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Comparison of adenoma detection rate between high-definition colonoscopes with different fields of view

170 degrees versus 140 degrees

Sang Yi Moon, MD[a], Jong Yoon Lee, MD[a,*], Jong Hoon Lee, MD, PhD[a]

Abstract

In newer generation colonoscopes, the field of view (FOV) varies approximately between 170° and 140°, depending on the type of colonoscopy. To the best of our knowledge, no study has investigated whether the visual field difference of the colonoscope affects quality indicators, such as the adenoma detection rate (ADR), without using additional devices to expand the FOV in colonoscopes with the same resolution. This study aimed to investigate the difference in quality indicators, such as ADR, between 170° and 140° FOV in colonoscopes with the same high-definition resolution. We retrospectively analyzed the medical records of patients who underwent screening or surveillance colonoscopy at the Dong-A University Hospital in Busan, South Korea, between March 2021 and February 2022. We calculated the overall ADR ratios for patients who underwent colonoscopy with 140° and 170° FOV. Polyp detection rate (PDR), sessile serrated PDR, and advanced neoplasia detection rate were calculated for each group. Factors associated with adenoma detection were identified using a logistical regression analysis. A total of 1711 patients were included in the study (838 patients in the 170° group and 873 patients in the 140° group). ADR (43.79 vs 41.92%, $P = .434$) did not significantly differ between the 2 groups. The generational differences were not statistically significant either for PDR (56.44 vs 53.49%, $P = .220$), sessile serrated PDR (1.19 vs 0.92%, $P = .575$), or advanced neoplasia detection rate (5.00 vs 4.58%, $P = .735$). Multivariate regression analysis revealed that, age, male sex, and long withdrawal time were the most significant factors affecting adenoma detection. This study revealed that there were no differences in ADR while employing high definition colonoscopes with a 170° FOV and a 140° FOV.

Abbreviations: ADR = adenoma detection rate, ANDR = advanced neoplasia detection rate, APC = adenomas per colonoscopy, CRC = colorectal cancer, FOV = field of view, FUSE = full-spectrum endoscopy, HD = high-definition, PDR = polyp detection rate, SSPDR = sessile serrated PDR.

Keywords: adenomatous polyps, colonic polyps, colonoscopy, endoscopy

1. Introduction

Colonoscopy is recommended for colorectal cancer (CRC) screening and surveillance.[1] Removing precancerous lesions by endoscopic resection is associated with lower incidence and mortality rates of CRC.[2,3] Despite its widespread use in CRC screening and surveillance, the technique remains suboptimal. Of the diagnosed CRCs, 1.8 to 9.0% are interval type of post-colonoscopy CRCs or interval CRC, which develops in the interval between a first screening colonoscopy and the subsequent surveillance colonoscopy.[4,5] Approximately half of interval CRCs are a result of missed lesions due to poor-quality colonoscopy.[6,7] The adenoma detection rate (ADR) is an important indicator for determining the quality of colonoscopy. It has been reported that the incidence of interval CRC after colonoscopy performed by endoscopists with low ADR is significantly higher than that after colonoscopy performed by endoscopists with high ADR.[8] Corley et al reported that every 1% increase in ADR lowers the rates of interval CRC by 3% and fatal interval CRC by 5%.[9] Therefore, medical societies recommend an average ADR of ≥25% in screening for high-quality colonoscopies.[10,11]

Recent advances in colonoscopy techniques have been aimed at increasing ADR. A withdrawal time of >6 minutes, adequate bowel preparation, and a high cecal insertion rate contributed to an increased ADR.[12–14] Advanced imaging techniques include high-resolution image quality, virtual chromoendoscopy, and wide fields of view (FOV).[15,16] Furthermore, colonoscopes with special equipment, such as Endocuff, EndoRings, and the third eye, are available to expose the additional colonic mucosa.[17–19]

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

[a] Department of Internal Medicine, Dong-A University College of Medicine, Busan, South Korea.

[*] Correspondence: Jong Yoon Lee, Dong-A University College of Medicine, Busan 49201, South Korea (e-mail: ljyhateo@gmail.com).

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Full-spectrum endoscopy (FUSE) is a new endoscopy technique that allows a panoramic 330° view of the colon and improves colonoscopy quality indicators.[20] However, because these studies use expensive equipment that are not commonly used, the FOV of commonly used colonoscopes may not reveal the factors that influence the ADR. To the best of our knowledge, no study has investigated the difference in quality indicators, such as ADR, between colonoscopes with different FOVs with the same resolution, without using additional devices to expand the FOV. In commonly used newer-generation colonoscopes, the FOV varies slightly, between 170° and 140°, depending on the type of colonoscopy. The CV-290 EVIS LUCERA ELITE (CV-290) (Olympus Medical, Tokyo, Japan) and EPK-i7010 (Pentax, Hoya Corporation, Tokyo, Japan) have the same high-definition (HD) resolution with 1080 intercalating vertical pixels; however, CV-290 has a 170° FOV and EPK-i7010 has a 140° FOV. This study aimed to investigate whether quality indicators such as ADR differed between colonoscopes with a 170° and a 140° FOV with same HD resolution.

2. Methods

2.1. Study design and patients

We retrospectively analyzed the medical records of patients who underwent screening or surveillance colonoscopy at the Dong-A University Hospital in Busan, South Korea, between March 2021 and February 2022. All patients who underwent colonoscopy were aged >30 years and had undergone either the first screening colonoscopy or surveillance colonoscopy 3 to 5 years after the initial screening. Colonoscopies were performed by 4 experienced endoscopists with 3 either second- or third-year gastroenterology fellows who could independently perform colonoscopies. Only proper bowel preparations (Boston Bowel Preparation Scale score ≥2 in all segments) were included in this study. Patients with symptoms of active bleeding or a history of inflammatory bowel disease, CRC, polyposis syndrome, or colon surgery were excluded.

2.2. Endoscopic procedures

Dong-A University Hospital is a tertiary hospital that performs colonoscopy using 2 types of HD video processor systems: CV-290 and EPK-i7010. CV-290 and EPK-i7010 have the same HD resolution (1080 intercalating vertical pixels); however, CV-290 has a 170° FOV and EPK-i7010 has a 140° FOV. Patients could schedule a time and date for colonoscopy but could not select an endoscopy system. The patients underwent bowel cleansing with 1 to 2 L of a polyethylene glycol solution containing ascorbic acid and an additional 1 to 2 L of water. Sedation colonoscopy was performed only if the patient desired it, and midazolam (2–5 mg) and/or propofol (10–60 mg) were used as sedatives.

2.3. Endpoints

The primary endpoint was the comparison of ADR between the 2 groups with different FOVs. We defined ADR as the proportion of patients with at least 1 adenoma detected among all examined patients.

The secondary endpoints were polyp detection rate (PDR), sessile serrated PDR (SSPDR), advanced neoplasia detection rate (ANDR), and number of adenomas per colonoscopy (APC). We defined PDR as the proportion of patients with at least 1 polyp, including adenoma and hyperplastic polyp, detected in all patients examined. Advanced neoplasia was defined as any adenoma ≥10 mm with villous histology or high-grade dysplasia and any SSP ≥10 mm with dysplasia. The calculations for SSPDR and ANDR were similar to those for ADR and PDR. APC was defined as the mean number of adenomas detected per colonoscope.

2.4. Statistics and data analysis

Statistical analysis was performed using SPSS software (version 26.0; IBM, Armonk, NY). Statistical significance was set at $P < .05$. The data were divided by group: the 170° FOV group and the 140° FOV group. Continuous data are presented as mean ± standard deviation and were analyzed using Student t test. Categorical data were analyzed using Pearson chi-squared or Fisher exact tests. A logistical regression model was used for the multivariate analysis to assess the association between clinical factors and adenoma detection. Variables found to be significantly associated in the univariate analysis were used as covariates in the multivariate analysis.

2.5. Ethics statement

The Ethics Committee approved our research protocols through international agreements (World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects). Formal consent was not required for this study. The study protocol was reviewed and approved by the Institutional Review Board of the Dong-A University College of Medicine (DAUHIRB-22-096).

3. Results

3.1. Demographic and clinical characteristics

A total of 1711 patients were included in this study. Approximately 48% (n = 838) of the procedures were performed using colonoscopes with a 170° FOV, while 52% (n = 873) were performed using colonoscopes with a 140° FOV. The demographic and clinical characteristics of the patients are presented in Table 1. There were no significant differences between the 2 groups (170° vs 140° FOV) in terms of age, sex, bowel preparation, sedation, examination day, reason for examination, and endoscopist experience.

3.2. Colonoscopy quality indicators between the groups

There were no significant differences in cecal intubation time (421.23 ± 216.96 vs 416.09 ± 227.09; $P = .630$) or withdrawal time (741.25 ± 420.21 vs 743.37 ± 402.05; $P = .915$) between colonoscopes with a 170° FOV and a 140° FOV. There were also no significant differences in PDR (56.44 vs 53.49%; $P = .220$), ADR (43.79 vs 41.92%; $P = .434$), SSPDR (1.19 vs 0.92%; $P = .304$), ANDR (5.00 vs 4.58%; $P = .735$), and number of APC (0.88 ± 1.52 vs 0.89 ± 1.59; $P = .987$) between the 2 groups (Table 2).

3.3. APC based on endoscopic feature, location, and size

Adenomas were classified based on their endoscopic features, their location, and their size. Based on their endoscopic features, adenomas were classified into 2 groups, polypoid and flat. The number of APC, according to their endoscopic features, was not significantly different between colonoscopes with 170° FOV to those with 140° FOV (polypoid: 0.05 ± 0.22 vs 0.05 ± 0.23, $P = .822$; flat: 0.83 ± 1.44 vs 0.83 ± 1.50, $P = .986$). Similarly, adenomas based on their location, were classified into 2 groups: proximal and distal. The number of APC, according to their location also did not differ significantly between colonoscopes with 170° FOV and those with 140° FOV (proximal: 0.62 ± 1.22 vs 0.62 ± 1.27, $P = .928$; distal: 0.26 ± 0.62 vs 0.27 ± 0.68, $P = .833$). Lastly, adenomas, were classified into 3 groups, based on their size: <5, 5 to 10, and >10 mm. The number of APC

Table 1

Demographic and clinical characteristics in patients who underwent colonoscopy.

	Colonoscopes with fields of view		
	170° (n = 838)	140° (n = 873)	*P* value
Age	62.20 ± 11.07	61.81 ± 12.26	.495
Gender			.986
Male	464 (55.4%)	483 (55.3%)	
Female	374 (44.6%)	390 (44.7%)	
Bowel preparation			.889
BBPS 8,9	635 (75.8%)	659 (75.5%)	
BBPS 6,7	203 (24.2%)	214 (24.5%)	
Sedation			.947
Yes	800 (95.5%)	834 (95.5%)	
No	38 (4.5%)	39 (4.5%)	
Examination of d			.803
Morning	142 (16.9%)	144 (16.5%)	
Afternoon	696 (83.1%)	729 (83.5%)	
Reason of examination			.415
Screening	629 (75.1%)	670 (76.7%)	
Surveillance	209 (24.9%)	203 (23.3%)	
Endoscopist's experience			.806
Experienced	527 (62.9%)	554 (63.5%)	
Trainee	311 (37.1%)	319 (36.5%)	

BPPS = Boston bowel preparation score.

Table 2

Colonoscopic quality indicators between the groups.

	Colonoscopes with fields of view		
	170° (n = 838)	140° (n = 873)	*P* value
Intubation time (s)	421.23 ± 216.96	416.06 ± 27.06	.630
Withdrawal time (s)	741.25 ± 420.21	743.37 ± 402.05	.915
PDR (%)	56.44 (473/838)	53.49 (467/873)	.220
ADR (%)	43.79 (367/838)	41.92 (366/873)	.434
SSPDR (%)	1.19 (10/838)	0.92 (8/873)	.575
ANDR (%)	5.00 (42/838)	4.58 (40/873)	.735
APC	0.88 ± 1.52	0.89 ± 1.59	.987

ADR = adenoma detection rate, ANDR = advanced neoplasm detection rate, APC = adenoma per colonoscopy, PDR = polyp detection rate, SSPDR = sessile serrated polyp detection rate.

according to their size also did not differ significantly between colonoscopes with 170° FOV and those with 140° FOV (<5 mm: 0.75 ± 1.35 vs 0.75 ± 1.23, *P* = .915; 5–10 mm: 0.10 ± 0.54 vs 0.09 ± 0.60, *P* = .697; >10 mm: 0.04 ± 0.23 vs 0.04 ± 0.37, *P* = .725) (Table 3).

3.4. Colonoscopy quality indicators according to endoscopists' experience

Quality indicators of the colonoscopes with 170° FOV and those with 140° FOV were further compared based on the endoscopists' experience. For trainee endoscopists, there were no statistically significant differences between colonoscopes with 170° FOV and those with 140° FOV in cecal intubation time (535.56 ± 252.21 vs 529.78 ± 314.68, *P* = .799), withdrawal time (793.38 ± 462.50 vs 756.99 ± 399.78, *P* = .291), PDR (52.73 vs 50.78%, *P* = .624), ADR (41.16 vs 40.13%, *P* = .792), or APC (0.80 ± 1.38 vs 0.85 ± 1.45, *P* = .664). Similarly, for experienced endoscopists as well, there were no statistically significant differences between colonoscopes in cecal intubation time (353.76 ± 158.50 vs 350.58 ± 112.25, *P* = .705), withdrawal time (710.49 ± 390.34 vs 735.52 ± 403.51, *P* = .301), PDR (58.63 vs 55.05%, *P* = .235), ADR (45.35 vs 42.96%, *P* = .429), and APC (0.94 ± 1.60 vs 0.91 ± 1.67, *P* = .782) (Table 4).

3.5. Univariate and multivariate analysis of factors associated with adenoma detection

Age, male sex, surveillance colonoscopy, and long withdrawal time were significantly associated with adenoma detection in the univariate logistic regression analysis. These factors were then analyzed as covariates in multivariate logistic regression analysis, out of which age, male sex, and long withdrawal time remained statistically significant as opposed to surveillance colonoscopy (Table 5).

4. Discussion

This single-center retrospective study aimed to evaluate the difference in quality indicators such as ADR between 170° and 140° FOV colonoscopes with the same HD resolution. We found that ADR was not affected by variations in the FOV of colonoscopes with the same high-resolution image quality. We also found that other colonoscopy quality indicators, such as PDR, SSPDR, ANDR, and APC, also did not differ based on the FOV.

Several innovations in endoscopic technology have been aimed at improving adenoma detection. Newer colonoscopes

Table 3

Adenomas per colonoscopy by endoscopic feature, location, and size.

	Colonoscopes with fields of view		
	170° (n = 838)	140°s (n = 873)	*P* value
Endoscopic feature			
Polypoid	0.05 ± 0.22 (44/838)	0.05 ± 0.23 (48/873)	.822
Flat	0.83 ± 1.44 (697/838)	0.83 ± 1.50 (725/873)	.986
Location			
Proximal	0.62 ± 1.22 (521/838)	0.62 ± 1.27 (538/873)	.928
Distal	0.26 ± 0.62 (220/838)	0.27 ± 0.68 (235/873)	.833
Size			
<5 mm	0.75 ± 1.35 (627/838)	0.75 ± 1.23 (659/873)	.915
5–10 mm	0.10 ± 0.54 (81/838)	0.09 ± 0.60 (75/873)	.697
>10 mm	0.04 ± 0.23 (33/838)	0.04 ± 0.37 (39/873)	.725
Overall	0.88 ± 1.52 (741/838)	0.89 ± 1.59 (773/873)	.987

APC = adenoma per colonoscopy.

Table 4

Colonoscopic quality indicators according to endoscopists' experience.

	Colonoscopes with fields of view		
	170° (n = 838)	**140° (n = 873)**	***P* value**
Trainee endoscopists			
Intubation time (s)	535.56 ± 252.21	529.78 ± 314.68	.799
Withdrawal time, (s)	793.38 ± 462.50	756.99 ± 399.78	.291
PDR, %	52.73 (164/311)	50.78 (162/319)	.624
ADR, %	41.16 (128/311)	40.13 (128/319)	.792
APC	0.80 ± 1.38	0.85 ± 1.45	.664
Experienced endoscopists			
Intubation time (s)	353.76 ± 158.50	350.58 ± 112.25	.705
Withdrawal time (s)	710.49 ± 390.34	735.52 ± 403.51	.301
PDR, %	58.63 (309/527)	55.05 (305/554)	.235
ADR, %	45.35 (239/527)	42.96 (238/554))	.429
APC	0.94 ± 1.60	0.91 ± 1.67	.782

ADR = adenoma detection rate, APC = adenoma per colonoscopy, PDR = polyp detection rate.

Table 5

Univariate and multivariate analysis for factors related to adenoma detection.

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	***P* value**	**OR (95% CI)**	***P* value**
Age (yr)	1.045 (1.035–1.055)	.000	1.037 (1.027–1.048)	.000
Gender		.000		.000
Male	1		1	
Female	.544 (.447–.661)	.	.626 (.502–.780)	
Indication of exam		.003		.581
Screening	1		1	
Surveillance	1.409 (1.128–1.761)		1.074 (.834–1.383)	
Withdrawal time (s)	1.003 (1.003–1.003)	.000	1.003 (1.002–1.003)	.000
Type of endoscopy		.434		
170°	1			
140°	0.926 (0.765–1.122)			

(such as Olympus CV-290 or CV-190) have a wider FOV of 170° than the older colonoscopes having a 140° FOV, and also possess features such as higher resolution and near focus.[21] Previous studies comparing older and newer colonoscopes from the same manufacturer have shown that newer colonoscopes have higher ADRs.[22–25] Studies that compared the newer CV-290 or CV-190 (170° FOV) with the older CV-260 or CV-165 (140° FOV) (Olympus Medical, Tokyo, Japan) have also reported differences in ADR, but the differences cannot be solely attributed to the FOV as there were differences also in the resolution.[22,24] Among comparative studies on colonoscopes of different generations, EPK-i7010 and EPK-i (Pentax, Hoya Corporation, Tokyo, Japan) showed higher ADRs in the latest generation. A study in which both generations of colonoscopes had an FOV of 140°, it was found that the difference between them was due to differences in the image quality.[25] In another study that was conducted to confirm the difference in the ADR depending on the manufacturer of the colonoscope, there was no difference in results with FOV 140° for colonoscopes from different manufacturers.[26] It is therefore necessary to determine whether the FOV affects the ADR because there are slight differences in the FOV of the latest generation of colonoscopes for each manufacturer.

To the best of our knowledge, no study has investigated whether the visual field difference of the colonoscope affects quality indicators, such as ADR, without using additional devices to expand the FOV of colonoscopes with the same resolution. The 2 types of colonoscopes used in this study were newer-generation colonoscopes with similar launch times. Our study confirmed that if the image quality was the same, a difference in FOV of 30° did not affect the quality indicators, including the ADR.

Special equipment, such as Endocuff, EndoRings, and FUSE, improve colonoscopic qualities; however, a study has shown that HD colonoscopy with Endocuff and EndoRings had a higher APC than that with FUSE,[27] due to the better HD image quality. The results showed that the image quality could affect adenoma detection more than the FOV. These results are consistent with those of our study, which showed that there was no difference in the ADR with different FOV at the same resolution. The human FOV is approximately 210° horizontally, but with binocular vision only 114° is required for depth perception.[28] Therefore, it can be seen that the expansion of the FOV contributes to improving colonoscopic quality. However, if the FOV is above a certain level, further expansion of the FOV does not proportionally improve the quality of the endoscope.

This study has some limitations. First, there were no significant differences in the variables between the 2 groups for a certain period. Therefore, it was impossible to identify all factors affecting ADR, such as family history, smoking history, and other comorbidities, which are difficult to confirm using chart review. However, this study retrospectively included a large number of patients who underwent screening or surveillance colonoscopy, and most patients were Korean. Therefore, it is estimated that there was no significant difference between the 2 groups for the factors that we have not reviewed. Second, endoscope manufacturers do not disclose the specifications of the video processors. The visual quality of the video processor can be quantified; however, the numerical specifications for color and brightness have not been disclosed. Therefore, only the

image quality and FOV were considered, not other subtle differences. However, the image quality specifications of the 2 manufacturers were the same at 1080 intercalating vertical pixels, and the image quality subjectively experienced by the endoscopists in this study was also similar. Among the factors affecting ADR in several studies, it has been proven that image quality is the most important.[22,24,27] This is the first study to confirm whether the difference in the FOV of the colonoscope affects the ADR without the use of special equipment to expand the FOV.

5. Conclusion

This study revealed no significant differences in ADR between HD colonoscopes with a 170° FOV and a 140° FOV. This shows that a slight difference in the FOV at the same resolution does not significantly impact colonoscopic quality.

Author contributions

Conceptualization: Jong Yoon Lee.
Data curation: Sang Yi Moon, Jong Yoon Lee.
Formal analysis: Sang Yi Moon, Jong Yoon Lee.
Funding acquisition: Jong Yoon Lee.
Investigation: Sang Yi Moon, Jong Yoon Lee.
Methodology: Jong Yoon Lee.
Supervision: Jong Yoon Lee, Jong Hoon Lee.
Validation: Jong Yoon Lee.
Visualization: Jong Yoon Lee.
Writing – original draft: Sang Yi Moon, Jong Yoon Lee.
Writing – review & editing: Jong Yoon Lee, Jong Hoon Lee.

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