air or fluid (41, 44, 52, 67, 68). The ratio dv/dp describes the relationship. Rectal compliance is reduced in patients with colitis (53, 54) and in patients with low spinal cord lesions and in diabetics with incontinence (41, 44, 52). In contrast, compliance is increased in high spinal cord lesion (42, 75).

When performed meticulously, anorectal manometry can provide useful information regarding anorectal function (23, 52, 67, 80). A technical review recommended the use of anorectal manometry for the evaluation of patients with incontinence because it can define the functional weakness of one or both sphincters and helps to perform and evaluate the responses to biofeedback training (67). Unfortunately, to date there has been no uniform technique or equipment for performing anorectal manometry (81). Also, there is a dearth of normative data and uniform methods of interpreting test results. Hence, there is an urgent need to develop standards of testing anorectal function and to validate the significance of abnormal results. Recently, the American Motility Society has initiated an international collaborative effort to develop standards for manometry testing and a consensus document has been published (82). Such efforts may lead to standardization of testing and interpretation of anorectal manometry.

Although there are insufficient data regarding normal values, overlap among healthy subjects and patients with incontinence (65, 67), and large confidence intervals in studies that have examined test reproducibility (64, 83), for the individual patient with incontinence, manometry testing can be very useful. Manometric tests of anorectal function may also be useful in assessing objective improvement following drug therapy (84), biofeedback therapy (85), or surgery (86).

Imaging the Anal Canal

***Recommendation*:** Anal endosonography is the simplest, most widely available and least expensive test for defining structural defects of the anal sphincter and should be considered in patients with suspected fecal incontinence.

ANAL ENDOSONOGRAPHY. Traditionally, anal endosonography has been performed using a 7 mHz rotating transducer with a focal length of 1–4 cm (87). It provides an assessment of the thickness and structural integrity of the external and internal anal sphincter muscle and can detect the presence of scarring, loss of muscle tissue, and other local pathology (87, 88). More recently, higher frequency (10–15 mHz) probes that provide better delineation of the sphincter complex have become available (89).

After vaginal delivery, anal endosonography has revealed occult sphincter injury in 35% of primipara women and most of these lesions were not detected clinically (27). In another study, sphincter defects were detected in 85% of women with third-degree perineal tear compared with 33% of subjects without tears (28). In studies that compared EMG mapping with anal endosonography, there was a high concordance rate for identifying sphincter defects using both modalities (90, 91). The technique is, however, operator dependent and requires both training and experience (67). Although endosonography can distinguish an internal sphincter injury from that of an external sphincter injury, it has a low specificity for demonstrating the etiology of fecal incontinence (92). Because anal endosonography is more widely available, is less expensive, and is certainly less painful than needle insertion, currently, it is the preferred technique for examining the morphology of anal sphincter muscles.

MAGNETIC RESONANCE IMAGING (MRI). In a recent small study, endoanal magnetic resonance imaging (MRI) has been shown to provide superior imaging with better spatial resolution, particularly for defining the anatomy of the external anal sphincter (89). One study showed that MRI was less accurate than anal endosonography (93), however, others disagree (89). A major contribution of anal MRI has been the recognition of external sphincter atrophy (94) and how this may adversely affect sphincter repair (95). Atrophy may also be present without pudendal neuropathy (96). The addition of dynamic pelvic MRI using fast imaging sequences or MRI colpocystography that involves filling the rectum with ultrasound gel as a contact agent and having the patient evacuate this while lying inside the magnet may define the anorectal anatomy more precisely (97, 98). The use of an endo-anal coil significantly enhances the resolution and allows more precise definition of sphincter muscles (96). Comparative studies that assess costs, availability, technical know how, clinical utility, and how MRI may influence treatment decisions are, however, warranted.

Defecography

Recommendation**:** Defecography is useful in patients with suspected rectal prolapse or in those with poor rectal evacuation but it is otherwise of limited value.

This is a radiographic test that provides morphological information regarding the rectum and anal canal and uses fluoroscopic techniques (99–101). It is used to assess several parameters such as the anorectal angle, pelvic floor descent, length of anal canal, presence of a rectocele, rectal prolapse, or mucosal intussusception. Approximately 150 ml of contrast material is placed into the rectum and the subject is asked to squeeze, cough, or expel the contrast. A variety of contrast materials that includes esophageal contrast barium, barium mixed with oatmeal, or other viscous materials have been used.

Although it can detect a number of abnormalities these can also be seen in otherwise asymptomatic individuals (67, 102, 103) and their presence correlates poorly with impaired rectal evacuation (52, 67). There is poor agreement between observers in the measurement of the anorectal angle (104, 105). It is unclear whether one should use the central axis of the rectum (99) or the posterior wall of the rectum (99–102, 104–106). The functional significance of identifying morphological defects has been questioned (67, 107). Many investigators have also questioned the rationale of performing defecography in patients with incontinence as it adds very little additional information to that obtained from manometry (67, 108–110). Although defecography can confirm the occurrence of incontinence at rest or during coughing, it is most useful for demonstrating rectal prolapse in suspected patients (67, 108–110).

Balloon Expulsion Test

Recommendation: Balloon expulsion test can identify impaired evacuation in patients with fecal seepage or in those with fecal impaction and overflow.

Almost all normal subjects can expel a balloon containing a 50 ml water-filled balloon (68) or a silicon-filled artificial stool from the rectum (111). In general, most patients with fecal incontinence have little or no difficulty with evacuation. But patients with fecal seepage (56, 57) and many elderly subjects with fecal incontinence secondary to fecal impaction (58) demonstrate impaired evacuation. In these selected patients a balloon expulsion test (63, 67, 68) may help to identify dyssynergia. Dyssynergia describes a condition where there is lack of coordination between the abdominal, the pelvic floor, and anal sphincter muscles during defecation (112–114). The presence of dyssynergic defecation, however, requires other objective tests (112–115). Nonetheless, if impaired evacuation is present, then a balloon expulsion test can be used to select patients with fecal seepage for biofeedback training and also to assess their therapeutic efficacy (56, 57).

Pudendal Nerve Terminal Latency (PNTML)

Recommendation**:** Pudendal nerve terminal motor latency may be useful in the assessment of patients prior to anal sphincter repair and is particularly helpful in predicting the outcome of surgery.

The pudendal nerve terminal motor latency measures neuromuscular integrity between the terminal portion of the pudendal nerve and the anal sphincter. An injury to the pudendal nerve leads to denervation of the anal sphincter muscle and muscle weakness. Thus, measurement of the nerve latency time can help to distinguish a weak sphincter muscle due to muscle injury from that due to nerve injury. A disposable electrode (St. Mark's electrode; Dantec-Medtronics, Minneapolis, MN) is used to measure the latency time (116). A prolonged nerve latency time suggests pudendal neuropathy.

Women who delivered vaginally with a prolonged second stage of labor or had forceps-assisted delivery were found to have a prolonged PNTML compared to women who delivered by caesarian section or spontaneously (117–120). It has also been shown that women with fecal incontinence after an obstetric injury have both pudendal neuropathy and anal sphincter defects (119, 120).

Fecal incontinence is often the end result of both nerve and muscle injury (118–120). In one study, women with obstetrical injury developed fecal incontinence only when there was associated pudendal neuropathy (121). Thus, PNTML by itself cannot identify the underlying mechanism for fecal incontinence. However, in conjunction with manometry and/or anal endosonography, it can provide the missing link. In a retrospective study of 55 patients with fecal incontinence, secondary to obstetric trauma and who underwent surgery, five patients with intact anal sphincter and six with a non-intact anal sphincter had a poor surgical outcome (122). Thus, neither anal endosonography nor PNTML could predict surgical outcome. Others have shown that no single test of anorectal function has high-enough discriminatory value or predictive value for defining the underlying pathophysiology (65). One study showed that surgical repair produced a good-to-excellent result in 80% of women with fecal incontinence but without pudendal neuropathy compared to 11% of women with neuropathy (119). Thus, it appears that women with sphincter defects alone fare better following sphincter repair than women with both sphincter defects and neuropathy. The AGA technical review, however, concluded that PNTML cannot be recommended for the evaluation of patients with fecal incontinence because it correlates poorly with clinical symptoms and histology findings; it does not discriminate muscle weakness caused by nerve or muscle injury; it had poor sensitivity and specificity; it was operator dependent; and that it did not predict surgical outcome (67).

However, two recent reviews of eight uncontrolled studies (118, 123) reported that patients with pudendal neuropathy generally have a poor surgical outcome when compared to those without neuropathy.

A normal PNTML does not exclude pudendal neuropathy, because the presence of a few intact nerve fibers can give a normal result, whereas an abnormal latency time is more significant. Thus, when interpreting the PNTML result, it is important to consider whether a patient has a pure muscle injury or a pure neurogenic injury or a mixed injury. In a patient with only muscle injury, there may be little or no nerve damage whereas in a patient with only neurogenic injury there may be little or no muscle disruption. In the vast majority of patients, however, there is a mixed injury. If so, the prognostic value of PNTML will depend to some extent on the degree of each type of injury, the age of the patient, and other coexisting problems (118). A well-designed multicenter prospective controlled trial is needed to better define the utility of this test, both for diagnostic purposes and for predicting the clinical outcome of therapeutic intervention(s).

Saline Infusion Test

***Recommendation*:** The saline infusion test can serve as a simple method for evaluating fecal incontinence, in particular for assessing clinical improvement after surgery or biofeedback therapy.

This test assesses the overall capacity of the defecation unit to maintain continence during conditions that simulate diarrhea (23, 69, 71, 80, 85, 124). With the patient lying on the bed, a 2-mm plastic tube is introduced approximately 10 cm into the rectum and taped in position. Next, the patient is transferred to a commode. The tube is connected to an infusion pump and either 1,500 ml (71, 124) or 800 ml (23, 68, 69) of warm saline (37°C) is infused into the rectum at a rate of 60 ml/min. The patient is instructed to hold the liquid for as long as possible. The volume of saline infused at the onset of first leak (defined as a leak of at least 15 ml), and the total volume retained at the end of infusion are recorded (23, 69, 71, 124). Most normal subjects should retain most of this volume without leakage (23, 69), whereas patients with fecal incontinence (65, 71, 85) or patients with impaired rectal compliance, such as ulcerative colitis (124), leak at much lower volumes. The test is also useful in assessing objective improvement of fecal incontinence after biofeedback therapy (85).

Clinical Utility of Tests for Fecal Incontinence

A diagnostic test is useful if it can provide information regarding the patients underlying pathophysiology, confirm a clinical suspicion, or guide clinical management. There are five studies that have evaluated clinical utility. In one prospective study, history alone could detect an underlying cause in only 9 of 80 patients (11%) with fecal incontinence whereas physiological tests revealed an abnormality in 44 patients (55%) (125). Undoubtedly, the aforementioned tests help to define the underlying mechanisms, but there is only limited information regarding their clinical utility and their impact on management.

In a large retrospective study of 302 patients with fecal incontinence, an underlying pathophysiological abnormality was identified, but only after performing manometry, EMG, and rectal sensory testing (25). Most patients had more than one pathophysiologic abnormality.

In another large study of 350 patients, incontinent patients had lower resting and squeeze sphincter pressures, a smaller rectal capacity, and leaked earlier following saline infusion in the rectum (80). However, both a single test or a combination of three different tests (anal manometry, rectal capacity, saline continence test) provided a low discriminatory value between continent and incontinent patients. This emphasizes the wide range of normal values and the ability of the body to compensate for the loss of any one mechanism.

In a prospective study, anorectal manometry with sensory testing not only confirmed a clinical impression but also provided new information that was not detected clinically (23). Furthermore, the diagnostic information obtained from these studies influenced both the management and the outcome of patients with incontinence (23). A single abnormality was found in 20% whereas more than one abnormality was found in 80% of patients (23, 24). In another study, abnormal sphincter pressure was found in 40 patients (71%) whereas altered rectal sensation or poor rectal compliance was present in 42 patients (75%) (125). These findings have been further confirmed by another study, which showed that physiological tests provided a definitive diagnosis in 66% of patients with incontinence (126). However, based on these tests alone, it is not possible to predict whether an individual patient is continent or incontinent. Consequently, an abnormal test result must be interpreted along with the patient's symptoms and other complementary tests. Tests of anorectal function provide objective data and define the underlying pathophysiology; most of this information cannot be detected clinically.

MANAGEMENT OF PATIENTS WITH FECAL INCONTINENCE

The goal of treatment for patients with fecal incontinence is to restore continence and to improve the quality of life. Several strategies that include both supportive and specific measures may be used (Table 3). An algorithmic approach for the evaluation and management of patients with fecal incontinence is presented in Fig. 2.

Supportive Measures

Recommendation: Supportive measures such as avoiding offending foods, ritualizing bowel habit, improving skin hygiene, and instituting lifestyle changes may serve as useful adjuncts to the management of fecal incontinence.

Table 3. A Summary of the Major Studies of Biofeedback Therapy in Fecal Incontinence

Author	Ref No.	Year	N	Age Range (years)	F/M	Training Method	Home Training	Sessions (range)	Follow-up	Outcome assessment	Improvement (%)
Engel	154	1974	7	6–54	5/2	EMG + Manometry	NA	1–4	6–16 mo.	Interview	57
Cerulli	170	1979	50	5–97	36/12	EMG + Manometry	NA	1	1–25 mo.	NA	72
Goldenberg	171	1980	12	12–78	6/6	Manometry	NA	>1	2–22 mo.	NA	83
Wald	153	1981	17	10–79	11/6	Manometry + HT	Yes	1 + 1	2–38 mo.	Interview	71
Wald	172	1984	11	25–75	8/3	Manometry + HT	Yes	NA	4–30 mo.	NA	73
Latimer	173	1984	8	8–72	4/4	EMG + Manometry		8(2/wk)	6 mo.	Diary	88
Whitehead	151	1985	18	65–72	15/3	EMG + Manometry	Yes	8(2/wk)	6 mo.	Diary	77
Buser*	147	1986	13	13–66	7/6	EMG + Manometry	Yes	1–3	16–30 mo.	NA	92
MacLeod	150	1987	113	25–88	67/48	EMG	NA	Mean 3.3	6–60 mo.	Rating	63
Riboli	174	1988	21	14–48	15/6	EMG + Manometry	NA	12(2/wk)	3 mo.	NA	86
Enck	175	1990	19	10–80	10/9	EMG + Manometry	Yes	5–10	3–6 mo.	Diary	63
Loening Baucke	176	1990	8	35–78	8/0	EMG + Manometry	Yes	3	12 mo.	Diary	50
Miner*	145	1990	25	17–76	17/8	EMG + Manometry	Yes	3	<24 mo.	Diary	76
Keck	155	1994	15	29–65	13/2	Manometry	NA	1–7	1–12 mo.	Interviews	73
Enck*	177	1994	28	33–83	14/4	EMG + Manometry	Yes	NA	60–72 mo.	Interviews	75
Guillemot*	160	1995	16	39–72	13/3	Manometry	Yes	4	30 mo.	Diary/ARM	56
Sangwan*	157	1995	28	30–74	22/1	Manometry	Yes	2–6	4–47 mo.	Interview/ARM	75
Rao*	85	1996	19	15–78	17/2	Manometry	Yes	Mean 6	12 mo.	Diary/ARM	75
Rieger	178	1997	30	29–85	30/0	EMG + Manometry	Yes	6	6–12 mo.	Interview	67
Patankar	156	1997	72	NA	NA	EMG + HT	Yes	2–11	NA	Interview	85
Glia*	149	1998	22	NA	NA	Manometry	Yes	NA	Mean 21 mo.	NA	63
Norton	159	1999	100	14–82	84/16	Manometry	Yes	2–8		Interview/ARM	67
Fynes	161	1999	39	18–48	39/0	EMG + Electrical Stimulation	Yes	12	3 mo.	Questionnaire/ARM	69
Ryn*	179	2000	37	22–82	36/1	EMG	Yes	2–11	12–59 mo.	Questionnaire	60 Short, 41 Long
Norton	158	2003	171	26–85	159/12	Manometry ± EMG	Yes	5 (1–9)	6–12 mo.	Questionnaire/ARM	54
Total			846	5–97				1–11	1–60 mo.		69

EMG = electromyography; HT = home trainer, NA = Not available, * Follow-up ≥ 12 months.

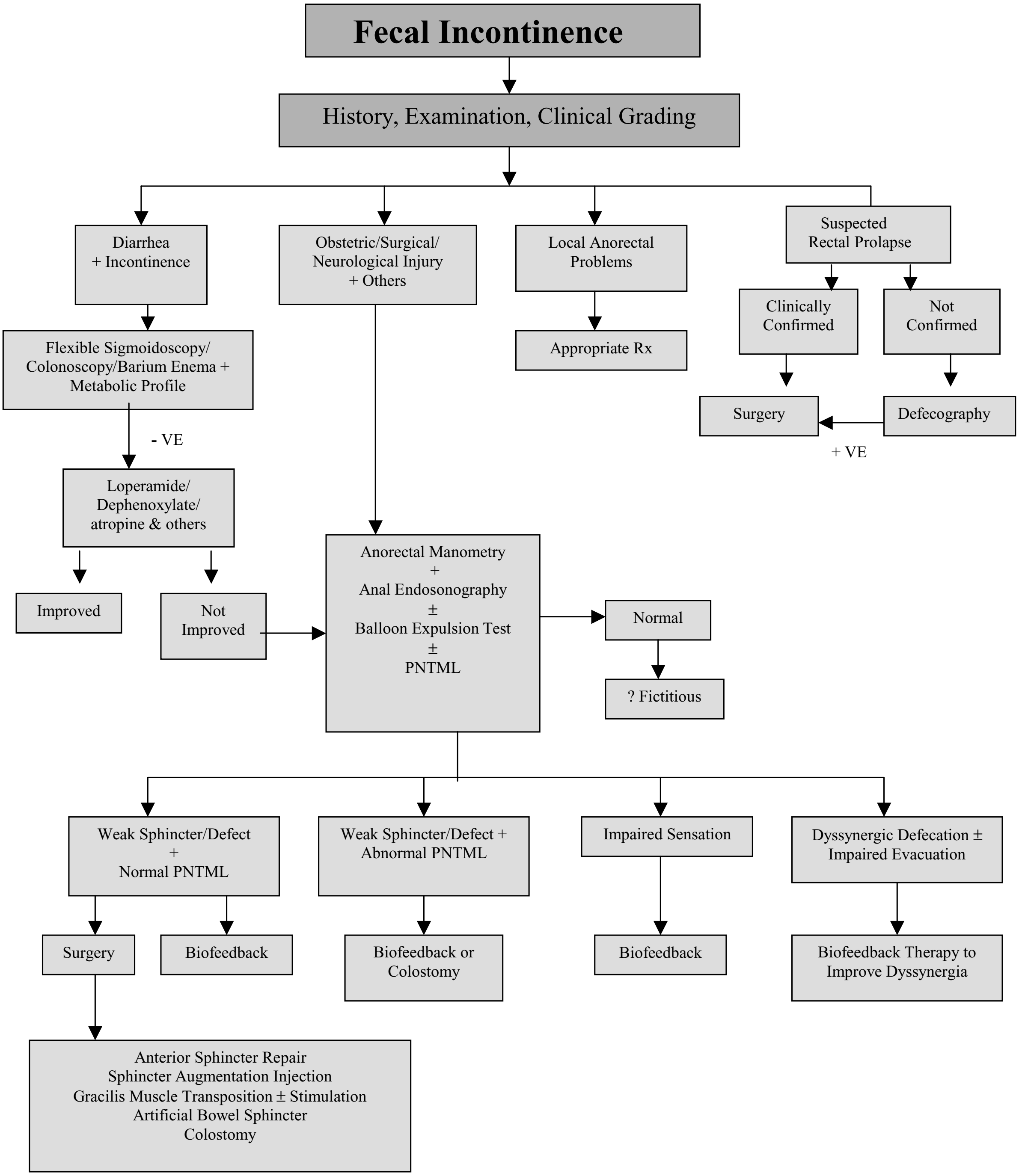

Figure 2. Algorithmic approach for the evaluation and management of patients with fecal incontinence.

A comprehensive history, (Table 1) detailed physical examination, and the use of prospective stool diary (Fig. 1), (24, 67) can provide important clues regarding the severity and type of incontinence as well as the predisposing condition(s), such as fecal impaction, dementia, neurological problems, inflammatory bowel disease or dietary factors (carbohydrate intolerance). If present, these issues should be treated or corrected aggressively.

In the management of the elderly or institutionalized patient with fecal incontinence, the availability of personnel experienced in the treatment of fecal incontinence, timely recognition of soiling, and immediate cleansing of the perianal skin is of paramount importance (127, 128). Hygienic measures such as changing undergarments, cleaning the perianal skin immediately following a soiling episode, the use of moist tissue paper (baby wipes), rather than dry toilet paper, and barrier creams such as zinc oxide and calamine lotion (Calmoseptine®, Calmoseptine Inc: Huntington Beach, CA) may be useful in preventing the skin excoriation (127, 129). Perianal fungal infections should be treated with topical antifungal agents. More significantly, scheduled toileting with a commode at the bedside or bedpan and supportive measures to improve the general well-being and nutrition of the patient may all prove effective. Stool deodorants (Periwash®, Sween Corp, MN, Derifil®, Rystan Corp. NJ, and Devrom®, Parthenon Co., UT) can be useful for disguising the smell of feces. In the institutionalized patient, ritualizing their bowel habit and instituting cognitive training may prove beneficial. These measures are important, failing which these patients have been shown to have a higher mortality compared to those without incontinence (130).

Other supportive measures can include dietary modifications such as reducing caffeine or fiber intake. Caffeine-containing coffee enhances the gastro-colonic response and increases colonic motility (131) and induces fluid secretion in the small intestine (132). Hence, reducing caffeine consumption, particularly after meals may help to lessen postprandial urgency and diarrhea. Brisk physical activity, particularly after meals or immediately after waking may precipitate fecal incontinence because these physiological events are associated with increased colonic motility (133, 134). Acute exercise can enhance colonic motor activity and transit (135). A food and symptom diary may identify appropriate dietary factors that cause diarrheal stools and incontinence, in particular, lactose or fructose malabsorption. Eliminating these food items may prove beneficial (136). Fiber supplements such as psyllium are often advocated in an attempt to increase stool bulk and reduce watery stools. However, there has been no published study to justify this approach. It is worth noting that fiber supplements can potentially worsen diarrhea by increasing colonic fermentation of unabsorbable fiber.

Specific Treatment

This may be considered under the following categories:

1. Pharmacologic therapy
2. Biofeedback therapy
3. Plugs, sphincter bulkers, and ancillary therapy
4. Surgery

PHARMACOLOGIC THERAPY. ***Recommendation*:** Loperamide or diphenoxylate/atropine can produce modest improvement in symptoms related to fecal incontinence.

Several drugs, each with a different mechanism of action, have been proposed to improve fecal incontinence.

Antidiarrheal agents such as loperamide hydrochloride (Imodium®—Janssen Pharmaceuticals: Titusville, NJ) or diphenoxylate/atropine sulphate (Lomotil®, Searle, Chicago, IL) remain the mainstay of drug treatment. A placebo-controlled study of loperamide 4 mg tid has been shown to reduce the frequency of incontinence, improve stool urgency and increase colonic transit time (84), as well as increase anal resting sphincter pressure (137) and reduce stool weight (138). Clinical improvement was also reported with diphenoxylate/atropine (Lomotil®) (139) but, objective testing showed no improvement in their ability to retain saline or spheres. Codeine phosphate shows similar benefit but may cause drowsiness and addiction, whereas diphenoxylate/atropine may cause dryness of mouth. Although most patients benefit temporarily, after a few days, many report crampy lower abdominal pain, or difficulty with evacuation on antidiarrheals. Hence, careful titration of the antidiarrheal dosage is required to produce the desired result. Idiopathic bile salt malabsorption may be an important underlying cause for diarrhea and incontinence (24, 69). Patients with this problem may benefit from titrated doses of ion exchange resins such as cholestyramine (Questran®, Bristol Laboratories, Princeton, NJ) or colestipol (Colestid®, Pharmacia & Upjohn, Kalamazoo, MI).

Postmenopausal women with fecal incontinence may benefit from estrogen replacement therapy. In a prospective, open-ended study of estrogen, 25% of 20 postmenopausal women with either flatus or fecal incontinence and stool urgency became asymptomatic after 6 months of treatment. An additional two thirds improved symptomatically (140). Anal resting pressures and voluntary squeeze pressures also increased following estrogen therapy (140). Recently, in a randomized trial of topical 10% phenylephrine cream, symptomatic improvement was observed in one half of patients with an ileoanal pouch and incontinence and a complete resolution in another one third (141). Another preliminary study suggested that valproate sodium, by activating GABA receptors may increase anal sphincter pressures, and reduce stool frequency and soiling in patients with ileoanal anastomosis (142). A most recent open-labeled study showed that amitriptyline (20 mg) was useful in the treatment of patients with urinary or fecal incontinence and without evidence of structural defects or neuropathy (143). Suppositories or enemas may also have a role in the treatment of incontinent patients with incomplete rectal evacuation or in those with post-defecation seepage. In some patients, constipating medications alternating with periodic enemas may provide more controlled evacuation of bowel contents, but these interventions have not been prospectively tested.

BIOFEEDBACK THERAPY. ***Recommendation:*** Biofeedback therapy is a safe and effective treatment. It improves symptoms of fecal incontinence, restores quality of life, and improves objective parameters of anorectal function. It is useful in patients with weak sphincters and/or impaired rectal sensation.

Behavioral therapy using "operant conditioning," techniques has been shown to improve bowel function and incontinence (144). The governing principle is that an individual acquires a new behavior through a process of trial and error. If this learning process is reinforced repeatedly, especially with instant feedback, the likelihood of acquiring and perfecting this behavior increases several-fold (144). The goals of biofeedback therapy in a patient with fecal incontinence are:

1. to improve the strength of the anal sphincter muscles;

2. to improve the coordination between the abdominal, gluteal, and anal sphincter muscles during voluntary squeeze and following rectal perception;
3. to enhance the anorectal sensory perception.

Because each goal requires a specific method of training, the treatment protocol should be customized for each patient based upon the underlying pathophysiologic mechanism(s). Biofeedback training is often performed using either visual, auditory, or verbal feedback techniques (144). The instruments used to provide feedback consist of a manometry or EMG probe that is inserted into the anorectum and a monitor or chart recorder for displaying the manometric changes (67, 144). When a patient is asked to squeeze and to maintain the squeeze for as long as possible, the anal sphincter muscle contracts. This increase in anal pressure or EMG activity can be displayed on a monitor and can serve as a visual cue that provides instant feedback to the patient regarding their performance. Similarly, the intensity or pitch of the auditory signals generated by the anal EMG activity can provide auditory feedback information. The verbal reinforcement is provided by the therapist (84, 144).

The aim of recto-anal coordination training is to achieve a maximum voluntary squeeze in less than 2 s after inflating a balloon in the rectum. In reality, this maneuver mimics the arrival of stool in the rectum and prepares the patient to react appropriately by contracting the right group of muscles (84, 144–146). Patients are taught how to selectively squeeze their anal muscles without increasing their intraabdominal pressure or inappropriately contracting their gluteal or thigh muscles. Also, this maneuver identifies sensory delay and trains the individual to use visual clues to improve sensorimotor coordination (145, 147). Sensory conditioning of the rectum educates the patient to perceive a lower volume of balloon distention but with the same intensity as they had felt earlier with a higher volume. This is achieved by repeatedly inflating and deflating a balloon in the rectum (84, 145, 147). Other approaches include an augmented biofeedback program that consists of electrical stimulation of the anal sphincter with EMG feedback.

These neuromuscular conditioning techniques must be used together with pelvic muscle strengthening (modified Kegel exercises) and other supportive measures in order to achieve sustained improvement of their bowel function. A component analysis as to which method of biofeedback, *i.e.*, muscle training or sensory training or both is more effective and as to whether Kegel exercises by themselves are effective has not been performed.

At the outset, it is often difficult to predict how many biofeedback treatment sessions are required. Most patients seem to require between four to six training sessions (85, 144). Studies that had employed a fixed number of treatment sessions, often less than three, showed a less favorable improvement response when compared to those, which titrated the number of sessions based on the patients' performance (144, 148). In one study, periodic reinforcement with biofeedback training at 6 wk, 3 months, and 6 months, was felt to confer additional benefit (85), but this merits further confirmation.

In the literature the terms "improvement," "success," or "cure" have been used interchangeably and the definition for each term has been inconsistent. In uncontrolled studies, subjective improvement has been reported in 40–85% of patients. (85, 144, 148–150). A few studies have relied upon prospective symptom diaries (85, 145–148, 151), but many others used telephone inquiries or one-time surveys (149, 152–156). Objective improvement in anorectal function has been less commonly reported (85, 145, 146, 153–158). This may be due to differences in the technique of training—motor or sensory coordination, the number of training sessions, whether or not periodic reinforcement was used (85), and whether short-term or long-term assessments were performed. In a recent study of 100 patients with fecal incontinence, two thirds improved at the end of treatment and those with urge incontinence alone faired better than those with passive incontinence (55% *vs* 23%), (159). A few authors have argued that therapeutic efficacy of biofeedback training cannot be predicted on the basis of manometric results (145, 146, 153). In most of these studies, there was minimal objective improvement. However, one controlled prospective study showed that 1 yr after starting therapy, there was significant increase in voluntary squeeze pressure and significant improvement in recto-anal coordination, improved rectal sensation and the capacity to retain saline infusion (85). Similar results of improved anal sphincter function have been reported in recent studies (157, 158, 161). Recently, a large randomized controlled study of 171 patients who received behavioral therapy has been published (158). This showed that approximately 54% of patients with mild-to-moderate fecal incontinence (median number of episodes = 1/wk) who received either standard care with advice or instrument-based biofeedback therapy improved. Although repeat objective testing was lacking in 40%, they suggested that behavioral approaches with or without instrumentation may be effective.

The presence of severe fecal incontinence, pudendal neuropathy, and underlying neurological problems are associated with poor prognosis when treated with biofeedback therapy (162–164). One study suggested that biofeedback therapy may be most beneficial in patients with urge incontinence (159). Biofeedback also seems to be useful in patients who have undergone sphincteroplasty, (165), post-anal repair (166), and low anterior resections (167, 168) and in children who have undergone correction of congenital anorectal anomalies (169). However, there has been no randomized, controlled trial comparing biofeedback therapy with other modalities including surgery.

Table 3 summarizes the major studies of biofeedback therapy that have been published in the literature during the past 15 yr (85, 145–147, 149, 151, 153–161, 169–171). The technique of biofeedback therapy has not been standardized and the optimal method of defining clinical improvement is also unclear. This limits our ability to perform a meta-analysis.

Similarly, it is unclear which component of biofeedback therapy is most effective and which patients are suitable for this therapy. Furthermore, the use of this treatment is largely restricted to specialized centers. As experience grows and the long-term efficacy of biofeedback therapy is confirmed in controlled studies, it is likely that this safe therapy, which is relatively inexpensive and easy to administer, but labor intensive will become more popular. It is worth noting that manometric parameters obtained at baseline do not appear to predict the clinical response to biofeedback treatment (157, 158). Hence, selection criteria, motivation of the individual, enthusiasm of the therapist, and severity of incontinence may each affect the outcome (144, 148, 158, 159).

In spite of a lack of uniform approach, most techniques of biofeedback therapy seem to confer benefit (Table 3). Hence, biofeedback therapy should be offered to all patients with fecal incontinence who have failed supportive measures, and especially to older patients and those with comorbid illnesses, to those with pudendal neuropathy and to those patients before reconstructive surgery.

PLUGS, SPHINCTER BULKERS, ELECTRICAL STIMULATION. ***Recommendation*****:** Anal plug devices, sphincter bulking therapies or electrical stimulation should be considered as experimental and merit controlled clinical trials.

An innovative disposable anal plug has been designed to temporarily occlude the anal canal (180). This device is attached to the perineum using a tape and can be easily retrieved. Unfortunately, many patients are unable to tolerate a prolonged insertion of this device, owing to many factors (181, 182). It may be useful for patients with impaired anal canal sensation, those with neurological disease (183), and those who are institutionalized or immobilized. In some patients with fecal seepage, insertion of an anal plug made up of cotton wool may prove beneficial.

Bulking the anal sphincter in order to augment its surface area and thereby provide a better seal for the anal canal has been attempted using a variety of agents. This includes autologous fat (184), glutaraldehyde-treated collagen (GAX), (185), or synthetic macromolecules (186). These materials are usually injected submucosally either at the site where the sphincter is deficient or circumferentially, if the whole muscle is degenerated or fragmented. Studies have shown definite improvement in the short term in patients with passive fecal incontinence (185, 186). The experience with these techniques is, however, limited and there is no controlled or long-term outcome study.

Electrical Stimulation. Here, electric current is applied to the anal canal to stimulate muscle contraction. In one study, treatment was administered daily for 10 days. There was some improvement in 10 of 15 patients and this was associated with an increase in voluntary squeeze pressure (187). In another study, 30-minute treatment sessions were given twice daily for 12 weeks, but only limited improvement was seen in 2 of 10 patients and there was no change in sphincter pressures (188). Neither study was controlled and the optimal method of delivering this treatment was unclear. In a meta-analysis it was reported that there were insufficient data to draw meaningful conclusions regarding the efficacy of this treatment (189).

An alternative treatment may be the use of sacral nerve stimulation. In one study that assessed the short-term effects (190), continence was restored in eight of nine patients. Similar results were reported by another study that followed up five patients (191). However, the precise indication for sacral nerve stimulation, its comorbidity, its long-term outcome and efficacy remain to be defined.

SURGERY. ***Recommendation*****:** Surgery should be considered in selected patients who have failed conservative measures or biofeedback therapy.

In most patients with fecal incontinence such as after obstetric trauma, overlapping sphincter repair is often sufficient (192). Here, the torn ends of the sphincter muscle are plicated together and to the puborectalis muscle. Overlapping sphincter repair as described by Parks involved a curved incision anterior to the anal canal with mobilization of the external sphincter, dividing it at the site of the scar, preservation of the scar tissue to anchor the sutures, and overlap repair using two rows of sutures (192). If an internal anal sphincter defect is identified, a separate imbrication of the internal anal sphincter may be undertaken. Symptom improvement in the range of 70–80% has been reported (192, 193), although one study reported a lower improvement rate (194). In patients with incontinence due to a weak, but intact anal sphincter, postanal repair has been tried (195). The long-term success of this approach ranges between 20% and 58% (196).

In those patients with severe structural damage of the anal sphincter and significant incontinence, neo-sphincter construction has been attempted using two different approaches: (1) construction of a neo-sphincter from autologous skeletal muscle, often the gracilis and rarely the glutei (123, 197); and (2) the use of an artificial bowel sphincter (198–200).

The technique of stimulated gracilis muscle transposition (dynamic graciloplasty) has been tested in many centers (199, 200). This technique uses the principle that a fast twitch fatigable skeletal muscle when stimulated over a long term can be transformed into a slow twitch fatigable muscle that can provide a sustained, sphincter-like muscle response. Such continuous stimulation is maintained by an implanted pacemaker (201, 202). When the subject has to defecate or expel gas, a magnetic external device is used to temporarily switch off the pacemaker. Clinical improvement (success) rates have ranged between 38% and 90% (mean 67%) (123). Another approach has been to implant an artificial bowel sphincter (198). The artificial sphincter consists of an implanted inflatable cuffed device that is filled with fluid from an implanted balloon reservoir that is controlled by a subcutaneous pump. The cuff is deflated to allow defecation (203). In one series of 24 carefully selected patients, although some had the device explanted, nearly 75% reported satisfactory results

(203). Both approaches require major surgery and the revision rate approaches 50%. At medium-term follow-up, 50–70% of patients have a functioning new sphincter (123, 191, 203). In one study, the total direct cost of dynamic graciloplasty was estimated to be $31,733, colostomy including stoma care was $71,576, and conventional treatment for fecal incontinence was $12,180 (204). Although, graciloplasty was more expensive than conventional treatment, patients rated their quality of life as better. Colostomy was the least favored procedure.

The Malone or antegrade continent enema procedure (205) consists of fashioning a cecostomy button or appendicostomy (206, 207). This allows periodic antegrade wash out of the colon and may be suitable for children (206, 207) and patients with neurological lesions (208).

If none of these techniques are suitable or have failed, a colostomy still remains a safe although esthetically a less preferable option for many patients (123, 209–211). It is particularly suitable for patients with spinal cord injury, and those immobilized with skin problems or other complications (209–211). A colostomy should not be regarded as a failure of medical or surgical treatment (123, 211). In many, the restoration of a normal quality of life and ameliorization of symptoms can be very rewarding. The use of a laparoscopic-assisted approach, trephine colostomy may help to fashion a stoma with minimal morbidity for the patient (212).

There are no controlled studies that have compared surgical management with pharmacological therapy or biofeedback therapy. Similarly, there are no controlled studies that have compared the different surgical approaches. However, several surgical techniques have been proposed. Because the outcome of most procedures ranges from significant improvement initially to a less satisfactory result in the long term, no single procedure is universally accepted. It is likely that through a better understanding of the underlying pathophysiology and the development of safer and better techniques and prospective controlled trials, in the near future it may become possible to select younger patients with well-defined sphincter defects for appropriate surgery.

Treatment of Subgroups with Fecal Incontinence

SPINAL CORD INJURY. Patients with spinal cord injury may develop fecal incontinence due to either a supra-spinal lesion or a lesion affecting the cauda equina (73, 75). In the former group, the sacral neuronal reflex arc is intact and the cough reflex is preserved. Therefore, reflex defecation is possible either through digital stimulation or with suppositories. In patients with low spinal cord or cauda equina lesions, digital stimulation may not be effective because the defecation reflex is often impaired. Here, the management consists of antidiarrheal agents to prevent continuous soiling with stool, followed by the periodic administration of enemas or the use of laxatives or lavage solutions at convenient intervals (24, 40). A cecostomy procedure may also be appropriate (213). In some patients colostomy may be the best option (209).

FECAL SEEPAGE. Because patients with fecal seepage show dyssynergic defecation with impaired rectal sensation (56, 214), neuromuscular conditioning with biofeedback techniques to improve dyssynergia can be useful (57). Therapy consisting of sensory conditioning and rectoanal coordination of the pelvic floor muscles to evacuate stools more completely was recently shown to substantially reduce the number of fecal seepage events and to objectively improve bowel function and anorectal function (57).

ELDERLY SUBJECTS OR CHILDREN WITH FECAL INCONTINENCE. Many of these patients also have fecal impaction and overflow (58, 215). After cleansing of the rectum, a habit-training program and laxative regimen should be established for the patient to ensure that a bowel movement occurs at least every other day. In the elderly, ritualizing their bowel habit, improving mobility, and cognitive training may be useful (127). In children, attention to both resolving parental conflicts and psychosocial stressors and alleviating the fear of a painful bowel movement may be critical for a successful outcome (214, 216).

APPENDIX

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