

## Review Article

# Effect of chewing gum on the postoperative recovery of gastrointestinal function

Wei Ge, Gang Chen, Yi-Tao Ding

*Department of General Surgery, Nanjing Drum Tower Hospital, The Affiliated Hospital of Nanjing University Medical School, Nanjing 210008, Jiangsu Province, P. R. China*

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**Abstract:** Postoperative gastrointestinal dysfunction remains a source of morbidity and the major determinant of length of stay after abdominal operation. There are many different reasons for postoperative gastrointestinal dysfunction such as stress response, perioperative interventions, bowel manipulation and so on. The mechanism of enhanced recovery from postoperative gastrointestinal dysfunction with the help of chewing gum is believed to be the cephalic-vagal stimulation of digestion which increases the promotability of neural and humoral factors that act on different parts of the gastrointestinal tract. Recently, there were a series of randomized controlled trials to confirm the role of chewing gum in the recovery of gastrointestinal function. The results suggested that chewing gum enhanced early recovery of bowel function following abdominal surgery except the gastrointestinal surgery. However, the effect of chewing gum in gastrointestinal surgery was controversial.

**Keywords:** Chewing gum, gastrointestinal function, RCT, postoperative ileus

## Introduction

Postoperative gastrointestinal dysfunction, especially postoperative ileus, is a major contributing factor in discomfort and prolonged hospital stay after abdominal surgery. Gastrointestinal dysfunction can cause the accumulation of secretions and gas, resulting in nausea, vomiting, and abdominal distension and pain. Recovery of gastrointestinal function is an important aspect and demands due attention. Methods to enhance the resumption of bowel function and, as a result, expedite postoperative recovery, have been increasingly investigated. Chewing gum, as a proxy for sham feeding, has been confirmed to be able to accelerate the motility of the gastrointestinal tract by a series of controlled studies. In this review, we summarized the effect of chewing gum on the postoperative recovery of gastrointestinal function after abdominal surgery.

## Factors of gastrointestinal dysfunction after abdominal operation

The etiology of postoperative gastrointestinal dysfunction is believed to be multifactorial [1],

and contributing factors included the stress response to surgery and the use of perioperative interventions. The severity of gastrointestinal dysfunction depended on the extent of surgical trauma and bowel manipulation. Surgical trauma caused a decrease in bowel motility through activation of sympathetic activity. Associated with the stress response is release of inflammatory mediators such as vasoactive intestinal peptide, substance P and nitric oxide, which contributed to postoperative gastrointestinal dysfunction and ileus [2-5].

Opioids, used as analgesics perioperatively, have a marked effect on time to return of normal gut function. Studies showed a dose related response to amount of morphine given and time to return to normal gut function [6].

## The mechanism of chewing gum in accelerating the return of gastrointestinal function after abdominal operation

Sham feeding has been reported to stimulate motility of the human duodenum, stomach, and the rectosigmoid [7-9]. The researches demonstrated that sham feeding increased the serum

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concentration of the peptide hormone gastrin, the neuropeptide neurotensin, and pancreatic polypeptide [8]. Besides, sham feeding also enhanced duodenal alkaline secretion [10]. Gum chewing mimics food intake and is considered as a kind of sham feeding. The physiologic mechanism for the enhanced recovery of bowel motility by gum chewing is assumed to be the activation of the cephalic-vagal pathway, which is stimulating intestinal myoelectric activity in an attempt to counteract activation of the gastrointestinal  $\mu$  opioid receptors [11]. This response leads to both humoral and nervous stimulation of bowel motility. Given this, gum chewing might be a safe and inexpensive way to provide the benefits of early stimulation of the gastrointestinal tract.

### **The clinical trials in verifying the effect of chewing gum in the return of gastrointestinal function after abdominal surgery**

#### *The effect of chewing gum in gastrointestinal surgery*

Bonventre S et al. performed a study to investigate the efficacy of chewing gum in resolving postoperative ileus in various surgical approaches including video laparoscopic cholecystectomy, laparotomic colo-rectal surgery, laparotomic Hartmann procedure, and laparotomic gastric surgery. The result showed that chewing gum did not induce a relevant reduction of ileus after surgery [12]. Patrick L et al. designed a study to determine whether chewing gum improved gastrointestinal recovery after colorectal resection surgery. They found that chewing gum after open and laparoscopic colorectal resectional surgery is safe, but does not hasten the return of gastrointestinal function [13]. Similarly, Karen Z et al. sought to evaluate the effect of sugared chewing gum in combination with early enteral feeding on recovery of gastrointestinal function after major colorectal surgery to ascertain any additive effects of this combination. They concluded that there does not appear to be any benefit to sugared chewing gum in comparison with no gum in patients undergoing major colorectal surgery managed with early feeding in the postoperative period. There may be increased incidence of bloating, indigestion, and eructation, possibly related to swallowed air during gum chewing [14]. Similar results were also got in some other studies [15-17].

However, some studies got the opposite conclusion. Recently, a study by Dutch researchers aimed to evaluate the effect of gum chewing on postoperative ileus and length of hospital stay. The result showed that 27% of patients allocated to chewing gum developed postoperative ileus (POI) compared with 48% of patients in the control group ( $P=0.02$ ). More patients in the chewing gum group first defecated within 4 days of surgery ( $P=0.006$ ) and passed first flatus within 48 h ( $P=0.044$ ). This study showed that gum chewing is a safe and simple treatment to reduce POI [18]. Duk YH et al. had got a similar result. They examined the effect of gum chewing after laparoscopic colorectal cancer surgery and the result showed that length of postoperative hospital stay was shorter in the gum-chewing group [19]. Sanjay M et al. made a study aimed to evaluate the effect of gum chewing on the duration of postoperative ileus following small bowel anastomosis performed for the closure of intestinal stoma, made as temporary diversion in the selected cases of typhoid perforation peritonitis. They concluded that the cases of relaparotomy requiring additional adhesiolysis and small bowel anastomosis for stoma closure are benefited by postoperative gum chewing [20]. The positive results were also got in some other researches [21-24]. **Table 1** summarized the study characteristics of the randomized controlled trials on chewing gum following gastrointestinal surgery.

Why these randomized controlled trials got inconsistent conclusion? We analyzed the study design, observation indexes and found some possible factors. Firstly, the experimental designs were not very scientific and perfect. The study should be designed as rigorous prospective and blinded randomized controlled trial. Many studies did not meet the principle of blind. The effect of bias from lack of blinding might account for many of the measured differences. Secondly, the groups of patients were inhomogenous. For example, multiple types of operations including small- and large-bowel resection, laparoscopic and open surgery, and inclusion of patients with and without ileostomies may add intergroup variability, thereby confounding the results, although randomization tried to minimize these issues. Besides, it should be easier to measure an effect with gum chewing after laparotomy than laparoscopic surgery because the magnitude of gastrointes-

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tinal dysfunction might be greater after laparotomy [25]. Thirdly, the difference in outcome could be the difference in feeding regimes. Presumably sham feeding would be no more efficient in promoting the efferent cephalic-vagal response than routing feeding, whereas, patients in many trials were allowed to progress to diet with different regimes. Fourthly, postoperative analgesia including occasional use of epidurals could affect the treatment effect. Fifthly, different outcomes may relate to adequate numbers and power. The findings of these trials have been limited by small sample size, potentially leading to a large variability in treatment effects due to random chance.

### *The effect of chewing gum in other abdominal surgery expect gastrointestinal surgery*

Hoon C et al. designed a study including 37 patients who underwent retropubic radical prostatectomy from January 2010 to February 2012 to investigate the efficacy of gum chewing in aiding the recovery of bowel motility after a radical retropubic prostatectomy. They found that gum chewing has a positive effect on the recovery of bowel motility and reduction of surgical hospital stay after a radical prostatectomy [26]. There were also some studies showed that gum chewing stimulated bowel motility in patients undergoing radical cystectomy with urinary diversion [27, 28]. Heinrich H et al. performed a randomized controlled trial to investigate the effect of postoperative gum chewing on bowel motility after laparoscopic gynecologic surgery. The result showed a significantly shorter interval between surgery and passage of first flatus in the intervention group compared with the control group (median 6.2 hours vs. 8.1 hours) and a significantly higher rate of regular bowel sounds 3 hours (76% vs. 47%) and 5 hours (91% vs. 78%) after surgery. These results confirmed that gum chewing seems to have beneficial effects on bowel motility when used as an adjunct treatment in postoperative care after minimally invasive surgery [29]. Similar to this study, there were some studies also concluded that chewing gum was effective method in terms of preventing paralytic ileus following abdominal gynecological surgery, improving patient comfort, and shorting the duration of hospitalization [30-40].

In 2010, Shin YJ, et al. studied the effect of chewing gum in the return of bowel function

after elective open liver resection and 42 patients with hepatocellular carcinoma were included. The study showed that chewing gum after surgery demonstrated faster bowel function recovery and lower xerostomia grade after elective open liver resection [41]. Kazuyoshi T et al. conducted a study to establish if gum chewing during the postoperative period promoted recovery of bowel function following abdominal aortic surgery. The result showed that flatus was passed on POD 1.49 in the gum group and on POD 2.35 in the control group ( $P=0.0004$ ) and the time to oral intake was 3.09 days in the gum group and 3.86 days in the control group ( $P=0.023$ ). The conclusion was that gum chewing enhanced early recovery of bowel function following transperitoneal abdominal aortic surgery [42]. **Table 2** summarized the study characteristics of the randomized controlled trials on chewing gum following abdominal surgery except gastrointestinal surgery.

The randomized controlled trials on chewing gum following abdominal surgery expect gastrointestinal surgery reached a consistent conclusion that chewing gum accelerated the postoperative recovery of gastrointestinal function. This conclusion was compelling in our opinion. However, why the results got in randomized controlled trials following gastrointestinal surgery were not consistent with these got in other abdominal surgeries. The reasons were inferred as follows. The abdominal surgery (except gastrointestinal surgery) did not involve the gastrointestinal tract. Chewing gum, a kind of sham feeding, hastened the return of gastrointestinal function through a series of ways. While, gastrointestinal surgery affected the integrity of the gastrointestinal tract. Return of gastrointestinal function lied on the process of intestinal tract to a great extent and chewing gum had little effect.

### **Prospect**

The use of chewing gum has emerged as a novel and simple strategy for promoting the recovery of gastrointestinal function. The researches up to now all supported that the conclusion that chewing gum enhanced early recovery of bowel function following abdominal surgery expect the gastrointestinal surgery and chewing gum can be used as a effective method as a part of enhanced recovery after surgery

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**Table 1.** Study characteristics of randomized controlled trials on chewing gum after gastrointestinal surgery

Author/Country	Cases	Type of surgery	Design of chewing gum	Observational index	Outcome
Bonventre S [12]/Italy (2014)	90	videolaparoscopic cholecystectomy, laparotomic colo-rectal surgery, laparotomic Hartmann procedure, laparotomic gastric surgery		time to flatus time to stool length of hospital stay	inefficacy
Lim P [13]/Australia (2013)	161	colorectal resectional surgery	sorbitol-free gum, qid for 15 min	time to first flatus time to bowel motion	inefficacy
Zaghiyan K [14]/America (2013)	127	colorectal surgery	sugared gum, tid for 45 min in combination with early enteral feeding	time to tolerating a low-residue diet time to flatus time to bowel movement length of postoperative hospital stay	inefficacy
Forrester DA [15]/America (2014)	47	open or laparoscopic sigmoid colectomy	sugarless gum, tid for >1 h	time to first flatus, time to bowel motion time to return of appetite	inefficacy
Quah HM [16]/England (2006)	38	open surgery for left-sided colorectal cancer	sugar-free gum, tid for >5 min	time to first flatus time to faeces	inefficacy
Niloff PH [17]/America (2006)	66	colorectal surgery	tid for 45 min	time to first flatus time to bowel movement	inefficacy
Heijkant TC [18]/Netherlands (2015)	120	colorectal surgery	sugarless gum, at least 3 times per hour	Postoperative ileus length of hospital stay	effective
Hwang DY [19]/Korea (2013)	132	laparoscopic colorectal cancer surgery	tid for 10-20 min	time to first flatus the length of hospital stay	effective
Marwah S [20]/Inida (2012)	100	small bowel anastomosis	tid for 1 h	time to first flatus time to faeces time to bowel motion time to return of appetite	effective
Schuster R [21]/America (2006)	34	sigmoid colon resection	sugarless gum, tid	time to first flatus time to bowel movement time to return of appetite	effective
Zhang Q [22]/China (2008)	18	gastrointestinal surgery	sugarless gum, tid	time to first flatus time to sound of bowel peristalsis	effective
Hirayama I [23]/Japan (2006)	22	colorectal surgery	tid for 30 min	time to first flatus time to faeces	effective
Asao T [24]/Japan (2002)	19	laparoscopic colectomy	tid	time to first flatus time to faeces	effective

**Table 2.** Study characteristics of randomized controlled trials on chewing gum after abdominal surgery expect gastrointestinal surgery

Author/Country	Cases	Type of surgery	Design of chewing gum	Observational indexes	Outcome
Choi H [26]/Korea (2014)	37	radical retropubic prostatectomy	tid for 30 min	time to flatus time to bowel movement length of postoperative hospital stay	effective

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Kouba EJ [27]/America (2007)	102	radical Cystectomy	every 2 to 4 h	time to flatus time to bowel movement length of hospital stay	effective
Choi H [28]/Korea (2011)	60	radical cystectomy	sugar-free gum, tid for 30 min	time to flatus time to bowel movement length of postoperative hospital stay	effective
Husslein H [29]/Austria (2013)	179	laparoscopic gynecologic surgery	every 2 h for 15 min	time to flatus time to bowel movement time to faeces	effective
Terzioglu F [30]/Turkey (2013)	240	abdominal gynecologic surgery	sugarless gum, every 2 h for 15 min	time to flatus time to bowel movement time to faeces	effective
Ledari FM [31]/Iran (2012)	100	cesarean section	sugarless gum, tid for 1 h	time to flatus time to bowel movement time to the first feeling of hunger time to faeces	effective
Kafali H [32]/Turkey (2010)	150	cesarean Section	sugarless gum, tid	time to flatus length of postoperative hospital stay	effective
Jernigan AM [33]/USA (2014)	109	benign gynecologic surgery	every 4 h for 15 min	time to first hunger time to toleration of clear liquids time to toleration of a regular diet time to faeces time to bowel movement	effective
Tazegül Pekin A [36]/Turkey (2014)	137	gynecologic surgery	every 4 h for 30 min	time to faeces time to flatus	effective
Ajuzieogu OV [37]/Nigeria (2014)	180	caesarean section	sugarless gum, tid	time to faeces time to flatus time to bowel movement	effective
Mohsenzadeh Ledari F [38]/Iran (2013)	60	cesarean section	sugar-free gum, tid for 1 h	time to flatus time to bowel movement time to feeling of hunger time to faeces	effective
Jakkaew B [39]/Thailand (2013)	50	cesarean section	qid for 30 min	time to the first flatus time to the first meal time to the first regular diet time to tolerance to the first meal	effective
Jang SY [41]/Korea (2012)	42	elective open liver resection	sugarless gum, tid for 1 h	time to flatus	effective
Takagi K [42]/Japan (2012)	44	abdominal aortic surgery	sugarless gum, tid	time to first flatus time to bowel movement time to resumed food intake	effective

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(ERAS) program for these surgeries. However, the effect of chewing gum in gastrointestinal surgery was controversial. The main reason may be that digestive tract was managed in the surgery, which influenced the recovery of gastrointestinal function to a large extent. So it is difficult to evaluate the effect of chewing gum in homogeneous research. Rigorous homogeneous, prospective and blinded randomized controlled trials are demanded to further confirm the role of chewing gum in the recovery of gastrointestinal surgery.

### Disclosure of conflict of interest

None.

**Address correspondence to:** Dr. Gang Chen and Yi-Tao Ding, Department of General Surgery, Nanjing Drum Tower Hospital, The Affiliated Hospital of Nanjing University Medical School, Nanjing 210008, Jiangsu Province, P. R. China. E-mail: gulou\_hospital@163.com (GC); drdingyitao@sina.com (YTD)

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