Serrated polyps
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Development and validation of the WASP-classification system for optical diagnosis of adenomas, hyperplastic polyps and sessile serrated polyps


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CHAPTER 9

ABSTRACT

Objective
Accurate endoscopic differentiation would enable to resect and discard small and diminutive colonic lesions, thereby increasing cost-efficiency. Current classification systems based on narrow band imaging (NBI), however, do not include neoplastic sessile serrated adenomas/polyps (SSA/Ps). We aimed to develop and validate a new classification system for endoscopic differentiation of adenomas, hyperplastic polyps and SSA/Ps <10 mm.

Design
We developed the Workgroup serrAted polypS and Polyposis (WASP) classification, combining the NBI International Colorectal Endoscopic classification and criteria for differentiation of SSA/Ps in a stepwise approach. Ten consultant gastroenterologists predicted polyp histology, including levels of confidence, based on the endoscopic aspect of 45 polyps, before and after participation in training in the WASP classification. After 6 months, the same endoscopists predicted polyp histology of a new set of 50 polyps, with a ratio of lesions comparable to daily practice.

Results
The accuracy of optical diagnosis was 0.63 (95% CI 0.54 to 0.71) at baseline, which improved to 0.79 (95% CI 0.72 to 0.86, p<0.001) after training. For polyps diagnosed with high confidence the accuracy was 0.73 (95% CI 0.64 to 0.82), which improved to 0.87 (95% CI 0.80 to 0.95, p<0.01). The accuracy of optical diagnosis after 6 months was 0.76 (95% CI 0.72 to 0.80), increasing to 0.84 (95% CI 0.81 to 0.88) considering high confidence diagnosis. The combined negative predictive value with high confidence of diminutive neoplastic lesions (adenomas and SSA/Ps together) was 0.91 (95% CI 0.83 to 0.96).

Conclusions
We developed and validated the first integrative classification method for endoscopic differentiation of small and diminutive adenomas, hyperplastic polyps and SSA/Ps. In a still image evaluation setting, introduction of the WASP classification significantly improved the accuracy of optical diagnosis overall as well as SSA/P in particular, which proved to be sustainable after 6 months.
Development and validation of the WASP-classification system

BACKGROUND

Colorectal cancer (CRC) arises from colorectal precursor lesions that often present as polyps. Detecting and resecting these lesions during colonoscopy decreases CRC incidence. Resecting all polyps, including all diminutive and small ones, also has its downsides considering complication risks and associated workload from gastroenterologists and pathologists. Compared with larger polyps (≥10 mm), small (6–9 mm) and diminutive (1–5 mm) polyps less often possess features of advanced neoplasia. Accurate optical diagnosis of small and diminutive polyps would allow to resect and discard these polyps without the need for histopathological assessment. Furthermore, all diminutive harmless hyperplastic polyps (HPs) in the rectosigmoid could be characterized and left in situ, resulting in safe and more cost-effective practice.

Colorectal polyps were historically subdivided into mainly adenomas (ADs) and HPs. ADs were assumed to be the only premalignant lesions, evolving to CRC via the traditional adenoma-carcinoma neoplasia pathway, while HPs were considered benign. For this reason international research has mainly focused on the endoscopic differentiation of ADs and HPs in order to increase the accuracy of optical diagnosis. The recent classification of WHO subdivides serrated polyps into HPs, sessile serrated adenomas/polyps (SSA/Ps) and traditional serrated adenomas (TSAs). SSA/Ps and TSAs can develop to cancer via the alternative serrated neoplasia pathway, which has been suggested to cause approximately 15–30% of all CRCs. SSA/Ps comprise up to 12% of all polyps in an asymptomatic average risk population, while the prevalence of TSA is far smaller (<1%). Therefore it is also important that all SSA/Ps are detected, correctly differentiated and radically resected during colonoscopy.

Endoscopic differentiation of SSA/Ps from ADs and HPs is difficult, even when advanced imaging techniques such as narrow band imaging (NBI) are used. As a result, validated classification systems to distinguish ADs, HPs and SSA/Ps using NBI do not currently exist. A recent study showed that with the use of the NBI International Colorectal Endoscopic (NICE) criteria, SSA/Ps are as often accounted as neoplastic as well as non-neoplastic polyps, which may limit the applicability of the NICE criteria in practice. In the past years, specific endoscopic features to characterise SSA/Ps have been described and could potentially be used to optimise the accuracy of optical diagnosis of colonic polyps, including SSA/Ps.

The aim of this study was to develop the first assessment method for optical diagnosis of small and diminutive colonic polyps which enables to differentiate ADs, HPs and SSA/Ps with the use of NBI and the NICE classification (the Workgroup serrAted polyP and Polyposis (WASP) classification) and to evaluate the improvement in diagnostic test accuracy among consultant gastroenterologists in the differentiation of these polyp subtypes after participation in a training module based on this classification system.
CHAPTER 9

METHODS

Development of the WASP classification

Based on a stepwise approach using the NICE classification and the criteria described by Hazewinkel et al., an assessment method was developed for the endoscopic differentiation of ADs, HPs and SSA/Ps (Figure 1): the WASP classification. According to this method, a colonic polyp is first assessed using the NICE criteria aiming to differentiate between polyps resembling HPs (type 1 polyps) and polyps resembling ADs (type 2 polyps). Using these criteria, the presence of at least one adenoma-like feature is sufficient to diagnose a type 2 polyp. These features are defined as (1) a darker colour than the surrounding mucosa, (2) prominent brown vessels or (3) an oval, tubular or branched surface pattern.

Subsequently the diagnostic criteria for SSA/Ps as described by Hazewinkel et al. are used to differentiate between SSA/Ps and HPs for type 1 polyps, and between SSA/Ps and ADs for type 2 polyps. The presence of at least two SSA/P-like features is hereby considered sufficient to diagnose an SSA/P. SSA/P-like features are defined as (1) a clouded surface, (2) indistinctive borders, (3) irregular shape or (4) dark spots inside the crypts.

Figure 1 | The WASP-classification: method for optical diagnosis of hyperplastic polyps, sessile serrated adenomas/polyps and adenomas based on the NICE-criteria and the Hazewinkel criteria in a stepwise approach
Training module development

One expert gastroenterologist regarding colonic polyps and NBI (ED) and a research fellow (JEGIJ) developed a training module based on the WASP classification system. At first the broad content of the training was designed and subdivided into the following main items:

- Clinical importance of the differentiation of small and diminutive colonic polyps
- Differentiation between type 1 and type 2 polyps using the NICE criteria\textsuperscript{11}
- Characterisation of SSA/P using the Hazewinkel criteria\textsuperscript{19}
- Endoscopic differentiation of SSA/P, AD and HP via a stepwise approach
- Training of endoscopic images of polyps with direct feedback (Figure 2).

Endoscopic images of small and diminutive polyps were retrieved from a prospectively collected database of polyps, collected in patients with serrated polyposis syndrome during endoscopic surveillance.\textsuperscript{23} These endoscopic images were used to illustrate the separate criteria for endoscopic differentiation of polyp subtypes as well as for the final training with direct feedback (Figure 2). Two gastroenterologists were asked to assess the comprehensibility and feasibility of a preliminary version of the module. Unclear segments were altered and missing information was added to the teaching module. The training module was developed using Microsoft PowerPoint (Microsoft Corporation,

![Optical diagram of colonic polyps](https://via.placeholder.com/150)

**Figure 2** | Representative screenshot of the training module: NBI image of SSA/P with direct feedback
Redmond, Washington, USA). Participation in the module was intended to take approximately 20 min of time.

First validation phase
The first validation phase was designed to assess the added value of the WASP classification in the increase in accuracy of optical diagnosis of colonic polyps. In total 10 consultant gastroenterologists were asked to participate in the training. All endoscopists were familiar with advanced imaging techniques and the classification of polyp histology using the NICE criteria. Before participation in the training a set of 45 non-magnified, non-manipulated endoscopic images of polyps (15 SSA/Ps, 15 HPs and 15 ADs, based on histology) were presented. For all polyps, a high-resolution white light endoscopy (HR-WLE) image and a NBI image were presented simultaneously. For each polyp, the participant predicted polyp histology, accompanied with a high level or low level of confidence. Patient characteristics as well as polyp location and size were not presented. No feedback was given afterwards. Participants were unaware of the used proportions of polyp subtypes. After the training module, the same set of 45 polyp images was presented in a changed, random order and assessed by the participants under identical circumstances.

Endoscopic images of small and diminutive polyps were retrieved from the same polyp database as used in the training module. Images of different polyps were selected to be used in the training module and in the validation phase. Only polyps with a HR-WLE and NBI image of sufficient quality were selected.

Second validation phase
The second validation phase was designed to assess the long-term learning effect of the introduction of the WASP classification as well as to evaluate the actual height of diagnostic performance, which could be compared with the Preservation and Incorporation of Valuable endoscopic Innovations (PIVI) statements. The same gastroenterologists were asked to participate in a second validation phase 6 months later. Participants predicted polyp histology of a new set of 50 non-magnified, non-manipulated endoscopic images of polyps, which consisted of 5 diminutive and 6 small SSA/Ps, 15 diminutive HPs and 1 small HP and 15 diminutive and 8 small ADs, comparable to proportions in daily practice. Again, for all polyps a HR-WLE image and a NBI image were presented simultaneously. For each polyp, the participant predicted polyp histology, accompanied with level of confidence. Patient characteristics as well as polyp location and size were not presented. Participants were unaware of the used proportions of polyp subtypes. No additional training was presented to the gastroenterologist before participation in this second validation phase. Images were retrieved from colonoscopies performed in the context of the Dutch population screening programme for CRC.

Histopathological diagnosis
For all polyps, the histopathological diagnosis was accounted as the reference standard. Polyps retrieved from the serrated polyposis database were assessed by two specialised GI pathologists (GAM and SvE)
Development and validation of the WASP-classification system

according to the revised Vienna criteria. Polyps retrieved during population screening were assessed by a specialised GI pathologist during daily practice and afterwards revised by GAM. Polyps were only included if both pathologists agreed on the diagnosis. The histopathological diagnosis was based on the morphological features on H&E staining. An SSA/P was defined as a serrated polyp with at least two irregular dilated crypts, including dilatation of the base of the crypts that often have a boot shape, L shape or inverted T shape. During revision the pathologists were blinded for patient characteristics, the endoscopic appearance of the lesions and for the diagnosis made by the other pathologist.

Ethical approval

This study was an educational endoscopic image evaluation study and therefore did not require revision by an institutional review board, as in agreement with the medical research involving human subjects act (WMO). This study was carried out in accordance with the Helsinki Declaration.

Statistical analysis

This study was powered based on the improvement in diagnostic accuracy after training during the first validation phase. An improvement in diagnostic accuracy of 10% was assumed to be of clinical relevance. With 15% discordant pairs, a significance level of 5% and a power of 90%, 135 observations were needed per group for paired analysis. To satisfy for the fact that a variety of observers scored the same set of polyps an inflation factor was calculated using the formula 1+(n−1)ρ, which is commonly used for clustered matched-pair data. Assuming an intra-rater correlation of 0.05 and using 45 observations per participant, the inflation factor was calculated to be 3.2 resulting in 432 observations (10 participants) needed for paired analysis.

The diagnostic accuracy of optical diagnosis was calculated with the histopathological diagnosis as the reference standard. Generalised estimating equations with two levels of non-nested clusters were used to compare the diagnostic performance before and after training. Generalised estimating equations were also used to compare the diagnostic performance in both groups for polyps that were diagnosed with a high level of confidence. In order to calculate the diagnostic accuracy of optical diagnosis for polyp subtypes, answers were dichotomised. ADs and SSA/Ps were hereby considered neoplastic polyps, while HPs were considered non-neoplastic.

The interobserver agreement in polyp diagnosis before and after training, as well as in the second validation phase, was calculated using Fleiss’ k. A k-value <0.20 was regarded as poor agreement; 0.21–0.40 as fair agreement; 0.41–0.60 as moderate agreement; 0.61–0.80 as good agreement and >0.81 as very good agreement. The pre-training and post-training agreements were compared using Wald statistics, by assuming that the k before and the k after training had a correlation of 0.3 since they are from the same patient group. STATA/IC V.10.1 (StataCorp; College Station, Texas, USA) and R V.2.15.0 (The R Foundation for Statistical Computing) were used for analysis. A p value <0.05 was considered statistically significant. The results of this study were reported in accordance with the...
standards for reporting of diagnostic accuracy statements for diagnostic accuracy studies as well as with the standards for reliability and agreement studies.\textsuperscript{33,34}

\section*{RESULTS}

\subsection*{Participants}
Ten consultant gastroenterologists from nine hospitals were recruited to participate in this study. Five gastroenterologists were working in an academic hospital and five in a regional hospital, all from different parts of the country. All endoscopists but one were trained and accredited to perform colonoscopies in Dutch population screening for CRC, indicating adequate colonoscopy experience and quality.\textsuperscript{35} All endoscopists were familiar with advanced imaging techniques and the classification of polyp histology using the NICE criteria. In the first validation phase, gastroenterologists participated in the study during live sessions with two to five participants at a time. In the second validation phase gastroenterologists participated via a web-based programme.

\begin{table}[h]
\centering
\begin{tabular}{lcccc}
\hline
 & \textbf{Accuracy (95\% CI)} & \textbf{Accuracy (95\% CI)} & \textbf{Improvement (95\% CI)} & \textbf{p-value} \\
 & \textbf{before training} & \textbf{after training} & & \\
\hline
Overall analysis & 0.63 (0.54-0.71) & 0.79 (0.72-0.86) & 0.16 (0.09-0.22) & <0.001 \\
with high confidence & 0.73 (0.64-0.82) & 0.87 (0.80, 0.95) & 0.14 (0.04-0.24) & <0.01 \\
Diminutive lesions & 0.61 (0.55-0.66) & 0.77 (0.72-0.81) & 0.16 (0.08-0.24) & <0.001 \\
with high confidence & 0.71 (0.64-0.78) & 0.86 (0.81-0.91) & 0.15 (0.03-0.27) & 0.02 \\
Small lesions & 0.67 (0.60.75) & 0.83 (0.77-0.89) & 0.16 (0.06-0.26) & <0.01 \\
with high confidence & 0.77 (0.68-0.85) & 0.90 (0.84-0.95) & 0.13 (0.02-0.24) & 0.02 \\
\hline
\end{tabular}
\caption{First validation phase: comparison of the overall pooled diagnostic accuracy of optical diagnosis before and after training}
\end{table}

CI = confidence interval; AD = adenoma, SSA/P = sessile serrated adenoma/polyp; HP = hyperplastic polyps

\subsection*{Diagnostic accuracy}
A comparison of the pooled overall diagnostic test accuracy before and after training is presented in Table 1. The overall accuracy of optical diagnosis was 0.63 (95\% CI 0.54 to 0.71) before training and increased significantly to 0.79 (95\% CI 0.72 to 0.86) after training (16\% improvement; 95\% CI 9\% to 22\%; p<0.001). The individual overall accuracy of nine participants increased after training, while one participant showed no improvement (Figure 3). For polyps diagnosed with a high level of confidence the pooled overall accuracy was 0.73 (95\% CI 0.64 to 0.72) before training, which significantly increased to 0.87 (95\% CI 0.80 to 0.95) after training (14\% improvement; 95\% CI 4\% to 24\%; p<0.01). The individual overall accuracy of eight participants increased after training, while the accuracy of two participants decreased (Figure 3). For diminutive as well as small lesions the pooled
Development and validation of the WASP-classification system

overall diagnostic accuracy significantly improved after training, unaware of the confidence level of polyp diagnoses (Table 1).

In Table 2 the pooled accuracy before and after training is presented, dichotomised for the characterisation of different polyp subtypes. The pooled accuracy of optical diagnosis increased significantly after training for the characterisation of neoplastic polyps (ADs and SSA/Ps combined) (10% improvement; 95% CI 5% to 15%; \( p < 0.001 \)), SSA/Ps (12% improvement; 95% CI 5% to 17%; \( p < 0.001 \)) and ADs (11% improvement; 95% CI 4% to 14%; \( p < 0.01 \)). The individual accuracy increased for all 10 gastroenterologists after training regarding neoplastic polyps as well as SSA/Ps and for eight gastroenterologists regarding ADs (Figure 3). For polyps diagnosed with high confidence similar improvement in pooled accuracy is shown for neoplastic polyps (8% improvement; 95% CI 2% to 15%; \( p < 0.01 \)), SSA/Ps (10% improvement; 95% CI 2% to 18%; \( p = 0.02 \)) and ADs (10% improvement; 95% CI 1% to 19%; \( p = 0.03 \)). The individual accuracy increased for nine gastroenterologists regarding neoplastic polyps as well as SSA/Ps and for eight gastroenterologists regarding ADs (Figure 3).

In Table 3 the pooled overall accuracy as well as the pooled dichotomised accuracy of optical diagnosis from the second validation phase is presented. The pooled accuracy of optical diagnosis was 0.76 (95% CI 0.72 to 0.80) overall, 0.87 (95% CI 0.84 to 0.90) when dichotomised for SSA/Ps, 0.83 (95% CI 0.80 to 0.87) when dichotomised for ADs and 0.82 (95% CI 0.79 to 0.86) when dichotomised for neoplastic lesions. The pooled accuracy of optical diagnosis with high confidence was 0.84 (95% CI 0.81 to 0.88) overall, 0.91 (95% CI 0.88 to 0.94) when dichotomised for SSA/Ps, 0.90 (95% CI 0.87 to 0.93) when dichotomised for ADs and 0.89 (95% CI 0.85 to 0.92) when dichotomised for neoplastic lesions.

The pooled negative predictive value (NPV) of diminutive neoplastic lesions was 0.83 (95% CI 0.75 to 0.89), which increased to 0.91 (95% CI 0.83 to 0.96) for diminutive neoplastic lesions diagnosed with high confidence (see online supplementary Table S1). In total 7 out of 10 gastroenterologists scored an NPV ≥90% for diminutive neoplastic lesions diagnosed with high level of confidence.

Table 2 | First validation phase: comparison of the dichotomized pooled diagnostic accuracy of optical diagnosis before and after training

<table>
<thead>
<tr>
<th></th>
<th>Accuracy (95% CI) before training</th>
<th>Accuracy (95% CI) after training</th>
<th>Improvement (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSA/P vs non-SSA/P with high confidence</td>
<td>0.74 (0.66-0.82)</td>
<td>0.86 (0.80-0.91)</td>
<td>0.12 (0.05-0.17)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>AD vs non-AD with high confidence</td>
<td>0.76 (0.67-0.84)</td>
<td>0.87 (0.80-0.94)</td>
<td>0.11 (0.04-0.18)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Neoplastic lesion vs HP with high confidence</td>
<td>0.76 (0.69-0.83)</td>
<td>0.86 (0.80-0.91)</td>
<td>0.10 (0.05-0.15)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Table 3 | Second validation phase: overall diagnostic accuracy of optical diagnosis from the second validation phase

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>SSA/P</th>
<th>AD</th>
<th>Neoplastic lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy (95% CI)</td>
<td>0.76 (0.72-0.80)</td>
<td>0.87 (0.84-0.90)</td>
<td>0.83 (0.80-0.87)</td>
<td>0.82 (0.79-0.86)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>SSA/P</th>
<th>AD</th>
<th>Neoplastic lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPV (95% CI)</td>
<td>0.83 (0.75-0.89)</td>
<td>0.91 (0.83 to 0.96)</td>
<td>0.91 (0.83 to 0.96)</td>
<td>0.91 (0.83 to 0.96)</td>
</tr>
</tbody>
</table>

CI = confidence interval; AD = adenoma, SSA/P = sessile serrated adenoma/polyp; HP = hyperplastic polyps
Figure 3 | Comparison of the individual and combined accuracy of optical diagnosis before and after participation in a training course about the use of the WASP-classification. Data are presented for all polyps and for those polyps that were diagnosed with a high level of confidence.
Diagnostic agreement

In the first validation phase the interobserver agreement of optical polyp diagnoses improved significantly from 0.32 (95% CI 0.28 to 0.35) at baseline to 0.58 (95% CI 0.55 to 0.62) after training about the use of the WASP classification (p<0.001). The interobserver agreement was considered moderate after training. In the second validation phase the interobserver agreement of optical diagnoses remained moderate with a Fleiss’ κ of 0.54 (95% CI 0.51 to 0.57). Interobserver agreement of optical diagnosis with high level of confidence could not be measured, since each individual diagnosed a different set of polyps with high confidence.

**DISCUSSION**

Advanced imaging techniques such as NBI facilitate the endoscopic differentiation of colonic polyp subtypes. Classification systems based on NBI that include the characterisation of common and premalignant SSA/Ps however do not yet exist, hindering optimal practice.\(^9\,11\) We developed the first integrative classification system for optical diagnosis of small and diminutive ADs, HPs and SSA/Ps (the WASP classification), combining the existing NICE classification and criteria by Hazewinkel et al\(^19\) in a stepwise approach.\(^9\) A structured training about the use of the WASP classification resulted in an overall significant increase in diagnostic accuracy of optical diagnosis for 10 consultant gastroenterologists predicting polyp histology (0.63 vs 0.79; 16% improvement; 95% CI 9% to 22%; p<0.001). For polyps diagnosed with a high level of confidence a similar increase in accuracy was found (0.73 vs 0.87; 14% improvement; 95% CI 4% to 24%; p<0.01). The accuracy for characterisation of SSA/Ps, ADs as well as SSA/Ps plus ADs (neoplastic polyps) also increased significantly after the training. The elevated diagnostic accuracy of optical diagnosis showed to be sustainable during long-term follow-up in an image evaluation setting. After 6 months the overall pooled accuracy was 0.76 (95% CI 0.72 to 0.80), which increased to 0.84 (95% CI 0.81 to 0.88) for polyps diagnosed with high confidence. The accuracy with high confidence was 0.91 (95% CI 0.88 to 0.94) for SSA/Ps and 0.89 (95% CI 0.85 to 0.92) for neoplastic lesions. The pooled NPV with high confidence of diminutive neoplastic lesions was 0.91

| Second validation phase: Pooled overall and dichotomized diagnostic accuracy of optical diagnosis |
|-------------------------------------------------|-----------------|-----------------|-----------------|
| Accuracy all lesions (95% CI) & Accuracy diminutive lesions (95% CI) & Accuracy small lesions (95% CI) |
| Overall analysis | 0.76 (0.72-0.80) & 0.74 (0.69-0.79) & 0.83 (0.75-0.88) |
| With high confidence | 0.84 (0.81-0.88) & 0.83 (0.79-0.88) & 0.86 (0.80-0.93) |
| SSA/P vs non-SSA/P | 0.87 (0.84-0.90) & 0.86 (0.82-0.90) & 0.88 (0.83-0.94) |
| with high confidence | 0.91 (0.88-0.94) & 0.91 (0.87-0.94) & 0.91 (0.85-0.96) |
| AD vs non-AD | 0.83 (0.80-0.87) & 0.81 (0.77-0.85) & 0.89 (0.84-0.94) |
| with high confidence | 0.90 (0.87-0.93) & 0.88 (0.84-0.92) & 0.91 (0.89-0.98) |
| Neoplastic lesions vs HP | 0.86 (0.79-0.86) & 0.81 (0.77-0.85) & 0.85 (0.80-0.92) |
| with high confidence | 0.89 (0.85-0.92) & 0.88 (0.84-0.92) & 0.90 (0.84-0.95) |

CI = confidence interval; SSA/P = sessile serrated adenoma/polyp; HPs = hyperplastic polyps
(CI 0.83 to 0.96), while 7 out of 10 individuals scored an NPV ≥90%. These results suggest an added value of the WASP classification system to existing characterization methods.

Several limitations in this study have to be acknowledged. First of all, still images were used to predict polyp histology. This does not fully resemble the optical diagnosis in daily practice, when polyps are assessed during real-time colonoscopy. This could potentially have led to selection bias, considering that it is not always possible to sufficiently visualise polyps during colonoscopy. On the other hand, real-time images of polyps might be easier to characterise if the polyp is sufficiently visualised, due to the opportunity to visualise the lesion from several angles, possibly improving the accuracy of optical diagnosis with high confidence compared with an image evaluation setting. Since the same polyps were assessed before and after training during the first validation phase, this will probably not have led to biased results considering the main objective of this study. A second potential shortcoming of this study is the fact that most images of polyps were derived from patients with serrated polyposis syndrome. The endoscopic features of polyps retrieved from this patient group could potentially differ from polyps retrieved from sporadic patients. There is however no reason to assume a difference in polyp phenotype of these polyps compared with their sporadic counterparts, and therefore we think that our data can be extrapolated to the general population.

This study is performed in the context of a broad discussion regarding the advantages and disadvantages of current policy concerning the management of small and diminutive polyps detected during colonoscopy. Small and diminutive polyps rarely have features of advanced neoplasia, and resecting and discarding these polyps could result in a more cost-effective practice (resect and discard policy). Furthermore all diminutive non-neoplastic polyps in the rectosigmoid could be characterized and left in situ (resect or leave in policy). The PIVI statements are composed to safely implement these strategies in daily practice. According to the PIVI statements the agreement in assignment of post-polypectomy surveillance intervals using real-time endoscopic assessment of the histology of diminutive polyps should be ≥90% when compared with decisions based on pathology assessment in order to safely discard a polyp without histopathological assessment. Other expert groups have stretched the ‘resect and discard policy’ towards small lesions as well. Furthermore it is stated in the PIVI statements that an NPV for the diagnosis of premalignant polyps of ≥90% is mandatory in order not to resect diminutive benign polyps in the rectosigmoid. Many studies on validated criteria for polyp assessment have been performed in order to reach the goals of the PIVI statements, which showed varying results.

Kumar et al recently demonstrated the shortcomings of the NICE criteria, as characterisation of SSA/Ps is not included. As a result, premalignant SSA/Ps were not differentiated and equally often diagnosed as neoplastic as well as non-neoplastic polyps. Subsequently several experts stated that the resect and discard theory could only be implemented when proper endoscopic differentiation of SSA/Ps is possible. We developed a classification system that could help to differentiate neoplastic
Development and validation of the WASP-classification system

We showed that a short training course on the use of the WASP classification significantly increases the overall accuracy of optical polyp diagnosis, resulting in a long-term overall diagnostic accuracy of 0.84 (95% CI 0.81 to 0.88) for polyps diagnosed with high confidence. An even larger accuracy with high confidence was reached differentiating SSA/Ps (0.91; 95% CI 0.88 to 0.94) as well as neoplastic lesions (0.89; 95% CI 0.85 to 0.92). Furthermore we showed that the combined NPV with high confidence of diminutive neoplastic lesions was 0.91 (95% CI 0.83 to 0.96), while 7 out of 10 individuals scored an NPV ≥90%. Although the accuracy of post-polypectomy surveillance intervals could not be evaluated in this study, introduction of the WASP classification seems promising, for the implementation of the ‘resect and discard policy’ for lesions <10 mm as well as for the implementation of the ‘resect or leave in policy’ for diminutive lesions in the rectosigmoid.

Three recent studies independently evaluated the usefulness of a short training in the diagnostic accuracy differentiating ADs from HPs in participants with varying endoscopic expertise. These studies individually showed that a short training increased the accuracy of optical diagnosis. Our study showed an improvement in overall accuracy after training for nine participating gastroenterologists, while one (already relatively high performing) gastroenterologist showed equal results. This indicates that the training course has a broad beneficial effect on an individual level. This effect can not solely be explained by an improvement in the use of the NICE criteria, since also the accuracy in the diagnosis of SSA/Ps increased for all 10 participants, resulting in a significant improvement overall.

Future research is needed to assess diagnostic performance using the WASP classification during real-time colonoscopies in daily practice in order to verify if the WASP classification is truly suitable for the implementation of the ‘resect and discard’ as well as the ‘resect or leave in’ policies, for expert as well as non-expert gastroenterologists. Furthermore integrative classification systems should be developed and validated to endoscopically differentiate polyp subtypes with the use of other virtual chromo-endoscopy techniques, such as high definition (HD) I-scan and flexible spectral imaging colour enhancement (FICE).

In conclusion, we developed and validated the first classification system for optical diagnosis of small and diminutive ADs, SSA/Ps and HPs using NBI. Endoscopic differentiation using the WASP classification showed a significant increase in the accuracy of optical diagnosis overall among experienced gastroenterologists as well as the accuracy characterising neoplastic lesions and SSA/Ps in particular, which proved to be sustainable after 6 months. This is the first classification system that facilitates the characterisation of all prevalent polyp subtypes, including premalignant SSA/Ps and could eventually contribute to realise a safe implementation of targeted polyp treatment in daily practice. Before this could be realised, the diagnostic performance of the WASP criteria should be assessed in daily practice and compared with conditions as set by the PIVI statements.
REFERENCES


