# Delayed surgical management of the disrupted anal sphincter

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## INTRODUCTION

Fecal incontinence is the involuntary loss of flatus or feces. The emotional, psychological, and social problems created by fecal incontinence can be devastating, debilitating, and costly [1].

- Delayed repair of anal sphincter disruption will be reviewed here. The anatomy and physiology of the anal sphincter, pathogenesis of anal sphincter dysfunction, and evaluation of patients with fecal incontinence are discussed separately. (See "Fecal incontinence in adults: Etiology and evaluation".)

- Primary surgical repair of anal sphincter injury related to childbirth is also discussed separately. (See "Repair of perineal lacerations associated with childbirth".)

In this topic, when discussing study results, we will use the terms "woman/en" or "patient(s)" as they are used in the studies presented. However, we encourage the reader to consider the specific counseling and treatment needs of transgender and gender diverse individuals.

## PREVALENCE

Fecal incontinence affects 9 percent of women aged 40 to 59 years old and as many as 21 percent of women aged over 80 years old [2]. Unfortunately, it is often unrecognized by clinicians because patients do not report their symptoms. Data are conflicting as to whether

the rate is higher in women than in men [3,4]. (See "Fecal incontinence in adults: Etiology and evaluation", section on 'Epidemiology'.)

## CLINICAL MANIFESTATIONS AND ETIOLOGY

The most common cause of fecal incontinence in healthy women is obstetric trauma, which can result in mechanical disruption of the anal sphincter muscles or damage to the nerves that innervate these muscles. The injury may be occult, and symptoms may not occur until many years after delivery, especially when injury involves the levator ani musculature or the upper and mid-anal canal, as seen with vacuum and forceps delivery [5-7].

Chronic anterior anal sphincter defects can occur along the entire length of the anal canal, with or without a visible laceration at time of delivery, or after breakdown of a primary perineal anal sphincter laceration. These patients typically complain of fecal urgency and can have incontinence of gas, mucus, liquid, and even solid feces. The severity of symptoms is, at least in part, dependent on the size of the tear, but also on the amount and functionality of the residual muscle and the degree of collateral damage to the levator ani musculature and pudendal nerves [8,9].

A rectovaginal fistula is another cause of fecal incontinence; it may occur after an unrecognized injury in the middle portion of the anal canal during a vacuum extraction, a forceps delivery, a breakdown of a repair of third- or fourth-degree laceration in the distal anal canal, or a combination of the above mechanisms. (See "Fecal and anal incontinence associated with pregnancy and childbirth: Counseling, evaluation, and management" and "Approach to episiotomy", section on 'Complications' and "Rectovaginal and anovaginal fistulas".)

## EVALUATION

**Physical examination** — Women with chronic anal sphincter tears frequently have complete disruption of the perineal body, as well as the external and internal anal sphincter. Disruption of the sphincter complex occurs anteriorly, and in many patients, the tear is easily identifiable on examination. Occasionally, the tear is less obvious: physical examination alone can miss a tear in as many as 25 percent of women who present with fecal incontinence [10]. Furthermore, clinical diagnosis of sphincter injury at time of an obstetric laceration repair overestimates degree and presence of sphincter injuries in 21 percent of women [11]. Therefore, anal sphincter ultrasound (endoanal, perineal, or endovaginal) should always be obtained as part of the evaluation of fecal incontinence and prior to any surgical repair (see 'Preoperative diagnostic studies' below). In addition, the rectovaginal septum is often attenuated. The anal mucosa usually is in direct proximity to the distal vaginal epithelium;

however, in some women, a thin bridge of perineal skin is present between the vaginal and anal epithelium.

In contrast to most chronic injuries to both the internal and external sphincter (fourth-degree lacerations or rupture of both sphincters with forceps/vacuum delivery), women with chronic partial anal sphincter injury (third-degree lacerations or rupture of external sphincter only with forceps/vacuum delivery) have a thinned, but intact, perineal body. The radial skin creases of the anal verge are noticeably absent anteriorly, corresponding to the anterior sphincter defect. This appearance is called the "dovetail" sign and indicates the external anal sphincter is not intact [12].

The woman should be asked to contract her anal sphincter as part of the examination. Upon voluntary contraction, constriction of the separated end of the external anal sphincter will create dimpling in the perianal skin. The location of the dimpling suggests the location of the snapped sphincter complex. Absence of this dimpling may be due to significant neurologic injury to the sphincter and should alert the clinician that simple anastomosis may not completely cure the incontinence.

After the external examination, an internal rectovaginal examination is essential. The examiner inserts an index finger into the anal canal while the thumb is inserted into the distal vagina. The presence or absence of intact muscle between the two fingers is assessed using a "pinch and drag" maneuver.

**Preoperative diagnostic studies —** The role of preoperative diagnostic studies in patients with disrupted anal sphincter is to confirm the diagnosis (if appropriate) and determine anatomic features important both to surgical planning and prognostic counseling. Appropriate patient selection for sphincter repairs is guided by preoperative endoanal ultrasound, anorectal physiology testing with anorectal manometry, and pudendal nerve terminal motor latency.

**Endoanal ultrasound —** Anal sphincter ultrasound (endoanal, perineal, endovaginal, translabial) is by far the most useful clinical tool for the diagnosis of anal sphincter disruption and all techniques have high sensitivity and specificity in describing sphincter integrity in expert hands [13]. Both the external and internal anal sphincter are easily visualized by these modalities, which can be used to confirm anal sphincter disruption and to help the surgeon identify the location of the snapped ends of the anal sphincter. An example of sphincter injury on endoanal ultrasound is shown in the image ( image 1). An injury to more than two-thirds of the anal sphincter complex (longitudinally) is more likely to benefit from repair than an injury to only one-third of the sphincter complex. Similarly, a wider sphincter gap (more than 45 degrees) is more likely to benefit from repair, though a gap wider than 180 degrees is generally difficult to reapproximate. Finally, even in presence of levator ani

avulsion, women with intact anal sphincters seem to have better long-term continence than the women with dual injuries [14,15].

- (See "Endorectal endoscopic ultrasound (EUS) in the evaluation of fecal incontinence".)
- (See "Ultrasound examination of the female pelvic floor", section on 'Conditions for evaluation'.)

**Anorectal physiology tests** — The role of anorectal physiology testing in predicting outcomes is controversial and poorly studied. At our institution, all patients with fecal incontinence are tested with both anorectal manometry and pudendal nerve testing at the time of their initial surgical consultation. The results of these tests are then used to educate the patients considering sphincteroplasty about their potential functional outcomes after surgery. However, given that data on the ability of anorectal physiology testing to predict outcomes are mostly retrospective, no individual test result in isolation is ever used to deny patients the opportunity for a sphincteroplasty as long as they understand that their testing results, when worrisome, mean there is an increased risk that surgery may not lead to an improvement in function.

Anorectal physiology testing is performed with either an air or water charged catheter system and can generate high- or low-resolution data regarding the pressures generated in the anus and rectum at rest, squeeze, and push.

- **Low-resolution testing** – For low-resolution testing, anal resting and squeeze pressures are calculated at each centimeter starting at 6 cm from the anal verge. The high-pressure zone is identified and then mean resting pressure, maximum resting pressure, and maximum squeeze pressure are calculated using the definitions of the American Society of Colon and Rectal Surgeons [16].
  - Mean resting pressure is the mean of the resting pressures recorded within the high-pressure zone.
  - Maximum resting pressure is the highest resting pressure recorded.
  - Maximum squeeze pressure is the highest pressure recorded above the baseline (zero) at any level of the anal canal during maximum squeeze effort.
- **High-resolution testing** – For high-resolution testing, interpretation generally follows the London Classification System [17]. This classification system allows for a more nuanced diagnosis of anal hypotension (or normotenstion) at rest with either normal contractility with squeeze versus hypocontractility or hypercontractility. Furthermore, high-resolution anoscopy helps pinpoint which area within the anal sphincter is nonfunctional, thus augmenting the information observed on anal sphincter ultrasound.

Patients with low resting anal pressures (anal hypotonia) on anorectal manometry are informed that retrospective studies show that patients with low preoperative mean resting and low squeeze pressures (anal hypocontractility) and/or a short anal canal showed more improvement in these measurements postoperatively than those with higher preoperative pressures and a longer anal canal [18]. They are also told that this postoperative improvement in anal tone and contractility pressures does not necessarily result in a better functional outcome, as measured by patient questionnaires. Patients who have high anal pressures on anorectal manometry are generally discouraged from undergoing sphincter repair without considering alternative treatment approaches first, such as sensitivity retraining, biofeedback, dietary modification, and sacral nerve stimulation. We feel that surgical repair is less likely to be successful in significantly augmenting sphincter function in this situation, especially if absence of anal hypocontractility is confirmed with high-quality testing [19].

Pudendal nerve testing is performed by gently inserting a digital electrode into the rectum to stimulate the pudendal nerve. The time from pudendal nerve stimulation to the first contraction of the external sphincter is electronically recorded ( figure 1). Patients who have unilateral or bilateral pudendal neuropathy are informed that some studies show that they may have a lower chance of a successful functional outcome [20,21]. An observational study reported that patients with bilateral normal pudendal nerve function have a 60 percent success rate after surgery, whereas patients with unilateral or no pudendal nerve function have only a 17 percent chance of a satisfactory functional outcome [21]. Given these data, patients with bilateral pudendal nerve delay are generally not considered for sphincter repair, unless they suffer from a visible cloaca.

## COUNSELING

Patients considering sphincteroplasty should be thoroughly informed about their chances for a successful functional outcome after surgery. In the absence of anorectal physiology testing and pudendal nerve terminal motor latency testing, they should understand that this procedure is most effective in women with moderate fecal incontinence (weekly loss of partial or complete solid bowel movements) or severe fecal incontinence (daily loss of complete solid bowel movements). Mild incontinence of gas, loss of liquid bowel movements, and occasional staining are less likely to improve with surgery. In fact, a repair can lead to worsening symptoms if a surgical complication occurs.

An ideal candidate for surgery is less than 60 years old, has symptoms of weekly loss of solid bowel movements, and tests results showing low anorectal manometry pressures with good pudendal nerve conduction. Unfortunately, even in this highly selected group of patients,

complete functional success only occurs in approximately 60 percent of patients, and the long-term success rate drops to 25 percent at 10 years [22,23].

As discussed above, unilateral or absent pudendal nerve function lowers success rates from 60 percent to 17 percent at a median of two years [21]. Thus, setting realistic short- and long-term expectations is an important part of the preoperative counseling that needs to be offered to these patients, and we find anorectal physiology testing results helpful during this discussion.

## PREOPERATIVE MANAGEMENT

**Bowel preparation** — Although there is no evidence-based guideline for a preoperative bowel regimen before anal surgery, common practice is a bowel prep before sphincter repair to diminish bacterial contamination of the perineal wound. For example, Nulytely or Golytely the night before surgery can be used as a mechanical bowel preparation.

**Antibiotics** — An antibiotic regimen that covers skin and enteric flora should be administered preoperatively. Appropriate regimens for patients with and without beta-lactam allergy, as well as the evidence behind these recommendations, can be found separately ( table 1). (See "Antimicrobial prophylaxis for prevention of surgical site infection in adults" and "Antimicrobial prophylaxis for prevention of surgical site infection following gastrointestinal procedures in adults" and "Antimicrobial prophylaxis for prevention of surgical site infection in adults", section on 'Timing'.)

**Foley catheter** — A Foley catheter is placed before the procedure. The Foley catheter is typically left in overnight and removed the morning after surgery because pain from the anal surgery often inhibits spontaneous voiding.

**Positioning** — Patients may be positioned in either the dorsal lithotomy or a jack knife prone position for the repair.

**Anesthesia** — General anesthesia without paralysis (eg, laryngeal mask anesthesia) facilitates identification of the sphincter muscles. (See "Overview of anesthesia", section on 'General anesthesia'.)

## SURGERY

**Goals** — The goal of sphincter repair is reconstruction of a cylindrical anal canal utilizing both external sphincter muscle and perineal body scar to allow circumferential contraction of the anal musculature when the patient attempts to defer defecation.

**Incision —** The perineal body is incised transversely in the plane that separates the rectum from the vagina.

**Dissection —** The vaginal and rectal walls are separated from each other by dissection to the levator ani complex, with care to avoid injuring the rectum, which could lead to a rectovaginal fistula postoperatively. The snapped ends of the external anal sphincter muscle are identified where they connect to the anterior perineal body scar created by the injury. The scar and the external sphincter muscles are carefully freed from the internal sphincter to allow the left and right external sphincter and scar complexes to overlap anteriorly. The scar connection to the muscle should not be trimmed off, as it is utilized in the repair. During this dissection, care should be taken not to extend the original incision and the final dissection laterally beyond the 180 degree circumference of the anus, as this may injure the pudendal nerves and thus compromise functional outcomes.

In situations where the internal anal sphincter is also injured anteriorly, both internal and external sphincters are mobilized en bloc to create the overlapping repair. Although some surgeons advocate separate dissection of the internal and external sphincters [24], we and others believe that this extra step is difficult to perform and does not necessarily translate in better function postoperatively [25,26].

**Repair —** Following mobilization of the external (and, if injured, the internal) anal sphincter, some surgeons, including myself, perform a levatorplasty to lengthen the anal canal, believing that this added maneuver may improve functional outcomes [27]. This can be accomplished with one or two interrupted nonabsorbable polypropylene sutures.

We use an overlap technique to attach the snapped ends of the external anal sphincter and the perineal body scar, which are sutured to each other with a nonabsorbable horizontal mattress stitch. These sutures should be placed in the scar, since the sutures are more likely to hold if placed in fibrous tissue. The goal is to create an overlap that forms a circumferential functioning muscular tunnel that surrounds the anal canal. Preservation of scar minimizes the lateral dissection necessary to create this tunnel and thus decreases the risk of injury to the pudendal nerves, which run laterally to the anal sphincter. Retrospective data suggest that preservation and utilization of scar in the overlap repair may improve short-term [28] and long-term functional outcomes [29]. However, no data from randomized trials are available to support this recommendation.

For acute repair of obstetric anal sphincter tears, where no scar is present to allow for an overlapping repair, the advantages of an overlapping sphincteroplasty as opposed to an end-to-end anastomosis are less clear. Though an overlapping repair has been advocated by some experts [24,30], most randomized trials have not demonstrated statistical or clinical superiority of this technique [31-35], with one exception [36]. In a 2013 meta-analysis of randomized trials comparing the overlap and end-to-end techniques, the overlap technique

was associated with a nonstatistical lower risk of one or more anal incontinence symptoms (RR 0.90, 95% CI 0.68-1.17; five trials, n = 2221), but this was primarily in the first 12 months after delivery and disappeared at 24 and 36 months [37]. Limitations of these studies were the inclusion of multiparous women and women with partial tears, and differences in measurement of outcomes and surgical experience.

Imbrication of the external anal sphincter provides an alternative in patients who have attenuation of the sphincter with incomplete disruptions and patients with wide lateral retraction of the muscle edges [38].

Lastly, the subcutaneous tissue and the skin are loosely closed with interrupted absorbable sutures. This allows drainage, which is important given the high risk of postoperative wound infections in these patients.

Diverting colostomy does not improve functional results or healing following repair [39-41]. We typically reserve colostomy for selected patients who present particularly challenging cases, such as some patients with Crohn's disease or recurrent sphincter repair.

## ALTERNATIVE TECHNIQUES

The small number of surgical trials for treatment of fecal incontinence (all causes), their small sample sizes, and methodological weaknesses make it impossible to identify clinically important differences among alternative surgical procedures [42].

**Sacral nerve stimulator —** The sacral nerve stimulator improves fecal continence in patients with disrupted anal sphincters, including those with previously failed overlapping sphincteroplasty. Over 80 percent of patients achieve a ≥50 percent reduction from baseline in incontinent episodes per week, with sustained long-term results [43,44]. Traditionally, this approach is reserved as a reasonable first-line option for patients who are not good candidates for an overlapping sphincteroplasty or who failed a sphincteroplasty or who prefer a nonsurgical approach. Surgical repair is generally less costly than sacral nerve stimulation, but is also more likely to have complications. (See "Fecal incontinence in adults: Management", section on 'Sacral nerve stimulation'.)

However, subsequent studies suggest the people may benefit from sacral nerve stimulation even when sphincter injuries are not repaired first. A retrospective comparison of patients treated with sacral nerve stimulation as an alternative to a sphincter repair reported a trend towards better results when sphincter repair was omitted [45]. This raises the possibility that many patients with sphincter injuries may develop eventual fecal incontinence from causes unrelated to this injury, such as bowel dysfunction [46,47].

**Artificial sphincter —** Insertion of an artificial bowel sphincter is effective in motivated patients who understand its high risks for wound infection and device malfunction and who have enough tissue between the rectum and the vagina to allow device placement [48]. However, the device is not available in most countries, including the United States. (See "Fecal incontinence in adults: Management".)

## POSTOPERATIVE CARE

Most patients stay overnight in the hospital, and are given a clear liquid diet. Expert opinions differ on whether a high fiber or low residue diet should be prescribed for the first month postoperatively. In general, immediately after surgery, we prescribe an oral laxative, such as milk of magnesia or polyethylene glycol, which can be given for the first few weeks to avoid constipation and to ensure that the patient is having loose stools. Two or three weeks later, we switch to a high fiber supplement such as Benefiber or Metamucil. A trial of women undergoing primary repair of third degree anal sphincter tears randomly assigned them to bowel confinement (codeine phosphate 60 mg orally three times daily) or laxatives (lactulose 10 mL orally three times daily) for the first three postoperative days and found no difference between groups in continence scores, anal manometry, and endoanal ultrasound findings three months after the repair [49]. However, patients in the laxative group had significantly earlier and less painful bowel motion.

## COMPLICATIONS

Wound breakdown is the most frequent complication: the reported infection rate ranges from 10 to 80 percent. Bowel confinement with narcotics [49], prolonged antibiotic treatment [50], and diverting colostomy [39-41] do not decrease the rate of postoperative infections and are not recommended.

## ADJUVANT NONSURGICAL MANAGEMENT

The primary treatment for obstetric and traumatic causes of fecal incontinence is surgical repair. However, mechanical injury to the continence mechanism is often associated with nonreversible neurologic injury that may become progressive with age and menopause.

Patients treated surgically also benefit from adjuvant treatments such as dietary manipulation, pharmacologic management, and behavioral and biofeedback techniques. As an example, biofeedback has been used to improve functional outcomes in patients with persistent fecal incontinence despite successful anatomical reapproximation of the anal

sphincter complex [51]. (See "Fecal incontinence in adults: Management", section on 'Initial management'.)

## FUTURE OBSTETRIC DELIVERIES

Women who have a secondary repair of an anal sphincter rupture should be thoroughly counseled regarding future pregnancy and deliveries. Experts recommend that a woman with persistent fecal incontinence and a poorly functioning anal sphincter despite secondary repair be offered a planned cesarean for subsequent deliveries. Clear recommendations cannot be made, however, regarding repeat vaginal deliveries versus cesarean sections in the women without residual fecal incontinence following an uneventful sphincter repair at the time of a vaginal delivery. (See "Fecal and anal incontinence associated with pregnancy and childbirth: Counseling, evaluation, and management", section on 'Approach to delivery'.)

## SUMMARY AND RECOMMENDATIONS

- **Etiologies –** The most common cause of fecal incontinence in healthy women is obstetric trauma that results in mechanical disruption to the anal sphincter muscles, damage to the nerves that innervate these muscles, and/or formation of a rectovaginal fistula. (See 'Clinical manifestations and etiology' above.)
- **Goal of surgical repair –** The goal of sphincter repair is reconstruction of a muscular cylinder to surround the anal canal and allow for circumferential muscular contraction upon attempts to defer defecation. (See 'Goals' above.)
  - **Repair technique –** We suggest an overlapping technique rather than an end-to-end technique (**Grade 2C**). (See 'Repair' above.)
  - **Implantable sacral nerve stimulator –** Implantation of a sacral nerve stimulator is a reasonable option for patients who are not good candidates for sphincteroplasty or who failed sphincteroplasty, and it may even be considered a first-line treatment for patients where the sphincter injury coexists with bowel dysfunction. (See 'Sacral nerve stimulator' above.)



### REFERENCES

1. Sung VW, Rogers ML, Myers DL, et al. National trends and costs of surgical treatment for female fecal incontinence. Am J Obstet Gynecol 2007; 197:652.e1.

2. Nygaard I, Barber MD, Burgio KL, et al. Prevalence of symptomatic pelvic floor disorders in US women. JAMA 2008; 300:1311.
3. Drossman DA, Li Z, Andruzzi E, et al. U.S. householder survey of functional gastrointestinal disorders. Prevalence, sociodemography, and health impact. Dig Dis Sci 1993; 38:1569.
4. Whitehead WE, Borrud L, Goode PS, et al. Fecal incontinence in US adults: epidemiology and risk factors. Gastroenterology 2009; 137:512.
5. Sultan AH, Kamm MA, Hudson CN, Bartram CI. Third degree obstetric anal sphincter tears: risk factors and outcome of primary repair. BMJ 1994; 308:887.
6. Dudding TC, Vaizey CJ, Kamm MA. Obstetric anal sphincter injury: incidence, risk factors, and management. Ann Surg 2008; 247:224.
7. Valsky DV, Cohen SM, Lipschuetz M, et al. Third- or Fourth-Degree Intrapartum Anal Sphincter Tears Are Associated With Levator Ani Avulsion in Primiparas. J Ultrasound Med 2016; 35:709.
8. Bordeianou L, Lee KY, Rockwood T, et al. Anal resting pressures at manometry correlate with the Fecal Incontinence Severity Index and with presence of sphincter defects on ultrasound. Dis Colon Rectum 2008; 51:1010.
9. Shek KL, Green K, Hall J, et al. Perineal and vaginal tears are clinical markers for occult levator ani trauma: a retrospective observational study. Ultrasound Obstet Gynecol 2016; 47:224.
10. Keating JP, Stewart PJ, Eyers AA, et al. Are special investigations of value in the management of patients with fecal incontinence? Dis Colon Rectum 1997; 40:896.
11. Jones A, Ferrari L, Martinez PI, et al. Anal endosonographic assessment of the accuracy of clinical diagnosis of obstetric anal sphincter injury. Int Urogynecol J 2022; 33:2977.
12. Toglia MR, DeLancey JO. Anal incontinence and the obstetrician-gynecologist. Obstet Gynecol 1994; 84:731.
13. Ignell C, Örnö AK, Stuart A. Correlations of obstetric anal sphincter injury (OASIS) grade, specific symptoms of anal incontinence, and measurements by endoanal and transperineal ultrasound. J Ultrasound 2021; 24:261.
14. Soerensen MM, Pedersen BG, Santoro GA, et al. Long-term function and morphology of the anal sphincters and the pelvic floor after primary repair of obstetric anal sphincter injury. Colorectal Dis 2014; 16:O347.
15. Oom DM, Steensma AB, Zimmerman DD, Schouten WR. Anterior sphincteroplasty for fecal incontinence: is the outcome compromised in patients with associated pelvic floor injury? Dis Colon Rectum 2010; 53:150.

16. Bordeianou LG, Carmichael JC, Paquette IM, et al. Consensus Statement of Definitions for Anorectal Physiology Testing and Pelvic Floor Terminology (Revised). Dis Colon Rectum 2018; 61:421.
17. Carrington EV, Heinrich H, Knowles CH, et al. The international anorectal physiology working group (IAPWG) recommendations: Standardized testing protocol and the London classification for disorders of anorectal function. Neurogastroenterol Motil 2020; 32:e13679.
18. Gearhart S, Hull T, Floruta C, et al. Anal manometric parameters: predictors of outcome following anal sphincter repair? J Gastrointest Surg 2005; 9:115.
19. Carrington EV, Knowles CH, Grossi U, Scott SM. High-resolution Anorectal Manometry Measures Are More Accurate Than Conventional Measures in Detecting Anal Hypocontractility in Women With Fecal Incontinence. Clin Gastroenterol Hepatol 2019; 17:477.
20. Ricciardi R, Mellgren AF, Madoff RD, et al. The utility of pudendal nerve terminal motor latencies in idiopathic incontinence. Dis Colon Rectum 2006; 49:852.
21. Gilliland R, Altomare DF, Moreira H Jr, et al. Pudendal neuropathy is predictive of failure following anterior overlapping sphincteroplasty. Dis Colon Rectum 1998; 41:1516.
22. Barisić G, Krivokapić Z, Marković V, et al. The role of overlapping sphincteroplasty in traumatic fecal incontinence. Acta Chir Iugosl 2000; 47:37.
23. Bravo Gutierrez A, Madoff RD, Lowry AC, et al. Long-term results of anterior sphincteroplasty. Dis Colon Rectum 2004; 47:727.
24. Goetz LH, Lowry AC. Overlapping sphincteroplasty: is it the standard of care? Clin Colon Rectal Surg 2005; 18:22.
25. Oberwalder M, Dinnewitzer A, Baig MK, et al. Do internal anal sphincter defects decrease the success rate of anal sphincter repair? Tech Coloproctol 2006; 10:94.
26. Wexner SD, Marchetti F, Jagelman DG. The role of sphincteroplasty for fecal incontinence reevaluated: a prospective physiologic and functional review. Dis Colon Rectum 1991; 34:22.
27. Aitola P, Hiltunen KM, Matikainen M. Functional results of anterior levatorplasty and external sphincter plication for faecal incontinence. Ann Chir Gynaecol 2000; 89:29.
28. Moscovitz I, Rotholtz NA, Baig MK, et al. Overlapping sphincteroplasty: does preservation of the scar influence immediate outcome? Colorectal Dis 2002; 4:275.
29. Fang DT, Nivatvongs S, Vermeulen FD, et al. Overlapping sphincteroplasty for acquired anal incontinence. Dis Colon Rectum 1984; 27:720.
30. Sultan AH, Monga AK, Kumar D, Stanton SL. Primary repair of obstetric anal sphincter rupture using the overlap technique. Br J Obstet Gynaecol 1999; 106:318.

31. Tjandra JJ, Han WR, Goh J, et al. Direct repair vs. overlapping sphincter repair: a randomized, controlled trial. Dis Colon Rectum 2003; 46:937.
32. Garcia V, Rogers RG, Kim SS, et al. Primary repair of obstetric anal sphincter laceration: a randomized trial of two surgical techniques. Am J Obstet Gynecol 2005; 192:1697.
33. Fitzpatrick M, Behan M, O'Connell PR, O'Herlihy C. A randomized clinical trial comparing primary overlap with approximation repair of third-degree obstetric tears. Am J Obstet Gynecol 2000; 183:1220.
34. Williams A, Adams EJ, Tincello DG, et al. How to repair an anal sphincter injury after vaginal delivery: results of a randomised controlled trial. BJOG 2006; 113:201.
35. Farrell SA, Gilmour D, Turnbull GK, et al. Overlapping compared with end-to-end repair of third- and fourth-degree obstetric anal sphincter tears: a randomized controlled trial. Obstet Gynecol 2010; 116:16.
36. Fernando RJ, Sultan AH, Kettle C, et al. Repair techniques for obstetric anal sphincter injuries: a randomized controlled trial. Obstet Gynecol 2006; 107:1261.
37. Fernando RJ, Sultan AH, Kettle C, Thakar R. Methods of repair for obstetric anal sphincter injury. Cochrane Database Syst Rev 2013; :CD002866.
38. Delancey JO, Toglia MR, Perucchini D. Internal and external anal sphincter anatomy as it relates to midline obstetric lacerations. Obstet Gynecol 1997; 90:924.
39. Arnaud A, Sarles JC, Sielezneff I, et al. Sphincter repair without overlapping for fecal incontinence. Dis Colon Rectum 1991; 34:744.
40. Schoetz DJ Jr. Operative therapy for anal incontinence. Surg Clin North Am 1985; 65:35.
41. Hasegawa H, Yoshioka K, Keighley MR. Randomized trial of fecal diversion for sphincter repair. Dis Colon Rectum 2000; 43:961.
42. Brown SR, Wadhawan H, Nelson RL. Surgery for faecal incontinence in adults. Cochrane Database Syst Rev 2010; :CD001757.
43. Matzel KE, Lux P, Heuer S, et al. Sacral nerve stimulation for faecal incontinence: long-term outcome. Colorectal Dis 2009; 11:636.
44. Wexner SD, Coller JA, Devroede G, et al. Sacral nerve stimulation for fecal incontinence: results of a 120-patient prospective multicenter study. Ann Surg 2010; 251:441.
45. Rodrigues FG, Chadi SA, Cracco AJ, et al. Faecal incontinence in patients with a sphincter defect: comparison of sphincteroplasty and sacral nerve stimulation. Colorectal Dis 2017; 19:456.
46. Bharucha AE, Zinsmeister AR, Schleck CD, Melton LJ 3rd. Bowel disturbances are the most important risk factors for late onset fecal incontinence: a population-based case-control study in women. Gastroenterology 2010; 139:1559.

47. Alavi K, Chan S, Wise P, et al. Fecal Incontinence: Etiology, Diagnosis, and Management. J Gastrointest Surg 2015; 19:1910.
48. Wong WD, Congliosi SM, Spencer MP, et al. The safety and efficacy of the artificial bowel sphincter for fecal incontinence: results from a multicenter cohort study. Dis Colon Rectum 2002; 45:1139.
49. Mahony R, Behan M, O'Herlihy C, O'Connell PR. Randomized, clinical trial of bowel confinement vs. laxative use after primary repair of a third-degree obstetric anal sphincter tear. Dis Colon Rectum 2004; 47:12.
50. McDonald M, Grabsch E, Marshall C, Forbes A. Single- versus multiple-dose antimicrobial prophylaxis for major surgery: a systematic review. Aust N Z J Surg 1998; 68:388.
51. Jensen LL, Lowry AC. Biofeedback improves functional outcome after sphincteroplasty. Dis Colon Rectum 1997; 40:197.

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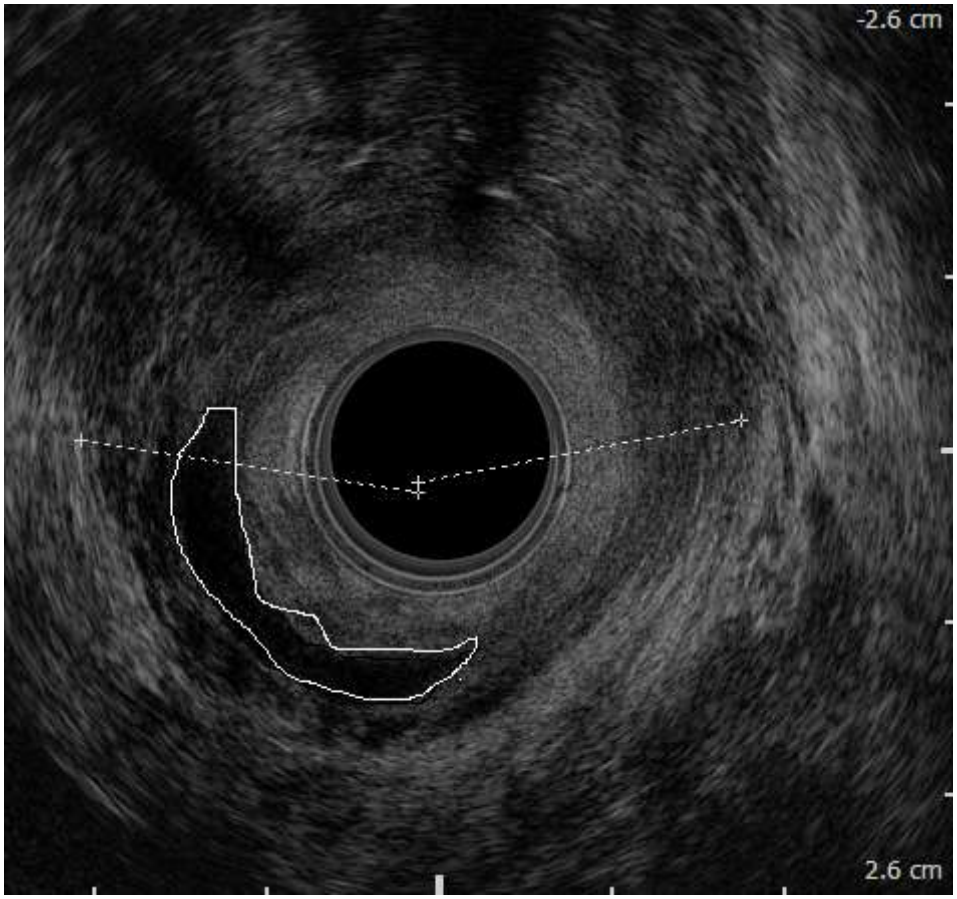
## GRAPHICS

### Endoanal ultrasound showing a retracted internal anal sphincter




The solid line represents the retracted internal anal sphincter.

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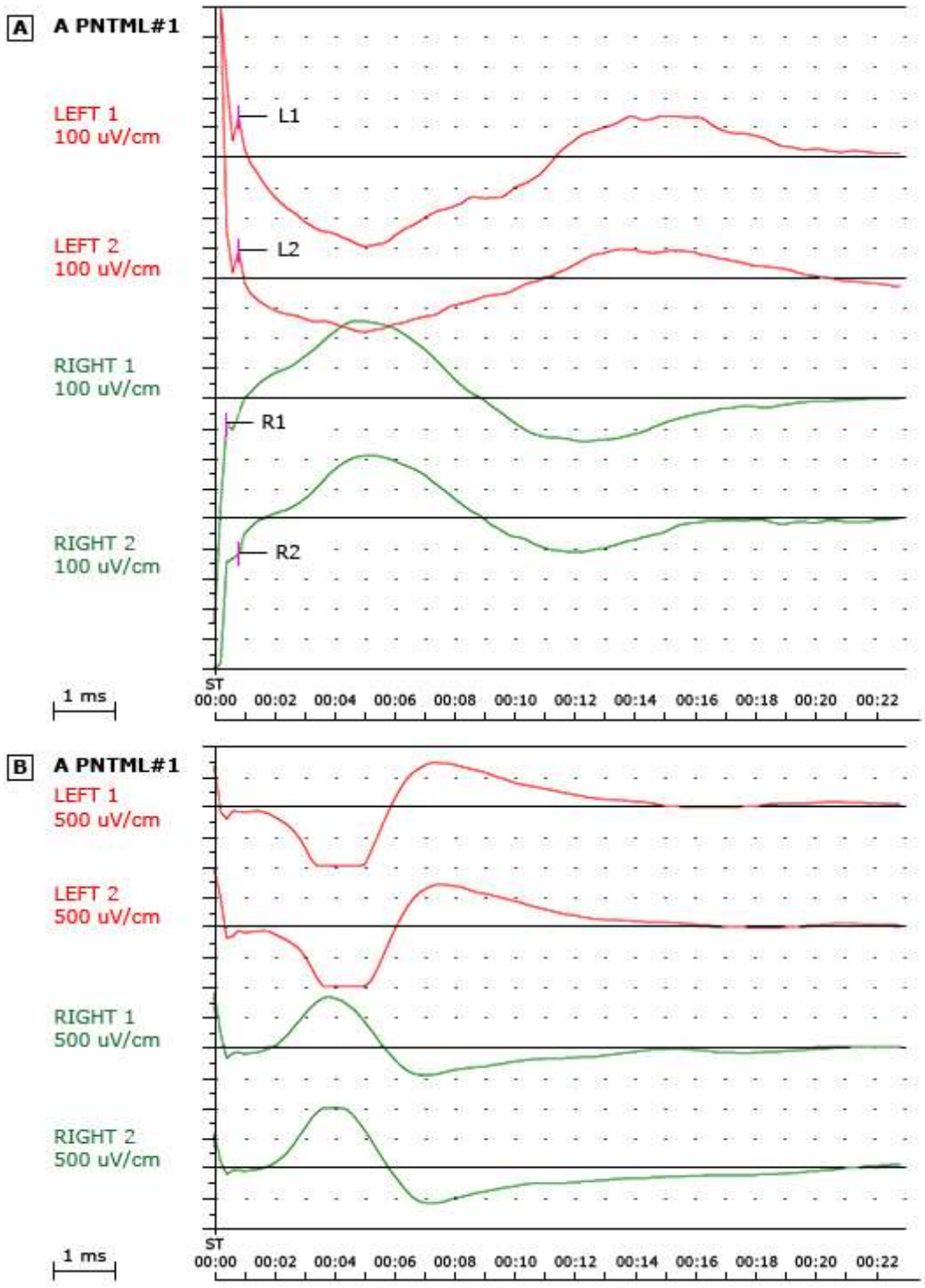
Graphic 76163 Version 3.0

## Pudendal nerve terminal motor latency tests




(A) In this patient, both right and left pudendal nerves fire less than 2 milliseconds after stimulation. This is considered normal.

(B) In this patient, the right and left pudendal nerves fire at 2 milliseconds. Since 2 milliseconds is the cutoff between normal and abnormal, this result would be labelled as indeterminate. Longer delays in firing would be labelled as abnormal.

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Graphic 51112 Version 3.0

## Antimicrobial prophylaxis for gastrointestinal surgery in adults

| Nature of operation | Common pathogens | Recommended antimicrobials | Usual adult dose* | Redose interval[¶] |
|---|---|---|---|---|
| **Gastroduodenal surgery** | | | | |
| Procedures involving entry into lumen of gastrointestinal tract | Enteric gram-negative bacilli, gram-positive cocci | Cefazolin[Δ] | <120 kg: 2 g IV<br>≥120 kg: 3 g IV | 4 hours |
| Procedures not involving entry into lumen of gastrointestinal tract (selective vagotomy, antireflux) | Enteric gram-negative bacilli, gram-positive cocci | High risk[◇] only: cefazolin[Δ] | <120 kg: 2 g IV<br>≥120 kg: 3 g IV | 4 hours |
| **Biliary tract surgery (including pancreatic procedures)** | | | | |
| Open procedure or laparoscopic procedure (high risk)[§] | Enteric gram-negative bacilli, enterococci, clostridia | Cefazolin[Δ¥] (preferred) | <120 kg: 2 g IV<br>≥120 kg: 3 g IV | 4 hours |
| | | **OR** cefotetan | 2 g IV | 6 hours |
| Laparoscopic procedure (low risk) | N/A | None | None | None |
| **Appendectomy[‡]** | | | | |
| | Enteric gram-negative bacilli, anaerobes, enterococci | Cefazolin[Δ]<br>PLUS metronidazole (preferred) | *For cefazolin:*<br><120 kg: 2 g IV<br>≥120 kg: 3 g IV<br>*For metronidazole:*<br>500 mg IV | *For cefazolin:*<br>4 hours<br>*For metronidazole:*<br>N/A |
| | | **OR** cefotetan[Δ] | 2 g IV | 6 hours |
| **Small intestine surgery** | | | | |
| Nonobstructed | Enteric gram-negative bacilli, gram-positive cocci | Cefazolin[Δ] | <120 kg: 2 g IV<br>≥120 kg: 3 g IV | 4 hours |

| | | | | |
|---|---|---|---|---|
| Obstructed | Enteric gram-negative bacilli, anaerobes, enterococci | Cefazolin[Δ]<br>PLUS metronidazole (preferred) | *For cefazolin:*<br><120 kg: 2 g IV<br>≥120 kg: 3 g IV<br>*For metronidazole:*<br>500 mg IV | *For cefazolin:*<br>4 hours<br>*For metronidazole:*<br>N/A |
| | | **OR** cefotetan[Δ] | 2 g IV | 6 hours |
| **Hernia repair** | | | | |
| | Aerobic gram-positive organisms | Cefazolin[Δ] | <120 kg: 2 g IV<br>≥120 kg: 3 g IV | 4 hours |
| **Colorectal surgery**[†] | | | | |
| | Enteric gram-negative bacilli, anaerobes, enterococci | Parenteral: | | |
| | | Cefazolin[Δ]<br>PLUS metronidazole (preferred) | *For cefazolin:*<br><120 kg: 2 g IV<br>≥120 kg: 3 g IV<br>*For metronidazole:*<br>500 mg IV | *For cefazolin:*<br>4 hours<br>*For metronidazole:*<br>N/A |
| | | **OR** cefotetan[Δ] | 2 g IV | 6 hours |
| | | Oral (used in conjunction with mechanical bowel preparation): | | |
| | | Neomycin PLUS erythromycin base or metronidazole | ** | ** |

IV: intravenous.

* Parenteral prophylactic antimicrobials can be given as a single IV dose begun within 60 minutes before the procedure. If vancomycin or a fluoroquinolone is used, the infusion should be started within 60 to 120 minutes before the initial incision to have adequate tissue levels at the time of incision and to minimize the possibility of an infusion reaction close to the time of induction of anesthesia.

¶ For prolonged procedures (>3 hours) or those with major blood loss or in patients with extensive burns, additional intraoperative doses should be given at intervals one to two times the half-life of the drug.

Δ For patients allergic to penicillins and cephalosporins, clindamycin (900 mg) or vancomycin (15 mg/kg IV; not to exceed 2 g) with either gentamicin (5 mg/kg IV), ciprofloxacin (400 mg IV), levofloxacin (500 mg IV), or aztreonam (2 g IV) is a reasonable alternative. Metronidazole (500 mg IV) plus an aminoglycoside or fluoroquinolone is also an acceptable alternative regimen, although metronidazole plus aztreonam should not be used, since this regimen does not have aerobic gram-positive activity.

◇ Severe obesity, gastrointestinal (GI) obstruction, decreased gastric acidity or GI motility, gastric bleeding, malignancy or perforation, or immunosuppression.

§ Factors that indicate high risk may include age >70 years, pregnancy, acute cholecystitis, nonfunctioning gallbladder, obstructive jaundice, common bile duct stones, immunosuppression.

¥ Cefotetan, cefoxitin, and ampicillin-sulbactam are reasonable alternatives.

‡ For a ruptured viscus, therapy is often continued for approximately 5 days.

† Use of ertapenem or other carbapenems not recommended due to concerns of resistance.

** In addition to mechanical bowel preparation, the following oral antibiotic regimen is administered: neomycin (1 g) plus erythromycin base (1 g) OR neomycin (1 g) plus metronidazole (1 g). The oral regimen should be given as 3 doses over approximately 10 hours the afternoon and evening before the operation. Issues related to mechanical bowel preparation are discussed further separately; refer to the UpToDate topic on overview of colon resection.

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*Data from:*

1. *Antimicrobial prophylaxis for surgery. Med Lett Drugs Ther 2016; 58:63.*
2. *Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Surg Infec (Larchmt) 2013; 14:73.*

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## Contributor Disclosures

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