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Serrated polyps in colorectal cancer prevention: prevalence, characteristics and clinical insights from a large retrospective cohort study

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Abstract

Background Colorectal carcinoma (CRC) screening has historically centered on the detection and removal of adenomas; however, serrated polyps, particularly sessile serrated polyps (SSPs), are increasingly acknowledged as pivotal contributors to CRC pathogenesis. This study comprehensively evaluates the prevalence, morphological characteristics, and clinical significance of serrated polyps.

Methods A retrospective analysis of colonoscopies (2017–2022) was performed. Detailed demographic, clinical, endoscopic, and pathological data were reviewed, comparing serrated polyps with adenomas and hyperplastic polyps in terms of prevalence, morphology, size, location, and dysplasia.

Results Among 22,175 colonoscopies, 5,836 polypectomies met inclusion criteria. Serrated polyps comprised 3.0% of all polyps and were predominantly proximal (88.5%) and flat (24.4%), with high-grade dysplasia in 21.3%. The mean age of patients with serrated polyps was 54.6 ± 8.1 years, and there was a female predominance (52.9%) compared to adenomas (39.8%, $p < 0.001$). A trend of lower detection rates among Arabs (2.08%) compared to Jewish patients (3.25%, $p = 0.072$) was observed. Fecal immunochemical testing (FIT) positivity was associated with elevated adenoma detection (32.3%) but not serrated polyp detection (3.2%).

Conclusions This study highlights our practice's low detection rate of serrated polyps, emphasizing the need for increased awareness and improved diagnostic practices. The high prevalence of flat lesions and elevated rates of dysplasia underscore the critical role they play in the prevention of CRC. The observed potential ethnic disparities and limitations of FIT suggest the need for targeted efforts to enhance detection and management practices.

Keywords Serrated polyps, Colorectal carcinoma, Sessile serrated polyps, Adenomas, Hyperplastic polyps, Colonoscopy, Polyp detection, High-grade dysplasia, Flat lesions

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Introduction

Colorectal carcinoma (CRC) poses a significant global health challenge, necessitating effective screening strategies that focus on detecting and removing premalignant lesions [1, 2]. While conventional adenomas have historically dominated the landscape of post-polypectomy surveillance, recent decades have highlighted the pivotal role of serrated polyps, specifically sessile serrated polyps (SSP), in the intricate process of colorectal carcinogenesis [3, 4].

Torlakovic et al. revolutionized our understanding of colorectal pathology by identifying a distinct neoplastic subgroup within hyperplastic polyps, thereby coining the term "sessile serrated adenoma" [5]. This nomenclature, including interchangeable terms like sessile serrated polyp, has evolved. The World Health Organization (WHO) now classifies serrated colonic neoplasia into distinct entities: hyperplastic polyps (HPs), sessile serrated lesions (SSLs) with or without dysplasia, traditional serrated adenomas (TSAs), and serrated adenomas, unclassified [6]. Notably, the distribution of these lesions exhibits site-specific tendencies, with sessile serrated lesions being more prevalent in the right colon and hyperplastic polyps more commonly found in the left colon [7].

Despite these advancements in classification, a substantial gap remains in knowledge regarding the prevalence and clinical relevance of SSPs and hyperplastic polyps [8]. The challenge lies in the scarcity of data on the frequency of these lesions and in the intricate task of accurately diagnosing and distinguishing between hyperplastic polyps and sessile serrated lesions [9]. This diagnostic conundrum introduces a layer of complexity to colorectal surveillance, as misclassification may impact the precision of surveillance intervals and potentially harm patient outcomes [10].

Unlike the well-established and widely accepted measures for adenoma detection, the realm of serrated polyps remains uncertain. While adenoma detection rates (ADRs) serve as benchmarks for systematic colonoscopy inspection, the detection of serrated polyps lacks a standardized metric, leading to a range of reported values [11, 12]. This absence of a universally accepted standard for serrated polyp detection is particularly pronounced in our practice, where the true prevalence of these lesions remains to be determined.

This retrospective study aims to bridge the critical knowledge gap by comprehensively analyzing a large dataset to elucidate the prevalence, distinctive features, and clinical significance of serrated polyps in comparison to other polyp types.

Methods

Study design and setting

This retrospective study spans 5 years (2017–2022) and focuses on patients undergoing colonoscopy at the Gastroenterology Department of Hillel Yaffe Medical Center, a university-affiliated hospital in Israel. The electronic records of patients with complete endoscopic and pathology data were meticulously reviewed to evaluate the prevalence, characteristics, and detection rates of adenomatous, hyperplastic, and serrated polyps. This offered a comprehensive analysis of their clinical and histological profiles.

Inclusion and exclusion criteria

The study included patients undergoing their first colonoscopy, excluding individuals under 18 years of age, those with a history of prior colectomy, or those with a personal history of CRC or other abdominal tumors. Endoscopic procedures that did not involve polypectomies or cases with incomplete or missing critical endoscopic or pathological data were excluded from the final analysis. Additionally, only procedures achieving cecal intubation and classified as having adequate bowel preparation were included. Bowel preparation quality was assessed using the Aronchick Scale, a validated, widely used grading system based on the visual clarity of the colonic mucosa during colonoscopy. Preparations were categorized as adequate (excellent, good, or fair) if they allowed for reliable lesion detection without requiring early repeat examination. Preparations rated as poor or inadequate—characterized by large amounts of solid stool or significant residual fluid obscuring visualization—were considered inadequate for the purposes of this study and were excluded.

Data collection

Demographic data, including age, sex, and ethnicity, were extracted from electronic medical records. Ethnicity was categorized, according to the Israeli Central Bureau of Statistics, into two major groups: Arabs and Jews. Relevant endoscopic data were also retrieved, encompassing bowel preparation quality, depth of examination, and detailed descriptions of polyp morphology (sessile, pedunculated, flat), location (proximal colon, distal colon, or rectum), and size (< 5 mm, 5–10 mm, and > 10 mm). Pathological findings were comprehensively reviewed for polyp classification, histological grade determination, and differentiation between dysplastic and non-dysplastic lesions, with specific attention to the presence of high-grade dysplasia (Fig. 1).

Comparative analysis

A detailed evaluation of serrated polyps was conducted to determine their prevalence and comprehensively

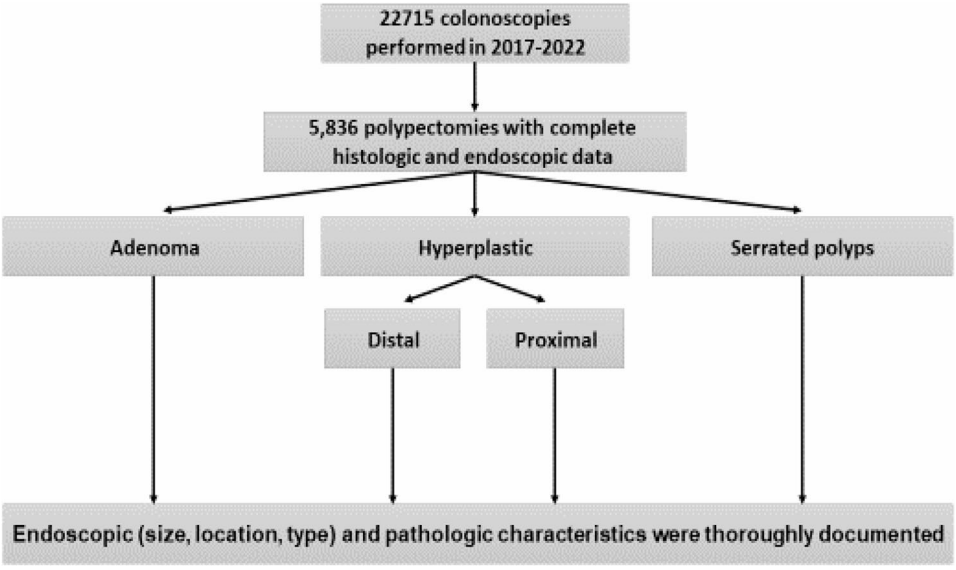

Fig. 1 Study algorithm for inclusion and classification of colorectal polyps. From 22,175 colonoscopies performed between 2017 and 2022, 5,836 polypectomies with complete histologic and endoscopic data meeting inclusion criteria were analyzed. Polyps were categorized as adenomatous, hyperplastic, or serrated based on pathology. Hyperplastic polyps were further classified by location. Endoscopic and histologic characteristics were systematically documented for all included cases

characterize their endoscopic and histological features. Polyps were categorized into three groups: adenomas, hyperplastic (non-serrated) polyps, and serrated polyps, based on histological criteria. Demographic, endoscopic, and pathological characteristics were compared across groups.

Statistical analysis

Categorical variables were summarized using descriptive statistics and analyzed with chi-square or Fisher's exact tests, as appropriate. Continuous variables were presented as means with standard deviations or medians with interquartile ranges, depending on data distribution, and analyzed using t-tests or non-parametric equivalents. A multivariable logistic regression model was constructed to identify independent predictors of serrated polyps relative to adenomatous polyps. Variables included were age, sex, ethnicity, polyp location (proximal vs. distal), morphology (flat vs. other), and colonoscopy indication (positive FIT vs. other), based on univariate significance ($p < 0.10$) and clinical relevance. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were reported. Results were visualized using a forest plot with a logarithmic scale centered at OR = 1.0, where OR > 1 indicated predictors favoring serrated polyps. All statistical analyses were performed using SPSS software, with significance defined as $p < 0.05$.

Results

Of the 22,175 colonoscopies performed during the study period, 5,836 polypectomies with complete endoscopic and histologic data met inclusion criteria. Adenomas constituted the majority (74.0%), comprising 3,297 tubular, 885 tubulovillous, and 137 villous adenomas. Hyperplastic polyps accounted for 1,343 cases (23.0%), while serrated polyps were identified in 174 cases (2.98%).

Serrated polyps were predominantly located in the proximal colon (88.5%) and were most commonly sessile (65.5%) or flat (20.1%), with 8.6% pedunculated. Their size distribution included 60.9% measuring 5–10 mm, 27.2% >10 mm, and 7.4% <5 mm. High-grade dysplasia (HGD) was observed in 21.3% of serrated polyps. In 32.5% of cases, serrated polyps co-occurred with synchronous adenomas or hyperplastic polyps (Fig. 2).

The mean age of patients with serrated polyps was 54.6 ± 8.1 years, significantly lower than in those with adenomas (58.7 ± 8.7, $p < 0.001$) but higher than in those with hyperplastic polyps (51.9 ± 9.2, $p < 0.001$). Serrated polyps were more frequent in females (52.9%), in contrast to adenomas (60.2% males, $p < 0.001$) and hyperplastic polyps (54.6% males, $p = 0.03$). Jewish patients constituted the majority across all groups, with a higher proportion in the serrated group (86.8%) compared to adenomas (78.0%) and hyperplastic polyps (83.1%, $p < 0.001$). Serrated polyp detection rates were lower among Arabs (2.08%) than Jews (3.25%), a non-significant trend ($p = 0.072$) (Table 1).

Serrated polyps exhibited a marked proximal predominance (88.5%) versus 41.9% in adenomas and 18.9% in

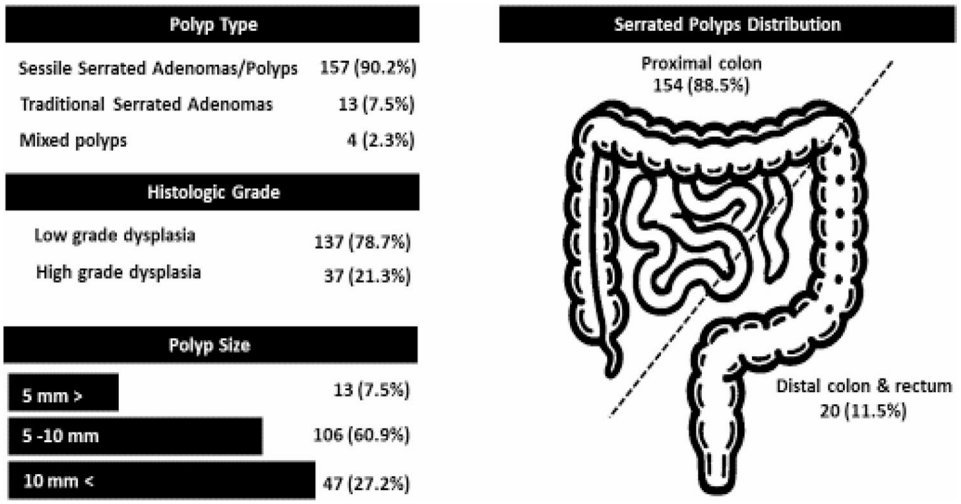

Fig. 2 Characteristics and distribution of serrated polyps in the study cohort. This figure summarizes key features of the 174 serrated polyps identified in the cohort. Most were sessile serrated lesions, 5–10 mm in size, showed low-grade dysplasia, and were located in the proximal colon

Table 1 Comparative characteristics of adenomas, hyperplastic, and serrated polyps. This table summarizes the demographic features, polyp morphology, anatomical location, and histologic findings across the three polyp subtypes. *P1* denotes comparisons between serrated and adenomatous polyps, while *P2* refers to comparisons between serrated and hyperplastic polyps. Values are presented as absolute numbers with corresponding percentages in parentheses

Variable	Adenomas (*n* = 4319)	Hyperplastic (*n* = 1343)	Serrated (*n* = 174)	*P*-Value (P1, P2)
Age	58.7 ± 8.7	51.9 ± 9.2	54.6 ± 8.1	$P^{1,2}$<0.001
Sex (male)	2600 (60.2%)	734 (54.6%)	82 (47.1%)	$P^{1,2}$<0.001
Ethnicity (Jewish)	3373 (78.0%)	1116 (83.1%)	151 (86.8%)	$P^{1,2}$<0.001
Polyp Location (proximal colon)	1813 (41.9%)	255 (18.9%)	154 (88.5%)	$P^{1,2}$<0.001
Shape (Sessile)	3007 (69.6%)	1125 (83.8%)	114 (65.5%)	$P^{1,2}$<0.001
Shape (Pedunculated)	777 (18.0%)	107 (7.9%)	15 (8.6%)	P^1 < 0.001; P^2 = 0.14
Shape (Flat)	332 (7.7%)	62 (4.6%)	35 (20.1%)	$P^{1,2}$<0.001
Shape (Undefined)	203 (4.7%)	50 (3.8%)	10 (5.7%)	$P^{1,2}$ >0.05
Size (< 5 mm)	1749 (42.1%)	1048 (78.0%)	13 (7.4%)	$P^{1,2}$<0.001
Size (5–10 mm)	1455 (33.7%)	189 (14.0%)	106 (60.9%)	$P^{1,2}$<0.001
Size (> 10 mm)	849 (19.6%)	51 (3.9%)	47 (27.2%)	$P^{1,2}$<0.001
Size (Undefined)	198 (4.6%)	55 (4.1%)	8 (4.6%)	$P^{1,2}$ >0.05
High grade dysplasia	802 (18.6%)	6 (0.5%)	37 (21.3%)	$P^{1,2}$<0.001

hyperplastic polyps ($p < 0.001$ for both). Flat morphology was more frequently observed in serrated polyps (24.4%) than in adenomas (7.7%) or hyperplastic polyps (4.6%, $p < 0.001$), although sessile morphology remained the most common across all types.

Age-stratified analysis revealed a progressive increase in detection rates for both adenomas and serrated polyps. Adenoma detection rose from 16.8% (< 40 years) to 36.9% (> 60 years), while serrated polyp detection increased from 1.4 to 4.2% across the same age strata (Fig. 3).

Analysis by colonoscopy indication demonstrated that ADR was highest following positive FIT (32.3%), followed by screening (21.4%) and rectal bleeding (20.1%). Serrated polyp detection, in contrast, was more uniform across indications, ranging from 1.8% (constipation) to 3.2% (positive FIT), and did not show a notable increase in FIT-positive cases (Fig. 4).

To identify independent predictors of serrated polyps, a multivariable logistic regression model was constructed comparing serrated to adenomatous polyps. Increasing age (OR 0.92; 95% CI 0.89–0.96; $p < 0.001$), male sex (OR 0.68; 95% CI 0.52–0.88; $p = 0.004$), and positive FIT (OR 0.72; 95% CI 0.54–0.96; $p = 0.03$) were independently associated with lower odds of serrated histology. Proximal location was independently associated with increased odds of serrated histology (OR 1.24; 95% CI 1.02–1.51; $p = 0.03$). Arab ethnicity (OR 1.41; 95% CI 0.96–2.08; $p = 0.08$) and flat morphology (OR 1.38; 95% CI 0.93–2.04; $p = 0.11$) showed non-significant trends toward association. These findings are depicted in Fig. 5.

Discussion

This study is the first in our practice to comprehensively investigate the prevalence and detection rates of serrated polyps, representing a significant step toward

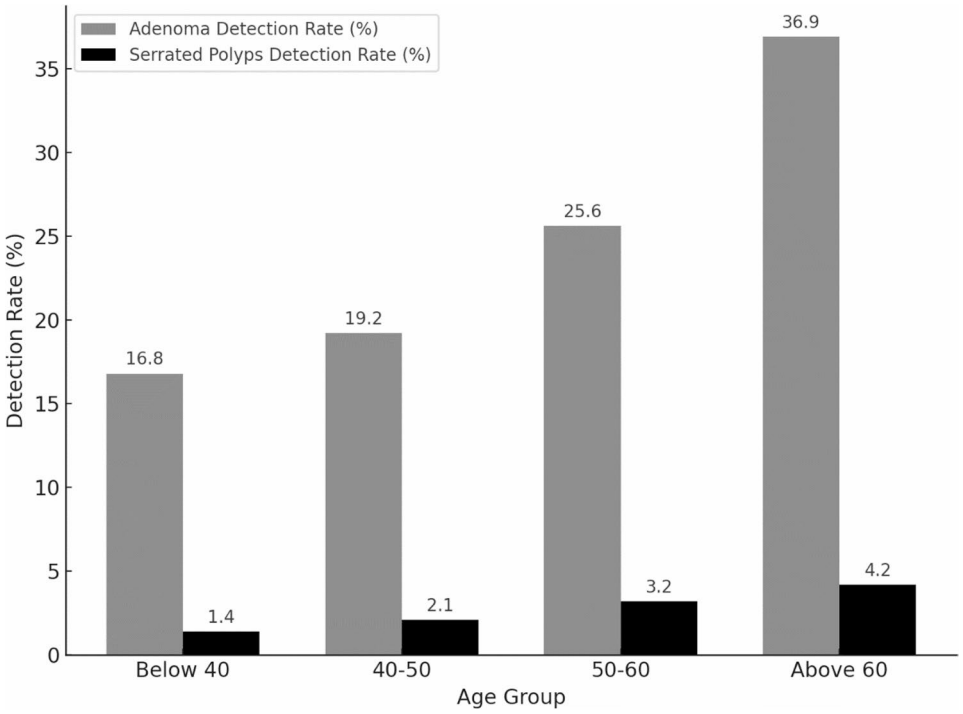

Fig. 3 Age-Dependent Trends in Detection Rates of Adenomas and Serrated Polyps. Both adenomas and serrated polyps demonstrated a progressive increase in detection rates across age groups. Adenoma detection rose markedly from 16.8% in patients under 40 years to 36.9% in those above 60, while serrated polyps showed a more modest increase from 1.4–4.2%. These findings highlight the shared influence of age on neoplastic detection, yet also underscore the persistently lower detection yield of serrated lesions across all age strata

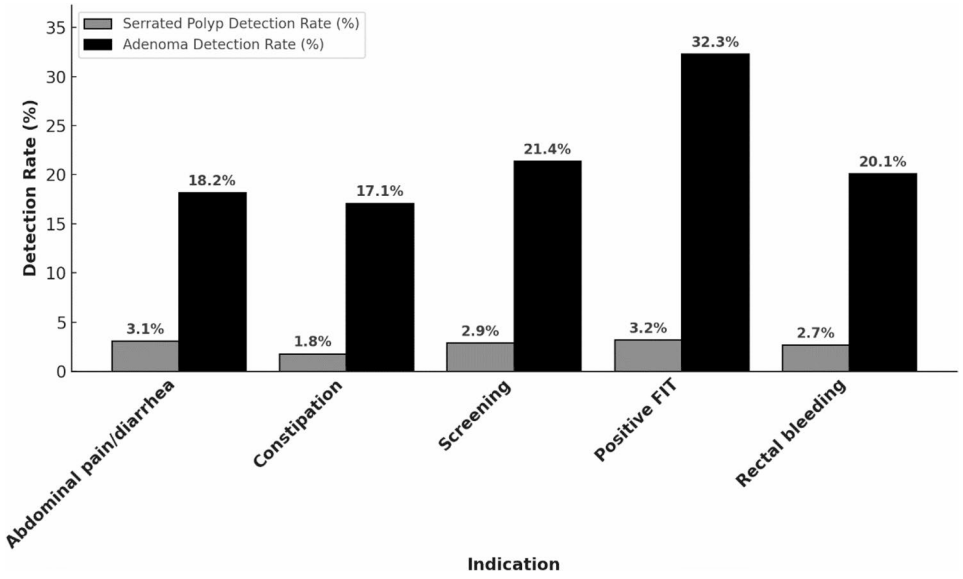

Fig. 4 Adenoma and Serrated polyps' detection rates by indication for colonoscopy. Detection rates of adenomas and serrated polyps are shown across common colonoscopy indications. Adenoma detection was highest among FIT-positive patients, while serrated polyp rates remained uniformly low across all indications

raising awareness and encouraging further research in this critical yet underexplored area of colorectal cancer prevention. Missed or misclassified serrated lesions have important clinical implications, including increased risk of interval cancers and surveillance errors, underscoring the need for rigorous detection protocols. The detection rate of serrated polyps in our cohort, at 3%, is notably lower than the pooled prevalence of 4.6% reported in a systematic review of global studies and falls short of the benchmarks achieved in high-performance examinations

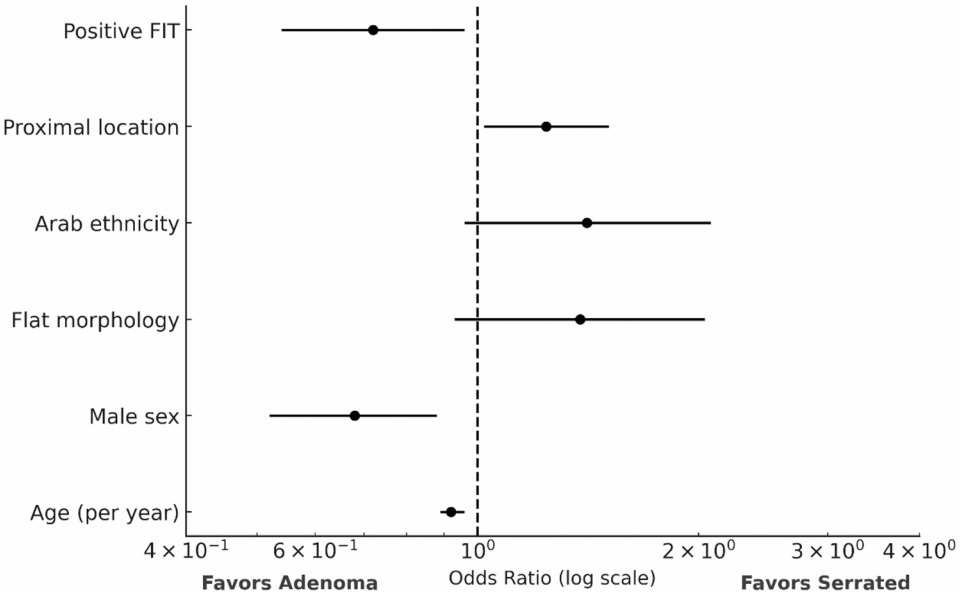

Fig. 5 Multivariable Logistic Regression Model for Predictors of Serrated Versus Adenomatous Polyps. Forest plot showing adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for predictors of serrated versus adenomatous colorectal polyps. The x-axis is plotted on a log scale and centered at OR = 1.0. Predictors with OR > 1 are associated with increased odds of serrated polyps (relative to adenomas), while OR < 1 favors adenomatous histology

where detection rates exceed 9% in some cases [13, 14]; current consensus now recommends a minimum sessile serrated lesion detection rate of 6% to optimize screening quality [15].

Several factors may contribute to the relatively low detection rate of serrated polyps observed in our cohort. While all included procedures met criteria for adequate bowel preparation—defined as fair to excellent on the Aronchick scale—the study lacked access to other key colonoscopy quality indicators. Specifically, data on individual endoscopist experience, procedural volume, and withdrawal time—factors known to significantly influence detection of flat or subtle lesions—were not systematically recorded or available for analysis. Although experienced staff supervised all procedures, many were performed by trainees, which may have introduced variability in detection performance. Importantly, despite these limitations, the overall adenoma detection rate in our cohort exceeded widely accepted benchmarks, suggesting that the low serrated polyp detection rate may reflect a true under-recognition of these lesions rather than general procedural quality deficits.

One critical consideration is the potential misclassification of some serrated polyps—particularly those located proximally—as hyperplastic polyps. This may reflect both limited awareness of the serrated pathway among pathologists and incomplete specimen retrieval during polypectomy, where inadequate sampling of the polyp base can obscure serrated features. Variability in the detection of serrated polyps often stems from a combination of endoscopic and pathological challenges [16]. Enhanced endoscopist training, stricter pathology protocols, and consideration of specimen-handling techniques are essential to improve diagnostic accuracy.

Our findings also demonstrate an age-associated increase in serrated polyp detection, mirroring trends observed with adenoma detection rates; this further emphasizes the need to optimize lesion recognition across all age groups to strengthen colorectal cancer prevention strategies. However, in the multivariable model, increasing age was independently associated with lower odds of serrated histology (OR 0.92, $p < 0.001$), suggesting that while detection of both adenomas and serrated polyps increases with age, age is more strongly associated with adenomatous lesions. Similarly, male sex was associated with decreased likelihood of serrated histology (OR 0.68, $p = 0.004$), reinforcing prior observations that serrated lesions are relatively more common in females.

We observed a high prevalence of flat serrated lesions (24.4%), which exceeds the proportions typically reported for conventional adenomas or hyperplastic polyps and is consistent with other studies highlighting the diagnostic challenges posed by flat morphology [17, 18]. These lesions are prone to camouflage by the surrounding mucosa, particularly in the proximal colon, making them more likely to be overlooked endoscopically [19]. While flat morphology showed a non-significant trend toward serrated histology in the multivariable model (OR 1.38, $p = 0.11$), its potential clinical relevance should not be dismissed.

In indication-based analysis, the detection rates of serrated polyps showed minimal variability across clinical

indications. Notably, a positive FIT, which was strongly associated with a significantly elevated adenoma detection rate (32.3%), did not yield a corresponding increase in serrated polyp detection (3.2%). This discrepancy highlights the distinct biological and clinical characteristics of serrated polyps compared to adenomas, as well as the inherent limitations of FIT in identifying serrated lesions [20, 21]. This is supported by our multivariable analysis, in which positive FIT was independently associated with lower odds of serrated histology (OR 0.72, $p = 0.03$), likely reflecting the reduced bleeding propensity of these lesions [22].

We also noted a significant disparity in serrated polyp detection rates between Jewish and Arab patients, with lower rates among the latter group. While this may reflect our center's demographic composition, it raises the possibility of ethnic differences in polyp biology or healthcare access. Although Arab ethnicity was not independently associated with serrated histology (OR 1.41, $p = 0.08$), the trend toward increased odds warrants further investigation. The absence of patient-level risk factors, such as family history, smoking status, or body mass index (BMI), limits our ability to explore potential confounders that might explain these disparities. Future studies should include comprehensive risk factor assessment to ensure equitable screening outcomes.

Recent prospective randomized trials have shown that artificial intelligence–based computer-aided detection (CADe) systems achieve higher serrated polyp detection rates and lower miss rates compared with routine colonoscopy [23–25]. Given our 3% detection rate, integrating AI-assisted tools could help us approach established benchmarks and reduce the likelihood of missed serrated lesions.

Despite its strengths, including a large and diverse cohort and comprehensive pathology review, this study has several limitations. The retrospective single-center design introduces inherent biases. We did not standardize criteria for assessing polyp morphology, which risks subjectivity in distinguishing between flat and sessile lesions. There was no central pathology review or immunohistochemical confirmation of serrated lesions, and incomplete specimen retrieval could have led to underdetection. Additionally, tiny hyperplastic-appearing polyps may not have been resected, introducing selection bias. The study lacked patient-level risk factor data and did not include long-term follow-up to assess clinical outcomes such as interval cancer incidence. Future multicenter, prospective studies with standardized endoscopic, pathological, and epidemiological protocols, as well as longitudinal follow-up, are needed to validate and extend our findings.

In conclusion, this study offers valuable insights into the prevalence and characteristics of serrated polyps in our practice, highlighting critical areas for improvement in detection and management. The multivariable analysis underscores the distinct profile of serrated polyps in terms of age, sex, endoscopic features, and indication. These findings lay the groundwork for future research and quality-improvement initiatives aimed at enhancing the detection of serrated lesions and ultimately improving colorectal cancer prevention [26].

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None.

Authors' contributions
Fadi Abu Baker: conception and design, analysis and interpretation of the data, formal analysis, critical revision of the article for important intellectual content; final approval of the article. Rawi Hazzan: conception and design; analysis and interpretation of the data; drafting of the article; critical revision of the article for important intellectual content; final approval of the article. Oren Gal, Mifleh Tatour, Baruch Ovadia, Dorin Nicola, Randa Taher study design; critical revision of the article for important intellectual content; final approval of the article.

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Data availability
The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to restrictions from HYMC as it contains information that could compromise the privacy of research participants.

Declarations

Ethics approval and consent to participate
This study was performed in accordance with the Helsinki Declaration and Rules of Good Clinical Practice. The study was approved by the Hillel Yaffe medical center (HYMC) review board, protocol code HYMC-0020-24. The HYMC ethics committee waived the need to obtain Informed consent for the collection, analysis, and publication of data for this retrospective, non-interventional study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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