COMPARISON OF MEAN DURATION OF POSTOPERATIVE ILEUS FOLLOWING ILEOSTOMY REVERSAL WITH GUM CHEWING VERSUS WITHOUT GUM CHEWING

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ABSTRACT: Introduction: Postoperative ileus is commonly seen following ileostomy reversal and can often be a cause of prolonged hospital stay. 'Gum chewing' has been proposed to reduce postoperative ileus by stimulating intestinal motility through a variety of possible mechanisms. This randomized control trail was conducted to compare the mean duration of postoperative ileus following ileostomy reversal with gum chewing versus without gum chewing. **Materials & Methods:** A total of 100 patients who previously had ileostomy made for typhoid perforation, now undergoing ileostomy reversal, 14 to 70 years of age and of both genders were included. The selected patients were then placed randomly into two groups i.e., Group A (Gum chewing) & Group B (Non-Gum chewing). Duration of postoperative ileus was defined as time interval between operation and passage of first flatus measured in hours. **Results:** The mean age of patients in group A was 36.44 ± 15.41 years and in group B was 39.08 ± 16.67 years. Majority of the patients 41 (41.0%) were between 14 to 30 years of age. Out of 100 patients, 68 (68.0%) were males and 32 (32.0%) were females with male to female ratio of 2.1:1. Mean duration of post-operative ileus in Group A (gum chewing) was 60.62 ± 7.37 hours while in Group B (non-gum chewing) was 74.22 ± 6.01 hours (p-value = 0.000). **Conclusion:** This study concluded that mean duration of postoperative ileus following ileostomy reversal is shorter in patients with gum chewing added to their postoperative care as compared to those without gum chewing.

KEYWORDS Postoperative ileus, ileostomy reversal, gum chewing

Introduction

Postoperative ileus is the transient inhibition of normal gastrointestinal motility after abdominal surgery which may last for 3 to 5 days.[1] It is an inevitable response to surgical trauma leading to uncomplicated ileus where the areas of gastrointestinal tract resume function at different times; small intestine usually within the first 24 hours, stomach about 12-24 hours later and large intestine between 48 to 72 hours.[2] If postoperative ileus lasts longer than 3 days, it is thought to be complicated and termed as postoperative paralytic ileus. Delayed return in bowel function lengthens hospital stay and may result in increased hospital-acquired infections or complications.[3] Postoperative ileus may cause symptoms of pain, distention, and vomiting. This results into increased length of hospital stay leading to increased cost. This cost has been estimated around $750,000000 per year in the United States.[4] Postoperative ileus is a common occurrence after abdominal operations and prevents early discharge from the hospital.[2] The exacerbating factors include type of anesthetic drugs, use of opioid analgesics, intraperitoneal surgery, degree of bowel manipulation, open vs laparoscopic surgery and postoperative hypokalemia.[1] Conventional methods for treating postoperative ileus include gastric decompression by Ryle's tube, keeping the patient nil by mouth, and administering intravenous fluids.[2] 'Gum chewing' has emerged as a simple modality for decreasing postoperative ileus. The proposed mechanism of action is that it stimulates bowel motility through cephalic-vagal reflex and also by increasing the production of gastrointestinal hormones and neural factors associated with bowel motility.[5-9] It has also been hypothesized that hexitols found in the sugarless chewing gums might contribute to the amelioration of postoperative ileus as they are believed to produce abdominal symptoms such as gas, bloating, and cramps in a dose-dependent manner.[10] Early feeding after

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the operation may stimulate bowel motility[11], however many patients fail to tolerate this approach especially after abdominal operations. In a study where patients were given water 4 hours after their operation, 20% of these patients did not tolerate this.[12] Gum chewing may activate the cephalic-vagal mechanism and increase the levels of promotility factors without the consequences of early feeding, which may not be well tolerated.[3] An ileostomy is a segment of distal ileum brought out through a defect in the abdominal wall onto its surface.[13] It could be a loop or end, temporary or permanent. Common indications of temporary ileostomy include de-functioning loop ileostomy to protect distal anastomosis, loop or end ileostomies formed as a result of typhoid or tuberculous perforation causing peritonitis, and trauma. All temporarily formed ileostomies would need subsequent closure or reversal. This is achieved by creating an anastomosis and returning the bowel to the abdominal cavity. This anastomosis, between two segments of bowel, can be end-to-end, end-to-side, side-to-end or side-to-side.[13] The two segments of the bowel anastomosed together can be ileum to ileum or ileum to colon, giving a configuration of ileo-ileal or ileo-colic anastomosis respectively. Review of the published literature shows that gum chewing after elective colonic anastomosis is a safe and effective method to stimulate bowel motility and reduces postoperative ileus.[14-16] Gum chewing is also part of the ERAS (Enhanced Recovery After Surgery) Guidelines for perioperative care in elective colonic surgery with moderate level of evidence.[17] However, trials studying the effects of gum chewing on postoperative ileus after small intestinal anastomosis are very few in number.[18] A study from India has reported gum chewing to significantly reduce the duration of postoperative ileus after relaparotomy for ileostomy closure which essentially involves small bowel anastomosis.[19] Some other studies have also reported the role of gum chewing in reducing POI following caesarian section [20,21], radical cystectomy with ileal conduit [22], open cholecystectomy [23], open appendectomy [24], and laparoscopic surgery for benign gynaecological conditions [25]. From the published literature, it can be inferred that gum chewing promotes early recovery from postoperative ileus and can be considered as an inexpensive and physiologic modality for stimulating bowel function. Ileostomy is a routine surgical procedure and so is its reversal. Postoperative ileus is a common occurrence after ileostomy reversal and often a cause of prolonged hospital stays of the patients. The purpose of this study is that if gum chewing proves to be effective in decreasing postoperative ileus following ileostomy reversal, it should be added as an adjunct treatment in postoperative care because it might contribute to shorter hospital stays and in turn decreased cost. Secondly, most of the studies were performed on elective colonic anastomosis [14-16], and there is very little published data analyzing the role of gum chewing in improving postoperative ileus following small bowel anastomosis [18], which is involved in ileostomy reversal. Moreover, despite the favorable international literature, there is no comparative data available locally to guide surgeons as to whether the addition of gum chewing to the management of postoperative ileus would be of any benefit. Since we have different spectrum of diseases, different demographics, different social and economic conditions; this randomized controlled trial would analyze the effect of gum chewing on the duration of postoperative ileus in our local population.

Material and Methods

Operational Definitions

Gum chewing: It means that patients in the study group (Group A) are given one stick (containing 5 grams) of chewing gum three times a day to be chewed for one hour starting from six hours after surgery until they pass flatus.

Duration of postoperative ileus: Although there are several clinical signs of resolution of ileus such as appearance of bowel sounds, passage of flatus, return of appetite etc., for the purpose of simplicity, duration of postoperative ileus is defined in terms of the time interval between the time of operation and passage of first flatus in hours. Other markers of resolution of postoperative ileus are not recorded.

Ileostomy reversal: An ileostomy reversal here means a surgery performed to reconnect a section of ileum (previously exteriorized in form of stoma) to the other part of ileum (ileo-ileal anastomosis) or the colon (ileo-colic anastomosis), allowing a patient to pass flatus and stool through the anus instead of an artificial opening created in the abdominal wall.

Methodology

This prospective, comparative trial was conducted at Department of Surgery, Jinnah Hospital, Lahore. The duration of study was from January 21, 2015 to July 20, 2015. A sample size of 100 cases (50 in each group) was calculated, using 95% confidence level, 80% power of test taking mean duration between time of surgery and passage of flatus as 58.48 ± 22.69 hours in gum chewing group and 73.12 ± 25.63 hours in non-gum chewing group.

Inclusion Criteria:

- All patients undergoing ileostomy reversal as per operational definition.
- Age 14 to 70 years.
- Both genders.
- Patients who are conscious and oriented to follow the instructions.

Exclusion Criteria

- Diabetic patients (HbA1c > 6.5% or previously diagnosed cases).
- Preoperative electrolyte imbalance (serum Potassium level less than 3.5 mmol/L and serum Sodium level <130 mmol/L).
- Patients with history of radiation to the abdomen.

Data Collection Procedure

After approval from the hospital ethics committee, all patients undergoing ileostomy reversal and fulfilling the selection criteria were included in the study. The indication of ileostomy formation in all of these patients was typhoid perforation peritonitis. Sampling technique was non-probability consecutive sampling and patients were recruited for the study after being reviewed in the outpatient department until desirable sample size was achieved. The demographic information (age, sex etc.) was recorded. An informed consent was taken after counselling the patients regarding the procedure and objective of the study. All the information was collected through a specially designed

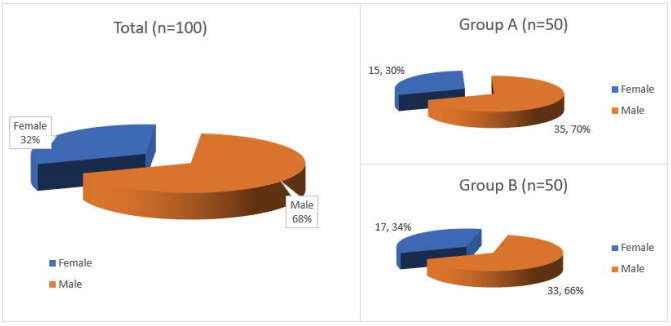

Figure 1: %age of patients according to Gender (n=100), and also for each group

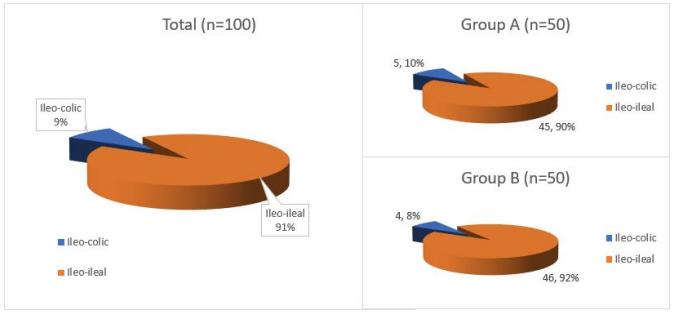

Figure 2: %age of patients according to the type of reversal (n=100), and also for each group

proforma. Randomization was done using lottery method, by drawing a slip, into study (Group A) and control (Group B) groups.

Group A: Gum chewing group.

Group B: Non-gum chewing group.

Anesthesia and the dose of perioperative opioid analgesics were standardized for both the groups. Patients in Group A were given one stick (containing 5 grams) of chewing gum three times a day to be chewed for one hour starting from six hours after operation until they passed flatus; in addition to the standard postoperative care including keeping the patient nil per oral, intravenous fluid administration, analgesia and serum electrolytes levels monitoring and optimization till ileus resolved and patient passed flatus; while patients in Group B were offered all the standard postoperative care received by Group A patients except chewing gum.

Patients were instructed to note down the time when they first passed flatus. This information was collected by assessors who were not aware of the intervention arm. The date and time of operation and the passage of first flatus were recorded on the specified proforma and the interval between operation and passage of first flatus in hours was calculated which had given us the duration of postoperative ileus in that patient. Time to the passage of stool was not recorded as most of the patients were discharged once oral intake was established and passed flatus.

Statistical Analysis

SPSS version 20 was used for data analysis. Qualitative variables like gender and type of reversal operation (i.e., ileo-ileal or ileo-colic anastomosis) were presented in the form of frequency and percentage. Quantitative variables like age, BMI and duration of postoperative ileus (i.e., interval between operation and passage of first flatus) were presented in the form of mean ± S.D. The Student's t test was used for the comparison of mean duration of postoperative ileus in both groups and other quantitative variables. The chi-square test was used for the comparison of qualitative variables. P value ≤ 0.05 was considered as significant. Data was then stratified for age, gender, BMI, and type of reversal operation. The Student's t-test was applied post-stratification and P value ≤ 0.05 was considered as significant.

Results

The age range in this study was from 14 to 70 years, with a mean age of 37.76 ± 16.03 years. The mean age of patients in group A was 36.44 ± 15.41 years and in group B was 39.08 ± 16.67 years (p-value = 0.413). The majority of the patients, 41 (41.0%), were

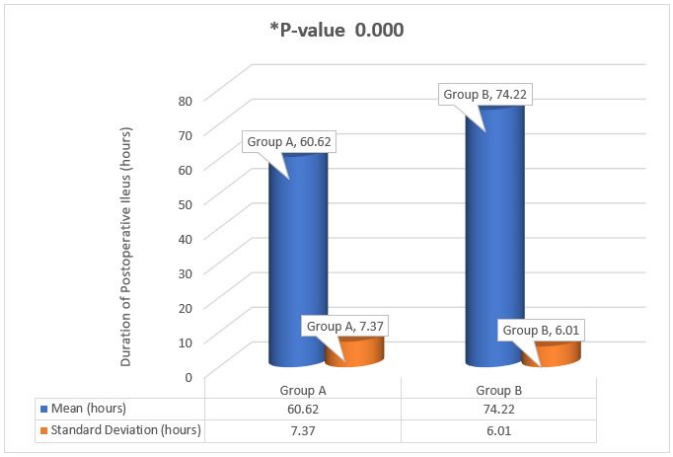

Figure 3: Comparison of mean duration of postoperative ileus in both groups. (*Test of significance: Student's t-test.)

between 14 to 30 years of age as shown in Table 1. Out of 100 patients, 68 (68.0%) were males and 32 (32.0%) were females, as shown in Table 2 and Figure 1, with male to female ratio of 2.1:1. There were no dropouts in either group.

The mean BMI was 24.78 ± 3.43kg/m2. The mean BMI in group A was 24.88 ± 3.52 kg/m2 and in group B was 24.68 ± 3.37 kg/m2 (p-value = 0.776). The majority of the patients, 55 (55.0%) were $\leq$25 kg/m2, as shown in Table 3. The percentage of patients according to the type of reversal is shown in Figure 2 and Table 4. Complications seen in both groups are given in Table 5, with no significant difference between the two groups. No mortality was seen in either of the two groups. The mean duration of post-operative ileus in group A (gum chewing) was 60.62 ± 7.37 hours, while in group B (non-gum chewing) was 74.22 ± 6.01 hours, as shown in Figure 3 (p-value = 0.000).

Stratification of the duration of postoperative ileus with respect to age groups (14 to 30 years, 31 to 50 years, and 51 to 70 years) is shown in Table 6, which depicts significant difference in the duration of postoperative ileus in all age groups among both groups (p-value = 0.000 for all age groups). Similarly, statistically significant difference was found in the duration of postoperative ileus in both genders among both groups, as shown in Table 7. The mean duration of postoperative ileus in group A males was 60.28 ± 6.73 hours versus 74.39 ± 5.55 hours in group B (p-value = 0.000), and in group A females was 61.40 ± 8.89 hours versus 73.88 ± 6.99 hours in group B (p-value = 0.000). Stratification of the duration of postoperative ileus among both groups with respect to two BMI groups, $\leq$25 kg/m2 (p-value=0.000) and >25 kg/m2 (p-value = 0.000) is shown in Table 8 and with re-

Table 1 Age distribution for both groups.

Age (years)	Group A (n=50)		Group B (n=50)		P-value	Total (n=100)	
	No. of patients	%age	No. of patients	%age		No. of patients	%age
14-30	21	42.0	20	40.0	**0.901***	41	41.0
31-50	17	34.0	16	32.0	**0.901***	33	33.0
51-70	12	24.0	14	28.0	**0.901***	26	26.0
Mean Age ± SD	34.44 ± 15.41		39.08 ± 16.67		**0.413****	37.76 ± 16.02	

*Test of significance: chi-square test **Test of significance: Student's t-test

Table 2 Percentage of patients for both groups according to Gender.

Gender	Group A (n=50)		Group B (n=50)		P-value	Total (n=100)	
	No. of patients	%age	No. of patients	%age		No. of patients	%age
Male	35	70%	33	66%	**0.668***	68	68%
Female	15	30%	17	34%	**0.668***	32	32%

*Test of significance: Chi-square test

Table 3 Distribution of patients for both groups according to BMI.

BMI	Group A (n=50)		Group B (n=50)		P-value	Total (n=100)	
	No. of patients	%age	No. of patients	%age		No. of patients	%age
$\leq$ 25 kg/m^2	27	54%	28	56%	**0.841***	55	55%
$>$25 kg/m^2	23	46%	22	44%	**0.841***	45	45%
Mean BMI ± SD	24.88 ± 3.52		24.68 ± 3.37		**0.773****	24.78 ± 3.43	

*Test of significance: Chi-square test **Test of significance: Student's t-test.

Table 4 Percentage of patients for both groups according to Type of Reversal.

Type of Reversal	Group A (n=50)		Group B (n=50)		P-value	Total (n=100)	
	No. of patients	%age	No. of patients	%age		No. of patients	%age
Ileo-ileal	45	90%	46	92%	**0.727***	91	91%
Ileo-colic	5	10%	4	8%	**0.727***	9	9%

*Test of significance: Chi-square test

Table 5 Complications in both groups.

Complications	Group A (n=50)	Group B (n=50)	P-value
Wound infection	3	4	0.695*
Postoperative fever	4	3	0.695*
Pneumonia	1	2	0.558*
Anastomotic Leak	1	1	1.000*
Mortality	-	-	-

*Test of significance: Chi-square test

Table 6 Stratification of the duration of postoperative ileus concerning age groups.

Age of patients (years)	Group A (n=50)		Group B (n=50)		P-value
	Duration of POI (hours)		Duration of POI (hours)		
	Mean	SD	Mean	SD	
14-30	59.61	6.96	73.9	5.83	**0.000**
31-50	62.05	8.05	74.31	6.12	**0.000**
51-70	60.33	7.36	74.57	6.53	**0.000**

*Test of significance: Student's t-test

Table 7 Stratification of the duration of postoperative ileus concerning gender.

Gender	Group A (n=50)		Group B (n=50)		P-value
	Duration of POI (hours)		Duration of POI (hours)		
	Mean	SD	Mean	SD	
Male	60.28	6.73	74.39	5.55	**0.000**
Female	61.40	8.89	73.88	6.99	**0.000**

*Test of significance: Student's t-test

Table 8 Stratification of the duration of postoperative ileus concerning BMI.

BMI	Group A (n=50)		Group B (n=50)		P-value
	Duration of POI (hours)		Duration of POI (hours)		
	Mean	SD	Mean	SD	
$\leq$ **25 kg/m^2**	60.11	7.19	73.96	5.91	**0.000**
$>$**25 kg/m^2**	61.21	7.69	74.54	6.25	**0.000**

*Test of significance: Student's t-test

Table 9 Stratification of the duration of postoperative ileus concerning the type of reversal.

Type of reversal	Group A (n=50)		Group B (n=50)		P-value
	Duration of POI (hours)		Duration of POI (hours)		
	Mean	SD	Mean	SD	
Ileo-ileal	60.73	7.46	74.19	6.02	**0.000**
Ileo-colic	59.6	7.09	74.5	6.75	**0.015**

*Test of significance: Student's t-test

spect to type of reversal, ileo-ileal (p-value = 0.000) and ileo-colic (p-value = 0.015), in Table 9.

Discussion

Postoperative ileus (POI) is considered a transient disturbance in gastrointestinal motility following abdominal surgery.[26,27] Almost all patients develop a degree of POI after abdominal operations.[28,29] This transient absence of bowel function is characterized by lack of bowel sounds, accumulation of gastrointestinal gas and fluid, abdominal pain and distention, nausea, vomiting, and delayed passage of flatus and stool.[26,27,30] Traditionally, POI is considered to be resolved once flatus or stool is passed. The chances of developing POI are more in operations that involve large incisions, increased bowel handling, or peritoneal exposure to irritants like pus or blood.[26] There are several other contributing factors including pharmacologic, inflammatory, hormonal, metabolic, gastrointestinal physiology, neurologic, psychological, and miscellaneous.[26] POI may extend the length of hospital stay (LOS) in patients 5 days longer than in those without POI [31] and increase the incurred cost.[29,31,32] Safe shortening of LOS by reducing the duration of POI not only improves the level of care provided but also saves money. Various methods have been advised to reduce POI, such as a minimally invasive surgical procedure (e.g., laparoscopy), epidural anesthesia, early ambulation, nasogastric tube decompression, and feeding [33]; however, POI poses an ongoing challenge. Moreover, Vermeulen et al. conducted a meta-analysis which concluded that routine insertion of nasogastric tube has no benefit on gastrointestinal function.[34] Also, it is quite uncomfortable. A new approach that focuses on patient comfort and is also evidence based should be considered. Sham feeding has been reported to stimulate bowel motility in humans.[35,36] Chewing gum is a type of sham feeding that simulates food ingestion without actually ingesting it.

The reduction in duration of POI caused by chewing gum is supported by several studies.[3,5,19-25,37-45] However, there are also studies that have showed no significant difference.[46-52] These discrepant pieces of evidence create uncertainty in the minds of surgeons about whether gum chewing has any effect in reducing the duration of POI at all or not. Several meta-analyses [14,15.18,53,54] showed a favorable effect of gum chewing on time to flatus and defecation, but all of these studies were small number size and the results were not robust.

In our study, the mean duration of post-operative ileus in Group A (gum chewing) was 60.62 ± 7.37 hours, while in Group B (non-gum chewing) was 74.22 ± 6.01 hours (p-value = 0.000). A similar study by Marwah et al. has reported that gum chewing reduces the duration of postoperative ileus after relaparotomy for ileostomy closure which was done for typhoid perforation peritonitis.[19] In that study, the mean time for the passage of first flatus and for the appearance of bowel sounds was significantly shorter in the study group (58.48±22.69 hours versus 73.12±25.63 hours, P=0.004 38.6±18.1 hours versus 46.52±19.20 hours, P=0.006 respectively).[19] The mean time for the passage of first stool was 84.96±38.288 hours (range 36-190 hours) in the study group compared with 109.20±37.41 hours (range 30-208 hours) in the control group with a P-value of 0.004.[19]

In another study [44], the mean time of return of bowel sounds after abdominal surgery was significantly less (21.4±2.8hours) in the experimental group than in the control group (23.7±2.8 hours). Likewise, the mean time of passage of flatus postoperatively was 58.2±9.3hours in the experimental group compared to 65.6±6.4 hours in the control group and the mean time of return of appetite after surgery was 59.9±9.8 hours in experimental group in comparison to 67.2±7.6 hours in the control group. Both of these results were also significant.[44]

A meta-analysis of 17 RCTs provides evidence that chewing gum significantly reduces recovery time following abdominal surgery.[45] Patients in the chewing gum treatment group, compared with the reference group, experienced a significant reduction of 0.31 days for time to first flatus, 0.51 days for time to first bowel movement, 0.72 days for LOS.[45] A clinical trial [3] studied 34 patients undergoing abdominal surgery, randomized into two groups: a gum-chewing group (n=17) or a control group (n=17). The patients in the intervention group chewed sugarless gum three times daily for one hour until they were discharged. Other confounding factors such as patient demographics, intraoperative, and postoperative care were standardized for both groups. Patients who were given the chewing gum, tolerated it well. The first passage of flatus was observed 65.4 hours postoperatively in the gum-chewing group and 80.2 hours in the control group (P-value 0.05). The first bowel movement occurred 63.2 hours after the operation in the gum-chewing group versus 89.4 hours in the control group (P-value 0.04). No major complications were seen in both groups. The total duration of hospital stay was less in the gum-chewing group (day 4.3) than in the control group (day 6.8), with P-value of 0.01.[3]

In our study, the primary aim was to compare the duration of postoperative ileus following ileostomy reversal which involves small bowel anastomosis, in the two groups, one receiving gum chewing and the other not. The study proves that gum chewing is an effective way to reduce duration of postoperative ileus. This is also supported by several other studies on reviewing published literature, although most of these studies were performed for colonic anastomosis.

Conclusion

This study concluded that the mean duration of postoperative ileus following ileostomy reversal is shorter in patients with gum chewing added to their postoperative care as compared to those without gum chewing. Gum chewing is an effective modality in decreasing postoperative ileus, which is also very safe and cheap. So, we recommend that it should be added as an adjunct treatment in postoperative care because it might contribute to shorter hospital stays and in turn decreased cost.

Ethical approval

Ethical approval was obtained from the Clinical Research Ethics Committee of the Jinnah Hospital Lahore/Allama Iqbal Medical College in April'2014. Informed consent was taken from all participants prior to inclusion in the study.

Disclosures

The authors have no funding or conflicts of interest to disclose.

References

1. Behm B, Stollman N. Postoperative ileus. Practical Gastroenterology. Westhampton Beach, NY: Shugar Publishing Inc; 2002:13-24.

2. Livingstone EH, Passaro EP Jr. Postoperative ileus. Dig Dis Sci 1990; 35:121-132.

3. Schuster R, Grewal N, Greaney GC, Waxman K. Gum chewing reduces ileus after elective open sigmoid colectomy. Arch. Surg. 2006; 141: 174–6.

4. Choi J, O'Connell TX. Safe and effective early postoperative feeding and hospital discharge after open colon resection. Am Surg. 1996; 62: 853-856.

5. Asao T, Kuwano H, Nakamura J, Morinaga N, Hirayama I, Ide M. Gum chewing enhances early recovery from postoperative ileus after laparoscopic colectomy. J. Am. Coll. Surg. 2002; 195: 30–2.

6. Miedema BW. Methods for decreasing postoperative gut dysmotility. Lancet Oncol. 2003; 4: 365-372.

7. Soffer EE, Adrian TE. Effect of meal composition and sham feeding on duodenojejunal motility in humans. Dig Dis Sci. 1992; 37: 1009-1014.

8. Stern RM, Crawford HE, Stewart WR, et al. Sham feeding: cephalic-vagal influences on gastric myoelectric activity. Dig Dis Sci. 1989; 34: 521-527.

9. Basse L, Hjort Jakobsen D, Billesbolle P, et al. A clinical pathway to accelerate recovery after colonic resection. Ann Surg. 2000; 232:51-57.

10. Tandeter H. Hypothesis: Hexitols in chewing gum may play role in reducing postoperative ileus. Med Hypotheses 2009; 72:39-40.

11. Stewart BT, Woods RJ, Collopy BT, et al. Early feeding after elective open colorectal resections: a prospective randomized trial. Aust N Z J Surg. 1998; 68: 125-128.

12. Bradshaw BG, Liu SS, Thirlby RC. Standardized perioperative care protocols and reduced length of stay after colon surgery. J Am Coll Surg. 1998; 186: 501-506.

13. Dunn KMB, Rothenberger DA. Colon, Rectum and Auns. In: Brunicardi FC, Andersen DK, Billiar TR, Dunn DL, Hunter JG, Matthews JB, Pollock RE. Schwart's principles of surgery. 9TH ed.: McGraw-Hill; 2010: 1013-1072.

14. Chan MK, Law WL. Use of chewing gum in reducing postoperative ileus after elective colorectal resection: A systemic review. Dis Colon Rectum 2007; 50: 2149-2157.

15. de Castro SM, van den Esschert JW, van Heek NT, Dalhuisen S, Koelemay MJ, Busch OR, et al. A systemic review of the efficacy of gum chewing for the amelioration of postoperative ileus. Dig Surg 2008; 25:39-45.

16. Vasquez W, Hernandez AV, Garcia-Sabrido JL. Is gum chewing useful for ileus after elective colorectal surgery? A systemic review and meta-analysis of randomized clinical trials. J Gastrointest Surg 2009;13: 649-656.

17. Gustafsson UO, Scott M, Schwenk W et al. Guidelines for perioperative care in elective colonic surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations. Clinical Nutrition 2012; 31(6): 783-800.

18. Noble EJ, Harris R, Hosie KB, Thomas S, Lewis SJ. Gum chewing reduces postoperative ileus? A systemic review and meta-analysis. Int J Surg 2009; 7: 100-105.

19. Marwah S, Singla S, Tinna P. Role of gum chewing on the duration of postoperative ileus following ileostomy closure done for typhoid ileal perforation: A prospective randomized trial. Saudi J Gastroenterol 2012;18: 111-117.

20. Ledari FM, Barat S, Delavar MA. Chewing gums has stimulatory effects on bowel function in patients undergoing cesarean section: a randomized controlled trial. Bosn. J. Basic Med. Sci. 2012; 12: 265–8.

21. Abd-El-Maeboud K, Ibrahim M, Shalaby D, Fikry M. Gum chewing stimulates early return of bowel motility after caesarean section. BJOG 2009; 116: 1334–1339.

22. Erik J. Kouba, Eric M. Wallen, and Raj S. Pruthi. Gum chewing stimulates bowel motility in patients undergoing radical cystectomy with urinary diversion. Urology 70: 1053–1056, 2007.

23. S. Askarpour, M.H.S. Shoushtari, M. Saadati. Study of the effect of early feeding, chewing gums, and laxative on ileus in patients who underwent open cholecystectomy. The Internet Journal of Surgery. 2009 Volume 22 Number 2.

24. Ngowe MN, Eyenga VC, Kengne BH, Bahebeck J, Sosso AM. Chewing gum reduces postoperative ileus after open appendectomy. Acta Chir. Belg. 2010; 110: 195–9.

25. Hussiein H, Franz M, Gutschi M, et al. Postoperative gum chewing after gynecologic laparoscopic surgery: a randomized controlled trial. Obstet Gynecol. 2013; 122: 85-90.

26. Mattei P, Rombeau JL. Review of the pathophysiology and management of postoperative ileus. World J Surg. 2006; 30: 1382–91.

27. Maron DJ, Fry RD. New therapies in the treatment of postoperative ileus after gastrointestinal surgery. Am J Ther. 2008; 15: 59–65.

28. Behm B, Stollman N. Postoperative ileus: etiologies and interventions. Clin Gastroenterol Hepatol. 2003; 1: 71–80.

29. Delaney CP. Clinical perspective on postoperative ileus and the effect of opiates. Neurogastroenterol. Motil. 2004; 16 (Suppl. 2): 61–6.

30. Holte K, Kehlet H. Postoperative ileus: a preventable event. Br. J. Surg. 2000; 87: 1480–93.

31. Kehlet H, Holte K. Review of postoperative ileus. Am. J. Surg. 2001; 182: 3S–10S.

32. Doorly MG, Senagore AJ. Pathogenesis and clinical and economic consequences of postoperative ileus. Surg. Clin. North Am. 2012; 92: 259–72.

33. Marderstein EL, Delaney CP. Management of postoperative ileus: focus on alvimopan. Ther. Clin. Risk Manag.2008; 4: 965–73.

34. Vermeulen H, Storm-Versloot MN, Busch OR, Ubbink DT. Nasogastric intubation after abdominal surgery: a meta-analysis of recent literature. Arch. Surg. 2006; 141: 307–14.

35. Jepsen JM, Skoubo-Kristensen E, Elsborg L. Rectosigmoid motility response to sham feeding in irritable bowel syndrome. Evidence of a cephalic phase. Scand. J. Gastroenterol. 1989; 24: 53–6.

36. Soffer EE, Adrian TE. Effect of meal composition and sham feeding on duodenojejunal motility in humans. Dig. Dis. Sci. 1992; 37: 1009–14.

37. Hirayama I, Suzuki M, Ide M, Asao T, Kuwano H. Gum-chewing stimulates bowel motility after surgery for colorectal cancer. Hepatogastroenterology 2006; 53: 206–8.

38. Zhang Q, Zhao P. Influence of gum chewing on return of gastrointestinal function after gastric abdominal surgery in children. Eur. J. Pediatr. Surg. 2008; 18: 44–6.

39. Kafali H, Duvan CI, Gozdemir E, Simavli S, Onaran Y, Keskin E. Influence of gum chewing on postoperative bowel activity after cesarean section. Gynecol. Obstet. Invest. 2010; 69: 84–7.

40. Shang H, Yang Y, Tong X, Zhang L, Fang A, Hong L. Gum chewing slightly enhances early recovery from postoperative ileus after cesarean section: results of a prospective, randomized, controlled trial. Am. J. Perinatol.2010; 27: 387–91.

41. Bahena-Aponte JA, Cardenas-Lailson E, Chavez-Tapia N, Flores-Gama F. Usefulness of chewing gum for the resolution of postoperative ileus in left colon resections. Rev. Gastroenterol. Mex. 2010; 75: 369–73.

42. Choi H, Kang SH, Yoon DK et al. Chewing gum has a stimulatory effect on bowel motility in patients after open or robotic radical cystectomy for bladder cancer: a prospective randomized comparative study. Urology 2011; 77: 884–90.

43. kagi K, Teshima H, Arinaga K et al. Gum chewing enhances early recovery of bowel function following transperitoneal abdominal aortic surgery. Surg. Today 2012; 42: 759–64.

44. Nimarta, Singh NV, Shruti, Gupta R. Effectiveness of chewing gum on bowel motility among the patients who have undergone Abdominal Surgery. Nursing and Midwifery Research J. 2013;9(3):108-17.

45. Li S, Liu Y, Peng Q, Xie L, Wang J, Qin X. Chewing gum reduces postoperative ileus following abdominal surgery. J Gastroenterol Hepatol. 2013; 28(7): 1122-1132.

46. McCormick J, Garvin R, Caushaj P. The effects of gum-chewing on bowel function and hospital stay after laparoscopic vs open colectomy: a multi-institution prospective randomized trial. J. Am. Coll. Surg. 2005; 201: S66–S7.

47. Matros E, Rocha F, Zinner M et al. Does gum chewing ameliorate postoperative ileus? Results of a prospective, randomized, placebo-controlled trial. J. Am. Coll. Surg. 2006; 202: 773–8.

48. Quah HM, Samad A, Neathey AJ, Hay DJ, Maw A. Does gum chewing reduce postoperative ileus following open colectomy for left-sided colon and rectal cancer? A prospective randomized controlled trial. Colorectal Dis. 2006; 8: 64–70.

49. Chou SJ, Lin CH, Hsieh HF, Yu JC, Chen TW, Chan DC. Gum chewing in patients with subtotal gastrectomy. Chir. Gastroenterol. 2006; 22: 269–71.

50. Cavusoglu YH, Azili MN, Karaman A. Does gum chewing reduce postoperative ileus after intestinal resection in children? A prospective randomized controlled trial. Eur. J. Pediatr. Surg. 2009; 19: 171–3.

51. Crainic C, Erickson K, Gardner J. Comparison of methods to facilitate postoperative bowel function. Medsurg Nurs. 2009; 18: 235–8.

52. Smith SR, Lim P, Draganic B. Effect of gum chewing on gastrointestinal recovery after laparoscopic colorectal resectional surgery: a prospective randomized clinical trial [Abstract]. ANZ J. Surg. 2010; 80 (Suppl.): A17.

53. Purkayastha S, Tilney HS, Darzi AW, Tekkis PP. Meta-analysis of randomized studies evaluating chewing gum to enhance postoperative recovery following colectomy. Arch. Surg. 2008; 143: 788–93.

54. Fitzgerald JE, Ahmed I. Systematic review and meta-analysis of chewing-gum therapy in the reduction of postoperative paralytic ileus following gastrointestinal surgery. World J. Surg. 2009; 33: 2557–66.