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# Comparison of laparoscopic and conventional surgery of intestinal anastomosis in dogs

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**Abstract**

The aim of this study was to evaluate operative laparoscopy in comparison with conventional laparotomy for intestinal resection and anastomosis in dogs. Eighteen adult dogs were equally and randomly divided into 3 groups: Group I: Intestinal anastomosis was performed extracorporeally, by laparoscopic-assisted surgery, in which a 5cm loop of small bowel was exteriorized through a mini-laparotomy opening (an enlarged trocar incision 1.5-2 cm in length), then surgically resected and anastomosed by simple interrupted suture 3-0 polygalactine. Group II: Underwent laparoscopic intracorporeal intestinal resection and anastomosis, in which the loop of the small bowel was suspended into the ventral abdominal wall, then it was resected and anastomsed with simple continuous suture by polygalactine 3-0. Group III: Small bowel resection and anastomosis was conducted by conventional laparotomy technique with simple interrupted pattern by polygalactine 3-0 suture. The result showed that laparoscopic intestinal resection and anastomosis by either intra- or extracorporeal techniques can be applied in dogs safely and have less morbidity rate. Intra abdominal adhesion of the omentum and even the bowel to the abdominal wall occurred in group III but not in groups I and II. The post operative hospitalization time was earlier in group I and II, as indicated by the earlier return of intestinal motility and appetite, in comparison to group III where it was delayed.

***Keywords:*** Anastamosis; Intestine; Canine; Laparotomy.

# مقارنة الجراحة المنظارية والتقليدية لتفمم الأمعاء في الكلاب

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فرع الجراحة والتوليد، كلية الطب البيطري، جامعة الموصل، الموصل، العراق

**الخلاصة**

كان الهدف من الدراسة تقييم فائدة جراحة البطن المنظارية بالمقارنة مع الجراحة التقليدية لقطع وتفميم الأمعاء في الكلاب. تم استخدام ١٨ كلبا تم تقسيمهم عشوائيا بالتساوي إلى ثلاث مجاميع: المجموعة الأولى: بمساعدة جراحة البطن المنظارية تم قطع وتفميم الأمعاء خارج تجويف البطن، بسحب جزء من الصائم خارج تجويف البطن من خلال الفتحة المستخدمة لإدخال المبزل والواقعة خلف الصرة بعد توسيعها قليلا (١,٥ – ٢ سم). بعدها تم قطع ٥ سم من الصائم وتفميمها باستعمال الخياطة المتقطعة البسيطة باستعمال خيط البوليكالكتين حجم صفر–٣. المجموعة الثانية: بواسطة جراحة البطن المنظارية، تم قطع ٥ سم من الصائم وتفميمها داخل التجويف ألبطني. بعدها علق جزء الأمعاء المراد أزالته بالجدار الداخلي للبطن، وتفميمها بالخياطة المستمرة البسيطة باستعمال خيط البوليكالكتين حجم صفر–٣. المجموعة الثالثة: تم فتح البطن بطريقة الجراحة التقليدية لقطع وتفميم الصائم. وخيطت بطريقة المتقطع البسيط بخيط البوليكالكتين حجم صفر–٣. أثبتت النتائج بأن تقنية جراحة البطن المنظارية لقطع وتفميم الأمعاء و كلتا الطريقتين (خارج أو داخل تجويف البطن) في المجموعتين الأولى والثانية، كانت أمنة ولم ينجم عنها مضاعفات خطيرة أو مميتة وعليه ننصح بتطبيقها في الكلاب. في حين تم تسجيل ألتصاقات الثرب والأمعاء مع جدار البطن في المجموعة الثالثة والتي كانت محدودة الحدوث في المجموعتين الأولى والثانية. و تم استعادة الشهية وحركة الأمعاء سريعا في المجموعتين الأولى والثانية بالمقارنة مع المجموعة الثالثة.

## Introduction

The advent of minimally invasive surgical techniques has allowed for resection of small bowel pathology without the need for a major laparotomy (1). Laparoscopy and thoracoscopy have tremendous clinical indications for diagnosis of organ disease and masses, and for cancer diagnosis and staging (2).

Indications for laparoscopic resection of small bowel are the same as those for open procedure and include benign and malignant neoplasm, strictures, or inflamed area from radiation or inflammatory bowel disease (IBD), Meckel's diverticulum, and bleeding arteriovenous malformations. Intestinal operations can be performed by constructing the anastomosis inside the peritoneal cavity (Intracorporeal anastomosis) or by bringing the loop to the outside through a small incision (Extracorporeal anastomosis).

The technique used depends on the nature and location of the lesions (3). Since the late 1980's, when laparoscopic cholecystectomy was first reported (4 and 5), the indications for laparoscopic surgery have been extended to include various abdominal operations because of the improvement of laparoscopic surgical techniques. Laparoscopic surgery for colorectal diseases have been performed widely (6 and 7), and several authors reported that it has advantages over open surgery in terms of less postoperative pain, a shorter hospital stay, and greater cost effectiveness (8 and 9). Numerous investigators have studied intestinal anastomotic healing and the varying sutured and stapled anastomosis parameters of intestinal healing compared in these studies include anastomotic strength, collagen content blood flow and leak rate. No clear consensus has been reached regarding which method is best (10). Reports on laparoscopic surgery to treat IBD in veterinary medicine are rare.

The aim of this work was to evaluate laparoscopic intestinal surgery in comparison with conventional laparotomy for performance of intestinal resection and anasto-mosis by either conventional laparotomy, or laparoscopic, and laparoscopic assisted surgical techniques on experimental dogs.

## Material and Methods

Animals: Eighteen adult local breed dogs, weighting 15-25 kg, from both sexes, aged from 1.5-3 years were used in the study. The animals were housed in the Animal House of College of Veterinary Medicine, under veterinary supervision and at similar management and feeding conditions throughout the experiment. All were healthy and free from congenital or acquired diseases as represented by their physical and clinical examination. Pre-operative preparation and anesthesia: Each animal underwent surgery was fastened from food for 24 hours, but water was in free access until administration of atropine premedication (0.04 mg/kg, i.m). Anesthesia induced intramuscularly, by a mixture of xylazine (5 mg/kg) and ketamine (15 mg/kg), and maintained by i.m. administration of increment doses from the same mixture.

Preparation of the operation site and animal position: The ventral abdominal wall was prepared for aseptic operation from xiphoid to pubis and bilaterally as far as the flank and placed on dorsal recumbency position on the surgical table.

Experimental design: The animals were divided randomly into three groups, each containing six animals:

Group One: Laparoscopic Assisted Intestinal Resection and Anastomosis (Extra Corporeal Suturing): In this group anastomosis was made by laparoscopic-assisted technique which was done as follows: One cm incision was made at the skin of the umbilical region by the aid of scalpel. The abdominal wall elevated by 2 towel clamps on both ends of the incision for creating a space between the body wall and the intra abdominal contents, then the veress needle was introduced into the abdominal cavity. Pneumoperitoneum was established by connecting the insufflator tube to the veress needle. The intra abdominal pressure was fixed at 12 mmHg at a rate of 8 l/minute. After establishing the pneumoperitoneum, the first trocar- cannula size 10 mm was inserted into the abdominal cavity through the same incision. The site of the incision was fixed and elevated by two towel clamps in order not to injure the abdominal organs during insertion of the trocar–cannula which was inserted by twisting and rotating motion. Then after, the trocar was removed and the telescope was inserted and the insufflator's tube was re-connected to the cannula for maintaining intra abdominal pressure. The abdominal viscera immediately examined by the telescope for the presence of trauma and bleeding which might be induced by the trocar–cannula during insertion. The viscera was examined and explored for any defects and diseased condition. A second trocar-cannula (10 mm) was inserted at the infra umbilical midline region, from 6-8 cm caudal to the first cannula site under direct vision of the laparoscope. The Babcock grasping forceps then introduced into the abdominal cavity through the second cannula, and the small intestine was explored and examined by elevating the omentum and the colon, and a loop of jejunum was grasped by the aid of double spoon grasper and lifted near to the tip of the cannula. The pneumoperitoneum was deflated by ceasing the flow of Co2 gas and allowing the intra-abdominal gas to escape through the tape of the cannula. Externally, the skin and underlying muscles, adjacent to the

second cannula, was incised cranially and caudally to about 1.5–2 cm (Figure 1) to exteriorize the grasped jejunal loop through it out side the abdominal cavity. The mesenteric vessels were double legated and the intestinal loop milked back and clamped by intestinal clamps. A piece of 5 cm jejunal loop and their mesenteric fold were resected and removed. The two ends of the resected intestine were approximated and sutured by simple interrupted sutures (Figure 2), using polygalactin size 3-0, and the mesentery by simple continuous suturing. The jejunal loop was washed with normal saline and gently returned into the abdominal cavity through the abdominal incision, and the abdominal wall incision was closed routinely. Pneumoperitoneum was re-established, and laparoscopic examination was created to ensure the return of jejunal loop into the abdominal cavity and not interrupted extra-peritoneally or strangulated.

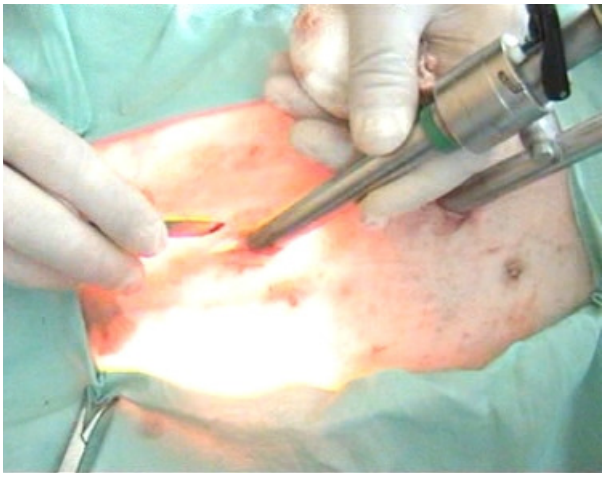

Figure 1: Enlargement of trocar site to exteriorize the grasped jejunal loop through it.

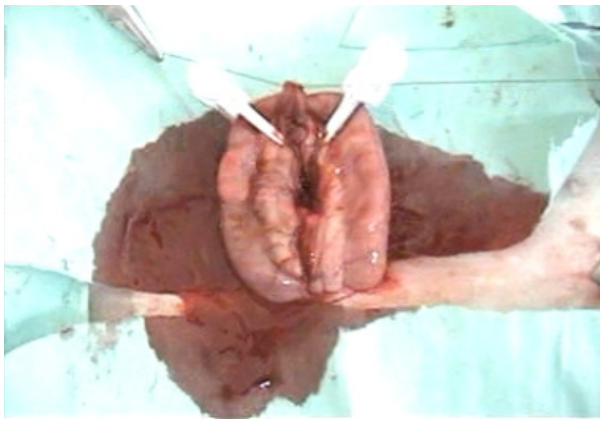

Figure 2: Extracorporeal suturing of the two ends of the resected intestine by simple interrupted sutures using polygalactin size 3-0.

Group Two: Laparoscopic Intestinal Resection and Anastomosis (Intracorporeal Suturing): In this group anastomosis was made by laparoscopic technique (intracorporeal suturing) as follows: The same procedures were used for inserting the veress needle; insufflations and insertion of first trocar–cannula, as mentioned in group one. Two additional trocar–cannula, size 10 mm and 5 mm were introduced from the right lateral abdomen (right lateral paraumblical region). They were used for inserting the laparoscopic instruments like Babcock grasper, scissor, needle holder, and reducers (Figure 3). Through the second cannula, Babcock grasper was introduced which was used for lifting the greater omentum and the colon, and for holding of the jejunal loop and its mesentery, which was tracked to face the viewing telescope. A series of 4-6 silk sutures (No. 0) were passed through the abdominal wall into the peritoneal cavity. The surgical needle was passed into the left quadrant by the assistant and pierced into the peritoneal cavity (Figure 3). Intracorporeally, the needle was passed through the anti-mesenteric border of the jejunum that was grasped by the Babcock forceps and returned back out of the abdomen at the point of insertion and the silk was clamped extracorporeally on the outer surface of the abdomen wall. The other stay sutures were placed by the same method in order to suspend the jejunal loop from within wall of the abdominal cavity in view of the laparoscopic telescope. The mesenteric vessels of the suspended jejunal loop either clamped by titanium clips or legated by polygalactin 3-0. The entrapment plastic sac was introduced into the abdominal cavity through the 10 mm port cannula by the aid of the reducers. A five cm. piece from the suspended loop of the intestine together with their mesenteric fold was resected on either side between the suspending stay sutures. The resected portion which was still suspended on the abdominal wall cavity by the stay sutures was loosened and was grasped by Babcock grasper and dragged into the sac, which was grasped by another grasper. The plastic sac was tightly closed and laid far from the surgical field in the pelvic cavity. The content of the opened ends of the gut was suctioned by the suction probe and their ends were anastomized by simple continuous suture using 3-0 polygalactin, starting from the mesenteric border (Figure 4). During suturing, the suspending sutures were loosened in order to achieve maximum approximation of the two ends. The mesenteric fold was finally sutured by simple continuous mattress. The entrapment plastic sac was partially exteriorized through the 10 mm port, and then opened and the resected piece of intestine was removed by the grasper and finally the whole sac was removed from the same port. Prior to routine closure of the laparoscopic ports, the abdominal cavity was lavaged by sterile isotonic saline by the aids of suction device.

Group Three: Intestinal Resection and Anastomosis by the Conventional Technique: In the third Control group,

enterectomy was performed by conventional laparotomy as follow: A mid line abdominal incision was made through the skin and lina alba (laparotomy) that was sufficient to allow complete exploration of the abdomen and GIT. A loop of jejunum was exteriorized and prepared for resection and anastomosis which was made by the same technique as mentioned in group one. The laparotomy incision was closed by routine manner.

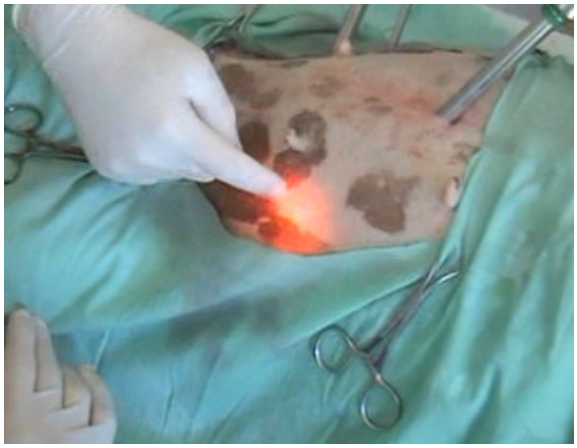

Figure 3: Sites for inserting suspending suture materials.

Post Operative Care: Postoperative care was individualized to each experimental dog. The animal was monitored closely for vomiting during recovery. To minimize illus, early feeding was encouraged. Small amounts of milk were offered to the patient 6 hours after surgery for 8 to 12 hours. When no vomiting occurred, small amounts of low-fat food were offered for the next 12-24 hours. Normal diet was re-introduced gradually beginning at 48 to 72 hours after surgery. Systemic antibiotic, penicilline-streptomycine was injected intra-muscularly, daily for 3 days at a dose rate of 10,000 I.U. /kg body weight and 10 mg/kg body weight, respectively. Wound care was carried routinely by daily cleaning and dressing. The physical health status of the animals was monitored after operation; the appetite for feeding and drinking, defecation, urination and respiration. The stitches were removed after 10 days.

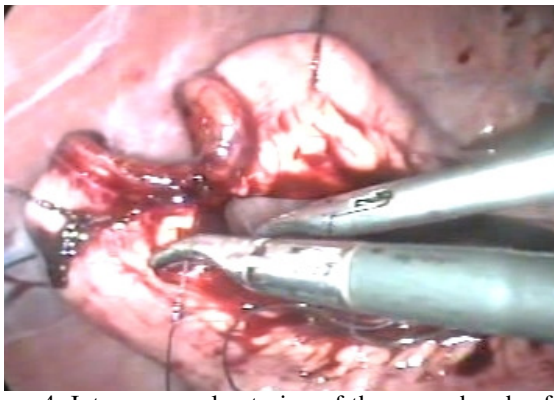

Figure 4: Intracorporeal suturing of the opened ends of the gut by simple interrupted sutures using polygalactin size 3-0.

Laparoscopic Postoperative Checking: One laparo-scopic check for each operated animal was carried out following 1-2 weeks post operation for the following reasons: Peritonitis; Intra-abdominal adhesions of the viscera; Peristaltic movement of the bowel; Presence or absence of leakage, or perforation at the site of anastomosis; presence of strangulation or volvulus; and presence of intra-abdominal abscess.

Biopsy Collection: Under the effect of general anesthesia and conventional laparotomy, biopsies were collected from the experimental animals at 15, 30, and 60 days after anastomosis. The biopsy involved the site of anastomosis for about 15 cm in length. The samples were thoroughly washed with normal saline solution and freshly stored in clean jars containing 100 ml of normal saline for further study. They were studied for; adhesions, leakage, abscess around the anastomotic site, distention and any other gross lesions.

**Results**

The laparoscopic intestinal resection and anastomosis was performed successfully in group 1 and 2. The two different techniques, i.e., the laparoscopic-assisted extracorporeal hand sewn anastomosis and the laparoscopic intracorporeal anastomosis, were without hindering troubles with regards to advanced laparoscopic procedures. The physical condition of the animals was good in both first and second groups, in comparison with the third group. The clinical pictures including the activities of the animals after operations; feeding, drinking, defecation, urination, abdominal pain or tenderness, and alertness were approximately similar in the first and second groups, but they were more marked in the third group, which was characterized by decreased activity and appetite, dullness, depression, restlessness and tenderness of the abdomen. All animals, in group one and two, regained their normal

appetite earlier, i.e., 12 hrs post operation, in comparison to group three and post operative ileus did not occurred in these two groups. While, in the third group the activities and the appetite were reduced and animals occasionally showed signs of pain (mild ileus) after feeding, which was characterized by abnormal posture, restlessness, barking, licking and biting the abdomen especially the site of operation. Other post operative complications like; leakage, wound dehiscence, peritonitis, stenosis, diarrhea, and abscessation, did not observed on the animals in first and second groups. While, in the third group signs of mild inflammation at the site of celiotomy incision (swelling, heat and tenderness) and in one case, post operative opening and evisceration occurred in which a small part of the omentum was eviscerated. Adhesion between the abdominal contents (omentum and intestine) and the abdominal wall did not occur in the first and second groups. While, adhesion between the abdominal contents and the site of celiotomy occurred in the third group, which was characterized by adhesions of the omentum to the ventral abdominal wall and in certain cases even the bowel with the omentum was adhered to the ventral abdominal wall. Adhesion of the omentum to the site of anastomosis occurred in all the three groups in different degrees but it was slightly higher in the third group and in certain cases adhesion between intestinal serosal surfaces occurred.

## Discussion

The laparoscopic procedures for intestinal resection and anastomosis either extracorporeally or intracorporeally produced an absolutely superb outstanding result. The procedures were performed safely in the experimental dogs, the same as they were applied on human in the published literatures (11 and 12). They offered advantages of smaller incision, less pain and quicker recovery over conventional surgery.

In group one, for which bowel resection was performed on the experimental animals by laparoscopic-assisted technique, the mini infra-umbilical trocar port was enlarged for about 1.5–2 cm (mini-laparotomy) through which the bowel was exteriorized for resection and extracorporeal suturing. The site of the infra-umbilical port was comfortable and allowed a successful application of the operations by that technique or converting to laparotomy in required situations. This technique was also applied by (13 and 14), as they used a vertical sub-umbilical incision in human. They described the ease of extended incision if conversion to laparotomy was needed. But, (15) used left upper quadrant port incision for exteriorizing the bowel as they described that the incision was directed near to the area of the disease. In this controversial study, we preferred the sub-umbilical region, because of the comfort reach to the diseased intestine, and easy to convert to conventional laparotomy in certain instances. In addition, adhesion did not occur and the muscle was not included or dissected during the procedure.

In group two, the laparoscopic intracorporeal technique was applied for bowel resection and anastomosis. The important maneuver of this procedure was suspending of the jejunum to the abdominal wall with trans-abdominal suspending sutures. This provided several advantages: fewer port sites were needed because there was no need for assistant to hold the bowel with clamps; the suture suspension fixes the intestinal segment, so that the mesentery dissected easily; the use of sutures to suspend the bowel was less traumatic to the bowel and mesentery when compared to clamping with surgical instruments; the bowel segments were easily manipulated and approximated for anastomosis. A comparable technique was applied by (16); however they used the stapling instead of suturing.

The postoperative condition of the experimental animals was good in the first and second groups in comparison to the third group. The compared clinical features were include; the animals activities, posture, feeding, drinking, defecation, urination, and pain. These clinical parameters were depending on the type of technique that was performed as described to a minimal invasive surgery in which minimal tissue trauma occurred during operation and the post operative complications were minimal. These parameters were considered as the basic advantages of laparoscopic surgery, which include less pain and risk of complications, shorter hospital stay, quicker recovery, much smaller scars and better cosmetic effect. Animal's appetite was returned earlier to normal in the first and second groups (12 hours post operation), in comparison to the 3rd group. This referred to the early return of the gastrointestinal functions in the first and second groups as a result of the resumed electrical activity by the gastrointestinal tract and reducing post operative illus, because the gastrointestinal tract was not manipulated roughly and the small amount of body fluid was lost. This parameter coincides with findings of others (17), when they evaluated the influence of conventional versus laparoscopic right sided colectomy on post operative motility of the stomach, small bowel, and large bowel. The results revealed that the median time until return to normal interdigestive pattern of myoelectrical activity after laparoscopic colectomy was about 40% less than conventional colectomy ($p<0.05$). Recovery from post operative ileus following laparoscopic surgery was more rapid than after conventional surgery in canine model. In laparoscopy there was less exposure of abdominal organs to atmosphere, thus reducing the consequent potential for intraabdominal infection; it prevents drying of the peritoneal surfaces, which may predispose the tissues to ischemia and possible intraperitoneal introduction of foreign bodies such as cotton, gauze, or talc…etc, which

delay healing process. This phenomenon of post operative complications was also described by (18). Peritoneal contamination affects intestinal wound strength healing especially with the intestinal contents as it contains a large number of microfloras, which may become pathogenic when it enters into the peritoneal cavity. This trouble may be observed in all cases of intestinal resection and anastomosis, due to opening of the intestinal lumen, and the possibility of contamination. This could be expected in all groups, especially in group two, where the intestinal segment was suspended, resected and the lumen was opened for a longer period than in the other two groups, and finally anastomsed inside the peritoneal cavity. Fortunately, peritonitis, or other complications, was not observed in all of the cases, except in one at which leakage had occurred 24 hours after the operation. The animal underwent laparotomy and the site of the leak was resected and re-anastomsed and the peritoneal cavity were lavaged with physiological saline and then irrigated with antibiotic solution. Short term peritoneal spoilage (12 hours) was reported in rat's model (19). Leakage at the site of anastomosis appears as an important postoperative complication so that the suturing technique should be applied securely in order to prevent leakage. In all experimental animals, no cases of leakage were observed, except in one case of the second group, as it was sutured intracorporeally. In this group, the possibility of loosening and opening of the stitches was expected because the intracorporeal suturing requires a great experience. Authors (20, 21 and 22) indicated that completely intracorporeally performed anastomosis is safe in the hands of laparoscopically experienced surgeon with the using of endoscopic linear stapling devices. This technique implies a very low percentage of postoperative stenosis (0–10%) and further more, a very low percentage of postoperative leakage (0–8%), while, laparoscopic intracorporeal sutured anastomosis is rarely performed because it is difficult, time consuming, and needs a greater experience as it needs about 40 anastomosis to be mastered.

Intra-abdominal adhesion is usually an almost inevitable sequela of abdominal operations. But, with minimal invasive surgery as a result of the small tiny openings in the peritoneum, this will be excluded (18). The adhesion may compromise bowel lumen diameter and prevent normal distention of the small intestine and signs of partial or complete obstruction may be noted. In addition, the patient will not be able to undergo laparoscopic operation. Some workers (18, 23) estimated that the adhesive small bowel obstruction is a common problem, especially for those patients with previous abdominal surgery and the incidence increases significantly after major abdominal operation. Although postoperative adhesions are not always symptomatic, some of them cause postoperative adhesive peritoneal diseases and become symptomatic. Studies conducted that prevention of adhesion did not only interfered with jejunal anastomotic resistance, but also improved intestinal healing (24). In this study, adhesion of the omentum and to certain extent, the intestine to the site of laparotomy, were responsible for the unusual signs of decreasing appetites, restlessness, and postoperative pain; characterized by barking, licking and biting to the site of operation especially after eating of a considerable quantity of food.

The study reveals the presence of major beneficial difference in laparoscopic versus conventional intestinal resections and anastomosis. Additionally, the laparoscopic-assisted method offered better advantages over laparoscopic technique, as it was: not time consuming procedure; suturing was secured properly; contamination reduced; no need for a great experience; less post operative complications; size of abdominal opening was approximately 2.5 cm; large portion of intestinal segment can be removed and fewer instruments were required.

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