Abdominoperineal Resection: How Is It Done and What Are the Results?

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ABSTRACT

Abdominoperineal resection (APR) for many years was the treatment of choice for most patients with rectal cancer. Recent advances in surgical technique and other treatment modalities have led to a marked increase in the rate of sphincter-sparing operations, with a concomitant decrease in APR. However, it is still necessary in selected patients, especially those with very distal tumors or poor sphincter function. This review will cover the history of APR, current operative strategy and complications, oncologic and quality of life results, as well as potential future advances.

KEYWORDS: Rectal cancer, abdominoperineal resection, surgery

Objectives: On completion of this article, the reader should be able to summarize the important steps in the performance of APR, its potential complications, and expected results.

Abdominoperineal resection (APR) completely removes the distal colon, rectum, and anal sphincter complex using both anterior abdominal and perineal incisions, resulting in a permanent colostomy. Developed more than 100 years ago, it remains an important tool in the treatment of rectal cancer despite advances in sphincter-sparing procedures. We will examine a brief history of this procedure, current operative techniques and complications, expected results, both oncologic and with regard to quality of life, and what the future may hold for this procedure.

Several recent reports have noted the increase in the use of sphincter-sparing options for patients diagnosed with rectal cancer. Abraham and colleagues found a 10% decrease (60.1% to 49.9%) in the rate of APR from 1989 to 2001 as compared with low anterior resection (LAR) using national administrative data.[1] When controlled for several variables, including patient demographics and hospital volume, patients were 28% more likely to have an LAR later in the study period. Schoetz[2] notes that LAR outnumbers APR 3 to 1 in the submitted case logs of recent colorectal fellows. This ratio is similar to that found in the Swedish rectal cancer registry, where ~25% of over 12000 patients with rectal cancer underwent APR from 1995–2002.[3] In no study or registry, however, has APR been eliminated.

HISTORY

Early in the 20th century, most patients with rectal cancer underwent perineal procedures to address typically advanced, symptomatic disease. These included the transcoccygeal Kraske approach and the transsphincteric approach developed by Bevan in America, later attributed to A. York Mason. Patients were typically left with profound sphincter dysfunction or fistulae following a protracted recovery. A two-staged operation, consisting of an initial laparotomy and colostomy followed by perineal excision, was used until the 1930s with reasonable results.

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The operation we now know as APR was first described by Miles in 1908,[3a] but initial reports showed a high operative mortality, up to 42%. Improvements in perioperative care that came later reduced this considerably. Refinements in technique continued through the first half of the 20th century. Gabriel described the operation in one stage, with the abdominal portion done supine and the perineal portion done in the left lateral position. Lloyd–Davies' synchronous approach to the abdomen and perineum with the patient in the lithotomy position eliminated the cumbersome and sometimes dangerous need to reposition the patient while under anesthesia.[4] Recent advances have included total mesorectal excision in patients undergoing APR and the addition of methods to enhance perineal wound healing, especially in patients who have received neoadjuvant chemoradiation. Minimally invasive techniques are also being applied to APR, with good initial results.

OPERATIVE TECHNIQUE

Unobstructed patients are given a mechanical bowel preparation the day before surgery. Parenteral antibiotics are given in the perioperative period. Based on the patient's age and overall medical condition, routine laboratories consisting of a CBC, chemistry, and PT/PTT will be obtained. Cardiopulmonary risk is assessed and blood is typed and cross-matched. The surgeon or an enterostomal therapist will mark the future colostomy site, which should be positioned to avoid the midline incision, bony prominences, scars and natural skin folds. If the staging work-up determines that the mass is large, shows evidence of invasion into adjacent structures, or there is ureteral obstruction, stents should be placed before proceeding with an APR.[5]

The patient is positioned after initiation of general anesthesia; regional anesthesia is possible, but not recommended. The patient can initially be positioned in modified lithotomy position using Allen stirrups or supine, if intraoperative repositioning to prone-jackknife or left lateral decubitus is chosen to perform the perineal portion of the operation. We prefer the two-team approach with the patient in lithotomy position. Bilateral sequential compression devices are placed on the calves. The patient's legs are placed in the stirrups such that the weight is borne on the heels and there is no pressure on the peroneal nerve as it passes around the fibular head. The hips must be abducted to accommodate the perineal dissector and are positioned at the end of the bed to allow ready access to the tip of the coccyx. A Foley catheter is placed and draped over the thigh so as not to interfere with the perineal dissection. A pad is placed under the sacrum to protect it as well as to allow the perineum to project beyond the end of the table.[6] A digital rectal exam is performed with the patient under general anesthesia to ensure that sphincter preserving surgery is not an option.[5] Rectal washout may be performed at this point with a dilute Betadine (Purdue Pharma, Stamford, CT) solution to remove any residual stool. This may be done using a closed system employing a three-way Foley with a Pezzar catheter, or with a chest tube and syringes. When all the effluent has drained, the anus is closed using a purse-string suture in the intersphincteric groove. The abdomen and perineum are then prepped and draped for surgery.

The abdomen is entered through a midline incision extending from the pubis cephalad to just above the umbilicus. This should allow adequate visualization of the abdomen for the procedure. The incision can be extended cephalad if the splenic flexure requires mobilization.[7] Exploration of the abdomen is performed at this point to assess for the presence of metastatic disease. The liver is palpated thoroughly and intraoperative ultrasound may be employed if available. The small bowel, peritoneal surfaces, and periaortic nodes are inspected.[5] Palpation of the pelvic mass helps assess resectability; patients with locally advanced disease or widespread metastases may be better served by palliative diversion alone. A wound protector and self-retaining retractor are placed to ease dissection. The small intestine is packed into the upper abdomen, and the resection is begun. The sigmoid is grasped and retracted to the patient's right. The lateral peritoneal edge is divided using electrocautery along the embryonic fusion plane beginning at the level of the junction of the descending and sigmoid colon. As the dissection progresses distally, the left ureter should be identified as it crosses the left common iliac as injury to the ureter occurs most commonly at this phase.[8] The opening in the parietal peritoneum is continued distally, medial to the ureter down to the level of the peritoneal reflection. The sigmoid and rectum are then retracted to the patient's left, and the parietal peritoneum at the base of the sigmoid mesentery is opened anterior to the aorta. The peritoneal incision is continued distally to the cul-de-sac medial to the right ureter, which can be readily identified as it enters the pelvis over the right common iliac artery. The peritoneum is further incised onto the sigmoid mesentery to the point where the colon will be divided. The blood supply is identified, skeletonized, and suture-ligated at the origin of the superior hemorrhoidal artery. It is unnecessary to ligate the inferior mesenteric artery at its origin as this has not been shown to increase survival.[4,8] Additionally, ligation at this point and not at the origin of the inferior mesenteric artery (IMA), eliminates one potential point for injury of the innervation of the genitalia or bladder; the preaortic sympathetic plexus can be drawn up into the suture ligature as the IMA is encircled.[6] For convenience, the proximal sigmoid can be divided with a linear stapling device and the cut end used as a handle to aid with the dissection. The areolar layer between the fascia propria of the rectum and the presacral

fascia can now be entered at the level of the sacral promontory. Care must be taken at this point to identify and preserve the hypogastric nerves. Dissection in the areolar layer is continued distally using either sharp dissection or electrocautery. Dissection is aided by using a lighted St. Mark's retractor to hold the mesorectum anteriorly. As the dissection continues distally, Waldeyer's fascia is divided with electrocautery or sharply to avoid injuring the presacral venous plexus. Blunt dissection, which was classically taught, should be avoided. The posterior dissection is continued down to the level of the levators.

The dissection is continued laterally, aided by counter traction from the assistant with the lighted St. Mark's retractor. The lateral ligaments are cauterized or suture-ligated. The lateral ligaments should be divided as close to the specimen as possible without compromising radial margins to avoid injury to the nervi erigentes. With division of the lateral stalks bilaterally, attention can be turned to the anterior dissection. The lateral peritoneal incisions are connected anteriorly at the rectouterine pouch, in women, or the rectovesical recess in men. It is not necessary to expose the seminal vesicles in men, thus avoiding injury to the nervi erigentes.[6] With downward traction on the rectum and upward traction with the lighted St. Mark's retractor on the vagina or prostate, the rectovaginal septum is dissected in women, or the layer posterior to Denonvilliers' fascia in men is dissected down to the pelvic floor anteriorly. In women, the presence of an anteriorly based tumor may require performance of a posterior vaginectomy. When the pelvic floor is reached circumferentially around the rectum, the abdominal portion of the dissection is completed.

Attention is then turned to creation of the colostomy prior to closing the abdomen and proceeding with the perineal dissection. A disk of skin is excised sharply at the previously marked site in the left lower quadrant. The subcutaneous fat is retracted, but not excised, to expose the anterior rectus sheath. A verticular cruciate incision is made in the rectus sheath using electrocautery. The rectus muscle is split longitudinally taking care not to injure the epigastric vessels. Using a laparotomy pad inside the abdomen to protect the bowel, a longitudinal incision is made through the posterior rectus sheath and peritoneum. The opening should be large enough to allow two fingers to pass with ease. The proximal cut end of the sigmoid or descending colon is grasped with a ringed forceps and drawn out through the opening. Tunneling the colon extraperitoneally does not prevent parastomal herniation as originally proposed.[5] If there is undo tension on the colostomy as it is pulled through the abdominal wall, additional mobilization should be performed to prevent retraction. Ischemia at the transected end of the bowel should prompt enlargement of the opening in the abdominal wall. At this point, the abdomen and pelvis are copiously irrigated and drains may be placed into the pelvis through the abdominal wall. The fascia and skin are closed and the colostomy is matured at skin level with multiple interrupted, absorbable sutures and full-thickness through the bowel through the dermis.

When a two-team approach is utilized, the perineal dissection begins simultaneously with the abdominal portion of the case as soon as the abdominal operator has determined that the lesion is resectable.[8] In the single team approach, the perineal dissection will either be undertaken in the lithotomy position or the patient will be repositioned into the left lateral decubitus or prone jackknife position. The operation can be completed with equal success regardless of how one chooses to proceed. Repositioning should be considered when there is a large anterior tumor or when a posterior vaginectomy is planned, as this gives excellent exposure and greatly facilitates the dissection. An elliptical incision is created that extends from the midpoint of the perineal body in the man, or the posterior vaginal introitus in the woman back to a point midway between the coccyx and the anus.[7] The incision should include the entirety of the external sphincter muscle, but does not need to extend laterally to the ischial tuberosities despite some evidence to suggest lower recurrence rates may be achieved with more radical resection. Wider margins on the perianal skin are taken for lower lesions.[9] The incision is continued down through the subcutaneous tissue into the ischiorectal fat using electrocautery. Self-retaining retractors may be employed to aide with dissection. The majority of the dissection, at this point, is directed posterior and laterally. The inferior hemorrhoidal vessels will be encountered in the posterior-lateral position and will require coagulation or suture ligation. Using a finger on the tip of the coccyx as a guide, the posterior dissection is directed anterior to the coccyx and the anococcygeal raphe is divided. The pelvis is entered sharply, anterior to the coccyx by a stab incision using closed curved scissors. The scissors are withdrawn in the open position to create an opening large enough to admit a finger. This maneuver can be assisted by the abdominal operator in the synchronous approach to avoid injury to the presacral plexus or damaging the rectal specimen. The perineal dissector then uses an index finger to guide resection of the levator muscle. This can usually be limited to resection of the puborectalis. This allows adequate remaining muscle to permit closure of the pelvic floor, although one must remain cognizant to take enough muscle to assure complete tumor resection. When all that remains is the anterior attachments, the specimen is drawn through the opening and used to provide traction to continue the remaining dissection. Lastly, the transverse perinei and rectourethralis muscles are divided anteriorly. As the last of the attachments of the rectum to the prostate or vagina are divided, care must be taken not to direct the

dissection too posterior and enter the rectum, or too anterior and damage the urogenital structures.[5] The specimen is then removed and the pelvis is irrigated. The drains are repositioned for maximum effect, and the perineal wound is closed. If sufficient levator muscle remains, the pelvic floor is reapproximated with multiple absorbable sutures. If the pelvic floor musculature cannot be closed, there is an increased risk for perineal herniation. The subcutaneous fat in the ischiorectal space is subsequently reapproximated in the midline using interrupted absorbable sutures. The skin is reapproximated using interrupted permanent monofilament suture in a vertical mattress fashion. These are left in place for 4 weeks to allow ample time for healing, especially if the patient has been radiated preoperatively.

Numerous articles have provided data supporting the use of laparoscopic techniques for oncologic procedures. Multi-institutional studies have shown that laparoscopic abdominoperineal resection can be performed safely and with reduced hospital stay.[10] Because the specimen is removed through the perineum, no large abdominal incisions are required, which significantly reduces postoperative pain. Preoperative preparation and patient positioning are identical to the open procedure, although a lesser degree of hip flexion may be necessary to allow uninhibited dissection in the left colic gutter. Because pneumoperitoneum will be required throughout the abdominal portion of the case, this case requires a sequential one or two team approach. For the abdominal dissection, four or five trocars may be used: a 10-mm umbilical trocar for a 30-degree laparoscope, 10-mm and 5-mm trocars in the right lower quadrant for the majority of the dissection, and at least one additional left lower quadrant 5-mm port for an assistant to provide retraction. The left lower quadrant trocar may be placed through the chosen colostomy site. The principles of the operation are identical to that of the open procedure. The Harmonic Scalpel (Ethicon Endo-Surgery, Inc., Cincinnati, OH) is often used for dissection and the blood supply may be ligated with either large endoclips, a LigaSure device (Valleylab, Boulder, CO), or with an Endoloop (Ethicon Endo-Surgery, Inc., Cincinnati, OH). The proximal sigmoid is divided with an endoscopic stapling device. At the completion of the abdominal dissection, the colostomy can be pulled up through the left lower quadrant trocar site with an opening created in identical fashion as the open technique. Closed suction pelvic drains may be placed laparoscopically, exiting the abdomen via the right lower quadrant trocar sites. At this point, the abdominal portion is completed and attention is turned to the perineal dissection, which is undertaken as described above.

Conversion rates for laparoscopic abdominoperineal resection vary from 1.4 to 48%.[11] Reasons for conversion include bleeding, inability to obtain exposure, large tumor size, adhesions, inguinal hernia, and radiation fibrosis.[10] Complication rates and types are similar and there is no significant difference is oncologic outcomes. Choice of technique should be based on appropriate patient selection and the skill and comfort level of the surgeon.

COMPLICATIONS

Abdominoperineal resection is one of the most complex procedures in the surgical armamentarium. Regardless of whether a one or two team approach is employed, the technical demands, length of the operation, and complex positioning requirements subject patients to all the general risks of major surgery as well as many risks specific to this procedure. Cardiac and pulmonary complications account for most of the 3% operative mortality seen in most series and therefore should be assessed preoperatively and measures taken to lessen their severity if possible.[5] Perioperative β blockade and prophylaxis for deep venous thrombosis with low molecular weight heparin are routine.

Procedure-specific complications may arise in a multitude of ways either in the short- or long-term. The most common immediate complication is intraabdominal or pelvic abscess, reported by Murrell et al[12] to affect 32% of the patients who had early problems. Other sources of morbidity can be categorized into those arising from nerve injury, urologic injury, the perineal wound, and the ostomy. There is the potential for both peroneal nerve injury from incorrect stirrup use and brachial plexus injury from steep Trendelenburg with shoulder rests; both of these may be avoided with careful attention to positioning.[5] The autonomic nerves that affect both sexual and urinary function may be injured at numerous sites during the pelvic dissection. The risk of postoperative sexual or urinary dysfunction can range from 10 to 60%.[13] Dissection at the sacral promontory may injure the hypogastric nerves if care is not taken to identify and isolate them during total mesorectal excision. The pelvic autonomic plexus is at risk if the pelvic dissection extends too far laterally, or if an extended lymph node dissection is undertaken. The nervi erigentes may also be injured if the lateral ligaments are divided too far laterally or anteriorly, or if the dissection of Denonvilliers' fascia proceeds too close to the prostate.[7] The sequelae of these injuries may manifest themselves in a variety of ways. Although urinary retention should be anticipated in the postoperative period, injury to the autonomic supply to the bladder may result in bladder dystonia, which may resolve over months or be permanent. Sexual dysfunction in men presents as the inability to achieve erection, partial erection, or retrograde ejaculation. Postoperative radiation tends to exacerbate male sexual dysfunction.[14] No adequate means of measuring sexual dysfunction in women has been devised.

Urologic injuries may be related to surgical technique or direct tumor involvement. Bladder injuries are usually of little consequence and can be repaired at the time of injury using two layers of absorbable suture. The ureters can be injured by either the abdominal operator or by the surgeon performing the perineal portion of the operation. If these injuries are noted at the time of the original operation, they can usually be repaired over a stent with little postoperative morbidity. The placement of preoperative stents has the dual role of involving the urologist at the outset of the procedure as well as improving the ability to identify ureteral injury at the time of surgery. If the ureteral injury is not identified until late, percutaneous nephrostomy prior to reconstruction of the injury has been shown to decrease reoperation and morbidity rates.[15] Additionally, the membranous urethra may be injured by the perineal dissector. This can usually be avoided by close attention to the position of the Foley catheter while dissecting, but is also readily identifiable when the catheter is exposed. Primary repair and prolonged Foley catheterization are usually the only therapy required, although there is a small risk of stricture depending on the nature of the injury.

The perineal wound poses a risk unique to those undergoing abdominoperineal resection and complications are common. Typically the perineal wound is either closed primarily or with a myocutaneous flap due to the significant morbidity of a large open perineal wound that carries an increased risk of perineal herniation. A review of risk factors for perineal wound complications undertaken by Christian et al[16] determined that higher rates of major wound complications occurred in patients who had APR performed for anal cancer as opposed to rectal cancer or inflammatory bowel disease. Additionally, flap closure, tumor size, higher body mass index, and diabetes increased the risk for major complications. Preoperative radiation and primary closure were not associated with increased rate of complications. Perineal herniation is an extremely rare condition with a prevalence of 5 in 1266 in one recent review.[17] It is more common in women. Symptoms include pressure, fullness or pain in the perineum, and it may lead to skin breakdown or evisceration.[8] Repair usually requires mesh and equal results can be obtained by either an abdominal or perineal approach.

The need for a permanent colostomy poses its own unique set of complications which may occur in the immediate setting or long-term. Ostomies that are poorly fashioned may be subject to ischemia that can progress to full-blown necrosis or may stabilize, but result in a stricture. These problems are usually caused by excessive tension on the ostomy, or an inadequate aperture through the abdominal wall. Ultimately, both scenarios will require revision. Over the long-term, the ostomy may retract if the patient gains significant weight or parastomal herniation may occur. Repair should be based on strong indications such as persistent symptoms or pouching difficulties. Multiple types of parastomal hernia repairs, using open and laparoscopic techniques, have been reported with recurrence rates ranging from 24 to 59%.[18] The lowest rates were with ostomy relocation. Rubin et al[19] proposed that for an initial parastomal hernia primary relocation might be the best option, saving fascial repair for recurrences. Strong consideration to this approach should be taken in an individual with a permanent ostomy and limited sites for placement. Additional ostomy problems secondary to improper siting may also ultimately require revision. The complications of abdominoperineal resection have far-reaching psychosocial and medicolegal implications and extensive preoperative discussion and documentation are imperative.

ONCOLOGIC RESULTS

In the late 1970s and early 1980s, with the development of reliable circular staplers, mid to lower rectal cancers were beginning to be managed with sphincter-sparing resections (SSR). Several studies showed that a 2-cm distal rectal margin was as good as a 5-cm margin. Two important well-done studies from the mid-1980s demonstrated the oncologic equivalence for SSR as compared with APR. Williams et al, in two articles in the *British Journal of Surgery*, found that the 5-year cancer-specific survival after SSR was 74%, compared with 62% after APR (not statistically different). This group also noted that for midrectal tumors, local recurrence rates were similar, 13.6% after SSR and 18.8% after APR. Neither total mesorectal excision (TME) nor adjuvant chemoradiation were used.[20,21]

The next advance in the surgical management of rectal cancer was the introduction of TME. Several studies in the 1990s demonstrated an oncologic disadvantage for patients undergoing APR, with frequent positive radial margins and an increased rate of tumor perforation. Not surprisingly, local recurrence rates for APR exceeded that of LAR. The Dutch Colorectal Cancer Group prospectively investigated the results from surgeons who had been trained in TME. APR patients had a survival of 38.5%, compared with 57.6% for those undergoing SSR ($p = 0.008$). Positive circumferential margins and tumor perforations were also significantly more common in APR patients.[22] Law and Chu found similar results among 504 consecutive patients undergoing resection of rectal cancers within 12 cm of the anal verge. Overall morbidity and operative mortality were similar between APR and SSR patients, but local recurrence at 5 years was more frequent following APR (23% versus 10%, $p = 0.01$). Five-year cancer-specific survival rates were also worse for APR (60 versus 74%, $p = 0.006$).[23] Radcliffe[26] noted several studies with a high incidence of positive

circumferential margins in APR[24,25] and has suggested the development of a technique standard with outcome auditing similar to that developed after TME.

Recent studies by experienced surgeons have shown that with careful technique, outcomes for APR are no worse than SSR. The Norwegian Rectal Cancer Project looked prospectively at over 2100 patients from 47 centers. Multivariate analysis showed that tumor distance from the anal verge, but not technique (APR versus SSR) influenced the risk of local recurrence.[27] Chuwa and Seow-Choen analyzed the oncologic outcomes of 791 patients undergoing curative resections for rectal cancer. APR was necessary in 12.1%. In their cohort, there was no difference in local recurrence or 5-year survival between APR patients and those receiving SSR.[28] These authors recommend careful attention to the radial margin at the most distal part of the rectum and upper anal canal where the mesorectum thins.

QUALITY OF LIFE

Quality of life (QOL) considerations are important when helping patients select the appropriate treatment for low rectal cancers. Many studies have addressed this issue over the past 20 years, comparing patients undergoing APR to those undergoing SSR. Initial reports demonstrated a QOL advantage for SSR. Williams and Johnston[29] showed that APR patients had considerably more sexual impairment, and only 40% returned to work, compared with 83% following SSR. Several other studies corroborated these findings.[30,31]

However, as anastomoses became technically feasible more distally in the rectum or upper anal canal, the differences in QOL diminished. Difficulties with evacuation and incontinence in very low SSR offset changes in sexuality found with APR.[32] Pachler and Wille-Jorgensen[33] examined 30 QOL studies and found 11 of sufficient merit to analyze, finding that in 6, QOL was not appreciably different when SSR and APR patients are compared. Vironen et al[34] found that bowel and urogenital dysfunction in both SSR and APR patients, and not simply the presence of a stoma, was the biggest determinant of QOL deficits following rectal cancer surgery. An interesting study by Zolciak and colleagues[35] looked at patient preferences before and after rectal cancer resection. Approximately half the patients who underwent APR preferred that operation at 4-year follow-up, suggesting a positive reappraisal of APR, once experienced.

FUTURE DIRECTIONS

The future of abdominoperineal resection lies in its ever-falling prevalence, as improved surgical techniques and the development of new technology have decreased the number of patients who require this radical and morbid procedure. The use of neoadjuvant therapy has eliminated a subset of patients who in past years would have undergone abdominoperineal resection, but subsequently were able to undergo sphincter-sparing procedures. Recent work has also focused on improving outcomes and decreasing the morbidity and the psychosocial aspects of a permanent ostomy.

Historically, a tumor whose distal margin was below 5 cm from the anal verge could not be treated with anything less than an abdominoperineal resection. Currently, techniques for intersphincteric resection are challenging surgical dogma. Using a combined abdominal and perineal approach, and resection of either part or the entire internal sphincter, tumors ranging from 1 to 5 cm from the anal verge have been resected with satisfactory oncologic and functional outcome. Alternate approaches have proposed resection of the internal sphincter as well as superficial external sphincter. Nighttime incontinence was higher, but patient satisfaction was still good. Recurrences are treated by salvage abdominoperineal resection. Effective treatment with internal sphincter resection mandates that the tumor not penetrate the internal sphincter. Magnetic resonance imaging is appropriate for making this determination.[36]

Neoadjuvant therapy has made it possible for significant downstaging of low rectal tumors and allowed a subset of patients to undergo sphincter-sparing surgery when they would have otherwise not have been candidates. Favorable clinical response to preoperative chemoradiation and tumor downstaging predict better 5-year survival and local control rates.[37] Despite evidence to suggest that complete response is not always prognostic for outcome,[38] it is encouraging that a subset of patients show complete dissolution of their tumor after neoadjuvant chemoradiation and it has been proposed that a certain subset of patients may not require surgery at all. Certainly, additional work with tumor markers to identify favorable populations and chemotherapeutic regimens may ultimately eliminate another population who would normally be treated with abdominoperineal resection.

Decreasing morbidity is another important focus for patients who will undergo abdominoperineal resection in the future. Work continues with a multitude of myocutaneous flaps to improve perineal wound-healing after abdominoperineal resection. Ramesh et al[39] treated 17 patients with gracilis, rectus abdominis, and gluteal flaps with a 94% healing rate and minimal morbidity. It would be reasonable to consider plastic surgery involvement for those patients with large tumors who have undergone preoperative irradiation, as they suggest. Lastly, to overcome the psychosocial effects of a permanent colostomy, extensive work has been performed in the area of pelvic floor and anal canal reconstruction. Techniques involving artificial sphincters and gracilis muscle transposition have been used with some success.

A small study comparing the artificial sphincter with the dynamic graciloplasty clearly favored graciloplasty; more late complications were seen in the artificial sphincter group and results were overall more encouraging with graciloplasty.[40] Some still favor the artificial sphincter because of its ease of use and the procedure is technically easier.[41] Contraindications to anal reconstruction are stage IV disease and regional lymph node metastases in patients with epidermoid tumors.[42]

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