Original Article

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Telescoping Colonic Anastomosis in Dogs: Gross and Microscopic Configurations

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Abstract

Introduction: Colorectal anastomotic leakage remains one of the most feared post-operative complications. The telescoping technique has been used but never widely acclaimed. The aim was to study both the external and internal features as well as the microscopic configuration of the invaginating colocolic anastomosis.

Materials and Methods: After the scheduled three-week post-operative period, animals were reopened for a second-look laparotomy to detect: an external appearance of the anastomosis, internal appearance of the anastomosis and histopathological study.

Results: Good and fair ratings were seen for external and internal appearance of the anastomosis, while no poor ratings were detected in our experiments. Microscopic study revealed a good healing process of the anastomotic lines.

Conclusion: Our data showed that the telescopic anastomosis is a secure, easy to be constructed, fast and cheap procedure for colonic anastomoses.

Key words: *Telescoping anastomosis, dogs, configurations, gross, microscopic*

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Introduction

Colorectal anastomotic leakage remains one of the most feared post-operative complications, and a long-term functional outcome might be adversely affected by this anastomotic leakage [1]. The safety of an intestinal anastomosis is usually measured by its complication rate, especially the incidence of anastomotic leakage [2]. Therefore, a wide variety of methods have been described to reestablish intestinal continuity, including single-layer continuous or two-layer interrupted anastomosis [1,2]. The telescoping or invagi-

nating technique has been used but never widely acclaimed. Gastrointestinal anastomoses by invagination were performed to restore gastroduodenal, ileocolic or colocolic continuity [3,4]. Experimental studies stated that the technique of anastomosis by means of invagination proved to be a most effective method of joining two parts of the colon, and both histology and the electronic microscope verified the exact conjunction of the different layers [5]. The aim of this paper was to study both the external and internal features as well as the microscopic configuration of the telescoping colocolic anastomosis in dogs.

Materials and Methods

Animals

70 mongrel dogs weighing 10 to 15 Kg were obtained from the animal house of the faculty of veterinary medicine, Suez-Canal University, Egypt, and were housed and fed a standard laboratory diet and water up to 2 pm. Animals were fasted, except for water, for 12 hours before the surgical intervention. Neither mechanical bowel preparation nor intraoperative bowel irrigation were performed. All the experiments were done in the surgical department, faculty of veterinary medicine, Suez-Canal University, Egypt. The local ethics committee for the use of laboratory animals approved all experimental procedures. Appropriate animal care and use were performed according to implementation and compliance with the Animal Welfare Act.

Surgical Procedure

The animals were premedicated preoperatively by intramuscular administration of chlorpromazine hydrochloride 1 mg/kg body weight 20-30 minutes prior to surgery. Induction of anesthesia was achieved by IV administration of sodium thiopental (Thiopental sodium, EPICIO, Egypt) 2.5 % solution 20-30 mg/kg [6] via a 20 gauge intravenous cannula. Anesthesia was maintained during the operation by further small doses of thiopental sodium.

The skin of the abdomen was shaved, and antisepsis was performed using povidone-iodine. A midline incision of approximately 5 cm was made below the umbilicus to the symphysis pubis. After reaching the abdominal cavity, the left colon was exposed and the colorectal junction was identified (Figure 1). Division

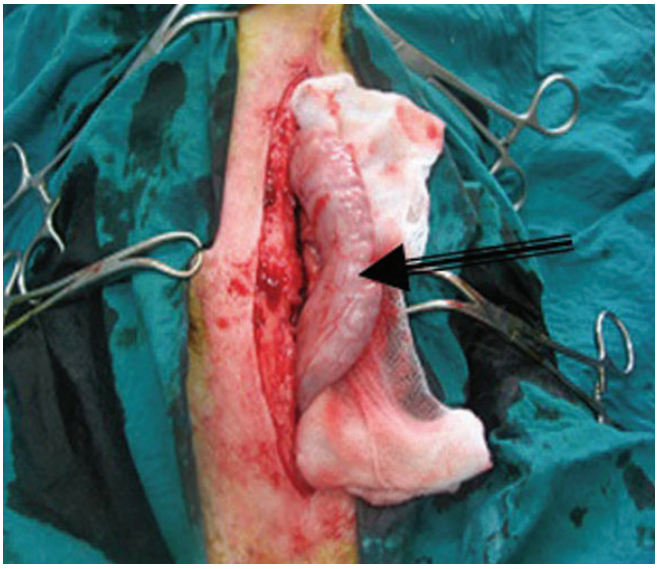

Figure 1: Exposure of the left colon and identification of the colorectal junction.

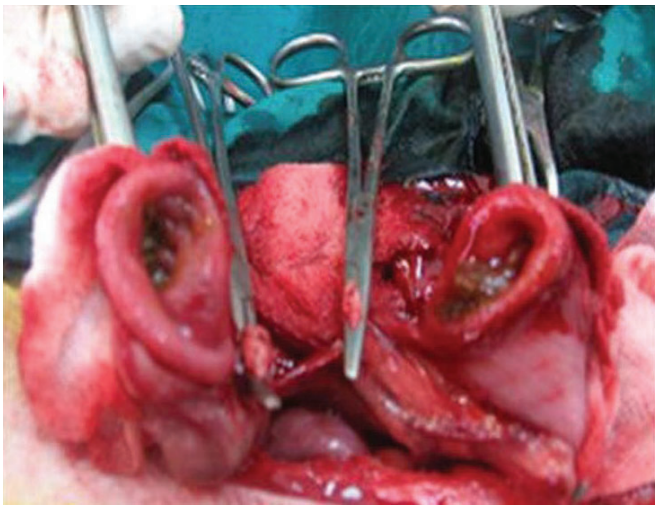

Figure 2: The two ends of the divided sigmoid colon between two non-crushing intestinal clamps.

of the sigmoid colon was done between two non-crushing intestinal clamps (Figure 2), and bowel continuity was restored using our technique. Four invaginating sutures were performed as through and through sutures starting from 10 mm from the edge of the distal segment, then from the submucosa-serosa of the proximal segment. The needle was then introduced again about a half cm apart into the serosa-submucosa of the proximal segment to the through and through of the distal segment. Another suture was applied to the opposite end of the colonic segments. By turning the position of the intestinal clamps, the posterior aspect of the colonic segments was put into view, and the same two sutures were repeated, creating the four sutures. By tying these sutures, invagination of the proximal segment into the

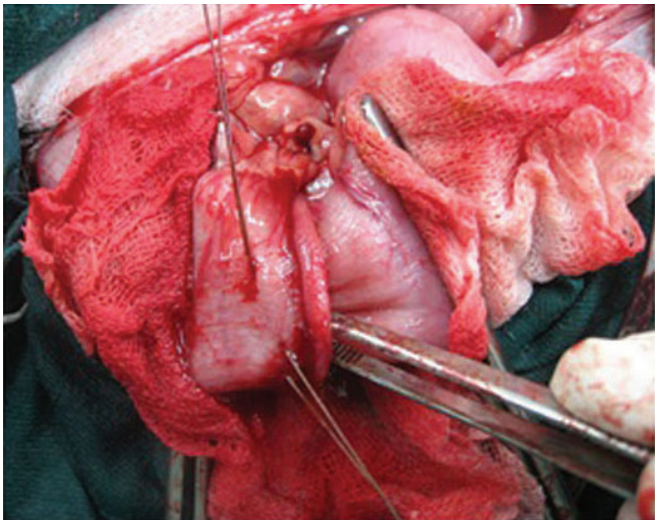

Figure 3: The start of invaginating the proximal segment into the distal one.

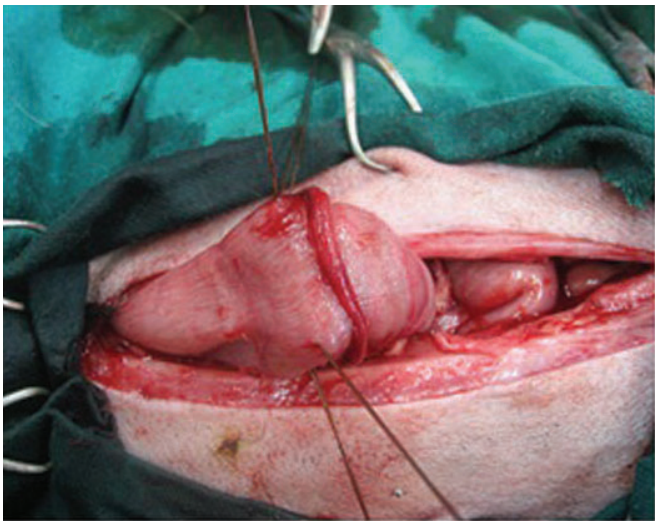

Figure 4: The rim of the distal segment just being sutured to the serosa of the proximal one, aiming to complete the invagination.

Figure 5: The interior aspect of the anastomotic areas with no mucosal ulcers and with good mucosal creeping. The invaginated segment was completely disappeared under cover of the mucosal creeping.

distal one was invited (Figure 3). Between these four sutures, the rim of the distal segment was sutured to the serosa of the proximal one (Figure 4) [7].

Post-operative Period

All dogs were observed in the postoperative period and data were collected day by day. Postoperative antibiotics [Ceftriaxone, Sandoz Egypt] were given intramuscularly as 25 mg / Kg / 24 hours, and the intravenous Ringer's acetate solution was administered in a dose of 40-60 ml/ kg / day [8] for two days; free access to plain water was then allowed. Dogs received subcutaneous injections of tramadol (2 mg/kg) just after recovery and another dose in the evening [9]. After the scheduled three- week post-operative period [7], all survived animals were reopened for a second-look laparotomy to detect the following parameters:

1- External appearance of the anastomosis

2- Internal appearance of the anastomosis

3- Histopathological study

External appearance of the anastomosis

The authors advocated a descriptive scaling system for evaluating the external anastomotic configuration. On gross examination, anastomotic lines were rated as good if there were no evidence of leakage or stenosis. A fair rating was assigned if there was stenosis only but not a leak, and a rating of poor was reserved for any evidence of leakage with or without stenosis [4]. Stenosis or stricture was considered where the proximal segment of the anastomosis was twice larger than that of the distal segment [5].

The interior aspect of the anastomotic areas was checked for:

a- A mucosal ulcer was considered if there was any mucosal loss near the suture line. Animals were classified accordingly as having good mucosal creeping, fair mucosal covering or ulcer formation.

b- Perianastomotic ischaemia or necrosis. Animals were classified as having or not having areas of ischaemia or necrosis at the perianastomotic lines.

c- Fate of the invaginated segment. Animals were classified as having their invaginated segment disappeared or still present (Figure 5).

A good rating was considered with good mucosal creeping, no ischaemia or necrosis and disappearance of the invaginated segment. A fair rating was consid-

ered with fair mucosal creeping, few ischaemia or necrosis and disappearance of the invaginated segment. A poor rating was considered in ulcer formation, massive ischaemia or necrosis or persistence of the invaginated segment.

We relied on the already documented system of histological grading for the healing process proposed by Saber [1].

1- Mucosal healing: 1- no epithelialization, 2- attempt at epithelialization, and 3- glandular formation (Figure 6).

2- Inflammatory cell exudate: 1- heavy infiltration, 2- moderate infiltration, and 3- mild infiltration.

3- Fibroblastic activity: 1- mild fibroblastic infiltration, 2- moderate infiltration, and 3- heavy infiltration (Figure 7).

4- Neo-capillary formation: 1- mild infiltration, 2- moderate infiltration, and 3- heavy infiltration (Figure 8).

Figure 6: The mucosal epithelium (A) with regenerative activity filling the gap (B) between the two cut ends of muscularis mucosa (Magnification: 100x).

Results

External appearance of the anastomosis

External appearance of the anastomosis was measured after the scheduled 3-week postoperative period; the majority of animals (52 / 70) were rated good (74.2%) and a fair rating was seen in 18/70 dogs (25.8 %), while no poor rating was detected in our experiments (Table 1).

Postoperative peritoneal findings

During the second-look laparotomy, no fecal peritonitis was found in the survived animals' periansotomotic abscesses.

Internal appearance of the anastomosis

Gross examination of the interior aspect of the anastomotic areas revealed that there were no mucosal

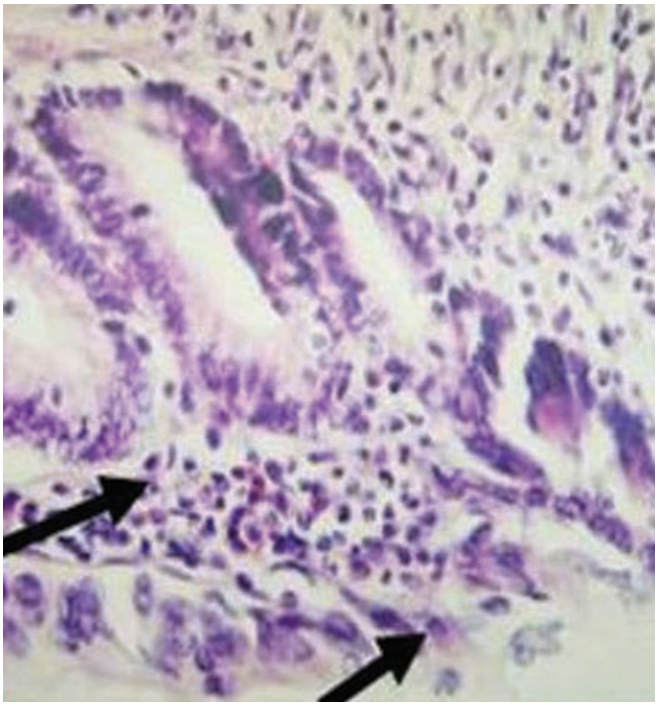

Figure 7: The fibroblastic activity pointed by the arrows with good regenerative power filling the gap between the two cut ends of muscularis mucosa (Magnification: 100x).

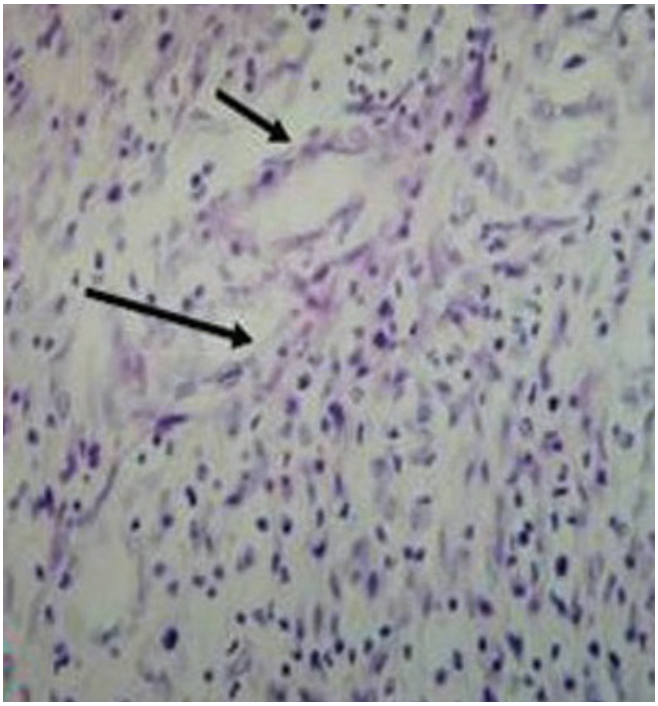

Figure 8: The neo-capillary formation with good vascularity and moderate infiltration, as denoted by the arrows (Magnification: 200x).

Table 1: Rating of the external appearance of the anastomosis.

Rating	Number	%
Mucosa:		
Good creeping	52	74.2
Fair creeping	18	25.8
Ulcer formation	0	0
Perianastomosis:		
No ischaemia or necrosis	70	100
Scattered ischaemia or necrosis	0	0
Massive ischaemia or necrosis	0	0
Invaginated part:		
Disappear	70	100
Present	0	0

ulcers in animals with good mucosal creeping, 15 dogs with fair mucosal covering and 12 dogs with scattered mucosal ulcers. Regarding the perianastomotic ischaemia or necrosis, there was no ischaemia or necrosis in animals. The invaginated segments were completely disappeared under cover of the mucosal creeping.

Scoring of the internal appearance of the anastomosis:

Histopathological study

Our independent histopathologist reported the following:

The histopathological score in group A :

a- Mucosal healing: there was good effacing between the two cut edges of the mucosal epithelium with good regenerative activity.

b- Fibroblastic activity: showed good regenerative power, filling the gap between the two cut ends of muscularis mucosa.

c- Inflammatory cell exudate showed focal aggregation of lymphocytes observed around the stitch.

d- Neo-capillary formation: there was good vascularity and two points were given for this moderate infiltration.

Discussion

The present study was undertaken to investigate the telescoping colonic anastomosis in dogs, regarding both the external and internal features as well as the microscopic configuration where neither mechanical bowel preparation nor intraoperative bowel irrigation were performed. Only few papers were found from 1957 to 2006 describing the telescoping colonic anastomosis technique [3-5,10]. At first, the length of the proximal invaginated segment was 40-50 mm [11], then as short as 10 mm in the present study and in a paper of the same interest [12]. In the present study, we used four invaginating sutures to securely fix the proximal end to the distal, a maneuver lacking in these previous works.

There are two major complications of intestinal anastomosis: leakage and stenosis. Anastomotic leakage is the most severe and common complication, and is associated with the highest mortality rate [13]. Clinical and radiological anastomotic leakage occurs in 1–30 % of cases, depending on the height of anastomosis, the type of operation, and the experience of the surgeon [13,14].

Saber [7] had recently demonstrated that the telescoping and invaginating anastomosis provided a more resistant suture line than the end-to-end single-layer technique during the early postoperative phase of intestinal wound healing, and the anastomotic leakage did not occur in his experiments. Our data came in concordance with these studies, as our animals experienced no leakage. The explanation of the absence of leakage in the present study is the proximal segment being invaginated into the distal, creating a self-intraluminal drainage, thus avoiding intraperitoneal access.

In an attempt to create strong anastomoses, a number of external anastomosis reinforcements have been tested, including peritoneal graft, omental graft, dura mater, and meshes [15]. Omentum is the tissue most often used for anastomosis reinforcement. Several studies suggested that omental reinforcement prevents anastomosis leakage [16], whereas others found that this approach caused an increased risk of infection associated with pedicular necrosis or late intestinal obstruction [15]. Both human dura mater and free peritoneal graft reinforcement showed reduced anastomosis healing that could be attributed to avascularity of grafts, to aggravated adhesions between anastomosis and intra-abdominal organs, and which consequently led to decreased anastomosis healing [17]. Non-absorbable meshes reinforce anastomoses permanently; however, they may increase the risk of peritoneal adhesion, anastomotic stenosis, and colon perforation, in the long term [15]. However, in the present study, after the scheduled three-week post-operative period, all ani-

mals showed patent healthy anastomoses with varying ratings of good and fair qualities where no perforation, dehiscence or stricture were seen, thus reflecting the fact that the telescoping and the invaginating segment, whatever its length, provides more protection for the suture line [3,4,6,7].

Benign anastomotic strictures frequently complicate colonic resections and occur in 3-30% of post-colorectal anastomosis according to varied definitions [15,18]. This anastomotic stricture is considered to be related to factors, such as ischemia or leakage, and suture techniques [19]. Our study documented that the interior aspect of the anastomotic areas revealed no mucosal ulcer, perianastomotic ischaemia or necrosis, together with an absence of leakage in animals with invaginating anastomosis in agreement with other reports [3,4,6,7]. This reflected the low incidence of anastomotic stenosis in our animals and gave the good and fair rating of external examination of anastomoses.

When the mucosal layer is included in surgical sutures, a certain degree of ischemic necrosis always develops, which delays the intestinal healing, prolongs inflammation and produces excessive cellular proliferation [20]. In concordance with these findings, our study stated that good regenerative activity of mucosal healing and good effacing between the two cut edges of the mucosal epithelium. Fibroblast activity occurs mainly during the third phase of the healing process. Fibroblasts migrate to the anastomotic site from surrounding tissues and start the collagen production (7,20). As a good parameter of healing, the fibroblastic activity showed good regenerative power, filling the gap between the two cut ends of muscularis mucosa. Neoangiogenesis is an important element of the healing process [7] and the healing power is directly proportional to the heaviness of neoangiogenesis [1,7].

Conclusion

The telescopic anastomosis is a secure, easy to be constructed, fast and cheap procedure for colonic anastomoses. The gross pictures of the exterior and interior aspects of telescopic anastomotic lines showed good ratings of anastomotic configuration. Also, the healing process was approved by the histological study.

Conflict of Interest statement

The authors have no conflicts of interest to declare.

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