

# Novel Colorectal Endoscopic Submucosal Dissection With Double-Endoscope and Snare-Based Traction

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**BACKGROUND:** Colorectal endoscopic submucosal dissection is technically demanding, and the traction offered by gravity, cap, or clip-with-line during conventional endoscopic submucosal dissection remains unsatisfactory. Robotic systems are still under development and are expensive. We proposed double-scope endoscopic submucosal dissection with strong and adjustable traction offered by snaring the lesion with additional scope.

**OBJECTIVE:** This study aimed to test the novel double-scope endoscopic submucosal dissection with snare-based traction.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text, and links to the digital files are provided in the HTML and PDF versions of this article on the journal's website ([www.dcrjournal.com](http://www.dcrjournal.com)).

**Funding/Support:** None reported.

**Financial Disclosure:** None reported.

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Dis Colon Rectum 2022; 65: 936–945

DOI: 10.1097/DCR.0000000000002355

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**DESIGN:** This was a retrospective study that reviewed double-scope endoscopic submucosal dissection compared with matched conventional endoscopic submucosal dissection, and size, location, morphology, and pathology between groups were compared.

**SETTINGS:** This study was conducted in a referral endoscopy center in a local hospital.

**PATIENTS:** This study included patients with colorectal lesions receiving double-scope endoscopic submucosal dissection and matched conventional endoscopic submucosal dissection.

**MAIN OUTCOME MEASURES:** The pathological completeness, procedure time, and complications were analyzed.

**RESULTS:** Fifteen double-scope endoscopic submucosal dissection procedures, with 11 lesions located in the proximal colon with a median size of 40 mm, were performed. The median procedure time of double-scope endoscopic submucosal dissection was 32.45 (interquartile range, 16.03–38.20) minutes. The time required for second scope insertion was 2.57 (interquartile range, 0.95–6.75) minutes; for snaring, 3.03 (interquartile range, 2.12–6.62) minutes; and for actual endoscopic submucosal dissection, 28.23 (interquartile range, 7.90–37.00) minutes. All lesions were resected completely. No major complication was encountered. The procedure time was significantly shorter than that of 14 matched conventional endoscopic submucosal dissections (54.61 [interquartile range, 33.11–97.25] min;  $p = 0.021$ ).

**LIMITATIONS:** This was a single-center, single-operator, retrospective case-controlled study with limited cases.

**CONCLUSIONS:** This study confirmed the feasibility of double-scope endoscopic submucosal dissection with snare-based traction to shorten procedure time and to simplify endoscopic submucosal dissection. Additional trials are required.

**KEY WORDS:** Colorectal neoplasm; Endoscopic submucosal dissection; Traction.

Endoscopic submucosal dissection (ESD) is one of the treatment choices for early-stage colorectal cancers.<sup>1-3</sup> The goal of ESD is to achieve curative resection through the endoscopic en bloc resection, with pathological R0 resection. However, this remains difficult to master.<sup>4</sup>

ESD includes the techniques of cutting the mucosa and dissecting the submucosal layer. Exposing the submucosal space is sometimes technically demanding, and poor visualization of the cutting plane increases the risk of bleeding or perforation. Building good traction to provide a good plane for ESD is crucial. Gravity, injection fluid, or a clip-with-line approach has been used to optimize traction during ESD to improve performance.<sup>5</sup> Nevertheless, ESD remains technically demanding, even with the use of these methods, and traction during ESD is still not satisfactory. The robotic system can offer an additional adjustable real-time traction, and the result is promising. However, the system is still expensive and under development.<sup>6,7</sup>

Double-scope ESD (DS-ESD) uses 2 separate endoscopes inserted into the lumen to allow separate traction and cutting. DS-ESD has been proven to be effective in the treatment of lesions in the upper GI region,<sup>8</sup> as well as in the rectum and distal colon.<sup>9</sup> However, little is known about its efficacy in all colorectal lesions.<sup>10</sup> First, double-scope insertion may be problematic for proximal lesions. Second, the traction from hemoclips or foreign body forceps often breaks the lesion.

We tested DS-ESD for both proximal and distal lesions. We used novel snaring-based traction by additional scope to grasp lesions to offer stronger and adjustable traction force. We conducted a preliminary study to evaluate the feasibility, safety, and efficiency of DS-ESD, compared to conventional ESD (c-ESD) for the resection of colorectal lesions.

## MATERIALS AND METHODS

All patients who underwent DS-ESD in Chia-Yi Christian Hospital were included in this analysis. Fifteen procedures were performed from January 2020 to June 2021. Patients for whom double-scope insertions failed were not included in this study. To prevent any complication from 2-scope insertion, we avoided DS-ESD for patients with known severe adhesion from previous abdominal

surgery. The control group comprised patients with lesions matched for size, location, morphology, and pathology and who underwent c-ESD during the same period. All procedures were performed by the same endoscopist who had performed more than 400 ESD procedures and more than 5000 colonoscopy insertions in 1 hospital.

This study was performed after obtaining ethical approval from the institutional review board of Chia-Yi Christian Hospital (approval 2020037, registered with the board on June 1, 2020). All patients were informed about the treatment procedure and gave signed informed consent.

### Colonic ESD Setting

Gastroscope water jet irrigation was used as the ESD scope (GIF Q260J, Olympus, Tokyo, Japan). The scope is short, which allows faster instrument exchange, and has a small diameter, which allows easy entry into the submucosal space. A transparent distal hood was applied to the distal end of the ESD scope (D-201-11304, Olympus; or DH-28GR, Fujifilm, Tokyo, Japan). To cut the mucosa and dissect the submucosal layer, a 20-W pulse-cut-slow setting or a 20-W force coagulation 2 setting of the electrocoagulation unit (ESG 100, Olympus) was used. The coagulation mode was 80-W soft coagulation or 20-W force coagulation 2. We used only an Olympus Dual J knife. Voluven (6% hydroxyethyl starch 130/0.4 in 0.9% sodium chloride injection) with minimal or no indigo carmine was used as the submucosal injection fluid.

All lesions were evaluated with magnified narrow band imaging (NBI) according to the Japan NBI Expert Team classification to evaluate the invasion depth before ESD. We did not perform chromoendoscopy with crystal violet to evaluate the Kudo classification for all the lesions. We performed magnified chromoendoscopy in some lesions only when magnified NBI failed to distinguish invasion depth of the lesion.

### Double-Scope ESD

#### Double-Scope Insertion

The first traction scope was inserted using the conventional 1-endoscopist method. All loops were shortened. For most patients, the first scope was a GIF Q290 gastroscope, which has a small outer diameter and can leave more room for the insertion of a second scope. However, a PCF Q260AZI, which is longer and has adjustable stiffness, was used if the GIF Q290 failed to reach the lesion because of redundant colon.

The second scope was the ESD scope, GIF Q260J with the transparent distal hood. The ESD scope was inserted along the axis of the first traction scope. As visualization of the lumen of the sigmoid colon (S colon) was generally poor, we attempted to hook colonic folds one at a time and rotated the second scope

around the first scope to find the area with less resistance to allow advancement of the scope. Abdominal compression and loop shortening were also crucial for second ESD scope insertion. During the second scope insertion, the assistant was asked to hold the shaft of the first scope at the point close to patient's anus. The endoscopist stood to the right of the patient and the assistant could stand or sit in any place where the scope could be held, usually to the left of the patient. The control part of the traction scope was put on the patient or the bed, and the endoscopist could adjust the big or small wheel during the procedure to create favorable traction.

### **Traction of the Lesion**

Snare-based traction was created using the traction scope. We performed dynamic submucosal injection and then used the snare to include and grip as much tissue as possible. After snaring, the lesion was shaped from flat into protruded (Figs. 1B and 2B). Then, we withdrew the traction scope a little and simultaneously pushed the shaft of the snare out of the scope to provide a better working field for the ESD scope. An assistant held the first scope to maintain favorable traction, and the endoscopist adjusted the traction force by manipulating the traction scope or the snare.

Foreign body forceps and biopsy forceps were not used for traction because they easily cause tissue tearing. To prevent premature cutting of the lesion with the snare, we did several things. First, we grasped tissue as large as possible. Second, the force of snare to hold the lesion for traction was not as strong as that for endoscopic mucosal resection (EMR). Third, we adjusted the bowel loop to prevent the scope accidentally dropping out because of colon looping. Fourth, we used snares with thick wire. We do not use snares designed for cold snaring because the wire is too thin.

To grasp the lesion as much as possible, just like during EMR, we usually injected from the center of the lesion to make the best central lifting. We used to inject from peripheral, which often caused the center of the lesion to be lifted less than peripheral. It made EMR or snaring the lesion harder. We are still concerned about the issue of possible tumor seeding; to avoid that, the injection should be gentle and should not puncture through the bowel wall.

### **Dissection With Double-Scope Snare-Based Traction**

We performed ESD with the traction provided by the snare from the traction scope. Essentially, we adjusted the traction and then dissected the lesion. In most cases, we used traction to push the lesion to perform cutting and dissection in the area closer to the operator. Then, we pulled back on the lesion to cut and dissect the area further from us (Figs. 1 and 2).

### **ESD of the Control Group**

All c-ESD cases were performed using the pocket-creation method (PCM), as described in a previous study.<sup>11</sup> The PCM involves an initial minimal mucosal incision to create a pocket in the submucosal layer to stabilize the tip of the endoscope and prevent dispersion of the injected solution.

### **Pathological Analysis**

The size of all tumors was measured with a ruler. Resected tissue was then fixed with 10% formalin solution, and 2-mm-thick sections were obtained for pathology. En bloc resection was the resection of an entire lesion in a single piece. R0 resection was defined as an en bloc resection with negative lateral and basal margins.<sup>12</sup>

### **Postprocedural Monitoring and Follow-Up**

All patients were admitted before and after the procedure. Baseline vital signs were taken every 8 hours, and pain or any other symptoms were recorded. All patients resumed eating 1 day after ESD. All patients were asked to return to the clinic, and any complications after discharge were recorded.

### **End Points and Outcome Evaluation**

Pathological results, resection completeness, and tumor pathology were recorded. The procedure descriptions were analyzed for procedure time, instruments used, and details of the ESD methods. Complications were also documented, including perforation, bleeding, and infection. Duration of hospital stay after resection, as well as procedure time and fibrosis noted during the procedure, were also documented. Fibrosis groups were defined as no fibrosis (F0: the fibrosis in submucosal area can be separated by injection with good fluid retention), minimal fibrosis (F1: the fibrosis in submucosal area can be separated by injection with poor fluid retention), and severe fibrosis (F2: the fibrosis in submucosal area cannot be separated by injection).

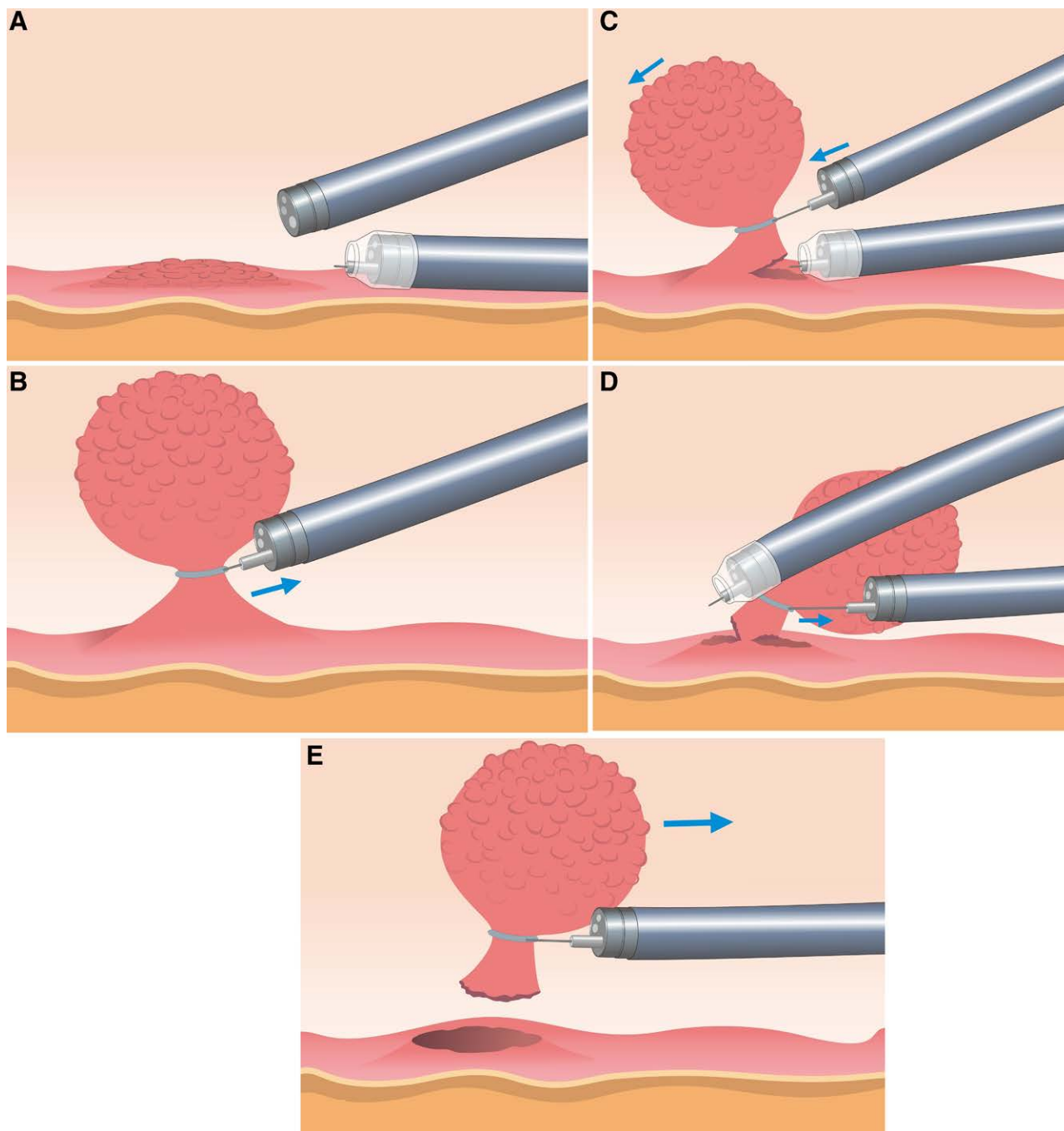
### **Statistical Analysis**

Characteristics of the study participants are reported as median (interquartile range [IQR]) for continuous variables and as number (%) for categorical variables. Comparisons of continuous data between groups were tested by the Mann-Whitney *U* test, and comparisons of categorical data were evaluated by the Pearson  $\chi^2$  test or the Fisher exact test when appropriate. All statistical analyses were performed with SPSS for Windows, version 21.0 (IBM Corp.), with *p* < 0.05 in 2-tailed tests considered significant.

## **RESULTS**

### **Participant and Lesion Characteristics**

Fifteen colonic tumor DS-ESDs were performed, and 90% of lesions were located in the proximal colon with a median



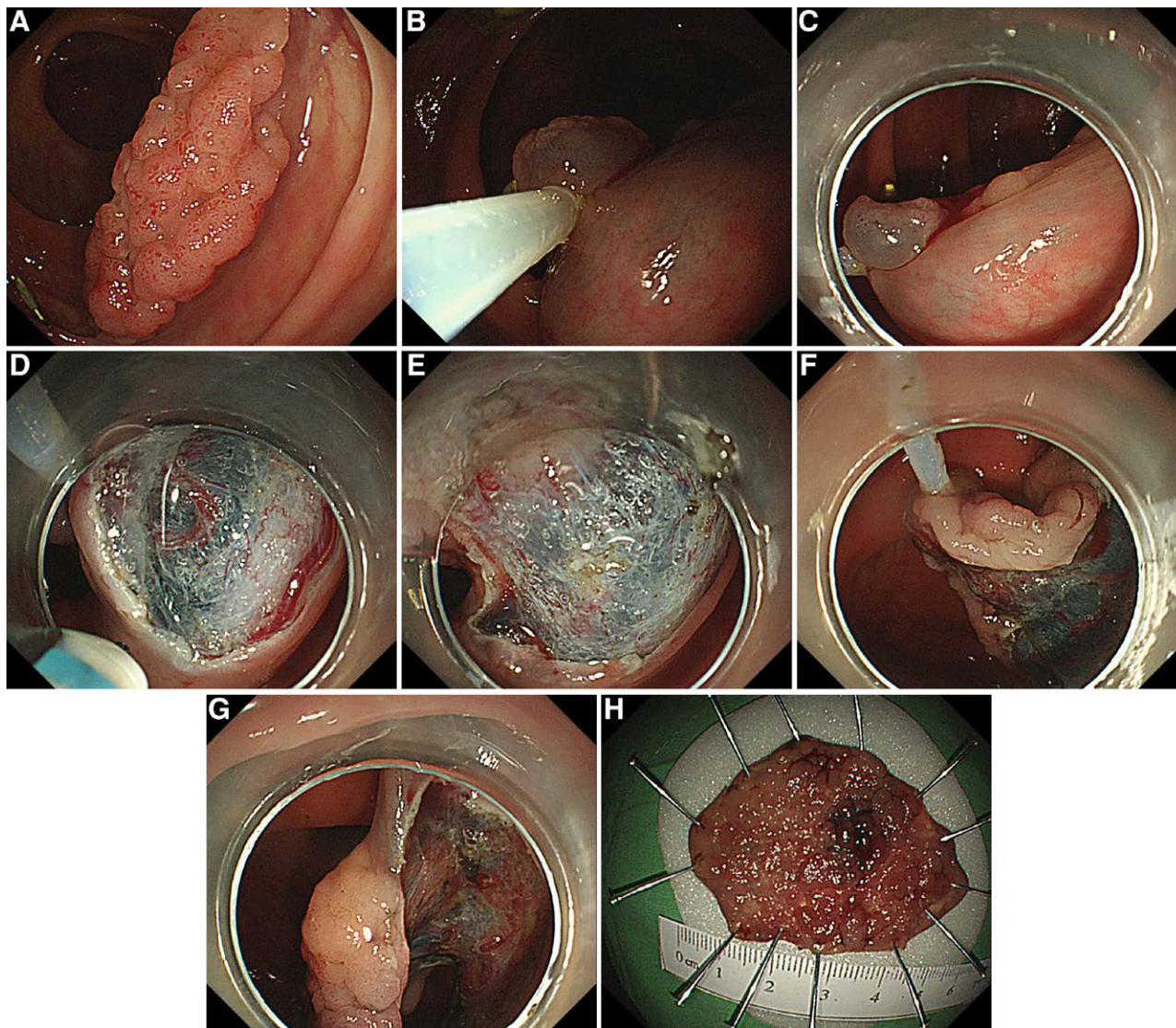
**FIGURE 1.** Steps of DS-ESD. A, Insertion of the first traction scope then second ESD scope. B, Creating traction by the first scope with snaring after injection. C and D, Dissection of the lesion with traction adjustment. E, Retrieving the lesion with the first scope. DS-ESD = double-scope endoscopic submucosal dissection.

size of 40 mm. Fourteen matched patients who underwent c-ESD were included for comparison (Table 1). The distributions of body weight, height, BMI, and sex were similar between the DS-ESD and c-ESD groups, but patients in the c-ESD group were older. All the lesions in the study were laterally spreading tumors. All of them were flat and were Paris 0-IIa lesions. The results of magnified NBI with Japan NBI expert team classification are presented

in Table 1. There were no statistically significant differences between the DS-ESD and c-ESD groups in terms of tumor size, tumor location, morphology, magnified NBI, or pathology type (Table 1).

#### **Successful Rate of Second Scope Insertion**

In the beginning, we used double-scope insertion, not only for ESD cases but also for bleeding ones to rescue



**FIGURE 2.** DS-ESD for ascending colon large flat lesion. A and H, Ascending colon 6-cm LST-G. B, A view from traction scope. After insertion of 2 endoscopes, the lesion was grasped with snare by traction scope. C, A view from ESD scope. The traction from the left can be observed. D and E, The submucosal layer was easy to expose with the traction. F and G, The traction was adjusted to have better field for dissection. DS-ESD = double-scope endoscopic submucosal dissection; LST-G = laterally spreading tumor-granular type.

the poor anatomical approach. The initial successful second scope insertion rate was low and is not included in the analysis. After 10 more cases, the insertion method of 2 scopes became stabilized. We used DS-ESD as a major ESD protocol afterward. During this study period, all double-scope insertions were successful. We never tried DS-ESD for patients with known severe adhesion from previous abdominal surgery to prevent complication from the insertion of 2 scopes.

#### Procedure Time

When considering the procedure time of DS-ESD, the pure median ESD time for DS-ESD was 28.23 (IQR, 7.90–37.00) minutes. When considering the total procedure time of DS-ESD, including second scope insertion,

snaring the lesion, and performing ESD, the median time was 32.45 (IQR, 16.03–38.20) minutes. The median procedure time for c-ESD was 54.61 (IQR, 33.11–97.25) minutes. Both total procedure time and pure ESD time in the DS-ESD group were significantly shorter than the total procedure time in the c-ESD group (Table 2). A reduction of about 40% in total procedure time was observed.

The procedures of the 15 cases are presented in detail in Table 3. DS-ESD with snare-based traction offered good traction with adequate force, without tearing the lesion, and allowed traction adjustment as needed (Figs. 1 and 2; (see [Supplemental Video](http://links.lww.com/DCR/B912) at <http://links.lww.com/DCR/B912>).

The time needed for the second scope (ESD scope) insertion was very similar to that for the first scope (traction

**TABLE 1.** Participants' and lesion characteristics on c-ESD and DS-ESD

Characteristics	c-ESD	DS-ESD	p
Age (y)	68.00 (64.75–79.25)	58.00 (52.00–69.00)	0.027
Body weight (kg)	62.60 (59.23–68.23)	65.10 (54.10–73.10)	0.727
Height (cm)	156.80 (153.63–161.23)	160.00 (155.20–169.90)	0.176
BMI (kg/m <sup>2</sup> )	25.19 (23.76–26.12)	25.26 (22.49–27.25)	0.760
Sex, n (%)			0.573
Female	8 (57.14)	7 (46.67)	
Male	6 (42.86)	8 (53.33)	
Tumor size (mm)	40.00 (35.00–45.00)	40.00 (32.00–50.00)	0.659
Tumor location, n (%)			0.237
Cecum-ICV	0 (0.00)	3 (20.00)	
Cecum	2 (14.29)	2 (13.33)	
A colon	6 (42.86)	5 (33.33)	
T colon	4 (28.57)	1 (6.67)	
S colon	2 (14.29)	4 (26.67)	
Morphology, n (%)			0.924
LST-NG	3 (21.43)	3 (20.00)	
LST-G	11 (78.57)	12 (80.00)	
Magnified NBI, n (%)			0.876
JNET2A	8 (57.14)	9 (60.00)	
JNET2B	6 (42.86)	6 (40.00)	
Pathology, n (%)			0.279
Tubular adenoma	8 (57.14)	7 (46.67)	
Tubulovillous adenoma	1 (7.14)	5 (33.33)	
Carcinoma in situ	4 (28.57)	3 (20.00)	
T1 cancer	1 (7.14)	0 (0.00)	

Continuous variables using Mann-Whitney *U* test presented as median (IQR); JNET classification was designed to predict invasion depth with magnified NBI.

A = ascending; c-ESD = conventional endoscopic submucosal dissection; DS-ESD = double-scope endoscopic submucosal dissection; ESD = endoscopic submucosal dissection; ICV = ileocecal valve; IQR = interquartile range; JNET = Japan NBI Expert Team; LST-G = laterally spreading tumor-granular type; LST-NG = laterally spreading tumor-nongranular type; NBI = narrow band imaging; S = sigmoid; T = transverse.

scope) insertion in DS-ESD. In case 7, we failed to reach the lesion with the gastroscope; thus, the PCF Q260AZI was used as the first scope. In case 10, we failed to insert a second scope because of looping, which caused the first scope to be pulled out during the second scope insertion. We retried using the PCF Q260AZI as a first scope, with successful second gastroscope (GIF Q260J) insertion. The double-scope insertion remained somewhat technically demanding, but the difficulty could be overcome by using the above-mentioned strategy.

In terms of snaring, the technique used was similar to that used for conventional endoscopic mucosal resection, with submucosal injection and snaring. The technique was not difficult and could be completed in a short time.

In case 10, we experienced poor lifting and failed to snare the lesion directly. First, we cut the lateral margin using an ESD knife and then successfully snared the lesion.

### Completeness and Complications

En bloc resection and R0 resection were successfully accomplished for all patients with DS-ESD. In the DS-ESD group, no lesion was torn by snaring. The pathological analysis showed no basal or lateral margin broken by snaring.

No major complications, as well as comparable hospital stay duration, were observed. Only minimal minor complications of bleeding or abdominal pain were noted, and both subsided with supportive care (Table 4).

**TABLE 2.** Procedure time of c-ESD and DS-ESD

Characteristics	c-ESD	DS-ESD	p
Total procedure time (min) <sup>a</sup>	54.61 (33.11–97.25)	32.45 (16.03–38.20)	0.021
Pure ESD time (min)	54.61 (33.11–97.25)	28.23 (7.90–37.00)	0.005
Second scope insertion time (min)		2.57 (0.95–6.75)	
Traction creation with snaring time (min)		3.03 (2.12–6.62)	

Continuous variables using Mann-Whitney *U* test presented as median (IQR).

c-ESD = conventional endoscopic submucosal dissection; DS-ESD = double-scope endoscopic submucosal dissection; ESD = endoscopic submucosal dissection; IQR = interquartile range.

<sup>a</sup>For DS-ESD, total time includes time of second scope insertion, snaring, and performing ESD.

**TABLE 3.** Parameter identification results for each patient

No.	Organ	Morphology	Size (mm)	Pathology	Insertion of first scope (min)	Insertion of second scope (min)	Traction with snaring (min)	ESD time (min)	Total procedure time (min)	Coagrasper used
1	A colon	LST-G	32	TVA	6.00	6.75	2.23	7.05	16.03	0
2	Cecum	LST-G	50	TVA	7.00	8.05	6.62	37.00	51.67	1
3	Cecum-ICV	LST-NG	60	Tis	5.00	3.00	2.00	86.00 <sup>a</sup>	91.00	3
4	A colon	LST-G	45	TVA	2.02	2.10	3.00	25.12	30.22	2
5	Cecum-ICV	LST-G	50	TVA	4.48	2.62	6.70	28.88	38.20	1
6	Cecum	LST-G	30	TA	5.73	2.50	2.50	7.20	12.20	1
7	A colon	LST-G	30	TA	17.00 <sup>b</sup>	7.38	3.72	16.92	28.02	1
8	A colon	LST-G	40	TA	3.08	4.07	2.12	21.73	27.92	1
9	S colon	LST-G	35	TA	0.38	0.47	3.03	28.95	32.45	1
10	T colon	LST-NG	35	Tis	2.00	17.03 <sup>c</sup>	11.27 <sup>d</sup>	6.20	34.50	1
11	S colon	LST-G	40	Tis	0.33	0.52	1.28	7.90	9.70	1
12	S colon	LST-G	80	TVA	0.82	0.80	3.53	119.95	124.28	2
13	S colon	LST-NG	45	Tis	0.60	0.95	20.05	48.07	10.07	0
14	A colon	LST-G	60	TA	2.13	1.40	3.25	29.30	33.95	1
15	Cecum-ICV	LST-G	27	TA	2.30	2.57	1.97	28.23	32.78	0

A = ascending; ESD = endoscopic submucosal dissection; ICV = ileocecal valve; LST-G = laterally spreading tumor-granular type; LST-NG = laterally spreading tumor-nongranular type; S = sigmoid; T = transverse; TA = tubular adenoma; TVA = tubulovillous adenoma; Tis = carcinoma in situ.

<sup>a</sup>Lesion with significant part of terminal ileum involvement.

<sup>b</sup>Technical memo: Failed first gastroscope insertion due to looping with PCF Q260AZI rescue.

<sup>c</sup>Technical memo: Failed second scope insertion due to looping, change first scope to PCF Q260AZI, then successful second scope.

<sup>d</sup>Technical memo: Failed snaring due to nonlifting, cutting lateral margin with ESD, then snaring with success.

### Fibrosis and Nonlifting

In the DS-ESD group, 93.33% of patients had F0 fibrosis (no fibrosis) and 6.67% had F1 fibrosis; in the c-ESD group, 28.57% of patients demonstrated F1 fibrosis (minimal fibrosis). DS-ESD offered good traction and allowed good observation of the submucosal layer, even after the injection fluid had faded away.

**TABLE 4.** Comparison of completeness and complications of c-ESD and DS-ESD

Characteristics	c-ESD	DS-ESD	p
En bloc resection, n (%)	14 (100)	15 (100)	
R0 resection, n (%)	14 (100)	15 (100)	
Major complication	0	0	
Minor complication, n (%)			0.96
No	13 (92.86)	14 (93.33)	
Yes	1 (7.14) <sup>a</sup>	1 (6.67) <sup>b</sup>	
Length of hospital stay (d)	3.00 (3.00–4.25)	3.00 (3.00–4.00)	0.232
Nonlifting, n (%)			1.000
No	14 (100.00)	14 (93.33)	
Yes	0 (0.00)	1 (6.67)	
Fibrosis, n (%)			0.169
F0	10 (71.43)	14 (93.33)	
F1	4 (28.57)	1 (6.67)	

Continuous variables using Mann-Whitney *U* test presented as median (IQR).

c-ESD = conventional endoscopic submucosal dissection; DS-ESD = double-scope endoscopic submucosal dissection; ESD = conventional endoscopic submucosal dissection; IQR = interquartile range.

<sup>a</sup>Prolonged abdominal pain, subsided with supportive care.

<sup>b</sup>Post-ESD bleeding, subsided with supportive care.

### DISCUSSION

We proved the potential efficacy of DS-ESD, with approximately 40% reduction in procedure time. DS-ESD has been proposed as a feasible method for improving traction with the assistance of force provided from a second scope in the upper GI tract and distal colon,<sup>9,13,14</sup> and our study showed that it is feasible to apply DS-ESD even in the proximal colon. Our novel snare-based traction also offers adjustable strong traction with less tissue tearing compared to the previous foreign body forceps-based traction.

c-ESD creates traction to expose the submucosal layer for dissection by cap, gravity, injection fluid, or clip-with-line methods.<sup>15</sup> All these methods have limitations, and the user experience is far from the laparoscopic surgeries. Using a cap to expose the submucosal layer is the technique most often used for colorectal ESD and requires a long time to master. Gravity may be less effective for thin lesions, and the effect of the patient's posture change is sometimes limited. The clip-with-line traction method is not easy to adjust after application, and the pulling force of the clip is not strong. The PCM is a simple but fixed technique, and the traction still mainly derives from the cap.<sup>15</sup> Compared with the actual surgery, the conventional method used to generate traction is not straightforward and has been an obstacle for ESD. Dual-channel scope is a special scope that can allow 2 instruments from 2 separate working channels. It can allow us to have traction offered from one channel and cutting from another channel. However, because the 2 channels are from the same scope, unlike DS-ESD, the direction and force of traction are always interfered by ESD cutting motions.

Robotic systems for ESD can offer additional adjustable and real-time traction and are promising.<sup>6,7</sup> These systems are still under development, and more studies are needed. The expense of these systems is estimated to be high.

Our study showed that DS-ESD could be used to provide multidirectional, real-time adjustable traction. In this study, using DS-ESD halved the duration of the ESD procedure. According to the latest reports, ESD took an average of 80 (18–553) minutes in North America,<sup>2</sup> with other types of traction accounting for 10.9% in the series. The dissection time using the PCM approach was  $69.5 \pm 44.4$  minutes in Japan.<sup>11</sup> The procedure time as reviewed in the European Society of Gastrointestinal Endoscopy guidelines is in the range of 86 to 101 minutes.<sup>3</sup> Our control group, in which c-ESD with PCM was used and takes about 1 hour on average, was similar to that in other previous reports. In the DS-ESD group, the mean lesion size was 40 mm, of which 5 were in the cecum, 5 were in the ascending colon, 1 was in the transverse colon, and 4 were in the S colon. Most were located in difficult-to-operate parts. However, the mean procedure time in the DS-ESD group was only 32.45 minutes, with 80% requiring <40 minutes. Only 2 cases had higher procedure times of 86 and 119.95 minutes because of terminal ileum involvement and large lesions at S colon. The mean DS-ESD procedure time was significantly shorter than the 60 minutes needed in c-ESD. During the DS-ESD, because the traction was good, there was no need for a change in position to implement gravity. Thus, the delicate and technically demanding movement of the cap to explore submucosal tissue was rarely needed, and it was much easier to see the submucosal layer clearly for cutting with the assistance of traction. We did not face the problem of poor injection fluid retention in the DS-ESD group because the traction was strong.

Previously, studies on DS-ESD have mainly focused on the esophagus and stomach.<sup>13,16–19</sup> Because it is not easy to apply double scopes to the proximal colon, the use of DS-ESD in the colorectal field has been limited to the S colon and rectum,<sup>9</sup> and case reports involved DS-ESD only in the cecum.<sup>14</sup> There were 2 novelties of DS-ESD in this study. First, this study used 2 gastroscopes or a PCF Q260AZI plus gastro-scope to allow 2 endoscopes to reach the proximal colon. The double-scope insertion method is difficult in the initial stage, but it can be performed stably after fewer than 10 trials, as described in the Materials and Methods section, and we expect that it will be easier to learn than the c-ESD. The double-scope system is easy to perform in the distal colon, and we also estimate that more than half of proximal ESD procedures can be adapted to using this system. Second, we used a snare to grasp the tumor. The snare allows more tissue to be taken, further avoiding the clip or foreign body forceps approach, which can only catch a small specimen and can easily tear the lesion. On comparison with floss traction, which can only offer a pulling force, our traction system can offer both pushing and pulling force with multiple fine direction adjustments by manipulating the non-ESD scope. With adjustable traction provided by the double scope, traction

could be provided in a manner that is more familiar and straightforward than that used in any ESD method to date. The major benefit from the traction with DS-ESD is that it can expose the submucosal layer widely and make the cutting during ESD much easier. With DS-ESD, we do not have to master very fine scope control for c-ESD to expose the thin submucosal layer with cap and dissect the thin submucosal layer without additional traction. We postulate that DS-ESD may help not only endoscopists who master c-ESD but also those with only some experience with c-ESD.

Regarding possible complications from DS-ESD, we did not encounter any major complications because we performed DS-ESD only in selected cases and in experienced hands. First, a complication may result from double-scope insertion. Theoretically, the space in the colon can allow 2 endoscopes because the cross-section area of the colon ranges from 9 cm<sup>2</sup> to 64 cm<sup>2</sup>, and the cross-section area for 2 scopes is around 2 cm<sup>2</sup> to 4 cm<sup>2</sup>. When we insert the second scope and the colon is already occupied by 1 scope, the visualization is not good, and there is always some resistance for us to pass limited space between the first scope and the colon wall. Trauma or perforation from the second endoscope insertion should be of concern. Regarding patient selection, the patient whose colon lumen is narrowed might make double-scope insertion riskier and more difficult. We avoided double-scope insertion for patients who might have a severe adhesion from abdominal surgery. As far as competency of the endoscopy skill, the endoscopist who performed DS-ESD had experience performing >5000 colonoscopy insertions and was very sensitive to the resistance during double-scope insertion. Second, regarding complications while performing DS-ESD, we postulated that DS-ESD may make ESD easier with the aid of traction and may lower the risk of complications from ESD.

Because DS-ESD is a novel technique, we suggest DS-ESD to be performed only by endoscopists who master colonoscopy insertion and have adequate ESD experience. We cannot judge a minimum proficiency of c-ESD to perform DS-ESD. Based on our experience of ESD teaching, at least 30 colorectal ESDs may be required for endoscopists to adapt this DS-ESD system into their ESD practice. We also suggest the endoscopists should have experience of at least 1000 successful cecal intubations before attempting double-scope insertion.

The sense of resistance and the experience of endoscopists are crucial to avoid possible complications. There have been no complications from double-scope insertion up to now. More studies are needed to confirm this. The double-scope insertion, such as conventional colonoscopy insertion, is influenced by the endoscopist's technique and the patient's bowel anatomic status, including the patient's weight, height, redundant bowel loops, or adhesions. We used different scopes to overcome this situation. Further study is needed to improve double-scope insertion. We suggest DS-ESD should be tried only by endoscopists who master colonoscopy insertion to avoid complications from insertion of 2 scopes.



The indications of ESD or EMR vary from those given in the guidelines from different countries. The indications of ESD or EMR in our institution are similar to those suggested in a clinical practice update of the American Gastroenterology Association: laterally spreading tumor-nongranular type  $\geq 20$  mm in size and laterally spreading tumor-granular type  $\geq 30$  mm in size. The update mentions that large colorectal lesions with piecemeal removal when endoscopic mucosal resection is performed are associated with increased (up to 20%) rates of recurrent neoplasia. ESD enables higher rates of en bloc resection and lower rates of recurrence. We also performed ESD in some smaller lesions if the anatomical approach was too difficult for EMR. We follow these indications because the risk of invasive cancer for large laterally spreading tumors of granular type or laterally spreading tumors of nongranular type still exists, and ESD has an acceptable risk (0.2% major risk in our institution) and procedure time (approximately 1 hour on average). Endoscopists should justify the benefit, risk, cost, and skill competency to choose ESD or EMR accordingly. The update of the American Gastroenterology Association suggests that patients with large complex colorectal polyps should be referred to a high-volume, specialized center for endoscopic removal by EMR or ESD.<sup>20</sup> The performance of ESD is good in the United States and other countries.<sup>1,2</sup> As the ESD technique improves over time, we believe the indication of EMR and ESD will be different in the future.

The main limitations of this study were that this was a single-center, single-operator, case-control study with limited case numbers. Therefore, further randomized controlled trials involving more patients and multiple centers are needed to allow generalization of the findings. Regarding selection bias, if the patient had a severe adhesion from abdominal surgery or other causes, we avoided double endoscopy to prevent possible complications from second scope insertion. If the lesion was too simple and if additional traction might not be necessary, we just performed c-ESD. Additional randomized controlled trials are necessary to overcome this bias issue. We can only conclude that ESD may be faster and easier if double-scope insertion is successful. Because all the DS-ESDs and c-ESDs were performed by experienced hands, the results of its efficacy and safety may not be generalized for all endoscopists. Colorectal ESD is a complex procedure because of the various lesion locations, bowel looping, and tumor characteristics. We acknowledge that no single method can solve all the difficulties involved in ESD. Further studies are required to define its role as a first-line or rescue ESD method.

## CONCLUSION

DS-ESD with snare-based traction can shorten procedure time. We also demonstrated its feasibility in proximal lesions. Further studies are required to confirm its utilization.

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