Patients with major fecal incontinence often do not benefit from medical treatment or biofeedback and thus are proposed for surgery. Different surgical options are available, the choice of which depends on the type of incontinence, the severity of symptoms, and the compliance of the patient. The efficacy of surgery still remains difficult to assess, but it is quite evident that none of the operations can guarantee a return to perfect continence. Surgical treatment for fecal incontinence can be divided in two main groups:

1. Operations to reinforce the existing muscles
   - Anterior sphincter repair (ASR)
   - Postanal repair
   - Total pelvic floor repair

2. Operations to create a neosphincter
   - Muscle transposition
     - Nonstimulated graciloplasty
     - Gluteoplasty
     - Dynamic graciloplasty (DGP)
   - Artificial bowel sphincter (ABS)

Other surgical options, such as stoma creation or colonic conduit, can help improve the quality of life when nothing else can be done.

In this chapter, we will focus on indications, techniques, and outcomes of the most common procedures, which are ASR and (less commonly) postanal repair for the first group, and stimulated graciloplasty and ABS for the second group. New procedures, such as sacral nerve modulation and implantation of sphincteric bulking material, also aim to improve continence through the existing muscles. These emerging operations have a very low morbidity and no mortality and, especially the former, seem to be valid alternatives to major procedures. These will be discussed in separate chapters.

Reinforcement of the Existing Sphincter

Anterior Sphincter Repair

Obstetric trauma is considered to be the commonest cause of fecal incontinence, and current opinion based on anal endosonography is that the majority of these patients have structural sphincter damage [1]. The first-line treatment for this condition is ASR. This is a relatively simple operation with low morbidity. However, its efficacy following recent longer-term outcome analyses has been recognized to be substantially less than previously reported.

Patient Selection

This operation should be considered in all incontinent patients with a demonstrable external sphincter defect, unresponsive to conservative treatment. Some authors argue that patients with abnormally prolonged pudendal nerve terminal motor latency (PNTML), especially if bilaterally prolonged, are not good candidates for repair [2–5], but this has not been confirmed by others [6–9]. There is a general agreement that results are probably poorer in older patients, in those with associated evacuatory disorders, and in the presence of multiple defects. However, none of these are absolute contraindications to the repair.
Notes on Techniques

Preoperatively, patients receive bowel preparation with stimulants or osmotic laxatives, antibiotics, and thromboembolic prophylaxis. Covering stoma has been demonstrated to be unnecessary [6, 10, 11]. Under general anesthesia, the patient is placed in a modified lithotomy position and catheterized. The prone jack-knife position can also be used and is more popular in North America, but we find that with the buttocks protruding well beyond the flexed knees, there is good exposure (Fig. VIII.2). A curvilinear incision is made in the anterior perineum at the edge of the pigmented anal skin. The incision is parallel to the anal margin and is extended for about 180° (Fig. VIII.3). The wound can be exposed with Gelpi or Lone Starr retractors, and the external sphincter ring is identified and progressively freed up.

Dissection is initiated in the midline, where scar tissue is present, and carried out in either direction, searching for the retracted edges of the sphincter muscle. Detection of the residual muscle may be facilitated by the use of diathermy. Once identified, the two ends of the external sphincter are mobilized from surrounding fat and from the internal sphincter up to the level of the levator muscles (Fig. VIII.4). Care must be taken.

Fig. VIII.2. Exposure of the operative field in Lloyd-Davies position. This lady had an extensive EAS scar with disruption of the perineal body

Fig. VIII.3. A curvilinear incision is made ad the edge of pigmenteded skin (dotted line)

Fig. VIII.4. The two ends of the external sphincter are freed up (black arrows)
posterolaterally, where the branches of the pudendal nerve enter the muscle. The scar tissue found anteriorly must not be excised because it will be used for the repair. However, it can be divided in the midline to facilitate mobilization of the two ends of the sphincter. If the internal anal sphincter is clearly identified, this can be imbricated separately from the external one, but this procedure did not appear to offer any benefit [9, 12]. At this stage, a levatorplasty can be added to tighten the anterior pelvic floor and reconstruct the perineal body (Fig. VIII.5). In this case, the levator muscles on each side are approximated together with interrupted stitches of a slow absorbable suture [i.e., 2/0 polydioxanone (PDS)]. The finding that levatorplasty improved outcome has been supported by some series [13–15] but not by others [4].

Finally, the two ends of the external sphincter are overlapped by suturing the scar tissue from one end to the middle part of the opposite sphincter muscle. Usually, 3–5 interrupted mattress stitches of 2/0 PDS on each side are placed, and they are tied snugly but not too tightly in order to avoid muscular ischemia (Fig. VIII.6). When scar tissue is not clearly evident, the sphincter ring can be plicated rather than divided and overlapped. Hemostasis must be meticulous. At the end of the procedure, the wound, which was originally transverse, can be usually closed in an inverted “Y” fashion, thus increasing the distance between anus and vagina (Fig. VIII.7). We often leave a small opening if there is any tension in order to minimize the risk of infection. Occasionally, it may be necessary to create an advancement or an island flap to cover the repair. Postoperatively, the urinary catheter is kept in situ for 24–36 h, and a normal diet is reintroduced the day after operation, supplemented with bulking laxatives to optimize stool consistency and avoid straining and impaction. Bowel confinement and the use of antidiarrheal drugs have been demonstrated to be unnecessary and are associated with more complications [16]. Daily wound cleansing is practiced.

Complications

ASR can be considered a relatively simple procedure with low morbidity and no mortality. The most common complication is wound infection. In the authors’ experience, this occurred in 24 patients (26%). Five required an examination under anesthesia while one developed perineal...
sepsis and required a colostomy that was closed 2 months later. Other complications were prolonged anal pain (8%) and dyspareunia (6%) [9]. These figures were consistent with the reported literature [2, 6, 17, 18]. Wound infection did not, in fact, appear to be significantly associated with failure; the literature is not clear on this point, with some authors reporting an increased risk for breakdown of the repair [2] while others found no deleterious effect [17, 18]. However, it significantly prolongs healing time. Recently, it has been reported that closing the wound with an island flap lowers the incidence of dehiscence to 15% [19]. Our current practice is often to leave part of the wound open. Some authors have reported a higher incidence of dyspareunia when the sphincter repair was augmented with a levatorplasty [8]. Our series and those of others have not confirmed this correlation. Sphincter repair can also cause evacuation difficulties, such as the need to strain and incomplete evacuation. This occurred in about 16% of the patients in our series [9].

Outcome

Anterior anal sphincter repair has been reported to achieve good results in 69–97% of patients in series comprising between 12 and 88 patients [2, 6, 10, 11, 17, 20–25]. However, these figures are likely to be overestimated. In fact, early reports attributed success to even minor improvements in control, and most of them based their evaluation on inappropriate incontinence scores that did not consider important factors such as urgency and quality of life. As recently demonstrated by Byrne et al. [26], quality of life is highly dependent on the ability to be able to leave the home. Our report showed that even though many patients had improved, they were severely restricted by urgency, and this significantly affected their quality of life and their satisfaction with the outcome of the procedure [9]. In former studies, a patient who might be fully continent but unable to leave the house because of urgency would have been categorized as a successful outcome.

The other important fact is that long-term follow-up showed that results obtained with ASR deteriorate with time (Table VIII.4). It is not clearly understood why this happens. Breakdown of the repair can occur, but this usually happens in the early period after surgery and therefore is an unlikely explanation. Some opine that dissection of the muscles for overlapping may impair innervation [7], but the most probable explanation is that there is a progressive weakening of the overlapped muscle due to normal aging or to the nature itself of the obstetric trauma [28], which may involve other perineal muscle and may include nerve damage.

Postanal Repair

This operation was developed by Parks [30] in an attempt to treat patients with idiopathic or neurogenic incontinence with an intact anal sphincter. At the time, ultrasonography was not available, and the only way to identify defects with certainty was serial electromyographic needle puncture of the perineum to document sphincter defects or integrity. Technically, with the patient in prone jack-knife or lithotomy positions, the intersphincteric plane is entered through a posterior V-shaped incision, and the opposite limbs of the ischiococcygeus, ileococcygeus, and puborectalis muscles are approximated together in order to strengthen the pelvic floor and restore the acute angulation at the anorectal junction. Further studies have shown that the success of this procedure, which only benefits, at most, 30–40% of patients
treated [31–33], does not depend on the modification of the anorectal angle but is dependent on the recreation of a high pressure zone in the anal canal [34, 35]. Because of the low success rate, and since it has been demonstrated that the same results are achieved with an anterior sphincteroplasty [36], this procedure has become less frequently performed. The combination of postanal repair with anterior levatorplasty is called total pelvic floor repair, but there is no evidence supporting the use of this combined procedure [37].

Creation of a Neosphincter

For patients with severe idiopathic or neurogenic incontinence or those with congenital anomalies or a destroyed sphincter, neosphincter creation is an alternative to a definitive stoma. This can be achieved either with transposition of healthy skeletal muscle or with insertion of prosthetic material. The muscles that can be used are basically gluteus maximus and gracilis because their vascular supplies allow transposition to the pelvic floor. Gracilis muscle has been demonstrated to be the most suitable for this purpose while gluteoplasty is burdened by higher functional deficit [38] and thus is only rarely performed.

Patient Selection

Patients selected for graciloplasty or artificial sphincter are those with severe fecal incontinence who fail to respond to conservative treatment or first-line surgery. Although there are no limits to age, it seems reasonable not to perform these operations in old patients with very limited activities and a short life expectancy. Furthermore, nonmotivated patients, those with psychological instability, low mental capacity, significant comorbidity, poor functional status, severe arthritis, or other disabilities limiting the use of the hands, or patients with Crohn’s disease or other chronic diarrheal state, should not be considered for sphincter replacement [39].

Dynamic Graciloplasty

Pickrell et al. first described gracilis muscle transposition [40] in 1952, but results were disappointing due to the inability of the muscle to maintain sustained contraction. More recently, the demonstration that chronic low-frequency (10–12 Hz) electrical stimulation transforms fatigue-prone type II skeletal muscle into fatigue-resistant type I muscle allowed the transposed gracilis to work as a sphincter [41, 42]. For these reasons, DGP has become the most common procedure to create a neosphincter.

Notes on Techniques

Initially, this operation was performed in three or two steps. In the three-stage procedure, the first stage consisted of devascularization of the distal part of the gracilis and creation of a loop colostomy, the second stage consisted of transposition of

Table VIII.4. Long-term results of anterior sphincter repair

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Patients (n)</th>
<th>Median FU (months)</th>
<th>Excellent/good S-T</th>
<th>L-T</th>
<th>Fair/poor S-T</th>
<th>L-T</th>
<th>Patients fully continenta S-T</th>
<th>L-T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Londono-Shimmer et al [2]</td>
<td>1994</td>
<td>94</td>
<td>58</td>
<td>50%</td>
<td></td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karoui et al [8]</td>
<td>2000</td>
<td>74</td>
<td>3</td>
<td>81%</td>
<td>51%</td>
<td>19%</td>
<td>49%</td>
<td>49%</td>
<td>28%</td>
</tr>
<tr>
<td>Malouf et al [7]</td>
<td>2000</td>
<td>46</td>
<td>40</td>
<td>79%</td>
<td>59%</td>
<td>21%</td>
<td>41%</td>
<td>n.r</td>
<td>n.r</td>
</tr>
<tr>
<td>Morren et al [27]</td>
<td>2001</td>
<td>55</td>
<td>40</td>
<td>56%</td>
<td></td>
<td>44%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halverson et al [28]</td>
<td>2002</td>
<td>49</td>
<td>62</td>
<td>45%</td>
<td></td>
<td>55%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gutierrez et al [29]</td>
<td>2004</td>
<td>130</td>
<td>120</td>
<td>64%</td>
<td>41%</td>
<td>36%</td>
<td>59%</td>
<td>18%</td>
<td>6%</td>
</tr>
<tr>
<td>Zorcolo et al [9]</td>
<td>2005</td>
<td>73</td>
<td>10</td>
<td>68%</td>
<td>54%</td>
<td>32%</td>
<td>46%</td>
<td>36%</td>
<td>16%</td>
</tr>
</tbody>
</table>

*a Patients fully continent or incontinent to flatus
FU follow-up, S-T short-term follow-up, L-T long-term follow-up, n.r. data not reported
the muscle around the anus, and the third stage consisted of colostomy closure. In the two-stage procedure, devascularization was avoided. However, it has been clarified that neither preliminary vascular delay nor fecal diversion have a role in reducing postoperative complications and outcome of DGP [43, 44], and thus it is now common practice to perform this operation in a single stage. Bowel preparation and antibiotic and thromboembolic prophylaxis is recommended. Under general anesthesia, the patient is placed in the modified Lloyd-Davies position, and catheterization is delayed until the end of the procedure. This avoids a potential risk of infection from the exposed catheter. Through a 10- to 15-cm incision in the medial aspect of the upper thigh, the left gracilis is mobilized (Fig. VIII.8), taking care to preserve its main neurovascular bundle located on the anterolateral side about one quarter of the way from the groin to the knee. This pedicle is the fulcrum about which the gracilis is rotated to reach the perineum. Blunt dissection is continued in the adductor canal. Another little medial incision at the distal thigh allows complete muscular dissection and the identification of a second blood vessel arising from the superficial femoral system. Finally, a 2-cm incision at the knee allows division of the tendon at its insertion to the tibia. When the muscle is fully mobilized and ready for the transposition, an electrode is positioned either epineurally or intramuscularly. The epineural electrode is placed over the main nerve trunk and sutured to the underlying adductor muscle with nonabsorbable sutures while intramuscular electrodes are usually fixed near the entry point of the nerve into the muscle. In both cases, the best area is chosen with a stimulation test.

Theoretically, with epineural stimulation, the whole muscle fibers are recruited and the necessary voltage is reduced, with a consequently longer battery life, but a direct comparison between the two techniques showed a significantly higher rate of lead displacement and failure for epineural stimulation [45–47]. However, new generation bipolar electrode paddles (i.e., model 3961 Medtronic) have lowered the risk of displacement [45]. Once the electrode has been positioned, the lead is tunneled to the homolateral iliac fossa where a subfascial pocket is made to accommodate the stimulator. Initially, the device was placed subcutaneously, but this resulted in a high rate of displacement [48]. Two lateral perineal incisions are made, and a circumanal tunnel is created in the extrasphincteric plane (Fig. VIII.9). This can be particularly difficult anteriorly, especially in patients with extensive scarring of the perineum. In these cases, an incision of the posterior vagina wall can help in creating the tunnel thereby avoiding inadvertent perforation of the anal canal [48].

With a further subcutaneous tunnel, the thigh incision is reached and the muscle is delivered to the perineum to be wrapped around the anus. Wrapping can be performed in various ways (Fig. VIII.10), but usually the choice is for the gamma (γ) configuration in which the muscle passes anterior to the anus and after a 360° loop its tendon is attached to the periosteum of the contralateral ischiatic tuberosity with a nonabsorbable suture (Fig. VIII.11). If the muscle is not long enough to reach the contralateral ischium, its tendon can be

Fig. VIII.8. Gracilis muscle is detached from its distal insertion and fully mobilised.
attached to the homolateral ischial tuberosity after a 270° loop in what is called an alpha (α) configuration. Epsilon configuration is when the muscle is initially passed posteriorly to the anus and then wrapped for 360° and attached to the contralateral ischiatic tuberosity. This is only possible with a long muscle. Fixing the tendon has to be done after moving the thigh back in a neutral position. The neosphincter should be snug but not too tight on the surgeon's finger. Frequent pitfalls, especially in inexpert hands, are inadequate fixation of the tendon, with subsequent tendon detachment, and a tendency to make the wrap too tight, which can lead to erosion and anal canal perforation. Thigh, abdominal, and perineal wounds are washed out with gentamicin solution and closed with interrupted stitches. Redivac drains can be left in situ for 24–48 h. Postoperatively, wounds are cleaned regularly, and the patient is kept on stool softeners.

Early stimulation (after 2 weeks) is recommended to avoid muscular atrophy. The surgeon can adjust all stimulation parameters via a computer that communicates with the stimulator by a radiofrequency coil. Initially, the stimulation is set to be intermittent, and the length of activation time is progressively increased over 6–8 weeks.
until the muscle develops fatigue resistance. After this period, continuous activation may be commenced. The patient is given a remote control to turn off the stimulator prior defecation. Latest controllers also allow the patient to increase or decrease the stimulation voltage within a preset range.

Complications

The rate of complications is high, but fortunately, most of them can be managed without affecting the outcome. In 2001, the Dynamic Graciloplasty Therapy Group [49] published the overall complications of a multicenter study. Data from 120 patients operated on between 1994 and 1999 in 20 dedicated centers were reported. There were 211 complications in 93 patients (77.5%). Eighty-nine of these complications (42%) were judged severe, requiring one or more operations, and occurred in 61 of the 120 patients (50%). The most common complication was sepsis, which was major in 18 patients (15%), necessitating a total of 46 reoperations, and minor in 29 patients (24%), ten of whom required surgery. The causes of severe infections included inadvertent intraoperative perforation of the anal canal in three patients, erosion of the tendon through the anal canal in six, erosion of a lead or stimulator through the skin in two, perineal infections in six, and infection at the device site in one. Other complications included pain/numbness of the thigh (38 patients), thromboembolic events (4), tendon erosion (2), or detachment (6), anal canal stenosis (7). Device problems such as lead dislodgment, stimulator migration, poor lead-to-stimulation connection, and others occurred 20 times in 17 patients (14%). Severe constipation requiring surgery was observed in 6 cases (5%), but another 16% of patients reported the regular use of enemas to empty their bowels.

Even if most of these complications can be successfully treated, they often require more than one additional intervention and can lead to significant delay in completion of therapy [49]. The only type of complication appearing to significantly affect outcome is major infection [49]. Probably, the high rate of adverse events presented in this multicentric study may be explained by the fact that most of the involved centers performed less than ten graciloplasty procedures. Other studies demonstrated that morbidity is lower in larger, single-center series [50, 51], but the figures are still quite disappointing (Table VIII.5). Rongen et al. [48] reported 138 complications in 200 patients, most of them occurring in the early years of their experience. Infections leading to explantation of the stimulator occurred eight times in the first 20 patients (40%) and only 16 times in the remaining 180 (9%). This significant reduction was related to a proper antibiotic prophylaxis and to the use of topical antibiotics such as gentamicin sponge-release. Other complications, such as anal perforation, tendon erosion, or stimulator or lead displacement, were also lowered with increasing experience. Evacuation disorders, which are not uncommon in the early postoperative period, persisted in 32 patients (16%). In the first 18 patients treated by the senior author [43], complications affected 50%, with a mean of three complications per patient (range 1–6): six had minor wound infection, one stimulator removal due to leakage of material from it, one painful perineal scarring, two experienced abnormal leg sensitivity, two post-operative pain and difficulty with walking, one leg swelling, while five were readmitted with fecal impaction despite the use of laxatives. Finally, 23 additional operations were required to treat problems; however, most of these were due to battery failure with the initial device used. These necessitated new lead placements because of a change to the improved hardware provided by Medtronic Inc. of Maastricht.
There were no erosion complications. Moreover, none of the complications caused failure and did not affect the outcome of the procedure.

**Outcome**

Functional results of DGP are often good, with improved or normal continence achieved in a majority of patients. Percentages varied from 55 to 85% [41, 43, 47, 48, 52–56, 58]. Less favorable results are obtained in patients treated for congenital incontinence (Table VIII.6); no other variables have been correlated with success or failure [44, 54]. The largest single-center study, conducted by Rongen et al. [48] regards 200 patients with a minimum follow-up of 2 years and a median follow-up of 5 years. They reported that 145 patients (72.5%) were either fully continent or incontinent to flatus. The number of failures was significantly higher among the first 20 cases treated, demonstrating that this is not a simple procedure and a learning curve is necessary. That study also showed that, differently from anterior sphincter repair, continence achieved with DGP does not deteriorate with time. However, this fact was not been confirmed by Thornton et al. [57]: about one third of their patients followed up for a median of 60 months deteriorated and received an end colostomy, and only 18% of the total maintained a good continence status. Results from other centers are reported in Table VIII.5.

**Artificial Sphincter**

After being successfully used in urinary incontinence [59], artificial sphincter has also been implanted to treat severe fecal incontinence [60]. This is an alternative to skeletal muscle transposition, especially in patients with neurological diseases affecting the lower body, such as myasthenia gravis or diabetic neuropathy [60, 61]. The artificial bowel sphincter (ABS) (American Medical System, Minnetonka, MN, USA), which is currently the most widely used system, maintains continence through a fluid-filled cuff that surrounds the anal canal. The cuff is connected to a little pump, usually placed subcutaneously in the scrotum or labia majora, and to a reservoir balloon implanted in the prevesical space (Figs. VIII.12-VIII.13). Squeezing the pump forces the fluid from...
the cuff into the reservoir and allows defecation. Positive abdominal pressure then makes the fluid gradually return to the cuff, thus keeping the anal canal closed.

**Note on Techniques**

Implant is performed under general or spinal anesthesia with the patient in the modified lithotomy position. Preoperative bowel preparation and antibiotic prophylaxis are strongly recommended. A tunnel is created around the anus in the extrasphincteric space to accommodate the cuff. This can be done either through two lateral curvilinear incisions or through a single anterior incision. This second approach is preferred in women because it allows entry to the rectovaginal septum, usually thinned and scarred, avoiding damage to the two organs. The tunnel should be created as proximal as possible (at least 5 cm from the skin [62]) to minimize the risk of skin erosion. At this point, the cuff can be placed.

The cuff is available in two widths: 2 and 2.9 cm, each with lengths varying from 9 to 14 cm. The appropriate size is chosen with a cuff sizer present in the kit. Prior to positioning, the cuff is filled with a radiopaque solution, emptied again to remove all the air bubbles, then passed circumferentially around the anus, taking care to end with the tube anteriorly at the site chosen for pump placement (left side for right-handed patients and vice versa). A suprapubic transverse incision is made, and the prevesical space is reached after dividing the rectal fascia and separating the linea alba. Before accommodating the balloon, a plane is bluntly dissected below Scarpa’s fascia into the scrotum or labia where the pump will be positioned. The tubing from the cuff is also passed subcutaneously to the abdominal wound. At this point, the pump device can be placed into the labia or scrotum with the deactivation button facing medially. The balloon is filled with a specific amount of fluid (usually 40 ml) to reach a pressure of 80–90 cm H₂O and placed in the retropubic space; the tubing from the cuff and the balloon are cut to the appropriate length and connected to the pump. The perineal incisions are closed in multiple absorbable layers in order to separate the device from the skin as much as possible and to prevent its dislocation. The suprapubic incision is also closed in layers, with the tubing remaining above the fascia. During the operation, careful aseptic techniques and wound irrigation
with antibiotic solution are recommended in order to minimize the risk of infection. Postoperatively, intravenous antibiotics are continued for 48 h, wounds are cleaned regularly, and the urinary catheter in female patients is left in place for 2–3 days. The device is activated after 4–6 weeks, provided that all the wounds are healed.

Complications

As recently published in a review about safety and effectiveness of ABS [63], no mortality has been associated with this operation, but almost all series reported a high reoperation rate (12-65%) and a significant proportion of definitive explantation of the device, with percentages varying from 17 to 41% (Table VIII.7). Moreover, these figures may increase in the long term, as noticed by Altomare et al. [68] and by Ortiz et al. [69], who calculated a 44% cumulative probability of device explantation at 48 months. The most common reason for removal is infection. Other causes, which usually develop during follow-up, are erosion of the skin or of the anal canal, and mechanical problems such as cuff rupture or loss of device function. Tables VIII.8 and 9 show the type and frequency of early and late complications, as noted in the wider single-center series presented in the literature [62]. Among 53 patients in this series, there were 33 early and 29 late complications requiring 16 reoperations (30%) and a definitive explant in ten patients (19%).

Outcome

When the device is not explanted, it is usually able to improve the continence, with all studies reporting a significant reduction in mean incontinence score. However, early success rates of 70-80% with a high proportion of patients fully continent [60, 74, 75] have not been subsequently confirmed in larger series and over the long term.

Table VIII.7. Complication rates and definitive explantation of artificial bowel sphincter

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Patients (n)</th>
<th>FU (months)</th>
<th>Reoperations (n)</th>
<th>Explants (n)</th>
<th>Reimplant (n)</th>
<th>Definitive explant (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaizey et al [64]</td>
<td>1998</td>
<td>6</td>
<td>10 (5–13)</td>
<td>1 (17%)</td>
<td>1</td>
<td>0</td>
<td>1 (17%)</td>
</tr>
<tr>
<td>Christiansen et al [65]</td>
<td>1999</td>
<td>17</td>
<td>60 (60–120)</td>
<td>6 (35%)</td>
<td>7</td>
<td>0</td>
<td>7 (41%)</td>
</tr>
<tr>
<td>O’Brien et al [66]</td>
<td>2000</td>
<td>13</td>
<td>n.r.</td>
<td>4 (31%)</td>
<td>3</td>
<td>0</td>
<td>3 (23%)</td>
</tr>
<tr>
<td>Altomare et al [67]</td>
<td>2001</td>
<td>28</td>
<td>19 (7–41)</td>
<td>7 (25%)</td>
<td>7</td>
<td>0</td>
<td>7 (25%)</td>
</tr>
<tr>
<td>Altomare et al. [68]a</td>
<td>2004</td>
<td>28</td>
<td>50</td>
<td></td>
<td></td>
<td>11</td>
<td>11 (39%)</td>
</tr>
<tr>
<td>Devesa et al [62]</td>
<td>2002</td>
<td>53</td>
<td>26 (7–55)</td>
<td>16 (30%)</td>
<td>10</td>
<td>2</td>
<td>10 (19%)</td>
</tr>
<tr>
<td>Ortiz et al [69]</td>
<td>2002</td>
<td>22</td>
<td>28 (6–48)</td>
<td>6 (27%)</td>
<td>9</td>
<td>2</td>
<td>7 (32%)</td>
</tr>
<tr>
<td>Lehar et al [70]</td>
<td>2002</td>
<td>16</td>
<td>25 (7–49)</td>
<td>2 (12%)</td>
<td>5</td>
<td>1</td>
<td>4 (25%)</td>
</tr>
<tr>
<td>Wong et al [71]</td>
<td>2002</td>
<td>112</td>
<td>12</td>
<td>73 (65%)</td>
<td>41</td>
<td>7</td>
<td>34 (30%)</td>
</tr>
<tr>
<td>Michot et al [72]</td>
<td>2003</td>
<td>25</td>
<td>34 (7–60)</td>
<td>8 (32%)</td>
<td>5</td>
<td></td>
<td>5 (20%)</td>
</tr>
<tr>
<td>Parker et al [73]</td>
<td>2003</td>
<td>45</td>
<td>91-39b</td>
<td>29 (64%)</td>
<td>20</td>
<td>2</td>
<td>18 (40%)</td>
</tr>
</tbody>
</table>

a Same patients at long-term
b Two groups of patients: I group (10 patients): mean follow-up 91 months; II group (35 patients): mean follow-up 39 month

Table VIII.8. Early complications after artificial bowel sphincter (adapted from Devesa et al. [62])

<table>
<thead>
<tr>
<th>Early complications</th>
<th>Patients (n=53)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound separation</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>Infection</td>
<td>7</td>
<td>13%</td>
</tr>
<tr>
<td>Hematoma</td>
<td>7</td>
<td>13%</td>
</tr>
<tr>
<td>Fever of unknown origin</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td>Urethral fistula</td>
<td>1/18</td>
<td>5.5%</td>
</tr>
<tr>
<td>Impaction</td>
<td>5</td>
<td>9%</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>4</td>
<td>8%</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>62%</td>
</tr>
</tbody>
</table>
Results from a multicenter cohort study involving the majority of centers dedicated to this procedure [71] indicate that only 53% of patients enrolled in the study were considered clinical successes at 1 year from implantation. In the series of Ortiz et al. [69], almost all patients with a functioning device (68% of the total) were able to control solid stools, but only four (27%) were fully continent. Long-term results from the Italian multicenter trial [68] are also disappointing: of 21 patients with a functional device, 14 (66%) were fully continent after a mean follow-up of 19 months, but only eight of them (28% of the entire series) remained continent after 50 months.

Good results and patient satisfaction may also be jeopardized by the occurrence of defecation difficulties. This event is quite common with ABS (see Table VIII.10) and not rarely, it needs to be corrected surgically. Fecal impaction requiring regular enemas ranges from 6 to 83% [63]. In the series by Parker et al. [73], surgery to correct defecation problems was necessary in 11% of patients. In the Italian multicenter trial [68], 50% of patients with functioning ABS no longer activated the pump because of obstructed defecation. The cause of this problem is unclear. Sometimes it may be from technical problems, such as closing the cuff to tightly around the anus [73, 76]. For this reason, Parker et al. [73] recommended a cuff not 1 cm but 2 cm larger than the measured size. Another possible explanation is that the quick refill of the cuff after being emptied would favor the persistence of feces in the rectum, which may become impacted [77]. Altomare et al. [68] suggest that in the long term, the artificial sphincter, because of the surrounding fibrosis, acts mainly as a passive obstacle to the passage of feces (like a Thiersch’s sling) rather than as a dynamic sphincter.

### Table VIII.9. Late complications after artificial bowel sphincter (adapted from Devesa et al. [62])

<table>
<thead>
<tr>
<th>Late Complications</th>
<th>Patients (n=50)a</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuff erosion</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Pump erosion</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Primary infection</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Impaction</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>Pain</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Pump malfunction</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>System leaks</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>58</td>
</tr>
</tbody>
</table>

a Two patients were explanted in the early postoperative period, and one was missing after discharge from the hospital.

### Table VIII.10. Complication rate and definitive explantation of artificial bowel sphincter

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Patient (n)</th>
<th>Mean FU</th>
<th>Patients with functioning device</th>
<th>Improved continencea</th>
<th>Overall success</th>
<th>Patients with defecation difficulties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaizey et al [64]</td>
<td>1998</td>
<td>6</td>
<td>9 (4–12)</td>
<td>5</td>
<td>5 (100%)</td>
<td>83%</td>
<td>80%</td>
</tr>
<tr>
<td>Christiansen et al [65]</td>
<td>1999</td>
<td>17</td>
<td>60 (60–120)</td>
<td>8</td>
<td>8 (100%)</td>
<td>47%</td>
<td>n.r.</td>
</tr>
<tr>
<td>O’Brien et al [66]</td>
<td>2000</td>
<td>13</td>
<td>n.r.</td>
<td>10</td>
<td>9 (90%)</td>
<td>69%</td>
<td>20%</td>
</tr>
<tr>
<td>Devesa et al [62]</td>
<td>2002</td>
<td>53</td>
<td>26 (7–55)</td>
<td>43</td>
<td>29 (65%)</td>
<td>55%</td>
<td>22%</td>
</tr>
<tr>
<td>Ortiz et al [69]</td>
<td>2002</td>
<td>22</td>
<td>28 (6–48)</td>
<td>15</td>
<td>14 (93%)</td>
<td>64%</td>
<td>13%</td>
</tr>
<tr>
<td>Lehur et al [70]</td>
<td>2002</td>
<td>16</td>
<td>25 (7–49)</td>
<td>12</td>
<td>11 (92%)</td>
<td>69%</td>
<td>42%</td>
</tr>
<tr>
<td>Wong et al [71]</td>
<td>2002</td>
<td>112</td>
<td>78b</td>
<td>78b</td>
<td>51 (84%)</td>
<td>53%</td>
<td>37%</td>
</tr>
<tr>
<td>Michot et al [72]</td>
<td>2003</td>
<td>25</td>
<td>34 (7–60)</td>
<td>20c</td>
<td>15 (75%)</td>
<td>60%</td>
<td>37%</td>
</tr>
<tr>
<td>Parker et al [73]</td>
<td>2003</td>
<td>45</td>
<td>91-39d</td>
<td>27</td>
<td>19 (70%)</td>
<td>42%</td>
<td>11%</td>
</tr>
<tr>
<td>Altomare et al [68]</td>
<td>2004</td>
<td>28</td>
<td>50</td>
<td>17</td>
<td>8 (47%)</td>
<td>28%</td>
<td>50%</td>
</tr>
</tbody>
</table>

a Percentages refer to patients with functioning device
b Outcome available for 61 patients
c Outcome available for 19 patients
d Two groups of patients: I group (10 patients): mean follow-up 91 months; II group (35 patients): mean follow-up 39 months.
Other Surgical Options

Colostomy and Colonic Conduit

Fecal diversion does not confer continence, but it gives patients back the possibility of controlling their bowel movements and an acceptable personal and social life [78]. The creation of a colostomy should not be considered a treatment failure but an option for those patients with severe incontinence not suitable for major operations. Usually, an end sigmoid colostomy with preservation of the rectum is chosen. Sometimes, in presence of persistent rectal symptoms such as leakage of mucus or blood, a subsequent proctectomy can be associated [79].

Another alternative is antegrade colonic irrigation, either through an appendicostomy or a cececostomy (Malone procedure [80]) or through the creation of a colonic conduit. The possibility of irrigating and empty the colon can improve defecation disorders and promote fecal continence. This is particularly useful in those forms of incontinence secondary to sensory and motor disorders that also result in rectal evacuatory difficulties [81]. However, this wash-out procedure can cause abdominal discomfort, resulting in unpleasantness for many patients. Appendicostomy is technically easier but has a higher rate of complications, such as stenosis or reflux of colonic contents; moreover, the appendix is often absent in adults or is too narrow to allow the passage of a catheter. A colonic conduit is typically created after mobilizing and dividing the hepatic flexure. The proximal transverse colon is intussuscepted to form an antireflux valve and then tunneled to the skin while the bowel continuity is restored by an end-to-side anastomosis between the ascending colon and the distal transverse colon. This procedure can also be useful in patients with DGP or artificial sphincter who developed severe evacuatory problems [82].

Conclusions

Many options are available to treat fecal incontinence, but surgeons and patients should have a clear understanding that none of the proposed operations can guaranty a complete return to normal status and that there are no preoperative variables at the moment that can predict whether a treatment will be successful or not. A correct assessment of the causes and severity of symptoms with diary data and validated incontinence [83] and quality of life scores [26] is important to orientate the choice of the treatment. Yet conservative therapies and minor procedures should always be offered first, limiting major operations, such as creation of a new sphincter, to very select cases. Anterior sphincter repair, because of its simplicity and very low morbidity rate, could be the initial procedure when a defect is clearly demonstrated. However, a realistic appraisal of the short and long-term relatively poor outcome may encourage more patients to accept a nonoperative approach.

DGP and ABS should be reserved for cases of severe incontinence in which easier procedures are not feasible or have failed. In both options, case selection is a critical aspect for success: ABS is clearly more indicated in fecal incontinence due to neurological disease that affects the muscles of the lower extremity while patients with a very thin or scarred perineum caused by obstetric trauma, perianal infection, previous surgery, or radiation might be best treated with a DGP. It is difficult to assert if one procedure is better than the other because no direct comparisons have been done. A randomized controlled trial would be useful, but it would be difficult to accomplish because of the limited number of patients and the limited number of surgeons with sufficient experience in both methods [39].

Although continence is improved in a large number of patients, DGP is a difficult operation with a high morbidity rate. Fortunately, most problems can be successfully managed and, at the end of the day, they do not affect the outcome, but patients (and surgeons) need to be really motivated and agree to the possibility of many admissions and reoperations to achieve a good result. Another problem with this procedure is that it is expensive, also considering that the impulse generator does have a median life of 7–8 years [48], after which it needs to be substituted. Nevertheless, Adang et al. [84] produced data showing that overall costs of DGP are lower than those of long-term stoma care. ABS is technically easier and also cheaper than DGP. Besides, it requires less training and gives the patient immediate continence. However, this procedure suffers from a high explantation rate and more technical problems than DGP. Furthermore, results seem to be not as good as thought early on, and difficult
defecation is a frequent problem [63]. Our opinion is that in expert hands, DGP can satisfy a higher number of patients. However, both DGP and ABS should remain limited to a small number of centers in which adequate patient volume and surgical experience help to assure low morbidity and satisfactory outcome. For those patients with untreatable incontinence or in whom major operations are contraindicated, end colostomy remains an option that affords an acceptable quality of life.

There is a relatively new treatment called sacral neuromodulation (SNM), which seems to be able to significantly improve symptoms in most patients with severe incontinence, irrespective of the nature of the incontinence. This procedure, which is the topic of next chapter, is easy to perform and almost without complications. Moreover, this is the only operation in which outcome can be predicted with a preliminary test – peripheral nerve evaluation (PNE) – which selects with an accuracy close to 100% patients who are good candidates for definitive implantation of the stimulator. For all these reasons this new procedure may become the treatment of choice when surgery is required.

References