Overlapping Sphincteroplasty: Is It the Standard of Care?

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ABSTRACT

Anal sphincter injury secondary to obstetric trauma during vaginal delivery occurs in nearly one of every five women. Episiotomy, forceps delivery, and prolonged second stage of labor have all been shown to increase the risk of sphincter disruption. One third of these women will go on to have alterations in anal continence ranging from occasional incontinence to gas to severely debilitating incontinence to solid stool. Symptoms often arise many years after delivery, suggesting that factors such as nerve damage and progressive degeneration of muscle fibers contribute to incontinence.

Surgical treatment of fecal incontinence secondary to sphincter injury has been varied and creative attempts have been made to find the repair with the greatest durability and fewest complications. Over the past few decades, overlapping sphincteroplasty emerged as such a repair with many reports of excellent short-term outcomes. Recently, however, published reports of long-term data reveal decreased function over time, causing many to question whether this repair truly is the best possible treatment.

Several controversies have arisen. These include (1) optimum timing from injury to repair; (2) how best to perform the repair; (3) whether or not fecal diversion, either medical or surgical, is beneficial; (4) whether or not pudendal neuropathy predicts outcome; and finally, (5) if patient's age at the time of repair affects outcome. Randomized controlled trials are lacking, so any conclusions drawn from reviewing current literature must be evaluated with this in mind. Nonetheless, important information can be gleaned from the available literature and future studies designed with the hope of improving treatment for this life-altering condition.

KEYWORDS: Fecal incontinence, anal sphincter injury, overlapping sphincteroplasty, obstetric trauma

Objectives: Upon completion of this article, the reader should be able to: (1) discuss operative and nonoperative controversies surrounding overlapping sphincteroplasty in the treatment of fecal incontinence secondary to obstetric trauma; and (2) list current therapeutic options for failed overlapping sphincteroplasty.

BACKGROUND AND ETIOLOGY

Sphincter disruption after vaginal delivery with resulting incontinence remains the most common indication for overlapping sphincteroplasty. Prior anorectal surgery

such as sphincterotomy and other anorectal trauma are rarer indications and will not be discussed here. Midline episiotomies, third-degree tears of the rectovaginal septum, prolonged second stage of labor, and the use of

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forceps to assist delivery have all been shown to increase the risk of injury to the anal sphincters.¹⁻⁵ Reported incidence rates are variable, ranging from 0.25% to 23.1%.⁶ Varma and associates⁷ found external anal sphincter disruption in 12% of patients with an intact perineum and 16.7% of patients who had undergone an episiotomy. A meta-analysis of studies with more than 100 subjects who underwent endoanal ultrasound after a vaginal delivery revealed a 26.9% incidence of anal sphincter defects in primiparous women and an 8.5% incidence of new sphincter defects in multiparous women.⁸

Not all women with sphincter defects report symptoms of incontinence. Measuring fecal incontinence rates after vaginal delivery is a difficult task. Psychosocial factors often preclude women from discussing this problem, even with physicians. Furthermore, many studies have been lacking in the use of standardized assessment tools such as the Fecal Incontinence Severity Index (FISI) and the Fecal Incontinence Quality of Life Scale (FIQLS).^{9,10} Such issues have likely led to a gross under-reporting of the problem. In addition, long-term follow-up of patients with documented sphincter defects is not available. Be that as it may, the generally accepted incidence of fecal incontinence after sphincter disruption is roughly 30%. Sultan¹¹ reported an incidence ranging from 30 to 50%. Oberwalder and colleagues⁸ found that 29.7% of patients with defects were symptomatic. In comparison, the general incidence of fecal incontinence in all women after childbirth is between 3% and 9% in the first postpartum year.⁶

Since, to the best of our knowledge, only one third of women with sphincter injuries develop symptoms of anal incontinence, factors other than a mechanical defect may be contributing to this problem. Nerve damage during labor, specifically traction neuropraxia to the pudendal nerves, is felt to be a causatory agent.¹² Early fatigability of the external sphincter complex has also been described. Furthermore, aging of the muscles with progressive fibrosis and increasing collagen deposition have been shown to decrease anal sphincter pressures.¹³ This may help explain the increasing incidence of fecal incontinence as women age.

DIAGNOSIS

Anorectal ultrasonography and anorectal physiology testing are considered essential tools to accurately define the extent of injury and assess function of the pudendal nerves. Appropriate surgical therapy is best determined using results from these studies. Liberman and associates¹⁴ prospectively studied the value of these modalities in guiding management of patients with fecal incontinence. They found that transanal ultrasound combined

with pudendal nerve terminal motor latency (PNTML) and anorectal manometry changed the pretest management plan in 10% of 90 patients studied. Of patients originally slotted to have medical therapy, 11% were found to have defects in need of surgical repair. Conversely, of patients slotted for surgical therapy, 7% were found to have insignificant or no defects and were changed to medical management. They concluded that assessment with anorectal physiology and transanal ultrasound should routinely be used for patients with fecal incontinence. Not doing so may result in inappropriate treatment, either surgical or medical.

OPERATIVE TECHNIQUE

Few modifications have been made to the operative technique described by Parks and McPartlin in 1971.¹⁵ In 1977, Slade et al¹⁶ described the technique widely used today. Overlapping sphincteroplasty is most commonly performed with the patient under general anesthesia in the prone-jackknife position. A roll is placed underneath the hips to elevate the buttocks which are then spread apart using heavy tape. Routine use of a Foley catheter will prevent problems with urinary retention postoperatively.

A curvilinear incision is made transversely between the anus and the vaginal introitus parallel to the outer edge of the external sphincter. Electrocautery is used to dissect the scar tissue and muscle complex from the rectum posteriorly and the vagina anteriorly. Bleeding from vaginal veins in the anterior plane will frequently require suture ligation. The cephalad extent of mobilization is the edge of the anorectal ring of muscles. Palpation both vaginally and rectally is essential during this dissection to prevent buttonholing either structure. It is best to err on the side of the vagina. Lateral mobilization is into the perirectal fat pads. Adequate mobilization is necessary to ensure a tension-free wrap.

In the standard technique, the scar tissue in the midline is then divided transversely. The resulting two ends are then overlapped to form a new sphincter complex. A series of 2-0 absorbable monofilament sutures are then placed. Two mattress sutures on either side of the anus are adequate. It is easiest to place all sutures prior to tying them down. If the perineal body is very thin, a levatoroplasty can then be done with interrupted sutures. Closure of the skin can be done a variety of ways. The increased bulk of the perineum precludes closure along the original incisional plane. A T-closure with interrupted absorbable sutures is often feasible. It is best to leave a small opening in the center of the wound or to insert a Penrose drain to prevent abscess formation. The drain can be removed prior to discharge. Vaginal packing is helpful to ensure hemostasis.

Table 1 Functional Outcomes of Overlapping Sphincteroplasty 1994–2004

Study/Year	No. of Patients	No. w/ Obst Injury	Months of F/U Median* / Mean (Range)	Excellent/ Good Results	Fair/Poor Results
Londono-Schimmer et al 1994 ¹⁷	60	56	58* (12–98)	36 (60%)	24 (40%)
Engel et al 1994 ¹⁸	55	55	15* (6–36)	43 (79%)	12 (21%)
Sitzler and Thomson 1996 ¹⁹	31	20	– (1–36)	23 (74%)	8 (26%)
Nikiteas et al 1996 ²⁰	42	26	38* (12–66)	28 (67%)	14 (33%)
Oliveira et al 1996 ²¹	55	46	29 (3–61)	39 (71%)	16 (29%)
Ternent et al 1997 ²²	16	16	12 (3–48)	12 (75%)	4 (25%)
Gilliland et al 1998 ²³	77	53	24* (2–96)	42 (55%)	35 (45%)
Young et al 1998 ²⁴	57	49	27 (1–77)	49 (88%)	8 (12%)
Rasmussen et al 1999 ²⁵	38	38	3	26 (68%)	12 (32%)
Buie et al 2001 ²⁶	158	144	43 (6–120)	97 (61%)	61 (39%)
Barisic et al 2000 ²⁷	53	38	– (5–60)	37 (70%)	16 (30%)
Rothbarth et al 2000 ²⁸	39	39	39 (12–114)	24 (62%)	15 (38%)
Karoui et al 2000 ²⁹	74	61	40 (9–98)	34 (45%)	40 (55%)
Malouf et al 2000 ³⁰	46	46	77* (60–96)	23 (50%)	23 (50%)
Halverson and Hull 2002 ³¹	49	31	69* (47–141)	18 (37%)	31 (63%)
Bravo-Gutierrez et al 2004 ³²	130	NA	120* (84–192)	24 (23%)	80 (77%)

DEFINING THE PROBLEM

Overlapping sphincteroplasty is widely accepted as the surgical treatment of choice for fecal incontinence secondary to sphincter defects. Over the past decade, several studies assessing postoperative outcomes have been published (see Table 1^{17–32}). When taken together, the percentage of patients who achieve some benefit from this procedure approaches 60%. Studies with short-term follow-up show a higher percentage of patients with excellent or good results than studies with longer follow-up. These latter studies reveal diminishing function and a higher percentage of patients with fair or poor results. For example, Sitzler and Thomson¹⁹ reported retrospectively on their experience with 31 patients, 20 of whom had incontinence secondary to obstetric trauma. Patients were followed from 1 to 36 months after operation. Fifteen of the obstetric trauma patients had a successful outcome defined as complete continence or incontinence to gas only. Five had incontinence to liquid or solid stool and were considered failures. Young and coworkers²⁴ studied 56 patients, 49 of whom had obstetric injury. At a mean follow-up of 27.2 months, 86% of patients rated their operation as a success. The median continence score, using the St. Mark's incontinence scoring system where 0 equals complete continence and 13 is complete incontinence, went from 13 preoperatively to 3 postoperatively.

Long-term results have proven to be less satisfying. Halverson and Hull,³¹ using the FISI and FIQLS questionnaires, contacted 49 patients a median of 69 months after sphincter repair. They found 54% of patients were incontinent to liquid or solid stool. Thirty-four percent had an FIQLS score of 16, the best possible score. Malouf and colleagues³⁰ assessed

38 patients who had undergone overlapping sphincteroplasty a minimum of 5 years prior. Using a detailed questionnaire, a modified Park's continence score (range 1 to 4 where 1 = continent to stool and flatus, 2 = incontinent to flatus, 3 = incontinent to liquid stool, and 4 = incontinent to formed stool) was determined for each patient. No one reported perfect continence to stool and flatus and only four were totally continent to both solid and liquid stool. The median score at 77 months postoperatively was 3. Twenty-three patients (50%) were felt to have long-term outcome successes, defined as "no need for further continence surgery, and either no or monthly or less frequent urge fecal incontinence." Most recently, Bravo-Gutierrez and coworkers³² assessed the long-term outcome of 130 patients a median of 10 years after overlapping sphincteroplasty. The FIQLS was used along with other questions to determine current bowel function and degree of incontinence. Only 6 patients (6%) reported no incontinence and 60 (58%) reported incontinence to solid stool. This was a significant decline in function when compared with the prior assessment done 3 years after sphincteroplasty.

A few comments are in order when reviewing the studies above. The issues of defining endpoints and measuring them accurately should be addressed. Arguably, the three most important postoperative endpoints are (1) condition of the sphincters as assessed by endoanal ultrasonography, (2) degree of continence, and (3) quality of life. Ideal results are, then, an intact wrap by endoanal ultrasonography, complete continence to gas and liquid and solid stool, and the highest possible quality-of-life rating.

Endoanal ultrasonography remains the best objective assessment of the anal sphincters postoperatively.

An intact wrap is easily identified, as are persistent defects. The association between an ultrasonographic defect and symptoms of incontinence is well documented. Engel et al³³ studied a group of patients with symptoms of incontinence. They divided patients into those with passive incontinence only ($n = 66$) and those with urge incontinence only ($n = 42$). Patients with passive incontinence alone had a significantly greater incidence of internal anal sphincter defects (35% compared with 2% of patients with urge incontinence alone). Those with urge incontinence alone had a significantly greater incidence of external sphincter defects (24% versus 18% with passive incontinence alone). In a separate study, the same investigators looked at outcomes after overlapping sphincteroplasty. They performed postoperative anal ultrasounds on 46 patients a median of 15 months after operation. Thirty-five patients reported "good" results and 11 reported "poor" results. Only 3 of the 35 patients with good results were found to have external sphincter defects on ultrasonography. This was a statistically significant difference when compared with patients with poor results, 6 of whom had external anal sphincter defects.¹⁸ Ternent and associates²² evaluated 16 patients with anterior sphincter defects who underwent overlapping sphincteroplasty. Postoperative anal ultrasounds were done a mean of 12 months after repair. Subjective assessment was done by questionnaire. Rank correlation analysis showed that the size of sphincter defects postoperatively was significantly related to a change in fecal continence scores. Savoye-Collet and colleagues³⁴ reported a similar correlation between persistent sphincter defects after repair and poor functional outcome.

Of the studies listed in Table 1, only five^{18,19,21,22,30} used ultrasound in their postoperative assessment. A lack of this type of objective analysis of sphincter repair makes it difficult to accurately determine etiologies for poor postoperative function. One can only speculate as to whether a failed wrap is the cause for persistent incontinence.

Subjective assessment of outcome is more complex. Both surgeon and patient evaluations are often included in published reports. The surgeon's assessment will often be overly positive, not placing as much importance as do patients on lesser degrees of incontinence.³¹ Patient self-evaluations are often routinely done with questionnaires on fecal incontinence and quality of life. A myriad of such questionnaires is currently in use, making comparisons of results nearly impossible. Defining quality of life is fraught with difficulty. Terms such as "excellent," "good," "fair," and "poor" have varied definitions and overlap exists between different questionnaires. Assessing degree of fecal incontinence is somewhat more straightforward. Incontinence to solid stool denotes worse sphincter function than incontinence to liquid stool, which in turn is

worse than incontinence to gas. However, different indices currently in use assign different values to each degree and may or may not include frequency of incontinence in the tabulation. More widespread use of standardized questionnaires, such as the FIS and FIQLS, will allow for uniform assessment of postoperative functional results. Worthwhile comparisons can then be made between studies on the overall efficacy of sphincter repair.

While it is safe to say that the majority of patients undergoing overlapping sphincteroplasty benefit from the procedure, results reviewed here clearly indicate room for improvement. What can be done to improve outcomes of this procedure? Specifically, what aspects of the operation, patient selection process, preoperative assessment, and postoperative management are beneficial and which are not? Unfortunately, definitive answers from randomized trials are rare. Most studies are retrospective and include too many variables to make conclusions accurate. Thus, a review of recent literature is bound to raise more questions than elicit adequate answers. Bearing this in mind, the following areas of debate will be addressed:

1. Does timing of repair, either immediately after injury or at a time remote from injury, influence outcome?
2. Does the type of repair—overlapping, end-to-end, or separate internal and external repair—influence outcome?
3. Does preoperative PNTML predict outcome?
4. Is there a need for fecal diversion, either medical or surgical, to improve healing and final outcome? and
5. What influence does patient age have on outcome?

TIMING OF REPAIR

When to perform a definitive repair of injured sphincter muscles remains controversial. While no study has been done comparing primary (immediate) repair versus secondary repair months to years after injury, several studies looking at one or the other exist. Traditionally, the primary repair has been the realm of the obstetricians. Third- and fourth-degree tears after delivery are "nearly exclusively" repaired at the time of acute injury. Sultan and coworkers³⁵ studied 34 women who had undergone an end-to-end primary repair of the anal sphincters after suffering a third-degree tear during delivery. Follow-up intervals ranged from 42 to 651 days. A persistent defect was found on endoanal ultrasound in 29 women (85%). Fourteen women (41%) had incontinence to flatus or flatus and liquid stool and 9 (26%) had fecal urgency. Nielsen and associates³⁶ reported persistent endoanal ultrasonographic defects in 14 of 24 women a median of 12 months after repair of an obstetric tear. Seven of the 24 women had symptoms of incontinence. Walsh and colleagues³⁷ studied 81

women 3 months after primary repair of a third-degree tear. Thirty women were found to have defects on endoanal ultrasound. Eleven of these patients were incontinent, 6 to flatus only and 5 to feces. No studies with long-term follow-up of such patients are currently available. (NB: Delaying repair several hours to days remains controversial and is actively being investigated at the Karolinska Institute. See Warshaw.⁶ A full discussion of this debate is outside the scope of this article.)

These data suggest that primary repair, often done in the face of severe third- or fourth-degree tears with tissues that are quite bruised and edematous, results in a high incidence of persistent defects and symptomatic incontinence. Thus, while a percentage of these women will have minimal incontinence, the majority will go on to require a delayed repair, typically performed as an overlapping sphincteroplasty by a colorectal surgeon.

It is worth mentioning two studies done by obstetricians to address this problem. The improved results with overlapping sphincteroplasty done as a delayed repair prompted the application of this method to the more immediate postinjury setting. Sultan and coworkers³⁸ performed an overlap repair in 31 women who were then followed for a mean of 4.5 months. Postoperative anorectal physiology studies and bowel symptoms were assessed. They found that no women were incontinent to liquid or solid stool and only 4 of 31 had fecal urgency. Mean maximal resting pressure was 58 mm Hg and mean maximal squeeze pressure was 54 mm Hg. Persistent external anal sphincter defects were detected in only 4 women (13%), a significant improvement in the over-50% incidence of persistent defects usually identified after primary end-to-end repair.³⁶ In a more recent study by Fitzpatrick and associates,³⁹ results were equivocal. They conducted a randomized trial of 112 women, 55 of whom had an overlap repair and 57 of whom had an end-to-end approximation repair. They found no statistically significant difference at 3 months after operation in symptoms of incontinence, mean resting and squeeze pressures, or in persistent sphincter defects. The latter were present in 89% of patients in the overlap group and in 93% of the end-to-end group. With no discernable difference between the two types of repair in the primary setting, other factors are likely responsible for poor functional outcomes.

TYPE OF REPAIR

Alternatives to the overlapping sphincteroplasty, including end-to-end approximation and separate internal and external repair, have been studied. One randomized trial exists comparing the overlapping sphincteroplasty with a primary end-to-end repair. Tjandra et al⁴⁰ enrolled 23 women with anterior sphincter defects on ultrasound for sphincter repair. Of these, 12 were randomized to a

direct end-to-end repair and 11 were randomized to the overlapping repair. At a median follow-up of 18 months, median continence scores using the Cleveland Continence Score were 3 in both groups. Mean resting pressures were 45 mm Hg and 50 mm Hg and maximum squeeze pressures were 125 mm Hg and 130 mm Hg in the direct and overlapping groups, respectively. Patient-rated "success" was achieved in 9 of 12 and 8 of 11 patients in each group. One patient in the overlap group developed a pudendal neuropathy postoperatively. The authors concluded that a technically simpler direct end-to-end repair will achieve results equal to the standard overlapping repair and potentially have decreased morbidity. Recognizing their numbers are small and follow-up short, they suggest that larger randomized trials be conducted. Publication of their long-term results is pending.

Briel and colleagues,⁴¹ in a prospective study of sphincter repair in women with obstetric trauma, addressed whether separate internal and external sphincter repair is beneficial. Thirty-one women underwent an anterior anal repair consisting of "combined restoration of the rectovaginal septum and perineal body, overlapping external anal sphincter repair and imbrication of the internal sphincter." This group was compared with a group of 24 women who had previously undergone a direct sphincter repair, namely the more standard overlapping repair. Postoperative ultrasounds were not performed. Follow-up at 24 months showed that continence was "restored" in 21 (68%) of 31 women undergoing anterior anal repair and in 15 (63%) of 24 women undergoing direct repair. This was not statistically significant. Long-term follow-up in both groups showed diminishing success. They concluded that the more extensive internal and external repair did not clearly show any benefit over direct repair. They suggest that prospective randomized trials be done to settle this issue definitively.

PUDENDAL NERVE ASSESSMENT

Pudendal neuropathy as evidenced by prolonged (greater than 2.2 milliseconds) PNTML is often listed as a factor in fecal incontinence secondary to obstetric injury.⁴² The battle continues to rage over whether or not this is true. Five studies^{17,23,27,43,44} claim prolonged PNTML is a strong predictor of poor postoperative function. Eleven^{18-22,25,26,28-32} do not show any statistically significant difference in postoperative continence in patients with or without prolongation of PNTML (Table 2). (NB: Young and associates²⁴ used concentric needle electromyography rather than PNTML in the majority of their patients.)

At first glance, the data from studies favoring the pudendal neuropathy factor in postoperative incontinence look impressive. Gilliland and colleagues²³ found

Table 2 Does Pudendal Neuropathy Predict Outcome after Sphincteroplasty?

Yes	No
Laurberg et al 1988 ⁴³	Engel et al 1994 ¹⁸
Sangwan et al 1996 ⁴⁴	Sitzler and Thomson 1996 ¹⁹
Gilliland et al 1998 ²³	Nikiteas et al 1996 ²⁰
Londono-Schimmer et al 1994 ¹⁷	Oliveira et al 1996 ²¹
Barisic et al 2000 ²⁷	Ternent et al 1997 ²²
	Rasmussen et al 1999 ²⁵
	Buie et al 2001 ²⁶
	Rothbarth et al 2000 ²⁸
	Karoui et al 2000 ²⁹
	Malouf et al 2000 ³⁰
	Halverson and Hull 2002 ³¹
	Bravo-Gutierrez et al 2004 ³²

that 37 of 59 patients (62.7%) with bilateral normal pudendal nerves rated their sphincteroplasty a success. This was significantly different ($p < 0.01$) from the 2 of 12 patients (16.7%) with unilateral or bilateral pudendal neuropathy who rated their operation a success. Londono-Schimmer and coworkers¹⁷ found that 14 of 20 patients (70%) with preoperative neuropathy had fair or poor results a median of 58.5 months after repair. Thirty-three of 74 patients (45%) without neuropathy reported fair or poor results ($p < 0.001$). Barisic and associates²⁷ reported a success rate of 86% in patients with "mild or no neuropathy" preoperatively and only 35% in patients with "severe neuropathy."

When taking sheer numbers into account, these three studies cannot compete with over 700 patients in the other 11 studies. Furthermore, in Barisic's paper, no objective definition of "mild" or "severe" neuropathy is given. Thus, it is difficult to know whether there is actually enough of a difference in values for "mild" and "severe" that would make PNTML results useful predictors of outcome. Current belief, then, is that preoperative pudendal neuropathy diagnosed via PNTML cannot be used to accurately predict postoperative function after sphincteroplasty and should not be used to exclude patients from surgery.

FECAL DIVERSION

As is the case with any perineal wound, healing after overlapping sphincteroplasty is often slow. Skin separation is common. More serious septic complications have been implicated as a cause of breakdown of the repair. A natural assumption is that fecal diversion, either medical or surgical, would improve healing. Two randomized trials addressing this assumption have been performed. Nessim et al⁴⁵ studied medical bowel confinement after anorectal reconstructive surgery and Hasegawa and associates⁴⁶ studied the use of diverting stomas

after sphincteroplasty. In Nessim's study, 32 patients undergoing sphincteroplasty were randomly assigned to either bowel confinement ($n=17$) or a regular diet ($n=15$) postoperatively. Bowel confinement consisted of a clear liquid diet and loperamide 4 mg three times a day for 3 days preoperatively, then codeine phosphate 30 mg four times a day for 3 days postoperatively. The regular diet group received a regular diet on the day of surgery. There was one wound infection in each group. Seven patients in the bowel confinement group but only two in the regular diet group had fecal impaction. Thirty percent of patients in the bowel confinement group but only 15% in the regular diet group required morphine via patient-controlled analgesia pumps. No significant difference was found in overall narcotic requirements between the two groups, however. At a mean follow-up of 13 months, postoperative continence scores were a mean of 6 (range 0 to 20) and 5 (range 0 to 12) in the bowel confinement group and regular diet group, respectively. This was not statistically significant. They concluded that the "omission of medical bowel confinement results in faster recovery to normal bowel function and better comfort without increasing the incidence of sepsis or being detrimental to functional outcome." In Hasegawa's study, 27 patients undergoing sphincter repair were randomized to receive a diverting stoma ($n=13$) or no stoma ($n=14$). Stomas were taken down a mean of 4 months after sphincter repair. Five complications related to the sphincter repair occurred in the stoma group and three in the no-stoma group. Seven stoma-related complications also occurred. Functional results in the two groups were similar with a mean incontinence score postoperatively of 7.8 in the stoma group (preoperative mean 13.5) and 9.6 in the no-stoma group (preoperative mean 14). They concluded that the use of a diverting stoma for routine postoperative care after sphincteroplasty does not provide any functional benefit and will likely increase morbidity overall.

AGE

Whether or not the older patient undergoing sphincter repair is more likely to have a poor outcome remains unclear. Three studies specifically address the issue of age at the time of repair and its effect on outcome. Simmang and coworkers⁴⁷ studied 14 patients between the ages of 55 and 81 years old who underwent overlapping sphincteroplasty. Thirteen of the 14 reported improvement of their symptoms. Seven reported complete continence and 3 were incontinent to flatus only. They concluded that advanced age did not preclude satisfactory results. Rasmussen and colleagues²⁵ looked at postoperative incontinence in 24 women under 40 years old and 14 women over 40 years old. Success was achieved in 20 out of 24 younger women and in only 6 of the 14 older women. They hypothesized that older

patients with late-onset incontinence after sphincter injury are more likely to have a generalized weakening of the pelvic floor contributing to their incontinence. Young et al²⁴ found that 21 of 27 (78%) patients younger than 40 years old and 28 of 30 (93%) patients older than 40 years old rated their overlapping sphincteroplasty a success. Median postoperative incontinence scores improved equally in both groups. They concluded that age did not correlate with postoperative function.

Of the remaining studies in Table 1 that include age as a variable in their assessment, four^{18-20,32} found that advanced age is associated with a poor outcome. Eight other studies^{21,22,24,28-31} found no correlation between age and outcome. Three studies^{17,23,27} did not assess age as a variable.

While age-related changes can occur in the anal sphincter muscles, specifically increased fibrosis and deposition of collagen,⁴² whether or not these and other degenerative changes of the pelvic floor contribute to an increased risk of postoperative incontinence in older patients has yet to be determined.

FAILED REPAIR

Finally, the issue of what to do when a repair has failed should be addressed. As the efficacy of the repair wanes over time, more and more women seek further treatment. Current options for these women are biofeedback, repeating the sphincter repair, or performing more novel methods of restoring continence, such as sacral nerve stimulation or implantation of an artificial bowel sphincter.

Biofeedback is safe and effective in the treatment of fecal incontinence. Jensen and Lowry⁴⁸ studied 28 women who had poor results after sphincteroplasty. Electromyographic biofeedback was begun an average of 32 months (range 2 to 192) after sphincteroplasty and continued for three or four weekly sessions. Twenty-five patients achieved success, with an average decrease in the number of incontinent episodes per week from 5.4 before biofeedback to 1.4 after biofeedback was completed ($p < 0.0001$). Three patients failed to show improvement. One underwent a colostomy, one an artificial bowel sphincter implantation, and one did not seek further treatment. No predictors of success were identified. Although admitting their small sample size and lack of controls, the authors confirmed the safety and efficacy of biofeedback in this setting.

Repeating an overlapping sphincteroplasty is beneficial in the majority of patients with persistent poor function. Giordano and associates⁴⁹ studied 36 women after repeat overlapping sphincteroplasty for persistent anterior sphincter defects seen on anal ultrasound. The first group of 31 women had undergone one or two previous repairs. A second group of 5 had undergone three or more. Of the first group, 21 (68%) felt they had

a successful outcome and 10 (32%) did not. Of the second group, 1 reported a good result and 4 reported failure. At a median follow-up of 20 months, the median incontinence score for all 36 went from 17 preoperatively to 7 postoperatively. Ultrasound investigation was done in 16 of the 36 patients. All patients reporting success had intact wraps but 5 of 8 patients reporting failure had persistent defects. They concluded that a repeat overlapping sphincteroplasty is a technically feasible option with good results in the majority of patients and should be offered to those who fail an initial repair. Pinedo and associates⁵⁰ studied 23 women a median of 20 months after repeat overlapping sphincter repair. Seventeen women had preoperative ultrasounds confirming persistent external anal sphincter defects. Patient-reported Wexner incontinence scores⁵¹ improved from a median of 19 preoperatively to 12 postoperatively ($p < 0.001$). Fifteen of the 23 patients reported they had improved by 50% or more. Postoperative ultrasounds were performed in 14 of the 23 patients. Eight showed good overlap and 6 did not. The 6 patients with a persistent defect failed to report improved function after repair. The authors concluded that offering a repeat overlapping sphincteroplasty to patients with persistent symptoms and sphincter defects is appropriate before pursuing more aggressive options. An evaluation of the long-term outcome in this same group of patients was reported by Vaizey and associates.⁵² Twenty-one of the original 23 patients were available for follow-up a median of 5 years after their repeat repair. Two patients had undergone further surgery for incontinence: one required a colostomy and one had a postanal repair. Thus, 19 patients were assessed via questionnaire. Objective analysis was not performed. Eleven of the 19 reported a Wexner incontinence score of less than 7. Results showed that those patients who had improved at the 20-month time point were the ones who remained improved at the 60-month time point. The overall rate of patient satisfaction was 60%. The authors concluded that this long-term success further validated the use of repeat overlapping sphincteroplasty as the treatment of choice in patients with persistent symptoms and sphincter defects after initial repair.

Sacral nerve stimulation, long the realm of urologists for the treatment of urinary incontinence, is now being applied to patients with fecal incontinence. Matzel and colleagues⁵³ reported on a trial of 37 patients, 8 of whom had had previous sphincter repairs. Incontinence scores and quality of life were assessed at 12 and 24 months after implantation of the permanent neurostimulation system. (Results were combined for patients with and without prior repair.) Mean incontinence episodes decreased from 16 per week to 3 per week at 12 months and 2 per week at 24 months ($p < 0.0001$ for each). Quality of life was improved significantly through the 24-month follow-up. Twelve patients

experienced device-related adverse events and 63% of these resolved. Recurrent infection in one patient and deterioration of bowel function in another required device removal. They concluded that sacral nerve stimulation is a safe and effective treatment option for fecal incontinence, although the exact mechanism of action remains unclear.

The artificial bowel sphincter has emerged as an option for patients with intractable fecal incontinence. Parker and coworkers⁵⁴ recently reported their experience with 45 patients who underwent implantation of the device over a 12-year period. Overall success was defined as a drop in the postoperative fecal incontinence score of at least 24 points (scale 0 to 120). This was achieved in 49% of patients, with a high infection and erosion rate (34%) and a need for revisional surgery in 37%. In patients who retained their devices, functional success was 88% at 1 year and 100% after 2 years. They concluded that despite the high morbidity, the artificial bowel sphincter is technically easier and actually much less morbid than procedures such as the dynamic graciloplasty. It should continue to be offered to patients with refractory, life-altering incontinence who have no other option to restore normalcy to their life.

SUMMARY

Surgical treatment of fecal incontinence secondary to obstetric injury with overlapping sphincteroplasty remains the standard of care. Relief from incapacitating symptoms is felt by the majority of patients for many years. Postoperative results are clearly better with delayed repair than with primary repair. However, long-term functional results of delayed repair deteriorate over time. Predictive factors are difficult to determine. The type of repair performed and postoperative fecal diversion do not appear to impact outcome. The impact of patient age and preoperative evidence of pudendal neuropathy is debatable, with the majority of studies suggesting neither has an impact on outcome. Malouf and associates³⁰ found that incontinence at 15 months after operation was the only predictive factor for poor functional results. In contrast, Karoui and colleagues²⁹ found that a preoperative internal sphincter defect was the only predictive factor. Bravo-Gutierrez et al³² found that advanced age and fecal incontinence at 3 years were predictive of poor functional results at 10 years postoperatively whereas Halverson and Hull³¹ could find no factors that were predictive of outcome. Thus, speculation persists as to what exactly is responsible for poor functional results and diminishing function over time. It is hoped that routine use of postoperative anal ultrasonography to diagnose persistent sphincter defects, combined with standardized fecal incontinence scores and quality of life scales, will provide more answers to these difficult problems.

In attempts to solve problems of fecal incontinence secondary to obstetric injury, an area of focus for many physicians, particularly obstetricians, is prevention of the injury. Hull, in her invited editorial, makes a plea for further studies investigating ways to prevent pelvic floor trauma during delivery, particularly ways to decide in whom cesarean section should be performed.^{32a} Focusing efforts on such studies will, we hope, cause a decrease in the incidence of sphincter injury and eventual fecal incontinence.

CONCLUSION

Overlapping sphincteroplasty should continue to be offered to women with fecal incontinence secondary to sphincter disruption as the best option currently available. Its long-term limitations should be recognized. Biofeedback and repeat sphincteroplasty should be considered for patients with poor results while more novel treatments, such as sacral nerve stimulation and artificial bowel sphincter placement, should be reserved for patients with intractable incontinence.

Further studies in ways to prevent serious sphincter injury after vaginal delivery will likely be the best option for decreasing the overall incidence of fecal incontinence.

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