



# Dissection of giant bulky colorectal lesions with muscle retracting sign (MRS+). Strategic management of gravitational traction during ESD might be the solution

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## Abstract

**Background** Large polyps have a higher risk of muscle retracting sign (MRS) positivity and display higher incomplete resection rates by endoscopic submucosal dissection (ESD). Techniques used are pocket creation methods and circumferential excision with traction application. This is a pilot study aiming to explore the efficacy and safety of a new ESD technique for MRS+ lesions.

**Methods** First, a 5-cm-long tunnel is created distally from the lesion, stabilizing the scope and enabling a deeper, flatter dissection plane. As the resection nears the lesion's center with suspected MRS, a local pocket is made for circular access to the muscle retraction tip. Effective gravity management is key for procedure success. Initially working against gravity (or opposite to the direction of gravity) allows better submucosal exposure. Subsequently, patient position is adjusted to allow the specimen to be pulled by gravity towards the dissection line. As a result, the altered position loosens the muscle layer, thereby reducing the tension at the MRS site and ultimately the perforation risk. Finally, a circumferential “360° dissection” is performed, with prophylactic coagulation applied at the muscle retraction tip to minimize bleeding from large feeding vessels.

**Results** Our cases series consists of 18 patients who underwent ESD for MRS+ colonic (3/18) and rectal (15/18) giant (> 4 cm) lesions, with en bloc and R0 resection documented in 16/18(89%) cases. Two patients were referred to surgery because of massive MRS+ and high risk of severe intraoperative bleeding.

**Conclusions** This case series demonstrates the efficacy of the aforementioned technique, yielding satisfactory results in the majority of cases—even those without curative resection. The application of this technique not only in giant rectal polyps but also in colonic protruding lesions amplifies the significance of the proposal.

**Keywords** Endoscopic submucosal dissection · Polyp · Colon · Resection · Muscle retracting sign

## Introduction

Protruding and laterally spreading colorectal lesions with dominant nodules are considered to entail a high risk for muscle retracting sign positivity (MRS+). MRS+ lesions have been associated with higher incomplete resection and perforation rates by endoscopic submucosal dissection (ESD) while also carrying greater risk for deep submucosal invasion (SM) [1–6]. This endoscopic feature could

be explained by desmoplastic reaction pulling the muscle layer close to the neoplastic core, fibrosis by former incomplete resection attempts, or tractional forces by gravity and peristalsis acting on the polypoid mass. Advanced endoscopic skills and novel techniques with creative ingenuity are required to surpass the resection difficulties caused by MRS+ lesions and avoid procedure discontinuation. Techniques employed are pocket creation ESD [2, 3], circumferential excision with traction application [4], and intermuscular dissection [5, 7] combined or not with clip muscle protection methods [8, 9]. However, the optimal resection method remains debatable.

The purpose of this study is to present an alternative ESD approach for MRS+ lesions and assess its efficacy and safety. Higher en bloc, R0, and curative resection rates

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combined with lower discontinuation rates are the main factors to consider. Also, providing accurate pathological diagnosis without the need for surgical interventions can be of great significance in non-curative resection, marginal cases.

## Patients and methods

### Patients

A prospective pilot study was conducted between October 2023 and February 2025, and 18 patients were enrolled. All procedures were performed by an expert ESD endoscopist (G.T.) who has performed more than 500 ESDs. The indications for ESD included (1) lesions greater than 20 mm in diameter, (2) lesions with scarring from prior endoscopic treatment or biopsy, (3) locally recurrent lesions following previous endoscopic resection, and (4) lesions suspected to be carcinoma with SM less than 1000  $\mu$ m prior to endoscopic intervention. Lesion evaluation was performed through white-light observation, assessment after indigo carmine dye spraying, and pit pattern analysis using zoom chromoendoscopy.

### ESD procedure

The DualKnife J (KD-655U; Olympus, Tokyo, Japan), the HookKnife J (KD-625UR, Olympus), and Coagrasper hemostatic forceps (FD-410LR, FD-411UR; Olympus) were used. A single large channel endoscope (GIF-190TH, Olympus) and a pediatric/slim colonoscope (PCF-H190TL, Olympus) with a 4-mm-long transparent distal attachment (D-201-11304, Olympus) were used paired with the ESG 300 (Olympus) electrosurgical generator.

### ESD technique

The method applied is based on pocket creation ESD and strategic management of gravitational traction. A schematic representation is shown in Fig. 1. Initially, a 5-cm-long tunnel is created distally from the lesion (Fig. 1a–d). This extended tunnel enables better scope stabilization in parallel with the muscle layer, resulting not only in better handling but also in a deeper and flatter dissection plane. When resection approaches the center of the lesion with suspected MRS, the dissection area is widened, making a local pocket, in order to attain circular access to the muscle retraction tip. By strategically using gravity during the procedure, one can enhance the efficiency and safety of this technique. Therefore, during tunneling initiation, the procedure is performed in the opposite direction to gravity without mechanical traction application. However, as the muscle retraction area is approached, the patient's position is altered, allowing gravity

to pull the specimen towards the dissection line (Fig. 1e, f). The presence of minimal traction only, owing to submucosal injection and endoscope cap, loosens the muscle layer, reducing muscle tension and perforation risk. Thereafter, a circumferential approach is applied to begin to “climb the mountain” from each quadrant, making a 360° dissection (Fig. 1g–j). When the muscle retraction tip is reached, where usually large feeding vessels penetrate the submucosa, preventive coagulation is applied to minimize bleeding, followed by the use of cutting current to complete dissection (Fig. 1i–l). Resection of such a giant (10 cm) lesion in the rectum is demonstrated in Fig. 2.

### Statistical analysis

Analysis was conducted in R with RStudio (RStudio Team (2020); RStudio: Integrated Development for R. RStudio, PBC, Boston, MA URL <http://www.rstudio.com/>). Descriptive statistics were presented as counts and percentages for qualitative data. Quantitative data were described by the mean and standard deviation (SD) or median with interquartile range (IQR).

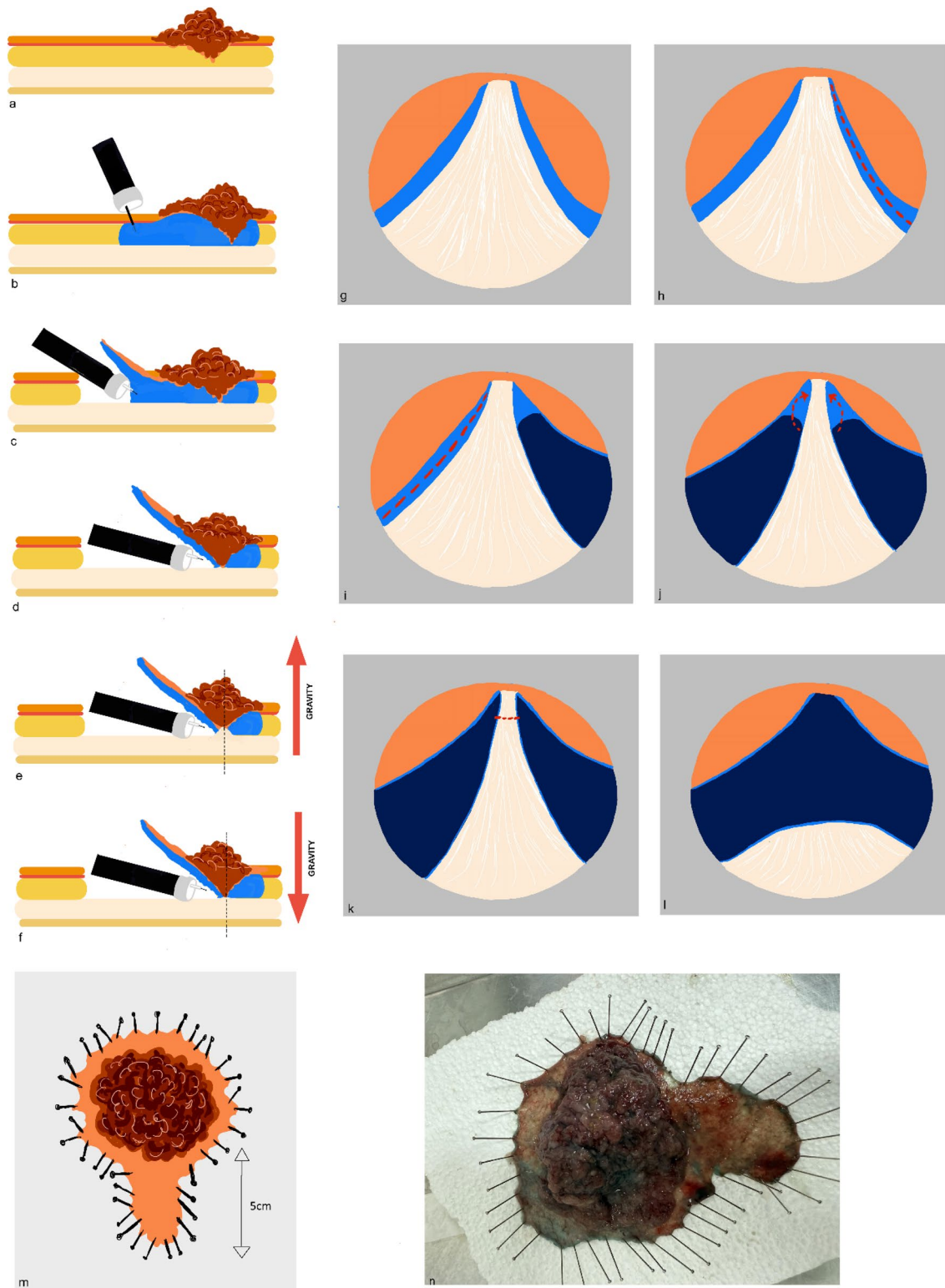
## Results

### Lesion characteristics

Characteristics of 18 MRS+ lesions in 18 patients who underwent ESD for colorectal neoplasms are summarized in Table 1. The median age was 71 (IQR 17) and 56% of patients were female. Mean lesion size was  $61 \pm 17$  mm and 15/18 lesions (83%) were located in the rectum. Regarding morphology, 61% and 39% of cases were protruding lesions (Is  $\pm$  0–IIa) and laterally spreading tumors—granular nodular mixed (LST-GM), respectively. Histology revealed high-grade dysplasia in 7/18 (39%), intramucosal cancer in 7/18 (39%), 1 (5.6%) T1bSM1, 1 (5.6%) T1bSM2, and 2 (11%) T1bSM3 lesions.

### Procedure outcomes

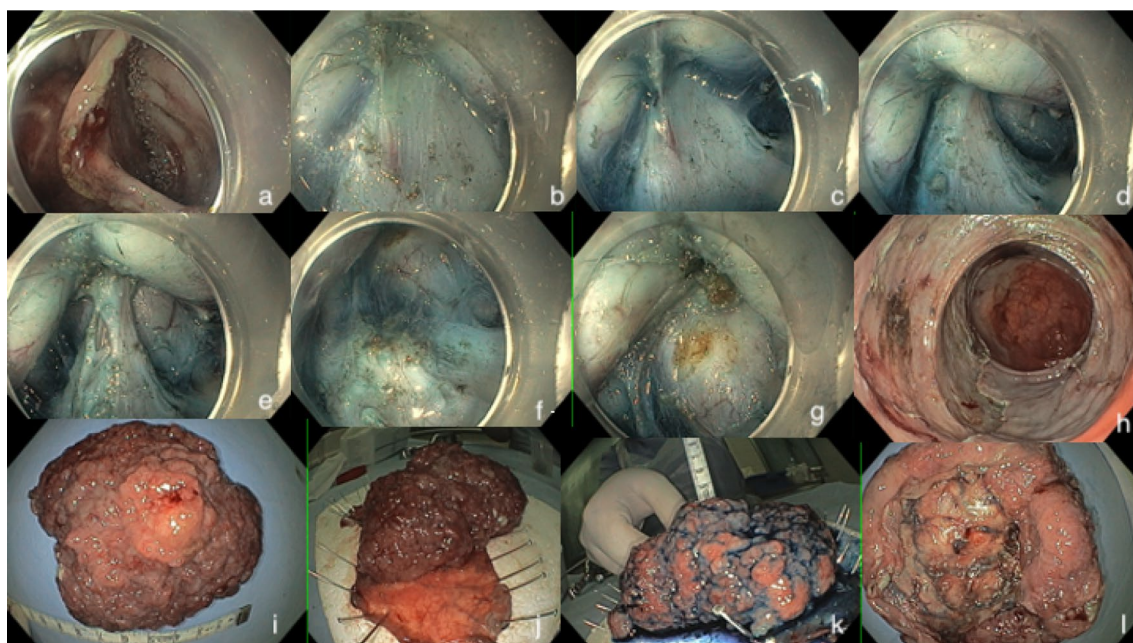
En bloc and R0 resection was reported in 16/18 (89%) of cases and with curative resection in 13/18 (72%) patients. One patient had a poorly differentiated T1bSM1 with a high budding score and two had more advanced (T1bSM3) lesions: one patient underwent transanal minimally invasive surgery due to massive muscle retraction and high risk of major intraprocedural bleeding, and the other patient underwent left hemicolectomy due to severely fibrotic MRS in a rectosigmoid junction lesion. No intraprocedural complications were reported. All patients were admitted,



**Fig. 1** Schematic representation of the described ESD technique. **a** Lateral view of the bowel. **b–d** Submucosal injection and long tunnel creation. **e, f** Altering gravitational traction and its effects on enhancement and attenuation of the muscle retraction. **g** Endoscopic view, facing the muscle retraction. **h** Dissection of the right side. **i** Dissection of the left side. **j** Dissection of the posterior side. **k** The

tip of the muscle retraction site where preventive coagulation current is applied. **l** Dissection completion with cutting current. **m** Pinned resected specimen, view from above, notice the mucosa stripe where tunneling was performed. **n** A corresponding picture of an actual specimen





**Fig. 2** Endoscopic images of a rectal MRS+ lesion resection. **a** Starting submucosal tunneling 5 cm distally to the polyp. **b** Facing muscle retracting sign (MRS+) with clear submucosal layer adjacent to retracting muscle layer. **c** Starting dissection from the right “slope” of the retracting muscle “mountain”. **d** Continuing with the dissection of the left side. **e** Completing the dissection of the back side and

coagulating the top. **f** Cutting at the top with release of the retraction. **g** Looking at the point of adhesion below the polyp. **h** Defect of the resection occupying 80% of the perimeter in the rectum. **i** A 10-cm resected protruding lesion. **j** 5 cm tunnel resected distally. **k** Resected polyp at an angle. **l** Resected polyp from behind

received a short course of antibiotics, and were discharged a few days later.

## Discussion

This pilot study proposes a novel ESD approach for MRS+ colorectal lesions. This method combines pocket creation methods (PCM), gravity management through stepwise patient position alteration, mobilization, and MRS site dissection. In the literature MRS lesions are known to impair endoscopic resection outcomes, but few reports exist on specific treatment modalities. Toyonaga et al. retrospectively compared ESD success rate and complication incidence based on MRS+ in a total of 357 colorectal lesions (329 MRS−/28 MRS+) [1]. Lower ESD success rates, en bloc (100% vs. 64.3%) and R0 resection (98.2% vs. 77.8%), were documented in MRS+ lesions in which also a higher, albeit not statistically significant, complication rate was observed. Additionally, ESD was aborted in 10 cases because of MRS. This study corroborates the lower ESD efficacy in MRS+ lesions when all procedures are carried out in the same manner, as no established technique is currently recommended for MRS+ lesions.

Hayashi et al. first described PCM as effective for an MRS+ colonic lesion [2]. Tanaka et al. retrospectively

compared 36 cases, 7 of which were completed using PCM versus conventional ESD [3]. PCM was associated with higher en bloc (100% vs. 48%) and R0 resection rates (71% vs. 31%). Albouys et al. also documented similar differences regarding en bloc (96.5% vs. 71.4%), R0 (85.6% vs. 61.9%), curative resection (81.3% vs. 41.6%), and surgery (45.2% vs. 6%) rates comparing MRS+ with MRS− lesions [4]. Furthermore, colonic MRS+ lesions had lower R0 resection rates compared to rectal MRS+ lesions (53% vs. 74.3%). Regarding the ESD method used, it is stated that all procedures were carried out by circumferential excision with traction application. Our results for en bloc, R0, and curative resections are 89%, 89%, and 72%, respectively. The discrepancies noted in Albouys et al.’ study between rectal and colonic lesions cannot be verified by our data (R0 resection was achieved in 3/3 of colon lesions in our sample).

It has been reported that deeper intermuscular dissection methods could be employed as potential alternatives to overcome resection challenges of MRS+ lesions [7, 10]. In this context, Toyonaga et al. evaluated the efficacy of intermuscular dissection for rectal MRS+ lesions in a case series of 10 lesions [5]. Peranal endoscopic myectomy demonstrated favorable results in efficacy and safety with successful treatment in 8/10 lesions without worsening the patients’ post-resection clinical course. There are few published reports

**Table 1** Characteristics of 18 MRS+ lesions in 18 patients who underwent endoscopic submucosal dissection (ESD) for colorectal neoplasms

Characteristic	N = 18
Sex	
Female	10 (56%)
Male	8 (44%)
Age (years)	71 (17)
Location	
Ascending	1 (5.6%)
Rectum	15 (83%)
Sigmoid	2 (11%)
Morphological type	
LST-GM	7 (39%)
Protruding lesion	11 (61%)
JNET type	
2A	9 (50%)
2B	8 (44%)
3	1 (5.6%)
Duration	148 ± 34
Polyp size	61 ± 17
Specimen size (mm)	82 ± 23
Resection	
R0	16 (89%)
En bloc	16 (89%)
Curative	13 (72%)
Histology	
High grade dysplasia	7 (39%)
Intramucosal cancer	7 (39%)
T1bSM1	1 (5.6%)
T1bSM2	1 (5.6%)
T1bSM3	2 (11%)
Depth of invasion (µm)	2125 ± 854
Surgery	
No	16 (89%)
Colectomy	1 (5.6%)
TAMIS	1 (5.6%)

Data are presented as *n* (%), median (IQR), or mean ± SD

*LST-GM* laterally spreading tumor–granular nodular mixed type, *JNET* Japan NBI expert team, *TAMIS* transanal minimally invasive surgery

for preemptive clip application at the muscle retraction area in order to prevent perforation and achieve R0 resection in MRS+ colonic lesions with good results [8, 9].

The current study demonstrates several strengths, including higher en bloc, R0, and curative resection rates compared to most previous studies, along with its prospective design. The method was successfully applied in both rectal and colonic bulky lesions, achieving a 100% success rate in the colon. Notably, this is the first time gravity exploitation, coagulation of feeding vessels at the MRS site tip, and

extended stabilization of submucosal tunnelling have been utilized for dissection of such lesions. No perforations or complications were documented. Furthermore, with a mean polyp size of  $61 \pm 17$  mm, the study reports an encouraging ESD success rate and surgery avoidance of up to 89%.

However, the study has some limitations. First, the small number of patients which can limit the statistical significance of the findings. Second, this is a single center study, which may introduce selection bias and overestimate the applicability of the results to other institutions or populations. Lastly, the study lacked an active comparison group, preventing a direct evaluation of the intervention's efficacy and safety relative to alternative approaches.

## Conclusion

In our case series we aim to determine an ESD method in MRS+ lesions that could achieve higher successful ESD resection rates without compromising safety. This case series demonstrates the efficacy of this technique, yielding satisfactory results in most cases—even those without curative resection. Nevertheless, while this technique is promising for these difficult lesions, additional evidence is needed to further validate this method and consolidate its efficacy.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s10151-025-03151-1>.

**Author contributions** G.T. and Y.K. conceptualized the idea. G.T. administrated the project, performed the resections and prepared Fig. 2. P.Z. performed the statistical analysis and table creation. P.Z. and K.D. wrote the main manuscript text. M.S. prepared Fig. 1. A.P., E.N., E.V., and D.D. obtained patient data, validated the results and performed routine communications to establish occurrence of complications. All authors reviewed the manuscript and accepted its final form.

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**Data availability** No datasets were generated or analysed during the current study.

## Declarations

**Conflict of interest** The authors declare no competing interests.

**Ethical approval** The study adhered to and was conducted according to the principles of the Declaration of Helsinki and current good clinical practice guidelines. The study was approved by the institutional ethics committee/scientific board. In accordance with internal hospital policy, all patients provided preoperative consent regarding the potential risks and complications of the procedure, as well as the use of their anonymized data for research purposes.

**Informed consent** All participants provided informed consent prior to their participation.

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