Article published online: 2022-09-13

Endocuff Vision to Improve Adenoma Vision: A Brief Overview

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J Digest Endosc 2022;13:193–198.

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Abstract

Colorectal cancer (CRC)-related mortality can be reduced through screening and early detection. The aim of any CRC screening program is to detect as many adenomas/polyps in the early stage as possible and hence, adenoma detection rate (ADR) is a key quality indicator of colonoscopy. Various methods and techniques have been studied and developed over the years to improve the quality of colonoscopy and thereby increase ADR. This ranges from use of various regimens to improve bowel preparation, defining an optimum colonoscope withdrawal time for the operator, distal attachment caps, use of different wavelength of light, colonoscope with increased degree of view to the use of modern-day artificial intelligence to improve ADR. Of all the various measures, use of distal attachment device seems an easy, cheap and readily usable technique to increase real-time ADR. A variety of such devices have been evaluated over time starting from simple transparent caps, EndoRings, Endocuff to Endocuff Vision for their effectiveness. In this review, we have provided a brief description of the various available distal attachment devices and a detailed technical overview of Endocuff and its modification the Endocuff Vision.

Keywords

- colonoscopy
- polyp
- adenoma detection rate
- distal attachment cap
- colorectal cancer

Introduction

Colonoscopy has been the procedure of choice for polyp/adenoma detection for quite some time now. It helps decrease interval colorectal cancers[1], although its diagnostic efficacy is affected by a host of factors. A good preparation, adequate time for withdrawal, operator expertise, and a high-definition scope are some of the prerequisites for obtaining an acceptable adenoma detection rate (ADR). As demonstrated by Corley et al, ADR is a critical factor in preventing interval colon cancer[2] and hence is considered as the primary quality indicator of colonoscopy. The optimal ADR should be at least 20% for centers that run a bowel cancer screening program. Various modifications have been implemented and evaluated over the ensuing years to improve ADR. We can achieve this by either using some attachment device at the tip of the colonoscope to increase visual field, use different light wavelengths (narrow band imaging and chromoendoscopy), employ artificial intelligence or by using a scope with a better 360 degrees view (full sense colonoscope).[3] Of all the various measures, use of distal attachment device seems an easy, cheap and readily usable technique to increase real-time ADR. Most of the polyps that are missed are usually behind the folds, haustra or hidden around flexures. The attachment devices are meant to address this lacuna of a standard colonoscopy by stretching out every corner of the colonic mucosa to unfold a hidden polyp. The attachment devices that are currently available include simple transparent caps, Endo-rings and Endocuff.[4] We, in this review,

DOI https://doi.org/10.1055/s-0042-1755338.
ISSN 0976-5042.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

aim to give a brief description of the various available distal attachment devices and a detailed technical overview of Endocuff and its modification the Endocuff Vision.

Available Distal Attachments and Their Mechanism of Action

A host of different distal attachment devices are available of which the most used are transparent cap, EndoRings, and Endocuff. ►**Table 1** gives a comparative summary of these various devices.

Transparent Cap

The most commonly used attachment device is the standard transparent cap which is easily available and is mostly used for therapeutic procedures to improve visualization. It separates the endoscope tip and thus, the lens of the scope from the mucosa or area of interest by a working distance of usually around 4 mm. This facilitates optimum visualization of the target area without experiencing "red-out." The various available transparent caps manufactured by different companies (Steris Healthcare, Dublin, Ireland; Olympus Medical, Tokyo, Japan; Finemedix, Seoul, Korea; Synectics Medical Ltd., Enfield, United Kingdom) have almost similar design.

Mir et al, in their meta-analysis, compared cap-assisted colonoscopy (CAC) with standard colonoscopy (SC) and found that CAC showed statistically significant superiority in total colonoscopy time ($p < 0.01$) and time to cecum ($p < 0.01$) compared with SC. CAC also showed better polyp detection rate (PDR) ($p < 0.01$) but not ADR ($p = 0.20$). Though on sensitivity analysis, ADR was better with CAC; terminal ileum intubation and cecal intubation rates were similar between the two groups ($p = 0.11$ and $p = 0.73$, respectively).[5] Thus, transparent cap is an easy-to-use, cheap tool and can help enhance the PDR.

EndoRings

EndoRings (EndoAid Ltd, Caesarea, Israel) comprises of flexible silicone rings that are attached in three circular rows around the distal end of the colonoscope. They improve visualization of colonic mucosa by mechanically straightening colonic folds during withdrawal and by keeping the tip of colonoscope in the center of the lumen. The CLEVER study, comparing EndoRings with SC in a randomized controlled trial, demonstrated that EndoRings had significantly lower adenoma (10.4 vs. 48.3%; $p < 0.0001$) and polyp miss rates (9.1 vs. 52.8%; $p < 0.0001$) than SC, with similar cecal intubation and withdrawal times.[6] However, a similar study, the SMART trial failed to demonstrate any advantage of EndoRings over SC.[7] With two studies exhibiting contradicting data, the role of EndoRings in the enhanced polyp detection strategy needs to be still established.

Endocuff

Endocuff (Arc Medical Design, Leeds, United Kingdom) is a device made of a plastic barrel with two rows of thermoplastic elastomer spikes. This device is attached to the tip of the colonoscope, and the spikes are used to flatten the mucosal folds during withdrawal. This can enable visualization of the polyps on the reverse side of the mucosal folds and increase right-sided ADRs.

Triantafyllou et al[8], in a multicenter RCT, showed that Endocuff-assisted colonoscopy had significantly lower overall and proximal colon adenoma miss rates compared with conventional colonoscopy (14.7 vs. 38.4% and 10.4 vs. 38.9%, respectively). Though revolutionary in design, Endocuff has been described to have a few drawbacks including mucosal lacerations and erosions and difficulty in terminal ileum intubation. This paved the path for its congener, namely Endocuff Vision.

Endocuff Vision

The new, second generation Endocuff Vision (ECV), from Olympus, has some modifications over the older version as is depicted in ►**Fig. 1**. Compared with the first-generation device, the ECV has only one row of flexible arms that are softer and 2 mm longer (►**Fig. 2**). The new design is a single-use device that is made of a polypropylene cylinder with a

Table 1 Distal attachment devices

Device	Distal attachment cap	Endocuff	Endocuff Vision	EndoRings
Manufacturer	Olympus, Centre Valley, Pennsylvania 1993	Arc Medical Leeds, United Kingdom 2011	Olympus Medical, Tokyo, Japan and Arc Medical Leeds, United Kingdom, 2016	EndoAid Ltd, Caesarea, Israel, 2015
Mode of action	Protruding cap manipulates and flattens haustral folds to inspect the mucosa on the proximal side of the fold maintaining optimal field of view	Hinged projections flatten and spread mucosa and folds	Hinged projections flatten and improve visibility behind the colon folds	Sequential rings stretch out the folds of the colon during withdrawal for a clear view
Disadvantages	Interfere with the field of view	Petechial marks on colon; Potential dislodgement; Larger model more effective than smaller; Ileum intubation may be difficult	Potential dislodgement	Ileum intubation may be difficult

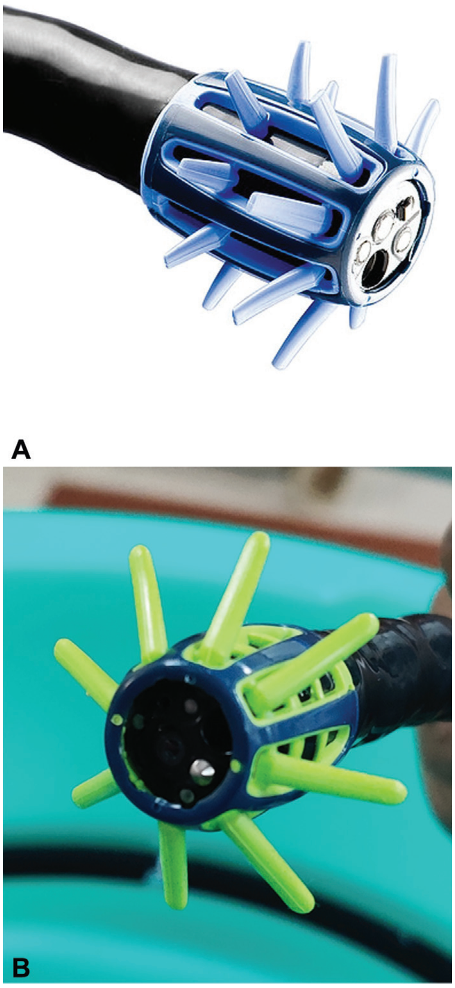

Fig. 1 **(A)** Endocuff; **(B)** Endocuff Vision. Source: https://www.red-dot.org/project/endocuff-27518

single row of eight spikes, longer than in the first generation Endocuff. There are four different color-coded sizes to fit in all scopes ranging from adult to pediatric ones (►**Table 2**). ECV is mounted at the tip of a colonoscope in the same way as the earlier version (►**Fig. 2**). It's spikes fold back while inserting the scope in the colon as there is a small hinge at the base of each spike. They help hold on to a fold and reduce the scope in case of a loop formation. It helps in early and controlled view of the upstream surface of the large colonic folds in the right colon and prevents sudden scope slip-back. This property also makes it easier for polypectomy by stabilizing the scope. After cecal intubation these spikes evert while coming back and increase the mucosal exposure with visualization behind the folds (►**Fig. 3**). Moreover, when in the sigmoid colon, the device facilitates the opening of contracted folds, permitting a clearer view of the in-between mucosa.

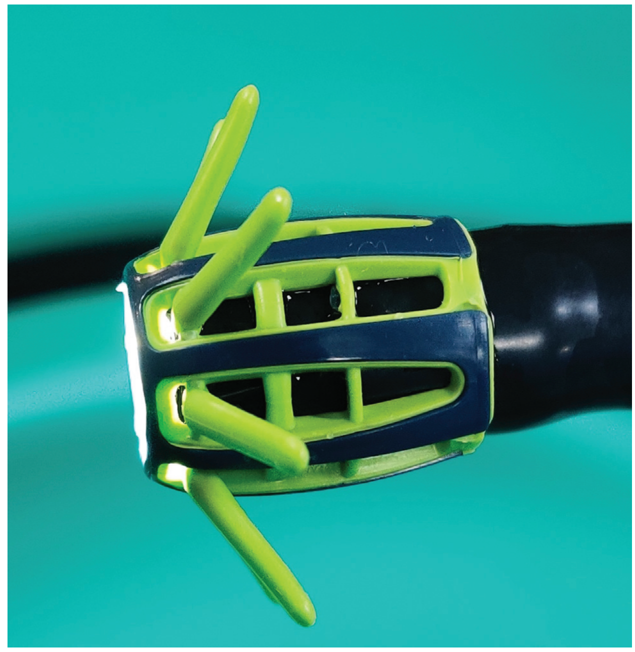

Fig. 2 Endocuff Vision mounted on the tip of a standard colonoscope: single row of spikes.

Is Endocuff Vision Better than the Original Endocuff?

Modifications of devices are aimed to improve the efficacy and reduce the adverse effects. For ECV, the data are still emerging as to whether one row is better than two. A recent network meta-analysis of 12 RCTs showed that while

Table 2 Endocuff Vision sizes and compatible scopes

Catalog number	Color	Size	Diameter (mm)	Compatible scopes
ARV110	Blue	Medium	11.0	PCF-H190DL/I
ARV120	Green	Large	11.2	CF-HQ190L/I, CF-Q180AL/I, CF-H180AL/I, CF-160 series, CF-1T 140L
ARV130	Purple	Small	10.4	PCF-H190L/I, PCF-H180AL/I, PCF-Q180, PCF-160 series
ARV140	Orange	Extra large	12.1	CF-H180DL/I

Source: https://medical.olympusamerica.com/products/endocuffvision.

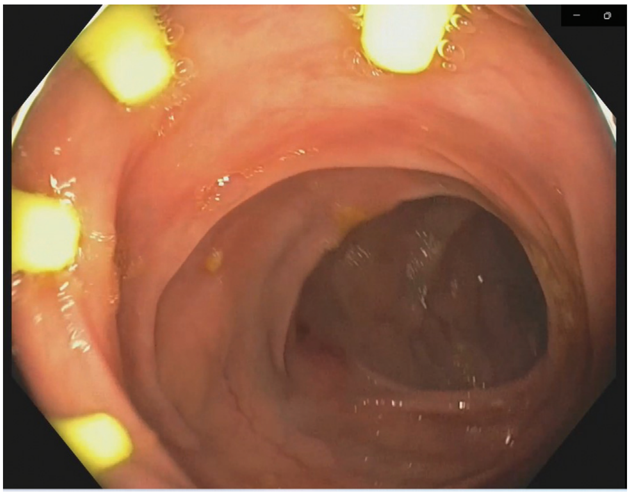

Fig. 3 Eversion of the spikes noted during withdrawal in colonoscopy to flatten the folds.

Endocuff had better ADR compared with high-definition colonoscopy (RR: 1.26; 955 CI 1.09–1.46), the same was not true for ECV (RR: 1.12; 95% CI 0.99–1.27).[9] The overall complication rates, specially lacerations/erosions were lower with ECV. While Endocuff seemed to fare better on ADR, ECV probably has a better safety profile. However, none of these studies had studied the two congeners head-to-head and thus, such trials are needed to answer this question better.

Does Endocuff Vision Score over Standard Colonoscopy?

Patel et al in their meta-analysis of eight RCTs comparing ECV with standard colonoscopy (SC) included 5,695 patients and in the final analysis, 2,862 patients (mean age, 62.8 years; 52.9% men) in the ECV group and 2,833 patients (mean age, 62.6 years; 54.2% men) in the SC group. Compared with SC, use of ECV was associated with a significant improvement in ADR (49.8 vs. 45.6%, respectively; RR, 1.12; $p = 0.02$), PDR (58.1 vs. 53%, respectively; RR, 1.12; $p = 0.009$), and adenoma per colonoscopy ($p < 0.01$). Furthermore, use of ECV had a 0.93 minute lower mean withdrawal time ($p < 0.01$) when compared with SC. The difference in ADR was larger in the screening/surveillance population (6.5%, $p = 0.02$) and when used by endoscopists with ADRs <30% (9.4%, $p = 0.03$).[10]

The ADENOMA trial by Ngu et al[11] demonstrated that ECV improved ADR from 36.2 to 40.9% ($p = 0.02$). ECV patients had higher detection of mean adenomas per procedure, sessile serrated polyps, left-sided, diminutive, small adenomas and cancers (cancer 4.1 vs. 2.3%, $p = 0.02$). Rees et al[12], in the B ADENOMA study, however did not find any significant difference due to ECV in ADR or PDR. A synopsis of the various RCTs using ECV in terms of ADR has been outlined in ►**Table 3**. Overall, ECV seemed to score over SC in terms of ADR and hence, can prove to be beneficial.

Performance of Endocuff in Various Technical Aspects

While ADR is the primary outcome assessed in any study using Endocuff, various other technical outcomes have also been reported. Rex et al[13] demonstrated that mean insertion time with Endocuff was 4.0 minutes compared with 4.4 minutes for SC ($p = 0.14$). Mean withdrawal time with Endocuff was 6.5 minutes compared with 8.4 minutes for SC ($p < 0.0001$).

Jacob et al[14] in their RCT found out that PDP was significantly higher in ECV group than SC (53% in the ECV group vs. 41.1% in SC. $p = 0.035$). However, no statistical difference was noted in terms of polyp site detection. The independent predictors of polyp detection were use of ECV, age >60 years, and withdrawal time. No complications were reported in their study and showed that if right size was used the dislodgement rate was negligible.

The ADENOMA trial[11] showed that the median intubation time was a minute faster with ECV ($p = 0.001$), but had no difference in cecal intubation rate or withdrawal time. ECV exhibited minor increase in discomfort on anal intubation with no or minimal sedation with an ECV removal rate of 4.1%. Thus, while conflicting data exist on the performance of ECV over SC in terms of cecal intubation or withdrawal time, the former performs better as far as PDR is concerned.

Table 3 Randomized controlled trials using Endocuff Vision

Author	*Year*	*Country*	*Patients (ECV/Comparator)*	*Comparison arm*	*Results (ECV/Comparator)*
Rex et al[13]	2020	United States	101/99	Standard colonoscopy	ADR (61.4 vs. 52%; $p = 0.21$)
Jacob et al[14]	2018	Australia	182/138	Standard colonoscopy	ADR (36.8 vs. 28.9%; $p =$ not significant)
Figura et al[18]	2019	Germany	118/122	Standard colonoscopy	ADR (38.1 vs. 42.6%, respectively; $p = 0.48$)
Ngu et al[11]	2017	United Kingdom	888/884	Standard colonoscopy	ADR (40.9 vs. 36.2%, respectively; $p = 0.02$)
Karsenti et al[19]	2019	France	1,026/1,032	Standard colonoscopy	ADR (39.2 vs. 29.4%, respectively; $p = 0.001$)
Rees et al[12]	2019	United Kingdom	1,610/1,612	Standard colonoscopy	ADR (13.3 vs. 12.2%, respectively; $p = 0.35$)

Abbreviations: ADR, adenoma detection rate; ECV, Endocuff Vision.

Comparison with Other Distal Attachment Devices

In the DETECT trial, by Rameshshanker R et al,[15] polyp miss rate was significantly lower in ECV (8.4%) as compared with CAC (26.1%, $p < 0.001$). Similar results were deduced for adenoma miss rate (ECV vs. CAC, 6 vs. 19%; $p = 0.002$) and diminutive adenoma (<5 mm) miss rate in the ECV group (1.8 vs. 19.6%, $p < 0.001$). However, there were no significant differences in the miss rates for small adenomas (5–9 mm) (3.7 vs. 2.9%, $p = 0.69$) or adenomas 10 mm or larger (1.6 vs. 2.6%, $p = 0.98$). The mean number of adenomas per procedure was significantly higher with ECV compared with CAC (1.5 vs. 0.8, $p < 0.001$). Cecal intubation time was significantly shorter with ECV than CAC (median 6 vs. 7 minutes, $p = 0.01$). However, withdrawal time (median 10 vs. 8 minutes, $p = 0.01$) was significantly longer in ECV.

Marsano et al[16] also looked at the benefit of different capped devices. They performed a randomized controlled trial looking at the ECV, transparent cap from Olympus, and conventional colonoscopy. In this study, the ADR of ECV stood out again with 54 versus 52% for conventional colonoscopy. Interestingly, they found that the transparent cap on ADR was of just 40%.

Overall, ECV showed slight benefit over other distal attachment devices in terms of ADR, probably more for diminutive polyps.

Caveats of the Device

The device makes the colonoscope tip wider than usual which may lead to painful anal intubation and the widened tip with the plastic fingers renders ileal intubation difficult. While no specific tip or trick has been outlined in literature, different authors have shared their experience that ileal intubation is difficult with an Endocuff device. In the authors' experience too, it was difficult to intubate the ileum. The purpose of this device is to see behind folds so that polyps are not missed in colon, ileal intubation may not be warranted while using ECV. Dislodgment can be an issue (removal rate 4.1%)[11] but it is rarely seen due to dry grip of plastic barrel over colonoscope tip.

AmplifEYE: Similar Looking Device

A device akin to ECV, with a single row of detection arms, is the AmplifEYE device (Medivators, Minneapolis, Minnesota, United States) which is less expensive. Both are U.S. FDA approved. In fact, a head-to-head trial, by Rex et al,[17] showed that both had similar ADR.

Conclusion

Overall, Endocuff, both the original and/or the newer version Vision, seems promising in enhancing ADR. It has performed better than SC alone or sometimes with other attachment devices. Multiple randomized controlled trials have been undertaken and the ADENOMA and DETECT studies are significant in this context. It is an affordable device and easy to use. Whether the single row of ECV is more efficacious than the older Endocuff is debatable, although ECV does have lower complication rates. The shortcomings include painful anal intubation, difficult ileal intubation, and a small dislodgement risk. However, more data are required before it can be recommended for regular use. In India, with the lack of a systematic bowel cancer screening program, experience with this attachment device is limited to some tertiary care centers alone. However, considering the simplicity and easy availability of the device, it may be advocated for more and more use in centers engaged with screening colonoscopies.

Authors' Contributions

J.S. contributed toward conception and design, review of literature, data analysis, drafting the work, and final approval. J.S. did the conception and design, data interpretation, intellectual review of the work, and final approval. All the authors have approved the final version of the work.

Funding

None.

Conflict of Interest

None declared.

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