



The Mettle to Use the Petals: Using Over-the-Scope Rings to Optimize Endoscopic Submucosal Dissection

Mike T. Wei^{1,2} · George Triadafilopoulos¹ · Shai Friedland^{1,2}

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Abbreviations

AC	Ascending colon
AdenoCA	Adenocarcinoma
AO	Appendiceal orifice
BMI	Body mass index
DC	Descending colon
EMR	Endoscopic mucosal resection
ESD	Endoscopic submucosal dissection
FUSE	Full spectrum endoscopy
HF	Hepatic flexure
HGD	High-grade dysplasia
ICV	Ileocecal valve
IQR	Interquartile range
LGD	Low-grade dysplasia
sm1	First submucosal layer
SSP	Sessile serrated polyp
TA	Tubular adenoma
VA	Villous adenoma
TC	Transverse colon
TI	Terminal ileum

Case Presentation and Evolution

A 62-year-old female with history of uncontrolled hypertension, diabetes, and chronic kidney disease was seen at an outpatient facility for screening colonoscopy. On review of systems, she denied abdominal pain, nausea or vomiting, change in bowel habits, or weight changes. She mentioned a family history of colorectal cancer in her paternal grandmother, though we do not have the age at diagnosis. During the initial colonoscopy, a 10-mm pedunculated ascending colon adenomatous polyp was identified and removed by hot snare. Moreover, there was also a depressed 20-mm lesion in the ascending colon that was not removed or biopsied in order to avoid inducing fibrosis. The patient was referred to Stanford for endoscopic treatment.

Six weeks later, the patient underwent colonoscopy for consideration of endoscopic submucosal dissection (ESD). The patient received monitored anesthesia care and had perfect Boston Bowel Preparation Scale of 9. For the procedure, a pleated ring was placed at the 15cm mark of the Olympus PCF colonoscope (Fig. 1), and the other was placed at the distal tip of the colonoscope, just behind a transparent cap [1]. On examination, the cecum was normal. The 20-mm polyp was depressed, consistent with a Paris IIc classification [2]. The surface appearance was concerning for early cancer (classification 2B of Japan Narrow Band Imaging Expert Team) (Fig. 2). In preparation for ESD, 15mL of hetastarch combined with diluted indigo carmine and epinephrine was injected with modest lift of the lesion from the muscularis propria. A partial circumferential incision around the lesion into the submucosa was performed using a DualKnife-J™ (Olympus, Tokyo, Japan). The lesion was then dissected from the underlying deep layers with the electrocautery knife, and the mucosal incision was gradually enlarged (Fig. 3). Additional injection fluid was injected as needed into the exposed submucosa using the DualKnife-J™. The lesion

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✉ Mike T. Wei
mtwei@stanford.edu
George Triadafilopoulos
vagt@stanford.edu
Shai Friedland
shaif@stanford.edu

¹ Division of Gastroenterology and Hepatology, Stanford University Medical Center, 300 Pasteur Drive, Palo Alto, CA 94305, USA

² Veterans Affairs Palo Alto, Palo Alto, CA, USA

Fig. 1 Daisycuffs™ pleated rings on the colonoscope, with distal transparent cap attachment



Fig. 2 **A** The 20-mm flat and depressed polyp. **B** Evaluation on narrow band imaging

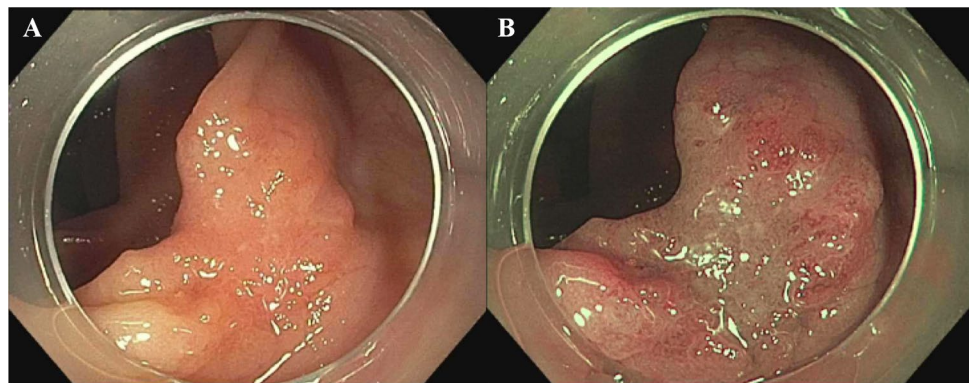
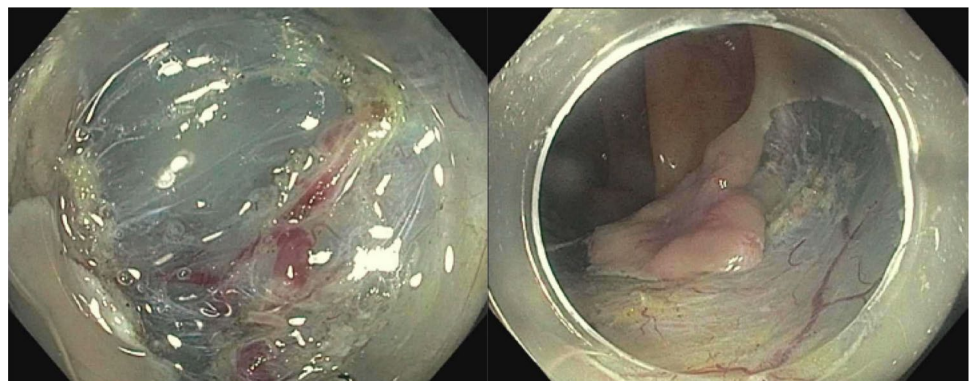


Fig. 3 A partial circumferential incision around the lesion into the submucosa was performed with a dual knife. The lesion was then dissected from the underlying deep layers with the electrocautery knife, and the mucosal incision was gradually enlarged



was resected *en bloc* with a 3–5-mm margin of normal mucosa (Fig. 4). There was no visible muscle injury. Several vessels were prophylactically coagulated during the submucosal dissection using a coagulation forceps. The patient was observed in the recovery room for 2 h and then discharged home on a liquid diet which was advanced to a regular diet the following morning. On post-procedure day 10, she developed hematochezia with a consequent 2 g/dl decrease of hemoglobin for which a clip was placed on a nonbleeding visible vessel at the wound and 1 unit of blood was transfused.

The lesion was pathologically determined to be an intramucosal adenocarcinoma arising in a tubular adenoma with high-grade dysplasia. The tumor was invasive into the muscularis mucosae (M3). No submucosal invasion was identified. There was no sign of dysplasia or carcinoma in the microscopically examined margins (R0). She has continued to do well, without any symptoms.

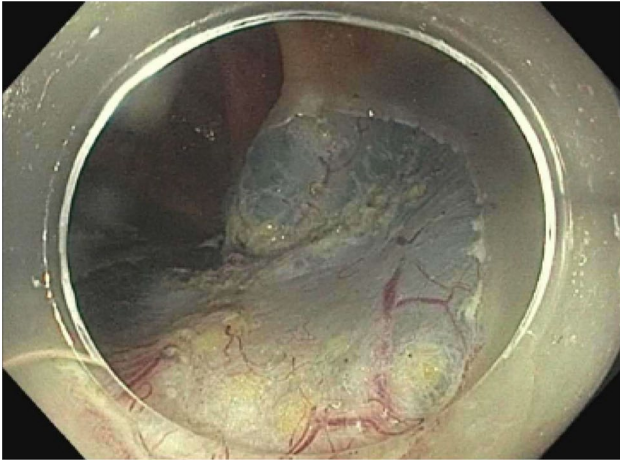


Fig. 4 The lesion was resected en bloc with a 3–5-mm margin of normal mucosa. A total 25-mm area was resected

Discussion

Endoscopic submucosal dissection (ESD) and endoscopic mucosal resection (EMR) are both accepted techniques for endoscopic resection of polyps [3–5]. ESD was developed to overcome the size limitations (~20-mm) of EMR but is significantly more technically demanding [5]. Given the difficulties inherent with ESD, it is imperative to identify tools and methods that optimize the ease, safety, and completeness of resection of the procedure [5, 6]. While there is an array of electrocautery knives used (such as straight, ball-tipped, insulation-tipped, and triangle-tipped), tools for hemostasis, traction devices, and lifting agents, tools intended to improve endoscope stability have been limited [6]. During ESD, maintaining precise control of the endoscope tip is essential in order to avoid inadvertently incising the thin muscularis layer of the colon [5, 6]. In the ascending colon, a short-type double balloon enteroscope system can be used to improve tip control and overcome looping although this device is not widely available [7]. A rigidizing overtube, which has recently become available, can be used with widely available colonoscope models [8]. In the past few years, over-the-scope disposable visualization aids with rings or finger-like projections, such as Endocuff Vision™ (Olympus, Tokyo, Japan) and Daisycuffs™ (Visualization Balloons, LLC, West Caldwell, NJ USA), have seen increased usage for the purpose of increasing the adenoma detection rate by flattening colonic folds during withdrawal [1, 9, 10]. Serendipitously, these accessories improve the efficiency of endoscopic polypectomy and EMR by stabilizing the scope tip [6]. After observing this effect on routine colonoscopy, we decided to adapt Daisycuffs™ for use in right colonic ESD.

The patient described herein exemplifies the merits of using over-the-scope rings. Daisycuffs™ are elastic

polymer pleating rings that can be placed along the shaft of the endoscope and were designed to primarily be used with Vizballoon® (Visualization Balloons, LLC, West Caldwell, NJ USA) urethane balloon catheters for endoscopic procedures in which insufflation is minimized or not feasible, such as visualization under clots during active upper gastrointestinal bleeding or performing difficult colonoscopies. Independently, Daisycuffs™ can help navigate the colon by pleating the intestines onto the scope and can also help maintain the lumen open even with minimal to no inflation. The pleated ring is 20-mm in diameter and fits onto endoscopes with diameters of 12.8–13.7 mm. Each pleated ring has 10 “petals” distributed evenly around the ring circumference. Though not published, the use of 3 Daisycuffs™ has been described to assist with single or double balloon enteroscopy [1]. Nevertheless, use of Daisycuffs™ in the context of EMR and ESD has not heretofore been published. As with the success in this patient, we have found it quite valuable in stabilizing the endoscope, facilitating large mucosal resections of lesions located in challenging positions and those with underlying complex histology (Tables 1 and 2).

Apropos to this case, we retrospectively reviewed patients who received colonoscopies utilizing the elastic polymer pleating rings at 2 hospitals with tertiary care endoscopy facilities (Stanford Hospital and Palo Alto Veterans Affairs). The elastic polymer pleating rings were utilized either for ESD or EMR of large (10–20-mm) and very large (>20-mm) polyps in the colon. Of 22 patients who received colonoscopies with use of the pleated rings, 16 patients underwent ESD (Table 1) and 6 underwent EMR (Table 2). The patients were primarily males (63.6%) with median age 69 (interquartile range [IQR] 61–74.5). There were 14 whites, 4 Asians, 2 Hispanics, 1 Black, and 1 other. Their median body mass index was 25.4 kg/m² (IQR 23.2–31.2 kg/m²). The median procedure time was 47.9 min (IQR 16.3–73.8 min). Most patients received monitored anesthesia care with 2 patients each receiving moderate sedation and general anesthesia.

The polyps were primarily in the ascending colon ($N=9$), followed by cecum ($N=5$), hepatic flexure ($N=3$), and transverse colon ($N=3$). The median size of the polyps removed was 28.1-mm (IQR 20.0–38.8-mm). For the ESD cases, median resection time, defined from the beginning of submucosal injection to completed resection of the polyp, was 61.8 min (IQR 46.3–78.8 min). Among the EMR procedures, there were 4 tubular adenomas with low-grade dysplasia, 1 serrated polyp without dysplasia, and 1 polypoid area of collagenous colitis without dysplasia. Among the ESD procedures, there were 2 serrated polyps without dysplasia, 1 serrated polyp with low-grade dysplasia, 7 tubular adenomas with low-grade dysplasia, 1 tubular adenoma with high grade dysplasia, 2 villous adenomas, 2 intramucosal cancers, and 1 cancer with superficial submucosal invasion. R0 resection was achieved in 14/16 cases, including the 3 cancers. For

Table 1 ESD cases performed using the pleated rings

	Age/Sex	BMI	Location	Size (mm)	Path	R0 Achieved	Time(min)
1	79/M	17.8	AC	20	AdenoCA SM1	Yes	25
2	73/M	23.1	Cecum	55	VA	Yes	90
3	72/M	33.3	DC	20	TA	Yes	70
4	59/F	23.4	AC	35	SSP with LGD	Yes	50
5	58/F	29.3	Cecum	25	SSP	Yes	60
6	75/M	22.7	TC	25	TA	Yes	75
7	68/M	26.3	AC	45	TA	**	75
8	79/M	21.1	TC	40	TA	Yes	60
9	70/M	37.1	HF	30	TA with HGD	Yes	58
10	61 M	25.2	ICV	15	TA	Yes	65
11	77/M	29.7	TC	40	TA	**	100
12	68/M	33.3	AC	23	TA	Yes	25
13	79/F	23.6	AC	30	VA	Yes	90
14	61/F	23.5	Cecum	20	SSP	Yes	20
15	72/M	21.9	AC	40	AdenoCA M3	Yes	90
16	61/F	22.6	AC	20	AdenoCA M3	Yes	35

**See procedure details

AC: ascending colon; AdenoCA: adenocarcinoma; AO: appendiceal orifice; BMI: body mass index; DC: descending colon; HF: hepatic flexure; HGD: high-grade dysplasia; ICV: ileocecal valve; LGD: low-grade dysplasia; M3: third mucosal layer; SM1: first submucosal layer; SSP: sessile serrated polyp; TA: tubular adenoma; VA: villous adenoma; TC: transverse colon; TI: terminal ileum

Table 2 EMR cases performed using the pleated rings

	Age/Sex	BMI	Location	Size (mm)	Path	Time (min)
1	76/F	25.5	Cecum	10	TA	10
2	73/M	38.8	AC	15	TA	15
3	62/M	23.5	AC	15	TA	10
4	55/F	31.7	HF	30	SSP	10
5	64/F	27.9	HF	50	Collagenous colitis	15
6	54/M	47.5	Cecum	15	TA	5

AC: ascending colon; BMI: body mass index; HF: hepatic flexure; SSP: sessile serrated polyp; TA: tubular adenoma

the 2 cases that did not achieve R0, in the first case (**ESD, Case 11**), ESD was attempted on a 40-mm flat/sessile polyp in the transverse colon. Since the endoscope was considered unstable after 40 min, the rings were removed and a rigidizing overtube was utilized [8]. Ultimately, given poor lifting in the central portion of the polyp, ESD was aborted and after additional submucosal injection, the specimen was removed using piecemeal (conversion) EMR. In the second case (**ESD, Case 7**), while there was question of focal extension of the tubular adenoma to the margin, there were issues with processing of the specimen; a significant portion of the tissue removed was not available for review (including the portions of the margin). As such, since the completeness of resection was equivocal,

we did not include this as R0. In 21 cases (not including ESD, Case 11), the endoscopist noted that the scope tip was stable with use of the pleated rings. There was 1 adverse event, a post-ESD bleed on day 10 in the patient described in the above clinical vignette.

In conclusion, based on this sample case and others performed, we find the Daisycuffs™ pleated ring to significantly increase the stability and procedural ease of ESD and EMR. The increased stability of the scope tip may enable the endoscopist to confidently excise the polyp. Further studies will be needed to better demonstrate the utility of the pleated rings in the context of ESD and EMR as well as for other endoscopic procedures.

Key Messages

- Although EMR and ESD are increasingly used for removal of colonic lesions, the techniques require special expertise, are time-consuming, and can be risky
- ESD in particular is preferred for removal of large polyps (> 20-mm) of variable histology but requires specialized endoscopic tools
- The Daisycuffs™ pleated ring significantly increases the stability and procedural ease of ESD and EMR, holding promise in assisting complex polypectomies of variable histology

Compliance with Ethical Standards

Conflicts of interest Mike Wei: Nothing to disclose.
George Triadafilopoulos: Nothing to disclose.
Shai Friedland: Consultant to Capsovision.

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