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## Effect of Sending Educational Video Clips via Smartphone Mobile Messenger on Bowel Preparation before Colonoscopy

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**Background/Aim:** We aimed to evaluate the efficacy of sending educational video clips via smartphone mobile messenger (SMM) on enhancing bowel preparation before colonoscopy.

**Methods:** This was a prospective, endoscopist-blinded, randomized controlled study. Patients in the SMM group received two video clips sent via SMM that explained the diet and regimen for bowel preparation, whereas those in the control group did not receive any video clips. We compared the quality of bowel preparation between the two groups, which was assessed by an endoscopist using the Ottawa scale.

**Results:** Between August and November 2014, 140 patients in the SMM group and 141 patients in the control group underwent colonoscopic examination. The total Ottawa score of the SMM group was significantly lower than that of the control group ( $5.47 \pm 1.74$  vs.  $5.97 \pm 1.78$ ,  $p=0.018$ ). These results were particularly prominent in the younger age group; the total Ottawa score of patients in the SMM group aged <40 years was significantly lower than that of patients in the control group aged <40 years ( $5.10 \pm 1.55$  vs.  $6.22 \pm 2.33$ ,  $p=0.034$ ).

**Conclusions:** We demonstrated that sending educational video clips via SMM could result in better bowel preparation, especially in the younger age group. **Clin Endosc 2019;52:53-58**

**Key Words:** Colonoscopy; Bowel preparation; Education

### INTRODUCTION

Colonoscopy is an important tool in the diagnosis and treatment of colorectal disease, and it should be preceded by adequate pretreatment in order to facilitate safe and effective testing.<sup>1</sup> However, bowel preparation is inadequate for up to one-third of all colonoscopies in daily clinical practice.<sup>2-4</sup>

Inadequate bowel preparation can increase the risk of missed lesions, risk of complications following the procedure, procedure time, and need to re-perform colonoscopic examination.<sup>5</sup> Adequate bowel preparation is closely linked to patient compliance, such as whether the patient used the appropriate administration method or had a low-residue diet.<sup>2</sup> To improve patient compliance, it may be helpful to enhance patient education on the importance of colonic cleansing before colonoscopy. Recently, several studies have reinforced the need for patient education on colonic cleansing prior to colonoscopy using a variety of methods, including cartoons, video clips, intensive education, or telephone-based re-education.<sup>6-9</sup> These studies showed that such educational methods may increase the quality of bowel preparation from 11.3% to 32.6%; however, many patients still do not achieve adequate bowel preparation. Therefore, further studies are needed to increase the effectiveness of patients' pre-colonoscopy colonic cleansing.

Since the launch of the iPhone (Apple Computer Inc.,

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Cupertino, CA, USA) in 2007, smartphone usage has risen remarkably worldwide. In Korea, the smartphone penetration rate is about 80%, and mobile messenger usage among smartphone users is up to 90%. Among various mobile messenger applications, KakaoTalk (Kakao Co., Seoul, Korea) is used the most in Korea and has the advantage of easily transferring pictures and videos via messenger. In this study, we hypothesized that sending educational video clips via smartphone mobile messenger (SMM, KakaoTalk) could be a useful tool to improve the quality of colonic cleansing before colonoscopy owing to the ease of transferring photos and videos to others and the capacity to view them repeatedly at any time. We aimed to evaluate the efficacy of sending educational video clips on colonic cleansing before colonoscopy via SMM and to assess whether it could be applied in clinical practice.

## MATERIALS AND METHODS

### Patients

This is a prospective, endoscopist-blinded, randomized controlled study. The study protocol was approved by the Institutional Review Board of Kosin University Gospel Hospital (KUGH 2014-07-074). Patients aged >30 years who were undergoing screening colonoscopy at the health examination center of Kosin University Gospel Hospital in Korea were enrolled. Patients with a history of abdominal surgery, inflammatory bowel disease, chronic kidney disease, heart failure, ascites, ileus or intestinal obstruction, or allergy to bowel preparation drugs and those who were pregnant were excluded. Written informed consent was obtained from all participants before enrollment in this study. All patients listened to explanations about the study purpose given by a well-trained nurse in the health examination center. The nurse provided education with an informational brochure on colonoscopy, which included the diet schedule (low-fiber diet for three days and soft diet for dinner the day before the colonoscopy), administration method of the bowel preparation regimen, process of colonoscopic examination, and side effects of the regimen. Then, subjects were randomized to either the SMM or control group using the table of random numbers. Patients in the SMM group received two video clips sent via KakaoTalk, whereas those in the control group did not receive any video clips.

### Creation of the video clips

A study investigator (SCJ) created two video clips introducing the diet and regimen for colonic cleansing before colonoscopy. The first video clip introduced the diet for colonic cleansing before colonoscopy. In this video clip, a low-fiber

diet for three days and soft diet for dinner the day before the colonoscopy were recommended, and foods to avoid including watermelon, oriental melon, grape, nut products, kimchi, vegetables, and seaweed were emphasized. The second video clip introduced the regimen for bowel preparation. This video clip explained the detailed preparation method of the polyethylene glycol electrolyte powder (PEG-ELP), which involved drinking 500 mL water after consuming 1 L PEG-ELP between 9:00 and 11:00 p.m. on the day before colonoscopy and drinking an additional 500 mL water after consuming 1 L PEG-ELP between 5:00 and 7:00 a.m. on the day of the colonoscopy. Each video clip was approximately 2-min long.

### Data collection and colonoscopy

On the day of the colonoscopy, all patients were interviewed by a study investigator (SCJ), and they filled out a questionnaire on aspects such as the viewing of each video, types of food consumed, start time of initial bowel preparation, time of final bowel preparation, and last stool color. Patient compliance was assessed as good or bad based on the food types consumed and time of bowel preparation. Side effects were categorized as mild, moderate, or severe. Colonoscopic examinations were performed by one experienced endoscopist (SJK) who was blinded to the group information. All colonoscopic examinations were performed between 09:00 a.m. to 01:00 p.m. During the examination, insertion time, withdrawal time, polyp detection, and bowel preparation scale were recorded. The bowel preparation scale was assessed according to the Ottawa bowel preparation scale,<sup>10</sup> with a score of 0–4 for the rectosigmoid, middle, and right colon and 0–2 for quantity of residual fluid. The total score was calculated by summing all scores. The scale ranges from 0 (perfect) to 14 (inadequate). When a polyp was detected during colonoscopic examination, biopsy and histologic assessments were performed to identify the adenoma component. Then, the polyp detection rate (PDR) (the number of colonoscopies in which one or more polyps were detected divided by the total number of colonoscopies) and adenoma detection rate (ADR) (the number of colonoscopies in which one or more adenomas were detected divided by the total number of colonoscopies) were assessed.

### Endpoints

The primary endpoint in this study was the quality of the bowel preparation, which was assessed by the endoscopist using the Ottawa scale. Adequate bowel preparation was defined as an Ottawa score of <6 at the time of colonoscopy. Secondary endpoints were colonoscopic insertion and withdrawal time, PDR, ADR, side effects during bowel preparation, and rate of sleep disturbance due to bowel preparation. Severe side effects were defined as  $\geq 10$  nausea/vomiting episodes or intol-

erable abdominal pain/discomfort.

### Statistical analysis

The number of patients in each group was calculated with an alpha of 0.05 and a power of 0.8, assuming a 12% difference in the rate of colonic cleansing based on previous studies. Accounting for a dropout rate of 10%, at least 153 subjects in each group were needed for the study. Continuous data with normal distributions are expressed as mean±standard deviation, and categorical data are presented as the number of subjects (%). Student's *t*-test and the chi-square test were performed for continuous and categorical variables, as appropriate. To analyze the factors associated with adequate bowel preparation, univariate and multivariate logistic regression analyses were performed. *P*-values of <0.05 were considered statistically significant. Statistical analyses were performed using SPSS version 23.0 (IBM Co., Armonk, NY, USA).

## RESULTS

### Patient characteristics

Between August and November 2014, 306 patients signed written informed consent forms and were randomized to the SMM and control groups. After randomization, 25 patients cancelled appointments and did not undergo colonoscopy. Finally, 140 patients from the SMM group and 141 patients from the control group underwent colonoscopic examination. The patient selection flowchart is presented in Fig. 1. Baseline characteristics are summarized in Table 1. The mean age of all participants was 48.3±9.9 years, and 161 (57.3%) patients were men. Patients in the SMM group were significantly younger and had lower body mass index (BMI). All participants performed bowel preparation with PEG-ELP.

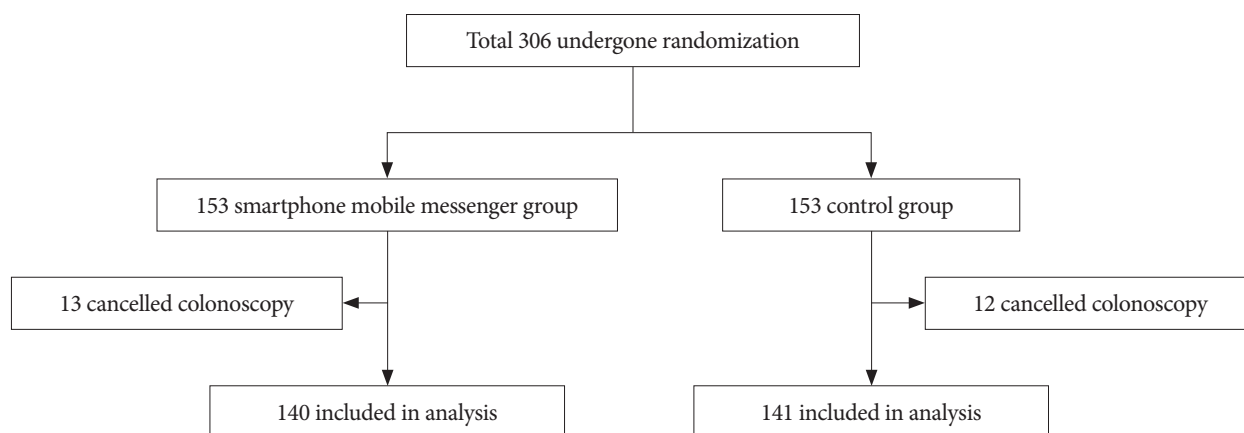


Fig. 1. Flowchart of the study.

Table 1. Baseline Characteristics

	SMM group (n=140)	Control group (n=141)	<i>p</i> -value
Age (yr)	46.7±9.9	49.9±9.6	0.006
Sex			0.959
Male	80 (57.1)	81 (57.4)	
Female	60 (42.9)	60 (42.6)	
BMI (kg/m <sup>2</sup> )	23.5±3.0	24.5±3.1	0.009
Previous experience of colonoscopy			0.257
No	67 (47.9)	58 (41.1)	
Yes	73 (52.1)	83 (58.9)	
Bowel preparation type			
PEG-ELP	140	141	1.000
Others	0	0	

Values are presented as mean±standard deviation or *n* (%).

SMM, smartphone mobile messenger; BMI, body mass index; PEG-ELP, polyethylene glycol electrolyte powder.

### Endpoints

As shown in Table 2, there were no significant differences between the two groups in the assessment of patient compliance, status of last defecation after bowel preparation, and adequate bowel preparation according to the Ottawa score (<6). In the SMM group, the odds ratio predicting adequate bowel preparation (Ottawa score <6) was 1.39 (95% confidence interval, 0.87–2.22;  $p=0.171$ ). The result did not change appreciably after adjusting for age, sex, BMI, and previous experience of colonoscopy. However, the total Ottawa score was significantly lower in the SMM group than in the control group ( $5.47\pm 1.74$  vs.  $5.97\pm 1.78$ ,  $p=0.018$ ). In particular, the Ottawa scores for the right and middle colon were significantly lower in the SMM group than in the control group (right colon,  $1.99\pm 0.59$  vs.  $2.12\pm 0.52$ ,  $p=0.035$ ; middle colon,  $1.48\pm 0.67$  vs.  $1.67\pm 0.64$ ,  $p=0.013$ ). These results were particularly prominent in the younger age group; the total Ottawa score of patients in the SMM group aged <40 years was significantly lower than that of patients in the control group aged <40 years ( $5.10\pm 1.55$  vs.  $6.22\pm 2.33$ ,  $p=0.034$ ; Table 3). However, these differences between the two groups were not significant in patients aged >40 years. Under 40 years of age, the patient compliance was significantly better in the SMM group than in the control group (data not shown). Between the two groups, the differences in cecal intubation time, severe symptoms during bowel preparation, and sleep disturbances were not significant, whereas the withdrawal time was longer in the control group than in the SMM group, and PDR and ADR were higher in the control group than in the SMM group (Table 4).

### DISCUSSION

In this prospective, endoscopist-blinded, randomized controlled study, we evaluated the efficacy of sending educational video clips via SMM on facilitating bowel preparation. Upon analyzing the results, we found that sending educational video clips via SMM may result in better bowel preparation, especially in the right and middle colon. In addition, we identified that this educational method could be especially helpful to patients in the younger age group.

Adequate bowel preparation is an important factor for achieving an efficient colonoscopic examination. The quality of bowel preparation is associated with both the cecal intubation rate and PDR, which are key quality indicators in colonoscopy,<sup>10,11</sup> whereas inadequate bowel preparation can result in an increased number of missed lesions and complication rates, as well as unnecessary costs when the examination has to be re-scheduled.<sup>12,13</sup> Several studies on bowel preparation education before colonoscopy have recently been reported, and they indicated that educating patients with various methods could effectively improve bowel preparation for colonoscopy.<sup>6,8,14-17</sup> In our study, we investigated whether sending educational video clips on bowel preparation before colonoscopy via SMM, an easy way to send photos and videos to participants that is used by most people in Korea, enhances the quality of pre-colonoscopy bowel preparation.

We defined the cut-off for adequate bowel preparation as an Ottawa score of 6 or less and evaluated the difference between the SMM and control groups in the assessment of adequate bowel preparation according to the Ottawa score (<6). The percentage of patients with an Ottawa score of <6 was high-

**Table 2.** Bowel Preparation Outcomes

	SMM group (n=140)	Control group (n=141)	p-value
Compliance			0.069
Good	136 (97.1)	129 (91.5)	
Bad	4 (2.9)	12 (8.5)	
Last defecation after bowel preparation			0.121
Clear, no residue	30 (21.4)	20 (14.2)	
Yellow residue	110 (78.6)	121 (85.8)	
Ottawa score	$5.47\pm 1.74$	$5.97\pm 1.78$	0.018
Right	$1.99\pm 0.59$	$2.13\pm 0.52$	0.035
Middle	$1.48\pm 0.67$	$1.67\pm 0.64$	0.013
Rectosigmoid	$1.23\pm 0.55$	$1.27\pm 0.56$	0.538
Fluid	$0.77\pm 0.63$	$0.89\pm 0.66$	0.113
Adequate bowel preparation for colonoscopy (Ottawa score <6)	71 (50.7)	60 (42.6)	0.170

Values are presented as mean±standard deviation or n (%). SMM, smartphone mobile messenger.

**Table 3.** Bowel Preparation Outcomes according to Age Group

	SMM group (n=140)	Control group (n=141)	p-value
Under 40 yr (n=66)	(n=39)	(n=27)	
Ottawa score	5.10±1.55	6.22±2.33	0.034
Right	1.97±0.54	2.19±0.62	0.147
Middle	1.46±0.64	1.70±0.78	0.172
Rectosigmoid	1.08±0.48	1.37±0.74	0.078
Fluid	0.59±0.59	0.96±0.65	0.019
41–50 yr (n=90)	(n=51)	(n=39)	
Ottawa score	5.59±1.76	5.82±1.60	0.521
Right	1.98±0.65	2.13±0.52	0.247
Middle	1.49±0.64	1.72±0.61	0.091
Rectosigmoid	1.27±0.57	1.21±0.41	0.503
Fluid	0.84±0.61	0.77±0.67	0.587
51–60 yr (n=98)	(n=38)	(n=60)	
Ottawa score	5.50±1.97	5.73±1.61	0.524
Right	1.95±0.61	2.08±0.50	0.232
Middle	1.39±0.76	1.58±0.62	0.181
Rectosigmoid	1.26±0.60	1.23±0.56	0.804
Fluid	0.89±0.69	0.83±0.59	0.638
Over 61 yr (n=27)	(n=12)	(n=15)	
Ottawa score	6.08±1.31	6.87±1.55	0.176
Right	2.25±0.45	2.27±0.46	0.925
Middle	1.75±0.62	1.87±0.52	0.599
Rectosigmoid	1.42±0.52	1.40±0.51	0.933
Fluid	0.67±0.49	1.33±0.82	0.015

Values are presented as mean±standard deviation.

SMM, smartphone mobile messenger.

**Table 4.** Colonoscopy Outcomes and Side Effects

	SMM group (n=140)	Control group (n=141)	p-value
Cecal intubation time (min)	2.7±1.6	2.5±1.3	0.352
Withdrawal time (min)	10.2±2.3	10.9±2.2	0.007
Polyp detection	62 (44.3)	84 (59.6)	0.010
Adenoma detection	32 (22.9)	49 (34.8)	0.028
Severe side effects during bowel preparation			
Nausea/vomiting	4 (2.8)	8 (5.7)	0.377
Abdominal pain/discomfort	8 (5.7)	8 (5.7)	1.000
Sleep disturbance	11 (7.9)	5 (3.5)	0.131

Values are presented as mean±standard deviation or n (%).

SMM, smartphone mobile messenger.

er in the SMM group than in the control group (50.7% vs. 42.6%), although the difference was not statistically significant. In comparison to the total Ottawa score, bowel preparation was significantly better in the SMM group than in the control group. These results suggest that sending educational video

clips via SMM may be a helpful tool for optimizing bowel preparation before colonoscopy. In addition, the total Ottawa score of patients aged <40 years was significantly lower in the SMM group than in the control group. This may be because younger people use their smartphones more often and more

adeptly compared to older people, which suggests that this approach using SMM may be more useful for younger patients. In our study, sending educational video clips via SMM was not helpful in improving bowel preparation in patients aged >40 years.

Adequate bowel preparation can be expected to increase PDR and ADR during colonoscopy. However, several recent studies reported that PDR and ADR are not closely related to the quality of bowel preparation.<sup>18-20</sup> In our study, PDR and ADR were significantly lower in the SMM group than in the control group. Older age (49.9±9.6 years vs. 46.7±9.9 years) and longer withdrawal time during colonoscopy (10.9±2.2 min vs. 10.2±2.3 min) in the control group than in the SMM group may have influenced these results. The incidence of severe side effects during bowel preparation including nausea/vomiting and abdominal pain/discomfort did not significantly differ between the SMM and control groups. In addition, sleep disturbances were not significantly different between the two groups.

This study has some limitations. First, age and BMI were quite different between the two groups, although this was a randomized controlled study. The age and BMI of the patients were significantly higher in the control group than in the SMM group. These differences might have affected the bowel preparation results as well as the PDR and ADR. Second, we checked the number of views among patients in the SMM group, and they were expected to have thoroughly viewed the video clips. However, we could not confirm whether they had in fact carefully viewed the video clips, which potentially constrains the assessment of impact and the feasibility of sending video clips via SMM. Third, these results may be difficult to generalize because this study was performed in a single medical center.

In conclusion, this randomized controlled study showed that sending educational video clips via SMM improved the quality of bowel preparation, especially in the younger age group. Although further longitudinal studies will be needed to clarify the usefulness of video clips sent via SMM in optimizing bowel preparation, we expect that using a smartphone messenger service could be a helpful tool to facilitate safer and more effective colonoscopies.

#### Conflicts of Interest

The authors have no financial conflicts of interest.

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