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ORIGINAL ARTICLE

# Evaluation of short-term loop colostomy in dogs using conventional and supporting subcutaneous silicone drain techniques

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## ABSTRACT

**Objective:** This study aimed at evaluating the supporting and non-supporting loop colostomy techniques in dogs.
**Materials and Methods:** In this study, 12 adult healthy mongrel dogs were used to carry out a short-term (21 days) temporary flank loop colostomy. The dogs were divided into two groups ($n$ = 6). In the first group (Con group), conventional stoma fixation was operated without loop support. In the second group [subcutaneous silicone drain (SSD) group], an SSD was used as a supporting bridge. The stoma was fixed by a modified, interrupted seromuscular vertical mattress suture pattern. Both peristomal and stomal complications were recorded.
**Results:** Results showed that a total of seven dogs (58%) suffered complications. There was a significant tendency toward less peristomal ($p$ = 0.012) and stomal complications ($p$ = 0.001) in the SSD group. The intensity of pain was significantly ($p$ < 0.05) different between the two groups in the first week post surgery. Comfort with stoma care was significantly ($p$ = 0.015) better in the SSD group, experiencing the best results.
**Conclusion:** It is concluded that an appropriate stoma location, using a soft supporting bridge, stoma fixation using modified interrupted neuromuscular vertical mattress sutures, and proper appliance fixation by adhesive tapes and a tight T-shirt may overcome the complications of short-term loop colostomy in dogs and introduce a satisfaction for stoma care.

## ARTICLE HISTORY

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Loop colostomy; stoma; flange; colon; subcutaneous silicon drains



## Introduction

A loop colostomy is frequently carried out for temporarily bypassing the caudal gastrointestinal tract [1,2]. It is carried out to decrease the prevalence of anastomotic complications [3]. The most critical complications during human rectal surgeries are anastomotic leakage, with a 12%–39% prevalence and 2%–24% mortalities [4]. Loop stoma reduces the complications related to anastomotic leak [5]. It could be considered a lifesaving surgery in dogs with caudal colonic and rectal diseases [6,7], especially in patients with acute or complicated rectal perforation, colonic or rectal carcinoma, colonic or rectal obstruction, acute neoplastic obstruction, and inflammatory stenosis or perforation. When the repair and/or anastomosis is advent, the lesion may not heal satisfactorily. Also, it may be associated with a fistula and peritonitis [2,8].

Regardless of the various colostomy techniques, the most straightforward method for managing fecal diversion is a stoma with a continuous flow system, with an attached skin flange and collection bag [8]. For many years, rigid supporting loop stoma was used to prevent the loop from falling back into the abdominal cavity [9]. As complications appeared, the bridge supporting the stoma limbs was changed and reinforced to be softer [10–12]. Some surgeons have even questioned whether the use of supporting bridges is necessary at all [13,14].

There is little information on the incorporation of colostomy in veterinary surgery [15,16]. The limited use of colostomy might be associated with difficulties in postoperative management. Another reason may be the lack of an evaluation scale of different techniques for supporting loop colostomy stoma in dogs. Therefore, this study aimed

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to assess supporting and non-supporting loop colostomy techniques to simplify the application, complications, and stoma management satisfaction. A further aim was to set a modified, interrupted seromuscular vertical mattress suture pattern in stoma fixation.

## Materials and Methods

### *Ethical statement*

The Mansoura Medical Research Ethics Committee permitted this study. The experimental procedures have been carried out as per the guidelines of animal welfare and ethical issues.

### *Animals*

In total, 12 adult apparently healthy Mongrel dogs of both sexes, aged 15–28 months, and weighing 11–18 kg were included in this study. All animals were housed in the Department of Surgery, Mansoura Veterinary Teaching Hospital, Mansoura University, Mansoura, Egypt. Dogs were kept in individual free stalls and were fed a diet based on milk, cooked, minced chicken meat with soup. All animals were healthy based on clinical findings, hematological evaluation, and abdominal ultrasonography. The animals expressed no painful signs using the short form of the Glasgow Composite Measure Pain Scale [17]. No analgesics were given 1 week before the start of the experiment.

### *Study design*

In all dogs, a short-term temporary flank loop colostomy was carried out. According to stoma fixation, dogs were randomly divided into two groups (six dogs each). In the first group (Con group), conventional stoma fixation was operated, whereas in the second group [subcutaneous silicone drain (SSD) group], the stoma was supported using an SSD.

### *Experimental procedures*

A day before the operation, a flat area without skin folds in the dorsal left flank region was aseptically prepared and marked in an awake dog in a standing position (Fig. 1A). Animals were fastened for 6 h before the operation. The dogs received preoperative doses of Cefotax (Cefotaxime, EIPICO, Egypt). Also, the dogs were pre-medicated with Atropine sulfate (1 mg/ml, Misr Co., Egypt) at 0.04 mg/kg body weight (BW) through intramuscular (IM) route, followed by an IM injection of Xylazine HCl (20 mg/ml, Xylaject-ADWIA, Egypt) at 1 mg/kg BW. General anesthesia was induced and maintained by intravenous administration of 2.5% thiopental sodium (25 mg/ml, Anapental, Sigma Tec, Egypt) to effect.

Animals were placed in the right lateral recumbence position. At the marked area in the dorsal relatively flat left paralumber fossa (just above the center of a line connecting the costochondral junction of the last rib and the ilium), a circular skin incision, 4 cm in diameter, was made. The underlying abdominal wall musculature was separated by blunt dissection to gain entrance into the abdominal cavity. Using a pair of Babcock's forceps, the descending colon was gently exteriorized through the abdominal opening. And then, a 4-cm anti-mesenteric longitudinal enterotomy was carried out in the mesocolon (Fig. 1B). Suturing was carried out by using a 3-0 polyglyconate suture (MaxonTM CV, Medtronic, USA). The excised skin borders to the exteriorized colon circumference were aligned in modified, interrupted seromuscular vertical mattress suture patterns (Fig. 2). A nipple-like protrusion was created via eversion of the mucosa over the skin edges, which minimize fecal contact with the skin (Fig. 1C).

In the SSD group, before stoma formation, a 10-cm free end of the silicone catheter piece (12 Fr, Enteplin, Egypt) was placed as a bridge through the mesenteric window at a right angle to the long axis of the bowel. The subcutaneous tissue was dissected dorsally and ventrally to the excised skin, and both ends of the bridge were subcutaneously placed into these pockets and sutured 3 cm dorsal and ventral to the incision to the subcutaneous tissue and underlying muscle fascia using 2-0 silk (Mersilk, Ethicon, UK) (Fig. 3A). Both points of the bridge were just beyond the circumference of the stoma flange. The stoma was carried out in the same manner mentioned earlier.

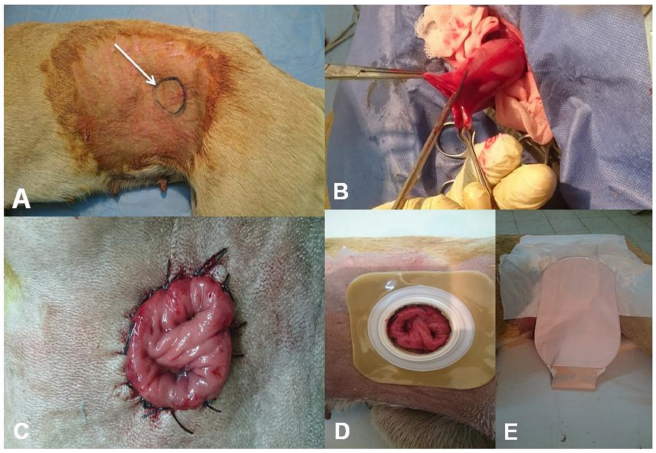


**Figure 1.** The planned colostomy site in which a flat area without folds in the left dorsal flank region was chosen (A; arrow). Anti-mesenteric longitudinal enterotomy (4 cm length) was carried out in the mesocolon (B). The stoma after fixation (note the everted colonic mucosa over the skin) (C). The adhesive flange was reconstructed to fit around the stoma and was adhered to the skin (D). An adhesive tape was applied to reinforce adhesion, and the colostomy bag was attached to the flange (E).

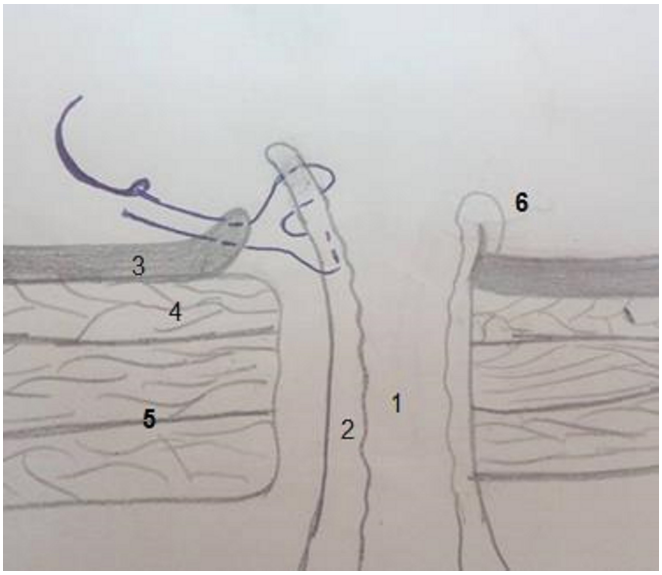


**Figure 2.** A modified, interrupted seromuscular vertical mattress suture pattern (1, lumen; 2, colonic mucosa; 3, skin; 4, subcutaneous tissue; 5, abdominal musculatures; and 6, the appearance of everted mucosa after stoma fixation).

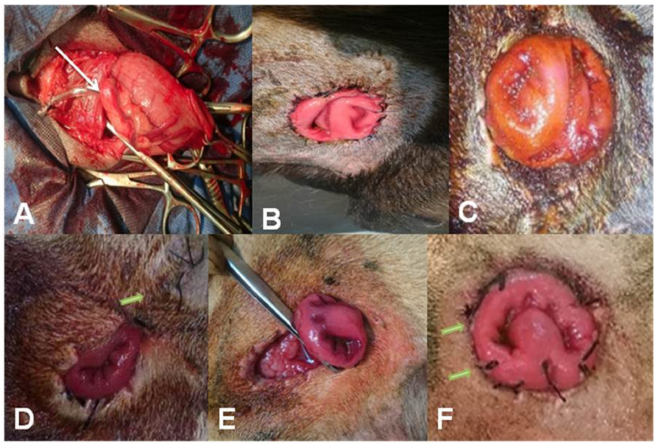


**Figure 3.** A silicone drain (arrow) sutured into the abdominal wall musculature beyond the abdominal wall defect in the dog with supporting stoma (A). Normal conventional colostomy 6 days post-surgery (B). Prolapsed conventional stoma in the dog with a peristomal hernia (C). Colostomy with retraction (note the additional fixating stitches) (D; arrow). Subcutaneous infiltration with granulation tissues 2 weeks after stoma dehiscence (E). Minute mucosal erosions around the fixating stitches (F; arrows).

The adhesive plastic of a two-piece appliance (LotFancy, San Francisco, CA) was reconstructed to a 45-mm diameter, then positioned with the stoma in the center of the opening and held down to allow firm adhesion to the skin (Fig. 1D). An adhesive tape was applied to the peristomal area of the flange to reinforce bonding. The colostomy bag was attached to the flange (Fig. 1F). A tight T-shirt was fitted after appliance fixation.

### *Postoperative follow-up*

Postoperatively, dogs received IM injections of Cefotax (Cefotaxime 50 mg/kg bw twice daily, EIPICO, Egypt) for 5 days and Ketoprofen (Ketofan, at 1 mg/kg BW, Amriya Pharm Ind., Egypt) for 4 days, and oral doses of 5 ml Lactulose (lactulose, EIPICO, Egypt) twice daily. The stoma was kept patent for 21 days, during which the pouches were evacuated twice daily. The pouches were changed every 3 days. Flanges were changed every 5 days and non-adherent or fecal soiling was evident between the skin and flange. Before applying a new flange, a peristomal skin dressing was applied using povidone-iodine (betadine antiseptic 1%, Mundipharma, Egypt). Mebo dressing cream (0.25% Beta-sitosterol, Gulf Pharmaceutical Industries, UAE) was applied twice daily on the peristomal skin in dogs with peristomal skin dermatitis.

Three weeks after the operation, colostomy closure was carried out under general anesthesia and aseptic preparation. The colon was separated bluntly from the surrounding skin and the adhered subcutaneous tissue and was closed transversely after trimming off the stoma site's edges. In the SSD group, the bridge and its stitches were removed. The exteriorized colon was washed using a sterile warm saline solution (NaCl 0.9%). Omentalization was carried out over the suture line in the colon (the closed stoma) before the colon was replaced into the abdominal cavity. The abdominal wall musculatures were trimmed and opposed in layers. The circular skin incision was trimmed and a conventional linear closure was carried out.

### *Recording data*

Data were recorded daily throughout the experiment (21 days). It included the occurrence of both peristomal (peristomal dermatitis, skin reaction to the adhesive tape, parastomal hernia, and appliance instability) and stomal (stoma retraction, stomal prolapse, stoma dehiscence, and the integrity of stomal intestinal mucosa) complications. During stoma closure, bridges, granulation tissue, and healing were observed.

Postoperative pain scores were recorded on days 1, 3, 5, 10, 15, and 20 after the operation using the short form of the Glasgow Composite Pain Scale [18]. Stoma care's comfort was recorded and graded according to the stoma therapist's level of satisfaction (1: good; 2: average; and 3: bad).

### *Statistical analysis*

Statistical analysis was carried out using Statistical Package for the Social Sciences (version 23.0, Inc, Chicago, IL). Differences in frequencies of complications between the two tested groups were statistically evaluated using Fisher's exact test to compare the distribution of the

identified difficulty between the two groups. A non-parametric Mann–Whitney U test was used to compare pain scores and stoma care comfort grades between the two groups at different time points on days 1, 3, 5, 10, 15, and 20 post-surgery). The differences were defined as significant for all analyses when $p$ was < 0.05.

## Results

All animals in this experiment succumbed to operation without mortalities. Seven dogs (Con group: $n$ = 1 and SSD group: $n$ = 6) had normal colostomies (Fig. 3B). Skin reaction to the adhesive and bridge–tunnel infection was not recorded in this study. Appliance instability and mucosal erosion were observed early in all the experimented animals in the first 4–6 postoperative days. The observed complications were categorized into peristomal and stomal complications (Table 1). Seven peristomal complications ($p$ = 0.012) and 10 stomal complications ($p$ = 0.001) were significantly observed in the Con group rather than one peristomal complication in the SSD group. The observed peristomal complications were skin dermatitis ($n$ = 6) and peristomal hernia ($n$ = 4), while the observed stomal complication was retraction ($n$ = 4), stomal prolapse ($n$ = 4), and wound dehiscence ($n$ = 2).

Concerning the intestinal mucosa, it appeared normal during the study. Minute mucosal erosions around stitches were observed early in all dogs (Fig. 3F) and disappeared once sutures were removed. Peristomal dermatitis was observed in four dogs during the study. It appeared as episodes of minor peristomal red skin rashes (Con = 3 and SSD = 1), which progressed to skin excoriation in two dogs with Con stoma. Treatment included a frequent change of the flange every 2 days and additional dressing with antibiotic ointment.

Four dogs in the Con group showed bulging in the peristomal skin area on the second and third day after the operation. Ultrasonography examination of the bulged part showed reducible loops of the small intestine that passed through the abdominal wall around the stoma into the subcutaneous spaces. These herniated loops did not affect the stoma's function, but stoma prolapse was observed in these dogs (Fig. 3C). Additional stitches in the skin were used to narrow the stoma to prevent further prolapse of the intestine.

Stoma retraction was observed in four dogs in the Con group (three after correction of stomal prolapse) within the second week post-surgery which was associated with poor appliance fit and spoilage. Additional fixating stitches, along with the exteriorization of a segment from the dorsal limb of the colon, were enough for stoma traction in two dogs (Fig. 3D). Meanwhile, in the other two dogs, stoma dehiscence was observed. The skin edges refreshment, wound debridement, and stoma resuturing were carried out. Dehiscence was refractory for healing by the first intention. In the third postoperative week, stoma retraction was not observed after the abdominal wall defect infiltrated with abundant granulation tissue (Fig. 3E). No stoma prolapse, retraction, or dehiscence was observed in dogs of the SSD group.

Results showed that pain intensity (Table 2) was significant ($p$ = 0.002) on the first and third postoperative days.

**Table 1.** Peristomal and stomal complications in dogs ($n$ = 12) undergoing temporary loop colostomy.

| Complication | Groups | | *p*-valueFisher's exact test |
|---|---|---|---|
| | Con ($n$ = 6) | SSD ($n$ = 6) | |
| Peristoma | 7 | 1 | 0.012* |
| Skin rashes | 3 (50%) | 1 (16.67%) | 0.540 NS |
| Skin excoriation | 2 (33.3%) | 0 | 0.438 NS |
| Hernia | 4 (66.67%) | 0 | 0.06NS |
| Stomal | 10 | | 0.001* |
| Stoma retraction | 4 (66.67%) | 0 | 0.06 NS |
| Stoma prolapse | 4 (66.67%) | 0 | 0.06 NS |
| Stoma dehiscence | 2 (33.3%) | 0 | 0.43 NS |

Con = conventional stoma; SSD = subcutaneous silicone drain-supporting stoma.
*Significant differences at $p$ < 0.05.
NSnon-significant differences.

**Table 2.** Postoperative pain score and grades of the comfort of stoma care (median (minimum–maximum)) in dogs ($n$ = 12) undergoing temporary loop colostomy.

| Postoperative day | Pain scores | | | Grade of the comfort of stoma care | | |
|---|---|---|---|---|---|---|
| | Con | SSD | *p*-value | Con | SSD | *p*-value |
| 1 | 5 (5–5) | 1.5 (1–3) | 0.002* | 3 (2–3) | 2 (2–3) | 0.57 NS |
| 3 | 4 (3–4) | 1 (1–2) | 0.002* | 3 (2–3) | 2 (1–2) | 0.06 NS |
| 5 | 4 (0–6) | 0 (0–1) | 0.04 * | 3 (2–3) | 1 (1–2) | 0.015 * |
| 10 | 2.5 (0–6) | 0 (0–0) | 0.182 NS | 3 (1–3) | 1 (1–1) | 0.015 * |
| 15 | 1.5 (0–5) | 0 (0–0) | 0.182 NS | 3 (1–3) | 1 (1–1) | 0.015 * |
| 20 | 1 (0–3) | 0 (0–0) | 0.182 NS | 2.5 (1–3) | 1 (1–1) | 0.015 * |

Con = conventional stoma; SSD = subcutaneous silicone drain-supporting stoma.
*Using Mann–Whitney Median (Fisher's Exact Sig.). $p$ < 0.05 was significant.
NSnon-significant differences.

Meanwhile, group-wise comparisons indicated that pain was significantly lower ($p$ = 0.004) in the SSD group. No pain reaction was observed during the manipulation of the intestine itself.

From the viewpoint of the stoma therapist, comfort and ease of stoma care (Table 2) were non-significant and considered as bad and was the most annoying complication (grade 3) on the first ($p$ = 0.57) and third ($p$ = 0.06) postoperative days between the two groups with the presence of local dressing medications. Since the SSD group showed less significant complications, stoma care was significantly ($p$ = 0.015) better (grade 1) than in dogs in the Con group, which was complicated with skin dermatitis, stomal prolapse, and stomal retraction, with local antibiotics medications. Adhesive tapes and a tight T-shirt were enough for appliance stability in dogs with normal colostomy without complications ($n$ = 7).

During stoma closure, the bridges appeared stable in the SSD group, with no tissue reaction or bridge–tunnel infection. Granulation tissue and adhesion were observed more frequently in the dog showing wound dehiscence. Skin healing was excellent in all dogs, with no infection.

## Discussion

Loop colostomy has been rarely recommended as a model of intestinal surgical interference in dogs, presumably because of doubts of frequent home management of fecal collection devices. Indeed, some authors strongly recommended temporarily bypassing the caudal intestinal tract, especially with a pre-existing septic abdomen or with pre/intraoperative hypotension, hypoalbuminemia, intestinal foreign body, and trauma [19,20]. Generally, dehiscence of full-thickness intestinal incisions was reported to be between 12 and 16% or even more in dogs [21,22].

Regardless of the tissue type, the incisions' healing process starts with tissues breaking down and strength loss before becoming more robust. In the initial stage of healing, when the inflammatory phase prevails and there is a tremendous loss of structural integrity, the healing process depends on the sutures and their capacity to engage the remaining tissue [23]. The early reduction in tissue strength rears, while the repair phase starts and fibroblasts and smooth muscle cells start to produce new collagen, with subsequent characteristic quick healing of healthy small intestine by the second week of surgery with a healing rate 75% [24]. Therefore, the animals were evaluated for 21 days as a temporary loop colostomy model.

Although plastic rods have been used for many years to mechanically support the stoma by preventing the intestinal loop from dropping back into the abdominal cavity [9], the use of supporting bridges is still questioned [13,14]. Consequently, due to surgeons' dissatisfaction with the rigid bridge, many alternative methods are recommended [11,12,25]. Therefore, softer materials that effectively support and prevent loop withdrawal into the wound that can guarantee correct and effective emptying of intestinal contents into the stoma appliance are recommended.

Although there is substantial progress in surgical techniques and enterostomal therapy, there is an extreme complication after stoma creation. The stoma-specific complications vary widely, with a 10%–70% rate, depending on the study's procedures, the duration of follow-up, and the definition of such complications [26]. In the current study, stoma-related difficulties were 71.4% and appeared only in dogs with non-supporting stomas.

Peristomal dermatitis is an inevitable complication among human patients with a stoma [27]. Despite the use of appropriate location, nipple-like protruded stoma, and downsizing and careful fitting of the appliance, [28] to minimize skin exposure, peristomal skin dermatitis was observed in dogs of the two groups. This could be explained that the abdomen after surgery becomes less distended and all stomas become less edematous, allowing contact between the peristomal skin and the noxious and irritating bowel content [29].

In the present study, rashes and excoriation were observed. Meanwhile, a severe degree of skin irritation was not observed in both groups. This could be attributed to the firmer and the less bile content of the colostomy output; therefore, less irritating and less contact with the skin [30].

In contrast to the results obtained by Arumugam et al. [31] parastomal hernia in most human series is the most recorded late complication. It occurs mainly due to the increased intra-abdominal pressure as straining. In this study, early parastomal hernia was observed in four cases with a conventional stoma. This could be attributed to the wide abdominal wall defects and the absence of the supporting bridge. Husain and Cataldo [29] recommended a proper surgical technique for hernia avoidance by creating a well-vascularized, tension-free, and untraumatized anastomosis between the skin and the intestines.

Although stoma prolapse in human issues is considered one of the most common late complications with an incidence of 2%–26% [32,33], in the present study, stoma prolapse was seen early in dogs with a conventional stoma and parastomal hernia. Husain and Cataldo [29] mentioned that prolapse could be seen with any stoma type under any condition. The prolapsed mucosa caused no pain and was reduced manually with little effort.

Although different techniques and materials have been proposed to prevent stoma retraction back into the abdominal cavity, the most recorded human stoma complication was retraction [34,35]. Fransson [36] did not use a supporting bridge, but depended on suturing the

seromuscular layer of the end of the exteriorized loop to the subcutaneous tissue to prevent retraction. In our study, 91.67% of all dogs showed no stoma retraction. This could be attributed to the presence of both the supporting bridge and the modified fixating stitches in the SSD group. On the contrary, in the Con group, the suture pattern was significant enough to prevent the stoma's retraction except in one dog, where retraction of the intestinal loop into the wound was observed. This happened due to the failure of stoma fixation stitches.

The fixation of the appliance to the skin was an early problem in the current study because all adhesives and sticks designed for human skin displayed low adhesive properties to the canine skin [15]. In addition to the adhesion problem, the dressing cream used for managing peristomal dermatitis exacerbated the problem of appliance pooling off and necessitated frequent appliance change day after day. Boyles and Hunt [37] warned that too frequently changing the flange may lead to excessive wear and tear of the peristomal skin. The adhesion problem was solved in the current study by frequent shaving of the skin, alcohol application, adhesive tape, and a tight T-shirt.

In the present study, no pain reaction was observed during stoma manipulation, which could be due to the absence of nerve endings in the stoma [20,38]. Meanwhile, animals in the Con group exhibited pain scores significantly higher than those in the SSD group because of the more frequencies of complication.

Concerning the stoma reversal, the stoma fixing method and peristomal adhesions are the reversal technique's cornerstones. As mentioned earlier, Fransson [36] relied upon suturing of the exteriorized colon to the subcutaneous tissue where the secondary adhesions make the subsequent stoma reversal technically more difficult. Conversely, during stoma reversal, adhesions and granulations were scant in all dogs except in the dog that showed stoma retraction, followed by dehiscence. The colon was fixed to the skin only at stoma by the modified, interrupted seromuscular vertical stitches.

Because of the omentum's protective role in healing the intestinal wall by forming fibrinous adhesions to the surgical incision and subsequent prevention of leakage of bowel content into the abdominal cavity [39], omentalization was operated immediately after intestinal wall closure, as advised by some authors, as this positively influences intestinal healing by providing blood supply and lymphatic drainage [40].

## Conclusion

It is concluded that appropriate stoma location, using a soft supporting bridge, stoma fixation using modified, interrupted seromuscular vertical mattress sutures, proper appliance fixation by adhesive tapes, and a tight T-shirt can overcome the complications of short-term loop colostomy in dogs and may introduce a satisfaction for home management.


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## Conflict of interest

The authors declare that they have no conflict of interest.

## Authors' contribution

All authors contributed equally to designing, experimentation, analysis, manuscript preparation, and finalization. All the authors gave their final approval for publication of the article.

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