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Impact of Deep Learning–Based Real-Time Polyp Detection on Adenoma Detection Rate and Concurrent Endoscopist-Performed Optical Biopsy Accuracy: Clinical Validation in Routine Colonoscopy

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ABSTRACT

Objective: Adenoma detection rate (ADR) is the strongest quality indicator of colonoscopy and is inversely associated with interval colorectal cancer risk. Although computer-aided detection (CADe) improves ADR in randomized trials, evidence from routine practice and its impact on concurrent endoscopist-performed optical biopsy remains limited. This study evaluated whether real-time deep learning–based CADe improves ADR in routine colonoscopy and assessed the diagnostic performance of endoscopist-performed optical biopsy.

Materials and Methods: This non-randomized prospective pragmatic study was conducted at a tertiary referral center in Türkiye between October 2025 and February 2026. A total of 2,122 consecutive colonoscopies were allocated by weekly alternation to AI-assisted detection (CADe-on, n=1,061) or standard colonoscopy (CADe-off, n=1,061). The CADe system was used exclusively for lesion detection, whereas optical diagnosis was performed by the endoscopist. The primary outcome was ADR; secondary outcomes included polyp detection rate (PDR), adenomas per colonoscopy (APC), lesion characteristics, withdrawal time, and optical biopsy accuracy using histopathology as the reference standard.

Results: Baseline characteristics were comparable between groups. ADR increased from 13.0% to 19.0% (absolute increase, 6% points; $p<0.001$), and AI assistance remained independently associated with adenoma detection (adjusted odds ratio 1.56; 95% confidence interval [CI] 1.22–1.99). PDR and APC were also higher in the AI-assisted group (35.4% vs. 28.7%, $p=0.002$; 0.32 ± 0.71 vs. 0.21 ± 0.54, $p=0.004$). Detection gains were mainly driven by diminutive and non-polypoid lesions, while withdrawal time did not differ significantly ($p=0.11$). Endoscopist-performed optical biopsy (428 polyps) showed sensitivity 88.4%, specificity 81.2%, positive predictive value 84.7%, negative predictive value (NPV) 85.4%, and overall accuracy 85.1% (95% CI 81.4–88.3). For diminutive rectosigmoid polyps, NPV was 91.2%, meeting the preservation and ıncorporation of valuable endoscopic ınnovations threshold.

Conclusion: Real-time CADe was associated with higher adenoma detection without prolonging withdrawal time. Endoscopist-performed optical characterization during AI-assisted colonoscopy showed reliable diagnostic performance, suggesting that this combined approach may be feasible in routine clinical practice.

Keywords: Adenoma detection rate, Artificial intelligence, Colonoscopy, Computer-aided detection, Deep learning

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INTRODUCTION

Colorectal cancer (CRC) remains a major cause of cancer-related morbidity and mortality worldwide despite the widespread implementation of screening programs.[1] Colonoscopy reduces both CRC incidence and mortality primarily through the detection and removal of adenomatous polyps. However, the protective effect of colonoscopy depends critically on the quality of mucosal inspection. The adenoma detection rate (ADR) has emerged as the most widely accepted quality indicator of colonoscopy performance and demonstrates a strong inverse association with the risk of interval CRC.[2] Even modest absolute improvements in ADR translate into clinically meaningful reductions in post-colonoscopy cancer risk.

Despite advances in high-definition imaging and enhanced visualization technologies, adenomas continue to be missed in a considerable proportion of examinations. Tandem colonoscopy studies consistently report miss rates ranging from 20% to 26%, with diminutive and non-polypoid (flat) lesions accounting for a disproportionate share of overlooked neoplasms.[3] These limitations have stimulated the development of artificial intelligence (AI)-based computer-aided detection (CADe) systems designed to assist endoscopists in real time. A growing body of randomized controlled trials and subsequent meta-analyses has shown that CADe increases ADR and reduces adenoma miss rates compared with standard colonoscopy.[4-6] However, most of the available evidence originates from controlled efficacy trials. Whether these benefits persist under the heterogeneous conditions of routine clinical practice – where bowel preparation quality, patient characteristics, and endoscopist experience vary substantially – remains uncertain.

In parallel with advances in lesion detection, real-time optical characterization remains an important component of colonoscopy practice. When sufficiently accurate, optical biopsy may facilitate risk-stratified management strategies such as the “resect-and-discard” or “leave-*in situ*” approach for diminutive rectosigmoid polyps.[7] Nevertheless, the performance of optical diagnosis performed by endoscopists in routine clinical settings, which involves considerable variability in bowel preparation, lesion morphology, and operator experience, remains incompletely characterized, particularly when combined with concurrent AI-assisted detection.

To date, prospective studies evaluating the combined clinical impact of integrating both real-time AI-assisted polyp detection and endoscopist-performed optical biopsy into routine colonoscopy practice are scarce. In particular, it remains unclear whether implementation outside controlled research environments can simultaneously improve adenoma detection while maintaining reliable histologic prediction by the endoscopist.

Therefore, the aim of this prospective pragmatic comparative study was twofold: first, to determine whether real-time deep learning–based CADe improves ADR in routine clinical practice; and second, to evaluate the diagnostic accuracy of endoscopist-performed optical biopsy during AI-assisted colonoscopy using histopathology as the reference standard.

MATERIALS AND METHODS

Study Design and Setting

This non-randomized prospective pragmatic comparative study was conducted at Kayseri City Hospital, a tertiary referral center in Türkiye, between October 01, 2025, and February 01, 2026. The study evaluated the clinical impact of integrating a deep learning–based real-time CADe system into routine colonoscopy practice.

To preserve routine clinical workflow while minimizing allocation bias, allocation to AI-assisted or standard colonoscopy was performed by weekly alternation rather than individual patient randomization. During AI-on weeks, the CADe platform was connected to the endoscopy video output, whereas during AI-off weeks, it remained disconnected. Consecutive patients undergoing colonoscopy within a given week were therefore allocated to the corresponding study arm. This design maintained routine scheduling while facilitating balanced distribution of patient characteristics and endoscopist workload across study periods. The distribution of endoscopists and colonoscopy indications was monitored throughout the study to ensure a comparable case mix between groups. No changes in endoscopic equipment, staffing, or bowel preparation protocols occurred during the study period.

Ethics Approval

The study protocol was approved by the Institutional Ethics Committee (Kayseri City Hospital Non-interventional Clinical Research Ethics Committee; Approval No: 585; September 26, 2025). All procedures were conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants before colonoscopy.

Study Population and Eligibility Criteria

Consecutive adult patients (≥18 years) undergoing elective colonoscopy for screening, surveillance, or diagnostic indications during the study period were eligible for inclusion.

Exclusion criteria were:

- Known inflammatory bowel disease

- Known CRC
- Hereditary CRC syndromes
- Prior colorectal resection
- Emergency colonoscopy.

Bowel preparation quality was assessed using the Boston Bowel Preparation Scale (BBPS) and recorded as a baseline covariate.[8] No patient was excluded solely on the basis of BBPS score, because bowel preparation quality was analyzed as a clinical variable in the primary comparative analysis. Baseline characteristics included age, sex, colonoscopy indication, bowel preparation quality, and withdrawal time.

AI-Assisted Colonoscopy Protocol

All colonoscopies were performed using high-definition colonoscopes (ELUXEO endoscopy system with EC-760Z-V/L colonoscopes, Fujifilm, Tokyo, Japan) in standard endoscopy units by one of five experienced gastroenterologists. Each endoscopist had more than 5 years of independent practice and had performed more than 1,000 colonoscopies before the study.

Before study initiation, all participating endoscopists completed a brief familiarization session with the CADe system to standardize interpretation of visual alerts.

During AI-on weeks, a proprietary deep learning–based CADe system implemented on a graphics processing unit-equipped workstation was connected to the endoscopy video output through a video capture interface for real-time lesion detection. The platform processed the live video stream during the withdrawal phase and displayed a visual alert on a dedicated monitor positioned within the endoscopist's field of view when a suspected lesion was identified. Because the system was used as a deployed clinical tool rather than developed in-house, detailed information regarding internal model architecture, training dataset composition, and algorithm-level validation metrics was not accessible to the investigators.

It is important to note that the CADe system was utilized exclusively for lesion detection. When a lesion was detected, the endoscopist – not the AI system – performed optical characterization based on mucosal and vascular pattern assessment using standard endoscopic criteria and recorded the predicted histologic classification before lesion resection. Clinical decision-making, including whether to resect or biopsy a lesion, was left to the discretion of the endoscopist.

During AI-off weeks, the CADe system was disconnected, and no automated feedback was provided.

All detected lesions were removed or biopsied according to current clinical guidelines. Resected specimens were submitted for histopathological examination, which served as the reference standard. Pathologists were blinded to study allocation and to the endoscopists' optical predictions.

Withdrawal time was defined as the time from cecal intubation to scope withdrawal, excluding time spent on therapeutic interventions.

Outcomes

The primary outcome was the ADR, defined as the proportion of colonoscopies in which at least one histologically confirmed adenoma was detected.[9]

Secondary outcomes included:

- Polyp detection rate (PDR)
- Adenomas per colonoscopy (APC)
- Lesion size, morphology, and location (Paris classification)
- Withdrawal time
- Diagnostic accuracy of endoscopist-performed optical biopsy.

Optical biopsy performance was evaluated on a per-polyp basis during AI-on weeks. Endoscopists documented their optical diagnosis for resected polyps before histopathological evaluation. The analysis included all resected polyps during AI-on weeks for which an endoscopist's optical diagnosis had been prospectively recorded (n=428). Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated with corresponding 95% confidence intervals (CIs) using histopathology as the reference standard.

Statistical Analysis

Normality of continuous variables was assessed using the Shapiro–Wilk test. Normally distributed variables are presented as mean ± standard deviation, whereas non-normally distributed variables are reported as median with interquartile range. Categorical variables are presented as counts and percentages.

Between-group comparisons were performed using the Student's t-test or the Mann–Whitney U test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables, as appropriate.

To evaluate the independent association between AI assistance and adenoma detection, a multivariable logistic regression model was constructed adjusting for age, sex, colonoscopy indication, bowel preparation quality, and withdrawal time. Withdrawal time was included as a covariate because longer inspection time is an established predictor of adenoma detection, and we aimed to isolate the effect **o**f AI independent of minor procedural time variations. Adjusted odds ratios (ORs) with 95% CIs were reported. Model calibration was assessed using the Hosmer–Lemeshow goodness-of-fit test.

All statistical tests were two-sided, and a $p<0.05$ was considered statistically significant. Statistical analyses were performed using the Statistical Package for the Social Sciences version 28.0 (IBM Corp., Armonk, NY, USA).

Sample Size Calculation

Based on our institution's baseline ADR of 13% observed in the year preceding the study, we aimed to detect an absolute increase of 6% points (13–19%), consistent with effect sizes reported in meta-analyses of CADe trials.

Assuming a two-sided alpha level of 0.05 and 80% power, approximately 1,000 patients per group were required. We enrolled 1,061 patients in each arm (total *n*=2,122), providing adequate statistical power for the primary analysis.

RESULTS

Study Population

A total of 2,122 consecutive colonoscopies were included in the analysis, with 1,061 procedures allocated to the AI-off group and 1,061 to the AI-on group. The study flow diagram is presented in Figure 1. Briefly, 2,345 colonoscopy procedures were assessed for eligibility; 223 were excluded due to inflammatory bowel disease (*n*=28), known CRC (*n*=17), hereditary syndromes (*n*=5), prior colorectal resection (*n*=41), emergency colonoscopy (*n*=33), or declined consent (*n*=99). No procedure was excluded based on bowel preparation quality. Baseline characteristics were comparable between groups (Table 1). The mean age was 58.4±12.1 years in the AI-off group and 57.9±11.8 years in the AI-on group (p=0.38). The proportion of male patients was 52.1% and 53.4%, respectively (p=0.56). Colonoscopy indications (screening, surveillance, or diagnostic) were similarly distributed between groups (p=0.72). Adequate bowel preparation (BBPS score ≥6) was achieved in 94.6% of procedures in the AI-off group and 95.2% in the AI-on group (p=0.49). Mean withdrawal time was 7.8±2.1 min in the AI-off group and 8.0 ± 2.3 min in the AI-on group (p=0.11).

Primary Outcome: ADR

AI assistance significantly improved adenoma detection. At least one histologically confirmed adenoma was detected in 138 of 1,061 colonoscopies (13.0%) in the AI-off group and in 202 of 1,061 colonoscopies (19.0%) in the AI-on group, corresponding to an absolute increase of 6.0% points (p<0.001) and a relative increase of 46%. The difference in ADR between groups is illustrated in Figure 2.

Secondary Outcomes

PDR was higher in the AI-on group than in the AI-off group (35.4% vs. 28.7%, p=0.002). Similarly, the mean number of APC increased from 0.21±0.54 in the AI-off group to 0.32±0.71 in the AI-on group (p=0.004).

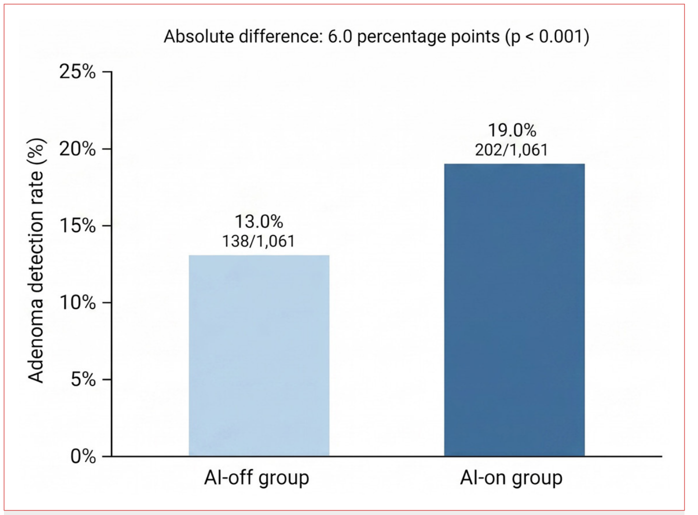

Figure 1. Study flow diagram. Flow diagram illustrating patient inclusion and allocation to study groups. A total of 2,345 colonoscopy procedures were assessed for eligibility between October 01, 2025, and February 01, 2026. Of these, 223 were excluded due to inflammatory bowel disease (*n*=28), known colorectal cancer (CRC) (*n*=17), hereditary CRC syndromes (*n*=5), prior colorectal resection (*n*=41), emergency colonoscopy (*n*=33), or declined consent (*n*=99). No procedure was excluded based on bowel preparation quality. The remaining 2,122 colonoscopies were allocated by weekly alternation: 1,061 to the AI-off group and 1,061 to the AI-on group

The increased detection rate was primarily driven by diminutive (≤5 mm) and non-polypoid lesions. The proportion of detected polyps measuring ≤5 mm increased from 58% in the AI-off group to 67% in the AI-on group (p=0.008). Non-polypoid lesions (Paris classification 0-II) were detected in 2.1% of AI-on colonoscopies compared with 1.1% in the AI-off group (p=0.02). Detailed lesion characteristics are presented in Table 2, and the distribution of polyp size categories across groups is illustrated in Figure 3.

Multivariable Analysis

After adjustment for age, sex, colonoscopy indication, bowel preparation quality, and withdrawal time, AI assistance remained independently associated with adenoma detection. AI-assisted colonoscopy was associated with higher odds of detecting at least one adenoma (adjusted OR 1.56; 95% CI 1.22–1.99; p<0.001). Older age, screening indication, and longer withdrawal time were also independently associated with adenoma detection. The complete regression model is presented in Table 3.

Table 1. Baseline characteristics of the study population

Variable	AI-off (*n*=1.061)	AI-on (*n*=1.061)	*p*
Age, years (mean±SD)	58.4±12.1	57.9±11.8	0.38
Male sex, *n* (%)	553 (52.1)	567 (53.4)	0.56
Indication for colonoscopy, *n* (%)			
Screening	412 (38.8)	426 (40.1)	0.72
Surveillance	265 (25.0)	251 (23.7)	
Diagnostic	384 (36.2)	384 (36.2)	
Adequate bowel preparation (BBPS ≥6), *n* (%)	1003 (94.6)	1011 (95.2)	0.49
Withdrawal time, minutes (mean±SD)	7.8±2.1	8.0±2.3	0.11

SD: Standard deviation, BBPS: Boston bowel preparation scale, AI: Artificial intelligence

Optical Biopsy Performance

During AI-on weeks, endoscopists were instructed to prospectively record optical diagnoses for resected polyps before histopathological evaluation. A total of 428 resected polyps with complete prospective optical diagnosis documentation were included in this sub-analysis. On a per-polyp basis, endoscopist-performed optical biopsy demonstrated a sensitivity of 88.4% (95% CI 83.6–92.1), specificity of 81.2% (95% CI 74.9–86.3), PPV of 84.7% (95% CI 80.1–88.5), and NPV of 85.4% (95% CI 80.8–89.1). Overall diagnostic accuracy was 85.1% (95% CI 81.4–88.3). For diminutive rectosigmoid polyps (≤5 mm), the NPV for adenomatous histology was 91.2% (95% CI 86.5–94.8). Table 4 summarizes the diagnostic performance of endoscopist-performed optical biopsy, and Figure 4 illustrates these estimates with corresponding CIs.

DISCUSSION

In this prospective pragmatic comparative study, implementation of a deep learning–based CADe system in routine colonoscopy practice was associated with a significant increase in ADR. ADR improved from 13% to 19%, corresponding to an absolute increase of six percentage points and a relative increase of 46%. Importantly, this association remained significant after adjustment for potential confounders, with AI assistance independently associated with higher odds of adenoma detection.

The observed improvement in ADR is consistent with a growing body of randomized evidence. Multiple randomized

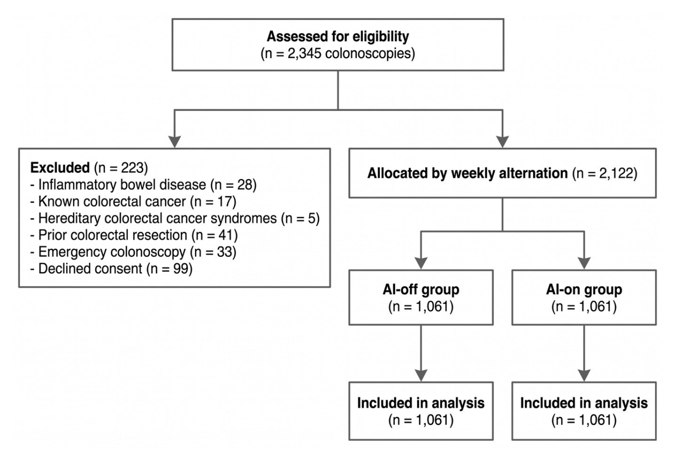

Figure 2. Comparison of adenoma detection rate between study groups. Adenoma detection rate (ADR) according to the study group. ADR was higher in the artificial intelligence (AI)-on group (19.0%, 202/1,061) compared with the AI-off group (13.0%, 138/1,061), corresponding to an absolute difference of 6.0% points (p<0.001)

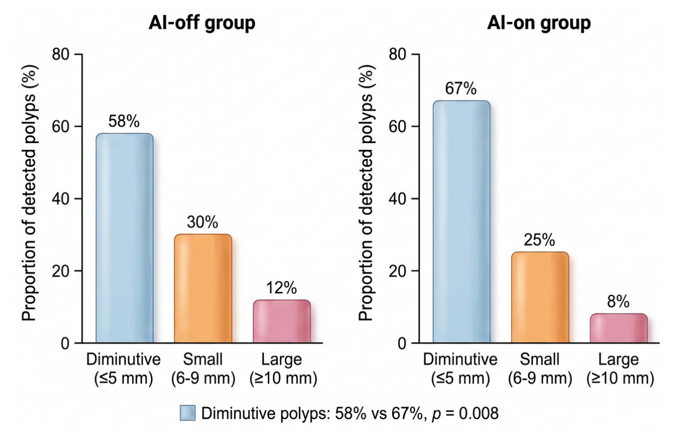

Figure 3. Distribution of polyp size categories in artificial intelligence (AI)-off and AI-on groups. Distribution of detected polyps according to size category. The proportion of diminutive polyps (≤5 mm) was higher in the AI-on group (67%) than in the AI-off group (58%) (p=0.008)

Table 2. Primary and secondary detection outcomes

Outcome	AI-off (*n*=1,061)	AI-on (*n*=1,061)	*p*
ADR, *n* (%)	138 (13.0)	202 (19.0)	<0.001
PDR, *n* (%)	305 (28.7)	376 (35.4)	0.002
APC, mean±SD	0.21±0.54	0.32±0.71	0.004
Diminutive polyps (≤5 mm), *n* (% of detected polyps)	177 (58)	252 (67)	0.008
Non-polypoid lesions (Paris 0-II), *n* (% of colonoscopies)	12 (1.1)	22 (2.1)	0.02
Withdrawal time, minutes (mean±SD)	7.8±2.1	8.0±2.3	0.11

ADR: Adenoma detection rate; PDR: Polyp detection rate; APC: Adenomas per colonoscopy; SD: Standard deviation; AI: Artificial intelligence.

Table 3. Multivariable logistic regression analysis for adenoma detection

Variable	Adjusted OR	95% CI	p
AI assistance (AI-on vs. AI-off)	1.56	1.22–1.99	<0.001
Age (per year increase)	1.02	1.01–1.03	0.01
Male sex	1.18	0.95–1.46	0.12
Screening indication (vs. diagnostic)	1.24	1.01–1.54	0.04
Adequate bowel preparation	1.31	0.90–1.89	0.15
Withdrawal time (per minute increase)	1.06	1.01–1.12	0.03

OR: Odds ratio; CI: Confidence interval; AI: Artificial intelligence.

controlled trials have demonstrated that CADe systems improve the detection of colorectal neoplasia (4–6). A comprehensive meta-analysis of randomized trials reported that AI-assisted colonoscopy significantly increases ADR (relative risk [RR] 1.19; 95% CI 1.14–1.25),[10] while another meta-analysis reported a similar magnitude of effect (RR 1.27; 95% CI 1.14–1.41).[11] Our findings extend this evidence by evaluating AI implementation in a pragmatic clinical setting using a non-randomized weekly alternation design rather than in tightly controlled experimental environments. The consistency between our results and those from randomized trials suggests that the benefits of CADe can be maintained in routine clinical practice.

The increase in detection observed in our cohort was primarily driven by diminutive (≤5 mm) and non-polypoid lesions. This pattern is consistent with previous studies showing that AI systems preferentially improve the detection of subtle lesions that are easily overlooked during conventional inspection.[3,6,12] Non-polypoid morphology has been associated with higher miss rates in tandem colonoscopy studies.[3] By facilitating the detection of these lesions, AI-assisted colonoscopy may contribute to reducing the risk of interval CRC. Although long-term oncologic outcomes cannot be determined from the present study, ADR is a validated surrogate marker for

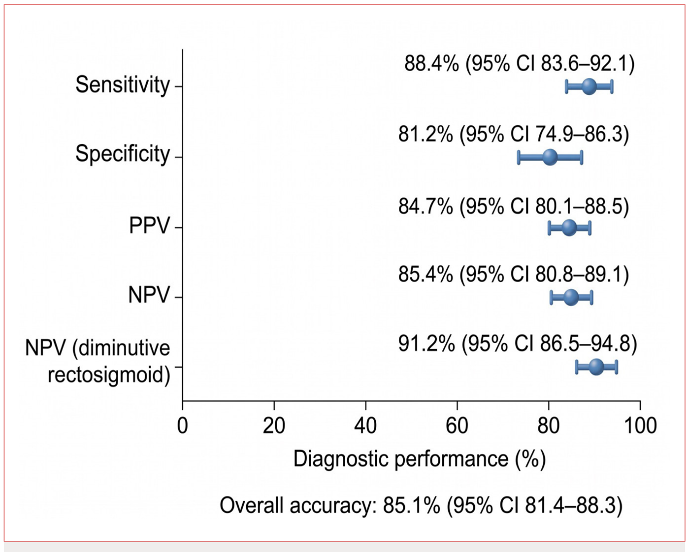

Figure 4. Diagnostic performance of endoscopist-performed optical biopsy. Forest plot showing diagnostic performance of endoscopist-performed optical biopsy, including sensitivity, specificity, positive predictive value, and negative predictive value, with corresponding 95% confidence intervals. Overall accuracy was 85.1% (95% confidence ınterval [CI] 81.4–88.3). For diminutive rectosigmoid polyps (≤5 mm), the negative predictive value was 91.2% (95% CI 86.5–94.8).

Table 4. Diagnostic performance of endoscopist-performed optical biopsy (per-polyp analysis)

Overall performance (n=428 polyps)		
Metric	**Estimate (%)**	**95% CI**
Sensitivity	88.4	83.6–92.1
Specificity	81.2	74.9–86.3
PPV	84.7	80.1–88.5
NPV	85.4	80.8–89.1
Overall accuracy	85.1	81.4–88.3
Subgroup: Diminutive rectosigmoid polyps (≤5 mm)		
Metric	**Estimate (%)**	**95 CI**
NPV	91.2	86.5–94.8

NPV: Negative predictive value; PPV: Positive predictive value; CI: Confidence interval.

CRC risk reduction.[2,13] Furthermore, a recent meta-analysis demonstrated that CADe significantly reduces adenoma miss rates (OR 0.58; 95% CI 0.45–0.74),[14] supporting the mechanistic basis of our findings.

Importantly, the implementation of AI assistance did not significantly prolong withdrawal time. This finding is consistent with prior randomized trials and pooled analyses indicating that CADe integration does not substantially increase procedure duration or disrupt endoscopic workflow.[15,16] In our study, withdrawal times in both groups remained within accepted quality standards, supporting the practical feasibility of AI-assisted colonoscopy in routine practice.

In addition to detection performance, we evaluated endoscopist-performed optical biopsy within an AI-assisted detection environment. Optical characterization demonstrated robust diagnostic performance, with a sensitivity of 88% and a specificity of 81%. For diminutive rectosigmoid polyps, the NPV exceeded 90%, meeting the preservation and ıncorporation of valuable endoscopic innovations threshold required for adopting a "leave-*in situ*" strategy.[7] Although our study was not designed to alter resection strategies, these findings suggest that endoscopist-performed optical diagnosis during AI-assisted colonoscopy may be feasible in routine clinical practice. Similar diagnostic performance has been reported in prospective multicenter studies evaluating real-time optical diagnosis of colorectal polyps.[17]

Structured diagnostic frameworks may further improve optical biopsy performance. Recent studies suggest that standardized approaches – such as the "3-s rule" for high-confidence optical diagnosis – can enhance diagnostic accuracy when combined with AI assistance.[18] In an *ex vivo* study including 35 endoscopists, AI-assisted optical characterization increased high-confidence diagnostic accuracy from 78.3% to 89.8%, with the largest improvements observed among less experienced endoscopists.[18] Although such structured decision rules were not implemented in our study, these findings may inform future strategies for improving optical diagnosis in clinical practice.

While controlled trials have demonstrated promising results for AI-assisted detection and optical diagnosis, real-world validation remains comparatively limited.[19,20] Soleymanjahi et al.[21] emphasized the importance of pragmatic evaluations beyond efficacy trials. Our findings contribute to this emerging evidence by demonstrating improved adenoma detection and stable diagnostic performance in a heterogeneous patient population representative of routine clinical practice. In addition, network meta-analyses indicate that improvements in adenoma detection appear consistent across different CADe platforms, suggesting that the observed benefit is not restricted to a specific device.[22] It should be noted that, as the present study employed a commercially available CADe system, detailed technical specifications regarding the underlying algorithm (e.g., architecture, training data) were not accessible to the investigators; this limitation should be considered when interpreting the findings.

Recent real-world investigations have also raised the possibility of unintended consequences associated with AI implementation. A retrospective study evaluating CAD integration reported that although ADR and PDR improved with AI-assisted colonoscopy, detection rates in non-AI procedures performed after AI introduction declined compared with the pre-implementation baseline.[23] This phenomenon may reflect changes in endoscopist attention or increased reliance on AI alerts. Although our study was not designed to evaluate such carryover effects, this observation highlights the importance of careful implementation strategies and ongoing quality monitoring.

Several limitations should be acknowledged. First, although the relative increase in ADR was substantial, the absolute increase was modest, consistent with pooled estimates reporting absolute improvements of approximately 5–10% depending on baseline ADR and study design.[24] Second, the non-randomized weekly alternation design, while pragmatic, may introduce temporal confounding despite the comparable case mix observed between groups; residual confounding cannot be entirely excluded. Third, the single-center design may limit generalizability to other settings with different patient populations or endoscopist experience levels. Fourth, long-term effects on interval CRC incidence cannot be evaluated in this study. Fifth, cost-effectiveness was not assessed, although previous modeling studies suggest potential economic benefits of AI-assisted colonoscopy in screening programs.[25] Finally, as a pragmatic study using a commercial CADe platform, detailed technical parameters of the AI system were not available for analysis, which precludes algorithm-specific comparisons.

Despite these limitations, the study has several strengths. The pragmatic design reflects routine clinical workflow, participating endoscopists were experienced and evenly distributed between study groups, histopathology served as the reference standard, and multivariable analysis confirmed the independent association between AI assistance and improved adenoma detection. Moreover, the simultaneous evaluation of CADe performance and endoscopist-performed optical biopsy within the same cohort provides a comprehensive assessment of AI integration into routine colonoscopy practice.

Overall, these findings suggest that integration of AI-based detection and endoscopist-performed optical characterization into routine colonoscopy is feasible and may improve detection of colorectal neoplasia without compromising procedural efficiency.

CONCLUSION

In this prospective pragmatic comparative study of 2,122 colonoscopies, integration of real-time CADe into routine colonoscopy practice was associated with a significant increase in ADR from 13% to 19%. Endoscopist-performed optical characterization during AI-assisted colonoscopy demonstrated reliable diagnostic performance, with an NPV exceeding 90% for diminutive rectosigmoid polyps. These findings suggest that AI-assisted colonoscopy may be feasible in routine clinical practice, although further multicenter studies with longer follow-up are required to determine whether improved detection translates into sustained reductions in CRC incidence and mortality.

DECLARATIONS

Ethics Committee Approval: The study protocol was approved by the Kayseri City Hospital Non-Interventional Clinical Research Ethics Committee (Approval No: 585; September 26, 2025).

Informed Consent: Written informed consent was obtained from all participants before colonoscopy.

Conflict of Interest: The authors declare that there is no conflict of interest.

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