FORCE APPLICATION DURING COLONOSCOPY AS A MARKER OF COMPETENCE: DEVELOPMENT OF A NOVEL TRAINING DEVICE

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BACKGROUND

- Colonoscopy is an important diagnostic and therapeutic procedure in the management of colonic disease.
- Maximizing patient comfort and minimizing complications is imperative.
- Force applied to the colon wall from the colonoscope shaft is a major contributor to discomfort and even perforation.
- Assessing this force, directly or indirectly, is challenging, but could provide valuable information about endoscopist competence.

OBJECTIVE

- Define the relationship between endoscopic skill and colonic displacement during colonoscopy.

METHODS

- Electromagnetic spatial tracking markers (NDI Medical) were applied to a training model of the colon (Kyoto Kagaku) (**Figure 1**)
- This allowed the position of the colon to be tracked in three-dimensional space
- Data from multiple sensors were combined using the root mean square (RMS) formula.
- Time, maximum velocity and acceleration, and mean and maximum displacement, were determined to advance the scope to the cecum.
- Participants included gastroenterology and general surgery trainees, and attending physicians who perform endoscopy as part of their clinical practice locally and national/ international faculty during local courses.

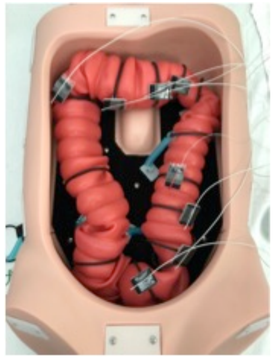


Figure 1. Tracking markers affixed to the colon training model.

RESULTS

- Seventy-five participants were enrolled, 17 (22.7%) attending physicians and 58 (77.3%) trainees
- Participant demographics are summarized in **Table 1**.

TABLE 1 – DEMOGRAPHIC INFORMATION		No (%)
SEX	Male	37 (49.3)
	Female	38 (50.7)
HANDEDNESS	Right	71 (94.7)
	Left	4 (5.3)
LEVEL / TYPE OF TRAINING	Medical Student	2 (2.7)
	Surgical Trainee	44 (58.7)
	GI Trainee	12 (16.0)
	Surgical Attending	12 (16.0)
	GI Attending	5 (6.7)
PRIMARY TECHNIQUE	Knob steering	14 (18.7)
	Torque Steering	58 (77.3)
	Patient Repositioning	3 (4.0)

- Mean procedure completion was 360.5s for trainees and 178.4s for attendings (mean difference: 182.1s, 95% CI: 93.0, 269.7; p = 0.0002).
- There was no difference in acceleration or velocity between groups.
- **Figure 2** shows displacement in different segments of the colon for trainees and attendings.

Table 2 shows our subgroup analyses. Torque steerers, and gastroenterologists, caused less displacement than knob steerers and surgeons, respectively

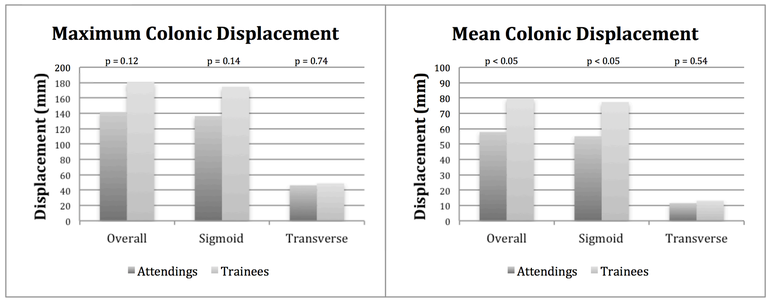


Figure 2. Maximum and mean colonic displacement during colonoscope advancement by attending and trainee endoscopists.

TABLE 2 – MAX AND MEAN DISPLACEMENT FOR SECONDARY VARIABLES

		Max (mm)		Mean (mm)	
Technique	Knob	224.0	p = 0.04	100.6	p = 0.07
	Torque	162.4		69.9	
Handedness	Left	239.8	p = 0.04	120.6	p = 0.23
	Right	167.7		72.2	
Sex	Female	184.1	p = 0.23	81.8	p = 0.16
	Male	158.7		67.6	
Specialty	GS	179.4	P = 0.006	78.2	p = 0.04
	GI	128.9		57.8	

DISCUSSION

- Studying the forces applied during colonoscopy is challenging.
- Prior studies measured force applied by the endoscopist's hand on the scope, or between the simulator and the examination table.
- Comparisons were between untrained students and experienced endoscopists.
- Ours is the first to our knowledge to compare surgical and GI trainees to experienced endoscopists.
- Limitations included widely variable trainee experiences amongst those enrolled, small numbers in our subgroup analyses, as well as friction with the simulator making loop reduction difficult.
- Software and technology used is widely available, and comparatively cheaper than virtual simulators.
- Added benefit of haptic feedback.

CONCLUSIONS

- Attending physicians advance the scope during colonoscopy in a manner that results in significantly less displacement than resident trainees.
- A force sensing sleeve for the colonoscope might allow continuous feedback to the endoscopist.