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Original Article

Survey of the Actual Practices Used for Endoscopic Removal of Colon Polyps in Korea: A Comparison with the Current Guidelines

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Background/Aims: We investigated the clinical practice patterns of Korean endoscopists for the endoscopic resection of colorectal polyps.

Methods: From September to November 2021, an online survey was conducted regarding the preferred resection methods for colorectal polyps, and responses were compared with the international guidelines.

Results: Among 246 respondents, those with <4 years, 4–9 years, and ≥10 years of experience in colonoscopy practices accounted for 25.6%, 34.1%, and 40.2% of endoscopists, respectively. The most preferred resection methods for non-pedunculated lesions were cold forceps polypectomy for ≤3 mm lesions (81.7%), cold snare polypectomy for 4–5 mm (61.0%) and 6–9 mm (43.5%) lesions, hot endoscopic mucosal resection (EMR) for 10–19 mm lesions (72.0%), precut EMR for 20–25 mm lesions (22.0%), and endoscopic submucosal dissection (ESD) for ≥26 mm lesions (29.3%). Hot EMR was favored for pedunculated lesions with a head size <20 mm and stalk size <10 mm (75.6%) and for those with a head size ≥20 mm or stalk size ≥10 mm (58.5%). For suspected superficial and deep submucosal lesions measuring 10–19 mm and ≥20 mm, ESD (26.0% and 38.6%) and surgery (36.6% and 46.3%) were preferred, respectively. The adherence rate to the guidelines ranged from 11.2% to 96.9%, depending on the size, shape, and histology of the lesions.

Conclusions: Adherence to the guidelines for endoscopic resection techniques varied depending on the characteristics of colorectal polyps. Thus, an individualized approach is required to increase adherence to the guidelines. **(Gut Liver 2025;19:77-86)**

Key Words: Colonic polyps; Endoscopic mucosal resection; Endoscopic submucosal dissection; Polypectomy

INTRODUCTION

Colorectal cancer ranks high among cancers in incidence and is one of the leading causes of cancer mortality worldwide, with approximately 2 million new cases and 1 million deaths estimated in 2020.[1,2] In 2019, the crude incidence and mortality of colorectal cancer in Korea were 56.5 and 17.3 per 100,000 persons, respectively, ranking fourth and third among all cancers, respectively.[3] Colonoscopic polypectomy is a reliable method for reducing the incidence and mortality of colorectal cancer by removing precancerous lesions.[4-6]

The technique chosen for polypectomy is primarily determined by factors such as lesion location, size, shape, and histology.[7] However, colonoscopic polypectomy can lead to complications such as bleeding, perforation, and post-polypectomy electrocoagulation.[8] In addition, post-colonoscopy colon cancer can occur when lesions are incompletely removed, and incomplete resection rates vary from 6.5% to 22.7%, depending on the operator's skill.[7,9] Revised international guidelines were published in 2020 to help clinicians safely and completely perform colonoscopic polypectomy, but no study has investigated the actual practice patterns of Korean endoscopists in various colorectal polyp scenarios since 2011.[7,10,11]

Therefore, we surveyed Korean endoscopists nationwide about their preferred methods for resecting colorectal lesions according to their shape and size, as well as the preferred measures for performing prophylactic hemostasis prior to the resection of large pedunculated lesions. Additionally, we surveyed the endoscopists on their methods for predicting the histology of lesions before resection.

MATERIALS AND METHODS

1. Survey method and survey participants

The content of this survey was reviewed and revised by the International Tumor Research Group of the Korean Association for the Study of Intestinal Diseases (KASID) (Supplementary Material 1). The survey questionnaire asked endoscopists about their preferred resection techniques in various polyp scenarios, prophylactic measures they used before resecting large pedunculated lesions, and their methods for predicting the histology of colorectal lesions. An invitation email, which included the subject, duration, purpose, URL of the survey, and estimated completion time, was sent twice to all registered KASID members (n=1,452). The survey was conducted from September to November 2021. Only those who agreed to participate in the survey could access the survey content, and all respondents who completed the survey were included in the analysis. The response data were securely stored in an encrypted database using the electronic survey tool (SurveyMonkey, San Mateo, CA, USA). If multiple responses were detected from the same IP address, only the initial response was included in the final analysis. The study protocol was approved by the Institutional Review Board of Keimyung University Dongsan Hospital (IRB number: 2019-1510). Informed consents were obtained from all participants.

2. Data collection and outcome measures

Demographic information was obtained about the respondents: sex, age group, endoscopist specialty, colonoscopy experience, and number of colonoscopies and polypectomies performed per month. Practice hospitals were categorized as follows: a primary facility for a primary outpatient clinic, a secondary facility for a hospital or general hospital, and a tertiary facility for a specialized general hospital or academic hospital. Clinical polyp scenarios were developed based on previous guidelines of the U.S. Multi-Society Task Force (USMSTF) on colorectal cancer and the European Society of Gastrointestinal Endoscopy (ESGE).[7,10] Diminutive (≤5 mm) lesions were classified as less than 3 mm and 4–5 mm, and lesions >10 mm were classified as 10–19 mm, 20–25 mm, and 26 mm or larger. We used a standard for stalk thickness of 10 mm for pedunculated lesions according to ESGE guidelines.[10] Lesions suspected of submucosal invasion were subdivided as 10–19 mm and 20 mm or larger. Except for polyp scenarios in which superficial or deep submucosal invasion was suspected, all pedunculated and non-pedunculated lesions were assumed to be noninvasive lesions. The polyp resection techniques that could be applied in each scenario were cold forceps polypectomy (CFP), cold or hot snare polypectomy (CSP or HSP) without submucosal injection, cold or hot endoscopic mucosal resection (EMR) with submucosal injection, precut EMR, endoscopic submucosal dissection (ESD), hybrid ESD, and surgery. Precut EMR was defined as injecting submucosal fluid around the polyp, creating a circumferential incision in the surrounding mucosa, and then removing the polyp with a snare.[12] Hybrid ESD involves snaring a polyp after making a circumferential incision and submucosal dissection to a certain extent using an ESD knife.[13,14] Dye chromoendoscopy is a traditional method for characterizing colorectal polyps using dye during a standard endoscopy, and equipment-based image-enhanced endoscopy (IEE) refers to virtual chromoendoscopy, which uses various technologies such as narrow-band imaging, Fuji intelligent color enhancement, and i-Scan.[15,16]

3. Statistical analysis

All responses were analyzed using descriptive statistics, and adherence to published international guidelines from the USMSTF and the ESGE was assessed.[7,10] The relationship between adherence to the guidelines and clinical variables was evaluated using univariate logistic regression analyses for lesions with adherence rates <60%. A two-sided p-value <0.05 was considered statistically significant. All statistical analyses were performed in R statistical software (version 4.1.2; R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

1. Clinical characteristics of respondents

A total of 246 endoscopists (16.9%) completed the questionnaire about resection techniques in various clinical polyp scenarios. Of the respondents, 76.0% (n=187) were men, and 41.9%, 41.5%, and 16.7% were <40 years, 40–49 years, and 50–69 years old, respectively (Table 1). Most respondents reported specializing in gastroenterology (96.7%), and 90.7% were certified gastrointestinal endoscopists. The percentages working in primary, secondary, and tertiary facilities were 22.4% (n=55), 21.5% (n=53), and 56.1% (n=138), respectively. Their colonoscopy experience was <4 years, 4–9 years, and ≥10 years in 25.6% (n=63), 34.1% (n=84), and 40.2% (n=99) of respondents, respectively. The average number of polyps resected per month was <50 polyps, 50–99 polyps, and ≥100 polyps in 44.7% (n=110), 29.7% (n=73), and 25.6% (n=63), respectively.

2. Preferred resection techniques for benign non-pedunculated and pedunculated lesions

For non-pedunculated lesions of ≤3 mm and 4–5 mm, CFP (81.7%, n=201) and CSP (61.0%, n=150) were the preferred resection techniques, whereas CSP (43.5%, n=107) or hot EMR (39.4%, n=97) was preferred for lesions of 6–9 mm (Table 2). Hot EMR was the preferred resection technique for a non-pedunculated lesion of 10–19 mm (72.0%, n=177), whereas precut EMR (22.0%, n=54) or hot EMR (20.3%, n=50) was preferred for a lesion of 20–25 mm. A lesion ≥26 mm was most often resected with ESD (29.3%, n=72).

When resecting a pedunculated polyp with a head <20 mm and stalk thickness <10 mm, 57.7% (n=142) of respondents used clips for prophylactic hemostasis, and 38.6% (n=95) reported taking no prophylactic measures (Fig. 1). For a polyp with a head ≥20 mm or stalk thickness ≥10 mm, clips (53.3%, n=131) or a detachable snare (32.5%, n=80) were used for prophylactic hemostasis. Hot EMR was the preferred resection technique for pedunculated polyps regardless of size: 75.6% (n=186) for a polyp with a head <20 mm and stalk thickness <10 mm and 58.5% (n=144) for a polyp with a head ≥20 mm or stalk thickness ≥10 mm.

3. Preferred polyp characterization methods and resection techniques for suspected submucosal cancer

When asked about characterizing the depth of invasion before resection, 9.8% (n=24) of the respondents said that they used white-light imaging alone, with equipment-based IEE always used by 32.5% (n=80) and used as needed by 52.8% (n=130) of respondents (Fig. 2). Only 2.4% (n=6) and 10.6% (n=26) used dye chromoendoscopy always and as needed, respectively.

When resecting a non-pedunculated superficial submucosal cancer, ESD (26.0%, n=64) or hot EMR (21.5%, n=53) was preferred for lesions of 10–19 mm, and ESD (38.6%, n=95) was preferred for a lesion ≥20 mm (Table 3). For deep submucosal cancer, surgery was preferred for lesions of 10–19 mm (36.6%, n=90) or ≥20 mm (46.3%, n=114).

Table 1. Baseline Characteristics of the Respondents (n=246)

Characteristic	No. (%)
Sex	
Male	187 (76.0)
Female	59 (24.0)
Age	
<40 yr	103 (41.9)
40–49 yr	102 (41.5)
50–69 yr	41 (16.7)
Specialty	
Gastroenterology	238 (96.7)
Others*	8 (3.3)
Practice hospital	
Primary facility	55 (22.4)
Secondary facility	53 (21.5)
Tertiary facility	138 (56.1)
Years in colonoscopy practice	
<4 yr	63 (25.6)
4–9 yr	84 (34.1)
≥10 yr	99 (40.2)
No. of colonoscopies performed per mo	
<50	74 (30.1)
50–99	97 (39.4)
≥100	75 (30.5)
No. of polypectomies performed per mo	
<50	110 (44.7)
50–99	73 (29.7)
≥100	63 (25.6)

*Others: general surgery (n=5), pediatrics (n=1), family medicine (n=1), and internal medicine other than gastroenterology (n=1).

Table 2. Preferred Resection Techniques for Benign Non-pedunculated and Pedunculated Lesions (n=246)

Variable	Non-pedunculated lesions						Pedunculated lesions	
	≤3 mm	4–5 mm	6–9 mm	10–19 mm	20–25 mm	≥26 mm	Head <20 mm and stalk thickness <10 mm	Head ≥20 mm or stalk thickness ≥10 mm
CFP	201 (81.7)	60 (24.4)	4 (1.6)	1 (0.4)	1 (0.4)	1 (0.4)	1 (0.4)	1 (0.4)
CSP	34 (13.8)	150 (61.0)	107 (43.5)	4 (1.6)	-	-	5 (2.0)	-
HSP	4 (1.6)	5 (2.0)	7 (2.8)	7 (2.8)	1 (0.4)	1 (0.4)	26 (10.6)	15 (6.1)
Cold EMR	2 (0.8)	12 (4.9)	31 (12.6)	17 (6.9)	3 (1.2)	-	6 (2.4)	3 (1.2)
Hot EMR	5 (2.0)	19 (7.7)	97 (39.4)	177 (72.0)	50 (20.3)	14 (5.7)	186 (75.6)	144 (58.5)
Precut EMR	-	-	-	17 (6.9)	54 (22.0)	17 (6.9)	4 (1.6)	9 (3.7)
Piecemeal EMR	-	-	-	5 (2.0)	25 (10.2)	32 (13.0)	2 (0.8)	3 (1.2)
ESD	-	-	-	1 (0.4)	31 (12.6)	72 (29.3)	3 (1.2)	9 (3.7)
Hybrid ESD	-	-	-	-	7 (2.8)	9 (3.7)	-	1 (0.4)
Surgery	-	-	-	-	-	-	-	1 (0.4)
Referral for removal	-	-	-	17 (6.9)	74 (30.1)	100 (40.7)	13 (5.3)	60 (24.4)

Data are presented as number (%).
CFP, cold forceps polypectomy; CSP, cold snare polypectomy; HSP, hot snare polypectomy; EMR, endoscopic resection technique; ESD, endoscopic submucosal dissection.

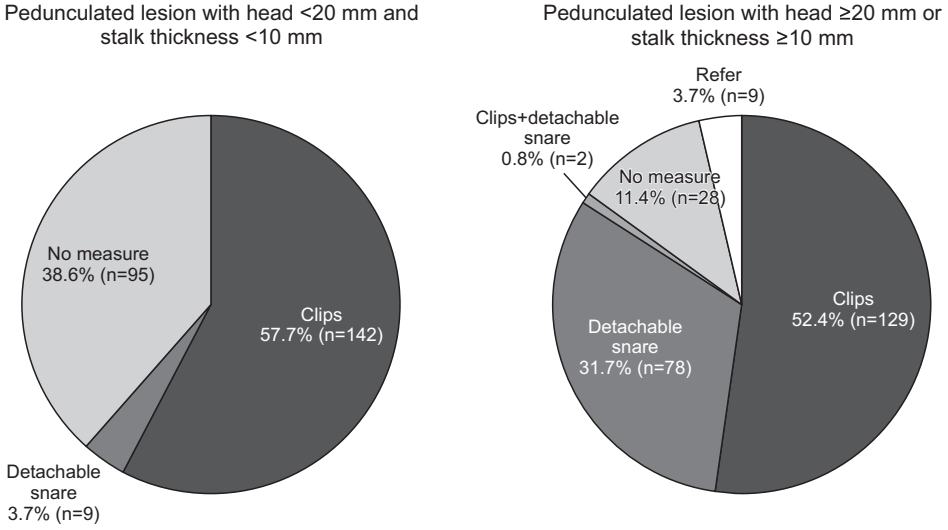

Fig. 1. Prophylactic hemostasis during endoscopic resection of a pedunculated polyp.

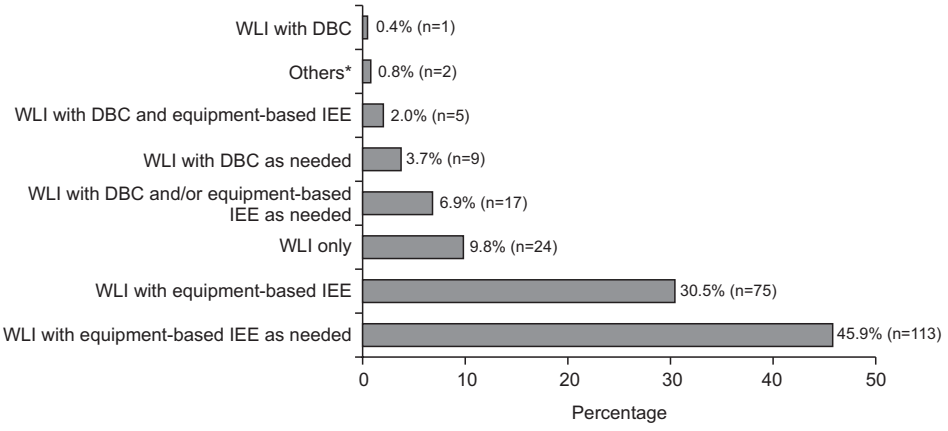

Fig. 2. Preferred methods for polyp characterization before endoscopic resection. WLI, white light imaging; DBC, dye-based chromoendoscopy; IEE, image-enhanced endoscopy. *Two participants reported predicting polyp histology by observing the lifting sign after submucosal fluid injection.

4. Adherence to international guidelines

The rates of adherence to the USMSTF and ESGE guidelines,[7,10] which recommend CSP for non-pedunculated lesions, were as follows: ≤3 mm, 13.8% (n=34/246); 4–5 mm, 61.0% (n=150/246); and 6–9 mm, 43.5% (n=107/246) (Table 4). For the recommendation to perform EMR for

Table 3. Preferred Resection Techniques for Suspected Superficial and Deep Submucosal Lesions (n=246)

Variable	Suspected superficial submucosal invasion		Suspected deep submucosal invasion	
	10–19 mm	≥20 mm	10–19 mm	≥20 mm
CFP	1 (0.4)	1 (0.4)	1 (0.4)	1 (0.4)
CSP	1 (0.4)	-	1 (0.4)	-
HSP	2 (0.8)	2 (0.8)	-	1 (0.4)
Cold EMR	2 (0.8)	-	-	-
Hot EMR	53 (21.5)	14 (5.7)	6 (2.4)	3 (1.2)
Precut EMR	26 (10.6)	6 (2.4)	3 (1.2)	1 (0.4)
Piecemeal EMR	-	1 (0.4)	1 (0.4)	-
ESD	64 (26.0)	95 (38.6)	37 (15.0)	18 (7.3)
Hybrid ESD	6 (2.4)	7 (2.8)	3 (1.2)	-
Surgery	2 (0.8)	10 (4.1)	90 (36.6)	114 (46.3)
Referral for removal	89 (36.2)	110 (44.7)	104 (42.3)	108 (43.9)

Data are presented as number (%).
CFP, cold forceps polypectomy; CSP, cold snare polypectomy; HSP, hot snare polypectomy; EMR, endoscopic resection technique; ESD, endoscopic submucosal dissection.

Table 4. Adherence to International Guidelines in Various Polyp Scenarios

Size	USMSTF[7]		ESGE[10]	
	Adherence*	Resection methods	Adherence*	Resection methods
Non-pedunculated lesion				
Noninvasive lesion				
≤3 mm	13.8 (34/246)	CSP	13.8 (34/246)	CSP
4–5 mm	61.0 (150/246)	CSP	61.0 (150/246)	CSP
6–9 mm	43.5 (107/246)	CSP	43.5 (107/246)	CSP
10–19 mm	96.9 (222/229)	CSP or HSP or cold EMR or hot EMR or precut EMR	87.8 (201/229)	HSP or hot EMR or precut EMR
20–25 mm	75.0 (129/172)	Hot EMR or precut EMR or piecemeal EMR	75.0 (129/172)	Hot EMR or precut EMR or piecemeal EMR
≥26 mm	43.2 (63/146)	Hot EMR or precut EMR or piecemeal EMR	43.2 (63/146)	Hot EMR or precut EMR or piecemeal EMR
Superficial submucosal invasion				
10–19 mm	94.9 (149/157)	Hot EMR or precut EMR or ESD or hybrid ESD	96.2 (151/157)	Hot EMR or precut EMR or ESD or hybrid ESD or surgery
≥20 mm	89.7 (122/136)	Hot EMR or precut EMR or ESD or hybrid ESD	82.4 (112/136)	ESD or hybrid ESD or surgery
Deep submucosal invasion				
10–19 mm	63.4 (90/142)	Surgery	63.4 (90/142)	Surgery
≥20 mm	82.6 (114/138)	Surgery	82.6 (114/138)	Surgery
Pedunculated lesion				
Head size <20 mm and stalk thickness <10 mm	NA†	HSP	11.2 (26/233)	HSP
Head size ≥20 mm or stalk thickness ≥10 mm	NA†	HSP	84.4 (157/186)	Hot EMR or HSP with prophylactic mechanical hemostasis

Data are presented as % (number/number).
USMSTF, United States Multi-Society Task Force on Colorectal Cancer; ESGE, European Society of Gastrointestinal Endoscopy; CSP, cold snare polypectomy; HSP, hot snare polypectomy; EMR, endoscopic resection technique; ESD, endoscopic submucosal dissection; NA, not applicable.
*The adherence rate was calculated as the proportion who preferred resection techniques recommended in the international guidelines, excluding those who selected "refer"; †Due to differences in the recommended standard for stalk thickness of a pedunculated lesion between USMSTF and ESGE guidelines, we were unable to obtain adherence rates to USMSTF guidelines; our survey used the ESGE standard of 10 mm.

a non-pedunculated lesion of 20–25 mm, the adherence rate was 75.0% (n=129/172) after excluding responses of "referral." Regarding surgery for deep submucosal cancer, the adherence rates were 63.4% (n=90/142) for 10–19 mm lesions and 82.6% (n=114/138) for ≥ 20 mm lesions. The adherence rates to the USMSTF and ESGE guidelines varied slightly: 96.9% (222/229) and 87.8% (201/222) for a non-pedunculated lesion of 10–19 mm, 94.9% (149/157)

and 96.2% (151/157) for superficial submucosal cancer of 10–19 mm, and 89.7% (122/136) and 82.4% (112/136) for superficial submucosal cancer ≥20 mm, respectively. The adherence rates to the ESGE recommendation[10] were 11.2% (26/233) for pedunculated lesions with a head <20 mm and stalk thickness <10 mm and 84.4% (157/186) for lesions with a head ≥20 mm or stalk thickness ≥10 mm.

5. Univariate analyses of factors affecting adherence to the guidelines

For a non-pedunculated lesion ≤3 mm, age ≥50 years, ≥10 years of colonoscopy experience, and performing ≥100 colonoscopies per month were associated with the selection of a resection method other than CSP (Table 5). However, no significant variables were found to correlate with guideline adherence for a lesion of 6–9 mm. On the other hand, higher adherence to guidelines in resecting non-pedunculated lesions ≥26 mm was observed among women and endoscopists working at primary or secondary centers. When dealing with a pedunculated lesion with a head size <20 mm and stalk thickness <10 mm, age ≥50 years was associated with a preference for HSP (Supplementary Table 1).

DISCUSSION

In this survey, we observed disparities between the preferred resection methods reported by clinicians and the recommendations of international guidelines, and those disparities varied with the polyp characteristics. Specifically, the preference for CSP to remove a non-pedunculated lesion under 10 mm was relatively low, and hot EMR with a submucosal saline injection and prophylactic hemostasis was the preferred approach for large pedunculated lesions. Additionally, clinicians tended to use equipment-based IEE always or as needed to characterize a lesion before resection.

In a survey of U.S. gastroenterologists (n=285) conducted in the early 2000s, the most preferred resection methods for lesions of 1–3 mm and 7–9 mm were CFP (50.3%) and HSP (79.2%), respectively, and those for lesions of 4–6 mm were highly variable: HSP (31.2%), hot forceps polypectomy (21.2%), CFP (18.5%), and CSP (14.8%).[17] In a previous survey of Korean endoscopists (n=252) conducted in 2011, CFP (81.3%) and hot EMR (81.7%) were the preferred resection methods for lesions <5 mm and ≥5 mm, respectively.[11] Based on our study findings, although the preference for CSP has increased for lesion <10 mm, a notable percentage of respondents still favor CFP (81.5%)

Table 5. Univariate Logistic Analyses of Factors Affecting Adherence to International Guidelines for Non-pedunculated Lesions ≤3 mm, 6–9 mm, and ≥26 mm

Variable	Non-pedunculated lesion ≤3 mm		Non-pedunculated lesion 6–9 mm		Non-pedunculated lesion ≥26 mm	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Female sex	0.97 (0.88–1.08)	0.619	0.94 (0.81–1.09)	0.425	1.28 (1.06–1.55)	0.012
Age						
<40 yr	1 (reference)		1 (reference)		1 (reference)	
40–49 yr	0.96 (0.88–1.06)	0.436	0.98 (0.86–1.13)	0.827	0.93 (0.77–1.12)	0.422
≥50 yr	0.88 (0.78–1.00)	0.049	0.97 (0.81–1.16)	0.729	1.07 (0.87–1.32)	0.518
Practice hospital						
Primary or secondary facility	1 (reference)		1 (reference)		1 (reference)	
Tertiary facility	0.95 (0.87–1.04)	0.254	1.09 (0.96–1.23)	0.199	0.73 (0.61–0.08)	0.001
Years in colonoscopy practice						
<4 yr	1 (reference)		1 (reference)		1 (reference)	
4–9 yr	0.99 (0.88–1.11)	0.835	1.02 (0.87–1.20)	0.811	0.82 (0.65–1.03)	0.094
≥10 yr	0.89 (0.80–0.99)	0.031	0.96 (0.82–1.12)	0.615	0.86 (0.70–1.06)	0.154
No. of colonoscopies performed per mo						
<50	1 (reference)		1 (reference)		1 (reference)	
50–99	0.90 (0.81–1.00)	0.053	0.98 (0.84–1.14)	0.763	0.93 (0.75–1.14)	0.475
≥100	0.88 (0.79–0.99)	0.030	0.99 (0.85–1.17)	0.942	0.94 (0.75–1.16)	0.551
No. of polypectomies performed per mo						
<50	1 (reference)		1 (reference)		1 (reference)	
50–99	0.94 (0.85–1.04)	0.262	1.07 (0.93–1.24)	0.349	0.93 (0.77–1.13)	0.480
≥100	0.90 (0.81–1.00)	0.061	1.13 (0.97–1.32)	0.109	0.89 (0.73–1.09)	0.272

OR, odds ratio; CI, confidence interval.

and hot EMR (39.4%) for non-pedunculated lesions ≤3 mm and 6–9 mm, respectively. Meanwhile, in a survey conducted in 2020, Asian endoscopists (n=154) also preferred HSP (38.3%), CSP (31.2%), and EMR (27.3%) for lesions 6–9 mm.[18] Both the USMSTF and ESGE guidelines recommended CSP for *en bloc* resection of diminutive (≤5 mm) and small (6–9 mm) lesions and suggest that CFP can be considered for a lesion ≤2 or 3 mm that can be resected in a single bite when CSP is technically difficult.[7,10] Considering that age ≥50 years, ≥10 years of colonoscopy experience, and performing ≥100 colonoscopies per month were associated with a preference for resection techniques other than CSP for a non-pedunculated lesion ≤3 mm, we speculate that this preference might arise from a potential gap in awareness about recent guidelines among those respondents. Although a diminutive lesion (≤5 mm) rarely contains advanced histological features,[19] it can be resected incompletely by CFP in up to 61% of cases.[20] In contrast, a meta-analysis showed that CSP had a lower risk than CFP of incomplete resection of a lesion ≤7 mm (relative risk [RR], 0.31; 95% confidence interval [CI], 0.14 to 0.67).[21] CSP also showed a rate of complete resection comparable to HSP for lesions of 4–9 mm in a multicenter randomized controlled trial.[22] Furthermore, HSP and hot EMR had a significantly higher risk of post-polypectomy bleeding than CSP in a large-scale retrospective study (propensity score matched odds ratio, 6.0; 95% CI, 1.34 to 26.80).[23] Though a submucosal injection can define the boundaries of the lesion, prevent thermal injury, and facilitate grabbing of a flat lesion,[24,25] hot EMR requires an electrosurgical unit and an injector and can take longer to complete than CSP.

Although the guidelines recommend EMR for a non-invasive lesion ≥20 mm,[7,10,26] it is noteworthy that 21.2% (n=31/146) and 55.5% (n=81/146) of our respondents chose ESD as the primary resection method for non-invasive lesions of 20–25 mm and ≥26 mm, respectively. For the resection of a lesion ≥20 mm, ESD showed a higher *en bloc* resection rate (pooled RR, 1.93; 95% CI, 1.39 to 2.69; p<0.001) and lower recurrence rate (pooled RR, 0.19; 95% CI, 0.09 to 0.43; p<0.001) than EMR, but it had a longer procedure time (pooled RR, 73.25; 95% CI, 59.25 to 87.25; p<0.001) and higher perforation risk (RR, 4.51; 95% CI, 2.53 to 8.05; p<0.001).[27] Whereas the Korean endoscopists in this survey tended to prefer ESD for treating a benign non-pedunculated lesion ≥26 mm, the American Gastroenterological Association suggests using ESD for lesions at risk of submucosal invasion to achieve *en bloc* resection and for recurrent or residual benign lesions.[28] Given the challenges associated with ESD and the possibility of varied clinical outcomes in non-Asian countries and low-volume centers,[29,30] further studies specifically tailored for Korean endoscopists are needed to establish the indications for ESD in large, benign, non-pedunculated lesions.

In our survey, most respondents preferred hot EMR for resecting a large pedunculated lesion. For a lesion with a head <20 mm and stalk thickness <10 mm, 61.4% favored a prophylactic clip or detachable snare application. However, the guidelines recommend prophylactic hemostatic measures only for lesions with a head ≥20 mm or stalk thickness ≥10 mm, and the USMSTF guidelines do not recommend an adrenaline injection before resection.[7,10] Although the application of either a detachable snare (2.7%) or an injection of adrenaline (2.9%) showed a lower risk of post-polypectomy bleeding than no prophylactic measure (15.1%, both p<0.05) when resecting a large pedunculated lesion ≥ 20 mm, a randomized controlled trial found no significant difference for lesions of 10–19 mm.[31] Moreover, a multicenter randomized controlled trial found no significant difference in the incidence of post-polypectomy bleeding between clip (5.1%) and detachable snare (5.7%) application after resection of a pedunculated polyp with a head ≥10 mm and stalk ≥5 mm (p=0.847).[32] Combined application of a detachable snare and a clip (3.1% vs 12.5%, p=0.02)[33] or adrenaline injection (1.2% vs 9.3%, p=0.02)[34] showed a lower incidence of overall or early post-polypectomy bleeding than an adrenaline injection alone. Because the role of prophylactic hemostasis has not been established, especially for lesions with a head <20 mm and stalk thickness <10 mm, further research on this topic is necessary.

In this survey, EMR or ESD was the preferred resection method for suspected superficial submucosal cancer, which is consistent with the guidelines.[7,10] ESD can be applied to early cancers that are endoscopically resectable but cannot be completely removed by EMR.[35] According to a multicenter retrospective study on early colorectal cancer that was treated by ESD in Korea, the *en bloc* resection and curative resection rates of superficial submucosal cancer were 89.8% and 71.4%, respectively, and the overall recurrence-free survival in patients with curative resection was 97.1% during a median follow-up period of 53.8 months (range, 12 to 138 months).[36] Another notable point in our survey is that 36.6% (n=52/142) of respondents chose endoscopic resection for a suspected deep submucosal cancer of 10–19 mm, and 17.4% (n=24/138) chose that technique for lesions ≥ 20 mm. Those respondents probably prefer histologic confirmation for such lesions over immediate surgery, even though the histologic complete resection rate through ESD is significantly lower for deep submucosal cancer than for superficial submucosal cancer (64.7% vs 97.4%, p<0.0001).[37] Although deep submucosal invasion is known to be a high-risk factor for lymph node

metastasis in early colorectal cancer and can indicate the need for additional surgery,[38,39] the absolute risk for lymph node metastasis in patients with deep submucosal invasion without other risk factors was only 2.6%, and it was not an independent predictor in a recent meta-analysis.[40] Thus, further research on appropriate resection methods is needed, especially for patients with deep submucosal invasion and the absence of other risk factors.

Dye chromoendoscopy and equipment-based IEE are valuable tools for the real-time optical diagnosis of diminutive polyps and for predicting deep submucosal invasion in patients undergoing colonoscopy.[41-43] In this survey, most respondents used equipment-based IEE to determine the characteristics of polyps, and dye chromoendoscopy was rarely used. Equipment-based IEE is convenient and less time-consuming than dye chromoendoscopy and demonstrates comparable diagnostic accuracy in predicting the histology of a lesion.[44] On the other hand, according to a meta-analysis, magnifying narrow-band imaging has slightly lower sensitivity than magnifying dye chromoendoscopy in predicting deep submucosal cancer (74% vs 84%, $p<0.01$), though the specificity was comparable.[45] In a survey of Japanese endoscopists, magnifying dye chromoendoscopy was thought to have higher diagnostic accuracy than magnifying narrow-band imaging in predicting the depth of invasion (88% vs 83%, $p=0.003$).[46] Because equipment-based IEE has not been shown to be superior to dye chromoendoscopy in predicting the depth of invasion, additional dye chromoendoscopy should be performed in cases in which submucosal invasion is suspected.[47]

It is important to acknowledge the limitations of this study. First, 56.0% of our respondents were working in tertiary facilities, which might have resulted in selection bias. In particular, the selection of resection methods for lesions that are difficult to remove in primary and secondary facilities might have influenced endoscopists working in tertiary facilities. Second, we failed to thoroughly examine the factors that influenced the selection of resection methods. Not only lesion characteristics, but also patient characteristics, local resources, and the availability of expertise can influence the choice of a resection method.[48] Although most demographic variables among endoscopists analyzed in this study did not have a significant effect, other factors might have influenced their decision-making. Third, we were unable to confirm the indications for which equipment-based IEE or dye chromoendoscopy were used to characterize polyps. Despite those limitations, our study is the first to investigate the actual practice patterns of Korean endoscopists in various colorectal polyp scenarios since the recent publication of international guidelines. Our findings provide valuable insights for educating clinicians about colorectal polypectomy and could serve as a foundation for developing future guidelines tailored to the Korean population.

In conclusion, our study surveyed clinicians about their preferred endoscopic resection techniques in various colorectal polyp scenarios and revealed that adherence to guidelines for endoscopic resection techniques varied according to the size and shape of the polyps. Most endoscopists performed hot EMR with a submucosal injection to remove a pedunculated polyp, and clips or detachable snares were often used for prophylactic hemostasis. Characterization of a lesion before resection was primarily performed using equipment-based IEE. An individualized approach might be required to increase adherence to the guidelines.

CONFLICTS OF INTEREST

H.J.L. is an editorial board member of the journal but was not involved in the peer reviewer selection, evaluation, or decision process of this article. No other potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

Study concept and design: J.K., E.R.K., D.H.Y., T.G.G. Acquisition and analysis of data: J.K., M.S.K., S.Y.K., S.J.K., S.N.H., E.S.K., D.S.M., D.H.B., S.J.O., H.J.L., J.Y.L., J.C. Interpretation of data: J.K., E.R.K. Drafting of the manuscript: J.K. Study supervision: E.R.K., D.H.Y., H.G.K., C.M.M., Y.J. Critical revision of the manuscript for important intellectual content: all authors. Approval of final manuscript: all authors.

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SUPPLEMENTARY MATERIALS

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