Thieme

The effect of train-the-colonoscopy-trainer course on colonoscopy quality indicators

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Figs. 1s–5s, Tables 1s–3s
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ABSTRACT

Background Systematic training in colonoscopy is highly recommended; however, we have limited knowledge of the effects of "training-the-colonoscopy-trainer" (TCT) courses. Using a national quality register on colonoscopy performance, we aimed to evaluate the effects of TCT participation on defined quality indicators.

Methods This observational study compared quality indicators (pain, cecal intubation, and polyp detection) between centers participating versus not participating in a TCT course. Nonparticipating centers were assigned a pseudoparticipating year to match their participating counterparts. Results were compared between first year after and the year before TCT (pseudo)participation. Time trends up to 5 years after TCT (pseudo)participation were also compared. Generalized estimating equation models, adjusted for age, sex, and bowel cleansing, were used.

Results 11 participating and 11 nonparticipating centers contributed 18 555 and 10 730 colonoscopies, respectively. In participating centers, there was a significant increase in detection of polyps ≥5 mm, from 26.4% to 29.2% (P=0.035), and reduction in moderate/severe pain experienced by women, from 38.2% to 33.6% (P=0.043); no significant changes were found in nonparticipating centers. Over 5 years, 20 participating and 18 nonparticipating centers contributed 85 691 and 41 569 colonoscopies, respectively. In participating centers, polyp detection rate increased linearly (P=0.003), and pain decreased linearly in women (P=0.004). Nonparticipating centers did not show any significant time trend during the study period.

Conclusions Participation in a TCT course improved polyp detection rates and reduced pain experienced by women. These effects were maintained during a 5-year follow-up.

Introduction

Although upskill and professional courses in general are appreciated and valued by participants when asked for their opinion in questionnaires, the ultimate effect on work performance and services provided by the participants may still be questioned. Participation in some courses may even stimulate elitism at the expense of teamwork [1,2].

A major part of the practical training in colonoscopy occurs in the workplace and this requires time and local competence in teaching and supervision. Training the colonoscopy trainers (TCT) for this task is important, desirable, and uncontroversial [3,4]. However, there is limited knowledge of the extent to which course participation improves the quality of local colonoscopy services [5]. Within the framework of a national quality assurance register in Norway – Gastronet – the present study aimed to evaluate the local impact and measured benefit for patients following endoscopist participation in a TCT course.

Methods

Centralized TCT courses were launched in Norway in late 2014 to train gastroenterologists in the teaching of colonoscopy. Since then, all gastrointestinal endoscopy centers in Norway have been offered the opportunity to send endoscopists to a TCT course. Participation is on a first-come, first-served basis and is restricted to five participants per course.

The TCT course is a Norwegian adaptation of the train the trainers endoscopy course in colonoscopy [6]. The course includes upskill training in colonoscopy and pedagogic principles for supervision and feedback. The aim is to improve both the trainer's own skills in colonoscopy and the skills needed to instruct trainees. This is a 3-day course held at dedicated endoscopy laboratories, with patients having consented to be examined in a teaching setting.

The quality register Gastronet for colonoscopy performance was started in Norway in 2003, and achieved status as a national quality register in 2012 [7]. For the present study, Gastronet data for the 6-year period 2014–2019 were available for analyses. Variables for quality assurance in the Gastronet register include cecum intubation rate, detection of polyps ≥ 5 mm diameter (PDR-5), and patient-reported pain (no pain, slight pain, moderate pain, and severe pain). These variables were selected as end points in the present study, with the pain categories dichotomized into "none or slight" and "moderate or severe" pain. We also registered bowel cleansing using the Boston Bowel Preparation Scale scores, dichotomized into a total score of ≥ 6 representing adequate cleansing and <6 for inadequate cleansing [8]. The variables were reported directly to Gastronet in endoscopist and patient report forms, respectively. The patient report form, which included patient-reported pain, was completed at home on the day after the examination and then mailed directly to the Gastronet secretariat in a prepaid return envelope. Two centers that reported fewer than 100 colonoscopies were excluded from the analyses (see **Fig. 1s** in the online-only Supplementary material).

Centers that did not participate in a TCT course were assigned a year of virtual participation ("pseudoparticipation") to match the year of participating centers, preferably within the same region (same or neighboring county) (**Table 1s**). The defined end point variables were compared between participating and nonparticipating centers the year before and the year after their participation or pseudoparticipation, respectively, and for the subsequent 5 years after physicians and nurses first attended a TCT course (or after pseudoparticipation in the centers not participating).

The study was considered a quality assurance project and therefore the need for approval was waived by the regional ethics committees of South-East Norway. Gastronet is approved by the Norwegian Data Protection Authority and the act of a patient returning the patient form was accepted as consent.

Statistical methods

We evaluated three binary outcomes: pain (no pain/slight pain vs. moderate/severe pain), cecum intubation (yes/no), and PDR-5 (yes/no). To account for the fact that groups of individuals were examined at the same center (e. g. individuals were nested within centers), we used generalized estimating equation (GEE) logit models, with center as the clustering variable and a compound-symmetry covariance structure to identify the independent explanatory factors.

We compared a) the calendar year before and after the (pseudo)participation and b) the subsequent ≤ 5 calendar years after (pseudo)participation. In the latter analysis, the year of pseudoparticipation was redefined for four centers (**Table 3s**) in order to provide controls for a full 5-year period of follow-up. We used time as a dichotomous explanatory variable (before/after [pseudo]participation), and as a continuous variable from zero (T0, year of [pseudo]participation) to 5 years (T5), respectively. In both analyses, to evaluate the difference in time trends between participating and nonparticipating/control centers, we entered an interaction term between time and participation in the GEE models. All models were adjusted for three confounders: age in years (continuous), sex, and bowel cleansing (adequate, not adequate, missing). Odds ratio (OR) with 95 % confidence interval (CI) were reported.

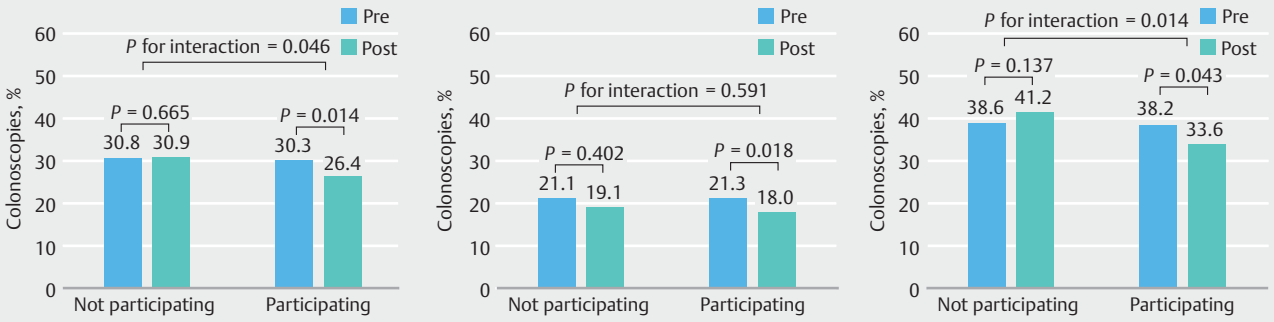
All analyses were performed using SAS version 9.4 (SAS Institute, Cary, North Carolina, USA). All tests were two-sided and *P* values of < 0.05 were considered statistically significant.

Results

A total of 57 centers were included in the study of TCT course participation for the study period 2014–2019. In all, the centers recorded 162 358 colonoscopies in Gastronet (**Fig. 1s**, **Table 1s**).

A total of 11 participating centers had colonoscopies registered before and after the year of TCT participation, contributing 18 555 colonoscopies to pre- vs. post course analysis. Similarly, 11 matched nonparticipating centers contributed 10 730 colonoscopies to this analysis.

The proportion of colonoscopies in which patients reported moderate or severe pain the year before TCT participation and



Men & women	Not participating		Participating	
	Pre	Post	Pre	Post
All	3835	3647	5390	6879
Pain	1181	1127	1633	1814
% Pain	30.8	30.9	30.3	26.4

a

Men	Not participating		Participating	
	Pre	Post	Pre	Post
All	1706	1700	2520	3190
Pain	360	325	536	574
% Pain	21.1	19.1	21.3	18.0

b

Women	Not participating		Participating	
	Pre	Post	Pre	Post
All	2129	1947	2870	3689
Pain	821	802	1097	1240
% Pain	38.6	41.2	38.2	33.6

c

▶ **Fig. 1** Patient-reported moderate or severe pain the year before and the year after participation in a "training-the-colonoscopy-trainer" (TCT) course. **a** Men and women. **b** Men. **c** Women. Participating = colonoscopies at centers participating in the TCT courses. Not participating = colonoscopies at centers not participating in the TCT courses (pseudoparticipation).

pseudoparticipation (nonparticipation), respectively, were quite similar, both overall (30.3 % and 30.8 %; $P = 0.608$) and by sex (▶ **Fig. 1a–c**). Moderate/severe pain changed from 30.3 % to 26.4 % (OR 0.85, 95 %CI 0.75–0.97; $P = 0.014$) (▶ **Fig. 1a**) in participating centers, and from 30.8 % to 30.9 % (OR 1.03, 95 %CI 0.90–1.19; $P = 0.665$) in nonparticipating centers. The changes in participating centers were statistically different from the changes in nonparticipating centers (P for interaction = 0.046). This difference was confirmed only for colonoscopies in women: moderate/severe pain changed from 38.2 % to 33.6 % (OR 0.85, 95 %CI 0.73–0.99; $P = 0.043$) (▶ **Fig. 1c**) in participating centers, and from 38.6 % to 41.2 % (OR 1.11, 95 %CI 0.97–1.28; $P = 0.137$) in nonparticipating centers (P for interaction = 0.014). For colonoscopies in men, the reporting of moderate/severe pain changed from 21.3 % to 18.0 % (OR 0.84, 95 %CI 0.73–0.97; $P = 0.018$) (▶ **Fig. 1b**) in participating centers, and from 21.1 % to 19.1 % (OR 0.91, 95 %CI 0.72–1.15; $P = 0.402$) in nonparticipating centers. The changes in participating centers were not statistically different from the changes in nonparticipating centers (P for interaction = 0.591).

In the year before TCT (pseudo)participation, intubation rates were higher in participating centers (95.4 %) than in nonparticipating centers (91.4 %; $P < 0.001$). Changes in intubation rates from the year before to the year after (pseudo)participation were not significant in participating centers or in nonparticipating centers (**Fig. 2s**).

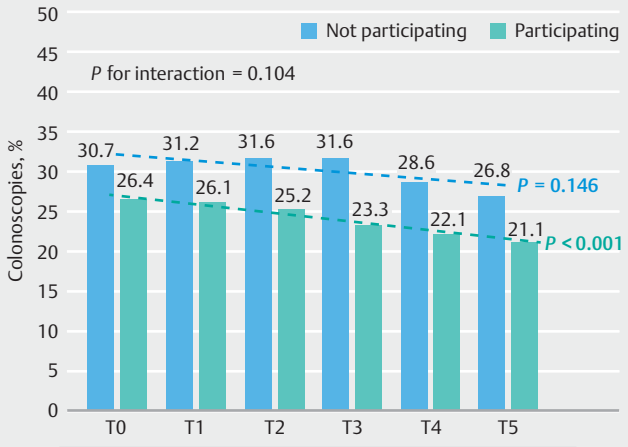
In the year before TCT (pseudo)participation, PDR-5 was higher in participating centers (26.4 %) than in nonparticipating centers (21.9 %; $P < 0.001$). PDR-5 significantly improved in participating centers, from 26.4 % to 29.2 % (OR 1.14, 95 %CI 1.01–1.28; $P = 0.035$), while a borderline significant opposite trend from 21.9 % to 19.9 % (OR 0.86, 95 %CI 0.74–1.01; $P = 0.059$) was observed in nonparticipating centers (**Fig. 3s a**). The changes in participating centers were statistically different from the changes in nonparticipating centers (P for interaction = 0.019). Similar results were observed in men and women (**Fig. 3s b,c**).

We then performed 5-year follow-up analyses (▶ **Fig. 2**, **Fig. 4s**, **Fig. 5s**), using the year of TCT (pseudo)participation rather than year of pre-TCT as baseline (**Table 3s**) and reporting the outcomes of interest for a total follow-up of 5 years. Over 5 years, 20 participating and 18 nonparticipating centers contributed 85 691 and 41 569 colonoscopies, respectively. At baseline, participating centers reported lower pain rates, higher intubation rates, and higher PDR-5 compared with nonparticipating centers ($P < 0.01$ for all three outcomes) (▶ **Fig. 2**, **Fig. 4s**, **Fig. 5s**).

A significant linear pain-reducing effect was shown for colonoscopies in women in TCT-participating centers (from 33.9 % to 28.0 %; OR for each additional year of follow-up [$OR_{1\ year}$] 0.93, 95 %CI 0.89–0.98; $P = 0.004$) (▶ **Fig. 2c**). A nonsignificant improvement was also seen for colonoscopies in women in nonparticipating centers (from 38.2 % to 36.1 %; $OR_{1\ year}$ 0.98, 95 % CI 0.95–1.02; $P = 0.297$). The linear trend in participating centers was borderline statistically different from the trend in nonparticipating centers (P for interaction = 0.067). For colonoscopies in men, both participating and nonparticipating centers had similar improvements in patients' pain perception (P for interaction = 0.301) (▶ **Fig. 2b**).

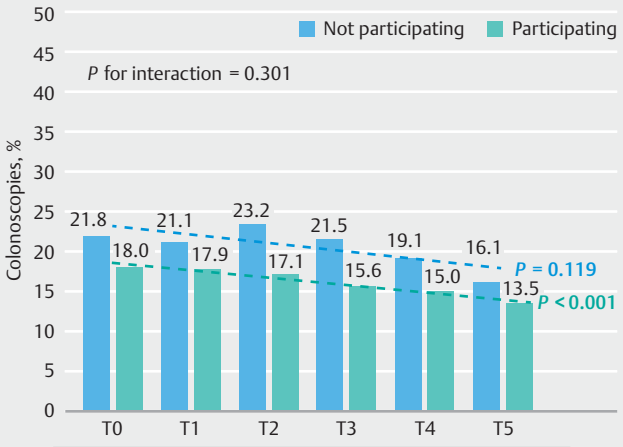
Participating centers showed an overall linear improvement in cecal intubation rate, from 95.6 % to 97.2 % ($OR_{1\ year}$ 1.17, 95 %CI 1.04–1.31; $P = 0.007$), but this was not significantly different from nonparticipating centers, which went from 94.2 % to 94.3 % ($OR_{1\ year}$ 1.18, 95 %CI 0.95–1.47; $P = 0.099$; P for interaction = 0.852) (**Fig. 4s a**). Similar results were found for men and women separately (**Fig. 4s b,c**).

In the follow-up analysis on PDR-5, there was an overall improvement after TCT participation (from 30.8 % to 37.9 %;



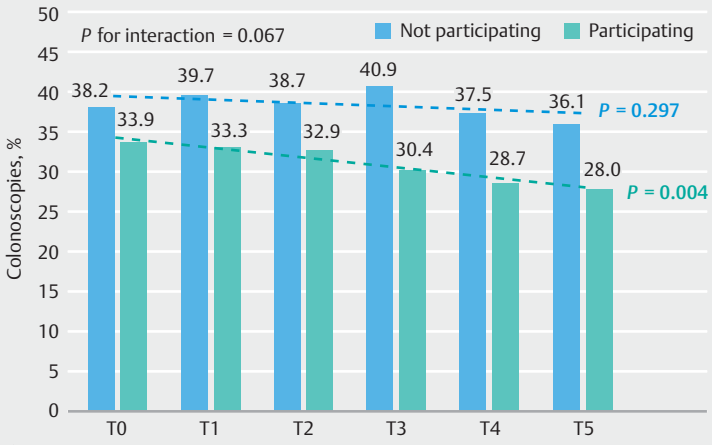
Men & women	Not participating					
	T0	T1	T2	T3	T4	T5
All	7878	8189	4554	3902	2122	2099
Pain	2418	2553	1438	1233	607	562
% Pain	30.7	31.2	31.6	31.6	28.6	26.8
	Participating					
All	12986	14334	8784	8618	6121	5847
Pain	3433	3736	2213	2005	1350	1235
% Pain	26.4	26.1	25.2	23.3	22.1	21.1

a



Men	Not participating					
	T0	T1	T2	T3	T4	T5
All	3613	3748	2091	1868	1029	977
Pain	789	791	486	401	197	157
% Pain	21.8	21.1	23.2	21.5	19.1	16.1
	Participating					
All	6091	6715	4278	4160	2978	2765
Pain	1095	1200	732	650	448	373
% Pain	18.0	17.9	17.1	15.6	15.0	13.5

b



Women	Not participating					
	T0	T1	T2	T3	T4	T5
All	4265	4441	2463	2034	1093	1122
Pain	1629	1762	952	832	410	405
% Pain	38.2	39.7	38.7	40.9	37.5	36.1
	Participating					
All	6895	7619	4506	4458	3143	3082
Pain	2338	2536	1481	1355	902	862
% Pain	33.9	33.3	32.9	30.4	28.7	28.0

c

▶ **Fig. 2** Moderate or severe pain reported during 5-year follow-up. **a** Men and women. **b** Men. **c** Women. Participating = colonoscopies at centers participating in the "training-the-colonoscopy-trainer" (TCT) courses. Not participating = colonoscopies at centers not participating in the TCT courses (pseudoparticipation).

$OR_{1\ year}$ 1.06, 95 %CI 1.02–1.10; P = 0.003), confirmed both for men (from 35.4 % to 41.5 %; $OR_{1\ year}$ 1.05, 95 %CI 1.00–1.10; P = 0.035) and for women (from 26.6 % to 34.6 %; $OR_{1\ year}$ 1.08, 95 % CI 1.01–1.17; P = 0.036). PDR-5 for nonparticipating centers did not change (**Fig. 5s b,c**). The linear trend in participating centers was statistically significantly different from the trend in nonparticipating centers in the whole study population (P for interaction 0.041), but only borderline statistically significantly different in men and women (P for interaction = 0.055 for men and 0.057 for women, respectively).

As a sensitivity analysis, we stratified the population of the TCT participating centers according to the median age. A significant linear pain-reducing trend was confirmed both for colonoscopies in women younger than 64 years and for colonoscopies in those 64 years or older. An overall improvement in PDR-5 was confirmed for colonoscopies in men and women younger than 65 years and for colonoscopies in those 65 years or older.

Discussion

Based on analyses of more than 140 000 colonoscopies during a 5-year follow-up period, the current study is, to our knowledge, the largest study to date evaluating the effects of courses aimed at improving the competence of colonoscopist trainers to train others.

A large randomized study in Poland comparing a TCT course with passive feedback on performance in 56 517 colonoscopies from 40 centers, showed a modest increase from 18.4 % to 24.1 % in adenoma detection rate (ADR) after 3 years – a net improvement of 3.9 % compared with the passive feedback group [5]. A meta-analysis based on 33 184 colonoscopies in 12 studies, showed an effect of feedback to endoscopists on their ADR, which increased from 30.5 % to 36.0 [9], but without improvement in withdrawal time (believed to contribute to improved adenoma and polyp detection). Polyp detection also improved, but similarly to our study, there was no effect on cecal intubation rate.

A Hawthorne effect may play a role, particularly in studies on polyp detection, as consciousness of being observed may, by itself, improve performance [10]. In our study, all 22 centers providing data to the pre-/post-TCT analyses (**Table 2s**) and 39 of the 40 centers included in the follow-up analyses (**Table 3s**) were well established with continuous reporting of colonoscopies to Gastronet and providing individual endoscopist feedback before entering the study. In centers where endoscopists are used to being observed and receiving regular feedback, the risk of bias due to a Hawthorne effect is reduced. In most centers, however, there is a continuous turnover with new endoscopists joining the service, and reporting from these centers may be more prone to a Hawthorne effect. We do not have data on endoscopist turnover in the centers studied, but a Hawthorne effect is markedly reduced compared with "standalone"/separate studies in which data are not fed continuously into a quality register.

In Gastronet, detection of polyps ≥ 5 mm (PDR-5) has been chosen as a quality variable rather than total PDR irrespective of size (including polyps < 5 mm, which are adenomatous in only about 20 % of cases [11]), or ADR, which requires a second phase of registration once a histology report is obtained. Several studies have found a good correlation between PDR and ADR [12]. PDR-5 may, however, be more closely correlated with polypectomy rates, as polypectomy should always be used for polyps ≥ 5 mm and is infrequently used for diminutive polyps [12]. In the current study, the unadjusted 2.8 % improvement in PDR-5 from 26.4 % to 29.2 % in our study is in line with the modest improvement observed in other studies [5, 9].

Pain related to colonoscopy is a major concern, as it affects patients' willingness to participate in screening programs [13]. If colonoscopy has a reputation for being painful, this may contribute to patients' delay and inadequacy in responding to bowel symptoms that ought to be investigated properly. Women experience pain during colonoscopy more frequently than men. It is therefore of particular value that participation in a centralized TCT course now seems to have an unadjusted short-term 4.6 % pain-reducing effect from 38.2 % to 33.6 % for women and this effect may be maintained during 5 years of follow-up. The standard procedure in Norway is light sedation/analgesics (usually midazolam and/or fentanyl/alfentanil) on demand and maintaining the ability of the patient to leave the premises immediately after the procedure. On average, sedation/analgesics are administered in 32 % of colonoscopies reported to Gastronet [14]. With this level of consciousness, we have found it most appropriate to provide the patient with a feedback form to be completed at home on the day after colonoscopy in order to reduce the risk that patients will feel pressured to please hospital staff/doctors and not be completely honest in their response. The form is sent directly to the Gastronet secretariat, not to the endoscopy center.

The lack of effect of TCT participation on cecal intubation rate is not surprising. Baseline data were good or acceptable in both sets of analyses – even in the pre- to post-TCT comparisons where intubation rate for women (89.8 %) at nonparticipating centers was close to the recommended minimum standard of 90 % [15].

There are several limitations to this study. The main weakness is lack of randomization to intervention (TCT participation) and control groups (TCT nonparticipation, i. e. TCT pseudoparticipants) in addition to reporting bias in quality registers [16]. The strengths of the study are mainly its size and design, with assignment of nonparticipating centers to years of pseudoparticipation and using GEE to adjust for cofactors and interactions. Patients admitted to a specific center share several important factors (e. g. same facilities, capacity, geographical area, endoscopists), which might influence the outcomes under investigation. Therefore, we used GEE models, which take into account the fact that individual patients within each center are more related to each other (e. g. correlated) than to individuals admitted to other centers.

Self-selection to participate remains a challenge for evaluation of all nonrandomized studies. Apart from similar baseline pain reporting in the two groups in the pre- to post-TCT year analysis, the other set of baseline data in our 5-year follow-up study suggests self-selection, where centers already performing well tend to send representatives to TCT courses more often than centers in greater need of quality improvement. Training in gastroenterology is very decentralized in Norway. Pain scores and rates for PDR-5 mm and cecal intubation were comparable for academic and nonacademic centers (data not shown). There may be quality-independent reasons for nonparticipation that may drive results in either direction. The decision not to send endoscopists to a TCT course may, for example, be related to a local need for "all hands on deck" to work through waiting lists, and not related to quality of colonoscopy. Other centers may have sent an endoscopist to a course but capacity problems at the center may then prohibit the knowledge obtained at the TCT course from being dispersed locally and an effect of TCT participation will not materialize.

Further to these limitations, we do not know how colonoscopy trainer competence at the different centers may have changed during the years of follow-up. Centers may send several of their endoscopists to these courses over the years with or without a need to substitute previous TCT course participants who

may have retired or moved to other centers. In addition, we do not know whether the improvements observed are a result of improved endoscopist performance, endoscopy technology, skills of endoscopy assistants or more liberal use of analgesics. However, in a previous report from Gastronet [14], there was no association between the use of sedoanalgesics and painless colonoscopies, emphasizing the importance of training technique.

Changing local standards and culture may take more than 1 year and may depend not only on local leadership to allow time for training, but also on the number of representatives at TCT courses and the number of endoscopists to be trained and supervised. Eventually, the climate for learning, the personality of TCT participants taking charge, and the receptiveness of those being trained are crucial factors for success. Efforts to monitor benefits of TCT course participation is to be encouraged.

The findings suggest that the current TCT courses in Norway have contributed to quality improvement at centers represented at the courses.

Acknowledgments

We are deeply in debt to all doctors and nurses in public and private colonoscopy centers who have provided data to the Gastronet register for analyses. Without them, there would be no Gastronet and no platform for the type of quality assurance studies demonstrated in this paper.

Competing interests

Birgitte Seip is head of the endoscopy school running TCT courses. The remaining authors declare that they have no conflicts of interest.

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