Safety of first surveillance colonoscopy at 12 months after piecemeal endoscopic mucosal resection of large non-pedunculated colorectal lesions

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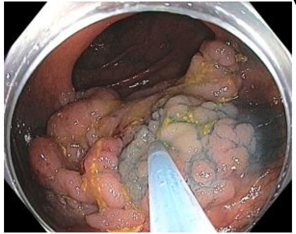
Safety of first surveillance colonoscopy at 12 months after piecemeal endoscopic mucosal resection (pEMR) of large non-pedunculated colorectal lesions

Included Lesions (n=561)



6 Month Recommendation (n=490)

12 Month Recommendation (n=71)

Completed follow-up between 2 and ≤10 months (n=461)

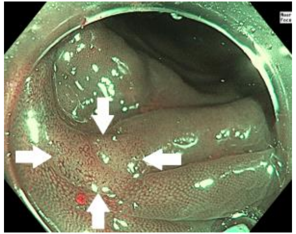
Completed follow-up between >10 and 36 months (n=29)

Completed follow-up between >10 and 36 months (n=71)

Actual 6 month follow-up group (n=461)

Actual 12 month follow-up group (n=100)

Overall recurrence rates (%, 95% CI):
Actual 6 months: 10.0 (7.5 – 13.0)
Actual 12 months: 9.0 (4.5 – 15.8)



Median size of recurrence, mm (Q1, Q3):
Actual 6 months: 10.0 (7, 12.5)
Actual 12 months: 4.0 (2.5, 5.5)

Cancer and high-grade dysplasia (HGD) at follow-up:
Actual 6 months: 1 with cancer, 0 with HGD
Actual 12 months: 0 with cancer or HGD

Conclusion: 12 month initial surveillance after piecemeal EMR of large (≥ 20 mm) non-pedunculated colorectal lesions is safe for selected lesions

Abstract:

Background and Aims: After piecemeal endoscopic mucosal resection (pEMR) of nonpedunculated colorectal lesions ≥ 20 mm, guidelines recommend first endoscopic surveillance at 6 months. However, initial surveillance at 12 months may be adequate for selected low-risk lesions, and could save the cost, risk and inconvenience of one surveillance examination.

Methods: We retrospectively examined a prospectively collected database of all colorectal lesions referred to our center for endoscopic resection between August 2019 and April 2023. We report recurrence rates of colorectal lesions ≥ 20 mm removed by pEMR who were assigned to 6-month first surveillance or assigned to 12-month first surveillance (or assigned to 6-month but did not return until after 10 months).

Results: There were 561 nonpedunculated lesions ≥ 20 mm that underwent first follow-up, including 490 lesions in 443 patients assigned to 6-month, and 71 lesions in 65 patients assigned to 12-month surveillance. Lesions assigned to 12-month surveillance were smaller (mean size 25.9 ± 6.1mm vs. 37.0 ± 17.4mm), more likely serrated (63.4% vs. 9.6%), and more often removed by cold pEMR (74.6% vs 20.4%). Twenty-nine lesions in 24 patients assigned 6-month surveillance presented after 10 months and their recurrence data were included in the group assigned 12-month surveillance.

Overall recurrence rates at 6 months and 12 months were 10.0% (46/461) and 9.0% (9/100), respectively. Mean recurrence sizes at 6 and 12 months were 10.9 ± 6.2mm and 4.2 ± 1.9mm, respectively. One patient in the 6-month surveillance group had cancer at the pEMR site, but no other recurrences at 6 or 12 months had either cancer or high-grade dysplasia.

Conclusion: Twelve-month surveillance appears acceptable for selected colorectal lesions ≥ 20 mm removed by pEMR. A randomized trial comparing initial 6-month to 12-month surveillance is warranted for selected lesions.

Introduction

The US Multi-Society Task Force on Colorectal Cancer recommends that patients with nonpedunculated colorectal lesions ≥ 20 mm in size and removed piecemeal should have an initial follow-up surveillance colonoscopy 6 months after endoscopic resection[1],[2]. However, some data suggest the risk of recurrence is low in selected lesions within this category, particularly lesions 20-30 mm in size without high grade dysplasia[3]. Further, the risk of cancer in serrated lesions is only 1/7 that of adenomas of comparable size[4], and serrated lesions are relatively slow growing with recurrence more likely detectable when the initial follow-up is at 12 months compared to 6 months[5].

In our center, we have practiced selective initial follow-up at 12 months for large serrated lesions removed piecemeal for some time[5], and have added 12-month follow-up for selected nonpedunculated adenomas removed piecemeal in recent years. A 12-month initial surveillance has certain advantages in lower cost, lower procedure and sedation-related risk, and greater convenience for patients. Thus, when the initial surveillance is at 6 months, the typical sequence of follow-up examinations is 6 months, 18 months, 54 months, and 114 months after the initial resection. When the initial surveillance is at 12 months, the typical sequence is 12 months, 48 months, and 108 months after the initial resection. Thus, an initial 12-month surveillance eliminates the need for 1 follow-up examination. Potential downsides of an initial 12-month surveillance interval include the theoretical risk of a delay in the diagnosis of cancer at initial follow-up, and the possibility of recurrences having either a large size that is more difficult to manage, or advanced histology compared to recurrences identified at 6 months.

In this paper, we describe our experience in a prospective study of the safety of initial 12-month surveillance after piecemeal endoscopic mucosal resection (pEMR) of selected nonpedunculated colorectal lesions ≥ 20 mm in size.

Methods

This was a retrospective review of a prospectively collected database on all patients referred to the senior endoscopist for resection of colorectal lesions between August 2019 and April 2023. This database is maintained as a quality database to ensure follow-up of patients and establish best practices. For purposes of this report, we obtained approval from the Institutional Review Board at Indiana University on June 21, 2023, to examine the de-identified database for the safety and efficacy of initial 12-month surveillance.

Lesions were excluded if the referred lesion was identified by pathology as other than an adenoma or serrated lesion, or if it was pedunculated, <20mm in size, unable to be resected endoscopically, removed en bloc, resected using the full-thickness resection device (FTRD) or by endoscopic submucosal dissection (ESD), referred for surgery because of cancer identified by pathology after complete resection, operated for delayed perforation, or did not return for first follow-up at our center. Lesions were excluded if they occurred in patients who completed first follow-up outside the 2 to 36 month interval designated for inclusion.

Patients were assigned to initial surveillance examination at 6 months or 12 months at the discretion of the senior endoscopist. In general, assignment to a 12-month interval was more likely for lesions 20-30 mm in size, serrated lesions, and lesions without high grade dysplasia (when the pathology report returned).

Patients who were recommended a 6-month follow-up were included in the 6 month follow up group if their first follow up occurred between 2 months and ≤ 10 complete months after the initial resection. Patients assigned to a 12-month follow up were included in the 12-month group if their initial follow up occurred after 10 full months and up to 36 months after initial resection. For purposes of comparing recurrence rates and recurrence characteristics, we included these patients in the surveillance interval group according to their actual time of first follow-up rather than the assigned interval at the time of resection.

Most lesions underwent initial resection using conventional inject and resect EMR. The submucosal injection fluid was either one of several viscous commercial fluids or hydroxyethyl starch. Hot EMR was performed using stiff snares (Captivator II, Boston Scientific, Marlborough, MA) usually of 15-25 mm in size [6]. Hot avulsion was used to resect flat or fibrotic tissue that resisted snare resection [7],[8]. For cold EMR, the same injection fluids were used with a dedicated 10 mm snare (Captivator Cold; Boston Scientific)[5]. In selected cases underwater EMR (UEMR) was performed without injection, and in all cases with electrocautery [9]. Whenever piecemeal resection was performed with electrocautery (conventional or UEMR), snare tip soft coagulation current was used to thermally treat the normal margin after all resection was completed [10-12], except in a small group of patients who were randomized to no margin treatment or margin treatment with argon plasma coagulation as part of a randomized controlled trial [12].

The primary outcome was the recurrence rate in lesions returning for first surveillance at 12 months, with the 6-month group as a comparator. EMR sites were inspected with white light and narrow band imaging and optical magnification. Pit patterns were used to distinguish recurrence from clip artifact. If there was visible tissue on the site consistent with the histology of the original lesion (adenoma vs serrated) the site was considered to have a visible recurrence regardless of whether the recurrence was confirmed by histology. This accounted for the potential of electrocautery (used to treat nearly all recurrences regardless of whether the initial resection was hot or cold) to destroy tiny visible recurrences. If there was no visible recurrence, EMR sites were usually biopsied along the scar using cold forceps. If there were multiple recurrences on the site, the maximum sizes of each recurrence were added to determine the size of the recurrence for that lesion.

Statistical analysis

Patient demographics and lesion characteristics are reported according to the follow-up interval to which patients were assigned. To compare lesion characteristics among the two groups, chi-square test and fisher's exact test were used for categorical variables, and student's t-test and Mann–Whitney U test were used for continuous variables, as appropriate. Recurrence rates are reported with 95% confidence intervals according to interval at which the first follow-up actually occurred. Jeffreys binomial procedure was used to calculate confidence intervals. The level of significance was set at 0.05. All analyses were conducted using SPSS 29 (IBM, New York, United States).

Results:

During the study interval from August 2019 until April 2023, there were 1594 lesions in 1306 patients referred to our center for endoscopic resection of a colorectal lesion. Figure 1 shows the flow of patients through the study. A total of 1033 lesions were excluded (Figure 1), leaving 561 nonpedunculated colorectal lesions ≥ 20 mm in 506 patients that were resected piecemeal and underwent at least 1 follow-up at our center in the time interval designated for inclusion.

Table 1 shows that there were 490 lesions in 443 patients assigned by the endoscopist to an initial 6-month follow-up, and 71 lesions in 65 patients assigned to an initial 12-month follow-up. Lesions that were assigned to a 12-month follow-up were smaller, more likely to be serrated, and more likely to undergo cold pEMR rather than pEMR with electrocautery. All included lesions were removed piecemeal, with 73% removed using electrocautery (Table 1), including 9% removed by piecemeal underwater EMR. Among included lesions without endoscopically visible recurrence, 78% underwent cold biopsy of the EMR scar at first follow-up.

Table 2 shows the features of lesions and patients that crossed over from their assigned post resection follow-up interval to the other interval group based on when they actually presented for follow-up. None of the patients assigned to a 12-month interval presented for follow-up at less than 10 complete months after the initial resection. There were 24 patients with 29 lesions that were assigned to a 6-month postresection interval but presented for their first surveillance more than 10 months after initial resection. These lesions were similar to other lesions assigned to a 6-month follow-up interval, and included 8 lesions with high grade dysplasia. These lesions were considered to be in the 12-month surveillance group for purposes of calculating recurrence rates. Only one of these 29 lesions ultimately had a recurrence at first follow-up.

Table 3 shows the recurrence rates for all lesions returning to our center for follow-up at 6 months versus 12 months, as well as the recurrence rates within the serrated group, within the adenomas, and within lesions with high grade dysplasia. Similar recurrence rates were observed at 6 months and 12 months. There was one lesion with cancer at follow-up 6.2 months after initial resection. The original lesion was a 40 mm traditional serrated adenoma in the ascending colon with high grade dysplasia identified in the pathology specimen. There were no other recurrences at 6 months or 12 months with either cancer or high grade dysplasia in the recurrence.

Larger lesion size was associated with recurrence in the 6 month but not the 12 month follow-up groups (Table 4). Most recurrences were endoscopically visible and verified by pathology after resection at follow-up (Table 5). This included 34 out of 46 lesions (73.9%) in the 6-month group and 7 out of 9 lesions (77.8%) in the 12-month follow-up group. In the 6-month group, there were 3 lesions (6.5%) that were endoscopically evident, but not verified by histology, and 9 lesions (19.6%) that were not endoscopically visible and were identified by pathology. In the 12-month group, 7 lesions (77.8%) were endoscopically evident and verified by pathology, 2 lesions (22.2%) were endoscopically evident and not verified by pathology, and no lesions were identified only by biopsy of the pEMR scar. Visible recurrences seen at 6 months were larger than those identified in the first follow-up at 12 month group ($p<0.001$; Table 5). All visible recurrences were treated endoscopically, except for the one patient with cancer, who underwent surgical resection. Surgery identified a T3 well-differentiated cancer 1.7 cm in maximum size with 1/35 lymph nodes positive on pathological examination. No distant metastasis was identified.

Discussion

In this prospective assessment of consecutive nonpedunculated lesions ≥ 20 mm, we demonstrated that selected nonpedunculated lesions ≥ 20 mm removed piecemeal can have their initial follow-up at 12 months without adverse outcomes. Lesions assigned to a 12-month initial surveillance interval were typically 20–30 mm in size and more often sessile serrated lesions.

Adenoma recurrence after EMR is variable depending on technique[13] although with the introduction of margin ablation the rate of recurrence of conventional piecemeal EMR with electrocautery is < 10% when performed by expert endoscopists[10],[11]. Several factors have been shown to predict recurrence. One Australian study of 1178 lesions identified size greater than ≥ 40 mm, high grade dysplasia, and intraprocedural bleeding as risk factors[14]. A more recent study developed a model with more accurate prediction of recurrence utilizing the variables size > 40 mm, right colon location, tubulovillous histology, and piecemeal resection[15].

Few data exist regarding the safety and recurrence outcomes at 12 months compared to 6 months for piecemeal EMR. One retrospective chart review of 200 patients published only as an abstract examined a standard interval (mean 164 days) versus extended interval (mean 512 days) for first surveillance and found the extended interval was safe with no higher risk of high grade dysplasia on follow-up. Notably, this study had unusually high recurrence rates in their standard interval (39.4%) while the recurrence rate of the extended interval was 14.9%[16]. A randomized trial that sought to determine if a 3 month follow up was superior to 6 months failed to demonstrate efficacy for an earlier follow up. Most of the recurrences in this study were endoscopically present at 6 months thus the authors argue that this may be the optimal surveillance interval; however, this study featured only adenomas with a median size 25 mm and overall recurrence rate was approximately 14%[17].

In our study, overall recurrence rates in the 12 month (9.0%) and 6 month (10%) surveillance groups were similar, while recurrences identified at 12 months were smaller than recurrences identified at 6 months. However, the two groups of lesions assigned to 6 months vs 12 months were quite different (Table 1). Importantly, the group assigned to 6 months had mean size 11 mm larger than the lesions assigned to 12 months, and increasing size is the most important predictor of recurrence. Second, the 12 month group was more likely to undergo cold EMR, which is associated with a higher recurrence rate when applied to large non-pedunculated adenomas[18]. Thus, the 6 month group is more a general comparator group than a true control group, and direct comparisons of recurrence rates and the size of recurrences in the two groups are problematic. The key result of this report is that there was no safety signal in a select group of patients with large non-pedunculated colorectal lesions removed piecemeal who did not undergo surveillance until 12 months post resection. Specifically, the absolute overall rate of recurrence in this select group was acceptable at 9%, recurrences were small, and no recurrence bore cancer or high grade dysplasia. These results suggest that selected nonpedunculated lesions ≥ 20 mm can be assigned an initial 12-month surveillance interval with safety and equal efficacy, compared to performing a 6-month surveillance colonoscopy initially in all nonpedunculated colorectal lesions ≥ 20 mm. EMR recurrences can be effectively and safely managed with standard polyp resection techniques[6, 19].

Our data suggest that reasonable criteria to define a subset of nonpedunculated lesions ≥ 20 mm that would be candidates for assignment of a 12-month initial surveillance interval would be size 20–30 mm and absence of high grade dysplasia. Our results suggest lesions in this subset should be considered for a randomized controlled trial comparing 6 to 12-month follow-up, or for additional observational studies of planned 12 month follow-up. If a 12-month initial surveillance is proven safe for certain large non-pedunculated lesions removed piecemeal, it could eliminate one surveillance examination for some patients with large non-pedunculated lesions, resulting in lower cost, lower procedural risk, lower carbon emissions and plastic waste, and less inconvenience to those patients. Thus, while lower recurrence rates are a potential cost advantage for endoscopic submucosal dissection (ESD) over EMR (because lower recurrence rates could require fewer follow-up colonoscopies), initial 12 month follow-up after EMR would partly negate this cost advantage of ESD[20]. There is an increasing awareness of the environmental cost of endoscopy[21]. One study found that 45% of the carbon emissions from a single endoscopy procedure are related to the travel of staff and patients[22]. Eliminating a surveillance colonoscopy would provide a positive environmental impact especially for referral centers with patients that may have significant travel burdens, in addition to the plastic waste generated, energy consumed, etc. of the actual procedure. Complications from colonoscopy are rare; however, there is risk associated with any procedure and reducing the number of procedures would reduce the risk of complications[23].

Limitations of this study include that the resections were performed by a single expert endoscopist, which could limit generalizability. However, the recurrence rates were comparable to a variety of other studies of recurrence after pEMR of large nonpedunculated lesions, and we used the 6-month follow-up lesions as an internal comparator group. Although the baseline lesions in the 6 and 12-month surveillance intervals are different in several regards, the key comparison is the features of the recurrences at 6 vs. 12-month follow-up. As noted above, , there was no safety signal concerning the features of recurrences at an initial 12-month follow-up. Strengths of this study include the prospective collection of data, and the large number of patients included.

In summary, we demonstrated in a prospective analysis that an initial 12-month surveillance interval is safe for selected nonpedunculated lesions ≥ 20 mm in size removed piecemeal. Our data suggest that reasonable criteria to define a subset of nonpedunculated lesions ≥ 20 mm that would be candidates for assignment of a 12-month initial surveillance interval would be size 20–30 mm and absence of high-grade dysplasia. We recommend a randomized trial comparing the outcomes of 6 vs. 12-month surveillance for this select group of large nonpedunculated colorectal lesions.

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Table 1. Patient demographics, lesion features, and removal method according to the assignment by the endoscopist to 6 vs 12-month interval for first follow-up after piecemeal endoscopic mucosal resection (pEMR)

	6 Months:	**12 Months:**	**p-value:**
Demographics:			
Total Patients, N	443	65‡	
Mean Age, y (SD, range)	65.4 (9.8, 28-90)	64.1 (11.1, 33-84)	0.311
Sex, n (%)			0.017
Male	220 (49.7%)	22 (33.8%)	
Female	223 (50.3%)	43 (66.2%)	
Race, n (%)			0.483
White	346 (78.1%)	48 (73.8%)	
Black	13 (2.9%)	1 (1.5%)	
Other/Unavailable	84 (19.0%)	16 (24.6%)	
Ethnicity, n (%)			0.480*
Hispanic or Latino	2 (0.5%)	0	
Not Hispanic or Latino	357 (80.6%)	49 (75.4%)	
Unavailable	84 (19.0%)	16 (24.6%)	
Total Lesions, N	490	71	
Lesion Size, mm			
Mean (SD)	37.0 (17.4)	25.9 (6.1)	<0.001†
Median (Q1, Q3)	30.00 (25, 40)	25.00 (22, 28)	<0.001††
Min-Max	20-150	20-50	
Polyp Histology, n (%)			<0.001*
Serrated	47 (9.6%)	45 (63.4%)	
Adenomatous	440 (89.8%)	26 (36.6%)	
Cancer	3 (0.6%)	0	
High Grade Dysplasia (HGD), n (%)	97 (19.8%)	4 (5.6%)	0.004
Paris Classification, n (%)			0.703**
Sessile:	191 (39.0%)	26 (36.6%)	
Is	99 (20.2%)	20 (28.2%)	
Isp	7 (1.4%)	2 (2.8%)	
Is+IIa	85 (17.3%)	4 (5.6%)	
Flat:	299 (61.0%)	45 (63.4%)	
IIa	292 (59.6%)	44 (62.0%)	
IIb	0	1 (1.4%)	
IIc	0	0	
IIa+IIb	1 (0.2%)	0	
IIa+IIc	6 (1.2%)	0	
Primary Lesion Location, n (%)			0.111***
Proximal Colon:	405 (82.7%)	64 (90.1%)	
Appendiceal Orifice	6 (1.2%)	0	
Cecum	100 (20.4%)	15 (21.1%)	
Ileocecal valve	41 (8.4%)	3 (4.2%)	
Ascending	152 (31.0%)	30 (42.3%)	

Hepatic Flexure	32 (6.5%)	2 (2.8%)	
Transverse	74 (15.1%)	14 (19.7%)	
Distal Colon:	85 (17.3%)	7 (9.9%)	
Splenic Flexure	4 (0.8%)	1 (1.4%)	
Descending	16 (3.3%)	1 (1.4%)	
Sigmoid	18 (3.7%)	4 (5.6%)	
Rectosigmoid	3 (0.6%)	1 (1.4%)	
Rectum	44 (9.0%)	0	
Removal Method, n (%)			<0.001
Hot Resection	390 (79.6%)	18 (25.4%)	
Cold Resection	100 (20.4%)	53 (74.6%)	

‡Two patients had polyps assigned 6 months and 12 months
†Student’s t
††Independent-Samples Mann-Whitney U Test
*Fisher’s exact test
**for the comparison of sessile/flat lesions
***for the comparison of proximal colon lesions/distal colon lesions

Table 2. Patient and lesion features of patients assigned to a 6-month interval for their initial follow-up who presented after 10 months post piecemeal endoscopic mucosal resection for their initial follow-up

	6 Month Crossover:
Demographics:	
Total Patients, N	24
Mean Age, y (SD, range)	61.0 (7.9, 44-73)
Sex, n (%)	
Male	9 (37.5%)
Female	15 (62.5%)
Race, n (%)	
White	19 (79.2%)
Black	1 (4.1%)
Other/Unavailable	4 (16.7%)
Ethnicity, n (%)	
Hispanic or Latino	0
Not Hispanic or Latino	19 (79.2%)
Unavailable	5 (20.8%)
Total Lesions, N	29
Lesion size, mm	
Mean (SD)	33.1 (15.4)
Median (Q1, Q3)	28.0 (25, 37.5)
Min - Max	20-90
Polyp Histology, n (%)	
Serrated	2 (6.9%)
Adenomatous	27 (93.1%)
High Grade Dysplasia (HGD), n (%)	8 (27.6%)
Paris Classification, n (%):	
Sessile:	15 (51.7%)
Is	8 (27.6%)
Isp	0
Is+IIa	7 (24.1%)
Flat:	14 (48.3%)
IIa	14 (48.3%)
IIb	0
IIc	0
IIa+IIb	0
IIa+IIc	0
Primary Lesion Location, n (%)	
Proximal Colon:	24 (82.8%)
Appendiceal Orifice	0
Cecum	4 (13.8%)
Ileocecal Valve	3 (10.3%)
Ascending	12 (41.4%)
Hepatic Flexure	4 (13.8%)

Transverse	1 (3.4%)
Distal Colon:	5 (17.2%)
Splenic Flexure	0
Descending	1 (3.4%)
Sigmoid	2 (6.9%)
Rectosigmoid	1 (3.4%)
Rectum	1 (3.4%)
Removal Method, n (%)	
Hot Resection	21 (72.4%)
Cold Resection	8 (27.6%)

Table 3. Recurrence rates overall and within the adenomas and serrated lesions separately among lesions according to whether they presented for initial follow-up in the 6-month vs 12-month windows.

Histology	**6 month group** n/N (%, 95% CI)	**12 month group** n/N (%, 95% CI)	**p-value**
Total Lesions, N	461	100	
Overall Recurrence:	46/461 (10.0%, 7.5-13.0)	9/100 (9.0%, 4.5-15.8)	0.766
Serrated Recurrence:	6/45 (13.3%, 5.8-25.4)	6/47 (12.8%, 5.5-24.4)	0.936
Adenoma Recurrence:	40/413 (9.7%, 7.1-12.8)	3/53 (5.7%, 1.6-14.3)	0.454*
Cancer Recurrence:	0/3	0/0	n/a
Recurrence of lesions with HGD on initial resection	11/92 (12.0%, 6.5-19.7)**	0/12	0.355*

*Fisher's exact test

** 92 includes 3 lesions with submucosally invasive cancer that underwent endoscopic follow-up

HGD: High grade dysplasia

Table 4. Comparison of lesions with and without recurrence according to whether they presented for first follow-up in the 6 month or the 12 month time frame

Characteristics:	**Lesions with recurrence at follow-up:**	**Lesions without recurrence at follow-up:**	**p-value:**
Lesions presenting for first follow-up at 6 months			
Total Lesions, N	46	415	
Mean Size (SD), mm	48.1 (28.9)	36.0 (15.3)	0.007*
Median Size, mm (Q1, Q3)	40.0 (30.0, 51.3)	30.0 (25.0, 40.0)	0.002†
Min – Max, mm	20-140	20-150	
Number of lesions with HGD on initial resection over total lesions in category, n/N (%)	11/46 (23.9%)	81/415 (19.5%)**	0.479
Lesions presenting for first follow-up at 12 month			
Total Lesions, N	9	91	
Mean Size, mm (SD)	24.7 (2.7)	28.3 (10.7)	0.014*
Median Size, mm (Q1, Q3)	24.0 (23.0, 27.5)	25.0 (22.0, 30.0)	0.386†
Min – Max, mm	20 - 28	20 - 90	
Number of lesions with HGD on initial resection over total lesions in category, n/N (%)	0/9	12/91 (13.2%)	0.595††

*Assuming unequal variance, t-test

†Independent samples Mann-Whitney U test

††Fisher's exact test

**The 3 lesions with cancer are included. None of the 3 lesions with cancer had a recurrence at first follow-up.

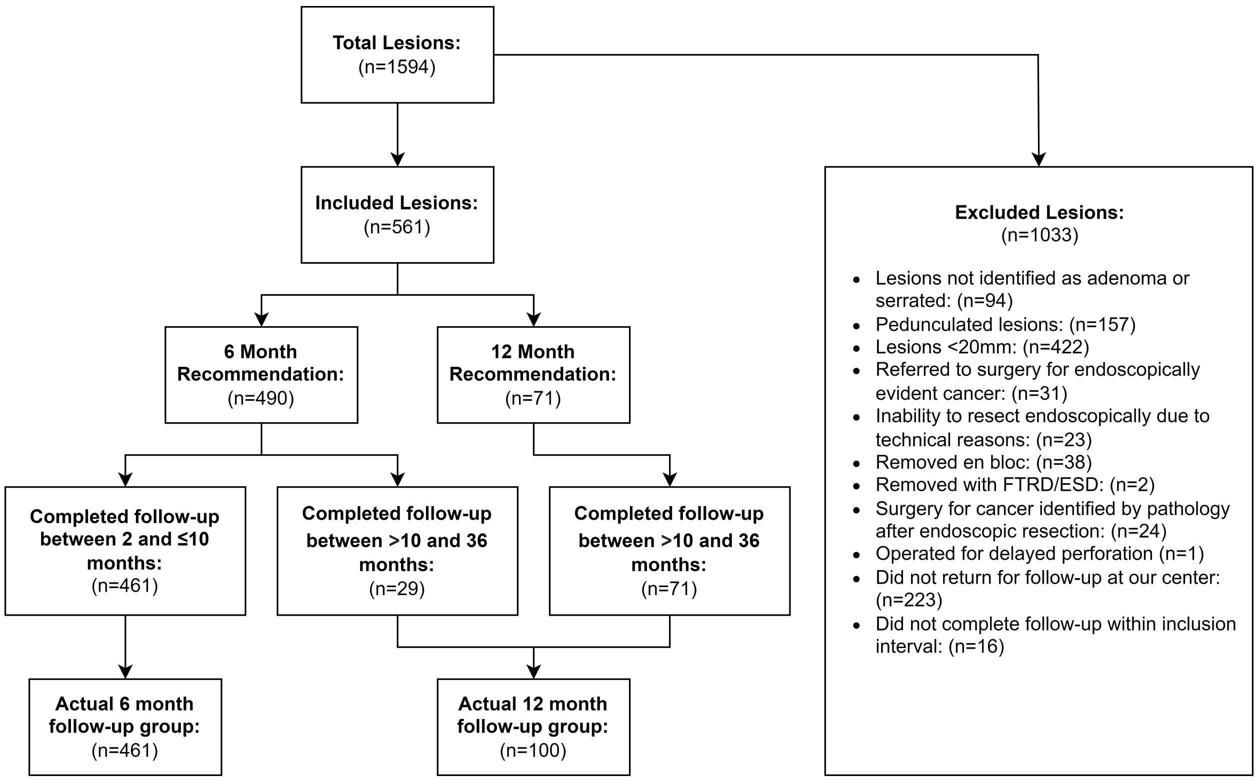
HGD: High grade dysplasia

Table 5. Features of the recurrences in lesions that underwent follow-up at 6 months and at 12 months

Classification:	**6 Month Surveillance:**	**12 Month Surveillance:**
Total number of recurrences, N	46	9
Size of visible recurrences, mm		
Mean (SD)	10.9 (6.2)	4.2 (1.9)
Median (Q1, Q3)	10.0 (7, 12.5) (n=37)	4.0, (2.5, 5.5) (n=9)
Min-Max	3 - 30	2 - 8
Types of recurrences, n/N (%)		
Visible recurrences with pathology confirmation	34/46 (73.9%)*	7/9 (77.8%)
Visible recurrence without pathology confirmation	3/46 (6.5%)	2/9 (22.2%)
Pathology recurrence (biopsy of site) without visible recurrence	9/46 (19.6%)	0/9

*includes one lesion with adenocarcinoma at first surveillance

Figure 1. Exclusion criteria and flow of patients through the study


Total Lesions:
(n=1594)
Included Lesions:
(n=561)
Excluded Lesions:
(n=1033)
Lesions not identified as adenoma or serrated: (n=94)
Pedunculated lesions: (n=157)
Lesions <20mm: (n=422)
Referred to surgery for endoscopically evident cancer: (n=31)
Inability to resect endoscopically due to technical reasons: (n=23)
Removed en bloc: (n=38)
Removed with FTRD/ESD: (n=2)
Surgery for cancer identified by pathology after endoscopic resection: (n=24)
Operated for delayed perforation (n=1)
Did not return for follow-up at our center: (n=223)
Did not complete follow-up within inclusion interval: (n=16)
6 Month Recommendation:
(n=490)
12 Month Recommendation:
(n=71)
Completed follow-up between 2 and ≤10 months:
(n=461)
Completed follow-up between >10 and 36 months:
(n=29)
Completed follow-up between >10 and 36 months:
(n=71)
Actual 6 month follow-up group:
(n=461)
Actual 12 month follow-up group:
(n=100)

Acronyms and abbreviations

EMR: Endoscopic Mucosal Resection

ESD: Endoscopic Submucosal Resection

FTRD: Full Thickness Resection Device

HGD: High Grade Dysplasia

Max: Maximum

Min: Minimum

mm: millimeters

pEMR: Piecemeal Endoscopic Mucosal Resection