ORIGINAL ARTICLE

Laparoscopic wedge resection as an alternative to laparoscopic oncological colon resection for benign endoscopically unresectable colon polyps

Carla Christine Maria Marres[1,2] | Marieke P. C. M. Smit[1] | Jarmila D. W. van der Bilt[1,2] |
Christianne J. Buskens[2] | Marco W. Mundt[3] | Paul C. M. Verbeek[1] |
Willem A. Bemelman[2] | Anthony Willem Hendrik van de Ven[1,2]

[1]Department of Surgery, Flevoziekenhuis, Almere, The Netherlands

[2]Department of Surgery, Amsterdam UMC, University of Amsterdam, Amsterdam, The Netherlands

[3]Department of Gastroenterology and Hepatology, Flevoziekenhuis, Almere, The Netherlands

Correspondence
Carla Christine Maria Marres, Meibergdreef 9, 1105 AZ Amsterdam, The Netherlands.
Email: c.c.m.marres@amsterdamumc.nl

Funding information
None.

Abstract

Aim: The aim of this study was to investigate, by comparing clinical and histological outcomes, whether laparoscopic (hybrid) wedge resection (LWR) could be a less invasive and safe alternative to laparoscopic oncological colon resection (OCR) for patients with an endoscopically unresectable, suspected benign, colon polyp.

Method: All patients with an endoscopically unresectable colon polyp who were referred for surgery between 2009 and 2018 and without biopsy-proven colon cancer were identified from a prospectively maintained database. Patients with macroscopic features of malignancy during endoscopy were excluded. Clinical and histological results for patients who underwent OCR or LWR were reviewed.

Results: One hundred-and-twenty-two patients were included. Ninety-seven patients underwent OCR and 25 LWR. Major complications occurred in 16.7% ($n = 16$) of the OCR group compared with 4.0% ($n = 1$) of the LWR group ($p = 0.06$). In the OCR group the anastomotic leakage rate was 6.3% ($n = 6$) and the mortality rate 3.1% ($n = 3$). No anastomotic leakage or deaths occurred in the LWR group. The median length of hospital stay after OCR was 5 days [interquartile range (IQR) 5–9 days)] compared with 2 days (IQR 2–4 days) after LWR ($p < 0.0001$). Definite pathology showed a malignancy rate of 4.2% ($n = 4$) in the OCR group and 4.0% ($n = 1$) (without high-risk features) in the LWR group.

Conclusion: This study shows that LWR was associated with significantly lower complication rates and acceptable oncological risks compared with OCR. Therefore we suggest that LWR is a safe alternative treatment, next to other endoscopic options. The treatment that is most suitable for an individual patient should be discussed in a multidisciplinary meeting.

KEYWORDS
colon polyps, colorectal surgery, laparoscopic

INTRODUCTION

In 2014, a national bowel cancer screening programme was introduced in the Netherlands with the aim of improving early detection of colon cancer and the overall survival of bowel cancer patients. After the start of this programme a major increase in patients with benign colon polyps being referred for an oncological colon resection (OCR) was demonstrated [1]. A decrease was seen in the postoperative malignancy rate of this group, from 14.1% prior the introduction of the screening programme to 6.6% after the introduction in 2014. The overall malignancy rate is low amongst suspected benign colon polyps if Kudo's pit pattern classification is used for differentiation of colorectal polyps [2]. Over the past years several advanced endoscopic techniques have been developed for the resection of large colon polyps, including (piecemeal) endoscopic mucosal resection [(p)EMR], endoscopic submucosal dissection (ESD) and endoscopic full-thickness resection (eFTR) [3–6]. Despite these advanced techniques there will still be patients who are referred for surgery. Up to now, most resections for these patients have been performed according to oncological principles without preoperative histological diagnosis of a malignancy. Despite advances in surgical techniques and improved specialization, OCRs are still associated with a complication rate of between 19% and 35%, including an anastomotic leakage rate of 2%–7% and a mortality rate between 2% and 4% [7,8].

An alternative to OCR is a hybrid laparoscopic wedge resection (LWR), in which a combined endoscopic and laparoscopic approach is used to remove only a small full-thickness wedge (by which a transmural specimen is obtained) of the colon at the site of the polyp. No lymph nodes or mesocolon are resected, so in case of an unexpected malignancy an additional oncological resection with lymph node resection might be needed.

The aim of this study was to investigate whether LWR is a safe alternative to the current OCR for endoscopically unresectable benign colon polyps.

METHOD

This study is a retrospective cohort study from a prospectively maintained database of all colon resections for benign and malignant disease conducted at the Flevoziekenhuis in Almere, the Netherlands. This is a teaching hospital serving a population of 200,000 and specializing in colorectal surgery. All medical records of patients who underwent colorectal surgery between January 2009 and October 2018 for a suspected benign polyp that could not be removed endoscopically were reviewed. Patients were excluded if the polyp could not be passed during the colonoscopy (polyps larger than approximately 5 cm) or if the polyp showed macroscopic signs of a malignancy. Kudo's pit pattern classification was used [9]. Endoscopic resectability of colon polyps was assessed by the endoscopist in a multidisciplinary 'polyp panel' (expert opinion). When a lesion was deemed to be not endoscopically resectable the patient was discussed in a weekly multidisciplinary gastrointestinal oncology

> **What does this paper add to the literature?**
>
> This is the first study to compare the outcome of laparoscopic wedge resection and oncological colon resection in patients with an endoscopically unresectable benign colon polyp who have been referred for surgery. The results demonstrate that the laparoscopic wedge resection should be the preferential surgical treatment for endoscopically unresectable benign colon polyps.

meeting resulting in advice for OCR or LWR. The final decision on the resection method was made in consultation with the patient, according to the principles of shared decision-making [10].

Patient characteristics collected included age, gender, body mass index (BMI), American Society of Anesthesiologists (ASA) classification and comorbidities. Pre- and postoperative polyp characteristics and pathology, type of surgery, postoperative complications and mortality were analysed.

Surgeries were performed laparoscopically by dedicated colorectal surgeons according to current oncological principles. For LWR, the patient is prepared for both surgery and colonoscopy at the same time. This includes the use of a laxative to clean the colon and improve vision during the colonoscopy, thereby increasing the chance of successful outcome of the operation. The normal routine of preoperative management for colon surgery is performed, including preoperative prophylactic antibiotic treatment with cefazoline and metronidazole 1 h prior to surgery. During LWR a small wedge or part of the colon wall with the polyp attached is resected. No lymph nodes or other tissue are resected. In all cases this operation is combined with the services of an experienced endoscopist who will perform endoscopic assistance in the same session. After the endoscopist has identified the polyp there are different ways to perform a local resection. The most often used resection was a stapled wedge resection of the bowel wall, after lifting the segment with a suture. In case of a mesenteric polyp, either a small wedge resection was performed with an anastomosis or the polyp was locally resected through an opening in the mesenteric abdominal wall, after which both defects were closed with a V-Loc suture.

Postoperatively, patients were managed according to the enhanced recovery after surgery (ERAS) protocol [11]. Postoperative complications occurring within 30 days after surgery were scored and graded according to the Clavien–Dindo classification for surgical complications [12]. Major complications were defined as grade 3b or higher. Histological analysis of the resected specimen and lymph nodes was performed according to standardized protocols. The histological results were further specified according to the TNM 5 classification, which was used at that time in the Netherlands [13]. High-risk T1 carcinomas, which require lymph node staging and thereby an additional OCR, were defined as the presence of one of the following characteristics: poorly differentiated tumour gradation, lymphovascular invasion, resection margin of less than 1 mm.

Endoscopic follow-up was performed in all patients after 1 year and then after 3 or 5 years, based on the number, size and location of the removed polyps [13].

Statistical analysis was performed using SPSS software (version 24.0; IBM, Chicago, IL). Continuous data are presented as mean values with standard deviation (SD) or as median values with the interquartile range (IQR). Discrete variables are presented as counts and percentages. Categorical data were compared between groups using the chi square test, and continuous data were compared using the independent samples *t*-test or Mann–Whitney *U*-test. A two-tailed *p*-value of <0.05 is considered statistically significant.

RESULTS

Patient demographics

A total of 122 patients with endoscopically unresectable (suspected) benign polyps were included in the study, of whom 97 underwent OCR and 25 LWR. Baseline characteristics are illustrated in Table 1. There were no significant differences between the two groups.

Clinical outcome

Major complications (Clavien–Dindo >3b) occurred in 16.7% (*n* = 16) of patients undergoing OCR compared with 4.0% (*n* = 1) of the LWR group (*p* = 0.06). The major complications in the OCR group included six patients with anastomotic leakage requiring reoperation (6.3%). Three patients underwent a relaparoscopy in suspicion of anastomotic leakage, but there were no signs of leakage per-operatively. Two of these patients who underwent a negative diagnostic laparoscopy died of cardiac and/or pulmonary complications. The death of one patient was caused by cardiac failure. One patient had a relaparoscopy because of an internal herniation, one had an iatrogenic perforation and one patient had an admission to intensive care in relation to pulmonary complications. The major complication in the LWR group was iatrogenic injury by a trocar in the small bowel in a patient with a history of abdominal surgery. The minor complication rate was 20.8% (*n* = 20) in the OCR group and 16.0% (*n* = 5) in the LWR group (*p* = 0.10). The minor complications in the LWR group consisted of two patients who had signs of tissue inflammation near the excision site; both recovered with intravenous antibiotics. One patient had an infected haematoma which required radiological drainage, and one patient needed a transfusion after rectal haemorrhage. No anastomotic leakages or deaths were reported in the patient group undergoing local excision. The median length of hospital stay in the OCR group was 5 days (IQR 5–9 days). The length of hospital stay in the LWR group was significantly shorter, with a median length of 2 days (IQR 2–4 days; *p* < 0.0001) (Table 2).

Histopathological outcome

Postoperative histopathological analysis showed a malignancy rate of 4.2% (*n* = 4) in the OCR group. Of these patients none had lymph node metastasis. Two patients had a T1 carcinoma, one was diagnosed with a T2 carcinoma and one with a T3 carcinoma. Neither of the two patients with a T1 carcinoma had any high-risk characteristics (Table 3). In the LWR group there was one patient with a T1 carcinoma without high-risk characteristics.

Follow-up

The median follow-up in the LWR group was 39 months (IQR 22–54 months) and no recurrences have been reported so far. The patient with a malignancy had a follow-up of 9 years without recurrence. In patients with high-risk colon cancer after OCR no signs of metastases or recurrences have been reported so far during routine oncological follow-up (median follow 4.5 years).

DISCUSSION

This study showed that patients who underwent a LWR experienced lower complication rates and had a significantly shorter length of hospital stay than patients who received an OCR. There was a low malignancy rate in both groups (<5%). To the best of our knowledge, this is the first study to compare LWR with OCR in patients with a benign colon polyp referred for surgery. According to the Dutch guideline for colon cancer, radical endoscopic resection is sufficient for polyps that reveal a postoperative histological result of a low-risk pT1 carcinoma. In all other cases the risk of lymph node metastases is too high, and therefore additional oncological surgery should be considered [13]. Of the 97 patients in our study who underwent an OCR only two had a high-risk carcinoma. None of the LWR group had a high-risk carcinoma. If the 122 patients in our study had had a LWR, only 1.6% would have an indication for additional surgery for further lymph node staging according to the guidelines. These results and the results in the literature prompt for good endoscopical analysis, such as good imaging after cleansing and optical analysis by an expert panel, to establish individual-based resection advice, namely (p)EMR, ESD, eFTR, LWR or OCR.

The mortality rate in the OCR group was relatively high compared with the mortality rate in all the patients undergoing an OCR in our hospital (1.3%). The higher mortality in the OCR group was due to cardiac and pulmonary complications, as mentioned previously. The complication rate is comparable with the complication rate for the total population undergoing oncological colon surgery in the Netherlands [7], but this is difficult to accept for patients who turn out to have a benign lesion, especially since the number of patients with a benign colon polyp who are referred for surgery is increasing after the introduction of the national bowel screening programme [1]. The national bowel screening programme takes the

	Oncological colon resection	Laparoscopic wedge excision	p-value
Total	N = 97 (%[a])	N = 25 (%[a])	
Age (years), median (IQR)	66 (61–72)	65 (61–70)	0.72[b]
Gender			0.10[c]
Female	37 (38.5)	10 (40.0)	
Male	60 (61.5)	15 (60.0)	
BMI (kg/m^2), median (IQR)	26.2 (24.4–29.1)	27.8 (24.8–30.7)	0.27[b]
ASA classification			0.30[c]
ASA 1	28 (29.1)	6 (24.0)	
ASA 2	51 (53.1)	12 (48.0)	
ASA 3	14 (14.6)	7 (28.0)	
ASA 4	3 (3.1)	0 (0.0)	
Preoperative pathology			0.09[c]
Tubulovillous	54 (55.6)	12 (48.0)	
Tubular	22 (22.6)	7 (28.0)	
Villous	4 (4.1)	0 (0.0)	
Other	17 (17.5)	6 (24.0)	
Dysplasia			0.87[c]
Low grade	49 (50.5)	15 (60.0)	
High grade	16 (16.5)	4 (16.7)	
Unknown	31 (32.0)	6 (24.0)	
Operation			0.38[c]
Laparoscopic	90 (92.8)	25 (100)	
Open	2 (2.1)	0 (0.0)	
Conversion	5 (5.2)	0 (0.)	
Type of OCR			
Right colectomy	66 (54.5)	-	
Left colectomy	6 (5.0)	-	
Sigmoidectomy	13 (10.7)	-	
Low anterior resection	3 (2.5)	-	
Subtotal colectomy	8 (6.6)	-	

TABLE 1 Patient characteristics

Abbreviations: ASA American Society of Anesthesiologists; BMI body mass index; IQR, interquartile range; OCR, oncological colon resection.

[a]Unless otherwise stated in the first column.

[b]Mann–Whitney *U*-test.

[c]Chi-square test.

complications after endoscopy into account in weighing the risks of the procedure against national health, but the risk of possible oncological surgery following an unresectable colon polyp is not taken into account [14].

Multiple previous studies have analysed the incidence of postoperative malignant histology in patients with endoscopically unresectable colon polyps who underwent a colon resection [15–25]. Reported malignancy rates vary between 8% and 22% and all authors conclude that an OCR is thereby the preferred treatment (Table 4). However, most studies were based on laparotomy instead of laparoscopic surgery, which makes reoperation for additional oncological resection with lymph node sampling in patients with

a >pT1 (high-risk) carcinoma more demanding. Nowadays, in the laparoscopic era, a completion lymphadenectomy within 2 weeks seems very feasible.

A few other studies have described outcomes after LWR. In the largest study, published in 2009, Wilhelm et al. [26] examined the combined laparoscopic-endoscopic resections of colorectal polyps in 146 patients. Treatments included laparoscopy-assisted endoscopic resection (n = 8), endoscopy-assisted wedge resection (n = 72), endoscopy-assisted transluminal resection (n = 40) and endoscopy-assisted segmental resection (n = 26). Postoperative complications occurred in 25% and a mortality rate of 0.7% was reported. This study included the highest number of patients who underwent a

TABLE 2 Postoperative clinical outcome

	Oncologic colon resection	Laparoscopic wedge excision	p-value
Total	N = 97 (%)	N = 25 (%)	
Malignancy rate	4 (4.2)	1 (4.0)	0.12[a]
Complications			
Clavien–Dindo >3b	16 (16.7)	1 (4.0)	0.06[a]
Clavien–Dindo <3b	20 (20.8)	5 (16.0)	0.10[a]
Anastomotic leakage	6 (6.3)	0 (0.0)	0.18[a]
Mortality	3 (3.1)	0 (0.0)	0.37[a]
Hospital stay (days), median (IQR)	5 (5–9)	2 (2–4)	<0.0001[b]

Abbreviation: IQR, interquartile range.

[a]Chi-square test.

[b]Mann–Whitney *U*-test.

TABLE 3 High risk characteristics malignancies found in patients with unresectable polyps

Characteristic	OCR			LWR
	T1N0 (n = 2)	T2N0 (n = 1)	T3N0 (n = 1)	T1 (n = 1)
Poorly differentiated tumour	0	0	1	0
Presence of lymphovascular invasion	0	1	1	0
Resection margin <1 mm	0	0	0	0
No. of harvested lymph nodes <10	0	1	0	0
Total	0	1	1	0

TABLE 4 Literature reporting the incidence of malignancy- and complication rates in patients with preoperative benign unresectable polyps who underwent an oncological colon resection

Author	Patients (N)	Malignancy (%)	Complications (%)	Anastomotic leakage (%)	Mortality (%)
Gorgun et al. (2016) [15]	439	8.0	18.9	1.1	0.0
Dulskas et al. (2015) [16]	42	9.5	9.5	0.0	0.0
Liu et al. (2013) [17]	40	67.5	5.0	NM	NM
Bertelson et al. (2012) [18]	750	17.0	NM	NM	NM
Loungnarath et al. (2010) [19]	165	13.0	23.0	2.6	1.8%
Hauenschild et al. (2009) [20]	58	0.0	9.3	NM	0.0
Itah et al. (2009) [21]	64	14.0	4.0	1.7	0.0
Benedix et al. (2008) [22]	525	18.0	20.8	3.6	0.9
Zmora et al. (2009) [23]	38	18.0	10.5	2.0	0.0
Brozovich et al. (2008) [24]	63	22.0	NM	NM	NM
Alder et al. (2006) [25]	79	16.0	37.0	NM	3.0

Abbreviation: NM, not mentioned.

similar treatment to the patients in our study. The complication rate after all local procedures seems relatively high compared with our results; however, laparoscopic techniques and further specialization have improved considerably over the past decades. Some smaller, but more recent, studies showed lower complication rates [27,28]. In 2016 [29] and 2020 [30] systematic reviews were published with available literature on all combined endoscopic and laparoscopic surgery-type procedures. All these included studies showed similar numbers of patients and results. But the most important part is that none of these studies showed a higher risk of complications than the complication rates of an OCR.

One of the limitations of this study was the retrospective study design. This resulted in an imbalance in the total number of patients included in the two groups. Patients were discussed in a multidisciplinary team where experts decided which surgical intervention was going to be performed. This method can lead to

conscious selection bias, but the finding that there are no significant differences in patient characteristics and comparable malignancy rates in both groups suggests otherwise. Another limitation is the relatively small number of patients included in this study. The strength of this study is the inclusion of consecutive patients from a single, nonacademic, nonreferral centre, which is a good reflection of daily clinical practice and the correlation of pathological findings to clinical outcome.

CONCLUSION

This study shows that LWR is a safe procedure in patients with endoscopically unresectable polyps, with both low morbidity and low and acceptable oncological risks. Therefore, we suggest that LWR is a safe alternative treatment, next to other endoscopic options ((p) EMR, ESD, eFTR), in patients with an endoscopically unresectable benign colon polyp. Which treatment is most suitable for each patient should be discussed in a multidisciplinary meeting.

CONFLICT OF INTEREST

None of the authors of this study has financial or other relationships that may cause a conflict of interest.

ETHICAL APPROVAL

The study was ethically approved by the Science Committee of our institution.

AUTHOR CONTRIBUTIONS

Design: CCMM and AWHvdV. Data collection: CCMM and MPCMS. Data analysis and interpretation: CCMM and MPCMS. Drafting the article: CCMM and MPCMS. Critical revision of manuscript: JDWvdB, CJB, MWM, PCMV, WAB and AWHvdV. Final approval: JDWvdB, CJB, MWM, PCMV, WAB and AWHvdV.

DATA AVAILABILITY STATEMENT

Data available on request due to privacy/ethical restrictions.

REFERENCES

1. Marres CC, Buskens CJ, Schriever E, Verbeek PCM, Mundt MW, Bemelman WA, et al. The impact of the national bowel screening program in the Netherlands on detection and treatment of endoscopically unresectable benign polyps. Tech Coloproctol. 2017;21(11):887–91.
2. Li M, Ali SM, Umm-a-OmarahGilani S, Liu J, Li Y-Q, Zuo X-L. Kudo's pit pattern classification for colorectal neoplasms: a meta-analysis. World J Gastroenterol. 2014;20(35):12649–56.
3. Peter V, Draganov MD. Endoscopic mucosal resection vs endoscopic submucosal dissection for colon polyps. Gastroenterol Hepatol. 2018;14(1):50–2.
4. Akintoye E, Kumar N, Aihara H, Nas H, Thompson C. Colorectal endoscopic submucosal dissection: a systematic review and meta-analysis. Endosc Int Open. 2016;4(10):E1030–E1044.
5. Schmidt A, Bauerfeind P, Gubler C, Damm M, Bauder M, Caca K, et al. Endoscopic full-thickness resection in the colorectum with a novel over-the-scope device: first experience. Endoscopy. 2015;47:719–25.
6. Richter-Schrag H-J, Walker C, Thimme R, Fischer A. Full thickness resection device (FTRD). Experience and outcome for benign neoplasms of the rectum and colon. Chir Z Alle Geb Oper Medizen. 2016;87:316–25.
7. Van Leersum NJ, Snijders HS, Henneman D, Kolfschoten NE, Gooiker GA, ten Berge MG, et al. The Dutch Surgical Colorectal Audit. Eur J Surg Oncol. 2013;39(10):1063–70.
8. Neale JA, Reickert C, Swartz A, Reddy S, Abbas MA, Rubinfeld I. Accuracy of national surgery quality improvement program models in predicting postoperative morbidity in patients undergoing colectomy. Perm J. 2014;18(1):14–8.
9. Kudo S, Tamura S, Nakajima T, Yamano H, Kusaka H, Watanabe H. Diagnosis of colorectal tumorous lesions by magnifying endoscopy. Gastrointest Endosc. 1996;44:8–14.
10. Stacey D, Hill S, McCaffery K, Boland L, Lewis KB. Shared decision making interventions: theoretical and empirical evidence with implications for health literacy. Stud Health Technol Inform. 2017;240:263–83.
11. ERAS Compliance Group. The impact of enhanced recovery protocol compliance on elective colorectal cancer resection: results from an international registry. Ann Surg. 2015;261(6):1153–9.
12. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004;240:205–13.
13. Oncoline. Cancer clinical practice guidelines. Guideline colon cancer. https://www.oncoline.nl/colorectaalcarcinoom.
14. Rijksinstituut voor Volksgezondheid en Milieu. Information on the national bowel screenings program. https://www.rivm.nl/bevolkingsonderzoek-darmkanker.
15. Gorgun E, Benlice C, Church JM. Does cancer risk in colonic polyps unsuitable for polypectomy support the need for advanced endoscopic resections? J Am Coll Surg. 2016;223(3):478–84.
16. Dulskas A, Samalavicius NE, Gupta RK, Zabulis V. Laparoscopic colorectal surgery for colorectal polyps: single institution experience. Wideochir Inne Tech Maloinwazyjne. 2015;10(1):73–8.
17. Liu JP, Huang PJ, Chen TF, Zheng ZH, Wei HB. Surgical treatment for endoscopically unresectable polyps of colon and rectum. Zhonghua Yi Xue Za Zhi. 2013;93(8):588–91.
18. Bertelson NL, Kalkbrenner KA, Merchea A, Dozois EJ, Landmann RG, De Petris G, et al. Colectomy for endoscopically unresectable polyps: how often is it cancer? Dis Colon Rectum. 2012;55(11):1111–6.
19. Loungnarath R, Mutch MG, Birnbaum EH, Read TE, Fleshman JW. laparoscopic colectomy using cancer principles is appropriate for colonoscopically unresectable adenomas of the colon. Dis Colon Rectum. 2010;53(7):1017–22.
20. Hauenschild L, Bader FG, Laubert T, Czymek R, Hildebrand P, Roblick UJ, et al. Laparoscopic colorectal resection for benign polyps not suitable for endoscopic polypectomy. Int J Colorectal Dis. 2009;24(7):755–9.
21. Itah R, Greenberg R, Nir S, Karin E, Skornick Y, Avital S. Laparoscopic surgery for colorectal polyps. J Soc Laparoendosc Surg. 2009;13(4):555–9.
22. Benedix F, Köckerling F, Lippert H, Scheidbach H. Laparoscopic resection for endoscopically unresectable colorectal polyps: analysis of 525 patients. Surg Endosc. 2008;22(12):2576–82.
23. Zmora O, Benjamin B, Reshef A, Neufeld D, Rosin D, Klein E, et al. Laparoscopic colectomy for colonic polyps. Surg Endosc. 2009;23(3):629–32.
24. Brozovich M, Read TE, Salgado J, Akbari RP, McCormick JT, Caushaj PF. Laparoscopic colectomy for apparently benign colorectal neoplasia: a word of caution. Surg Endosc. 2008;22(2):506–9.

25. Alder AC, Hamilton EC, Anthony T, Sarosi GA Jr. Cancer risk in endoscopically unresectable colon polyps. Am J Surg. 2006;192(5):644–8.

26. Wilhelm D, von Delius S, Weber L, Meining A, Schneider A, Friess H, et al. Combined laparoscopic-endoscopic resections of colorectal polyps: 10-year experience and follow-up. Surg Endosc. 2009;23:688–93.

27. Giavarini L, Boni L, Cortellezzi CC, Segato S, Cassinotti E, Rausei S, et al. Laparoscopic caecal wedge resection with intraoperative endoscopic assistance. Int J Surg. 2013;11(Suppl 1):S58–S60.

28. Leicher LW, de Vos Tot Nedervee Ncappel WH, van Westreenen HL. Limited endoscopic-assisted wedge resection for excision of colon polyps. Dis Colon Rectum. 2017;60:299–302.

29. Nakajima K, Sharma SK, Lee SW, Milsom JW. Avoiding colorectal resection for polyps: is CELS the best method? Surg Endosc. 2016;30(3):807–18.

30. Liu Z-H, Jiang LI, Chan F-Y, Li M-W, Fan J-M. Combined endo-laparoscopic surgery for difficult benign colorectal polyps. J Gastrointest Oncol. 2020;11(3):475–85.