



Devices and techniques for endoscopic treatment of residual and fibrotic colorectal polyps (with videos)

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Background and Aims: Residual neoplasia after macroscopically complete EMR of large colon polyps has been reported in 10% to 32% of resections. Often, residual polyps at the site of prior polypectomy are fibrotic and non-lifting, making additional resection challenging.

Methods: This document reviews devices and methods for the endoscopic treatment of fibrotic and/or residual polyps. In addition, techniques reported to reduce the incidence of residual neoplasia after endoscopic resection are discussed.

Results: Descriptions of technologies and available outcomes data are summarized for argon plasma coagulation ablation, snare-tip coagulation, avulsion techniques, grasp-and-snare technique, EndoRotor endoscopic resection system, endoscopic full-thickness resection device, and salvage endoscopic submucosal dissection.

Conclusions: Several technologies and techniques discussed in this document may aid in the prevention and/or resection of fibrotic and nonlifting polyps. (Gastrointest Endosc 2020;92:474-82.)

The American Society for Gastrointestinal Endoscopy (ASGE) Technology Committee provides reviews of existing, new, or emerging endoscopic technologies that have an impact on the practice of GI endoscopy. Evidence-based methodology is used, with a Medline literature search to identify pertinent clinical studies on the topic and a MAUDE (U.S. Food and Drug Administration Center for Devices and Radiological Health) database search to identify the reported adverse events of a given technology. Both are supplemented by accessing the “related articles” feature of PubMed and by scrutinizing pertinent references cited by the identified studies. Controlled clinical trials are emphasized, but in many cases data from randomized, controlled trials are lack-

ing. In such cases, large case series, preliminary clinical studies, and expert opinions are used. Technical data are gathered from traditional and web-based publications, proprietary publications, and informal communications with pertinent vendors.

Technology Status Evaluation Reports are drafted by 1 or 2 members of the ASGE Technology Committee, reviewed and edited by the committee as a whole, and approved by the Governing Board of the ASGE. When financial guidance is indicated, the most recent coding data and list prices at the time of publication are provided. For this review, the Medline database was searched through August 2018 for articles related to devices and methods for endoscopic resection of fibrotic, residual, or recurrent colon polyps, using relevant terms including colonoscopy, colon, polyp, refractory, fibrotic, residual, recurrent, full-thickness resection, EndoRotor, avulsion, endoscopic mucosal resection, endoscopic submucosal dissection, and microsurgery, among others. Technology Status Evaluation Reports are scientific reviews provided solely for educational and informational purposes. Technology Status Evaluation Reports are not rules and



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BACKGROUND

Colonoscopy with polypectomy is associated with a reduced incidence of and mortality from colorectal cancer.¹⁻³ To maximize the preventative benefit of colonoscopic polypectomy, complete excision of polyps must be achieved. It has been estimated that up to 27% of interval cancers are because of incompletely resected lesions.⁴⁻⁶ Residual neoplasia after macroscopically complete EMR of large colon polyps has been reported in 10% to 32% of resections.⁷⁻¹⁰ Often, residual polyps at the site of prior polypectomy are fibrotic and nonlifting, making subsequent resection challenging.

Most colorectal polyps separate from the muscularis propria and lift during a submucosal injection. The “nonlifting sign” was first described in the 1990s as being indicative of invasive colon cancer,^{11,12} predicting extension to the deep submucosa or beyond.¹³ However, prior manipulations of a polyp (eg, partial resection, biopsy sampling, or an immediately adjacent tattoo) can induce submucosal fibrosis and an associated nonlifting sign.¹⁴ When these manipulations are performed before referral to an appropriately trained and experienced endoscopist, the likelihood of complete resection is decreased, and, consequently, the likelihood of polyp recurrence is increased.¹⁴ Given this, the recommended best practice is to refrain from snare sampling, minimize or avoid forceps biopsy sampling, and place tattoos at a sufficient distance (3-5 cm) from the lesion before an attempt at resection.¹⁴

It is critical to strive to distinguish benign polyps that resist standard snare resection or recur after an initial resection because of submucosal fibrosis from those neoplasms that are because of invasive cancer.^{15,16} In addition to the patient’s procedural history, determination of endoscopic features of invasive cancer, electronic image enhancement, and chromoendoscopy have been used to aid differentiation of these lesions.¹⁷⁻¹⁹ In this document we primarily discuss devices and methods for the endoscopic treatment of fibrotic and/or residual polyps but also review techniques reported to reduce the incidence of residual neoplasia after endoscopic resection.

TECHNIQUES AND TECHNOLOGY UNDER REVIEW

Performing safe and effective endoscopic therapy for advanced colonic lesions requires proper expertise. The techniques described in this review are more complex than routine endoscopy and carry increased risks for adverse events.²⁰ Prerequisite training and experience are

necessary to safely perform these procedures.²⁰ It is recommended that these procedures be performed in an appropriate setting with the availability of experienced nursing and anesthesia staff.²⁰

Avulsion techniques

Avulsion techniques seek to remove visible neoplasia using forceps when snare resection is incomplete. In descriptions of “hot avulsion,” a hot biopsy forceps is used to grasp and retract visible neoplasia while a proprietary microprocessor-controlled cutting current (ENDO CUT I, Effect 2/3; Erbe, Marietta, Ga, USA) or soft coagulation current (SOFT COAG 80 W; Erbe) is delivered^{21,22} (Video 1, available online at www.giejournal.org). Care is taken to grasp only residual mucosal neoplasia to minimize deep thermal injury. This is achieved by avoiding forceful pressure on the tissue before closing the cups of the forceps.²¹ Some published reports have described using a “tapping” technique to deliver short, 1-second bursts of current.^{22,23} Hot avulsion differs from traditional hot biopsy forceps polypectomy²¹ in that forced coagulation current is avoided. Evidence from animal models has demonstrated a significant risk for transmural thermal injury when forced coagulation current is used with monopolar forceps.^{24,25} Also, use of a cutting current (eg, ENDO CUT I) may limit thermal destruction of tissue and allow for pathologic evaluation.

A retrospective study from a single endoscopist at a U.S. academic medical center compared hot avulsion with argon plasma coagulation (APC).²¹ This series included 223 colorectal lesions ≥ 20 mm, including 109 lesions with visible residual neoplasia after piecemeal endoscopic resection. Of these, 63 were treated with APC ablation, whereas 46 were treated with hot avulsion. The recurrence rate for lesions treated with avulsion was significantly lower than those treated with APC (10% vs 59%; odds ratio, .079; $P < .001$). In this study 41% of patients had polyps with prior manipulations and associated submucosal fibrosis. In another retrospective study, 20 patients with nonlifting colorectal polyps > 20 mm in size were treated with piecemeal EMR and adjunctive hot avulsion.²² On follow-up colonoscopies performed at 4 to 12 months, recurrent neoplasia was observed in 3 of 20 patients (15%). Each of these 3 patients had small areas of residual disease treated successfully with repeat hot avulsion. Another retrospective series compared endoscopic resection outcomes between lesions that required the use of hot avulsion (to remove visible neoplasia that could not be removed with a snare) with lesions that did not require hot avulsion.²⁶ This series included 482 patients with 537 lesions, of which 112 (21%) required hot avulsion. The recurrence rate in the avulsion group was similar to the group that did not require avulsion (17.5% vs 16%; $P = .76$).

With the “cold avulsion” technique, the visible nonlifting neoplasia is removed in a piecemeal fashion using a

standard or jumbo cold biopsy forceps. In some descriptions of cold avulsion, an adjunctive ablative technique has also been used. In one such method termed CAST (Cold-forceps Avulsion with adjuvant Snare-Tip soft coagulation), the exposed submucosa and polypectomy margins are ablated using snare-tip soft coagulation (SOFT COAG effect 4, 80 W; Erbe) after cold forceps avulsion.²⁷ Another reported method, termed ablation and cold avulsion, alternates APC ablation (25-40 W, 1.6-2 L/min) with cold avulsion of the cauterized polyp until a submucosal scar is seen.²⁸

A prospective single-center observational cohort study evaluated 657 patients with laterally spreading colorectal lesions ≥ 20 mm treated with EMR.²⁷ A subset of 101 patients (15.4%) underwent CAST for nonlifting areas (63 with no prior lesion manipulation, 38 with prior manipulation). CAST was technically successful in all cases, and adverse events were comparable with lesions that did not require CAST. The rate of recurrence was equivalent between lesions managed with lift-assisted complete EMR and nonlifting lesions with prior manipulation that required CAST (15.5% vs 15.3%; not significant).

Outcomes using the ablation and cold avulsion method were reported in a retrospective series of 15 patients with fibrotic polyps ranging from .5 to 4 cm not amenable to complete resection with the standard lift-assisted piecemeal EMR technique.²⁸ A previous attempt at resection had been performed in 12 of 15 patients. In a follow-up ranging from 3 to 7 months, residual polyp tissue was seen in 2 of 14 patients (1 patient had not yet been reassessed), both of whom were successfully treated with further endoscopic therapy.

Postpolypectomy bleeding has been reported in 0% to 4% of patients undergoing APC ablation of refractory nonlifting polyps and in 5% to 7% of patients undergoing hot avulsion; other adverse events have not been reported with these technique.^{21,22} Reported adverse events in a series of 101 patients treated with the CAST technique included concern for deep muscle injury managed with endoscopic clipping (12%), delayed bleeding (6%), and intraprocedural perforation managed with endoscopic clipping (3%).²⁷

Ablation techniques

Ablative techniques such as snare tip and APC have been used to eradicate neoplasia after incomplete snare resection.²¹ The mechanism of action for ablative methods is tissue destruction, and thus there is a lack of pathologic assessment and risk stratification for recurrence. When used for the ablation of residual grossly visible polyp tissue, ablative techniques have been associated with a substantial risk of recurrence, believed to be because of incomplete treatment of deeper layers.^{9,16,29} As such, ablative strategies are typically used for ablation of normal-appearing mucosa at polypectomy margins to reduce the risk of recurrence.³⁰

Argon plasma coagulation. The most commonly used ablative technique in conjunction with colorectal EMR is APC.^{20,31} APC is described in detail in the American Society for Gastrointestinal Endoscopy (ASGE) Technology Committee article entitled "Electrosurgical generators."³² Settings (eg, wattage and flow rate) are often physician and technique dependent and also influenced by anatomy (eg, location in the colon, fibrotic tissue) and generator model. A single-center, randomized controlled trial evaluated the role of adjunctive APC in 34 consecutive patients with known sessile colon polyps >15 mm referred for polypectomy.³³ In 21 patients the polyps were completely excised, and these patients were then randomized to APC of the polypectomy edges and base ($n = 10$) versus no APC ($n = 11$). At a 3-month follow-up examination, there were fewer recurrences in the group randomized to APC (1/10) versus no APC (7/11, $P = .02$).

Snare-tip coagulation. Snare-tip coagulation is a technique first described to treat submucosal vessels exposed during wide-field EMR.³⁴ More recently, this technique has been applied to prevent recurrence of residual adenoma. With this technique, the snare tip is positioned 1 to 2 mm beyond the snare sheath. The tip of the snare is sequentially applied around the entire margin of an EMR defect while intermittently delivering coagulating current to the normal-appearing tissue (Video 2, available online at www.giejournal.org). Descriptions of this technique have used a microprocessor-controlled coagulating current with a voltage output that is capped at 190 V to limit deep tissue injury (SOFT COAG mode, 80 W, Effect 4; Erbe Eletromedizin, Tübingen, Germany).^{30,31} Snare-tip coagulation appears to be cost-effective because the device is usually the same snare used for the resection.

A large, multicenter, randomized controlled trial assigned patients undergoing EMR of colorectal polyps ≥ 20 mm to snare-tip coagulation of a clean mucosectomy margin ($n = 210$) versus no further treatment ($n = 206$).³⁰ On follow-up endoscopy 5 to 6 months later, the snare-tip coagulation group had a significantly lower rate of recurrent neoplasia than the control group (5% vs 21%, $P < .001$). The rate of adverse events was low and did not differ between the 2 groups.

Other modalities. Although other ablative modalities (eg, radiofrequency ablation, cryotherapy) are commonly used in GI endoscopy, their potential utility and safety in the context of refractory colorectal neoplasia remain an area of uncertainty because of a paucity of data,^{35,36} and so they are not discussed further.

Grasp-and-snare technique

A grasp-and-snare technique that uses a double-channel endoscope has been used for en bloc resection of polyps that demonstrated poor lifting.^{37,38} With this technique, the creation of a submucosal lift is attempted, even if it



Figure 1. The EndoRotor system. (Image courtesy of and used with permission from Interscope Medical, Inc.)

is suboptimal. The snare is advanced from the endoscope and opened in a manner such that the lesion is encircled. A grasping forceps is then advanced through the other channel and used to grasp and retract the polyp into the opened snare. Air is suctioned, the snare is closed, and the grasping forceps is then released. Efforts are made to ensure that muscularis propria has not been entrapped in the snare capture. The lesion is then resected with standard electrocautery settings for polypectomy. The procedure can be repeated if en bloc resection was not achieved.

The grasp-and-snare technique was evaluated in a retrospective study of 17 lesions that were referred for EMR but were either nonlifting or located in an anatomically challenging position, including 13 colonic lesions.³⁸ Although the authors reported complete resection in 14 of 17 patients (82%), 12 of 17 (71%) received adjunctive APC ablation. Residual neoplasia was seen in 3 of 17 patients (18%) at 1 year. In 13 colonic lesions treated with the grasp-and-snare technique, 1 patient developed a colonic perforation requiring surgery, and 1 patient experienced self-limited hematochezia that did not require transfusion or endoscopic evaluation.³⁸



Figure 2. The EndoRotor catheter and cutting tool. (Image courtesy of and used with permission from Interscope Medical, Inc.)

EndoRotor endoscopic resection system

The EndoRotor endoscopic resection system (Interscope Medical, Inc, Whitinsville, Mass, USA) is an automated mechanical endoscopic resection system for use in the GI tract for benign or premalignant tissue removal. It is cleared by the U.S. Food and Drug Administration for removal of residual tissue from peripheral margins at the time of EMR. The EndoRotor system comprises a console that houses the motor drive, peristaltic pump, and vacuum regulation, a foot pedal, a catheter device, and a specimen collection trap (Fig. 1).

The 3.1-mm-diameter, single-use catheter is compatible with endoscopes with a 3.2-mm or larger working channel and is available in multiple lengths between 124 and 189 cm. The catheter is constructed with 2 layers, an outer braided sheath, and a stainless steel inner cutting tool nested within. A 3-mm window in the outer sheath near the distal tip exposes the inner cutting tool; a solid line on the catheter 180 degrees opposite the cutting window assists in positioning the cutting surface. The foot pedal-activated console motor rotates the cutting tool between 1000 and 1750 times per minute via a torque coil. Simultaneously, irrigation fluid is delivered between the inner wall of the braided sheath and the cutting tool, and suction is applied via the hollow lumen of the inner cutting tool, which aspirates the resected tissue onto a micron filter within the specimen trap. The catheter may be rotated to alter the orientation of the cutting window. Catheters are available with 2 different profiles of the inner cutting tool, including a standard beveled design and an “XT” (extra teeth) design marketed for greater tissue acquisition. (Fig. 2). The collected tissue resembles biopsy forceps specimens and can be used for histopathologic examination using standard methods.

The console controls the cutter rotation speed, irrigation, and vacuum. The manufacturer recommends vacuum levels of 200 to 300 mm Hg when resecting scarred lesions and 50 to 100 mm Hg when completing EMR margin resections. The speed of the cutter rotation is at the discretion

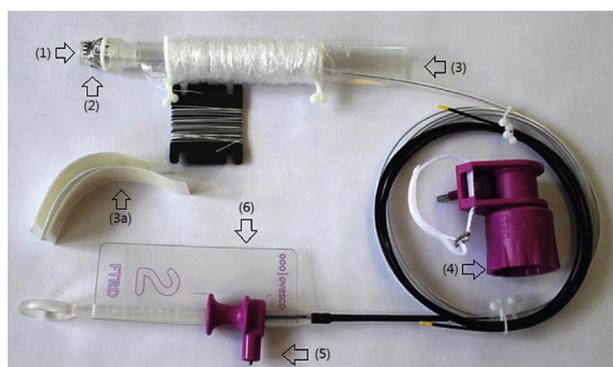


Figure 3. Full-thickness resection device components: (1) cap with the preloaded snare; (2) 14-mm over-the-scope clip; (3) endoscope sleeve with fixation tapes (3a); (4) hand wheel; (5) integrated polyfile HF snare with thin diameter (.2 mm); (6) snare safety lock, marked with “2” for second procedure step (resection after clipping). (Image courtesy of and used with permission from Ovesco Endoscopy AG. Legend from reference 68.)

of the endoscopist; lower speeds acquire larger bites of tissue. The blue foot pedal activates catheter rotation, and the orange foot pedal activates aspiration, which is necessary for effective tissue resection. [Video 3](#) (available online at www.giejournal.org) demonstrates use of the EndoRotor system on a sigmoid polyp refractory to standard resection techniques.³⁹

Successful use of the EndoRotor device to resect a residual colorectal polyp in EMR scars has been described in a small case series.⁴⁰ The EndoRotor has also been used to enhance the completeness of EMR in a series of 31 patients with laterally spreading colorectal lesions ≥ 30 mm.⁴¹ The device was applied to the lesion borders after all abnormal-appearing tissue was removed by a snare. Residual neoplasia not appreciated on white-light endoscopy or electronic chromoendoscopy was present in the EndoRotor specimens in 4 of 31 patients (13%). Safety and efficacy data from larger series are not yet available given the relatively recent release of this device.

Endoscopic full-thickness resection device

Endoscopic full-thickness resection of fibrotic colonic polyps allows for definitive diagnosis and potentially curative treatment for lesions not amenable to conventional polypectomy or mucosal resection techniques. The full-thickness resection device (FTRD Colonic; Ovesco Endoscopy, Tübingen, Germany) is a single-use over-the-scope device used to remove refractory colorectal lesions 2 to 3 cm in size.

The resection technique involves creating circumferential markings of the lateral margins of the lesion with coagulation. A transparent cap with a 12.3-mm over-the-scope clip is mounted onto a standard colonoscope. The cap has an outer diameter of 21 mm, an inner diameter of 13 mm, and is much longer (23 mm) than standard over-the-scope caps (3-6 mm).⁴² A monofilament polypectomy snare is preloaded into the tip of the cap and runs external to the colonoscope shaft in a plastic sheath to

leave the working channel free for other devices ([Fig. 3](#)). A grasping forceps is advanced through the working channel of the colonoscope to grasp the lesion. The lesion is retracted into the cap until the lateral margins are visible in the cap. Suctioning the lesion into the cap should be avoided because of the risk of unintentional clipping of adjacent vessels or organs. The over-the-scope clip is then deployed, creating a colonic wall duplication that isolates the target lesion. The preloaded snare is closed above the clip, and resection of the specimen is performed using a monopolar current. Snare settings described in the literature include the ENDO CUT Q (Erbe) and pure cutting modes.⁴³⁻⁴⁵ [Video 4](#) (available online at www.giejournal.org) demonstrates use of the FTRD on a previously manipulated nonlifting tubulovillous adenoma in the ascending colon refractory to standard resection techniques.

Recently, a smaller version of the FTRD has become available (diagnostic FTRD; Ovesco Endoscopy). It is marketed for full-thickness biopsy sampling in the rectum and colon for diseases such as Hirschsprung disease, enteric ganglionitis, and GI amyloidosis. It can also be used for full-thickness resection of lesions smaller than 2 cm and with a pediatric colonoscope. The diagnostic FTRD has an outer cap diameter of 19.5 mm, an inner diameter of 12.1 mm, and a length of 23 mm. The diagnostic FTRD clip is the same size (12.3 mm) as the clip supplied with the standard FTRD.

A multicenter, prospective, nonrandomized study (n = 181) evaluated the FTRD in colorectal lesions difficult to resect with conventional endoscopic techniques.⁴⁶ A subgroup of 127 patients with difficult adenomas included 104 nonlifting adenomas (72 with prior manipulation and 32 without prior manipulation). The target lesion was reached in 100% of cases, and the R0 resection rate in this difficult adenoma group was 77.7%. There was 3-month follow-up in 117 patients in the difficult adenoma group, and residual neoplasia was noted in 18 (15.3%) of these patients.

Multiple retrospective case reports and series have also described use of the FTRD for resection of colonic lesions poorly suited for conventional EMR or in patients unfit for surgery because of advanced age and/or comorbidities.^{42-45,47-57} In 3 representative retrospective series (of 20, 25, and 33 cases, respectively), the most common indication was fibrotic, nonlifting adenoma, the reported technical success rates and R0 resection (defined as no gross or microscopic polyp remaining at the primary resection site) rates both ranged from 75% to 88%, and reported median specimen diameters were 24 to 27 mm.^{48,49,53}

Major adverse events reported with use of the FTRD were major bleeding (0%-3.2%), immediate perforation (0-2.8%), and delayed perforation (0%-3.2%).^{42,43,46,48,49,51-54,57} Acute appendicitis and enterocolonic fistula have also been described.⁴⁶ The rate of surgery after adverse events with the FTRD ranged from 0% to 11%.^{42,43,46,48,49,51,53,54,57}

TABLE 1. Devices and list prices

Manufacturer	Device	Price (U.S.\$)
Multiple	Hot biopsy forceps	66.95-85.70
Multiple	APC probe	165-320
EndoRotor endoscopic resection system (Interscope Medical, Inc, Whitinsville, Mass, USA)	EndoRotor system kit (console, foot control, power cord, system cart, vacuum pump)	25,000
	EndoRotor catheter 3.2 mm × 1890 mm	800
	EndoRotor catheter 3.2 mm × 1240 mm	800
	EndoRotor catheter XT 3.2 mm × 1240 mm	1250
	EndoRotor specimen trap	50
Endoscopic full-thickness resection device (Ovesco Endoscopy Tübingen, Germany)	Colonic FTRD system set	1245
	prOVE FTRD cap set box (2 caps)	92
	FTRD grasper set box (5 graspers)	615

APC, Argon plasma coagulation; XT, extra teeth; FTRD, full-thickness resection device.

Minor adverse events included minor bleeding and postpolypectomy syndrome.^{46,49,52,54} Technical device malfunction has also been reported, including inability to close the snare and snare rupture.⁵³

One technical challenge of the FTRD system is that the long transparent cap limits the endoscopic view and flexibility of the colonoscope tip.⁴⁹ In some cases, endoscope advancement through difficult anatomic locations such as the sigmoid or colonic flexures to reach proximal colon lesions can be challenging. A proprietary test cap (prOVE) that is identical in dimensions to the FTRD cap is available from the manufacturer and may be used to assess whether or not the lesion can be successfully reached and retracted into the cap. Also, the transparent cap does not reliably permit R0 resection of lesions more than 3 cm in size depending on the thickness, rigidity, and mobility of the GI wall.⁵³

Salvage endoscopic submucosal dissection

Endoscopic submucosal dissection (ESD) is an established technique for en bloc endoscopic resection of GI epithelial lesions. ESD technique and electrosurgical knives were reviewed in detail in an ASGE Technology Status Evaluation report entitled “Endoscopic submucosal dissection.”⁵⁸ In nonlifting lesions, creating an adequate submucosal cushion to perform ESD is often challenging. However, ESD techniques have been described as a salvage therapy for endoscopic removal of nonlifting colorectal lesions.⁵⁹⁻⁶⁴

Salvage ESD was evaluated in a single-center prospective study of 30 patients with residual colorectal lesions after attempted EMR.⁶¹ The technical success rate was 100% with R0 resection achieved in 25 of 30 patients (83%). One patient with R1 margins (defined as removal of all

macroscopic disease but positive microscopic margins for neoplasia) elected for surgical excision of recurrent adenoma, whereas 2 patients with R1 margins underwent a second salvage ESD and achieved an R0 resection. Two patients with Rx margins because of electrocautery artifact had no endoscopic or histopathologic evidence of residual disease during follow-up. There was no evidence of residual or recurrent disease at a 6-month median follow-up in 29 of 30 patients (96%). A retrospective series described 11 patients with residual rectal polyps who underwent salvage ESD after incomplete EMR.⁶⁰ Complete resection was attained in 10 of 11 patients (90.9%) and R0 resection in 6 of 11 patients (54.5%). All 10 patients with complete resection at salvage ESD were free of recurrence at a mean follow-up of 19.2 months. Reported rates of perforation with salvage ESD for refractory colorectal lesions have ranged from 0% to 9%^{47,48}; in 1 study a case of asymptomatic subcutaneous emphysema managed conservatively was described.⁶⁰

FINANCIAL CONSIDERATIONS

List prices for devices and equipment reviewed in this document are shown in Table 1. The costs for electrosurgical generators are available in the ASGE Technology Status Evaluation report entitled “Electrosurgical generators.”³² The costs for ESD devices are available in the ASGE Technology Status Evaluation report entitled “Endoscopic submucosal dissection.”⁵⁸

The Current Procedural Terminology (CPT) code 45390 (colonoscopy, flexible; with endoscopic mucosal resection) may be used to document colorectal EMR when a submucosal lift is used. The use of adjunctive techniques

and devices after endoscopic resection is associated with additional costs, although dedicated CPT codes for many of these modalities are lacking. Currently, the use of EndoRotor is billed under the 45390 code. Other potentially applicable CPT codes for the management of refractory colorectal polyps include 45380 (colonoscopy, flexible; with biopsy, single or multiple), 45384 (colonoscopy, flexible; with removal of tumors, polyps, or other lesions by hot biopsy forceps), 45388 (colonoscopy, flexible; with ablation of tumors, polyps, or other lesions), and 45385 (colonoscopy, flexible; with removal of tumors, polyps, or other lesions by snare technique). Of note, codes 45385 and 45381 (colonoscopy, flexible; with directed submucosal injections, any substance) are not separately reportable with code 45390. For techniques and devices without an applicable CPT code, such as use of the FTRD, consideration can be given to reporting an unlisted procedure code (45399 colon, 45999 rectum) in addition to code 45390 (colonoscopy, flexible; with endoscopic mucosal resection), with supporting documentation to seek appropriate reimbursement.

AREAS FOR FUTURE RESEARCH

Most devices and techniques highlighted in this review have only been evaluated in a single-arm manner. Additional comparative data would be useful to further explore the effectiveness, ease of use, safety, and cost-effectiveness of these potentially competing modalities. Also, some of these devices and techniques have been developed and evaluated in expert centers; data from nonexperts would provide insight into the generalizability of the reported outcomes. Incisionless surgical treatments performed by colorectal surgeons such as transanal endoscopic microsurgery and transanal minimally invasive surgery are also therapeutic options for removal of refractory rectal lesions. Comparative outcomes between these surgical treatments and flexible endoscopic modalities for refractory polyps are lacking. Finally, new devices, endoluminal platforms, and techniques for endoscopic resection are in development and may eventually have a role in the management of these challenging lesions.⁶⁵⁻⁶⁷

SUMMARY

Complete removal of colorectal polyps reduces the risk of interval colon cancer.⁴⁻⁷ Endoscopic resection of fibrotic, nonlifting, or residual colon polyps is challenging. The use of adjunctive techniques and devices may improve the likelihood of complete endoscopic resection of these lesions, avoiding more invasive surgical resections or neoplastic recurrence. Therapies to resect or ablate the mucosa at the margins of an endoscopic resection may reduce the risk for local recurrent neoplasia. Future comparative research may help guide the best approach to these difficult polyps.

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Abbreviations: APC, argon plasma coagulation; ASGE, American Society for Gastrointestinal Endoscopy; CAST, Cold-forceps Avulsion with adjuvant Snare-Tip soft coagulation; CPT, Current Procedural Terminology; ESD, endoscopic submucosal dissection; FTRD, full-thickness resection device.

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