

# Effects of olive oil applied to the nonfunctional distal colon on atrophic changes in patients undergoing ostomy

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## Abstract

**Aim:** Temporary colostomy is commonly performed for diseases requiring multi-stage surgery in pediatric surgical practice such as for anal atresia and Hirschsprung's disease. Through this study, we aimed to decrease the diameter difference between the proximal and distal colon and subsequently provide surgical ease and to investigate the effect of 1-month application of pure olive oil, which is considered a trophic factor, to prevent distal colonic atrophy.

**Materials and Methods:** In total, 24 pediatric patients who were treated at our clinic between June 2017 and November 2018 and who were scheduled to undergo colostomy closure were prospectively followed up. The patients were grouped into the following two groups: control group (n = 10), patients who were administered 5 cc 0.9% physiological saline solution twice a day for a month and olive oil group (n = 9), patients who were administered 5 cc pure olive oil as a trophic agent twice a day for a month.

**Results:** There were significant differences in terms of mucosal thickness, muscular thickness, wall thickness, and colonic lumen diameter between the proximal and distal colon in the control group. On the other hand, in the olive oil group, there was no significant difference between the proximal and distal colon. However, there was a significant difference between the two groups in terms of first bowel movement and discharge times.

**Conclusion:** Administration of olive oil from the distal colon opening prior to performing colostomy closure can decrease the diameter difference between the proximal and distal colons and provide easier surgical performance.

**Keywords:** Nonfunctional distal colon; colostomy closure; atrophic changes; olive oil; children.

## INTRODUCTION

Temporary colostomy is commonly performed for diseases requiring multi-stage surgery in pediatric surgical practice such as for anal atresia and Hirschsprung's disease (1). Patients who have undergone ostomy for any reason exhibit atrophic changes characterized with a decrease in the diameter and wall thickness of the distal colon segment, which is deprived of the trophic effect of food, bile, and pancreatic fluids (2-5). We have clinically observed that the diameter difference between the proximal and distal colon occurring because of such atrophic changes in the distal colon causes surgical difficulty (e.g., fish-mouth application to the distal colon) during colostomy closure. In previous studies, most of which were animal experiments, various materials such as short-chain fatty acid (SCFA), fibers, glutamine, psyllium, and growth hormone were used to prevent the atrophy of a nonfunctional distal colon (3, 6-11). In our study, olive

oil was used to prevent distal colonic atrophy. Olive oil is the symbol of the Mediterranean diet and is acquired from the fruits of the *Olea europea* L. tree (12). Olive oil directly acquired using mechanical extraction of olives is a complex mixture comprising free fatty acids and triglycerides at a ratio of 98% and 230 different minor components such as phenolic compounds, sterols, hydrocarbons, volatile compounds, antioxidants, squalene, and pigments at a ratio of 2% (12).

Through this study, we aimed to decrease the diameter difference between the proximal and distal colon and subsequently provide surgical ease and to investigate the effect of 1-month application of pure olive oil, which is considered a trophic factor, to prevent distal colonic atrophy.

## MATERIAL and METHODS

In total, 24 pediatric patients who were treated at our

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clinic between June 2017 and November 2018 and who were scheduled to undergo colostomy closure were prospectively followed up. Of these, 19 pediatric patients with anal atresia and Hirschsprung's disease who had undergone loop colostomy and divergent colostomy closure were included in the study. Due to anatomic and physiological differences between the small and large intestine, patients with ileostomy were excluded from the study. Moreover, patients who underwent open colostomy at another clinic, other types of colostomy such as Hartmann's pouch and end colostomy were excluded. The patients were monitored and treated by three pediatric surgery experts. Patients who had colostomy closure time were randomly selected to receive one patient into an olive oil group and the other to be included in the control group.

The patients were grouped into the following two groups: control group (n = 10), patients who were administered 5 cc 0.9% physiological saline solution twice a day for a month and olive oil group (n = 9), patients who were administered 5 cc pure olive oil as a trophic agent twice a day for a month.

First, the families were trained for effective administration of olive oil to the distal colonic lumen. Olive oil was administered to the lumen using a 5-cc syringe without an attached needle. Effective administration of olive oil was considered when no leakage of the oil from the distal colon was observed and was confirmed by subsequent elimination of olive oil from the anus of a child. The children and their parents nicely tolerated the administration of the oil or saline. One patient in the olive oil group who was considered to not have received effective administration of olive oil was excluded from the study.

Colonic lumen diameter and wall thickness were macroscopically measured, whereas the mucosal and muscular thicknesses of the related colon segment were microscopically measured under a light microscope. In both groups, age, sex, primary diagnosis of patients, level and type of ostomy performed, colostomy duration, surgical duration, first bowel movement (accepted as passing of gas or stool), discharge time, and complication rates were recorded. Further, statistically significant differences between the two groups were analyzed. Informed consent was obtained and an approval from the Ethics Committee of our hospital was acquired (28/06/2018-05).

### Surgical Method

Intravenous ceftriaxone and metronidazole were administered to all patients 1 day prior to the surgery, which were continued until the day of discharge. Preoperative fasting was performed a day prior to the surgery. Colon cleansing was not performed for any patient due to still controversial (13, 14). Further, skin preparation was performed with 10% povidone-iodine under general anesthesia for all patients, and the ostomy ends were released with peripheral incision. Other colonic segments were not explored to perform adhesiolysis. To provide colon continuation, intraperitoneal end-to-end anastomosis was performed with double-line 4/0 polyglactin sutures for all patients. Next, the

peritoneal cavity was washed with warm physiological saline solution and aspirated following anastomosis. Later, the peritoneum was continuously closed with 3/0 polyglactin sutures, fascia with 2/0 polyglactin sutures, subcutaneous tissues with 4/0 polyglactin sutures, and the skin with 4/0 polypropylene sutures. However, a drain was not used. One nasogastric tube was routinely placed during the operation, and the tube was removed following the first bowel movement. Then, the patients started the consumption of an oral diet.

### Pathological Evaluation

Intestinal tissue samples were fixed in 10% buffered formaldehyde, embedded in paraffin, and processed by standard methods. Histopathological tissue sections (3- $\mu$ m thick) stained with hematoxylin and eosin were evaluated using light microscopy. Further, automated measurements of the mucosal thickness (micron), muscular layer (micron), and complete colonic wall (cm) were performed. The height of each layer was defined using a binary cursor; the average of 30 measurements was used for each parameter.

### Statistical Analysis

The study data were analyzed using SPSS 21 package program (SPSS Inc. Chicago, Illinois, USA) with 95% confidence. Descriptive statistical analysis was used to examine the demographic characteristics stated in the study. Age and sex distributions of the groups were determined with chi-square test. The statistical differences between the data were analyzed using Mann-Whitney U-test, one of the non-parametric tests.

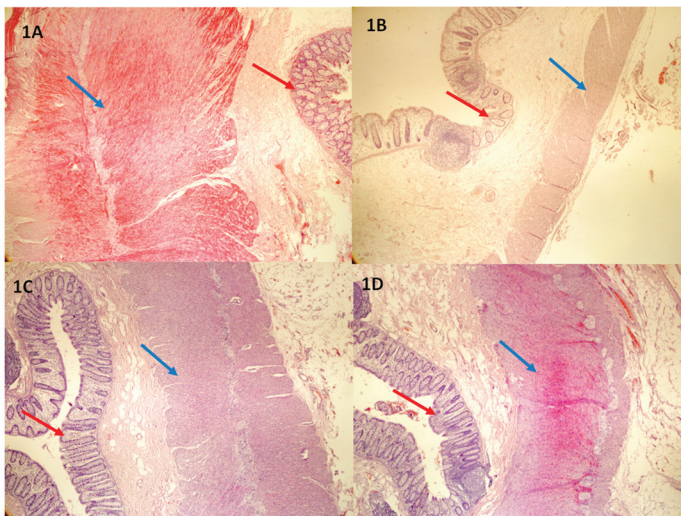
## RESULTS

There was no statistically significant difference between the two groups in terms of age and sex distributions ( $p > 0.05$ ). Demographic characteristics of all patients are summarized in (Table 1). Results of the macroscopic lumen diameter (cm) and colon wall thickness (cm); microscopic mucosal and muscular thicknesses (micron) proximal and distal colon values of the control and olive oil groups are summarized in Tables 2 and 3, respectively. As seen in Tables 2 and 3, there were significant differences in terms of mucosal thickness, muscular thickness (Figure 1A-B), wall thickness, and colonic lumen diameter (Figure 2A-B) between the proximal and distal colon in the control group ( $p = 0.003, 0.001, 0.002, \text{ and } 0.04$ , respectively). On the other hand, in the olive oil group, there was no significant difference in terms of mucosal thickness, muscular thickness (Figure. 1C- D), wall thickness, and colonic lumen diameter (Figure 2C- D) between the proximal and distal colon ( $p = 0.340, 0.222, 0.190, \text{ and } 0.1$ , respectively). However, there was a significant difference between the two groups in terms of first bowel movement and discharge times ( $p = 0.002 \text{ and } 0.001$ , respectively; Table 4). Box plots for the control and olive oil groups' values were shown in (Figure 3A-B-C-D).

While fish-mouth was required for the distal colon of all control group patients during colostomy closure (Figure 2A- B), the olive oil group patients did not require it (Figure 2C-D).

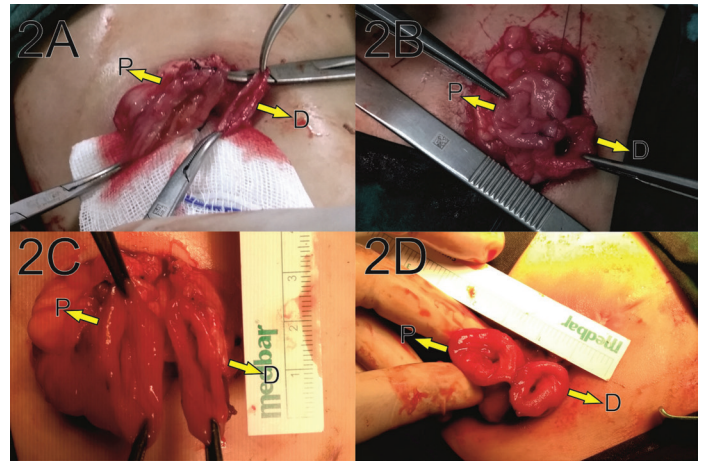
**Table 1. Demographic characteristics of patients**

	Control group Median (Max-Min)	OO group Median (Max-Min)
<b>Gender</b>	Female (n=3) Male (n=7)	Female (n=4) Male (n=5)
<b>Age (month)</b>	10 (7-60)	9 (8-24)
<b>Diagnosis</b>	Anal atresia (n=3) Hirschsprung (n=7)	Hirschsprung (n=9)
<b>Colostomy duration (Month)</b>	5 (3-7)	6 (3-9)
<b>Colostomy type</b>	Diverging sigmoidostomy (n=3) Loop transverse colostomy (n=7)	Loop transverse colostomy (n=9)
<b>Operation time (Minute)</b>	101 (80-125)	86 (65-110)



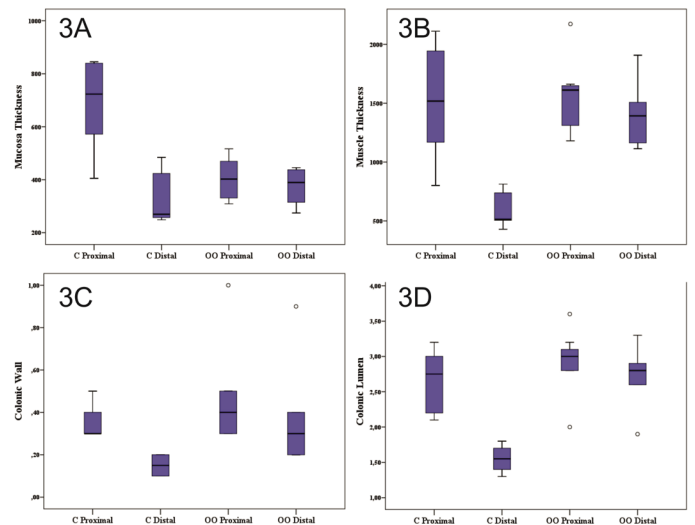
**Figure 1 A-B.** Proximal mucosal and muscle thickness in control group (H+E, x40) (Figure 1A), Distal mucosal and muscle thickness in control group (H+E, x40) (Figure 1B) (Red arrow shows mucosal thickness, blue arrow shows muscle thickness)

**Figure 1 C-D.** Proximal mucosal and muscle thickness in olive oil group (H+E, x40) (Figure 1C), Distal mucosal and muscle thickness in olive oil group (H+E, x40) (Figure 1D) (Red arrow shows mucosal thickness, blue arrow shows muscle thickness)



**Figure 2 A-B.** PWall thickness, and colonic lumen diameter (Figure 2A and B, two patient samples) between the proximal and distal colon in the control group (P: Proximal, D: Distal)

**Figure 2 C-D.** PWall thickness, and colonic lumen diameter (Figure 2C and D, two patient samples) between the proximal and distal colon in the olive oil group (P: Proximal, D: Distal)



**Figure 3 A-B-C-D.** Box plots for the control and olive oil groups in terms of mucosal thickness (Figure 3A), muscular thickness (Figure 3B), wall thickness (Figure 3C), and colonic lumen diameter (Figure 3D).

**Table 2. Macroscopic lumen diameter (cm) and colon wall thickness (cm); microscopic mucosal and muscular thicknesses (micron) with statistically analyzed proximal and distal colon values of the control group**

	C_Proximal		C_Distal		P value
	Median	Min - Max	Median	Min - Max	
<b>Mucosa (micron)</b>	638.09	405.42 - 844.45	290.15	248.52 - 484.47	.003
<b>Muscle (micron)</b>	1386.49	801.34 - 2111.67	513.40	429.12 - 813.21	.001
<b>Colonic Wall thickness (cm)</b>	.30	0.20 - 0.50	.10	0.10 - 0.20	.002
<b>Colonic luminal diameter (cm)</b>	26.00	3 - 32	15.00	13 - 18	.04

**Table 3. Macroscopic lumen diameter (cm) and colon wall thickness (cm); microscopic mucosal and muscular thicknesses (micron) with statistically analyzed proximal and distal colon values of the olive oil group**

	OO_Proximal		OO_Distal		P value
	Median	Min - Max	Median	Min - Max	
<b>Mucosa</b>	402.33	308.94 - 555.63	389.56	274.30 - 457.78	.340
<b>Muscle</b>	1526.82	915.23 - 2172.82	1202.01	864.69 - 1907.59	.222
<b>Colonic Wall thickness</b>	.40	0.30 - 1	.30	0.20 - 0.90	.190
<b>Colonic luminal diameter</b>	28.00	2 - 36	26.00	3 - 33	0.1

**Table 4. Results of the first bowel movement; and discharge time of the patients with statistically analyzed proximal and distal colon values of the control and olive oil groups**

	Control group		OO group		P value
	Median	Min - Max	Median	Min - Max	
First bowel movement (day)	3.00	3 - 4	2.00	2 - 3	0.002
Discharged (day)	6.00	5 - 7	5.00	4 - 6	0.001

Complications of wound infection were observed in one patient of both groups with systemic and topical antibiotic administration following colostomy closure. Notably, no other complications were encountered.

## DISCUSSION

Intestinal flora and luminal contents (bile, food, and pancreatic secretions) are the chief trophic factors that facilitate normal mucosal growth and prevent atrophy of the gastrointestinal system (2,4). When the colon is separated by an ostomy, the luminal environment and mechanical stimulation of the colon change; further, radical morphological changes occur related to the muscular and mucosal layers of the intestinal wall (2-4,6,8,11). Major muscular and mucosal atrophy and thinning of all layers of the colonic wall following surgical diversion have been previously reported (2,6,8,11).

The epithelial cells of the colorectal mucosa use SCFA acquired from the bacterial fermentation of carbohydrates found in the lumen, particularly acetic, propionic, and butyric acids (5,8,11). Absence of diet in the colonic lumen prevents fatty acid formation, absorption, and consumption by the epithelial cells, resulting in atrophy (2-4,8,11). Our objective was to have a similar physiological effect with oleic (55.23%–86.64%), linoleic, linoleic, palmitic, and palmitoleic acids, which are the most commonly found fatty acids in olive oil (15). Many effects of olive oil including anti-oxidizing, anti-inflammatory, anti-atherogenic, anti-ulcer, anti-carcinogenic, antimicrobial, diabetic, nervous system protective, and skin protective, and anti-aging effects have been discussed in the literature (16-21). However, to the best of our knowledge, olive oil has not been used as an agent against atrophic intestine to date.

SCFA infusion has been shown to have a trophic effect on rectum during routine rectal SCFA enema in patients with Hartmann's pouch (5,7,10). In other studies, for long-term b-hGH treatment, glutamine, fibers, psyllium, and Maharishi Amrit Kalash were administered for rectal enema and lumen irrigation; of these, only fibers and glutamine reportedly prevented atrophy (2,5,8,9,11). In our study, olive oil was directly administered to the distal colonic lumen as antegrade rather than retrograde continence enema to prevent distal colonic atrophy, which differed from the methods used in previous studies.

Duration of colostomy closure ranges between 77 and 110 min (1,13,14). In our study, the duration was similar to that found in the literature; in fact, it was even shorter for the olive oil group, possibly because of the absence of

fish-mouth for the distal segment. Further, there was no significant difference between the two groups in terms of duration of colostomy closure ( $p > 0.5$ ; Table 1).

Anastomotic leakage, delayed functioning of anastomosis, and surgical site infections (SSIs) are important complications leading to higher morbidity and longer hospitalization stay, which may occur following closed colostomy (1,13,14). It was argued that the complications following colostomy closure may be related to the trophic changes in the nonfunctional colonic wall (5). Postoperative use of SCFA was recommended for decreasing the risk of leakage due to increased microcirculation flow on the sides of resection (5). In our study, the effect of olive oil on anastomotic complications was not analyzed because there were no significant complications in both groups. The rates of SSIs, which are an important morbidity cause in patients following surgeries, range between 0% and 36% (1). SSI was observed in one patient each of the control and olive oil groups (10% and 11%) in our study.

One limitation of the study was the low number of study patients and heterogeneity of colostomies, warranting further studies with higher number of patients.

## CONCLUSION

Administration of olive oil from the distal colon opening prior to performing colostomy closure can decrease the diameter difference between the proximal and distal colons and provide easier surgical performance. We believe that larger series or animal experiments are warranted to further examine the effects of olive oil on anastomotic complications.

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