

## A New Technique for Intestinal End-to-End Anastomosis in Dogs

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### Abstract

In this study a new appositional end-to-end intestinal anastomosis with interrupted intraluminal knotting Vs extraluminal was investigated experimentally on eight dogs that were divided randomly into two groups (A & B), including four for each.

In group (A) anastomosis was performed by end-to-end appositional by simple interrupted stitches, with their knots tied intraluminally. While, in group (B) anastomosis was performed by the same appositional method, but the stitches were tied extraluminally, by poly glycolic acid 0-3 suture material for both groups.

The results showed that the anastomotic procedure in group (A) as compared with group (B) was associated with minimal degrees of stenosis & minimal intra-abdominal adhesions macroscopically, and with higher rates of healing process microscopically.

In conclusion, this new intestinal appositional end-to-end anastomosis by simple interrupted sutures with the knots tied intraluminally, provided minimal degrees of stenosis & adhesions and higher rates of healing process.

### تقنية جديدة لتفمم الأمعاء نهاية \_ لنهاية في الكلاب

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فرع الجراحة والتوليد - كلية الطب البيطري/جامعة السلیمانیة

### الخلاصة

في هذه الدراسة تم الاستقصاء تجريبيا في ثمان كلاب، تم تقسيمهم عشوائيا بالتساوي إلى مجموعتين (أ) و (ب)، عن تقنية جديدة لتفمم الأمعاء نهاية- لنهاية بطريقة الخياطة المتقطعة مع وضع عقدها داخل الجوف المعوي ومقارنتها مع نفس طريقة التفمم والخياطة عدا عن وضع العقد خارج الجوف المعوي.

في المجموعة (أ) تم التفمم نهاية- لنهاية بخياطتها بطريقة المتقطع البسيط مع وضع العقد داخل الجوف المعوي. بينما في المجموعة (ب) تم التفمم بنفس الطريقة لكن بوضع العقد خارج الجوف المعوي، وتمت الخياطة في المجموعتين بخيط حامض البولي كلاكولين حجم صفر-ثلاثة. بينت نتائج عمليات التفمم في المجموعة (أ) بالمقارنة مع تلك التي في المجموعة (ب)، بمصاحبتها بدرجات قليلة من التضيق والالتصاق المرئي بالعين المجردة ودرجات عالية للالتئام النسيجي ألمجهري.

وتم الاستنتاج بان طريقة التفمم الجديدة للأمعاء، نهاية- لنهاية بخياطة المتقطع البسيط مع وضع العقد داخل الجوف المعوي، أثبتت تفوقها لمصاحبتها بدرجات قليلة من التضيق والالتصاق وعلى نحو أفضل لعمليات الالتئام النسيجي.

## Introduction

The basic principles of intestinal suture were established more than 100 years ago by Travers, Lembert and Halsted (1). Ingenious methods for anastomosis have been described by different configuration which may be; end-to-end, end-to-side, or side-to-side; by inverted, or everted in single or multiple layers. It can be sutured in an interrupted or continuous fashion with absorbable or non absorbable sutures or be stapled. Other ingenious methods include bio-fragmental rings, fibrin glue, laser welding and internal stenting (2, 3).

The creation of a join between two bowel ends is an operative procedure that is of central importance in the practice of a general surgeon. Despite the potentially disastrous consequences that can arise from leakage of an intestinal anastomosis, joining bowel segments is one of the procedures that junior surgeons often perform in the emergency setting. With proper supervision and appreciation of fundamental concerns, however, there is little difference between the outcomes of anastomosis performed by trainees and those performed by established surgeons (4, 5).

The aim of this study was to investigate a new appositional end-to-end intestinal anastomosis with interrupted stitches knotted intraluminally, compared to the extraluminal knotting in dog's model.

## Materials and Methods

Eight adult local breed dogs, aged from 1.5-3 years, and weighing about 15-25 kg, from both sexes, were used. All animals were healthy and free from congenital or acquired diseases as represented by their physical and clinical examination. The animals were fastened before surgery for 18-24 hrs from food, but water was given freely until administration of premedication.

General anesthesia was preceded by premedication with atropine sulphate (0.04 mg/kg, subcutaneously), and thirty minutes later, by a mixture of Xylazine 2% (2 mg/kg) and Ketamine 5% (15 mg/kg) by intramuscular injection. The dogs were placed dorsally, prepared and operated routinely for aseptic midline laparotomy. The animals were divided randomly into two groups, each containing four animals.

**Group A:** Anastomosis by intraluminal suture knots: Following midline laparotomy and complete explorations of the abdomen and GIT. The jejunum was allocated and about 40 cm part of it packed away from the abdomen and its central part milked proximally and distally, and held by two Doyen intestinal forceps, 4 to 5 cm apart from the proposed resection site. Two other Doyen (non crushing) forceps, 1- 2 cm away from the upper and lower margins of previously applied ones, were clamped on the intestine. The mesenteric arteries and veins supplying the isolated piece of the jejunum were double ligated with Polygalactin size 3/0. The arcadial vessels located within the mesenteric fat were also ligated at the allocated area of resection. Intestinal and mesenteric resection was performed, by incising the gut between the two upper and lower Doyen forceps and the mesentery above its ligated vessels. After resection, anastomosis was made by closely seated single row of simple interrupted stitches with 3/0 Polygalactin sutures. The first suture was placed in the mesenteric border, while the second was placed on the antimesenteric border. The atraumatic needle was passed through the mucosal to the serosal layers from one side, and through the serosal to mucosal layers of the opposite side. The apposed ends of the intestine was tighten by intraluminal knotting of the each stitch (Fig.1, 2-A). After the anastomosis has been completed, it was checked for leakage. The mesenteric defect then closed with a simple continuous pattern. Finally, the jejunal loop was washed with normal saline and gently returned into the abdominal cavity through the abdominal incision, and the celiotomy incision was closed routinely.

**Group B (control group):** Anastomosis by extraluminal suture knots: In this group intestinal anastomosis was made by similar procedures described in group A, except in

passing of the suturing needle during appositional from the serosal surface toward the mucosal layer of the intestine in one side, to the mucosal and the serosal layer of the opposite side in order to apply the knots extraluminally (Fig. 2; B).

**Post operative (P.O.) care:** Fluid and electrolyte deficits were corrected and antibiotic therapy was continued in the post operative period. The normal diet was reintroduced gradually, beginning 48 to 72 hours after surgery. Prophylactic antibiotics were continued for 5 days.

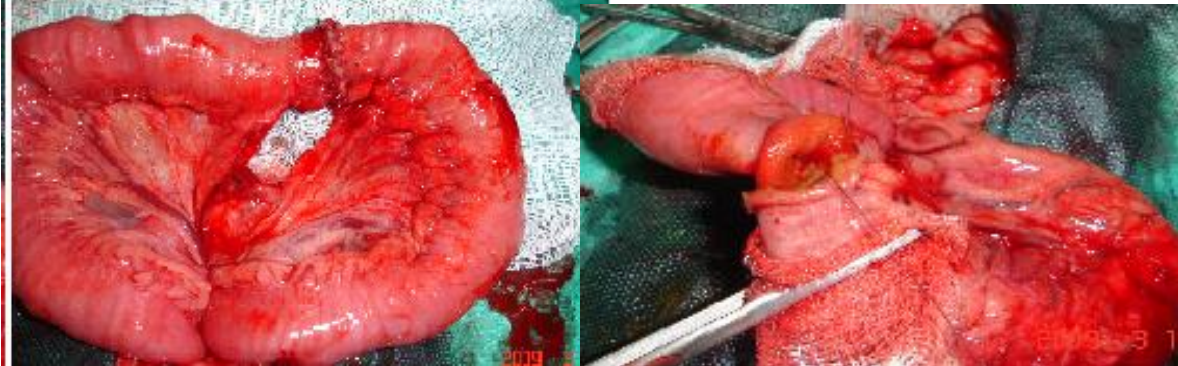
**Biopsy Collections:** Under the effects of general anesthesia and conventional laparotomy, about 30 cm piece from the anastomized intestine was collected from the experimental animals at the 15<sup>th</sup> and 30<sup>th</sup> P.O. days, for radiological and histopathological studies.

**Radiological Study:** To study the degree of stenosis, radiographic examinations were performed for all collected intestinal specimens, about 2-3 hrs post their collections. One of the ends of the intestinal specimen was closed by a crushing forceps and filled with freshly prepared Barium sulphate meal (25%) and the other end closed by another forceps. The barium filled intestinal specimen was radiographed by X-ray of 70 KV and 5 mas. Degree of stenosis was measured by the following formula (6): Degree of stenosis=  $100(1-2A/B+C)$

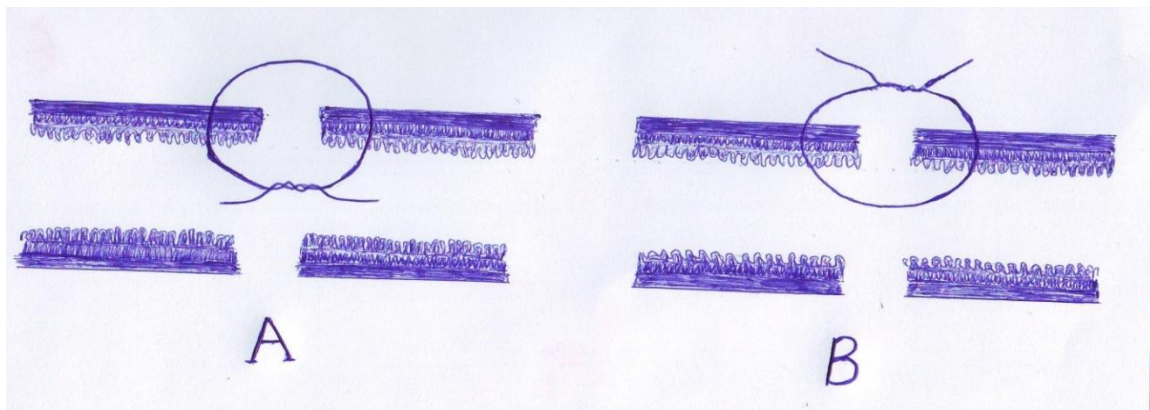
A = diameter at the site of anastomosis. B and C = diameter 2 cm far from the site of anastomosis proximally and distally, respectively.

#### **Histological examination**

The histological examination of intestinal biopsies obtained in this study was performed according to Luna (7).



**Fig. (1) End-to-End anastomosis in Jejunum of group (A) by simple interrupted appositional technique. Knotting of the stitches was applied intraluminally**



**Fig. (2) A- Intraluminal knotting, B-Extraluminal knotting**

## Results

The results of this study were obtained according to the clinical, radiological, and histopathological findings.

Clinically, intestinal resection and anastomosis in both groups were obtained without hindering troubles and the animals were showed to be both physically and clinically without P.O. complications.

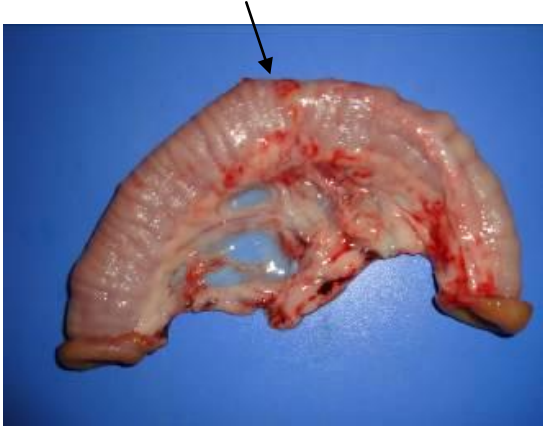
Adhesions of the omentum to the anastomosis site were found at 15<sup>th</sup> and 30<sup>th</sup> days P.O. in both groups, but the rate of their extent and density was lower and/ or absent in group (A) especially after 30 days as compared to the group (B) in all specimens (Fig. 3 and 4).

The results of the radiological study showed lower percentage of anastomotic stenosis in group (A) as compared to group (B), in the intestinal specimens that have been taken at the 15<sup>th</sup> and 30<sup>th</sup> P.O. days (Table 1).

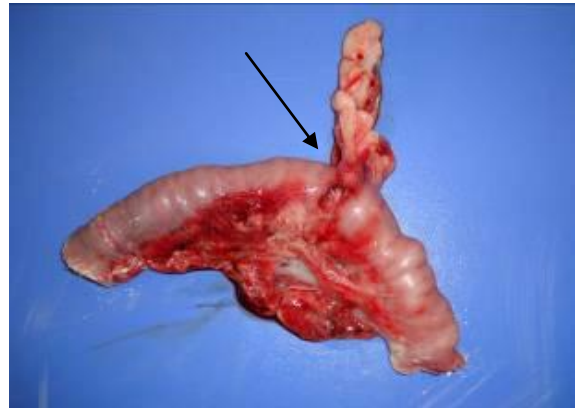
The histopathological examination of the intestinal biopsies revealed that the healing process at the anastomosis site was faster in animals of the group A than in animals of group B. Normal epithelization associated with moderate fibrous connective tissue proliferation in the submucosal layer and normal appearance and arrangement of the muscularis and serosal layers were evident 15 days following anastomosis in animals of group A (Fig. 9 and 10). On the other hand, partial epithelial regeneration and loss of villi associated with marked fibrous connective tissue proliferation in the submucosal layer and marked thickening of the serosal layer due to fibrous connective tissue proliferation and profound infiltration of inflammatory cells were apparent until the day 30 after anastomosis in animals of group B (Fig. 11 and 12).

**Table (1) The degree and percentage of stenosis in dog's intestine at 15 and 30 days following end-to-end anastomosis in group A and B**

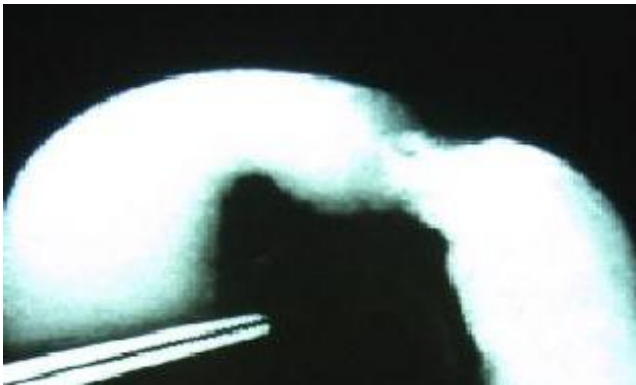
Group	No. of animals	Degree of anastomotic stenosis			
		At 15 days		At 30 days	
		Percentage%	Mean	Percentage %	Mean
<b>A</b>	1	41	<b>39.65</b>	33.9	<b>34.6</b>
	2	38.3		35.3	
<b>B</b>	1	62.7	<b>66.05</b>	48.6	<b>49.5</b>
	2	69.4		50.4	



**Fig (3) Postmortem view for a piece of intestinal segment 30 days after intestinal anastomosis in group A show minimal rate of adhesion with omentum**



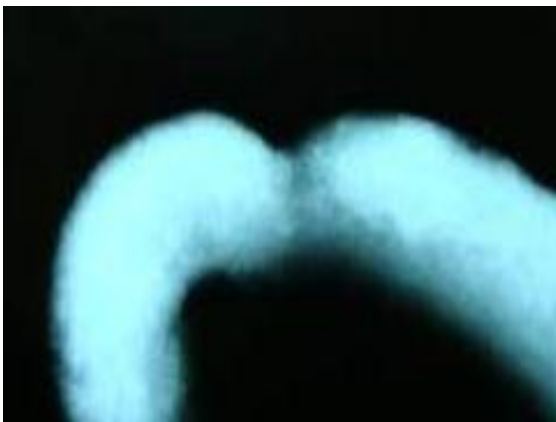
**Fig. (4) Postmortem view intestinal segment 30 days after intestinal anastomosis in group B show a higher rate of adhesion with omentum**



**Fig. (5) X-ray view at the anastomotic site after 15 days in group A**



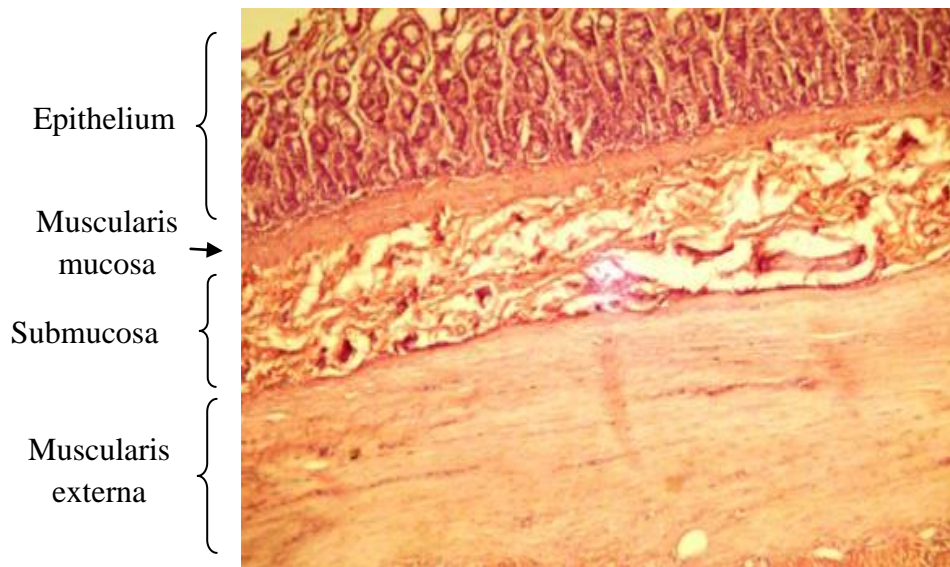
**Fig (6) X-ray view at the anastomotic site after 15days in group B**



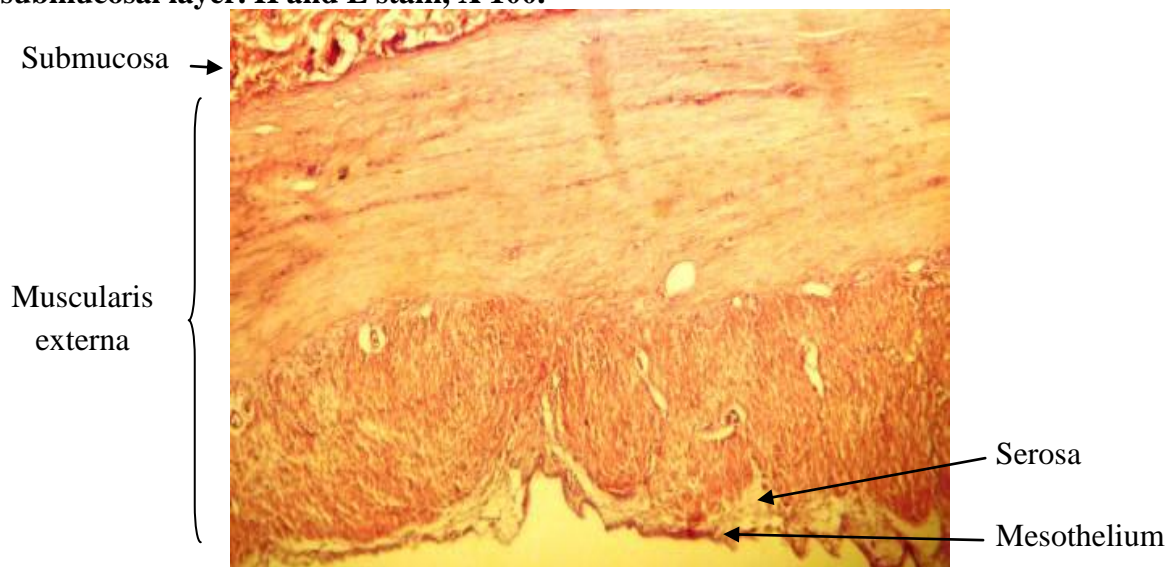
**Fig (7) X-ray view at the anastomotic site after 30 days in group A**



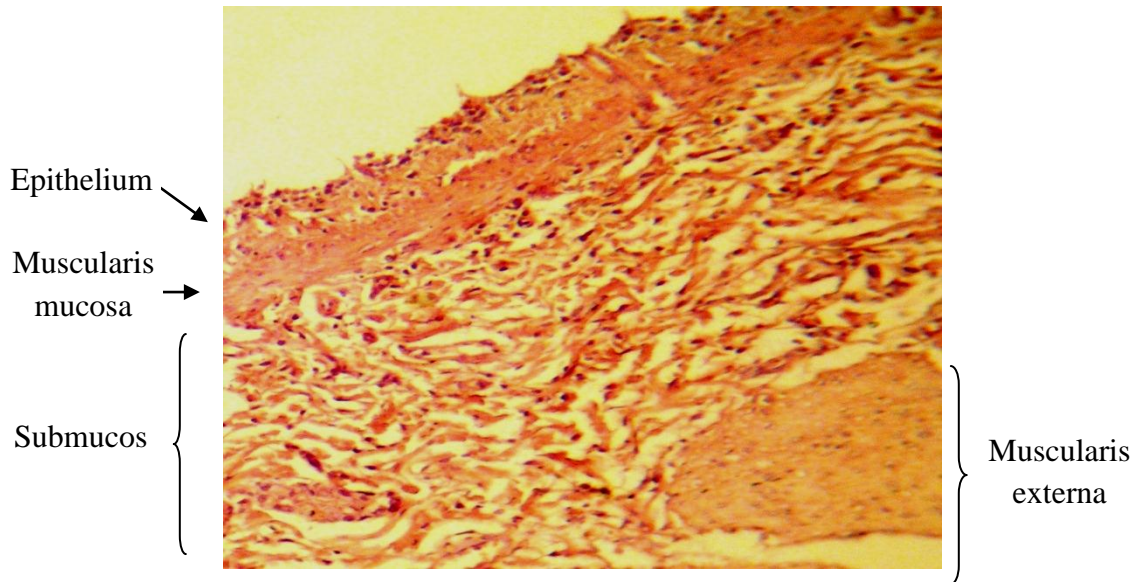
**Fig (8) X-ray view at the anastomotic site after 30 days in group B**



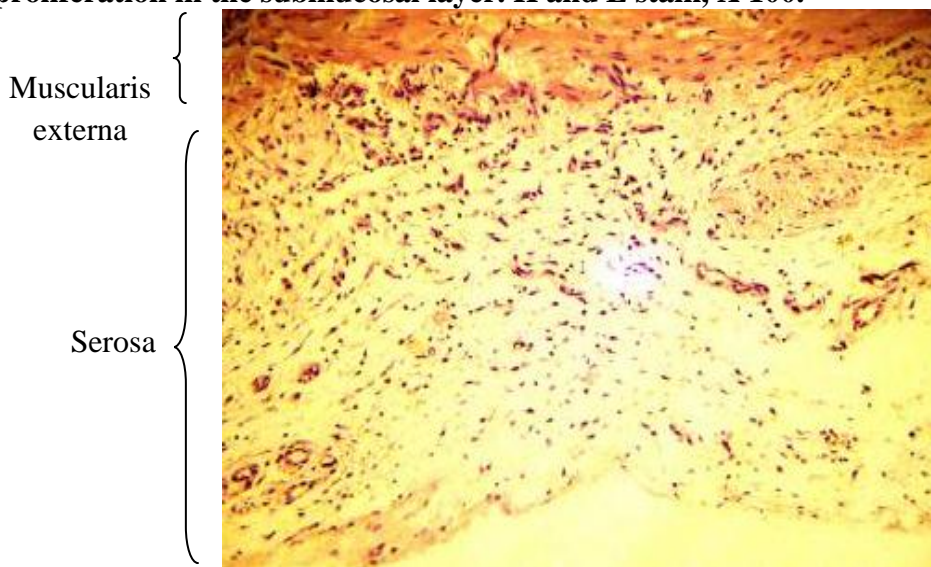
**Fig. (9)** A histomicrograph of a biopsy obtained from the anastomosis site 15 days following anastomosis in the jejunum of a dog in group A. It shows normal epithelization associated with moderate fibrous connective tissue proliferation in the submucosal layer. H and E stain, X 100.



**Fig. (10)** Higher magnification view of deeper layers of the tissue section illustrated in the previous figure. It shows normal appearance and arrangement of the muscularis and serosal layers. The mesothelium is almost normal. X 100.



**Fig. (11)** A histomicrograph of a biopsy obtained from the anastomosis site 30 days following anastomosis in the jejunum of a dog in group B. It shows slow epithelial regeneration and loss of villi associated with marked fibrous connective tissue proliferation in the submucosal layer. H and E stain, X 100.



**Fig. (12)** Higher magnification view of deeper layers of the tissue section illustrated in the previous figure. It shows marked thickening of the serosal layer due to fibrous connective tissue proliferation and profound infiltration of inflammatory cells. Angiogenesis (new blood vessel formation) is also evident. H and E stain, X 200.

### Discussion

Numerous anastomotic techniques have been described for small intestinal anastomosis in animals (8, 9). Optimal intestinal healing is dependent on a good blood supply, accurate mucosal apposition, and minimal surgical trauma. Several investigations have shown that

the method of apposition influences the repair process of the epithelium. In this regard, satisfactory apposition of submucosal layers is most important (10).

In the present study, the single-layered appositional suture pattern gave an effective technique for small intestinal anastomosis in dogs. It allowed for maximal luminal diameter and minimal surgery time, in which application of the knots intraluminally as in group (A), prevented formation of postanastomotic abdominal adhesions that usually associated with appositional anastomosis (11).

Previous studies have demonstrated that inverting intestinal anastomosis results in decreased perianastomotic adhesion formation because inversion of the serosa minimizes peritoneal exposure of bacteria laden mucosa and suture material (12), while standard, two-layer, inverting small intestinal anastomosis provide a tight serosal seal, the internal mucosal cuff produced as a result of tissue inversion markedly decreases intestinal luminal diameter (13).

Adhesions between the omentum and intestine occurred in both groups (A) and (B), but its rate was lower in group (A) in which the knots were tied intraluminally. The intraluminally applied knots in group (A), was concluded to minimize the presence of suture knots masses intra-abdominally, which reduces the rate of inflammatory reactions at the site of anastomosis, and consequently with least intra-abdominal adhesions. On the other hand, hydrolysis of the intra-luminally placed masses of suture knots proposed to occur within a shorter period of time, although (14) cited that the rates of absorption of polygalactine 910 dose not significantly influenced by exposure to digestive enzymes, but more rapidly hydrolyzed in alkaline environment. While, in group (B) at which the stitches knots were placed out on the serosal surface, the knots became in direct contact with internal viscera, that could enhance excessive inflammatory reactions with the abdominal viscera especially with the omentum, and this could be the cause for the higher rates of adhesions seen grossly with the 1<sup>st</sup> and 2<sup>nd</sup> looks in group (B). Extraluminal placement of the knots could prolong absorption of the suture materials, but this needs further investigation to ensure this proposed explanation, whereby many factors like the type of suturing, contamination and the usage of ideal suture materials were proposed by previous investigators (15).

A variant degree of stenosis was shown in table (1) between the two studied groups. These differences was referred to the fact that rapid healing and quick regeneration were enhanced by group (A) Vs group (B). The higher rates of perianastomotic adhesions observed within the 1<sup>st</sup> and 2<sup>nd</sup> post anastomosis looks in group (B) caused at least by the possibility of excessive local reactions, by the extralumenally located knots that enhanced excessive fibrosis at the site of anastomosis and resulted in higher rates of stenosis and subsequent greater intraluminal stricture formation (8, 16).

The histomorphologic results in the present study indicated minimal tissue reaction and faster healing process in animals of group A as revealed by the normal epithelization, moderate fibrous connective tissue proliferation and normal arrangement of the muscularis and serosal layers that were evident 15 days following anastomosis. On the other hand, partial epithelial regeneration and loss of villi associated with marked submucosal fibrosis and marked serosal thickening were apparent until the day 30<sup>th</sup> P.O. after anastomosis in group B. This finding can be attributed to the extraluminary positioned suture knots that may induce higher rates of perianastomotic inflammatory reactions (17, 18), as compared to group A.



The study concluded the superiority of intestinal appositional technique with simple interrupted pattern with the stitches placed intraluminally Vs the routine extraluminal placement of the knots.

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