

Original Article

A Prospective Randomized Controlled Trial of Efficacy of Gum Chewing on Gastrointestinal Recovery after Laparoscopic Colorectal Surgery

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Purpose. Postoperative ileus has been considered a temporary disturbance in gastric and bowel motility following abdominal surgery. This study aimed to assess the effects of gum chewing after laparoscopic colorectal surgery.

Methods. Patients were randomized into two groups: the experimental group (gum chewing), which chewed gum three times within 3 days after surgery (gum was chewed continuously for 15 min each time until the first passage of flatus), and the control group, which received usual care without using gum chewing.

Results. After randomization, 30 patients (15 no gum; 15 gum) were included in our analysis. There was no significant difference in time to flatus (62.6 vs. 90.3 h, $p = 0.07$), postoperative pain scores (4.3 vs. 5.5, $p = 0.201$) and the length of operative hospital stay (11.8 vs. 14.4 days, $p = 0.189$) between patients assigned to the gum and no gum groups. However, time to remove the nasogastric tube (49.8 vs. 75.4 h, $p = 0.015$) were significant.

Conclusion. Gum chewing changed the length of operative hospital stay after laparoscopic colorectal surgery. However, gum chewing following laparoscopy surgery did not demonstrate an effect on recovery of bowel function.

[J Soc Colon Rectal Surgeon (Taiwan) 2018;29:1-7]

Key Words

Gum chewing;
Colorectal surgery;
Flatus time;
Gastrointestinal function;
Ileus

Most patients undergoing gastrointestinal surgery experience recovery of bowel functions

within a few days. Postoperative ileus can cause the accumulation of secretions and gas, resulting in nau-

Received: March 8, 2017.

Accepted: December 27, 2017.

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sea, vomiting, and abdominal distention and pain. The delay in discharge due to postoperative ileus results in prolonged hospitalization and increased medical costs.¹⁻³

Gum chewing, as the concept for sham feeding, is thought to be effective due to direct cephalic-vagal stimulation, triggering of gastrointestinal hormone release, and increase in the production of saliva and pancreatic secretions, which may accelerate the motility of the gastrointestinal tract.⁴ Gum chewing is safe and effective for decreasing postoperative paralytic ileus.^{3,5-7}

A systematic review and a meta-analysis indicated statistical evidence that the use of gum chewing reduced the time to first flatus and the length of hospital stay.^{1,8} However, conflicting results have been found.^{8,9} All previously reported studies on gum chewing have been for patients who were maintained with nothing by mouth (NPO) in the initial postoperative period until passage of flatus. The potential cost savings from the reduction of even one postoperative day compared to the cost of several sticks of gum chewing are huge and have even greater cost implications for a healthcare provider.

In Taiwan, to our knowledge, there is one study on the effect of gum chewing on open gastrointestinal surgery (excluding colon and rectal surgery) in a southern hospital in Taiwan. Therefore, in a prospective randomized clinical trial, we investigated the effects of gum chewing on gastrointestinal function and the overall recovery in colorectal patients who were fed early after laparoscopic colorectal surgery.

Materials and Methods

We conducted a prospective study of the medical records of 30 patients with colorectal cancer from the southern medical center in Taiwan between April and December 2015. The demographic and clinical data were collected from chart review and patient visits. Colorectal cancer was diagnosed according to the results of physical examination and findings of computed tomography, magnetic resonance imaging, and colonoscopy, or at operation.

Study design

This was a single medical center with 1:1 random-

ization to compare gastrointestinal function recovery in patients who did and did not gum chewing after laparoscopic colorectal surgery. All research-related activities were approved by the Institutional Review Board and written informed consent obtained before randomization.

Study population

Male and female patients between 45 and 82 years old undergoing laparoscopic colorectal surgery at our institution by the study investigators were recruited for this study. Laparoscopic colorectal surgery was defined as elective or urgent surgery requiring an abdominal incision with resection of the small or large bowel, or rectum. Patients were recruited by study investigators during their preoperative hospitalization. Exclusion criteria included emergency case, pregnancy, patients with abdominal radiation, conversion to open surgery, patients observed in the intensive care unit postoperatively, and patients who suffered any serious adverse event and requiring emergent surgery. In addition, violation of the study protocol by any patient or patient-care team resulted in study exclusion.

Study protocol and interventions

Surgery was performed by three surgeons. After enrollment, but before surgery, patients were randomly assigned to gum or no gum patient groups via random ballot. Patients randomly assigned to the gum group were instructed to chew sugarless gum chewing for 15 min, three times daily (0900, 1300, and 1800) on postoperative days (PODs) 1 to 3. Gum chewing was provided by the study investigators, and patients were only allowed to chew the specified gum allocated for the study. Patients randomly assigned to the no gum group were instructed not to chew gum. The time to the first flatus were recorded for all of the patients. Patients were discharged when they were tolerating a low-residue diet without emesis and diarrhea, voiding without difficulty after removal of the indwelling catheter, and adequately controlling pain with oral medications. On each morning of PODs 1 to 3, patients were interviewed by the investigator to ensure adherence to the

study protocol and assess the flatus time.

Data were collected by an independent investigator. Data regarding complications, pathological outcomes, and length of stay were collected at discharge time. Gum chewing, by its nature, the patients, ward nurses, and the investigator were not able to be blinded. All other clinicians were blinded. Patients were educated by the investigator to conceal their allocation by avoiding the interference.

Outcome

The primary outcome was return of gastrointestinal function. This was measured by time to first flatus after operation. To accurately monitor recovery of bowel function, the patients were instructed to notify secondary outcome measures including nasogastric tube removal as 30-60 ml of water was allowed until the first flatus and with no symptoms of nausea, vomiting, abdominal pain or distension, duration of postoperative hospitalization, postoperative pain measured by visual analog scales (VAS), complication during hospitalization, and any adverse events possibly related to treatment with gum chewing.

Statistics

We determined a sample size of 15 patients per group, for a total of 30 patients. Randomization was performed through ballot and by a single investigator on the first day of hospitalization. The ballot assigned a random value of 0 or 1 to each patient. Patients assigned a 0 value were given no gum, and those assigned a 1 value were enrolled in the gum group.

Data were analyzed by *t*-test for continuous variables and Pearson's χ^2 test for categorical variables. All calculations were performed using PASW Statistics version 17.0 (SPSS, Inc., Chicago, IL, USA). The two-sided level of significance was accepted at the 5% level.

Results

Between April and December 2015, of the 60 study-eligible patients, 42 patients were enrolled: 22

were assigned randomly to the gum and 20 to the no gum groups. Twelve patients were subsequently excluded or dropped out after randomization (5 no gum and 7 gum patients), leaving 30 patients for the study analysis (15 no gum, 15 gum; Fig. 1).

Demographic and surgical characteristics of the two patient groups are shown in Table 1. There was no difference between the two groups in terms of age, sex and TNM stage. There was no difference in the amount and type of additional parenteral or oral analgesics used between the two groups.

Gum chewing did not appear to have much effect on the recovery from postoperative ileus (Table 2). The mean time to the first passage of flatus was 62.6 h for the gum group and 90.3 h for the no gum group ($p = 0.07$). Time to first flatus was earlier in the gum group, but this did not show a significant difference. The mean actual length of hospital stay was 11.8 and 14.4 days for patients in the gum and no gum groups, respectively ($p = 0.189$). The length of hospital stay was shorter in the gum group, but this did not show a significant difference. The mean postoperative pain scale was 4.3 and 5.5 in the gum and no gum groups, respectively ($p = 0.201$), and the mean time to remove the NG tube was 49.8 and 75.4 h, respectively, which was significantly different ($p = 0.015$).

There was no difference in the postoperative complication rates between the two groups ($p = 0.154$). One patient in the no gum group had ileus and one had pleural effusion. The incidence of ileus was 6.7% (1/15).

Discussion

Postoperative ileus may be defined as the delayed return of coordinated intestinal motility following abdominal surgery. Postoperative ileus is a major factor that can lead to prolonged hospital stay after colorectal surgery.¹⁰ The return of gastrointestinal motility begins in the small intestine, and is then seen in the stomach, and finally, the colon. The timing of the return of postoperative gastrointestinal motility varies according to the surgical procedure¹¹ and other clinical variables, but motility is usually seen in the small intestine in 4 to 24 h, the stomach in 2 to 4 days, and

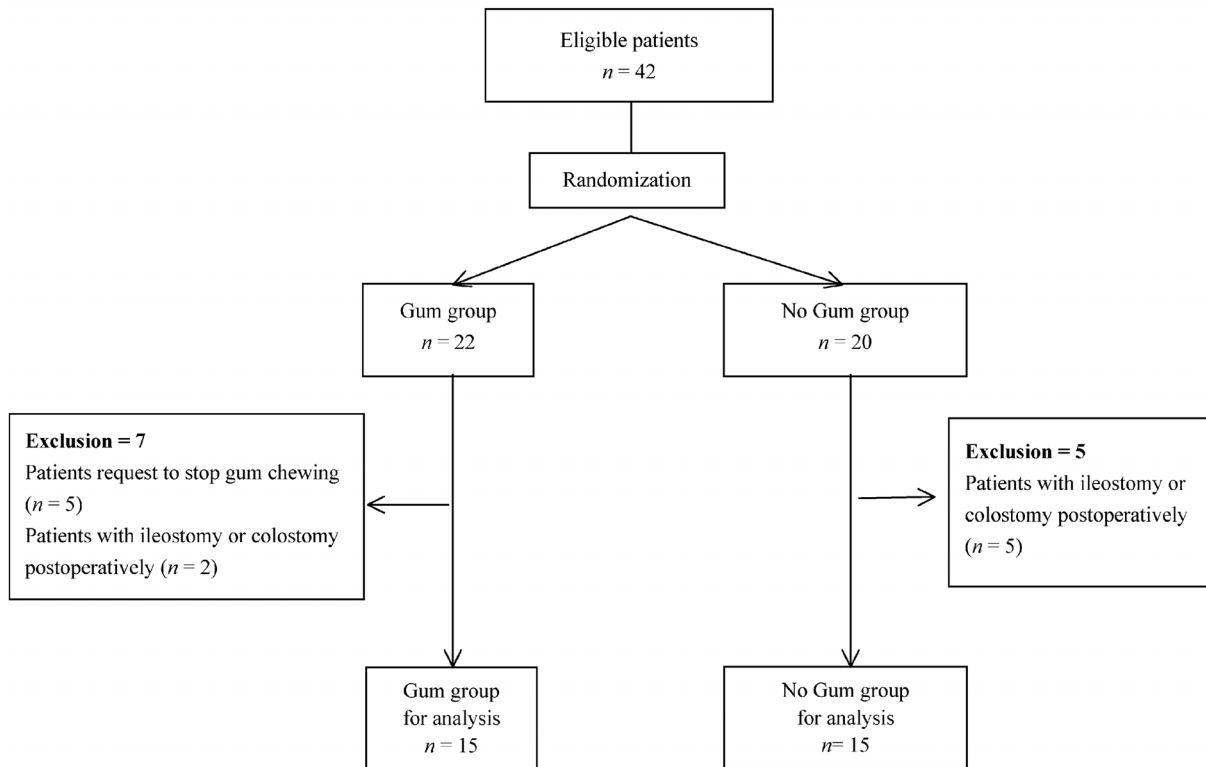


Fig. 1. Disposition of the patients in the study.

Table 1. Preoperative and operative data

	No gum (n = 15)	Gum (n = 15)	p value
Age (years)	67.4 (SD 10.85)	60.7 (SD 7.41)	0.06
Sex, M:F	8:7	11:4	0.27
Site of tumor			0.31
Right colon	1 (6.7%)	1 (6.7%)	
Left colon	6 (40%)	3 (20%)	
Rectum	8 (53.35%)	11 (73.3%)	
TNM stage			0.52
T1	0 (0%)	0 (0%)	
T2	5 (33.3%)	3 (20%)	
T3	9 (60%)	11 (73.3%)	
T4	1 (6.7%)	1 (6.7%)	
TNM stage			0.66
N0	8 (53.3%)	10 (66.7%)	
N1	4 (26.7%)	2 (13.3%)	
N2	3 (20%)	3 (20%)	
TNM stage			0.56
M0	14 (93.3%)	13 (86.7%)	
M1	1 (0.7%)	2 (13.3%)	
Operative procedure			0.29
Right hemicolectomy	1 (6.7%)	1 (6.7%)	
Left hemicolectomy	6 (40%)	2 (13.3%)	
Low anterior resection	7 (46.6%)	12 (80%)	
Sigmoid colectomy	1 (6.7%)	0(0%)	
Complication			0.15
None	13 (86.6%)	15 (100%)	
Ileus	1 (6.7%)	0 (0%)	
Lung effusion	1 (6.7%)	0 (0%)	

Table 2. Time to event for outcomes

Median time	No gum (n = 15)	Gum (n = 15)	p value
To flatus	90.3 (SD 48.7)	62.6 (SD 29.01)	0.07
To remove NG tube	75.4 (SD 32.18)	49.8 (SD 20.91)	0.02
Length of day	14.4 (SD 6.88)	11.8 (SD 2.65)	0.19
Mean pain scale	5.5 (SD 2.5)	4.3 (SD 2.26)	0.20

the colon in 3 to 7 days postoperatively.¹¹ Previous research regarding the efficacy of postoperative gum chewing in ameliorating postoperative ileus had mixed results. With a larger sample size, the results of the present study support the benefits of gum chewing in patients undergoing laparoscopic colorectal surgery.

Short et al.¹² demonstrated statistical evidence that the use of gum chewing reduced time to first flatus (overall reduction of 10.4 h; 95% confidence interval [CI], -11.9, -8.9 and 12.5 h [95% CI, -17.2, -7.8] in colorectal surgery). There was statistical evidence that the use of gum chewing slightly reduced time to first flatus (overall reduction of 0.7 days [95% CI, -0.8, -0.5] and 1.0 days [95% CI, -1.6, -0.4] in colorectal surgery).¹²

Hwang et al.¹³ evaluated 132 patients undergoing laparoscopic colorectal cancer surgery. One group ($n = 67$) did not chew gum and the second ($n = 65$) received gum chewing. They found that the first passage of gas was slightly earlier in the gum chewing group, but the difference was not significant. However, the length of hospital stay was 6.7 days in the gum chewing group, which was significantly shorter than that in the no gum chewing group (7.3 days, $p = 0.018$).¹³

Asao et al.⁵ studied 19 patients following elective laparoscopic colorectal surgery. They randomly assigned patients to two groups: 10 did and 9 did not chew gum. They reported that the mean time to the first flatus was 2.1 in the gum-chewing group and 3.2 in the control group ($p < 0.01$). The patients experienced a shorter time to first flatus by 1 day, and concluded that gum chewing aids early recovery from postoperative ileus and recommended postoperative gum chewing following abdominal surgery.⁵

Lim et al.¹⁴ studied 168 patients following open or laparoscopic colorectal resection surgery. They randomly assigned patients to two groups, 84 in the open group and 84 in the laparoscopic group. Among the laparoscopic group, 42 patients did and 42 did not chew gum. The mean time to the first flatus was 42.75 ± 3.92 h and 50.97 ± 3.79 h, respectively ($p = 0.134$). There was no difference in the symptoms of ileus.¹⁴

Shum et al.¹⁵ studied 82 patients following laparoscopic colorectal resection surgery. They randomly assigned patients to two groups, 41 did and 41 did not chew gum. The mean time to the first flatus was significantly shorter in the chewing group (18 vs. 34 h; $p = 0.007$). Duration of hospital stay was not significantly different in the two groups (5 days in the gum group versus 5.5 days in the no gum group; $p = 0.142$).¹⁵

Despite various studies suggesting a possible benefit of gum chewing after colorectal surgery, our study does not support the use of gum chewing after colorectal surgery for the reduction of postoperative ileus. The mechanism to explain any potential stimulated gastrointestinal motility via gum chewing must be fully understood and may not be related to the presumed cephalic-vagal reflex, but rather to the motility effects of hexitols in sugar-free gum.

In the Cochrane review, 18 studies showed that patients' use of gum chewing could reduce the length of hospital stay by 1 day in the colorectal surgery group.¹² But our study not supported the use of gum chewing after colorectal surgery for reduction of length of hospital days. Two meta-analyses showed a shortened length of hospital day.^{1,16} The variety of potential targets for intervention to reduce ileus and the length of hospital stay has to use multimodal rehabilitation strategies, which may include the use of drugs and early feeding. Three days after the operation, the patients of one doctor could try water with or without the first flatus. But other patients of another two doctors could try water and remove NG tube until the first flatus time. This was the difference in the early feeding management of the three doctors. Maybe this would influence the length of hospital stay.

In another southern medical center, they set up the retrospective study that focused on the influence of gum chewing on the gastric and small intestine (excluding colon and rectum) surgery patients. Our study is the first one that focused on the effect of gum chewing on laparoscopic colorectal surgery in Taiwan. There were some limitations in our study. First, the study was a pilot study, and using the small sample size to evaluate the exact effect of gum chewing was not easy. We suggest more participants inclusion in the future study for evaluating the exact effect of gum chewing on recovery from laparoscopic colorectal surgery. Second, 5 patients requested to stop the study due to nausea (80%, 4/5) and vomiting (20%, 1/5) after gum chewing. Based on the comfort of participants, they requested to drop out of the study. This may also cause statistical bias.

Conclusions

In conclusion, this study showed that the length of postoperative hospital stay was shorter in the gum chewing group, and we believe that gum chewing is an easy and cost-effective method to reduce the length of postoperative hospital stay and time to remove the NG tube in patients undergoing laparoscopic colorectal cancer surgery. However, this study could not

prove that gum chewing on its own facilitated early recovery from postoperative ileus in patients undergoing laparoscopic colorectal surgery, although there is some evidence that gum chewing after surgery may help the digestive system to recover. We know that many factors affect flatus and ileus, and that modern treatment plans attempt to reduce the risk of ileus. The potential cost savings from the reduction of even 1 postoperative day compared to the cost of several sticks of gum chewing are huge and have even greater cost implications for a healthcare provider.

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原 著

咀嚼口香糖對腹腔鏡結直腸癌切除術後腸道功能恢復之成效：前瞻性隨機控制試驗

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目的 腹部手術後腸阻塞為常見的併發症，使得病人易出現腹脹、廣泛性腹痛、噁心、嘔吐、延遲的排便及排氣，因而延長了住院天數以及增加醫療費用的支出。本研究之目的在於以實證模式探討咀嚼口香糖對於腹腔鏡結直腸癌術後病人促進腸道功能恢復之成效。

方法 本研究採實驗性研究設計，以抽籤方式將個案隨機分成實驗組（咀嚼口香糖）與對照組，實驗組於術後隔天開始咀嚼口香糖，一天三次，每次至少 15 分鐘，為期三天，如病人已出現排氣即可終止收案；對照組則維持一般常規，同樣監測三天。

結果 在隨機分派後，共 30 位個案納入研究分析，其中實驗組及對照組各 15 人。兩組研究對象在排氣時間 (62.6 vs. 90.3 h, $p = 0.07$)、術後疼痛指數 (4.3 vs. 5.5, $p = 0.201$) 及住院天數長短 (11.8 vs. 14.4 days, $p = 0.189$) 皆無顯著差異。然而術後移除鼻胃管時間有顯著差異 (49.8 vs. 75.4 h, $p = 0.015$)。

結論 本研究發現腹腔鏡結直腸癌術後咀嚼口香糖有助於減少住院天數。然而，咀嚼口香糖對於腹腔鏡術後腸道功能恢復並無明顯成效。

關鍵詞 咀嚼口香糖、結直腸癌、排氣時間、腸道功能、腸阻塞。