

# Comparison of Stapler, Single Layer and Double Layer Techniques for Colon Closure in Dogs

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**Abstract:** The present study was performed on 18 healthy dogs (aged 16.80±1.22 months) and body weight (17.07±2.21 kg) to determine the best suturing technique among single layer, double layer and stapler technique for the closure of colon in dogs. All dog were divided into three groups, placing 6 animals in each group, i.e. group A was closed with single layer suture technique, group B was closed with double layer suture technique and group C was closed with stapler technique. The number of stitches required for colon closure were 8.83, 16.33 and 9.16 in groups –A, B and C respectively. The mean number of stitches and time taken for the completion of double layer technique was significantly higher ( $P<0.01$ ) than single layer and stapler techniques. The mean of total duration of abdominal closure was 47.00, 45.16 and 34.83 minutes in group A, B and C respectively. The mean of total duration for surgery was 57.16, 64.50 and 46.33 minutes in group A, B and C respectively. The study reveals that all the techniques were not completely free from complications and advantages. Although stapler technique had some advantages like minimal adhesion between anastomotic line and other structures, higher bursting wall tension at operated site and less duration required for closure of anastomosis. It is concluded that stapler technique used in this study proved better than single layer and double layer suture techniques in dogs.

**Keywords:** Comparison, Stapler, Techniques, Colon, Dogs.

## INTRODUCTION

Wound is a break in the continuity of the cellular and molecular structure of the body while its repairing is more complex process which takes proper period of time [1, 2]. The majority of the surgical wounds are created by the surgeons therefore their obligation is to provide a hygienic environment which ultimately promotes the wound healing process [3]. The existing treatment strategies are designed multi directional as including surgery, radiation and chemicals however it is surprising that wound healing process becomes a globally important matter of discussion. Whether the wound is surgically created or due to some other reason and the patients undergo some form of surgical procedure during the course of their disease for treatment or diagnostic purpose [4]. Intestinal disorders due to various causes are more common in canine, which needed surgical facilitation at an early stage [5]. Adoption of foreign bodies in bowel blockage related to fluid imbalance as a result of increase secretion impaired by oral intake fluid and vomiting [6], foreign bodies of intestine are frequently originate upon

domesticated animal which shows multiplicity of clinical signs related to the obstruction location which need surgical facility. Intestinal alignments with modern suturing instruments show good results in clinical use [7], and best surgical technique is the fundamental requirement for colon surgery which causes low tissue damage and less complication rate [8].

## MATERIAL METHODS

This study was performed on 18 healthy dogs at Department of Surgery and Obstetrics, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam. The dogs were arranged from surrounding area of Tandojam. Healthy animals were used in this research study in order to achieve the required results. Dogs of varying ages between 10 to 20 months old with an average body weight of 17.07± 2.21 kg were brought 12 days before start of the surgery for adaptation the surrounding environment.

### Experimental Design

#### Groups

Eighteen dogs were randomly divided into 3 groups, A, B and group C by placing 6 animals in each group.

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**Table 1: Experimental Design**

Groups	Procedure	No. of Animals	Techniques
A	Enterotomy	6	Single layer colon suturing
B	Enterotomy	6	Double layer colon suturing
C	Enterotomy	6	Stapler (Intestinal linear stapler, Haier)
<b>Total</b>		<b>18</b>	

One suturing technique was employed on the colon of dogs in each group (Table 1).

### **Techniques of Suturing**

Three suturing techniques such as stapler, single layer and double layer were applied on colon of dogs each technique for each group. Single layer and double layer for group A and B respectively were carried out with using Dexon 3/0 (suture material) while Stapler (Intestinal linear stapler, Haier Private Limited) was used in group C.

### **Pre-Operative Preparations**

Each dog was off fed for 12 hours and water was withheld for 6 hours before the start of the experiments. Dogs were operated randomly one dog for each day.

### **Anaesthesia and Surgical Procedure**

Xylazine hydrochloride 0.5 mg/kg IM was used as pre-medication, anaesthesia was induced and maintained with 10 mg/kg IV thiopental sodium (Pentothal Sodium, Abbott). Xylazine which is a good sedative analgesic was injected i/m 10 minutes before surgery for the purpose of keeping the animal calm and easily handled. The experiment were conducted under aseptically and hygienic condition in the operation theater in the Department of Surgery & Obstetrics SAU, Tandojam. After induction the anaesthetized animal was placed on the operated table in order to perform the surgical procedure. The incision site was prepared by clipping the hairs of the surrounded area.

### **Post-Operative Care**

Antiseptics (pyodine) were applied on the incision site after suturing. Antibiotics (Amoxicillin 10mg/kg) 3cc was given to dogs daily up to 10 days to avoid secondary infections. Anti-inflammatory analgesics (Diclofenac Sodium, Meloxicam) were given to reduce inflammation and pain. Soft food were offered to the operated dogs up to completion of healing. Dogs were monitored daily two times i.e. (morning and evening)

for physiological and clinical parameter post-operatively (Feeding, drinking, urination, defecation and behavior, pulse rate, respiration rate and body temperature etc.). The clinical appearance of wound were scored two time points 18 to 24 hrs and 10 to 14 days post-surgically. Skin wound healing were observed through naked eye in each day. Wounds were scored based on swelling, erythema, dehiscence and discharge.

### **Necropsy Findings**

The dogs were euthanized with magnesium sulphate intravenously. After euthanization the operated side of each euthanized dog was reopened. The anastomotic site was evaluated by collecting tissue sample during dissection on 3<sup>rd</sup>, 10<sup>th</sup> and 20<sup>th</sup> day after surgery for histopathological study, by scarifying nine animals per occasion three from each group.

## **RESULTS AND DISCUSSION**

This study was performed to compare three unlike colon suturing techniques in relation to postoperative complications which was based on the clinical observations. The study was conducted through a proper channel without arising any issue. The mean number of stitches in colon of group A was  $8.83 \pm 0.60$  and time taken for colon closure was  $9.50 \pm 0.42$  minutes, the mean no of stitches for peritoneum were  $9.16 \pm 0.47$  and duration for its closing was  $14.16 \pm 0.54$  minutes. No of stitches in linea alba were  $9.83 \pm 0.47$  and complete in  $7.66 \pm 0.66$ . The no of stitches for skin closing were  $10.16 \pm 0.47$  and time taken for its completion was  $9.16 \pm 0.47$  minutes. The total duration of abdominal closure and for surgery was  $47 \pm 1.71$  and  $57.16 \pm 1.81$  minutes respectively. The mean number of total stitches in colon of group B was  $16.33 \pm 0.42$  and total time taken for colon closure was  $18.33 \pm 0.55$  minutes, the mean no of stitches for peritoneum was  $8.16 \pm 0.30$  and duration for its closing was  $6.50 \pm 0.34$  minutes. No of stitches in linea alba  $7.66 \pm 0.21$ , closure with  $6.33 \pm 0.80$  minutes. The no of stitches for skin closing were  $9.00 \pm 0.36$  and time taken for its

completion was  $6.16 \pm 0.30$  minutes. The total duration of abdominal closure and for surgery was  $45.16 \pm 0.4014$  and  $45.16 \pm 0.40$  minutes respectively. The mean number of stitches in colon of group C was  $9.16 \pm 0.30$  and time taken for colon closure was  $5 \pm 0.25$  minutes, the mean no of stitches for peritoneum were  $9.33 \pm 0.4216$  and duration for its closing was  $7 \pm 0.5774$  minutes. No of stitches in linea alba  $9.5 \pm 0.42$  and closure with  $6.66 \pm 0.49$  minutes. The no of stitches for skin closing were  $10.16 \pm 0.47$  and time taken for its completion was  $8.66 \pm 0.33$  minutes. The total duration of abdominal closure and for surgery were  $34.83 \pm 1.35$  and  $46.33 \pm 1.23$  minutes respectively. Lumen diameter of colon at day three were recorded as  $32.50 \pm 2.50$ ,  $36.50 \pm 1.50$  and  $37.50 \pm 7.50$  mm respectively of group-A, B and C, At day 10<sup>th</sup>  $31.50 \pm 3.50$ ,  $35 \pm 5.00$  and  $32.5 \pm 2.50$  mm, while at day 20<sup>th</sup> the lumen diameter was  $41 \pm 30$ ,  $37.50 \pm 7.50$  and  $40 \pm 0.00$  mm of group-A, B and C respectively. Bursting pressure at day 3 was recorded as  $205.00 \pm 5.00$ ,  $225.00 \pm 5.00$  and  $170.00 \pm 20.00$

mm of Hg of group-A, B and C respectively. At day 10<sup>th</sup>  $230.00 \pm 10.00$ ,  $195.00 \pm 15.00$  and  $210.00 \pm 10.00$  mm of Hg. While at day 20<sup>th</sup>  $285.00 \pm 5.00$ ,  $215.00 \pm 25.00$  and  $170.00 \pm 30.00$  mm of Hg of group-A, B and C respectively. of busting pressure of the operated sites.

The mean of the number of stitches in colon of group A (Single layer technique) and C (Stapler technique) were not significantly different from each other while the mean of the number of stitches and time taken for its closure of group B (Double layer technique) was significantly higher form both of the groups i.e.(group A and C). Time of colon closure with stapler technique was significantly lower than Single layer and double layer technique. However the mean of all other parameters were not significantly different from each other. There were no significant difference in the adhesion % among the all groups. Similarly observations were recorded by [9], [7], while comparing oppositional single layer, inverted two layer and

**Table 2: Mean Values of Colon Lumen Diameter at 3<sup>rd</sup>, 10<sup>th</sup> and 20<sup>th</sup> Post Surgically in Group-A, Band C of Dogs**

PARAMETER	Group A (Single layer technique)	Group B (Double layer technique)	Group C (Stapler technique)
	Mean $\pm$ S.E	Mean $\pm$ S.E	Mean $\pm$ S.E
Lumen diameter of colon 3 days post surgically	$32.50 \pm 2.50$	$36.50 \pm 1.50$	$37.50 \pm 7.50$
Lumen diameter of colon 10 days post surgically	$31.5 \pm 3.500$	$35 \pm 5.00$	$32.50 \pm 2.50$
Lumen diameter of colon 20 days post surgically	$41.00 \pm 3.00$	$37.5 \pm 7.500$	$40.00 \pm 0.00$

**Table 3: Mean Values of Parameters i.e. Total no. of Stitches and Duration in Colon, Peritoneum, Linea Alba and Skin for Laparotomy and Anastomosis of Colon in Group-A, B and C**

PARAMETER	Group A (Single layer technique)	Group B (Double layer technique)	Group C (Stapler technique)
	Mean $\pm$ S.E	Mean $\pm$ S.E	Mean $\pm$ S.E
Total no of stitches in colon	$8.83 \pm 0.60$	$16.33 \pm 0.42$	$9.16 \pm 0.30$
Total colon closure time (mines)	$9.50 \pm 0.42$	$18.33 \pm 0.55$	$5 \pm 0.25$
No of stitches in peritoneum	$9.17 \pm 0.47$	$8.16 \pm 0.3073$	$9.33 \pm 0.42$
Duration of closure of peritoneum (minutes)	$14.167 \pm 0.5426$	$6.50 \pm 0.34$	$7.00 \pm 0.57$
No of stitches in linea alba	$9.83 \pm 0.47$	$7.66 \pm 0.21$	$9.50 \pm 0.42$
Duration of closure of linea alba (minutes)	$7.66 \pm 0.66$	$6.33 \pm 0.80$	$6.66 \pm 0.49$
No of stitches for skin closure	$10.16 \pm 0.47$	$9.00 \pm 0.36$	$10.16 \pm 0.47$
Duration of closure of skin (minutes)	$9.17 \pm 0.47$	$6.17 \pm 0.30$	$8.6667 \pm 0.33$

**Table 4: Mean Values of Colon Bursting Pressure Diameter at 3<sup>rd</sup>, 10<sup>th</sup> and 20<sup>th</sup> Post Surgically in Group-A, B and C.**

PARAMETER	Group A (Single layer technique)	Group B (Double layer technique)	Group C (Stapler technique)
	Mean $\pm$ S.E	Mean $\pm$ S.E	Mean $\pm$ S.E
Bursting pressure of normal colon	348.33 $\pm$ 8.62	342.50 $\pm$ 14.24	361.67 $\pm$ 14.47
Bursting pressure of colon 3 days post surgically	205.00 $\pm$ 5.00	225.00 $\pm$ 5.00	170.00 $\pm$ 20.00
Bursting pressure of colon 10 days post surgically	230.00 $\pm$ 10.00	195.00 $\pm$ 15.00	210.00 $\pm$ 10.00
Bursting pressure of colon 20 days post surgically	285.00 $\pm$ 5.00	215.00 $\pm$ 25.00	170.00 $\pm$ 30.00

oppositional two layer end to end intestinal anastomotic techniques for colon closing in dogs and horses, and [6] Comparison of two jejunal anastomosis techniques in dogs treated preoperatively with dexamethasonm. During this study no evidence of post-operative complications such as peritonitis, evisceration, suture breakdown and leakage were recorded. This is an agreement with the observations of [4]. Two Techniques of Intestinal Wall Suture in Surgical Treatment of Ileus in Dogs and the Importance of Omentalisation. They performed hand-sewn single-layer approximation suture of the intestinal wall in 28 patients, whereas in the remaining 24 patients two-layer inverting technique of the intestinal wall suture was performed. No significant difference was demonstrated ( $p > 0.05$ ) in the postoperative complication in their study. Lumen diameter and

bursting pressure of all the three groups were recorded, the mean of lumen diameter of group A, B and group C were, 35.500 mm, 36.333 mm and 36 mm respectively. Bursting pressure of group A, B and group C were recorded 240.00 mm of Hg, 211.67 mm of Hg and 183.33 mm of Hg respectively. In group C stapler technique indicated low mean value (183.33 mm of Hg) of busting pressure of the operated sites. Similarly observation were made by [2]. Comparison of staple and suture techniques for end-to-end anastomosis of the small colon in horses.

During this research work two patients one from each group A and B were died due to intestinal leakage after day 3 post surgically. The Table 5 represented the leakage % in group-A, B and C.

**Table 5: Average Bursting Pressure (mm of Hg) of Colon at Operated Sites in Group A, B and C Animals**

Groups	Dogs no	Control	Operated	Days after surgery	Mean $\pm$ S.E	
					Control	Operated
A	1	360	210	3	348.33 $\pm$ 8.62	240.00 $\pm$ 15.27
	2	365	200	3		
	3	320	220	10		
	4	325	240	10		
	5	350	280	20		
	6	370	290	20		
B	1	400	220	3	342.50 $\pm$ 14.24	211.67 $\pm$ 23.16
	2	360	230	3		
	3	330	180	10		
	4	345	210	10		
	5	320	190	20		
	6	300	240	20		
C	1	390	150	3	361.67 $\pm$ 14.47	183.33 $\pm$ 12.82
	2	350	190	3		
	3	400	220	10		
	4	360	200	10		
	5	370	200	20		
	6	300	140	20		

The bursting pressure of colon at 3<sup>rd</sup>, 10<sup>th</sup> and 20<sup>th</sup> were compared with normal colon. After euthanization of animals, the bursting pressure for group-A was  $348.33 \pm 8.62$  and  $240.00 \pm 15.27$  mm of Hg respectively for normal and operated colon. Group-B  $342.50 \pm 14.24$  and  $211.67 \pm 23.166$  mm of Hg for normal and operated while group-C was  $361.67 \pm 14.47$  and  $183.33 \pm 12.82$  mm of Hg respectively for normal and operated colon.

The lumen diameter of colon at 3<sup>rd</sup>, 10<sup>th</sup> and 20<sup>th</sup> were compared to normal colon diameter. After euthanization the lumen diameter was  $45.50 \pm 2.92$  and  $35.00 \pm 2.33$  mm respectively for normal and operated colon for group-A. For group-B was  $42.66 \pm 1.87$  and  $36.33 \pm 2.40$  mm for normal and operated while for group-C was  $43.66 \pm 2.99$  and  $36.00 \pm 2.91$  mm respectively for normal and operated colon.

## CONCLUSION

The study reveals that all the techniques were not completely free from complications. Although stapler technique had some advantages like minimal adhesion between anastomotic line and other structures, higher bursting wall tension and less duration required for closure of anastomosis. Stapler technique is superior than single layer and double layer suture technique in the sense that it provide rapid closure, lesser leakage, less narrowing of anastomotic lumen diameter, histologically better apposition of the anastomotic layers with minimum adhesions, excellent wound

healing and lesser complications. It is concluded that stapler technique used in this study proved better than single layer and double layer suture technique in dogs.

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