

Mistakes in polypectomy and how to avoid them

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Colonoscopy and polypectomy prevent colorectal cancer by detecting and resecting its precursors — colorectal polyps.^{1,2} The quality of both colonoscopy (detection of all polyps) and polypectomy (complete polyp resection) matter in order to emphasize its preventative effect.^{3,4} Whilst training in colonoscopy is becoming standardised in many countries, training in polypectomy lags far behind, with both trainees and established endoscopic practitioners often performing this procedure without formal training by a competent instructor.⁵

Much evidence now exists for what constitutes best practice in colorectal polypectomy, which can guide training priorities. This article presents you with ten of the most typical mistakes made when performing polypectomy and the corresponding published evidence on how to avoid them.

Mistake 1 Not considering cold snare polypectomy for small colorectal polyps

Cold snare polypectomy has gained widespread acceptance as an effective and safe mean of removing small (< 10mm) colorectal polyps.^{6,7} The significant advantage of cold snare polypectomy is safety, with negligible rates of delayed bleeding⁸ and perforation described only in case reports.⁹ Despite this data, evidence suggests that endoscopists are hesitant to move away from hot snare polypectomy for such polyps.¹⁰ This could be due to the misconception that cold snare polypectomy is difficult¹¹ and that

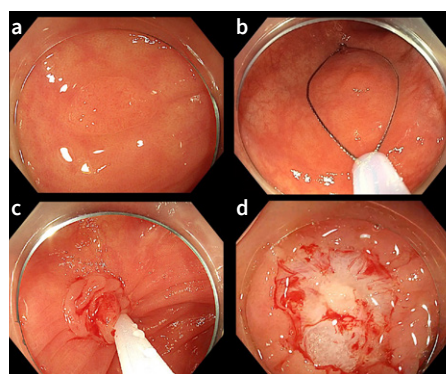


Figure 1 | a | Colorectal polyp < 10mm. b | Thin-wire snare placed around the colorectal polyp with a 1-2 mm margin of normal tissue. c | Cold snare polypectomy showing the 'fried egg' appearance of the polyp as the egg yolk with a margin of normal tissue as the egg white. d | Cold snare polypectomy defect after irrigation with endoscope flushing pump demonstrating no evidence of residual adenoma.

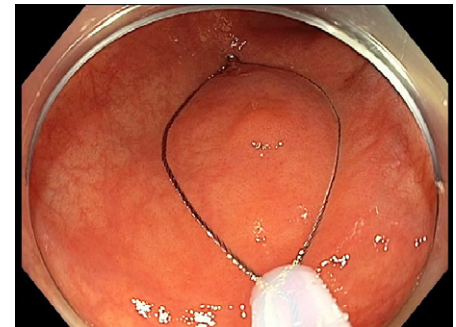
high rates of immediate bleeding imply a great risk of post-procedural bleeding.^{12,13}

Guidelines recommend the application of cold snare polypectomy as a first-line therapy to all colorectal polyps that are < 10 mm in size.¹⁴ The technique involves the use of a thin-wire (< 0.4mm diameter) snare and capture of a 1-2 mm of normal tissue around the polyp. After resection, the base of the defect can be inspected by expansion using an endoscope flushing pump for residual polyp. It should be noted that immediate bleeding does not require treatment unless pulsatile (very rare). The online resource for this mistake illustrates the best practice in cold snare techniques (see figure 1).¹⁵

Mistake 2 Not understanding how to discriminate cancer within larger colorectal polyps

Most colorectal polyps are benign and can be safely and effectively removed by endoscopic polypectomy.¹⁶ Polyps ≥ 10mm in size are at higher risk for containing submucosally invasive cancer.^{17,18} Determining which polyps are at high risk of containing cancer and stratifying them to endoscopic *en bloc* resection at an expert centre or surgery (rather than piecemeal resection) is critical to avoid adverse patient outcomes (unnecessary surgery, missed cancer or repeated colonoscopy examinations).¹⁹⁻²¹

The first step in identifying cancer within a colorectal polyp is to detect a demarcated area where a regular pit/vascular pattern (Kudo III/IV, JNET 2A, NICE II) becomes disordered (Kudo V, JNET 2B or 3, NICE III) (see figure 2).²²⁻²⁴ This type of endoscopic imaging of cancer evidence is



termed OVERT (visible on the surface) and is often associated with a depression or extra redness within the polyp. One video-based study amongst endoscopists of varied experience showed that the absence of a detected demarcated area practically ruled out the presence of cancer histologically (negative predictive value = 97.6%, 95% CI: 96.0-99.0%).²⁵

If OVERT cancer is suspected, the detection procedure should be terminated after acquisition of high-quality images (focused on any demarcated area) and/or video. The lesion and patient management should then be discussed in a multidisciplinary meeting including a tertiary centre endoscopist.

It is increasingly accepted that certain features of polyps without OVERT evidence of cancer can be used to predict the risk of containing invisible or hidden (COVERT) cancer buried beneath the surface.²⁶ The risk-factors for COVERT cancer include

- Size (the larger the size, the greater the risk)
- Paris classification (presence of a 0-Is component, i.e., a large nodule increases the risk)
- Location (higher risk in rectal location)
- Granularity (presence of non-granular component increases the risk)

These factors can be combined into a score to assess the risk of buried cancer based on multivariate modelling.²⁷ This can then be used for a consent process with the patient regarding the choice of the technique; *en bloc* endoscopic resection or piecemeal endoscopic resection.²⁸

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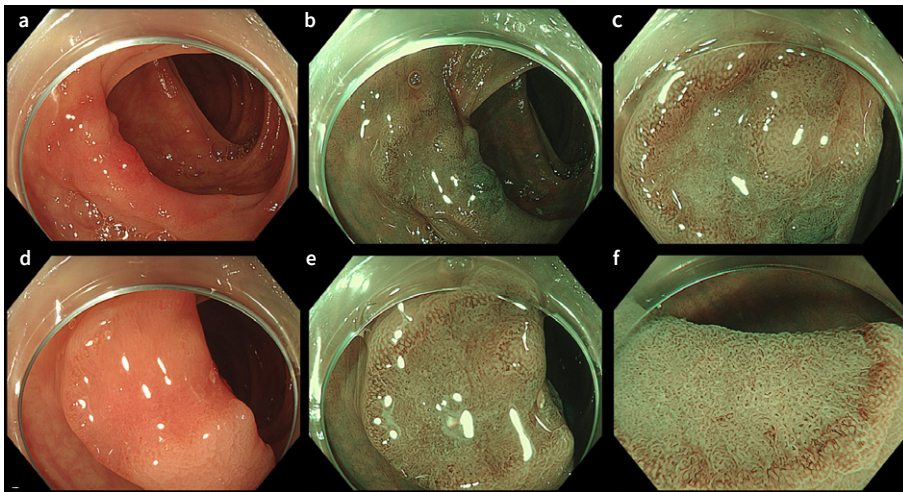


Figure 2 | a,b | Colorectal polyp with a demarcated area seen from afar (a) and up-close (b) in High Definition White Light Imaging c,d | Colorectal polyp with demarcated area seen from afar (c) and up-close (d) with Narrow Band Imaging e | Colorectal polyp with demarcated area seen with Narrow Band imaging and Near Focus. f | Colorectal polyp with demarcated area seen under water with Narrow Band imaging and Near Focus.

The issue with most of the above systems for detecting cancer within colorectal polyps is that their use requires training and many endoscopists are not routinely exposed to such polyps. Therefore, online training packages²⁹ have a significant role in exposing endoscopists to large numbers of these rarely detected lesions³⁰ and their interpretation.

Mistake 3 Starting resection of a polyp beyond the competency of the endoscopist

It is established that there are specific features of colorectal polyps which determine how difficult they will be to resect endoscopically. The SMSA score³¹ (see table 1) describes four characteristics (polyp size, morphology, site, and access). It generates four categories of colorectal polyp complexity and has been shown to

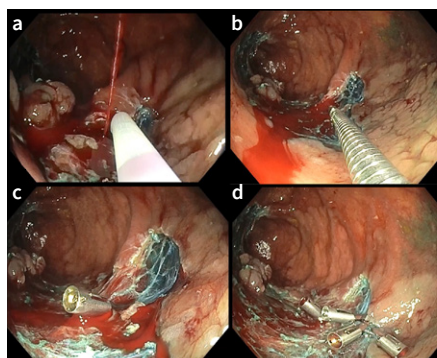


Figure 3 | Example of undertaking a polypectomy beyond the performing endoscopists' competency a | Spurting intra-procedural bleeding. b | Attempt at clip placement for bleeding (note device extended far from the endoscope and preventing visualisation of the exact bleeding point). c | Persistent bleeding after placement of the first clip. d | Multiple clips with persistent oozing bleeding and impeding the possibility for further resection in this area. See also Mistake 5.

predict important outcomes after polypectomy, including incomplete resection and the frequency of adverse events (including delayed bleeding and perforation).³²

Furthermore, among the most difficult to resect polyps (SMSA group 4), there is a subset which requires specific expertise. For this reason, a modification to the SMSA score has been suggested, which allows for the identification of such polyps. Known as the SMSA+ score (see table 1), it combines two published scores^{33,34} and includes size ≥ 40 mm, non-lifting polyps, non-granular polyps ≥ 20 mm, location at flexures, the anorectal junction, the ileocaecal valve, and the appendiceal orifice or diverticulum involvement.

Endoscopic practitioners should not attempt resection of a colorectal polyp beyond their competency (see figure 3). Resection of SMSA group 3 polyps or above should be attempted by those performing polypectomy routinely and can deal with adverse events. SMSA+ polyps should be attempted only by practitioners who regularly perform referral practice for endoscopic mucosal resection (EMR).³⁵ This is highlighted by the possible consequences that patients must face after a failed attempt at polypectomy:

- Need for multiple procedures where one may have sufficed in expert hands (repeat bowel preparation, lost workdays for patients, inconvenience).³⁶ In our experience, there are often multiple attempts by the initial endoscopist prior to referral
- Morbidity, unnecessary hospital admission or even need for surgery due to an adverse event that cannot be managed by the endoscopist
- Need for unnecessary surgery due to scar formation and non-lifting at a second attempt or adverse events related to a second attempt³⁷

The SMSA Score									
Size	Points	Morphology	Points	Site	Points	Access	Points	SMSA score	
<1cm	1	Pedunculated	1	Left Colon	1	Easy	1	1	4-5 points
1 – 1.9 cm	3	Sessile	2	Right Colon	2	Difficult	3	2	6-9 points
2 – 2.9 cm	5	Flat	3					3	9-12 points
3 – 3.9 cm	7							4	> 12 points
> 4 cm	9								
The SMSA + Score									
Size	Points	Difficult location*	Points	Non-lifting / previous attempt	Points	Granularity	Points	SMSA+	≥ 1 points
< 4 cm	0	No	0	Lifting/ no previous attempt	0	Granular	0		
≥ 4 cm	1	Yes	1	Non-lifting/ previous attempt	1	Non-granular	1		

* Direct ileocecal valve involvement/diverticulum involvement/anorectal junction/appendiceal orifice involvement/ location at flexures

Table 1 | SMSA score and SMSA+ score.

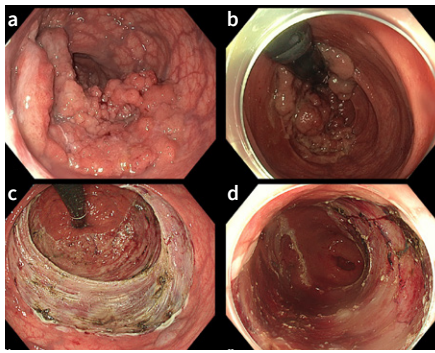


Figure 4 | a | Rectal polyp. b | Defect of rectal polyp seen in panel a. resected with endoscopic submucosal dissection (ESD). c | Rectal polyp. d | Defect of rectal polyp seen in panel c. resected with endoscopic mucosal resection (EMR). In this case, there are distinct advantages to the ESD approach given the increased risk of covert submucosal invasion in this lesion morphology and the rectal location. In smaller lesions outside the rectum without evidence of submucosal invasion, this is not the case and piecemeal resection is considered safe with similar effective and long-term results.

Mistake 4 Pursuing *en bloc* resection for polyps at low risk of submucosal invasive cancer

Decisions about whether to attempt *en bloc* polypectomy of colorectal polyps larger than 10 mm in size should be made solely based on whether the polyp is likely to contain submucosal invasive cancer. Multiple evidence-based methods exist to stratify polyps according to the risk of cancer including the Kudo, NICE, JNET and Sano classifications.^{22-24,38} Algorithms to decide on the presence of cancer in polyps are helpful. One such algorithm takes a demarcated area of regular-irregular pattern as a starting point and identifies the difference between visible and hidden cancer within polyps.²⁵ Whichever method is used to risk-stratify the polyp, there are some important considerations (see methodology in

Mistake 2). A good way to acquaint yourself with the appearances of potentially malignant polyps is to see many examples (either in a dedicated endoscopy fellowship or in an online environment (see figure 4).³⁰

Once a decision has been made that a polyp is not at high risk for cancer, *en-bloc* resection does not need to be pursued. Indeed, *en bloc* resection in this situation risks higher rates of intra-procedural perforation and delayed bleeding. Furthermore, 20% of resections deemed to be *en-bloc* endoscopically are not confirmed histologically.³⁹ In addition, suppose thermal margin ablation is routinely applied to all polypectomy defects of polyps in this size range. In that case, the effect of *en bloc* resection on preventing recurrence after piecemeal endoscopic mucosal resection (pEMR) is negated.^{40,41} (see figure 4)

Mistake 5 Technical mistakes when performing colorectal polypectomy

Performing an endoscopic resection far from the endoscope is not encouraged (see figure 3b). This limits clear visualisation of the lesion, advancing the resection margin, which affords less precise control of the used instrument. It may also result in incomplete resection, residual islands of adenoma or inadvertent adverse events.

Furthermore, it is recommended to avoid over-insufflation. While a distended colon is useful for optimal detection of polyps, over-distention can make polypectomy difficult because excessive tension in the colonic wall leads to poor tissue capture. A key principle in endoscopic mucosal resection of larger polyps (EMR) is the ‘inject and resect’ principle. It is wise to inject only the specific part of the lesion you want to resect (not the whole polyp) before snare resection (see figure 5c). Over-injection can cause excessive mucosal tension and makes the polyp

more difficult to capture with the snare. Using the lifting agent to facilitate access to the target lesion is advised. Once you have resected one or more pieces, inject again, and proceed in this way.

Moreover, snare placement needs to be precise to avoid islands of residual adenoma and incomplete resection. To start, place the snare over the polyp (in the 6 o'clock position to maximise visualisation and allow maximum downward pressure from the endoscope tip) and include a rim of normal tissue (1-2 mm). Keep the polyp close to the endoscope and exert firm downward pressure with the tip of the snare. Visualise the ‘V’ of the snare during closure to ensure the desired piece of tissue is captured. This process is better demonstrated in video examples illustrating best practice in EMR.^{42,43}

Mistake 6 Skipping the pre-treatment of pedunculated polyp stalks > 10 mm with mechanical ligation

Complete resection of pedunculated polyps is often technically more straightforward to achieve than with flat polyps since the stalk does not contain polyp and acts as a visible resection margin which can be safely transected. The larger the pedunculated polyp the greater the risk of significant intra-procedural bleeding once the stalk is transected. This risk is most significant when the diameter of the stalk exceeds 10 mm.^{44,45}

Therefore, to prevent significant and difficult-to-control bleeding from a pedunculated polyp stalk, mechanical ligation of large diameter stalks is recommended by international guidelines¹⁴ prior to transection. Options for mechanical ligation include placement of endoscopic clips or use of a flexible nylon polyloop.

Endoscopic clips are often difficult to place and do not provide complete compression of the central feeding vessels in larger stalks so the nylon polyloop is preferred. The steps to place such loops are (see figure 6):⁴⁶

- Open the loop fully with the colonoscope tip positioned orally in relation to the polyp head
- Withdraw the colonoscope over the polyp head and manoeuvre the loop over the head
- Manoeuvre the loop as close to the colonic wall (bottom of the stalk) as possible using the tip of the catheter as a guide
- To check the position, pull the loop back into the colonoscope to exert traction on the stalk
- Close the loop and deploy once satisfied with the position
- Once the loop is deployed, perform the same manoeuvres with a snare to place and resect just above the loop leaving the maximum possible distance between the resection site and the polyp head along the stalk

If oozing bleeding is observed after the transection snare tip, soft coagulation⁴⁷ can be applied to the bleeding point.

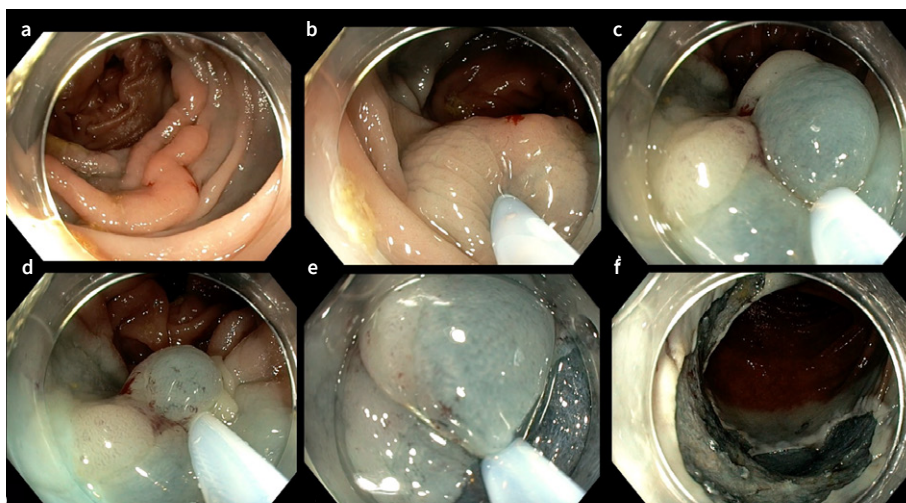


Figure 5 | a | Colorectal polyp. b | Injection. c | First snare placement, with rim of normal tissue. d | First snare closure demonstrating rim of normal tissue. e | Placement of snare using defect to avoid islands. V of snare clearly visible. f | End result of pEMR.

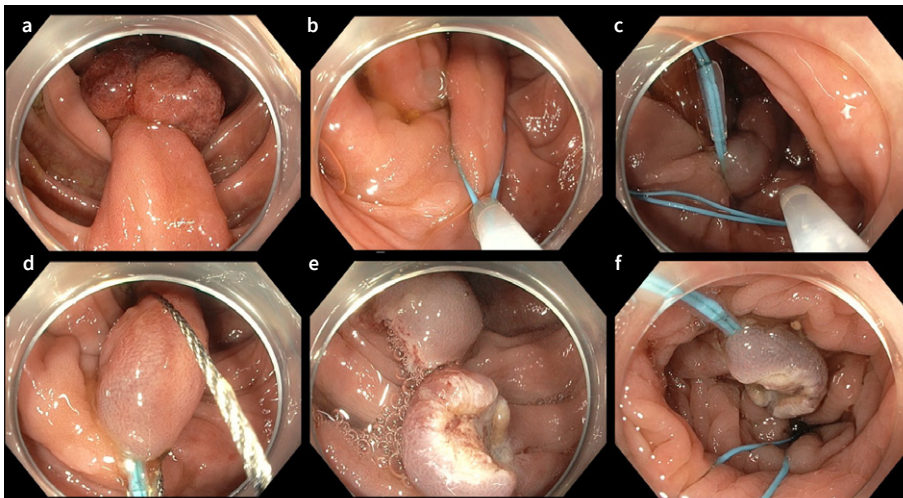


Figure 6 | a | Pedunculated colorectal polyp with stalk ≥ 10 mm in diameter. b,c | Mechanical ligation with nylon polyloop. b | Demonstrates the positioning of the loop at the base of the stalk close to the colonic wall d | Snare placement above nylon polyloop showing the snare just above the loop in the same orientation as the loop across the stalk. e,f | Hot snare polypectomy defect of pedunculated colorectal polyp with the nylon polyloop sitting just below the resection site.

Mistake 7 Neglecting to check the post-resection defect after polypectomy

Carefully imaging the defect (ulcer made after polypectomy) can predict many of the major complications after EMR and, in most cases, allow the endoscopist to mitigate their risk of appearance (see figure 7).⁴⁸

- **Mucosa** – carefully checking the margin of the post-resection defect (helped by expansion of the defect using a chromic dye or an endoscope flushing pump) will allow identification of residual adenoma which should then be resected with a snare. Further inspection within the defect may identify superficial resection or residual adenomatous tissue.
- **Submucosa** – carefully checking the submucosal layer may identify bleeding

vessels which can be coagulated and prevent post-EMR bleeding. Coagulation of non-bleeding vessels is unhelpful⁴⁹ (due to the invisible deep submucosal vessel injury which leads to delayed bleeding) and the available evidence suggests it is not required. The size of the resected area (larger = greater risk) predicts the frequency of post-EMR bleeding along with the location in the right colon.⁵⁰

- **Muscularis** – identifying evidence of injury to the muscularity’s propria (deep mural injury) using the Sydney classification⁵¹ is critical to preventing delayed perforation (syndrome of pain and fever indicating full thickness muscularis injury after a polypectomy). Types II (uninterpretable submucosal plane), III (target sign) and IV (actual hole) deep mural injury should be identified and treated.

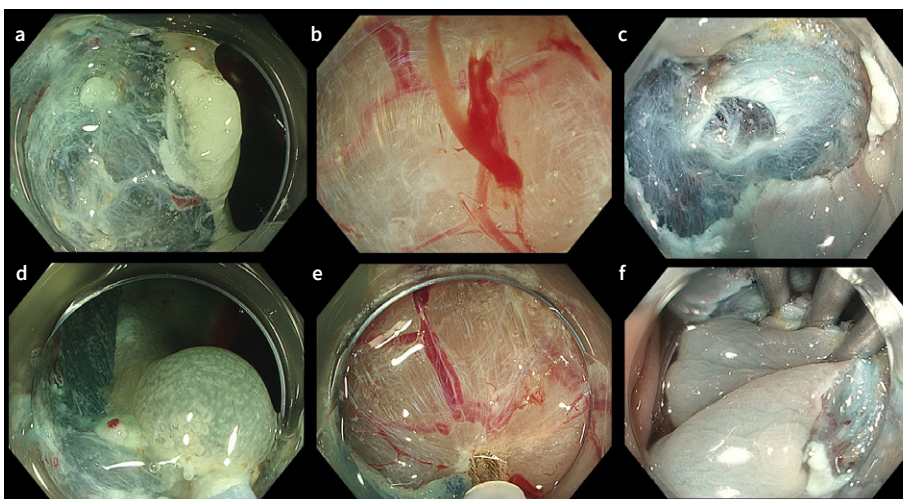


Figure 7 | a | Residual adenoma at margin of post-EMR defect. b | Snare resection of residual adenoma. c | Bleeding vessel in the submucosa of an EMR defect. d | Treatment of bleeding vessel with soft coagulation using the tip of the snare (soft coagulation). e | Type III deep mural injury (Target sign). f | Complete closure with clips of deep mural injury.

Mistake 8 Using clips to treat bleeding during an ongoing polypectomy procedure

Bleeding during a hot snare polypectomy in progress is not uncommon. However, bleeding that continues for more than twenty seconds requires endoscopic control methods. A common mistake is to attempt to use mechanical closure (endoscopic clips) to stop bleeding in the presence of further polyps to resect. Mechanical closure in this situation is often challenging and does not reliably and precisely stop the bleeding. Furthermore, the placed clip can hinder further resection.

Use of thermal coagulation of bleeding vessels within an ongoing polypectomy defect is therefore recommended. The procedure is as follows (see figure 8):

- Use an endoscope flushing pump to clear blood from the working field or change patient position
- Watch carefully as you stop flushing
- There is always a causative vessel, and it will likely be at the apex of a fan radiating from the vessel (see figure 8b)
- Use the tip of the snare being used for the resection (using e.g. Soft Coagulation systems⁴⁷) to pin the vessel down mechanically until cessation of bleeding is observed
- Apply 2-3 seconds of diathermy
- Gently lift the snare and reassess
- If there is persistent bleeding, then repeat 2-3 times
- If bleeding continues, use a coagulation forceps

Mechanical ligation (closure of the defect with clips) can prevent delayed bleeding after complete polyp resection and cessation of any intraprocedural bleeding using thermal methods, especially for patients at-risk (older age, large polyp, need to restart anticoagulants, right colon location).^{52,53}

Mistake 9 Not applying thermal ablation to the margin of a large (≥ 20 mm) flat polypectomy defect

After polypectomy of flat colorectal polyps, recurrence is often described as the ‘Achilles’ Heel’ of endoscopic mucosal resection. Rates of up to 15% are described in the literature even at expert centres.^{17,18,54} The rate of recurrence (at least at first surveillance colonoscopy) can be dramatically improved by adding thermal ablation of the post-EMR margin to the resection defect.^{40,41} Thermal ablation refers to the application of snare tip soft coagulation to the margin of the mucosal defect without macroscopic evidence of residual adenoma,

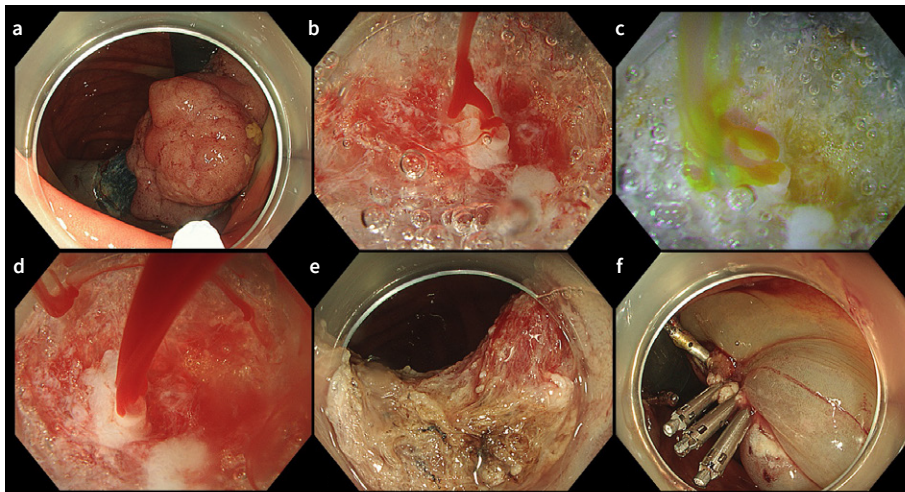


Figure 8 | a | Large Paris 0-IIa+Is colorectal polyp draped over a fold in the ascending colon. b,d | Bleeding vessel seen with White light imaging and Near focus, under water. c | Bleeding vessel seen with Red Dichromatic Imaging (RDI). e | Treated bleeding vessel after soft coagulation with snare tip soft coagulation (STSC) and a coagulation forceps f | Complete closure with clips after completion of polyp resection (since lesion size and significant intraprocedural bleeding are risk factors for delayed bleeding).

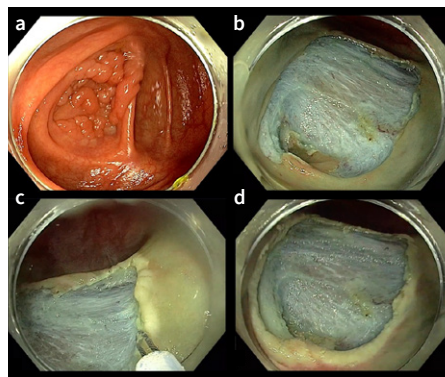


Figure 9 | a | Colorectal polyp in the caecum involving the appendiceal orifice. b | Defect after piecemeal EMR of the polyp. c | Progressing thermal ablation of the margin using snare tip soft coagulation. d | End result demonstrating complete thermal ablation of the margin.

and it includes the following steps (see figure 9):⁵⁵

- Check that the margin of the polypectomy defect contains no endoscopically visible adenoma
- Extend the tip of the snare 1-2 mm beyond the sheath
- Apply pulses of soft coagulation current to the margin whilst holding the shaft of the colonoscope rather than the snare catheter for better accuracy and tip-control
- Proceed until a 1-2 mm rim of visible (white) ablation is present around the whole defect margin, evidence suggests that incomplete thermal ablation is ineffective⁴¹

A large randomised controlled trial demonstrated that thermal ablation delivers up to four times reduction in the rate of residual adenoma at the first surveillance trial.⁴⁰ Larger

validation studies have now been performed, demonstrating almost absent recurrence rates during long-term follow-up.⁴¹

Mistake 10 Failing to identify the post endoscopic resection scar when performing surveillance

Endoscopic mucosal resection of large non-pedunculated (flat) colorectal polyps (LNPCPs), mainly when performed piecemeal, must be viewed as a two-step procedure whilst recurrence rates remain high (since there can be no pathological confirmation of complete resection). That is, the initial complete resection (first procedure) and the surveillance procedure after six months (second procedure).^{56,57} In the future, with the widespread application of thermal ablation of the post-EMR margin and benign histology, there is a more likely scope to

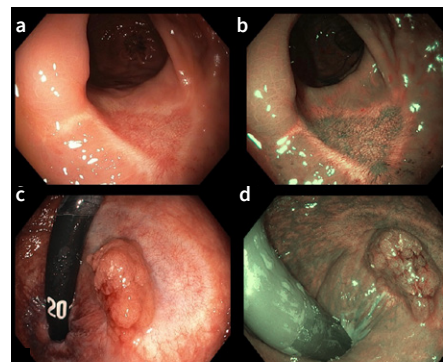


Figure 10 | a | Appearance of a bland endoscopic resection scar at the first surveillance six months after EMR without evidence of recurrence. b | Same scar as in a under virtual chromoendoscopy. c | Appearance of an endoscopic resection scar at first surveillance six months after EMR with evidence of recurrence. d | Same scar as in c under virtual chromoendoscopy.

lengthen surveillance intervals. It follows that the resection scar must be located at the second procedure and interrogated for residual or recurrent adenoma before confirming that a polyp has been cured. Problems occur when practitioners performing routine colonoscopy do not know how to identify a resection scar and search for residual adenoma within one. International guidance, therefore, recommends that surveillance after EMR of LNCP is performed at the centre that performed the resection, at least for the first surveillance procedure.

To identify a resection scar, it is crucial to read the initial procedure report to identify the location. At this location, seek an area of pale mucosa (under white light) into which large colonic blood vessels cannot be followed (see figure 10).⁵⁸

To identify recurrence within a resection scar,⁵⁹ it is preferred to use virtual chromoendoscopy and magnification. Search for an area within the scar where scar mucosa (large, open, non-neoplastic type I pits/NICE I vascular pattern) becomes neoplastic (short or long branching pits corresponding to Kudo type III or IV/NICE II vascular pattern). Be aware that the use of clips during the initial resection can produce raised areas of inflammation within scars, without presenting recurrence (clip artifact).^{60,61}

If recurrence is suspected, treat it at the detection procedure to avoid the patient requiring a repeat procedure and bowel preparation (which is another good reason to perform the first surveillance procedure at the referral centre).

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Your polypectomy briefing

UEG Week

- 'Cold snare polypectomy for superficial non-ampullary duodenal epithelial tumor: a multicenter prospective confirmatory trial (D-COP trial)' session at UEG Week Virtual 2021 [<https://ueg.eu/library/cold-snare-polypectomy-for-superficial-non-ampullary-duodenal-epithelial-tumor-a-multicenter-prospective-confirmatory-trial-d-cop-trial/247835>]
- 'Advances in Polypectomy & EMR (Steris Endoscopy)' session at UEG Week Virtual 2020 [<https://ueg.eu/library/advances-in-polypectomy-emr-steris-endoscopy/241310>]
- 'Anticoagulation and polypectomy' session at UEG Week Virtual 2020 [<https://ueg.eu/library/anticoagulation-and-polypectomy/234604>]

Standards and Guidelines

- Vanbiervliet G, Moss A, Arvanitakis M, Arnelo U, Beyna T, Busch O, et al. Endoscopic management of superficial nonampullary duodenal tumors: European Society of Gastrointestinal

Endoscopy (ESGE) Guideline. *Endoscopy* 2021;53(05):522-34. [<https://ueg.eu/library/endoscopic-management-of-superficial-nonampullary-duodenal-tumors-european-society-of-gastrointestinal-endoscopy-esge-guideline/248691>]

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