Practice pattern of Endoscopic Submucosal Dissection for Colorectal Tumors in Korea

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ABSTRACT

**Background/Aims:** Until now, the indication of colorectal endoscopic submucosal dissection (ESD) is not so concretely established in Korea. The purpose of the present study is to establish indication of colorectal ESD in Korea.

**Methods:** We sent questionnaires to 18 expert members of Korean Society of Gastrointestinal Endoscopy ESD study group and Korean Association for the Study of Intestinal Diseases between September 2013 and July 2014.

**Results:** ESD is indicated as follows: (1) for tumors (> 2 cm in diameter) in which en bloc EMR is difficult, high grade dysplasia, mucosal cancer, or shallowly submucosa-invading cancer by pre-procedural histology; granular mixed nodular type LSTs, nongranular LSTs, any LST with depressed area; tumor with pit pattern III, IV, V-i or NBI pattern II or IIIa; (2) partially non-lifted benign tumors with fibrosis, well-lifted or partially non-lifted shallow submucosa-invading cancers; (3) sporadic localized tumors in the background of chronic inflammation; and (4) rectal carcinoid tumors and GISTs (< 2 cm in diameter).

**Conclusions:** These questionnaire results seem to be broader than Japanese indications and may have reflected on the real practice situation in Korea. In the near future, standard indication of colorectal ESD should be established on the basis of nation-wide questionnaire survey.

**Keywords:** Colorectal; Endoscopic submucosal dissection; Korea
INTRODUCTION

A complete en bloc resection is possible with ESD (endoscopic submucosal dissection), irrespective of the size of the lesion.\textsuperscript{1,2} Multiple studies have shown high rates of successful neoplastic tissue resection and lower recurrence rates following ESD with en bloc resection compared with piecemeal EMR (endoscopic mucosal resection).\textsuperscript{3,4} And en bloc resection also facilitates clear pathologic evaluation for the resected margin. So, en bloc resection is preferred for all neoplastic lesions. However, there are disadvantages of ESD. The important disadvantages of ESD are risk of perforation, labor and time-intensiveness, and potentially high cost in comparison of piecemeal EMR. So we have to maintain balance between the advantages of ESD and its disadvantages.

When en bloc resection is technically difficult by conventional snare EMR, ESD or alternative method piecemeal EMR is considered. Setting up indication of colorectal ESD may be almost synonymous with balancing between piecemeal EMR and ESD.

The most critical problem of EPMR (endoscopic piecemeal mucosal resection) is a higher rate of local recurrence. Saito et al.\textsuperscript{3} reported that the local recurrence rate after EPMR was 14%, which was definitely higher than 2% after ESD. However the perforation rate by EPMR was 1.3% and was significantly lower than 6.2% by ESD. Other studies reporting local recurrence rates after EPMR varied from 10 to 50%.\textsuperscript{4-8}
As colorectal ESD is becoming more popular without standard indication of colorectal ESD in Korea, so we want to know how Korean doctors think about the indication of colorectal ESD. The purpose of the present study is to determine the current status of colorectal ESD and is to establish indication of colorectal ESD in Korea.
MATERIALS AND METHODS

We sent questionnaires to 27 expert members of Korean Society of Gastrointestinal Endoscopy ESD study group and Korean Association for the Study of Intestinal Diseases between September 2013 and July 2014. Eighteen doctors answered finally and half of them has an experience of colorectal ESD more than 100 cases.

The questions included in the survey were to choose preferred methods (EPMR, either EPMR or ESD, ESD, either ESD or surgery, surgery) in the following circumstances: (1) decision-making based on the pre-procedural clinical assessment of histology for treatment colorectal tumors larger than 2 cm in diameter; (2) decision-making based on the gross morphology for treatment colorectal tumors larger than 2 cm in diameter; (3) decision-making based on the presence of ulcer/depression for treatment colorectal tumors larger than 2 cm in diameter; (4) decision-making based on the pit pattern for treatment colorectal tumors larger than 2 cm in diameter; (5) decision-making based on the NBI (narrow band imaging) pattern for treatment colorectal tumors larger than 2 cm in diameter; (6) decision-making based on the non-lifting sign for treatment colorectal tumors larger than 2 cm in diameter; (7) sporadic localized tumors in the background of chronic inflammation; (8) local residual early colorectal cancer after endoscopic resection; and (9) the probability of ESD for treatment of the rectal subepithelial tumor.

Most colorectal tumors larger than 2 cm in diameter are called laterally spreading tumors (LST),
which are classified into two types according to their morphology, granular type (LST-G) and non-granular type (LST-NG). Each type has two subtypes. The former consists of a homogenous (LST-G-H) type and a nodular mixed (LST-G-NM) type, while the latter consists of a flat elevated (LST-NG-FE) type and a pseudodepressed (LST-NG-PD) type. Among LSTs, significantly higher malignancy rates with submucosal invasion was described for LST-NG as opposed to LST-G and was reported for LST-NG-PD, LST-G-MN in individual subtypes.\textsuperscript{9,10}

The Kudo pit pattern classification is most commonly used for differentiation of neoplasm as well as histological grading and depth evaluation of early cancers.\textsuperscript{11,12} Type I includes round pits that are observed in normal mucosa. Type II includes stellar or papillary pits, and these pits always indicate hyperplasia. Type III\textsubscript{S} includes small tubular or round pit that are smaller than normal pits, and they indicate neoplastic lesions, occasionally including carcinoma that can be resected by endoscopy. Type III\textsubscript{L} includes tubular or roundish pits that are larger than normal pits. Almost all of Type III\textsubscript{L} lesions are tubular adenomas in pathology, which can be treated by polypectomy. Type IV includes branch-like or gyrus-like pits, most of which are tubulovillous adenoma. Mucosal carcinoma is present in 35\% of these pits and can be treated by endoscopy. Type V-i includes irregularly arranged pits that may be submucosal invasive carcinoma, for which the proper treatment straddles the borderline between endoscopic and surgical therapy. Lastly, type V-N includes nonstructured pits, which indicate massive submucosal invasive carcinoma and require surgical resection with lymph node dissection.
Capillary patterns, as assessed by magnifying NBI, are also useful for differentiation of colorectal neoplasm, and they are highly accurate for distinguishing low grade dysplasia from high grade dysplasia/invasive cancer.\textsuperscript{13,14} Sano et al. classified 3 types and names of microvascular architectures based on the magnified NBI pattern.\textsuperscript{15} Type I has no meshed capillary vessels. Type II has meshed capillary vessels surrounding the mucosal glands. Type III lesions were further classified into 2 groups: types III\textsubscript{a} and III\textsubscript{b}. Type III\textsubscript{a} has irregular meshed capillary vessels, whereas irregular meshed capillary vessels disappear or loosen in type III\textsubscript{b}. Generally, types I, II, III\textsubscript{a}, and III\textsubscript{b} are observed in nonneoplastic lesions, adenomas, mucosal or slightly invasive submucosal carcinoma, and massive invasive submucosal carcinoma, respectively.

Lesion-lifted conditions are related to tumor pathology and the extent of tumor invasion, and they often correspond to particular macroscopic types of tumor.\textsuperscript{16} We classified the lesion-lifted condition at the time of submucosal fluid injection into 3 categories. A ‘well-lifted’ lesion is completely lifted by submucosal injection. A ‘partially non-lifted’ lesion is slightly lifted, but the surrounding mucosa lifts higher than the lesion. A ‘severely non-lifted’ lesion is not lifted, and only the surrounding mucosa is elevated. Whereas almost well-lifted lesions are found to be sm1 or shallower, partially non-lifted lesions range from sm1 to sm3, and most of the non-lifted lesions show to sm3 or deeper. sm1, sm2, sm3 are upper, middle, and lower thirds of the submucosal layer, respectively.\textsuperscript{17}

So suspect of invasion depth or histology for treatment colorectal tumors could be inferred from
the gross morphology, the pit pattern, the NBI pattern, and the non-lifting sign as mentioned above. The answer to each question was described in frequency analysis.
RESULTS

First question is, when you treat tumors larger than 2 cm, what would you prefer if pre-procedural clinical assessment of histology suggests as follows. When adenoma with low grade dysplasia is suspected, EPMR and ESD were similarly considered. 7 doctors (38.9%) preferred ‘EPMR or ESD’ than EPMR (6 doctors, 33.3%) or ESD (5 doctors, 27.8%). When high grade dysplasia was suspected, more doctors preferred ESD (10 doctors, 58.3%). Preference of ESD became more definite, when mucosal cancer was suspected. 14 doctors (77.8%) favored ESD. When shallowly submucosa-invading cancer was suspected, ESD was still mostly preferred (11 doctors, 61.1%), however, some doctors chose ‘ESD or surgery’ (4 doctors, 22.2%) or surgery (3 doctors, 16.7%). The summary is in Table 1. For Adenoma with low grade dysplasia, EPMR or ESD were preferred. However, from high grade dysplasia to shallowly submucosa-invading cancers, ESD was indicated.

Second question is about decision-making based on the gross morphology. For granular homogeneous type LST, EPMR and ESD were similarly considered. 7 doctors (38.9%) preferred ‘EPMR or ESD’. For granular and mixed nodular type LST, ESD (11 doctors, 61.1%) was preferred. For nongranular flat elevated type LST, 11 doctors (61.1%) preferred ESD. For nongranular pseudodepressed type LST, ESD was also preferred (12 doctors, 66.7%), and some doctors chose ‘ESD or surgery’ (4 doctors, 22.2%) or surgery (2 doctors, 11.1%). In summary, for granular homogeneous type LST, EPMR or ESD were similarly considered. For all the other type of LSTs
ESD was preferred (Table 2).

Third question is about decision-making based on the presence of ulcer or depression. For any LSTs with depressed IIc area, ESD was still preferred (10 doctors, 55.6%). However, when ulcer was observed in the LST, surgery was preferred (9 doctors, 50.0%). Table 3 is the summary.

Fourth question is about decision-making based on the pit pattern. For large tumors with pit pattern II, which is suggestive of hyperplastic polyp or serrated neoplasm, doctors chose EPMR and ESD similarly. 7 doctors (38.9%) favored ‘EPMR or ESD’, but EPMR (5 doctors, 27.8%) or ESD (6 doctors, 33.3%) was also preferred similarly. For pit pattern III or IV, which is suggestive of benign adenoma, ESD was preferred (10 doctors, 55.6%). For pit pattern V-i, which may indicate high grade dysplasia or mucosal cancer, most doctors preferred ESD (12 doctors, 66.7%). For the lesions with pit pattern V-N, surgery was preferred (9 doctors, 50.0%). However, significant portion of doctors would try ESD. 8 doctors (44.4%) chose ‘ESD or surgery’. There is the summary in Table 4. For the large tumors with pit pattern III, IV and V-i, ESD was preferred.

Fifth question is about decision-making based on the NBI pattern. For the large tumors with NBI pattern I, which may be suggestive of hyperplastic or serrated neoplasm, EPMR and ESD were similarly considered. 8 doctors (44.4%) preferred ‘EPMR or ESD’. 4 doctors (22.2%) chose EPMR and 6 doctors (33.3%) did ESD. For the NBI pattern II, ESD was preferred (10 doctors, 55.6%). For NBI pattern IIIa, which is suggestive of mucosal cancer, ESD was preferred (12 doctors, 66.7%). For
NBI pattern IIIb, ESD and surgery was similarly considered (10 doctors, 55.6%). The summary is in Table 5.

In addition, we considered other special situations.

Non-lifting sign is one of the major technical obstacles in endoscopic treatment. For partially non-lifted benign tumors with fibrosis, ESD was firstly considered (10 doctors, 55.6%). However, for severely non-lifted benign tumors with fibrosis, ESD and surgery were similarly considered. 5 doctors (27.8%) chose ‘ESD or surgery’. Also ESD (5 doctors, 27.8%) and surgery (5 doctors, 27.8%) were preferred equally. When shallow submucosa-invading cancer is suspected, but the tumor is well-lifted, 12 doctors (66.7%) preferred ESD. When the shallow submucosa-invading cancer is partially non-lifted, still ESD was firstly considered (9 doctors, 50.0%). Even though a tumor was suspected shallowly submucosa-invading cancer, severe non-lifting sign made doctors move to surgery (11 doctors, 61.1%). When a tumor is suspected massively submucosa-invading cancer, but lifted well, ESD and surgery are considered similarly (6 doctors, 33.3%). For partially non-lifted massively submucosa-invading cancers, surgery was preferred (12 doctors, 66.7%). For severely non-lifted massively submucosa-invading cancers, surgery was preferred, as well (16 doctors, 88.9%). So based on non-lifting sign, ESD was preferred for partially non-lifted lesions with benign fibrosis, shallow submucosa-invading cancer suspected with well-lifted and partially non-lifted sign (Table 6).
If sporadic localized tumors develop in the background chronic inflammation such as inflammatory bowel disease, ESD (10 doctors, 55.6%) was mostly preferred.

For local residual cancers after endoscopic resection, ESD (7 doctors, 38.9%) and surgery (8 doctors, 44.4%) was similarly considered.

Last question is whether ESD is one of the options for the treatment of rectal subepithelial tumors. For small rectal carcinoid tumors smaller than 2 cm, most doctors said, ‘probably yes’ (11 doctors, 61.1%), but not ‘definite yes’ (6 doctors, 33.3%). For rectal gastrointestinal stromal tumor (GIST) smaller than 2 cm, ESD was also considered as ‘probable’ indication (11 doctors, 61.1%), but not ‘definite’ indication (4 doctors, 22.2%). But ESD was not thought to be an indication for the treatment of rectal subepithelial tumors larger than 2 cm.
DISCUSSION

In conclusion, we summarize Korean doctors’ indication for colorectal ESD.

For tumors larger than 2 cm, in which en bloc EMR is difficult, ESD is indicated when pre-procedural clinical assessment of histology was suggestive of high grade dysplasia, mucosal cancer, or shallowly submucosa-invading cancer. Additionally, for granular mixed nodular type LSTs, nongranular LSTs, any LST with depressed area (IIc), and the tumor with pit pattern III, IV, V-i or NBI pattern II or IIIa, ESD is indicated. For partially non-lifted benign tumors with fibrosis, well-lifted shallow submucosa-invading cancers, partially non-lifted shallow submucosa-invading cancers, ESD is also indicated. Sporadic localized tumor in the background of chronic inflammation is another indication of colorectal ESD. For rectal carcinoid tumors and GISTs smaller than 2 cm in diameter, ESD is probably indicated (Table 7).

As we noted above, Korean consensus indications seem to be broader than Japanese indications (Table 8). In comparison with Japanese indications, many Korean doctors tend to include more benign-looking tumors in ESD indication. There are many advantages of colorectal ESD as follows: its minimal invasiveness; curative potential with decreased the risk of local tumor recurrence; performing en bloc resection and providing an accurate histopathological diagnosis. Also, various devices, peripheral equipment, and techniques for colorectal ESD have been developed. By gaining experience in performing colorectal ESD procedures, these indications might be more
expanded. We think indication of colorectal ESD should be made more strictly to prevent unnecessary abuse because of its technical difficulty with the risk of complications and its longer procedure time.

An important limitation of this study was that only 18 doctors answered the questionnaire. In spite of this limitation, these questionnaire results may have reflected on the real practice situation in Korea. Further studies included more participants are needed.

Colorectal ESD was introduced in Korea around 2003. Despite its brief history, colorectal ESD has been performed to some level in major training hospitals and specialized colorectal hospitals in Korea, especially for rectal LST. In the near future, we hope that nation-wide questionnaire survey should be conducted to analyze the actual situation of colorectal ESD and standard indication of colorectal ESD should be established on the basis of the surveys.
CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

ACKNOWLEDGMENTS

We would like to especially thank 18 expert members of Korean Society of Gastrointestinal Endoscopy ESD study group and Korean Association for the Study of Intestinal Diseases for supporting this research survey.
REFERENCES


Table 1.

EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection

Table 2.

LST, laterally spreading tumor; EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection

Table 3.

LST, laterally spreading tumor; EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection

Table 4.

LST, laterally spreading tumor; EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection

Table 5.

NBI, narrow band imaging; EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection

Table 6.
EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection

Table 7.

LST-NG, laterally spreading tumor-nongranular type; LST-G-MN, laterally spreading tumor-granular-mixed nodular type; LST, laterally spreading tumor; GIST, gastrointestinal stromal tumor

Table 8.

EMR, endoscopic mucosal resection; ESD, endoscopic submucosal dissection; LST-NG, laterally spreading tumor-nongranular type.
Table 1. Decision-making based on the pre-procedural assessment of histology for the treatment of tumors larger than 2 cm in diameter

<table>
<thead>
<tr>
<th>Pre-procedural assessment of histology</th>
<th>Preferred treatment</th>
<th>EPMR (%)</th>
<th>EPMR or ESD (%)</th>
<th>ESD (%)</th>
<th>ESD or Surgery (%)</th>
<th>Surgery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenoma with low grade dysplasia</td>
<td>EPMR or ESD</td>
<td>6 (33.3%)</td>
<td>7 (38.9%)</td>
<td>5 (27.8%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Adenoma with high grade dysplasia</td>
<td>ESD</td>
<td>5 (27.8%)</td>
<td>3 (16.7%)</td>
<td>10 (58.3%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mucosal cancer</td>
<td>ESD</td>
<td>1 (5.6%)</td>
<td>1 (5.6%)</td>
<td>14 (77.8%)</td>
<td>2 (11.1%)</td>
<td>-</td>
</tr>
<tr>
<td>Shallowly submucosa-invading cancer</td>
<td>ESD</td>
<td>-</td>
<td>-</td>
<td>11 (61.1%)</td>
<td>4 (22.2%)</td>
<td>3 (16.7%)</td>
</tr>
</tbody>
</table>

EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection

Table 2. Decision-making based on the gross morphology for the treatment of LSTs larger than 2 cm in diameter

<table>
<thead>
<tr>
<th>Morphologic type of LSTs</th>
<th>Preferred treatment</th>
<th>EPMR (%)</th>
<th>EPMR or ESD (%)</th>
<th>ESD (%)</th>
<th>ESD or Surgery (%)</th>
<th>Surgery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LST-granular-homogeneous type</td>
<td>EPMR or ESD</td>
<td>4 (22.2%)</td>
<td>7 (38.9%)</td>
<td>7 (38.9%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LST-granular-mixed nodular type</td>
<td>ESD</td>
<td>2 (11.1%)</td>
<td>4 (22.2%)</td>
<td>11 (61.1%)</td>
<td>1 (5.6%)</td>
<td>-</td>
</tr>
<tr>
<td>LST-nongranular-flat elevated type</td>
<td>ESD</td>
<td>-</td>
<td>7 (38.9%)</td>
<td>11 (61.1%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LST-nongranular-pseudodepressed type</td>
<td>ESD</td>
<td>-</td>
<td>-</td>
<td>12 (66.7%)</td>
<td>4 (22.2%)</td>
<td>2 (11.1%)</td>
</tr>
</tbody>
</table>

LST, laterally spreading tumor; EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection

Table 3. Decision-making based on the presence of depression/ulcer for the treatment of LSTs larger than 2 cm in diameter

<table>
<thead>
<tr>
<th>Presence of depression or ulcer</th>
<th>Preferred treatment</th>
<th>EPMR (%)</th>
<th>EPMR or ESD (%)</th>
<th>ESD (%)</th>
<th>ESD or Surgery (%)</th>
<th>Surgery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any LSTs with depressed area (IIc)</td>
<td>ESD</td>
<td>-</td>
<td>-</td>
<td>10 (55.6%)</td>
<td>6 (33.3%)</td>
<td>2 (11.1%)</td>
</tr>
<tr>
<td>Any LSTs with ulcer</td>
<td>Surgery</td>
<td>-</td>
<td>-</td>
<td>4 (22.2%)</td>
<td>5 (27.8%)</td>
<td>9 (50.0%)</td>
</tr>
</tbody>
</table>

LST, laterally spreading tumor; EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection
Table 4. Decision-making based on the pit pattern for the treatment of tumors larger than 2 cm in diameter

<table>
<thead>
<tr>
<th>Pit pattern</th>
<th>Preferred treatment</th>
<th>EPMR (%)</th>
<th>EPMR or ESD (%)</th>
<th>ESD (%)</th>
<th>ESD or ESD (%)</th>
<th>Surgery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>EPMR or ESD</td>
<td>5 (27.8%)</td>
<td>7 (38.9%)</td>
<td>6 (33.3%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>III or IV</td>
<td>ESD</td>
<td>3 (16.7%)</td>
<td>5 (27.8%)</td>
<td>10 (55.6%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>V-i</td>
<td>ESD</td>
<td>-</td>
<td>-</td>
<td>12 (66.7%)</td>
<td>4 (22.2%)</td>
<td>2 (11.1%)</td>
</tr>
<tr>
<td>V-N</td>
<td>Surgery (ESD or surgery)</td>
<td>-</td>
<td>-</td>
<td>1 (5.6%)</td>
<td>8 (44.4%)</td>
<td>9 (50.0%)</td>
</tr>
</tbody>
</table>

LST, laterally spreading tumor; EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection

Table 5. Decision-making based on the NBI pattern for the treatment of tumors larger than 2 cm in diameter

<table>
<thead>
<tr>
<th>NBI pattern</th>
<th>Preferred treatment</th>
<th>EPMR (%)</th>
<th>EPMR or ESD (%)</th>
<th>ESD (%)</th>
<th>ESD or ESD (%)</th>
<th>Surgery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>EPMR or ESD</td>
<td>4 (22.2%)</td>
<td>8 (44.4%)</td>
<td>6 (33.3%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>II</td>
<td>ESD</td>
<td>2 (11.1%)</td>
<td>6 (33.3%)</td>
<td>10 (55.6%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>IIIa</td>
<td>ESD</td>
<td>-</td>
<td>1 (5.6%)</td>
<td>12 (66.7%)</td>
<td>3 (16.7%)</td>
<td>2 (11.1%)</td>
</tr>
<tr>
<td>IIIb</td>
<td>ESD or surgery</td>
<td>-</td>
<td>-</td>
<td>2 (11.1%)</td>
<td>10 (55.6%)</td>
<td>6 (33.3%)</td>
</tr>
</tbody>
</table>

NBI, narrow band imaging; EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection

Table 6. Decision-making based on the non-lifting sign for the treatment of tumors of any size

<table>
<thead>
<tr>
<th>Non-lifting sign</th>
<th>Preferred treatment</th>
<th>EPMR (%)</th>
<th>EPMR or ESD (%)</th>
<th>ESD (%)</th>
<th>ESD or ESD (%)</th>
<th>Surgery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partially non-lifted benign lesions with fibrosis</td>
<td>ESD</td>
<td>2 (11.1%)</td>
<td>4 (22.2%)</td>
<td>10 (55.6%)</td>
<td>2 (11.1%)</td>
<td>-</td>
</tr>
<tr>
<td>Severely non-lifted benign lesions with fibrosis</td>
<td>ESD or surgery</td>
<td>1 (5.6%)</td>
<td>2 (11.1%)</td>
<td>5 (27.8%)</td>
<td>5 (27.8%)</td>
<td>5 (27.8%)</td>
</tr>
<tr>
<td>Shallow submucosa-invading cancer suspected, but well-lifted</td>
<td>ESD</td>
<td>1 (5.6%)</td>
<td>2 (11.1%)</td>
<td>12 (66.7%)</td>
<td>2 (11.1%)</td>
<td>1 (5.6%)</td>
</tr>
<tr>
<td>Shallow submucosa-invading cancer</td>
<td>ESD</td>
<td>1 (5.6%)</td>
<td>-</td>
<td>9 (50.0%)</td>
<td>5 (27.8%)</td>
<td>3 (16.7%)</td>
</tr>
</tbody>
</table>
suspected, & partially non-lifted

Shallow submucosa-invading cancer suspected, & severely non-lifted

Massively submucosa-invading cancer suspected, but well-lifted

Massively submucosa-invading cancer suspected, & partially non-lifted

Massively submucosa-invading cancer suspected, & severely non-lifted

Surgery - - 3 (16.7%) 4 (22.2%) 11 (61.1%)  

ESD or surgery 1 (5.6%) 1 (5.6%) 5 (27.8%) 6 (33.3%) 5 (27.8%)  

Surgery - 1 (5.6%) 2 (11.1%) 3 (16.7%) 12 (66.7%)  

Surgery - - - 2 (11.1%) 16 (88.9%)  

EPMR, endoscopic piecemeal mucosal resection; ESD, endoscopic submucosal dissection

Table 7. Indication of colorectal endoscopic submucosal dissection for colorectal tumors in Korea

1. Large sized tumors (> 2 cm in diameter) in which en bloc EMR is difficult

   High grade dysplasia, mucosal cancer, or shallowly submucosa-invading cancer

   by pre-procedural clinical assessment of histopathology

   LST-NG, LST-G-MN, any LST with depressed area

   Tumor with III, IV, Vi type pit pattern or II, IIIa type NBI pattern.

2. Tumors with non-lifting sign

   Partially non-lifted benign tumors with fibrosis

   Shallow submucosa-invading cancer suspected, but well-lifted

   Shallow submucosa-invading cancer suspected, & partially non-lifted

3. Sporadic localized tumors in the background of chronic inflammation such as ulcerative colitis

4. Rectal carcinoid tumors and GISTs (< 2 cm in diameter)

LST-NG, laterally spreading tumor-nongranular type; LST-G-MN, laterally spreading tumor-granular-mixed nodular type; LST, laterally spreading tumor; GIST, gastrointestinal stromal tumor
Table 8. Indication of endoscopic submucosal dissection for colorectal tumor by colorectal ESD standardization implementation working group in Japan

1. Large sized (> 2 cm in diameter) lesions in which en bloc resection using snare EMR is difficult, although it is indicative for endoscopic treatment
   LST-NG, particularly those of the pseudo-depressed type
   Lesions showing Vi type pit pattern in Kudo's classification
   Carcinoma with submucosal infiltration
   Large depressed type lesion
   Large elevated lesion suspected to be carcinoma

2. Mucosal lesions with fibrosis caused by prolapse due to biopsy or peristalsis of the lesions

3. Sporadic localized tumors in chronic inflammation such as ulcerative colitis

4. Local residual early carcinoma after endoscopic resection

EMR, endoscopic mucosal resection; ESD, endoscopic submucosal dissection; LST-NG, laterally spreading tumor-nongranular type