

Validation of the GPAT – the Global Polypectomy Assessment Tool: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement



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ABSTRACT

Background Colorectal polypectomy is operator dependent, with variable rates of complete resection. The currently available assessment tools do not provide specific competency-based evaluation of provider technique. We aimed to validate the Global Polypectomy Assessment Tool (GPAT), a novel competency assessment tool for colorectal polypectomy.

Methods GPAT was derived from the ESGE Curriculum for Training in endoscopic mucosal resection in the colon. Members of the curriculum taskforce plus three invited trainees and three medical students (collectively: the assessors) anonymously assessed nine endoscopic-view only polypectomy videos. The primary end point was the correlation of the assessors' GPAT scores with a consensus-derived reference GPAT score per video. Secondary end points were the assessors' subjective impression versus

their GPAT score and interobserver agreement among assessors' GPAT scores.

Results 171 GPAT assessments by 19 assessors (consultant gastroenterologists [n=10], trainee gastroenterologists [n=4], consultant surgeons [n=2], and medical students [n=3]) were analyzed. Reference GPAT scores did not differ significantly from those of the assessors (73.1% [95%CI 64.6%–81.6%] vs. 69.3% [95%CI 64.9%–81.2%]; $P=0.47$). There was moderate IOA in GPAT scores among gastroenterologists (intraclass correlation coefficient [ICC], 0.52 [moderate]) but not among nongastroenterologists (ICC 0.32 [poor]). GPAT correlated with assessors' subjective impression of polypectomy quality (correlation coefficient 0.98 [95%CI 0.90–1.00]; $P<0.001$). Overall assessors' qualitative usability scoring of GPAT was positive.

Conclusions GPAT allows standardized scoring of polypectomies, with moderate IOA among gastroenterologists and correlation with subjective impressions of polypectomy quality. GPAT could standardize assessment of trainee polypectomy competency offering structured feedback on performance.

ABBREVIATIONS

CRC	colorectal cancer
CSP	cold snare polypectomy
DOPyS	Direct Observation of Polypectomy Skills
EMR	endoscopic mucosal resection
ESGE	European Society of Gastrointestinal Endoscopy
GPAT	Global Polypectomy Assessment Tool
ICC	intraclass correlation coefficient
IOA	interobserver agreement
HSP	hot snare polypectomy
PCCRC	post-colonoscopy CRC
SMSA	size, morphology, site, and access

Introduction

Colorectal cancer (CRC) can be prevented by detection and complete resection of colorectal polyps using endoscopic polypectomy [1,2]. Despite a large and growing body of published evidence on how to perform high quality polypectomy, rates of incomplete resection ranging from 1.5% [3] to 17.7% [4], even for small (<10 mm) polyps, are reported [5–7]; the situation for larger polyps is even worse [8]. Incomplete resection risks propagation of residual polyp tissue, resource intensive follow-up [9], and even post-colonoscopy CRC (PCCRC) [10–14].

The observed variation in rates of incomplete polyp resection is likely to depend on training. This currently is often experiential, unstructured, and dependent on trainers without conscious competence in the technique. High quality training requires a competency framework to allow standardized com-

munication of best practice between the trainer and trainee. The most commonly used tool to assess polypectomy competency is DOPyS [15] – a score derived in 2011, which largely focuses on subjective, nonevidence-based statements and requires significant experience for its effective use [16].

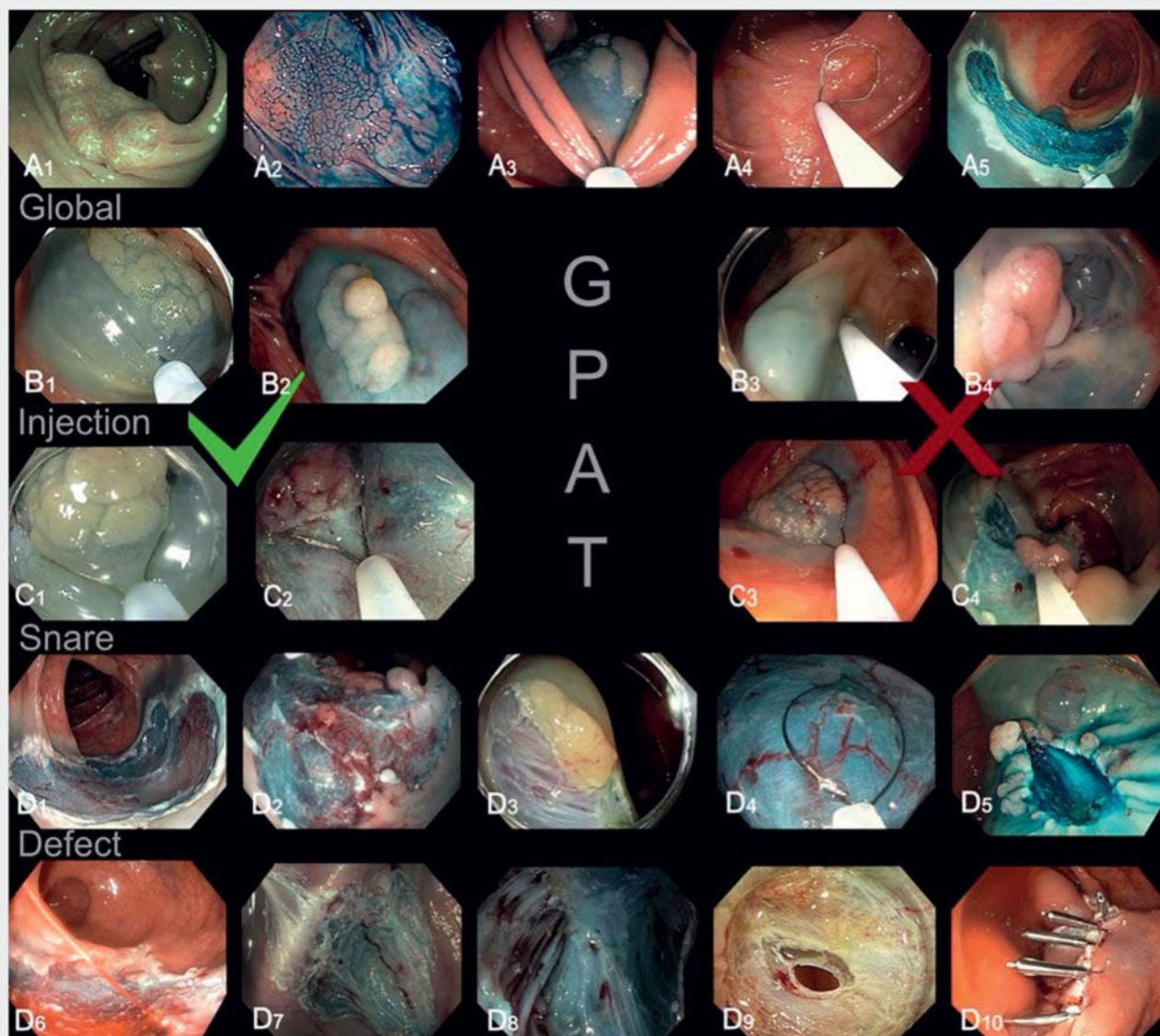
In conjunction with the development of the recent ESGE Curriculum for Training in endoscopic mucosal resection in the colon [17], we sought to develop a modern competency assessment tool (the Global Polypectomy Assessment Tool [GPAT]), based on a Delphi consensus process [18], defining best practice in all types of endoscopic polypectomy, and to validate it in a video-based study involving a varied population of endoscopists.

Methods**Development of the GPAT**

The GPAT subtaskforce (**Table 1s**, see online-only Supplementary material) selected statements from the final ESGE Curriculum for Training in endoscopic mucosal resection in the colon (**► Fig. 1**) [17] (hereafter referred to as “the Curriculum”) that focused on polypectomy technique and which could be assessed from a video. These statements were included in the preliminary GPAT.

Structure of the GPAT

The GPAT was designed so that it could be used for all types and sizes of polyps in the colon, and such that it adapts depending on whether cold snare polypectomy (CSP) or hot snare polypectomy (HSP) is performed. Certain statements that are broadly applicable were defined as mandatory for both CSP



► **Fig. 1** Example images illustrating best practice techniques (with **B3,4** and **C3,4**, poor practice examples) in endoscopic mucosal resection for: **A** global competencies; **B** injection technique; **C** snare placement technique; **D** defect assessment technique; showing: **A1,2** full appreciation/demonstration of the extent of the polyp to be resected; **A3** best positioning with respect to the polyp (at 6 o'clock, close to the colonoscope); **A4** selection of the appropriate technique for the polyp to be resected (e.g. correct decision for en bloc cold snare polypectomy in this example); **A5** tip control (controlled stable and purposeful, resulting in uniform application of snare-tip soft coagulation); **B1,2** injection performed in the correct plane, facilitating access to the lesion; **B3** transmural nondynamic injection (poor practice); **B4** nonlifting, with repeated and failed submucosal injection resulting in intramucosal blebs (poor practice); **C1** the snare oriented near to 6 o'clock, visualization of the snare V during closure, with the snare near to the colonoscope; **C2** use of the transected tissue edge as a guide (within the defect), and visualization of the snare V during closure, with the snare close to the colonoscope; **C3** the snare positioned far from the colonoscope, with too much snare extended from the sheath and no margin of normal tissue (poor practice); **C4** poor tissue capture and too far from the colonoscope (likely to result in scraping of polyp tissue and incomplete mucosal layer excision; poor practice); **D1** complete margin ablation, following systematic application with entire margin ablation achieved; **D2,4** incomplete mucosal layer excision with evidence of residual polyp tissue on islands of muscularis mucosae; **D3** residual polyp tissue at the resection margin; **D5** evidence of deep mural injury (DMI) type I, with residual polyp tissue at the defect edge, and failed submucosal injection resulting in an intramucosal bleb; **D6** intraprocedural bleeding; **D7** DMI type I; **D8** DMI type III associated with an area of fibrosis; **D9** DMI type IV; **D10** complete closure of a post-endoscopic mucosal resection (EMR) mucosal defect to prevent post-EMR bleeding.

and HSP, whereas some were defined as mandatory for HSP only (► **Table 1**). Non-mandatory questions can be skipped and, if

skipped, do not contribute to the denominator or numerator of the GPAT.

Once selected, GPAT statements were modified for the purpose of an online tool and grouped into domains (► **Table 1**) [19]. To aid interpretation, text was attached to each GPAT statement describing important aspects of best/poor practice.

Statements could be scored from 1 (poor) to 5 (very good) on a Likert scale. Example videos were created and attached to the statements to illustrate best practice [20].

► **Table 1** Components of the Global Polypectomy Assessment Tool (GPAT). An abbreviated version for use during an endoscopic procedure is shown in **Table 2** s.

Component	Possible responses and scoring		Mandatory ¹		Curriculum statement ²	Maximum score
			Hot	Cold		
Domain: Global competencies						20
Tip control	1 Very poor	Uncontrolled, shaky and undirected	X	X		5
	5 Very good	Controlled, stable and purposeful				
Fully appreciates/ demonstrates extent of the polyp to be resected	1 Very poor	Focuses on one area, does not demonstrate appreciation of the entire polyp	X	X	3(i), 3(ii), 3(iii)	5
	5 Very good	Clearly appreciates entire extent of the polyp; approach and resection reflect this				
Positioning with respect to the polyp	1 Very poor	Lesion not at 6 o'clock, far from the colonoscope, fluid covering lesion (poor use of gravity)	X	X	17(iii), 20(iii)	5
	5 Very good	Lesion at or near 6 o'clock, close to the colonoscope, fluid lies away from lesion (good use of gravity)				
Technique selected is appropriate for the polyp	1 Very poor	No clear need for en bloc resection if selected, lesion unsuitable for cold snare, hot snare for polyp <10 mm	X	X	4	5
	5 Very good	Correct decision for en bloc vs. piecemeal resection, hot vs. cold appropriate for the polyp				
Domain: Injection technique (Best Practice Video Chapter 1) ³						15
Injection is performed in the correct plane	1 Very poor	Injection infrequently results in sustained submucosal lifting (transmural / intramucosal injection)	X		16(iv), 16(v), 16(vi), 16(vii) (cold snare) 19(v), 19(vi), 19(vii), 19(viii) (hot snare)	5
	5 Very good	The submucosal plane is quickly found and rapidly results in sustained mucosal lifting				
Injection is performed dynamically	1 Very poor	Once the needle is situated in the submucosa, there is no movement of the needle away from the muscularis toward the center of the lumen	X		16(iv) (cold snare) 19(v) (hot snare)	5
	5 Very good	Once the needle is in the submucosa, there is graduated movement of the needle away from the muscularis towards the center of the lumen				
Injection is used to improve lesion access	1 Very poor	Injection does not facilitate access to the target lesion	X		16(i), 16(viii) (cold snare) 19(i), 19(ii), 19(ix) (hot snare)	5
	5 Very good	Injection clearly facilitates access to the target lesion				
Domain: Snare placement technique (Best Practice Video Chapter 2 and 3) ³						25
Appropriate snare size/type selected	1 Very poor	Snare clearly too large/small and of incorrect type (thin wire vs. thick wire) for the polyp	X	X	17(i), 17(ii), 20(i), 20(ii)	5
	5 Very good	Snare of appropriate size and type for the polyp				

► **Table 1** (Continuation)

Component	Possible responses and scoring		Mandatory ¹		Curriculum statement ²	Maximum score
			Hot	Cold		
Stable position with lesion at 6 o'clock OR transformed to 6 o'clock	1 Very poor	Snare position is not consistently maintained at 6 o'clock and/or the position is unstable	X	X	17(iii), 20(iii)	5
	5 Very good	Snare position is consistently maintained at 6 o'clock and the position is stable				
Maximizing snare capture	1 Very poor	Poor capture of tissue/scrapes the surface of the polyp/no use of downward pressure/no use of gas aspiration/may result in incomplete mucosal layer excision	X	X	17(iii), 20(iii)	5
	5 Very good	Good capture of polyp tissue within snare/use of downward pressure/use of gas aspiration resulting in complete capture of adequate target tissue				
Snare V precisely visualized during placement and closure	1 Very poor	Snare V not visualized during closure and far from the colonoscope	X	X	17(vii), 17(ix), 17(x) 20(vii), 20(ix), 20(x), 20(xi)	5
	5 Very good	Snare V visualized consistently during closure and near to the colonoscope				
Residual tissue islands avoided if piecemeal resection or complete if en bloc	1 Very poor	Snare placement does not include normal margin (at edge) or does not use transected tissue edge (within lesion) as a guide resulting in tissue islands/incomplete en bloc resection	X	X	17(iii) 20(iii)	5
	5 Very good	Snare placement includes >2–3 mm normal margin (at edge) of tissue or uses transected tissue edge as a guide (within defect) resulting in no tissue islands/complete en bloc				
Domain: Safety checks prior to resection (Best Practice Video Chapter 4) ³						10
Moves closed snare to confirm independent movement from deeper structures	1 Very poor	Does not check tissue mobility prior to transection with respect to deeper structures	X		20(xv), 20(xvi)	5
	5 Very good	Checks mobility prior to transection with respect to deeper structures				
Lifts snare away from muscularis propria prior to cutting	1 Very poor	Does not lift the snare prior to applying electro-surgical energy	X		20(xx)	5
	5 Very good	Lifts the snare away from the muscularis prior to the application of electrosurgical energy				
Doman: Defect assessment after resection (Best Practice Video Chapter 5 and 6) ³						20
Mucosa: looks for, detects, and removes residual adenomatous tissue at margin and within defect	1 Very poor	Does not ostensibly and systematically check for residual adenomatous tissue at the defect margin or within the defect, and/or does not remove it successfully	X	X	22(i), 22(ii), 22(iii), 22(iv)	5
	5 Very good	Ostensibly and systematically checks for residual adenomatous tissue within the defect and at the defect margin, and removes it successfully				
Thermal ablation of the post-EMR margin	1 Very poor	Unsteady application, results in areas of incomplete ablation, ablates visible polyp tissue, messy result			22(iv)	5
	5 Very good	Steady systematic application, does not ablate visible polyp tissue, complete ablation of the entire margin achieved				

► Table 1 (Continuation)

Component	Possible responses and scoring		Mandatory ¹		Curriculum statement ²	Maximum score
			Hot	Cold		
Submucosa: looks for, detects, and treats any bleeding vessels within the defect	1 Very poor	Neither detects nor treats bleeding vessels in submucosa; treats benign submucosal appearances	X		22(v), 22(vi), 22(vii), 22(viii)	5
	5 Very good	Detects and treats bleeding vessels in the submucosa; does not treat other submucosal appearances including herniating vessels				
Muscularis: looks for, detects, and treats deep mural injury ≥ II (Sydney classification)	1 Very poor	Misses signs of deep mural injury (types II–V) which require clip closure	X		22(ix), 22(x), 22(xi)	5
	5 Very good	Detects and treats types II–V deep mural injury or confirms they are not present				
Domain: Accessory techniques in polypectomy (Best Practice Video Chapter 7) ³						15
Placement of through- the- scope clips	1 Very poor	Poor tissue capture, poor use of suction and positioning to maximize correct orientation and amount of tissue captured			29(x) 30(iv), 30(v), 30(vi)	5
	5 Very good	Good use of suction, positioning, and rotation to capture required tissue and achieves secure appearing closure				
Use of polyp retrieval device	1 Very poor	Poor positioning, does not capture all pieces, does not use sequential place and retrieve technique			25(i)	5
	5 Very good	6 o'clock position, sequential place and retrieve technique applied, captures all pieces successfully				
Use of coagulation grasper	1 Very poor	Does not use water, does not wait for cessation of bleeding after forceps closure prior to application of electrosurgical energy, does not tent vessel away from the muscularis to apply electrosurgical energy			29(ix)	5
	5 Very good	Uses water to identify the causative vessel, confirms correct placement with cessation of bleeding after closure, tents vessel away from the muscularis to apply electrosurgical energy				
Total GPAT score						105 ⁴

EMR, endoscopic mucosal resection.

¹ "Hot" and "cold" refer to snare polypectomy with and without use of electrosurgical energy, respectively.² Refers to statements from the ESGE Curriculum for Training in endoscopic mucosal resection in the colon [17].³ Refers to the best practice video [19].⁴ Denotes maximum denominator; the actual denominator depends on the questions filled in.

Once all required fields are completed, an overall score (x/y [the GPAT score]) is generated by this tool, providing an indication of the quality of the polypectomy. Whilst the numerator (x) of this fraction defines the sum of all allocated scores, the denominator (y) reflects the number of questions answered (five points for each question) depending on the type of polypectomy (HSP vs. CSP), whether any accessory techniques were used (clips, polyp retrieval devices, or coagulation graspers), and if margin ablation was performed. GPAT (with all optional fields filled in) is distributed in the following way over its domains, with a maximum denominator of 105: global competencies, 20/105 (19.0%); injection technique, 15/105 (14.3%); snare placement technique, 25/105 (23.8%); safety checks prior to resection, 10/105 (9.5%); defect assessment, 20/105 (19.0%); accessory techniques, 15/105 (14.3%).

The "size, morphology, site, and access" (SMSA) score [21], a widely established and validated tool in grading the difficulty of polypectomy, is calculated alongside the GPAT. Two further published tools to grade EMR difficulty [21, 22] were combined by the authors into the SMSA+ score and included in the GPAT. The SMSA and SMSA+ scores were included to grade procedural complexity and did not contribute to the GPAT score.

Round 1

In the first round of the Delphi process, the statements for the GPAT and the accompanying best practice statements and videos were subjected to review by the whole curriculum taskforce. Statements which did not reach a level of agreement of $\geq 80\%$ were removed. Best practice statements/videos that were not agreed on were modified by the GPAT subtaskforce. A

subsequent iterative round of voting was then performed using the same methodology.

Round 2

The GPAT subtaskforce used the agreed GPAT statements to assess polypectomy videos in an anonymous online environment to assess their usability for this validation study. The candidate videos of polypectomies (endoscopic-view only) were selected from a prospectively collected database during a 6-month period (November 2020–April 2021) by endoscopists with varying levels of experience. Both endoscopists and patients consented to inclusion in the study. The endoscopists did not know that the videos would be used for polypectomy technique assessment, nor were they aware which parameters would be used.

The study was approved by the institutional review board of the Ghent University Hospital in March 2023.

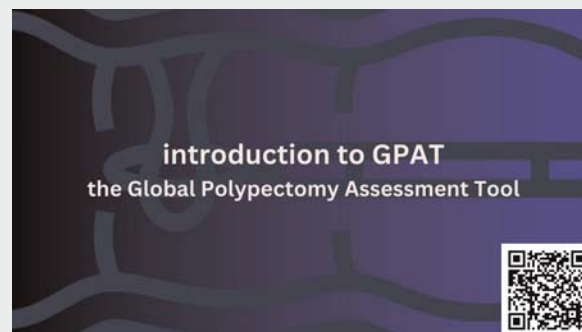
A total of 43 polypectomy videos were anonymized and edited to show one polypectomy (video starting at the inspection of the polyp and ending with inspection of the post-polypectomy defect). Videos were rejected if: (i) the total length of the polypectomy was >10 minutes (five videos); or (ii) it was considered that poor video quality or an incomplete video would potentially interfere with interpretation (15 videos). From the remaining 23 videos, nine were selected, which represented a balance of expert performed, piecemeal versus en bloc resection, polyp size, cold versus hot snare resection, and location left versus right colon [23]. More information can be found in **Appendix 1 s, Table 3 s**.

Round 3

In the third round, members of the curriculum taskforce (10 consultant gastroenterologists, two consultant surgeons, and one trainee gastroenterologist) plus three extra invited trainee gastroenterologists and three invited medical students (the assessors) were requested to rate the nine videos retained in round 2. The GPAT subtaskforce authors, who were also involved in statement review, separately rated the videos in a consensus meeting and this single score per video served as the reference GPAT score. The medical students involved had never observed a colonic polypectomy. Assessors were required to give their explicit consent for the use of their entered data in this study.

To facilitate anonymous rating, an online survey was created using SurveyMonkey (Momentive, USA). Before starting the survey, the assessors were asked to watch a short introductory video of 4 minutes 41 seconds (explaining the design of the survey [2 minutes 4 seconds] and how to use the GPAT [2 minutes 37 seconds]) (► **Video 1**) [24]. All assessors were asked to apply the GPAT to the same nine polypectomy videos, which were presented in a random order.

Assessor demographic data were collected. For each polyp, the location was given in the introductory text. The first survey question was a subjective score (out of 10) on the quality of the polypectomy (“overall subjective impression score”). The second question required the assessor to use the online version of the GPAT to rate the video. The third (qualitative) question enquired about aspects of the polypectomy that could not be



► **Video 1** Video used as an introduction to the online survey prior to video rating.

The first part (0:00–0:38) explains the purpose of the survey. The second part (0:39–01:38) provides practical information about the survey. The third part (01:39–03:39) explains the GPAT tool and how to use it. The final part (03:40–4:40) explains how to fill in the survey after calculating the GPAT score using the online calculator.

Online content viewable at:
<https://doi.org/10.1055/a-2541-4028>

scored using the tool but that the participant felt were worth mentioning. The fourth qualitative question enquired about the quality of the assessed video (**Appendix 2 s**).

End points

The primary end point was the correlation of assessor GPAT scores with the reference GPAT score.

The secondary end points were:

- interobserver agreement (IOA) among assessors' GPAT scores
- assessors' subjective impression score versus their GPAT score
- correlation of GPAT scores overall and per domain with the reference GPAT score.

Statistics

Data were analyzed using R Studio, version 4.2.2 [25]. The IOA was interpreted using the intraclass correlation coefficient (ICC) with criteria proposed by Koo and Li [26]: <0.50, poor agreement; >0.5 and <0.75, moderate agreement; >0.75 and <0.9, good agreement; >0.9, excellent agreement. Correlation between the endoscopists' overall impression and the GPAT was calculated using the Pearson correlation coefficient, and other comparisons between continuous variables were calculated using a *t* test. Two-sided *P* values <0.05 were considered significant.

Results

Demographics

A total of 171 GPAT assessments were collected. The assessors, who originated from seven countries, were consultant gastroenterologists ($n=10$; 47.3%), trainee gastroenterologists ($n=4$; 21.1%), consultant surgeons ($n=2$; 10.5%), and medical students ($n=3$; 15.8%), of whom 11 (57.8%) had performed over 1000 colonoscopies (**Table 4s**).

Assessors' GPAT scores versus reference GPAT score

The GPAT scores assigned by the assessors and the reference GPAT score were positively correlated (correlation coefficient 0.75 [95%CI 0.17–0.94]; $P=0.02$) (**Fig. 1s**) and there was no significant difference between the overall GPAT scores when considering all polyps together (mean reference GPAT score 73.1% [95%CI 64.6%–81.6%] vs. mean assessor score 69.3% [95%CI 64.9%–81.2%]; $P=0.47$) (**Table 2**; **Fig. 2**).

Statistically significant differences were seen between the reference GPAT score and the assessors' scores in 4/9 polyps (numbers 2, 4, 7, and 8); three of these polypectomies were performed using CSP. An attempt by the GPAT subtaskforce to explain these discrepancies can be found in **Appendix 3s**.

When considering specific domains of the GPAT individually, there was no significant difference in any domain when all nine polyps were considered together between the mean assessor GPAT scores and the reference GPAT score (**Table 2**; **Appendix 4s**; **Fig. 2s**). Differences were only seen when analysis was restricted to single domains of single polyps.

Assessors' subjective impression of the polypectomy versus GPAT

The GPAT scores were positively correlated with the assessors' overall subjective impression scores (correlation coefficient 0.98 [95%CI 0.90–1.00]; $P<0.001$) (**Fig. 3**). The assessors' mean overall subjective impression score was similar to their mean GPAT score (61.6% [95%CI 54.5%–79.5%] vs. 69.3% [95%CI 64.9%–81.2%]; $P=0.23$).

Interassessor agreement for specific polypectomies

When considering only gastroenterologists, moderate agreement was found in the overall GPAT scores for both consultants and trainees (ICC 0.51 [95%CI 0.28–0.81] and ICC 0.60 [95%CI 0.29–0.87], respectively). When considering consultant gastroenterologists and trainee gastroenterologists together (forming the group of assessors with experience in polypectomy), the agreement was still moderate (ICC 0.52 [95%CI 0.30–0.81]). In contrast, when considering assessors without any experience in polypectomy (medical students), poor agreement was found (ICC 0.32 [95%CI 0.01–0.72]). The overall IOA for GPAT was poor (ICC 0.25 [95%CI 0.10–0.64]). For comparison, the SMSA IOA was similarly poor (ICC 0.42 [95%CI 0.22–0.74]) (**Table 3**).

Discussion

Colonoscopic polypectomy practice is known to depend significantly on the operator with wide variation in rates of incomplete resection [3–8]. The ESGE Curriculum for Training in endoscopic mucosal resection in the colon [17] fully deconstructed the technical approach to polypectomy of nonpedunculated polyps ≥ 10 mm. This study demonstrates that the GPAT, an assessment tool based on the curriculum, allows a standardized description of the quality of polypectomy, requires minimal training, correlates with overall endoscopist subjective impression, and is consistent among raters with polypectomy experience.

Standardized assessment tools are critical for procedural specialties and are widespread in surgery [27]. DOPyS is currently the most widely known tool for evaluating the quality of endoscopic colorectal polypectomy. Similarly derived from expert consensus and validation, the DOPyS has been widely implemented in the UK accreditation scheme for colonoscopy [15] and has been used to demonstrate improvement in competency after simulation training in polypectomy [28]. The cold snare polypectomy assessment tool (CSPAT) is another tool to assess polypectomy quality, focusing on cold snare resection of polyps of <1 cm [29]. To the authors' knowledge, neither of these tools has been linked to polypectomy outcomes. A summary of the existing tools, with their advantages and disadvantages, is given in **Appendix 5s** and **Table 5s**.

The GPAT is a modern online self-calculating polypectomy-specific competency framework with seven domains, which follows a sequential deconstructed approach to the resection of any colorectal polyp. Its advantages over the existing tools include the fact that each item contains statements detailing best versus poor practice (supported by videos), which are scored on a 5-point Likert scale. The GPAT is applicable to live and video-based assessment and has an associated logbook that allows tracking of progress over time. It includes an SMSA score calculator to establish the difficulty of the polypectomy, but the SMSA score does not influence the GPAT score. The tool is intuitive to use with minimal training (only a short introductory video).

Whilst the GPAT is currently not linked to polypectomy provider outcomes, important observations from this study suggest it reliably determines the quality of polypectomy. GPAT scoring correlates strongly with the subjective assessor impression suggesting internal validity (with GPAT adding polypectomy domain scoring and the potential for deconstructed feedback). Furthermore, among consultant and trainee gastroenterologists (groups who will commonly use GPAT), there was moderate IOA (similar to other established scores, such as SMSA (**Appendix 6s**) and BBPS [30]). Per-domain (stage of technique) of the score, there was a strong positive correlation between the reference GPAT score assigned to each video and the assessors' responses. Finally, in the groups without any experience in endoscopy and polypectomy, the IOA was poor, indicating that some experience with colonoscopic polypectomy is required to use the score, further adding to the validity of the score.

► **Table 2** Primary outcome: comparison of assessors' Global Polypectomy Assessment Tool (GPAT) scores versus the reference score, per polyp and overall.

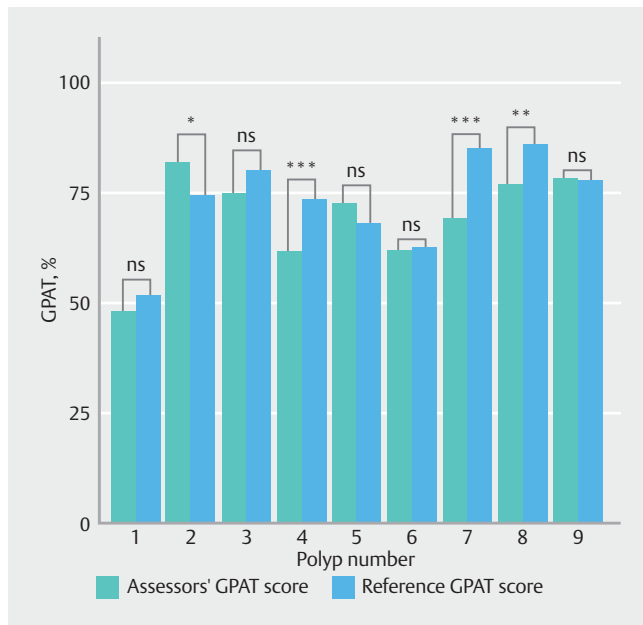
		Polyp number and method of polypectomy									All
		1	2	3	4	5	6	7	8	9	
		Cold	Cold	Cold	Cold	Hot	Hot	Hot	Hot	Hot	
General	RS, %	65	80	90	75	75	60	85	100	85	79.4
	AS, %	53	82.5	77.5	67.2	75	67.2	72.8	80	78.3	72.6
	Δ	-12	2.5	-12.5	-7.8	0	7.2	-12.2	-20	-6.7	-6.8
	P value	**	ns	***	**	ns	ns	***	***	*	ns
Injection	RS, %	26.7	80	NA	NA	53.3	NA	100	73.3	66.7	65.7
	AS, %	40.7	78.1	NA	NA	70.4	NA	71.2	78	78.1	67
	Δ	14	-1.9	NA	NA	17.1	NA	-28.8	4.7	11.4	1.3
	P value	**	ns	NA	NA	**	NA	***	ns	***	ns
Snare	RS, %	55	70	75	70	60	65	80	90	80	71.7
	AS, %	48.2	85.7	72.6	55.7	77	67.8	64.2	79.6	77.3	69.8
	Δ	-6.8	15.7	-2.4	-14.3	17	2.8	-15.8	-10.4	-2.7	-1.9
	P value	ns	***	ns	***	***	ns	***	**	ns	ns
Safety	RS, %	NA	80	NA	NA	70	60	NA	90	70	74
	AS, %	NA	85	NA	NA	65	62.9	NA	82.3	79.4	74.9
	Δ	NA	5	NA	NA	-5	2.9	NA	-7.7	9.4	0.9
	P value	NA	*	NA	NA	ns	ns	NA	*	*	ns
Defect	RS, %	60	60	60	80	80	66.6	60	86.7	80	70.3
	AS, %	51.5	75.8	74.4	66.1	70.6	53.2	68.2	70	79.2	67.7
	Δ	-8.5	15.8	14.4	-13.9	-9.4	-13.4	8.2	-16.7	-0.8	-2.6
	P value	ns	***	**	**	**	*	ns	***	ns	ns
Accessories	RS, %	NA	NA	NA	NA	60	60	NA	40	NA	53.3
	AS, %	NA	NA	NA	NA	71.5	63.1	NA	57.3	NA	64
	Δ	NA	NA	NA	NA	11.5	3.1	NA	17.3	NA	10.7
	P value	NA	NA	NA	NA	**	ns	NA	**	NA	ns
GPAT	RS, %	51.7	74.1	80	73.3	67.7	62.3	85	85.9	77.6	73.1 (11.1)
	AS (SD), %	48.1 (14.5)	81.7 (8.8)	74.5 (11.9)	61.5 (10.6)	72.4 (11.9)	61.8 (15.8)	69.1 (12)	76.7 (10.9)	78.2 (10.8)	69.3 (10.5)
	Δ	-3.6	7.6	-5.5	-11.8	4.7	-0.5	-15.9	-9.2	0.6	-3.8
	P value	0.3	0.02	0.06	<0.001	0.11	0.88	<0.001	0.002	0.81	0.47

AS, assessors' GPAT score; NA, not applicable (polyp did not contain this domain); RS, reference GPAT score; Δ, difference between AS and RS.
 * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; ns, not significant.

A major advantage of the GPAT over existing tools is its applicability to video assessment: feedback on polypectomy practice can be given separately from the often busy clinical practice hours using videos recorded during the procedure; this approach is backed by a growing body of literature [31]. Video assessment has other advantages including facilitating

educational research and helping to eliminate the Hawthorne and Halo effects on procedural assessment [20,28,31,32].

The GPAT also enables structured feedback on a polypectomy, an approach grounded in educational theory [33–35]. It was specifically developed as a score card to provide structured feedback per domain (e.g. injection technique, snare place-

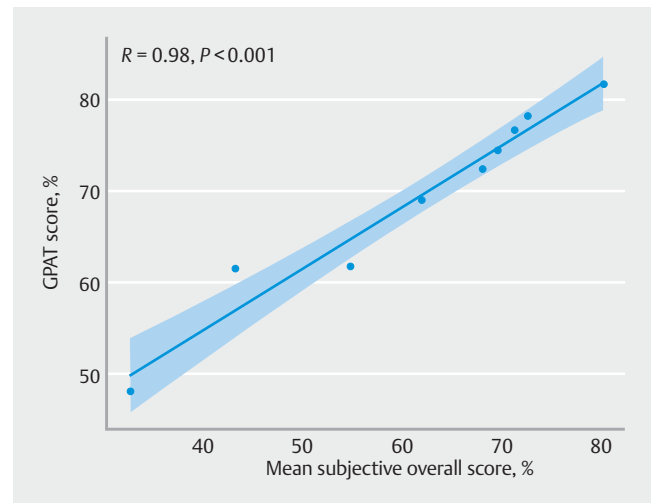


► **Fig. 2** Comparison of Global Polypectomy Assessment Tool (GPAT) score determined by assessors with the reference GPAT score per polyp.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; ns, nonsignificant.

ment technique, etc.). After each assessment, a trainee can see which domains scored well and which need improvement, both for a single polypectomy and over multiple procedures. This specific and targeted feedback, in combination with the descriptive text and explainer videos, allows rapid skills acquisition.

The next steps for the GPAT include considering polypectomy difficulty in the calculation of the GPAT score itself. For example, a subsequent version of the GPAT could include a mathematical weighting to the final score depending on the SMSA score (e.g. 0.25 for SMSA 2; 0.5 for SMSA 3; 0.75 for SMSA 4; and 1 for polyps with any SMSA+ criterion). This would be a natural extension of including the SMSA score to assess difficulty and is used in many fields of academic assessment. This approach could finally allow the comparison of polypec-



► **Fig. 3** Scatterplot of the mean subjective overall impression score and Global Polypectomy Assessment Tool (GPAT) score with a line of best fit.

tomy technique whilst controlling for the most significant confounders.

This study demonstrates credible initial validation of the GPAT. Limitations include the small study population (19 assessors completed the survey) and low number of videos (9 videos of <10 minutes were included). These two factors could have introduced bias into the study. Future studies should include more and longer videos, with a variety of endoscopist performers and assessors at different stages of their training. Based on qualitative feedback from assessors, future iterations of the GPAT might include an option to click on “nonapplicable” for certain criteria. The GPAT could also be broadened to include nonvideo observations with endoscopic nontechnical skills (ENTS)-type parameters [36]. These could be presented separately to allow video and live assessment.

In addition, although the overall (mean) GPAT score, when considering all polyps combined, did not show a statistically significant difference between the reference GPAT score and the scores of the other assessors, some polyps showed statisti-

► **Table 3** Interobserver agreement in the Global Polypectomy Assessment Tool (GPAT) and SMSA scores for each category of assessor.

	GPAT		SMSA score	
	ICC (95%CI)	Agreement	ICC (95%CI)	Agreement
Gastroenterologist	0.52 (0.30–0.81)	Moderate	0.46 (0.24–0.79)	Poor
▪ Consultant	0.51 (0.28–0.81)	Moderate	0.44 (0.20–0.78)	Poor
▪ Trainee	0.60 (0.29–0.87)	Moderate	0.57 (0.21–0.87)	Moderate
Nongastroenterologist	0.27 (0.05–0.64)	Poor	0.17 (0.00–0.56)	Poor
▪ Medical student	0.32 (0.01–0.72)	Poor	0.26 (0.06–0.71)	Poor
▪ Consultant surgeon	0.47 (0.11–0.86)	Poor	0.37 (0.35–0.81)	Poor

ICC, intraclass correlation coefficient; SMSA, size, morphology, site, and access.

cally significant differences between assessors within specific domains; however, there was no discernable pattern that specific domains were always significantly variable between raters. This issue could also be due to the low number of videos and/or raters. One approach to address this issue might be to provide more clarity at the level of the individual statements about exactly what constitutes very poor versus very good practice, using more narrated deconstructed videos.

In conclusion, a novel freely accessible web-based assessment tool for colorectal polypectomy (GPAT) has been demonstrated to deliver standardized scoring of polypectomy competency after only a 3-minute training video for consultant and trainee gastroenterologists. Pending larger validation studies, the GPAT may allow standardized assessment of polypectomy competency, feedback on areas of poor performance, demonstration of improvement over time, assessment of more difficult cases, and a method to accredit endoscopists in different levels of polypectomy.

Acknowledgments

The authors would like to thank the experts who contributed to the original Delphi consensus.

Conflict of interest

R. Bisschops has received speaker's fees and been on the advisory boards of Pentax, Medtronic, and Fujifilm, and has been on the advisory boards of Cook Medical, Boston Scientific, and Olympus; his department has received research grants and organisational support for events from Pentax and Medtronic, plus organisational support for events from Erbe, Ovesco, and Olympus (all within the last 3 years). D.J. Tate has received consultancy fees from Olympus Medical EMEA (2019 to present) and Fujifilm (2021 to present), and educational grants from Pentax, Olympus, Fujifilm, Boston Scientific, Prion Medical, Ovesco, Medtronic, CREO Medical, and Cook Medical (2021 to present). H. Thorlacious is a co-founder and owner of CarpoNovum (2002 to present). J. Anderson, M.E. Argenziano, P. Bhandari, I. Boškoski, M.J. Bourke, M. Bugajski, L. Debels, A. de Crem, L. Desomer, L. Fuccio, S.J. Heitman, H. Kashida, R.R.T. Lee, I. Lyutakov, L. Rivero-Sánchez, C. Schoonjans, S. Smeets, T. Tham, and S. Thomas Gibson declare that they have no conflicts of interest.

Clinical Trial

Trial Registration: ClinicalTrials.gov | Registration number (trial ID): NCT05877456 | Type of study: Prospective observational study

References

- [1] Winawer SJ, Zauber AG, Ho MN et al. The National Polyp Study Workgroup. Prevention of colorectal cancer by colonoscopic polypectomy. *NEJM* 1993; 329: 1977–1981
- [2] Zauber AG, Winawer SJ, O'Brien MJ et al. Colonoscopic polypectomy and long-term prevention of colorectal-cancer deaths. *NEJM* 2012; 366: 687–696
- [3] Sidhu M, Forbes N, Tate DJ et al. A randomized controlled trial of cold snare polypectomy technique: technique matters more than snare wire diameter. *Am J Gastroenterol* 2022; 117: 100
- [4] Arimoto J, Chiba H, Higurashi T et al. Risk factors for incomplete polyp resection after cold snare polypectomy. *Int J Colorectal Dis* 2019; 34: 1563–1569
- [5] Motchum L, Djinbachian R, Rahme E et al. Incomplete resection rates of 4- to 20-mm non-pedunculated colorectal polyps when using wide-field cold snare resection with routine submucosal injection. *Endosc Int Open* 2023; 11: E480–E489
- [6] Liu W, Gong J, Gu L. The efficacy and safety of cold snare versus hot snare polypectomy for endoscopic removal of small colorectal polyps: a systematic review and meta-analysis of randomized controlled trials. *Int J Colorectal Dis* 2023; 38: 136
- [7] von Renteln D, Djinbachian R, Benard F et al. Incomplete resection of 4–20 mm colorectal polyps when using cold snare and associated factors. *Endoscopy* 2023; 55: 929–937
- [8] Pohl H, Srivastava A, Bensen SP et al. Incomplete polyp resection during colonoscopy—results of the complete adenoma resection (CARE) study. *Gastroenterology* 2013; 144: 74–80.e1
- [9] Sung H, Ferlay J, Siegel RL et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA Cancer J Clin* 2021; 71: 209–249
- [10] Adler J, Toy D, Anderson JC et al. Metachronous neoplasias arise in a higher proportion of colon segments from which large polyps were previously removed, and can be used to estimate incomplete resection of 10–20 mm colorectal polyps. *Clin Gastroenterol Hepatol* 2019; 17: 2277–2284
- [11] Djinbachian R, Iratni R, Durand M et al. Rates of incomplete resection of 1- to 20-mm colorectal polyps: a systematic review and meta-analysis. *Gastroenterology* 2020; 159: 904–914.e12
- [12] Tollivoro TA, Jensen CD, Marks AR et al. Index colonoscopy-related risk factors for postcolonoscopy colorectal cancers. *Gastrointest Endosc* 2019; 89: 168–176.e3
- [13] Samadder NJ, Curtin K, Tuohy TM et al. Characteristics of missed or interval colorectal cancer and patient survival: a population-based study. *Gastroenterology* 2014; 146: 950–960
- [14] Anderson R, Burr NE, Valori R. Causes of post-colonoscopy colorectal cancers based on world endoscopy organization system of analysis. *Gastroenterology* 2020; 158: 1287–1299.e2
- [15] Gupta S, Anderson J, Bhandari P et al. Development and validation of a novel method for assessing competency in polypectomy: direct observation of polypectomy skills. *Gastrointest Endosc* 2011; 73: 1232–1239.e2
- [16] Gupta S, Bassett P, Man R et al. Validation of a novel method for assessing competency in polypectomy. *Gastrointest Endosc* 2012; 75: 568–575
- [17] Tate DA, Argenziano ME, Anderson J et al. Curriculum for training in endoscopic mucosal resection in the colon: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement. *Endoscopy* 2023; 55: 645–679
- [18] Okoli C, Pawlowski SD. The Delphi method as a research tool: an example, design considerations and applications. *Inf Manag* 2004; 42: 15–29
- [19] GPAT – The global polypectomy assessment tool. Accessed: 8 January 2025. www.gieqs.com/gpat
- [20] GPAT best practice video. Accessed: 8 January 2025. www.gieqs.com/videos/1215
- [21] Gupta S, Miskovic D, Bhandari P et al. A novel method for determining the difficulty of colonoscopic polypectomy. *Frontline Gastroenterol* 2013; 4: 244–248

- [22] Sidhu M, Tate DJ, Desomer L et al. Mo1662. SMSA-EMR score is a novel endoscopic risk assessment tool for predicting critical endoscopic mucosal resection outcomes. *Gastrointest Endosc* 2018; 87: AB467–AB468
- [23] GPAT showcase. Accessed: 8 January 2025. <https://vimeo.com/showcase/10417029>
- [24] Introduction to the study. Accessed: 8 January 2025. <https://vimeo.com/562536661>
- [25] Posit team. RStudio: Integrated Development Environment for R (2022). Accessed: 8 January 2025. <https://posit.co>
- [26] Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *J Chiropr Med* 2016; 15: 155–163
- [27] Miskovic D, Wyles SM, Carter F et al. Development, validation and implementation of a monitoring tool for training in laparoscopic colorectal surgery in the English National Training Program. *Surg Endosc* 2011; 25: 1136–1142
- [28] Patel RV, Barsuk JH, Cohen ER et al. Simulation-based training improves polypectomy skills among practicing endoscopists. *Endosc Int Open* 2021; 9: E1633–E1639
- [29] Patel SG, Duloy A, Kaltenbach T et al. Development and validation of a video-based cold snare polypectomy assessment tool (with videos). *Gastrointest Endosc* 2019; 89: 1222–1230.e2
- [30] Crapé L, Debels L, Schoonjans C et al. Development and validation of a novel score for the completeness of caecal intubation - the CCIS (completeness of caecal intubation score). *Gastrointest Endosc* 2022; 95: AB85–AB86
- [31] Jeyalingam T, Walsh CM. Video-based assessments: a promising step in improving polypectomy competency. *Gastrointest Endosc* 2019; 89: 1231–1233
- [32] Scaffidi MA, Grover SC, Carnahan H et al. A prospective comparison of live and video-based assessments of colonoscopy performance. *Gastrointest Endosc* 2018; 87: 766–775
- [33] Patel K, Faiz O, Rutter M et al. The impact of the introduction of formalised polypectomy assessment on training in the UK. *Frontline Gastroenterol* 2017; 8: 104–109
- [34] Anderson J, Lockett M. Training in therapeutic endoscopy: meeting present and future challenges. *Frontline Gastroenterol* 2019; 10: 135–140
- [35] Samuel A, Konopasky A, Schuwirth LWT et al. Five principles for using educational theory: strategies for advancing health professions education research. *Acad Med* 2020; 95: 518–522
- [36] Hitchins CR, Metzner M, Edworthy J et al. Non-technical skills and gastrointestinal endoscopy: a review of the literature. *Frontline Gastroenterol* 2018; 9: 129–134

The Global Polypectomy Assessment Tool (GPAT), a novel polypectomy assessment tool – validation of a competency framework for any polypectomy

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Table 1s: Members of the EMR curriculum taskforce and GPAT subtaskforce.

The EMR curriculum taskforce	All members of the taskforce responsible for creating and reviewing the curriculum for training in endoscopic mucosal resection in the colon: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement. David J. Tate, Maria Eva Argenziano, John Anderson, Pradeep Bhandari, Ivo Boškoski, Marek Bugajski, Lobke Desomer, Steven J. Heitman, Hiroshi Kashida, Vladimir Kriazhov, Ralph R. T. Lee, Ivan Lyutakov, Pedro Pimentel-Nunes, Liseth Rivero-Sánchez, Siwan Thomas-Gibson, Henrik Thorlacius, Michael J. Bourke, Tony C. Tham, Raf Bisschops
The GPAT sub-taskforce	David J. Tate, Maria Eva Argenziano, John Anderson (from the EMR curriculum taskforce) plus Sander Smeets, Alexander De Crem and Roland Valori
Assessors	The curriculum taskforce members plus 3 invited trainee gastroenterologists plus 3 invited medical students excluding the GPAT sub-taskforce
Authors	GPAT subtaskforce + EMR curriculum taskforce not including assessors who were not part of the above groups De Crem, Alexander C.; Smeets, Sander; Argenziano, Maria Eva; Anderson John; Bhandari, Pradeep; Boškoski, Ivo; Bugajski, Marek; Bourke, Michael J.; Debels, Lynn; Desomer, Lobke; Heitman, Steven J.; Kashida, Hiroshi; Lee, Ralph R.T.; Lyutakov, Ivan; Rivero-Sánchez, Liseth; Schoonjans, Christophe; Thomas-Gibson, Siwan; Thorlacius, Henrik; Tham, Tony C; Bisschops, Raf; Tate, David J.

Table 2s: Abbreviated GPAT form.

Component	Mandatory		Score 1-Very poor 5-very good
	Hot	Cold	
Domain : Global Competencies			/20
Tip control	X	X	/5
Fully appreciates/demonstrates extent of the polyp to be resected	X	X	/5
Positioning with respect to the polyp	X	X	/5
Technique selected is appropriate for the polyp	X	X	/5
Domain : Injection technique			/15
Injection is performed in the correct plane	X		/5
Injection is performed dynamically	X		/5
Injection is used to improve lesion access	X		/5
Domain: Snare placement technique			/25
Appropriate snare size/type selected	X	X	/5
Stable position with lesion at 6 o'clock OR transformed to 6 o'clock	X	X	/5
Maximizing snare capture	X	X	/5
Snare V precisely visualized during placement and closure	X	X	/5
Residual tissue islands avoided if piecemeal resection or complete if en bloc	X	X	/5
Domain : Safety checks prior to resection			/10
Moves closed snare to confirm independent movement from deeper structures	X		/5
Lifts snare away from muscularis propria prior to cutting	X		/5

Doman : Defect assessment after resection			/20
Mucosa: looks for, detects, and removes residual adenomatous tissue at margin and within defect	X	X	/5
Thermal ablation of the post-EMR margin			/5
Submucosa: looks for, detects, and treats any bleeding vessels within the defect	X		/5
Muscularis: looks for, detects, and treats deep mural injury $\geq$ II (Sydney classification)	X		/5
Domain: Accessory techniques in polypectomy			/15
Placement of through- the-scope clips			/5
Use of polyp retrieval device			/5
Use of coagulation grasper			/5
Total GPAT Score			/ *

*The denominator of the total GPAT score is the sum of the maximum scores for each applicable field.

Appendix 1s: Selection of videos.

The useability score is a subjective score out of 5 (0 being completely unusable, 5 being the maximum score and all videos with a score <4 were excluded) awarded by the reference GPAT score to filter out videos of bad quality (i.e. ‘shaky image’), videos that don’t demonstrate a specific technique or showing poor bowel preparation etc.

The characteristics of each video were mapped by the reference GPAT score (piecemeal versus ‘en bloc’; large versus small; hot versus cold snare; location) and a representative selection was made based on all these characteristics. To keep characteristics balanced with at least 30% of each characteristic represented, 9 videos were selected and subsequently embedded in our online Survey. The average duration of the videos was 5 minutes and 23 seconds (longest: 9 minutes 13 seconds; shortest 2 minutes 9 seconds). All videos as shown in the survey are accessible online(1).

Table 3s: Characteristics of the videos.

Useability		Expert	Piecemeal vs.		Cold vs		Location
Video	(/5)		en bloc	Size	Hot	Duration	
1	5	No	Piecemeal	Large	Cold	9:13	Right
2	4	No	En bloc	Small	Cold	2:52	Left
3	4	Yes	En bloc	Small	Cold	2:09	Right
4	5	No	En bloc	Small	Cold	6:10	Left
5	4	No	En bloc	Large	Hot	4:35	Left
6	4	No	En bloc	Large	Hot	3:08	Left
7	4	Yes	Piecemeal	Large	Cold	8:26	Right
8	4	Yes	En bloc	Small	Hot	6:02	Left
9	5	No	Piecemeal	Large	Hot	5:49	Right

Useability score

The useability score is a subjective score awarded by the senior author and curriculum taskforce leader to filter out videos of bad quality (i.e. ‘shaky image’), videos that don’t demonstrate a specific technique or showing poor bowel preparation etc.

Duration is noted in minutes:seconds(2).

Appendix 2s: Questions asked per polyp.

Per polyp presented

Question 1:

What is your opinion of the overall quality of the polypectomy without reference to the score? (/10)

Question 2:

Copy paste the scores generated by the online GPAT tool.

Question 3:

Please comment upon things you could not score that were good or bad about this polypectomy because there was no option available in the score.

Question 4:

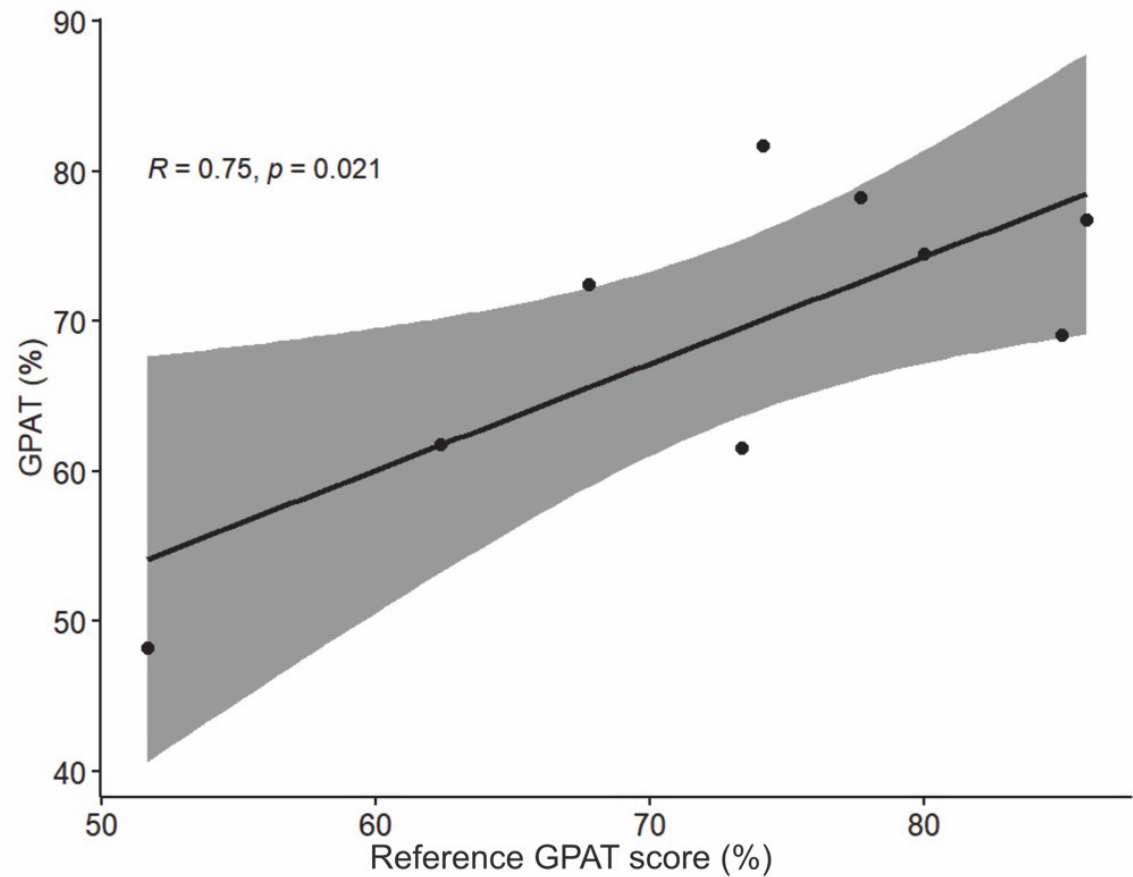
Do you think the quality and content of the video is adequate to make the assessments detailed

Table 4s: Demographics of assessors included in the study.

Assessor number	Grade	Years in role	Colonoscopy experience (n)	EMRs performed / year (n)	Country
1	Consultant gastroenterologist	5	1000+	101+	Belgium
2	Consultant gastroenterologist	14	1000+	26-50	Belgium
3	Consultant gastroenterologist	35	1000+	101+	Japan
4	Consultant gastroenterologist	1	401-999	1-25	Belgium
5	Trainee gastroenterologist	1	1000+	1-25	Belgium
6	Consultant gastroenterologist	1	1000+	26-50	Belgium
7	Consultant gastroenterologist	33	1000+	101+	Belgium
8	Trainee gastroenterologist	3	1000+	26-50	Belgium
9	Trainee gastroenterologist	3	401-999	1-25	Belgium
10	Consultant surgeon	15	1000+	101+	Sweden
11	Consultant gastroenterologist	2	1000+	1-25	Belgium

12	Consultant gastroenterologist	7	1000+	26-50	Spain
13	Trainee gastroenterologist	1	1-50	0	Italy
14	Consultant surgeon	20	1000+	51-100	UK
15	Consultant gastroenterologist	1	401-999	26-50	Belgium
16	Medical student	6	0	0	Belgium
17	Consultant gastroenterologist	3	401-999	51-100	Bulgaria
18	Medical student	6	1-50	0	Belgium
19	Medical student	6	0	0	Belgium

Figure 1s: Scatterplot of the assessors GPAT score (%) and the reference GPAT score (%).



GPAT – Global Polypectomy Assessment Tool

Appendix 3s: Discrepancies explained.

Polyp video 2 depicted a non-granular Paris IIa polyp in the left colon resected using cold snare polypectomy. Assessors scored the domains of snare placement and defect assessment **higher** than the reference GPAT score. After reviewing it was suggested that the lack of meticulous defect assessment shown in the video and the semi-pedunculated nature of the polyp potentially led to the discrepancy.

Polyp video 4 depicted a small (<5mm) Paris IIa polyp in the left colon resected using cold snare polypectomy. Assessors scored the domains general, snare placement and defect assessment **lower** than the reference GPAT score. After reviewing it was suggested that the poor visualisation of snare placement, snare closure and the mucosal defect after resection and an apparent tissue island in the defect led to the discrepancy.

Polyp video 7 depicted a non-granular Paris IIa polyp in the right colon resected using piecemeal cold snare EMR. The assessors scored the domains of general, injection and snare placement **lower** than the reference GPAT score. After reviewing no clear explanation was found.

Polyp video 8 depicted a Paris Isp lesion in the left colon resected using hot snare polypectomy. The assessors scored the domains general, snare placement and defect assessment **lower** than the reference GPAT score. After reviewing no clear explanation was found.

Appendix 4s: GPAT scores of individual domains as scored by assessors vs reference GPAT score.

For the domain *Global competencies* in particular, the score assigned by the assessors and the one assigned by the reference GPAT score were not significantly different (72.6% vs.79.4% $p = 0.20$) [Figure 2s, part A].

Similar results were obtained for the domain *Injection technique* (mean assessors 67% /reference GPAT score 65.7%, $p = 0.90$) [Figure 2s, part B], *Snare placement* technique (mean assessors 69.8% /reference GPAT score 71.7% $p = 0.73$) [Figure 2s, part C], *Safety checks prior to resection* (mean assessors 74.9% /reference GPAT score 74%, $p = 0.89$) [Figure 2s, part D], *Defect assessment after resection* (mean assessors

67.7%/reference GPAT score 70.3%, $p = 0.59$) [Figure 2s, part E] and *Accessory techniques in polypectomy* (mean assessors 64%/reference GPAT score 53.3%, $p = 0.24$) [Figure 2s, part F]. Not all domains were applicable to all videos due to difference in technique chosen for the resection (HSP vs CSP).

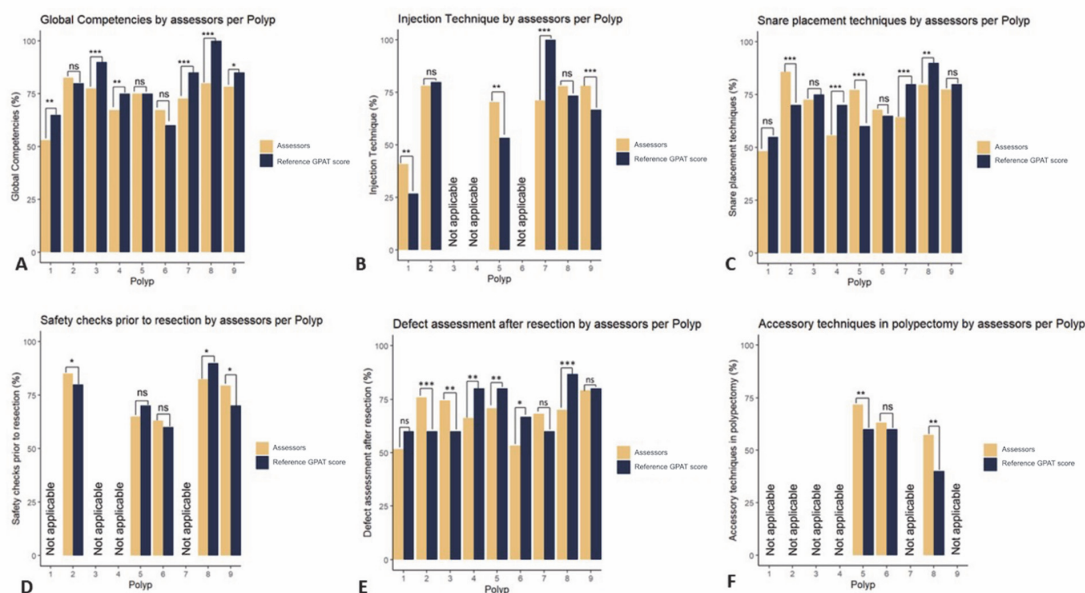


Figure 2s: GPAT scores of individual domains as scored by assessors vs reference GPAT score.

GPAT scores of individual domains as scored by assessors (gold bars) versus reference GPAT score (blue bars). A) Global Competencies B) Fraction of the domain “Injection Technique” C) Fraction of the domain “Snare Placement Technique” D) Fraction of the domain “Safety checks prior to resection” E) Fraction of the domain “Defect assessment after resection” F) Fraction of the domain “Accessory techniques in polypectomy”. GPAT – Global Polypectomy Assessment Tool. * significant to $P < 0.05$ ** $P < 0.01$; *** <0.001 ; ns – non significant

Appendix 5s: Literature review of current polypectomy assessment tools.

Other competency frameworks exist which evaluate the quality of colorectal polypectomy, two are specifically focussed on polypectomy and 4 are orientated on general colonoscopy(3-8).

DOPyS was developed in 2011 by Gupta et al. by a working group comprising of members of the UK-based endoscopic training and accreditation body–Joint Advisory Group (JAG), British Society of Gastro-enterology (BSGE), and representation from all the professional bodies that perform BCS colonoscopy (physicians, surgeons, and nurse endoscopists)(9). The score was validated by using the developed tool to score 47 videos of polypectomies. The positive effect of this scoring system on skill acquisition was illustrated in 2017 by Patel et al(10).

The DOPyS scoring system has several benefits; it is a structured way to assess a polypectomy and provide feedback, it can be used both on live cases and on videos. But it has also some drawbacks; it is not intuitive in its use, so the assessors need to be trained before using it. All 33 items are scored on a 4-point scale (4: highly skilled performance, 3 competent and safe throughout procedure no uncorrected errors, 2 some standards not yet met, aspects to be improved, some errors uncorrected, 1 accepted standards not yet met) these are very generic and do not specify what, for example ‘highly skilled performance’, means for a specific topic. It does not provide examples of best practice and no objective statements about what constitutes a good vs a poor technique(11). Both the need for training of the assessors and the very generic 4 point scale may contribute to the hawk – dove phenomenon where the assessment of the same polypectomy by a harsh assessor will give a different result compared to a more generous observer(12). DOPyS was not designed for the assessment of small polypectomies (<1cm) which actually comprises the majority of polypectomies performed in day-to-day endoscopy and is not specifically designed to be used on videos of polypectomies somewhat limiting its use.

In their consensus statement for training and certification in colonoscopy the JAG advises that DOPyS should be used as the polypectomy competency assessment tool and that Competence in polypectomy should be based on achieving all competencies defined in the DOPyS form rather than a set minimum number of procedures(13).

A second tool was developed based on DOPyS; the Cold snare polypectomy assessment tool (CSPAT). It consists of 12 items specifically focussed on cold snare resection of polyps of <1 cm. A mayor benefit of this score is that every item has specific statements linked to the 4-point scale, making it more intuitive to use, eliminating the necessity of lengthy training of the assessors and minimizing the Hawk – Dove effect. Drawbacks of this score system is that it assumes that the selected technique is correct for the polyp in question, so it does not allow for specific feedback/teaching on the choice of technique. Another drawback is that CSPAT is specifically designed for a video-based assessment and is less useful in an in-person setting(4).

DOPyS and CSPAT are the only, currently validated scoring tools specifically designed for polypectomy. DOPyS also has already proven to have a positive impact on trainees' documented exposure to therapeutic lower gastrointestinal endoscopy as well as providing formal evidence of skills acquisition(10).

However, to date there is no evidence that DOPyS or CSPAT correlates with actual patient outcome after polypectomy.

In addition to these 2 polypectomy specific assessment tools, several organisations and authors attempted to implement polypectomy in a more general colonoscopy competency assessment tool.

Firstly, the American society of gastrointestinal endoscopy (ASGE) produced the “assessment of competency in endoscopy (ACE); colonoscopy skills assessment tool” in which 2 general questions are posed about therapeutics:

- What was the fellow's participation in the therapeutic manoeuvre 1—novice, performed with significant hands-on assistance or coaching; 2—intermediate, performed with minor hands-on assistance or significant coaching; 3—advanced, performed independently, with minor coaching; or 4—superior, performed independently without coaching

- What was the fellow's knowledge of the therapeutic tool 1—novice, unsure of the possible tool indicated or settings for pathology encountered; 2—intermediate, able to identify possible appropriate tool choices but not sure which would be ideal; 3—advanced, independently selects the correct tool yet needs coaching on settings; or 4—superior, independently identifies correct tool and settings as applicable(5).

Walsh et al designed the "Gastrointestinal Endoscopy Competency Assessment Tool (GIECAT)" in 2013. This tool is focussed on general endoscopic competency and only has 1 item regarding the technique of polypectomy; "Performs therapeutic manoeuvres (biopsy and/or polypectomy) independently, appropriately, and safely(6).

In 2010 Sedlack et al developed the "Mayo Colonoscopy Skills Assessment Tool" in which they focus on general colonoscopy skills. This tool contains 2 items focussed on therapeutic manoeuvres. - Item 11a. Therapeutic tool/cautery setting selection

1- Novice - Unsure of the possible tool(s) indicated for pathology. 2- Intermediate - Able to identify possible appropriate tool choices but not sure which would be ideal. 3- Advanced - Independently selects the correct tool yet needs coaching on settings. 4- Superior - Independently identifies correct tool and settings as applicable.

- 11b. What was the fellow's participation in the therapeutic manoeuvre. 1- Novice - Performed with significant hands-on assistance. 2- Intermediate - Performed with minor hands-on assistance or significant coaching. 3- Advanced - Performed Independently with minor coaching. 4- Superior - Performed Independently without coaching(7).

Another colonoscopy assessment tool was developed by kumar et al. 2018, namely The Skill Assessment in Fellow Endoscopy Training (SAFE-T) tool. This tool consists of 5 questions that captures both summative and formative feedback adapted into a web-based application. In this questionnaire there is only 1 query regarding polypectomy: "Complexity of interventions" which can be scored along a 3-point scale; 0: no

interventions performed; 1: straightforward (biopsy); 2: average (snare polypectomy); 3 challenging (complex polypectomy). The score is dependent on the complexity level the fellow reaches without intervention by the supervising gastroenterologist. The tool includes the formative feedback by providing a list of aspects on which the fellow needs to focus in the next case(8).

This tool is however, very user-friendly because it only has 5 questions, very broad and does not go into detail with regards to the specific cognitive and motor skills required for polypectomy.

These 4 competency frameworks focus on general colonoscopy skills and include only 1 or 2 items about polypectomy. They are insufficient to fully assess and provide feedback on all aspects of polypectomy. These tools are also not yet linked to overall patient outcome. Lastly these tools do not provide a tailored description of each score per item and no best practice videos, so they need specific training of the assessors and there is a risk of the hawk – dove phenomenon.

Table 5s: Literature review.

Assessment tool	Polypectomy specific	Any polypectomy	Video and live assessment	Online format	Self-calculating	Log-book	Short training video	Descriptive scoring scale	Best practice videos	Cohort	Statistical method	Refs
GPAT	YES	YES	YES	YES	YES	YES	YES	YES	YES	171 assessments (9 videos assessed by 19 assessors)	-IOA, overall impression vs GPAT ¹	This article
DOPyS	YES	YES (with adaptations for small polyps)	YES (with adaptations for video-based assessment)	NO	NO	NO	NO	NO	NO	329 assessments (47 videos by 7 assessors)	G-theory analysis	(3, 9, 10)
CSPAT	YES	NO	NO (video)	NO	NO	NO	YES	YES	NO	715 assessments (55 videos by 13 assessors)	IOA ²	(4)
ACE colonoscopy	NO	/	NO (live)	NO	NO	NO	NO	NO	NO	1061 colonoscopies assessed (performed by 93 fellows)	Means, linear regression, autoregressive generalized estimation equation ³	(5)
GIECAT	NO	/	NO (live)	NO	NO	NO	NO	NO	NO	116 colonoscopies assessed (performed by 61 endoscopists of varying experience)	ICC model 1, ICC model 2, Cronbach's and Kuder-Richardson formula, pearsons correlation coefficient, separate Kruskal-Wallis tests with post hoc Mann-Whitney U pairwise comparisons,	(6)

											Spearman's correlation coefficient ⁴	
MCSAT	NO	/	NO (live)	NO	NO	NO	NO	NO	NO	6390 colonoscopies assessed (performed by 41 fellows)	-Interitem correlation: Pearson product-moment correlation coefficient -Relationship to other variables (caecal intubation rate) using t test	(7)
SAFE-T	NO	/	NO (live)	YES	NO	NO	YES	NO	NO	350 colonoscopies assessed (performed by 15 fellows)	Independent T-test, inter-rater reliability, Pearson correlation coefficient	(8)

¹ IOA was interpreted using the ICC, correlation between first impression and GPAT: Pearson correlation coefficient, other comparisons between continuous variables using t-test.

² IOA was determined by Weighted kappa statistics.

³ The mean scores of each performance metric were calculated at each of the assessment intervals (every 50th procedure). The differences in the average scores between each stage of training were analyzed by using linear regression predicting motor or cognitive skill scores. An autoregressive generalized estimating equation (with an order of 1) was used to adjust for the institution and to account for within-fellow variability by using a random effect.

⁴ -Interrater reliability was established by using the ICC model 1 and average measures

-Test-retest reliability was used to assess whether the tool produces consistent results when completed by the same rater, using the ICC model 2

-internal structure validity: item-total correlations, interitem correlations and internal consistency (by using Cronbach's and Kuder- Richardson formula 20)

- endoscopists' total combined score for the technical, cognitive and integrative items were compared with their respective overall physician global ratings of technical, cognitive, and integrative skills by using Pearson's correlation coefficient

- the relationship between GRS (global rating scale) and CL (checklist) scores was examined by using Pearson's correlation coefficient
 - Discriminative validity GiECAT total, GRS, and CL scores of novice, intermediate, and experienced endoscopists were compared by using separate Kruskal-Wallis tests with post hoc Mann-Whitney U pairwise comparisons
 - Concurrent validity was examined by using correlation analysis with Spearman's correlation coefficient to examine the relationship between total, GRS, and CL scores with colonoscopy experience, caecal intubation rate, terminal ileal intubation rate, and physician global assessment (PGA) of skill.
- ⁵Independent T-test to compare SAFE-T scores between years of training, rate of caecal intubation and case complexity.
- Inter-rater reliability was assessed with the kappa agreement statistic
 - Pearson correlation coefficient to assess the relationship to MCSAT

Appendix 6s: IOA SMSA score

Similarly, when looking at the agreement for the well-validated SMSA score the group of trainee gastroenterologists showed moderate agreement (ICC 0.566 [95% CI 0.208 – 0.871]), the consultant gastroenterologist showed poor agreement (ICC: 0.435 [95% CI 0.204 – 0.78]) and same the group of gastroenterologists (consultant + trainee) demonstrated poor agreement (ICC: 0.463 [95% CI 0.242 – 0.794]). In contrast the medical students and consultant surgeons showed poor agreement (respectively: ICC: 0.257 [95% CI 0.063 – 0.707] and ICC: 0.365 [95% CI 0.345 – 0.81]). Finally, the group of non-gastroenterologists (medical students and surgeons) showed poor agreement (ICC: 0.172 [95% CI 0.003 – 0.559]).

References

1. [Available from: <https://vimeo.com/showcase/10417029>
2. GPAT showcase [Available from: <https://vimeo.com/showcase/10417029?>
3. Gupta S, Anderson J, Bhandari P, McKaig B, Rupert P, Rembacken B, et al. Development and validation of a novel method for assessing competency in polypectomy: direct observation of polypectomy skills. *Gastrointestinal endoscopy*. Wolfson Unit for Endoscopy, St. Mark's Hospital and Imperial College London HA1 3UJ., United Kingdom.: Elsevier, Inc.; 2011. p. 1232-9 e2.
4. Patel SG, Duloy A, Kaltenbach T, Hall M, Kahi C, Pohl H, et al. Development and validation of a video-based cold snare polypectomy assessment tool (with videos). *Gastrointest Endosc*. 2019;89(6):1222-30.e2.
5. Sedlack RE, Coyle WJ, Obstein KL, Al-Haddad MA, Bakis G, Christie JA, et al. ASGE's assessment of competency in endoscopy evaluation tools for colonoscopy and EGD. *Gastrointest Endosc*. 2014;79(1):1-7.
6. Walsh CM, Ling SC, Khanna N, Cooper MA, Grover SC, May G, et al. Gastrointestinal Endoscopy Competency Assessment Tool: development of a procedure-specific assessment tool for colonoscopy. *Gastrointest Endosc*. 2014;79(5):798-807.e5.
7. Sedlack RE. The Mayo Colonoscopy Skills Assessment Tool: validation of a unique instrument to assess colonoscopy skills in trainees. *Gastrointest Endosc*. 2010;72(6):1125-33, 33.e1-3.
8. Kumar NL, Kugener G, Perencevich ML, Saltzman JR. The SAFE-T assessment tool: derivation and validation of a web-based application for point-of-care evaluation of gastroenterology fellow performance in colonoscopy. *Gastrointest Endosc*. 2018;87(1):262-9.
9. Gupta S, Anderson J, Bhandari P, McKaig B, Rupert P, Rembacken B, et al. Development and validation of a novel method for assessing competency in polypectomy: direct observation of polypectomy skills. *Gastrointest Endosc*. 2011;73(6):1232-9.e2.
10. Patel K, Faiz O, Rutter M, Dunckley P, Thomas-Gibson S. The impact of the introduction of formalised polypectomy assessment on training in the UK. *Frontline Gastroenterol*. 2017;8(2):104-9.
11. Duloy AM, Kaltenbach TR, Keswani RN. Assessing colon polypectomy competency and its association with established quality metrics. *Gastrointest Endosc*. 2018;87(3):635-44.
12. van Doorn SC, Bastiaansen BA, Thomas-Gibson S, Fockens P, Dekker E. Polypectomy skills of gastroenterology fellows: can we improve them? *Endosc Int Open*. 2016;4(2):E182-9.
13. Siau K, Pelitari S, Green S, McKaig B, Rajendran A, Feeney M, et al. JAG consensus statements for training and certification in colonoscopy. *Frontline Gastroenterol*. 2023;14(3):201-21.