

## Prospective Study

## Measurement system that improves the accuracy of polyp size determined at colonoscopy

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### Abstract

**AIM:** To assess the accuracy of polyp size using an endoscopic lesion measurement system (ELMS).

**METHODS:** The accuracy of polyp size assessment was compared among measurements acquired by visual estimation, disposable graduated biopsy forceps

(DGBF; used as a "scale-plate") and the ELMS.

**RESULTS:** There were 192 polyps from 166 cases included in this study. The mean diameter of the post polypectomy measurement was  $0.85 \pm 0.53$  cm (range: 0.2-3.0 cm). The mean diameter by visual estimation was  $1.10 \pm 0.53$  cm, which was significantly different compared to the actual size of the polyp ( $P < 0.001$ ). The mean diameters obtained using DGBF ( $0.87 \pm 0.54$  cm) and ELMS ( $0.85 \pm 0.53$  cm) did not significantly differ from the actual size of the polyp. The difference between the measurements from the ELMS and DGBF was not significant.

**CONCLUSION:** Unlike visual estimations at colonoscopy, endoscopic graduated biopsy forceps and the endoscopic lesion measurement system are accurate methods to estimate polyp size.

**Key words:** Accuracy; Colonoscopy; Endoscopic lesion measurement system; Polyp size measurement

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**Core tip:** In this study, we established an endoscopic lesion measurement system (ELMS) to measure polyp size during endoscopy. We measured 192 polyps from 162 patients and found that the accuracy of visual estimation for colonic polyp size is low. The accuracy of estimating polyp size was distinctly increased when measured by disposable graduated biopsy forceps and ELMS. In particular, the accuracy of estimation by ELMS was higher than the clinician's estimation and DGBF for polyps  $> 1$  cm.

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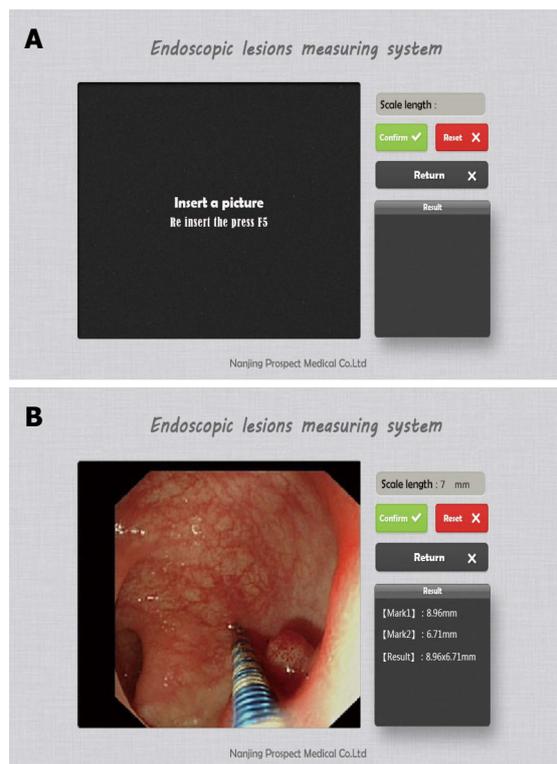
## INTRODUCTION

Tumor size determined at colonoscopy is associated with the treatment plan developed for the tumor. However, there are currently no standard criteria used for measuring the size of a tumor identified at colonoscopy. Many clinicians evaluate the size of a tumor based on their experience. Sometimes, this type of assessment has been inconsistent with the actual size of the tumor<sup>[1]</sup>. Morales *et al*<sup>[2]</sup> used open biopsy forceps to evaluate the diameter of colon polyps at colonoscopy, and three quarters of the results were inconsistent with the actual results. Eichenseer *et al*<sup>[3]</sup> compared the estimated size of 10-25-mm polyps determined at endoscopy by 15 different endoscopists, with the histopathology of post-fixation polyp measurements; the results showed that the mean size variation was 73.6% (range: 13%-127%). The size of approximately 62.6% (range: 0%-91%) of the polyps was incorrectly estimated, overestimated in many cases, which could lead to inappropriate advice concerning the treatment plan. Liu *et al*<sup>[4]</sup> developed disposable graduated biopsy forceps (DGBF) that could increase the accuracy of polyp size estimation. However, there continues to be variability, especially for visual estimation of polyps larger than 2 cm. To estimate the size of polyps at colonoscopy more accurately, we designed an endoscopic lesion measurement system (ELMS) using DGBF as a "scale-plate" and assessed its accuracy in a clinical setting.

## MATERIALS AND METHODS

### Development and use of the ELMS

DGBF were used as a "scale-plate" to design the ELMS. When a polyp was observed at colonoscopy, DGBF parallel to the lesion were pressed onto it and a picture was taken. The image was viewed using the ELMS. First, the length was defined using an endwise graduation scale; then, the endwise diameter of a lesion was measured with the given length as a scale plate. Second, the diameter of the biopsy forceps was used as a scale plate to measure the size of a polyp. According to the results of the up arc of the circumference divided by the length of the arc, if the lesion occupied a quarter of the enteric cavity, then the actual diameter of the polyp was considered to be 1.1 times the measurement. When the lesion occupied one third of the enteric cavity, the size of the polyp was considered to be 1.2 times that of the measurement; the size of the polyp was estimated to be 1.6 times that of the measurement when it occupied half of the enteric cavity (Figure 1).



**Figure 1** Interface of the endoscopic lesion measurement system. A: Sketch of the endoscopic lesion measurement system; B: Entering interface.

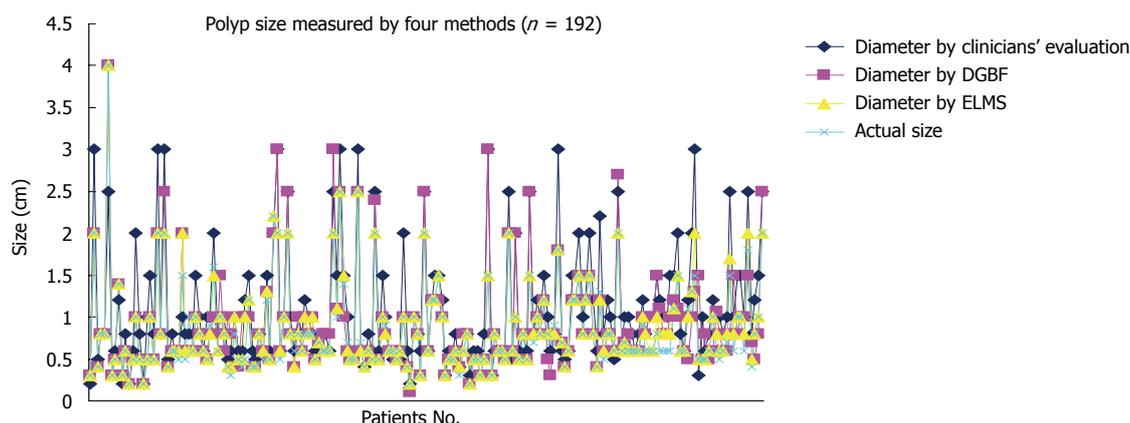
### Study subjects

Patients with colon polyps were enrolled from the National Center of Colorectal Surgery, Nanjing University of Traditional Chinese Medicine. First, when the clinician observed a polyp or tumor, the width of the largest diameter of the tumor was determined; then, a graduated biopsy forceps was inserted and used to measure the width of the largest diameter of the tumor from the vertical view, and a picture was obtained according to the ELMS protocol. Next, the ELMS was used to measure the size of the lesion. Finally, the "gold standard" for the width of the largest diameter of the tumor was accurately measured using vernier calipers after the tumor was excised by surgery or endoscopy. A correct measurement was considered when the variation between the evaluation size and actual size was < 10%. The estimated accuracy rate was equal to the number of polyps accurately evaluated divided by the total number of polyps observed. Five endoscopists with experience from over 2000 colonoscopy cases were involved in this study.

The ethics committee of the Third Affiliated Hospital of Nanjing University of Traditional Chinese Medicine approved this study.

### Statistical analysis

Data were analyzed using SPSS 17.0 software for Windows (SPSS Inc., Chicago, IL, United States). A paired Student's *t*-test was used to compare the



**Figure 2 Polyp size assessments.** Comparison of actual polyp size with clinicians' evaluations, disposable graduated biopsy forceps (DGBF), and the endoscopic lesion measurement system (ELMS).

**Table 1 Comparison of the methods for measuring the largest diameter ( $n = 192$ )**

Method	Size (cm)	P		
		VC	CE	DGBF
VC	0.85 ± 0.69	-	-	-
CE	1.10 ± 0.53	< 0.001	-	-
DGBF	0.87 ± 0.54	0.134	< 0.001	-
ELMS	0.85 ± 0.53	0.289	< 0.001	0.027

Data are expressed as mean ± SD. CE: Clinicians' evaluation; DGBF: Disposable graduated biopsy forceps; ELMS: Endoscopic lesion measurement system; VC: Vernier caliper.

ratio of the estimated size by the endoscopists, the DGBF or the ELMS, to the actual size measured by vernier calipers. Analysis of variance was used to compare the differences among the four groups. Data are presented as mean ± SD;  $P < 0.05$  was considered to be statistically significant.

## RESULTS

### Basic clinical characteristics of the polyps

From August 2013 to March 2014, 166 patients (110 male, 56 female; mean age: 58.7 ± 11.2 years, range: 28-84 years) were included in this study with 192 colorectal polyps: rectal ( $n = 69$ ), sigmoid ( $n = 64$ ), descending ( $n = 16$ ), transverse ( $n = 15$ ), and ascending (cecum;  $n = 28$ ) colon polyps. Five of the patients underwent laparoscopic colectomy, and the remainder had endoscopic mucosal resection. The pathologic results of all resected lesions included tubular adenomas ( $n = 117$ ), villous adenomas ( $n = 27$ ; one of which was mucosal cancer), tubulovillous adenomas ( $n = 46$ ), and neuroendocrine tumors (carcinoid;  $n = 2$ ).

### Comparison of the largest diameters

The mean largest diameter of the resected polyps measured by vernier calipers was 0.85 ± 0.53 cm (range: 0.2-3.0 cm), of which 134 were < 1 cm, 43

were 1-2 cm, and 15 were > 2 cm. Measurements of all polyps using all methods are depicted in Figure 2. Measurements taken using DGBF and the ELMS differed significantly from clinicians' evaluations ( $P_s < 0.001$ ), but not from the vernier calipers (Table 1).

### Comparison of the ratio of the estimated sizes according to method

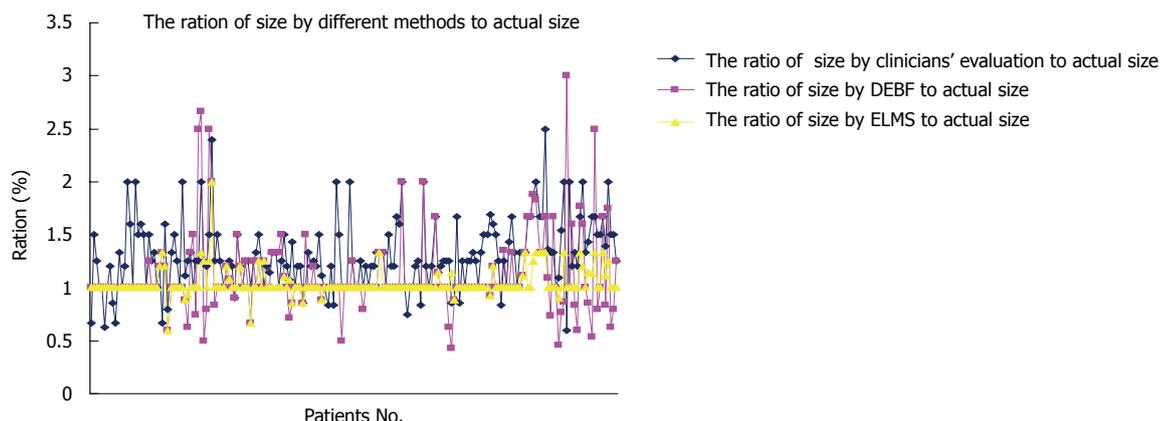
The ratios of the estimated sizes compared to vernier calipers are presented in Figure 3. Consistent with the mean diameters, the ratios obtained by DGBF and the ELMS differed significantly from those obtained using the clinicians' evaluations ( $P_s < 0.001$ ), but not from each other (Table 2).

### Influence of tumor size on measurement accuracy

For polyps less than 1 cm, only 20.6% (28/134) were accurately estimated by the clinicians' evaluations, whereas significantly larger proportions were accurately assessed by DGBF and the ELMS ( $P_s < 0.001$ ) (Table 3). Similar results were found with polyps 1-2 cm in diameter. In contrast, none of the polyps larger than 2 cm were accurately measured by the clinicians' evaluations. However, significantly more polyps were accurately estimated by DGBF and the ELMS ( $P_s < 0.05$ ).

## DISCUSSION

The size of a polyp determined at colonoscopy is crucial for assessing its type and selecting a treatment plan<sup>[5-7]</sup>. Data presented here demonstrate that clinicians' evaluations do not accurately estimate the actual size, consistent with previous findings<sup>[3,4]</sup>. As a result, inappropriate advice might be given for follow-up. Gopalswamy *et al*<sup>[8]</sup> compared the accuracy of a linear probe, visual estimation and forceps for estimating polyp size during colonoscopy and found that the measurement using a linear probe was most consistent with the actual polyp size. However, the linear probe requires special



**Figure 3 Accuracy of polyp size measurement methods.** Ratio of the actual polyp diameter to the largest diameter determined by visual estimation, disposable graduated biopsy forceps (DGBF) and the endoscopic lesion measurement system (ELMS).

**Table 2 Comparison of the ratio of actual to estimated measurement (n = 192)**

Ratio	Size (cm)	P	
		DGBF:VC	ELMS:VC
CE:VC	1.30 ± 0.33	< 0.001	< 0.001
DGBF:VC	1.11 ± 0.37	-	0.021
ELMS:VC	1.04 ± 0.13	-	-

Data are expressed as mean ± SD. CE: Clinicians' evaluation; DGBF: Disposable graduated biopsy forceps; ELMS: Endoscopic lesion measurement system; VC: Vernier caliper.

**Table 3 Influence of tumor size on measurement accuracy**

Polyp size	Method	Rate of accurate estimation	P	
			CE	DGBF
< 1 cm	CE	20.6% (28/134)	-	-
	DGBF	61.2% (82/134)	< 0.001	-
	ELMS	75.4% (101/134)	< 0.001	0.001
1-2 cm	CE	14.0% (6/43)	-	-
	DGBF	48.8% (21/43)	< 0.001	-
	ELMS	74.4% (32/43)	< 0.001	0.003
> 2 cm	CE	0.0% (0/15)	-	-
	DGBF	40.0% (6/15)	0.008	-
	ELMS	80.0% (12/15)	0.046	0.212

CE: Clinicians' evaluation; DGBF: Disposable graduated biopsy forceps; ELMS: Endoscopic lesion measurement system.

software for estimation, which adds to examination time and cost. The open biopsy forceps method was found to be the least accurate method. Using DGBF can increase the accuracy of estimation of polyp size, though the results can be inaccurate due to visual deviation, especially for the transverse diameter of the side of the developing tumor. In order to reduce visual deviation, we developed a system that uses this method as a "scale-plate" to increase the measurement accuracy.

In this study, the average largest diameter of the resected polyps measured by the endoscopists was significantly larger than the actual size. However, measurements taken with DGBE or the ELMS did not differ, demonstrating the increased estimation accuracy, which was consistent with the report by Liu *et al*<sup>[4]</sup>. The accuracy rate of DGBE was lower than that by ELMS, though a 25% error rate was still evident for polyps < 1 cm. The reasons for this may be that, first, a reduced visual deviation of these polyps increased the accuracy of the biopsy forceps. Second, many of the polyps < 1 cm were a protruding type. Due to the potential deviation of visual angle when taking pictures, the measurement deviation was more than 10%, which would be judged to be inaccurate whereas deviation of < 1 mm would not affect the choice of treatment. Notably, none of the polyps > 2 cm were accurately estimated by endoscopists' visual estimations,

suggesting increased visual deviation. Thus, the accuracy of the ELMS tended to increase with the diameter, though the number of large polyps was insufficient for statistical comparison. Future studies will include a larger number of polyps > 2 cm to address this. This study only estimated the largest diameters and did not compare the transverse or endwise diameters of the lesions, which will also be investigated in future studies.

In conclusion, the accuracy of estimating polyp size diameter at colonoscopy that relied on endoscopists' experience was low. This accuracy can significantly be increased using DGBF and the ELMS.

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## COMMENTS

### Background

Determination of tumor size *via* colonoscopy is related to the nature and treatment of the tumor. However, there are still no standardized criteria for this,

and many clinicians evaluate the size based on their experience, which is often inconsistent with the actual size of the tumor. The authors developed disposable graduated biopsy forceps (DGBF) to increase the accuracy of estimating the size of the polyps, as there is still visual variations, especially for polyps > 2 cm in diameter. To estimate the size of polyps *via* colonoscopy more accurately, the authors designed an endoscopic lesion measurement system (ELMS) using DGBF as a "scale-plate" and evaluated its use in the clinic.

### Research frontiers

The accuracy of estimating polyp size was compared among different methods by visual estimation, DGBF and ELMS.

### Innovations and breakthroughs

In this study, the authors established an ELMS to measure the endoscopic polyp size. The authors found that the accuracy of visual estimation for polyp size is low. Use of the DGBF and ELMS significantly increased the accuracy of size estimation. The accuracy of estimation by ELMS tend to be higher with increasing polyp size.

### Applications

This system is very easy to learn and provides objective estimation of polyp size under endoscopy. It can be used in clinical practice and does not increase the medical cost.

### Peer-review

An ELMS can improve the accuracy of endoscopic polyp size measurement. The investigators have compared a new technique versus standard to grade endoscopic polyp size. They find significant differences between the old and new methods. This is potentially a compelling study. However, there must be some improvements.

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