

## Original Research Article

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# An observational comparative study of single layer continuous extramucosal anastomosis versus conventional double layer intestinal anastomosis

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## ABSTRACT

**Background:** Conventional double layered technique of intestinal anastomosis are widely in practise. Some surgeons also practice single layer technique either continuous or interrupted. This was a prospective observational study to compare safety, efficacy and feasibility of single versus double layered continuous techniques.

**Methods:** Patients undergoing intestinal anastomosis with either of these two techniques were observed prospectively for various outcome parameters like length of suture material used, time taken for anastomosis, and that for entire surgery, postoperative complications, return of bowel activity etc. Data such obtained was analysed for statistical significance by applying chi-square test and unpaired 't' test.

**Results:** Length of suture used for single layer (mean of 15.06 cm) was statistically significantly lesser than that for double layer (mean 19.90 cm) ( $p=0.001$ ). Time taken for anastomosis and overall surgical time too was significantly less for single layer group ( $p=0.001$  and  $0.022$  respectively). Complications including anastomotic dehiscence were not significantly different between two groups. Postoperative recovery of bowel function was earlier in single layer group with marginal statistical significance ( $p=0.048$ ).

**Conclusions:** Thus in our study, single layer continuous method of intestinal anastomosis resulted in significant reduction in time, suture material length and cost; without any difference in complications and it marginally hastens the postoperative recovery of bowel function. So single layer continuous method can be recommended for intestinal anastomosis.

**Keywords:** Anastomosis, Anastomotic dehiscence, Double layer continuous, Postoperative recover, Single layer continuous

## INTRODUCTION

Intestinal anastomosis is one of the commonly performed procedure in general and gastrointestinal surgery operation theatre in both elective and emergency settings. The basic principles of intestinal suturing were established more than 100 years ago by Travers, Lembert and Halsted and have since undergone little modification.<sup>1</sup> Historically, two layered anastomoses consisting of an inner transmural

layer of continuous sutures and an outer seromuscular layer of interrupted sutures has been performed by most surgeons. Also there is another school of thought that, a single extra mucosal layer, which include the toughest layer, submucosa is enough for a healthy anastomosis.<sup>2</sup>

Proposed advantage of single layer anastomosis include shorter surgery time and lower cost.<sup>3-5</sup> We proposed to study the feasibility and outcome of following two

methods; single layer continuous extra mucosal anastomosis, conventional double layered continuous full thickness inner layer and interrupted seromuscular outer layer.<sup>6</sup>

Practice of single layer anastomosis is very limited as the surgeons has yet not developed faith in single layer anastomosis because of limited number of studies. This study aims to add to the current knowledge about safety outcomes the two method of intestinal anastomosis and also the length of suture material used and the time taken is per unit length of circumference of intestine which give a more precise idea of its cost efficacy.

Aim was to compare the safety and efficacy and resource utilization in single layer extra-mucosal and double layer full thickness intestinal anastomosis and objectives was to study post op complication like anastomotic dehiscence, obstruction due to anastomotic stricture, bleeding, to compare material length utilized and time taken for anastomosis, return of bowel function.

## METHODS

This was a prospective observational comparative study consisting of 100 patients, who will be grouped into 2 groups, one who have undergone extra-mucosal single layer anastomosis and the other with full thickness transmural anastomosis.

### ***Inclusion criteria***

Patients more than 18 years of age, undergoing resection and anastomosis of intestine surgery for various indications like bowel gangrene due to vascular compromise caused by mesenteric vascular disease, intestinal obstruction, intussusceptions, or volvulus, malignancy, benign conditions (e.g., intestinal polyps, intussusception, roundworm infestation with intestinal obstruction), infections (eg, tuberculosis complicated with stricture or perforation) and traumatic perforations.

### ***Exclusion criteria***

Pregnant females, patients with uncontrolled diabetes, h/o steroid intake, severe anaemia, immune-compromised, patients in whom anastomoses are preceded by proximal diverting stoma as dehiscence and obstruction may not be clinically manifested, death due to medical reasons during the period of study, esophageal and rectal anastomoses, radiation enteritis complicated with bleeding, stricture or perforation, post chemotherapy.

### ***Sample size***

69 patients in each study group. So 138 in total.

The following formula has been used for sample size calculation:

$$n = Z^2 P(1-P)/d^2$$

n = sample size

Z = Z statistics for level of confidence

P = Expected prevalence or proportion (In proportion of 1; if 10%, P=0.1)

D = Precision ( in proportion of one; if 5%, d=0.05)

$$n = (1.96)^2(0.1)(1-0.1)/(0.05)^2$$

$$= 138.$$

### ***Procedure***

The study was conducted after permission from institutional ethics committee for biomedical research. Patients undergoing intestinal anastomosis either with single layer extramucosal method (study group) or with double layer full thickness method (control group) were enrolled in the study before surgery after obtaining written informed consent from them.

In control group that is double layer anastomosis; anastomoses were constructed with a 3-0 polydioxanone suture incorporating transmural (full thickness involving all layers) continuous sutures for inner layer and 3-0 silk Lembert (seromuscular means partial thickness incorporating only serosa and muscularis propria) interrupted sutures for the outer layer. Each suture bite was taken to include 3 mm of the bowel wall. Each successive suture bite was taken approximately 3 mm ahead of previous bite.

In study group that is single layer anastomosis group; anastomoses were performed with 3-0 polydioxanone in continuous fashion including all layers of the bowel wall except the mucosa (i.e. serosa, muscularis propria, submucosa). Each bite will include 3 mm of the serousubmucosal wall. Each successive suture was taken approx 3 mm ahead of previous suture.

All anastomosis were done by consultant with atleast 3 years of experience. Both groups received same standard of post-operative care. Investigations done as a routine standard of care were recorded in case record form and no additional investigations were done for the purpose of study alone. All patient in both groups were followed till discharge from hospital as all the outcome parameter were expected to occur during hospital stay.

Outcome parameters assessed were, length of suture material used, time taken for anastomosis, time taken for surgery, postoperative return of peristalsis and passage of flatus, postoperative complications like paralytic ileus, bowel obstruction, anastomotic dehiscence diagnosed by presence of enteric contents like bile or faeces in drain or wound or diagnosed on radiological imaging like CT scans, postoperative ICU and hospital stay.

Patients were assessed for outcome parameters as per predetermined schedule as follows.

Frequency of follow up, patients were assessed daily till post-operative day 7 and then every 3rd day or till discharge whichever is early. Data were recorded in the case record form. All the data thus collected was analysed statistically. Qualitative data generated was entered in Microsoft Excel sheets with inbuilt statistical tests. The proportions of outcome parameters were compared in two group using chi square test and unpaired t test.

## RESULTS

The mean age of population undergoing intestinal anastomosis in our study was 44.02 (SD.17.38) years. Amongst all the patients undergoing anastomosis 70.3% were males and 29.7% were females.

**Table 1: Demographics of sample.**

Variables	Value (%)	
<b>Age in years, mean (SD)</b>	44.02 (17.38)	
<b>Sex, n (%)</b>	Male	97 (70.3)
	Female	41 (29.7)
<b>BMI in kg/m<sup>2</sup>, mean (SD)</b>	22.42 (2.06)	
<b>Diabetes, n (%)</b>	Yes	33 (23.9)
	No	105 (76.1)
<b>Hypertension, n (%)</b>	Yes	36 (26.1)
	No	102 (73.9)
<b>Asthma, n (%)</b>	Yes	4 (2.9)
	No	134 (97.1)
<b>TB, n (%)</b>	Yes	44 (31.9)
	No	94 (68.1)
<b>Alcoholism, n (%)</b>	Yes	71 (51.4)
	No	67 (48.6)
<b>Smoking, n (%)</b>	Yes	43 (31.2)
	No	95 (68.8)
	No	87 (63.0)

Mean BMI of the study population was 22.42 kg/m<sup>2</sup> (SD.2.06). 26.1% patient were hypertensives and 23.9% patient were diabetics. 51.4% patient were alcoholics,

31.2% patient were smokers and 37% consumed tobacco (Table 1).

Abdominal tuberculosis was the most important condition requiring resection anastomosis. Of the total of 138 patient 44 (31.9%) patient had tuberculosis, most of them were obstruction at IC junction, caecal perforation requiring quarter colectomy or an ileal stricture requiring resection and anastomosis. 85 (61.6%) out of 138 anastomosis were ileo-ileal, 22 (15.9%) was ileo-ascending and 20 (14.5%) were jejunio-ileal.

**Table 2: Comparison of per-operative parameters and recovery outcomes.**

Variables	Anastomosis type		Unpaired t-test
	Single-layer (n=69)	Double-layer (n=69)	
<b>Length of suture used, mean (SD)</b>	37.04 (3.75)	60.77 (7.02)	t value.-24.762, p value.0.001
<b>Time taken for surgery in minutes, mean (SD)</b>	130.46 (19.30)	138.77 (22.55)	t-value.-2.233, p value.0.022
<b>Time taken for anastomosis in minutes, mean (SD)</b>	32.77 (4.81)	39.64 (5.45)	t-value.-7.846, p value.0.001
<b>POD resuming peristalsis, mean (SD)</b>	3.41 (0.63)	3.74 (0.90)	t-value.-2.522, p value.0.013
<b>POD resuming flatus, mean (SD)</b>	4.67 (0.78)	5.20 (1.08)	t-value.-3.346, p value.0.001
<b>Hospital stay in days, mean (SD)</b>	8.84 (3.11)	10.44 (5.87)	t-value.-1.996, p value.0.048
<b>ICU days*, mean (SD)</b>	2.25 (1.89)	3.6 (3.59)	t-value.-0.701, p value.0.497

**Table 3: Comparison of postoperative complications.**

Postoperative complications	Single layer group (n=69)	Double layer group (n=69)	Total	Chi <sup>2</sup> value (p value)
<b>Post-op distension, N (%)</b>	Yes 0 (0.0)	1 (1.5)	1 (0.7)	1.001 (0.500)
	No 69 (100.0)	68 (98.5)	137 (99.3)	
<b>Post-op vomiting, N (%)</b>	Yes 1 (1.5)	2 (2.9)	3 (2.2)	0.341 (0.500)
	No 68 (98.5)	67 (97.1)	135 (97.8)	
<b>Feces, bile, and pus in drain, N (%)</b>	Yes 4 (5.8)	8 (11.6)	12 (8.7)	1.460 (0.183)
	No 65 (94.2)	61 (88.4)	126 (91.3)	
<b>AXR: free gas/ air fluid levels, N (%)</b>	Yes 1 (1.5)	1 (1.5)	2 (1.5)	0.000 (1.000)
	No 68 (98.5)	68 (98.5)	136 (98.5)	
<b>ICU admission, N (%)</b>	Yes 4 (5.8)	10 (14.5)	14 (10.1)	2.862 (0.078)
	No 65 (94.2)	59 (85.5)	124 (89.9)	

Continued.

Postoperative complications	Single layer group (n=69)	Double layer group (n=69)	Total	Chi <sup>2</sup> value (p value)
<b>Death, n (%)</b>	Yes 0 (0.0) No 69 (100.0)	1 (1.5) 68 (98.5)	1 (0.7) 137 (99.3)	1.001 (0.500)

\*only 14 subjects were admitted to ICU, n= 4 for Single-layer and n=10 for double layer.

### **Length of suture material used**

Average of length of suture material used in single layer anastomosis was 37.04 cm whereas 60.77 cm was used in double layer anastomosis. P value was 0.001, hence the result was statistically significant (Table 2).

### **Time taken for anastomosis**

The average time taken for single layer anastomosis was 32.7 min while for double layer anastomosis was 39.64 min. with p value of 0.001, the result was statistically significant (p.0.001). This also translated in reduction in time taken for entire surgical procedure in single layer group to 130 mins compared to double layer group of 138 mins and this difference too was statistically significant with p value of 0.022.

Post-operative recovery of bowel function. The average period of resuming peristalsis post-surgery was 3.41 days in single layer anastomosis group and 3.71 days in double layer anastomosis group (p.0.013). The average period of passing of flatus post-surgery is 4.67 days in single layer and 5.2 days in double layer anastomosis group and the difference was statistically significant (p.0.001).

### **Complications (Table 3)**

- One patient who underwent double layer anastomosis had post-operative abdominal distension due to paralytic ileus which responded to conservative management.
- 3 patients had post-operative vomiting. 1 in single layer anastomosis group and 2 in double layer anastomosis group. One of which was the same patient who had paralytic ileus.
- 4 patient who underwent single layer anastomosis had feces/bile/pus in their drain s/o leak whereas 8 patient from double layer group had feces/bile/pus in their drain. The difference was statistically insignificant, p value=0.183.

### **Post-operative hospital stay**

In single layer group post-operative hospital stay was 8.84 days whereas in double layer group, post op stay was 10.44 days. And the difference was statistically significant (p=0.048).

### **ICU admission**

In single layer group, 4 patients required post-operative ICU admission. In double layer group 10 patients required

post-operative ICU admission. The difference was statistically insignificant (p=0.078).

### **Death**

There was 1 death in double layer group but that was not related to anastomosis. Patient was a known asthmatic and died of status asthmaticus.

## **DISCUSSION**

The mean age of population undergoing intestinal anastomosis is 44.02. In a RCT published in 2017 by Sibabratna Kar in Journal of Clinical and Diagnostic Research about comparison of single layer vs double layer anastomosis the mean age was 42 years.<sup>7</sup> Similarly Baviskar et al conducted a study on comparison of single layer versus double layer continuous anastomotic technique for small bowel resection and anastomosis where majority of patients were in the age group of 40-50 years and children.<sup>8</sup> Study conducted by Bhargava et al from Department of General Surgery, Sri Guru Ram Das Institute of Medical Sciences and Research, Vallab, Sri Amritsar, Punjab, India comparing single and double layer anastomosis showed a mean age of 32 years.<sup>9</sup> Among the patients undergoing anastomosis 70.3% were male and 29.7% were female.

In the study conducted by study conducted by Bhargava et al from Department of General Surgery, Sri Guru Ram Das Institute of Medical Sciences and Research, Vallab, Sri Amritsar, Punjab 59 out of 84 patients were male i.e 70.2% were male which coincide with our study.<sup>9</sup> In a RCT conducted by Burch et al comparing single versus double layer anastomosis, study published in Annals of Surgery 2000 there were 82 out of 132 males i.e 62.1%.<sup>10</sup>

In a RCT published in 2017 by Kar et al in Journal of Clinical and Diagnostic Research about comparison of single layer vs double layer anastomosis 34 of 97 patient had inflammatory pathology. In a study published in Annals of Surgery in 2000 by Burch et al conducted in Denver Health Medical Center, USA 31 out of 132 patient had inflammatory pathology, there were 35 patient of cancer and 31 patient of trauma.

In a study published in Pakistan Journal of Surgery by Shaikh et al from Dow university of health science and civil hospital, Karachi published in 2009, 38 out of 100 patients were having TB.<sup>11</sup> This suggest that inflammatory pathology plays a major contribution in intestinal disease requiring resection and anastomosis where as in western world cancer is the major etiology.

Length of suture materials required for performance of anastomosis was significantly less in single layer group. It is especially important for cost reduction in resource poor and developing country like us.

In our study time required for anastomosis and in turn for surgery was significantly less in single as compared to double layer group.

In a metanalysis including 6 studies done in 2006 by Shikata et al covering articles from 1966 to 2004 the arithmetical mean duration of anastomosis procedure in two included studies was 23.4 min vs. 36.9 min for single layer anastomosis vs double layer anastomosis respectively.<sup>12</sup> In a study of single-layer versus double layer intestinal anastomosis of small bowel at Nepalgunj Teaching Hospital published in July 2014 in mean time required in constructing the single layer anastomosis was  $17.59 \pm 1.16$  minute and for double layer anastomosis it was  $30.16 \pm 1.28$  minutes.<sup>13</sup>

In a study published in annals of surgery in 2000 by Burch et al conducted in Denver Health Medical Center, USA a mean of 20.8 minutes was required to construct a single-layer anastomosis versus 30.7 minutes for the two-layer technique.<sup>10</sup> In a RCT published in 2017 by Kar et al in Journal of Clinical and Diagnostic Research about comparison of single layer vs double layer anastomosis a mean of  $15.12 \pm 2.27$  minutes was required to construct a single-layer anastomosis versus  $24.38 \pm 2.26$  minutes for the two-layer technique.

In our study too, time required for anastomosis was significantly less in single layer group compared to double layer group which translated in statistically significant reduction in overall operation time. And reduced overall operative time indirectly is expected to lead to better postoperative recovery and improved patient outcomes. In our study, the incidents of complications like postoperative bowel obstruction, anastomotic dehiscence were not significantly different in both the groups (Table 3).

In a study of single-layer versus double layer intestinal anastomosis of small bowel at Nepalgunj Teaching Hospital published in July 2014 anastomotic leakage in single layer group occurred in 3 (9.37%) and in double layer group it was 2 (6.67%) which was statistically insignificant ( $p=0.696$ ). In a study published in annals of surgery in 2000 by Burch et al conducted in Denver Health Medical Center, USA anastomotic leakage in single layer group occurred in 2 (3.1%) and in double layer group it was 1 (1.5%).<sup>10</sup>

In a RCT published in 2017 by Kar et al in Journal of Clinical and Diagnostic Research about comparison of single layer vs double layer anastomosis there was no significant difference in the complication rates between the two groups ( $p$  value  $>0.05$ ).

In the study conducted by study conducted by Bhargava et al from Department of General Surgery, Sri Guru Ram Das Institute of Medical Sciences and Research, Vallab, Sri Amritsar, Punjab, there was leak in 1 patient (2.38%) in single layer group and 2 patient (4.7%) in double layer group, the 'p' value was 0.64 which was not statistically significant.

The apparent success of the single-layer continuous anastomosis may be attributed to several factors. Because less mesentery is cleared for the single-layer anastomosis, the cut edge of the bowel is more likely to have an adequate blood supply. Another factor is related to the properties of a continuous monofilament synthetic suture line. Although it is certainly possible to create an ischemic continuous anastomosis by applying too much tension while following the suture, Hautefeuille has argued that this is easier to avoid with a continuous suture because there is no point in the anastomosis where the bowel is completely devoid of its blood supply.

In contrast, this can easily occur to the tissue enclosed by an interrupted suture. Further, the surface of monofilament synthetic suture is slick and may permit areas of relative excess extension to equilibrate with surrounding areas of less tension by minute movements of tissue with respect to the suture material. Bailey et al have speculated that the continuous single-layer suture, which resembles a circular coiled spring, may be able to expand and contract depending on intraluminal forces. This, they argue, may also explain the rarity of stenosis of the suture line.

In our study, hospital stay was significantly marginally lesser in single layer group compared to double layer group. In a study published in annals of surgery in 2000 by Jon M Burch conducted in Denver Health Medical Center, USA, in single layer group post-operative hospital stay was 7.9 days were as for double layer group post op stay was 9.9 days although it did not quite reach statistical significance. In a RCT published in 2017 Kar et al in Journal of Clinical and Diagnostic Research about comparison of single layer vs double layer anastomosis post-operative hospital stay was  $5.9 \pm 1.43$  days in single layer group and  $7.29 \pm 1.89$  days for double layer group ( $p=0.023$ ). In a metanalysis published in BMC surgery journal including 6 studies done in 2006 by Satoru Shikata covering articles from 1966 to 2004 arithmetical mean length of hospital stay was 9.9 days vs. 13.0 days in single layer and double layer group respectively.

More number of patients in double layer group needed ICU stay but the difference was statistically insignificant ( $p=0.078$ ). Even though the difference is statistically insignificant, the increased days in ICU creates an economic burden on health sector.<sup>14,15</sup> These findings signify that single layer continuous is equally safe and effective method of bowel anastomosis in comparison to double layer and it can be recommended. As it has additional advantage of reducing operative time with better patient outcomes as well as its resource friendly.<sup>16</sup>

Limitation of study is that this is nonrandomised purely observational and retrospective study. Hence it is prone for selection biases.

## CONCLUSION

Thus in our study, single layer continuous method of intestinal anastomosis resulted in significant reduction in time, suture material length and cost; without any difference in complications and it marginally hastens the postoperative recovery of bowel function. So single layer continuous method can be recommended for intestinal anastomosis.

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