Effects of Gum Chewing on Recovery From Postoperative Ileus: A Randomized Clinical Trail

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ABSTRACT

Background: Sham feeding with products such as chewing gum has been theorized to decrease the incidence and time to resolution of postoperative ileus. The conflicting findings in the literature on this subject are because in part of the use of mixed study populations, which has led to difficulties in assessing the value of sham feeding in ameliorating this condition.

Purpose: The aim of this study was to evaluate the efficacy of postsurgical gum chewing in restoring normal bowel movement in patients with colorectal cancer who had undergone abdominal surgery for colon resection.

Methods: A randomized controlled trial was used to examine the time to first postoperative flatus and defecation. The intervention group (n = 30) received xylitol chewing gum on the first day after colon resection, one piece of gum for 15 minutes, 3 times daily, until the time to first flatus and defecation. Both the intervention and control groups (n = 30) received standard postsurgical care and were encouraged to walk as soon as possible after surgery. The time to first flatus was reported by patients.

Results: The time to first flatus and defecation in the intervention group was significantly shorter than that in the control group (39.13 ± 15.66 vs. 52.92 ± 21.97 hours and 54.55 ± 18.90 vs. 77.98 ± 34.59 hours, respectively). However, after controlling for age and surgical duration, only time to first flatus was significantly shorter in the intervention group. Significantly positive correlations were found between time to first flatus and time to first defecation in both groups.

Conclusions/Implications for Practice: In this study, gum chewing was shown to have a positive effect on the time to first postoperative flatus and defecation. This inexpensive and non-invasive intervention may be recommended to decrease the time to resolution of postsurgical ileus in middle-aged and older patients who have undergone open abdominal surgery for colorectal resection.

Key Words: postsurgical ileus, sham feeding, chewing gum, colorectal cancer, bowel movement.

Introduction

Postoperative ileus is the lack of bowel movement after surgery, which is assessed using the time to first passage of flatus and defecation as well as the restoration of tolerance for eating (Vather et al., 2013). After open colorectal resection, disordered electrical activity in the gastrointestinal tract and a lack of coordinated propulsive action typically lead to postoperative ileus, which normally lasts approximately 4–5 days (Behm & Stollman, 2003). Although the pathophysiological mechanism of postoperative ileus after colorectal resection remains an issue of debate in the literature, three mechanisms, including sympathetic nervous system overreaction, activation of the inhibitory neural reflex reaction, and inflammatory response processes, have been proposed (Bauer & Boeckxstaens, 2004; Chapman et al., 2018; Livingston & Passaro, 1990). Factors associated with postoperative ileus after colorectal resection include the surgical method used, of analgesics, presence of an underlying disease, and type of postoperative care provided. Use of the laparoscopic approach and younger age have been associated with lower rates of postoperative ileus after colorectal resections (Sapci et al., 2020). Kasparek et al. (2003) found that patients undergoing laparoscopy had superior bowel peristalsis compared with those undergoing open abdominal surgery. In one study, patients who received colorectal resection with laparoscopy had postoperative ileus for an average of 1.9 fewer days than their peers who received abdominal surgery (Chen et al., 2000). Although postoperative analgesic drugs such as morphine have analgesic effects, they inhibit presynaptic excitatory neurons, which block smooth intestinal muscle function and lead to postoperative ileus (Bauer et al., 1991). After colorectal resection, a nasogastric tube that helps stomach decompression is routinely placed postoperatively in a patient’s stomach for a few days until the...
recovery of intestinal peristalsis. Patients with postoperative nasogastric tube decompression will recover bowel peristalsis (Nelson et al., 2007) as well as eat earlier, but their probability of abdominal bloating, nausea, and vomiting is significantly higher than in patients without postoperative nasogastric tube decompression (Venara et al., 2020). Current practice guidelines recommend that postoperative nasogastric tubes do not necessarily need to be routinely placed after elective colorectal surgery (Gustafsson et al., 2019). Studies have confirmed that early food intake after colorectal resection reduces the time of first flatus and defecation significantly (Chapman et al., 2018) and reduces hospitalization days compared with traditional care (Pisarska et al., 2016).

Sham feeding refers to promoting gastrointestinal peristalsis by viewing, smelling, chewing, and tasting without ingesting food into the gastrointestinal tract. Postoperative sham feeding uses chewing gum to promote the recovery of gastrointestinal peristalsis. Although not completely understood, the physiologic theory that underpins gum chewing (sham feeding) with regard to stimulating peristalsis and reducing the time to postoperative intestinal recovery includes the concept that oral and masticatory stimulation provided by gum chewing imitates food ingestion sufficiently to stimulate a neurohumoral reflex that increases gastrointestinal fluid secretion. This in turn promotes gastrointestinal motility. In addition, oral stimulation and chewing may stimulate the vagus nerve, which is also involved in promoting peristalsis. Finally, none of the current theories sufficiently explain the effect of mastication/gum chewing on reducing postoperative inflammation in the gut, which may lead to a lower incidence of postoperative infection. In prior studies, the physiologic changes associated with chewing gum seem to promote normal gastrointestinal function and, subsequently, postoperative/anesthetic recovery (van den Heijkant et al., 2015; Yang et al., 2018). Gum chewing itself seems to exhibit paradoxical physiologic responses. For instance, one study showed that, during a stressful experience, chewing flavorless gum stimulated the sympathetic nervous system, which was seen in subjects as an increased heart rate (Walker et al., 2016). Conversely, another study showed a parasympathetic response to gum chewing that led to increased peristalsis and the secretion of gastrin (Ohta et al., 2017). Although the findings have been inconsistent, postoperative gum chewing has been explored in the literature most commonly in the context of recovery from surgical procedures such as resection for colorectal cancer (Liu et al., 2017; Yang et al., 2018), cesarean section (Altraigey et al., 2020; Lee et al., 2018), and bladder cystectomy (Choi et al., 2020; Kobayashi et al., 2015), no significant effect on reducing average hospitalization days (de Lee et al., 2018), and no significant effect on preventing postoperative nausea, vomiting, or bloating (Liu et al., 2017). A meta-analysis of gum chewing after colectomy from 2002 to 2013 indicates that gum chewing reduces the time to first postoperative flatus by approximately 31 minutes, time to first postoperative defecation by approximately 30 minutes, and number of hospitalization days by 0.687-fold. However, early food intake was not found to significantly improve the postoperative recovery of gastrointestinal peristalsis (Ho et al., 2014). A possible reason for the inconsistent results of sham feeding using chewing gum to reduce the incidence of postoperative ileus may be the differences in the underlying types of colorectal cancer and the heterogeneity among surgical and postoperative care methods.

Although many studies have been conducted to examine the efficacy of chewing gum in patients undergoing colorectal resection, conclusions have remained inconsistent. This may be attributable to differences in intestinal injuries affecting intestinal function, differences in length of time under anesthesia, and differences in anesthetic or pain control agents used in pain control affecting intestinal function and time to recovery of peristalsis. Considering the multiple factors known to affect postoperative ileus, chewing gum as an intervention remains a safe, accessible, and inexpensive option that should continue to be explored. This study offers experimental evidence that contributes to a body of literature that supports the practice of chewing gum to alleviate postoperative ileus in a well-defined sample. Therefore, it is vital that we continue to evaluate and examine current practices. This demands empirical data with rigorous sampling criteria and randomized study designs from the global health community. The Taiwanese sample in this study was used to explore the efficacy of postoperative gum chewing in restoring bowel function in patients with colorectal cancer who had undergone open abdominal surgery to remove colorectal lesions. The effect indicators were time to first postoperative flatus and time to first postoperative defecation. The research hypothesis was that the times to first postoperative flatus and defecation would be shorter in participants who performed the gum-chewing intervention than in their non-gum-chewing peers.

**Methods**

**Design**

This study was a prospective, single-blind, parallel-group, randomized controlled trial conducted in the gastrointestinal surgical ward of a medical hospital and a regional teaching hospital in southern Taiwan. Recruitment was conducted from May 2015 to January 2016.

**Samples and Sampling**

The inclusion criteria for this study were patients who were 40–75 years old; diagnosed as having colorectal cancer at...
Stage I, II, or III; scheduled for open colorectal resection with only one bowel anastomosis; conscious, alert, and able to communicate in either Mandarin or Taiwanese; and not fitted with a nasogastric tube after surgery. The exclusion criteria included having a Karnofsky Scale score of 2–4, receiving emergency surgery, evidence on the abdominal computed tomography of intra-abdominal infection before surgery, loop colostomy after surgery, ileostomy after surgery, prior pelvic radiation therapy, and temporomandibular joint or chewing muscle dysfunction. During the study period, potential participants were recruited by the nurse practitioner on the gastrointestinal surgical floor from among the patient population who had been admitted to the ward for colorectal resection. The study was briefly described, and if the patient was interested in learning more about the study, the nurse practitioner contacted the researcher who met with the patient, described the study, and reviewed the informed consent statement. After the patient signed informed consent, the researcher reviewed the patient’s medical records to evaluate whether or not they met the inclusion/exclusion criteria. Patients who did not meet the inclusion criteria were notified, and their consent form was marked and filed as “Does not meet inclusion/exclusion criteria.”

Randomization was performed using a coin toss, with heads assigned to the control group and tails assigned to the intervention group. The coin toss/randomization was performed with each participant upon enrollment in the study, with the first 30 participants randomized into the control group taken as the first study group. Data were gathered on these participants from enrollment to discharge. After the control group had reached the target sample size of 30 participants, patients were enrolled using the same procedure into the intervention group. The intervention and data collection were performed until the target sample size of 30 was reached.

The method of Schuster et al. (2006) was followed to calculate sample size, means, and standard deviations of the time to first flatus, with 65.4 ± 14.8 and 80.2 ± 19.1 hours presumed, respectively, for the experimental and control groups. An a priori power analysis was conducted using G*Power 3.1.9.4 (Faul et al., 2009) to test the difference between two independent means. Results showed that an independent sample t test with 30 participants per group (n = 60) would be sensitive to the effect of Cohen’s d = 0.87 with 95% power (alpha = .05, one-tailed). The trial achieved the number of participants needed to allow meaningful statistical analysis. All 60 of the participants completed the study, giving a dropout rate of zero (Figure 1).

Procedure
This study was approved by the institutional review board of Kaohsiung Medical University Chung-Ho Memorial Hospital (KMUHIRB-E-20150036). First, the researcher obtained from a nurse practitioner a list of patients scheduled for open colorectal resection. During the recruitment process, the researcher provided to patients an explanation of the study along with the aims,
procedure, and anticipated time required to complete the assessment. The researcher also explained that neither the assessment nor gum chewing was expected to cause obvious side effects and that the participants could refuse to participate or withdraw from the study at any time without any consequences on their care. Potential participants verbally agreed to participate, allowed the researcher to review their medical records, and then completed a written consent form. Subsequently, the researcher reviewed the medical records of each to confirm eligibility. The researcher collected all of the data. Blind analysis was performed by a second, independent researcher.

Measurement
The Karnofsky Scale (Crooks et al., 1991) was used as the screening tool to measure overall functional status. The baseline characteristics of the participants, including age, gender, functional capability, cancer stage, and abdominal surgical history, were assessed by the researcher. Postoperative information included types of analgesics used after surgery (e.g., nonsteroidal anti-inflammatory drugs, weak or strong opioid analgesics), length of surgery in hours, and length of post-surgical hospital stay in days. Presence of a postoperative ileus was assessed as the main outcome measure of the intervention and was evaluated at the same time each day by the researcher. Primary end points were the times to first flatus and defecation. The time to first flatus was self-reported by the participants. Bowel sounds were assessed with auscultation by the researcher and used as additional evidence of peristaltic activity.

Intervention and Control
All of the participants underwent the same perioperative management protocol, which included colon cleansing with 90 ml of Fleet phospho-soda oral saline laxative. Standardized postoperative care consisted of oxygen at 2 L/minute delivered via nasal cannula if oxygen saturation was lower than 95%. On the first postoperative day, oxygen was discontinued if oxygen saturation was greater than 95% with no chief complaints of dyspnea. In addition, the participants were encouraged to use the incentive spirometer 10 times per hour to prevent respiratory complications such as pneumonia. During the postoperative period, all of the participants were encouraged to get out of bed and walk as soon as possible. The control group received standard care only, whereas the intervention group received standard care and the gum-chewing intervention. After the first flatus, all of the participants began a liquid diet and progressed to a soft diet, as tolerated.

A commercially available mint-flavored, sugar-free xylitol chewing gum containing 1.2–1.37 grams of xylitol per piece was used in the intervention. The participants in the intervention group began to chew gum on the first day after surgery and chewed one piece of gum for 15 minutes, 3 times daily at 9:00 a.m., 2:00 p.m., and 7:00 p.m., respectively. The gum was regularly provided to participants by a registered nurse until the time of first reported flatus.

Statistical Analysis
Data were analyzed using IBM SPSS Statistics Version 20.0 (IBM Inc., Armonk, NY, USA), with statistical significance defined as one-tailed \( p < .05 \). An independent \( t \) test was performed to examine the effects of time to first flatus between the two groups. The Mann–Whitney \( U \) test was performed to examine the effects of time to first defecation between the two groups. An analysis of covariance (ANCOVA) using the covariates of age and surgical duration based on the study findings of Fesharakizadeh et al. (2013) was performed to examine the differences in times to first flatus and to first defecation between the two groups. In addition, Spearman’s rank correlation was examined to identify significant correlations between time to first flatus and time to first defecation.

To test for homogeneity, differences in baseline characteristics were evaluated using independent \( t \) tests for continuous variables and chi-square tests for categorical variables. Although no differences in basic attributes indicated adequate randomization and equivalent homogeneous groups, there remained a potential risk of inference error. To ensure analysis rigor, the factors identified in previous studies as influencing the effect of the intervention indicators were included in the analysis as potential confounders.

Results
Three eligible participants were excluded, including two because of unexpected intensive care unit admissions after surgery with nasogastric tube placement and one because of an unexpected loop colostomy placement.

Baseline Characteristics
Detailed descriptive statistics for the intervention and control groups are given in Table 1. The intervention group was composed of 17 men and 13 women aged 40–75 years, with a mean age of 59.57 (SD = 9.56) years. Half (50%) had been diagnosed with Stage II colorectal cancer. The average surgical duration for this group was 160.33 minutes (SD = 71.89), and the average length of hospital stay after surgery was 7.48 days (SD = 2.31). Two thirds of the intervention group participants (66.7%) were able to perform normal activities of daily living without assistance, two thirds used strong opioid analgesics, and one third used nonsteroidal anti-inflammatory analgesics. Only two (6.7%) had a prior history of abdominal surgery.

The control group was composed of 18 men and 12 women aged 40–75 years, with a mean age of 58.07 (SD = 9.47) years. Nearly half (46.6%) had been diagnosed with Stage III colorectal cancer. The average surgical duration for this group was 185.23 minutes (SD = 73.51), and the average length of hospitalization after surgery was 9.57 days (SD = 10.43). Slightly over two thirds of the control group participants (70%) were able to perform all activities of daily living without assistance, and half used either...
nonsteroidal anti-inflammatory or strong opioid analgesics. Five (16.7%) had a prior history of abdominal surgery.

### Postoperative Ileus Recovery Results

The mean time to first flatus was 39.13 ± 15.66 hours in the intervention group (n = 30) and 52.92 ± 21.97 hours in the control group (n = 30). Normality for time to first flatus in both groups was met based on the Shapiro-Wilk test (p > .5), whereas independent t tests revealed that the time to first flatus in the intervention group was significantly shorter than that in the control group, t(52) = 2.80, p < .05, d = 0.73, η² = .119 (Table 2). Moreover, after controlling for age and surgical duration, the ANCOVA results showed a significant effect of gum chewing, F(1, 58) = 7.64, p = .008, partial η² = .12 (Table 3), indicating that the intervention group had a shorter time to first flatus (M = 39.07, SE = 3.53) than the control group (M = 52.98, SE = 3.53).

The mean time to first defecation was 54.55 ± 18.90 hours in the intervention group and 77.98 ± 34.59 hours in the control group. Normality for time to first defecation was met in the intervention group (p > .5) but not in the control group based on the results of the Shapiro–Wilk test. The results of the Mann–Whitney U test, a nonparametric statistic, revealed that time to first defecation in the intervention group was significantly shorter than that in the control group.

### Table 1

**Absolute and Relative Frequency of Participants in the Intervention and Control Groups (N = 60)**

| Variable                                      | Total (N = 60) | Intervention (n = 30) | Control (n = 30) | t/χ² | p    |
|-----------------------------------------------|----------------|-----------------------|-----------------|------|------|
| **Baseline characteristics**                  |                |                       |                 |      |      |
| Age (years; M ± SD)                           | 58.85 9.46     | 59.57 9.56            | 58.07 9.47      | t = −0.61 | .544 |
| Gender                                        | 35 58.3        | 17 56.7               | 18 60.0         | 0.07 | .395 |
| Male                                          |                |                       |                 |      |      |
| Female                                        | 25 41.7        | 13 43.3               | 12 40.0         | 0.08 | .390 |
| Functional capability                         | 41 68.3        | 20 66.7               | 21 70.0         |      |      |
| Level 0                                       | 19 31.7        | 10 33.3               | 9 30.0          | 3.49 | .080 |
| Level 1                                       |                |                       |                 |      |      |
| Cancer stage                                  | 13 21.7        | 5 16.7                | 8 26.7          |      |      |
| I                                             | 23 38.3        | 15 50.0               | 8 26.7          |      |      |
| II                                            | 24 40.0        | 10 33.3               | 14 46.6         |      |      |
| Surgical history (abdominal) a                | 53 88.3        | 28 93.3               | 25 83.3         |      |      |
| No                                            | 7 11.7         | 2 6.7                 | 5 16.7          |      |      |
| Yes                                           |                |                       |                 |      |      |
| **Postoperative information**                 |                |                       |                 |      |      |
| Type of analgesics                            | 25 41.7        | 10 33.3               | 15 50.0         | 1.71 | .095 |
| Nonsteroidal anti-inflammatory                | 35 58.3        | 20 66.7               | 15 50.0         |      |      |
| Strong opioid                                |                |                       |                 |      |      |
| Surgical duration (minutes; M and SD)         | 172.78 73.17   | 160.33 71.89          | 185.23 73.51    | t = 1.33 | .190 |
| Length of hospital stay (days; M and SD)      | 8.52 7.56      | 7.48 2.31             | 9.57 10.43      | t = 1.08 | .287 |

a Fisher’s exact test.

### Table 2

**Effects of Time to First Postoperative Flatus and Defecation Between the Intervention and Control Groups (N = 60)**

| Variable                                      | Median | Mean  | SD   | t    | p   | η² |
|-----------------------------------------------|--------|-------|------|------|-----|----|
| Time to first postsurgical flatus a (hours)   |        |       |      |      |     |    |
| Intervention                                  | 39.13  | 15.66 |      | 2.80 | .004* | .119 |
| Control                                       | 52.92  | 21.97 |      |      |     |    |
| Time to first postsurgical defecation b (hours)|        |       |      |      | .025* | .034 |
| Intervention                                  | 54.85  | 18.90 |      |      |     |    |
| Control                                       | 71.16  | 34.59 |      |      |     |    |

a t Tests. b Mann–Whitney U test.

*p < .05.

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(p < .05, d = 0.84, η² = .034; Table 2). However, after controlling for age and surgical duration, the ANCOVA showed no significant effect for gum chewing, F(1, 58) = 3.34, p = .073, partial η² = .056 (Table 3), indicating that the intervention and control groups had similar times to first defecation (M = 62.74, SE = 6.55 vs. M = 79.79, SE = 6.55).

Spearman’s rank correlations indicated significantly positive correlations between time to first flatus and time to first defecation in both the intervention (r_s = .376, p < .05) and control (r_s = .533, p < .01) groups.

### Discussion

The main findings of this study showed that the gum-chewing intervention after colorectal cancer resection reduced times to first postoperative flatus and defecation significantly compared with those who did not receive the intervention. For patients who received the intervention, the times to first postoperative flatus and defecation were 13.79 and 13.42 hours earlier, respectively, in the intervention group than in the control group. The statistical data were used in a meta-analysis to examine the effects of gum chewing on postoperative ileus after abdominal surgery reported in Li et al. (2013) and to identify any differences between that study and this study. A single t-test was performed, with results revealing that the average time to first flatus for the intervention group in this study was significantly earlier than that in the comparison study (p = .014) and that the average time to first defecation was not significantly different between the two studies (p = .751). This result dovetails with the general consensus in the literature by showing that a gum-chewing intervention after open colorectal resection significantly accelerates the times to first flatus and defecation (Liu et al., 2017; van den Heijkant et al., 2015). An analysis of studies that did not show significant effects for gum chewing found that those studies included patients with laparoscopy and open abdominal surgery (Forrester et al., 2014; Harnsberger et al., 2019). Laparoscopy, which causes less tissue damage than open abdominal surgery and requires less time under anesthesia, results in a postoperative flatus time that is 29 hours earlier than that of open abdominal surgery (Procaccianti et al., 2013). In this study, only patients with colorectal cancer who had undergone open colorectal resection of any segment of the large intestine were recruited to control for potential confounding factors (i.e., differences in surgical procedure and time exposed to general anesthesia), reduce sample selection bias, and enhance internal validity. Moreover, the gum-chewing effect may be related to inadequate postoperative nasogastric tube decompression. Prior studies indicate that patients without nasogastric tube decompression after colorectal surgery experienced earlier first postoperative flatus times (Lei et al., 2004; Venara et al., 2020) up to 12 hours earlier (Nelson et al., 2007) than those with nasogastric tube decompression. Patients with nasogastric tubes were excluded from this study to control for this confounding factor under the presumption that not having a postoperative nasogastric tube ensures that gum chewing stimulates the vagus nerve, promoting gastrointestinal tract peristalsis and substantially reducing the times to first postoperative flatus and defecation.

Second, in this study, having an earlier first postoperative flatus was associated with having an earlier first postoperative defecation in both groups. Clinically, patients’ first flatus after general anesthesia indicates that the nerves that stimulate the large intestine have recovered to stimulate peristalsis. Patients can gradually begin to eat after the first flatus, which increases the secretion of gastrin, initiates the gastroduodenal reflexes, enhances the contraction function of the large intestine to accelerate peristalsis, and generates movement of the large intestine to allow feces to move to the rectum and be discharged through the anus (Spencer et al., 2016). The aforementioned physiological response echoes the research presented in this article. As all of the participants started to eat after their first postoperative flatus, it may be reasonably speculated that the earlier the first postoperative flatus in patients, the sooner they can start eating to stimulate bowel peristalsis. The physiological function of peristalsis reduced the time to first postoperative defecation.

### Table 3

**Effects of Time to First Postsurgical Flatus and Defecation Between the Intervention and Control Groups After Controlling for Age and Operation Duration (N = 60)**

| Variable/Covariance | Intervention | Control | F  | p   | Partial η² |
|---------------------|--------------|---------|----|-----|------------|
|                     | Mean         | SE      | Mean| SE  |            |
| Time to first postoperative flatus (hours) | 39.07       | 3.53    | 52.98| 3.53| 7.64       | .008* | .120 |
| Age                 |              |         |     |     |            |
| Operation duration  |              |         |     |     |            |
| Time to first postoperative defecation (hours) | 62.74       | 6.55    | 79.79| 6.55| 3.34       | .073  | .056 |
| Age                 |              |         |     |     |            |
| Operation duration  |              |         |     |     |            |

Note. SE = standard error.  
*p < .05.
A crucial finding of this study is that, after adjusting for patient age and surgical duration, the gum-chewing intervention had a significant effect on reducing the time to first postoperative flatus. Fesharakizadeh et al. (2013) reported that the operation duration of open colorectal resection may be used as a predictor of the time of first postoperative flatus, with longer operation times associated with longer wait times before the first postoperative flatus. Therefore, when a patient undergoes a longer operation, the time of first postoperative flatus may be delayed, which may be improved by gum chewing. Interestingly, inconsistent results on the effects of time to first postoperative defecation between the intervention and control groups suggest that age and surgical duration are important factors in the recovery of bowel function. Although no significant difference in surgical duration was found between the two groups in this study, the mean of surgical duration was nearly 25 minutes longer in the control group than in the intervention group. This finding reinforces the important association between risk of postoperative ileus and length of the procedure and/or anesthesia (Ceretti et al., 2018; Venara et al., 2019) and confirms the significance of a successful approach to improving bowel function. Additional explanations may be that chewing mimics food intake and thus stimulates patient motivation to eat, which in turn increases appetite and promotes a general sense of recovery after a major surgery. Finally, consistent with the findings of previous reports of no significant difference in length of hospital stay between gum chewing and control groups (Forrester et al., 2014; Kobayashi et al., 2015; van den Heijkant et al., 2015), this study found that patients in the intervention group were discharged 2.09 days earlier than their control group peers. The gum-chewing intervention for postoperative ileus may be suitable for patients who are cognitively intact and able to safely chew gum.

Limitations

This study was affected by five primary limitations: (a) No quantitative monitoring or recording of postoperative physical activities was performed. Participants were encouraged to leave their beds early without a fixed standard procedure to follow. Thus, examining whether their recovery from postoperative ileus was affected by differences in physical activities was not possible. (b) During the study, xylitol chewing gum was distributed 3 times a day. Patients were monitored by the same researcher as they chewed the gum for 15 minutes before spitting it out. Patients' chewing methods and speeds varied and could not be standardized. Thus, the influence of differences in chewing speed on the results was not assessed. (c) This study was limited to patients in a medical center and a regional teaching hospital in southern Taiwan, which limits the generalizability of the results to patients in other regions. (d) Each piece of gum contained 1.2–1.37 grams of xylitol, and 3.6–4.11 grams of xylitol were consumed per day (considered a very small amount) by the intervention group participants. Although xylitol was not the focus of this study, this ingredient conceivably may influence gastrointestinal system functions. (e) Bowel movement functions are associated with age and digestive capability, both of which may affect speed of recovery from surgery. Considering these possible confounders, potential participants in the youngest and oldest age brackets were excluded from participation, which may have led to a selection bias. Future studies will be necessary to explore the effective amount of xylitol on the gastrointestinal system and compare the effects of different types of chewing gum (e.g., xylitol-free, sorbitol, sorbitol-free) to corroborate this mechanism. Furthermore, using a more inclusive age range, larger multicenter trials, and larger sample sizes are warranted to improve generalizability.

Conclusions

The results of this study support the positive effects of gum chewing on recovery from postoperative ileus after colorectal resection and confirm that postoperative gum chewing significantly improves the times to first postoperative flatus and defecation. Moreover, the sooner that participants passed their first postoperative flatus, the faster they passed their first postoperative defecation. These findings enhance clinical knowledge regarding the relationship between flatus and defecation and provide evidence for noninvasive interventions that promote postoperative ileus recovery in patients with colorectal cancer who have undergone open colorectal resection. The results further strengthen past empirical data regarding the use of gum chewing in sham feeding strategies to improve postoperative ileus in middle-aged and older patients who have undergone open colorectal resection.

Clinically, the noninvasive nature of the gum-chewing intervention achieved a high acceptance rate among participants. Saliva secretion increases during gum chewing, which moistens the oral mucosa and throat, and improves comfort. In this and other studies, no cases of serious complications or death have occurred as a result of postoperative gum chewing. The average length of hospitalization in the intervention group was shorter than that in the control group. Finally, the results of this study support gum chewing as a safe, inexpensive, and noninvasive intervention worthy of widespread clinical application.

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Author Contributions

Study conception and design: YCH, SYS
Data collection: SYS
Data analysis and interpretation: YCH
Drafting of the article: YCH, SYS
Critical revision of the article: YCH
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