



## A COMPARATIVE STUDY OF SINGLE LAYER EXTRAMUCOSAL AND CONVENTIONAL DOUBLE LAYER COLOSTOMY CLOSURE IN PAEDIATRIC PATIENTS

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### ABSTRACT

A study was done on 30 paediatric patients with colostomy who were divided in two groups for colostomy closure by single or double layer technique. Efficacy of the techniques were assessed on the duration of anastomosis, post operative parameters, length of hospital stay, risk of wound infection, anastomotic leak, morbidity and cost of sutures. In our study, time for anastomosis in single layer group was 14.3 minutes while in the double layer group was 22.3 minutes. The incidence of wound infection was 6.7% in single layer versus 26.67% in double layer. There was one case of anastomotic leak in the double layer group. The cost of the anastomosis was half for single layer versus double layer group. The results suggested that a single layer extramucosal colostomy closure was a technically simpler, less expensive, resulted in no increased risk of leak or postoperative complications as compared to double layered colostomy closure.

**KEYWORDS** : colostomy closure; single layer anastomosis; double layer anastomosis

### INTRODUCTION:

The word anastomosis comes from the Greek word 'ana' without, and 'stoma' a mouth, i.e. when a tubular viscous (bowel) or vessel is joined after resection or bypass without exteriorisation with a stoma.

Conventional double layer technique consists of inner transmural full thickness sutures followed by Lembert's<sup>1</sup> interrupted seromuscular sutures. The inner layer is haemostatic and watertight while the outer layer inverts the inner layer and protects it.

Single layer extramucosal anastomosis can be continuous or interrupted, extramucosal or full thickness.

Recent advances in the field of anastomosis involve use of titanium staples preloaded on surgical staplers to perform anastomosis. Anastomosis techniques have improved considerably over the past years with the introduction of staplers for mechanical suturing. The advantage of having a reliable anastomosis and saving valuable operating room time compared with manual suturing, have been tainted by the higher cost for the single use stapling devices that need to be stocked in many variations and sizes.

A major challenge is the integrity of the anastomosis in order to avoid the risk of anastomosis leaking or rupturing into the peritoneal cavity with life threatening contamination and severe postoperative complications

The art of bowel anastomosis dates back into the 19<sup>th</sup> century. Halsted<sup>2</sup> advocated a single layer anastomosis and popularized extramucosal technique. According to him, "It was a bad surgery for the suture to enter the bowel lumen." But this technique couldn't gain widespread acceptance, the reason given by Aird<sup>3</sup> was, "It requires courage to deviate from the routinely performed two layer technique, to a single layer technique."

We decided to carry out a study to compare the results of single layer extramucosal to conventional double layer techniques of anastomosis for safety and efficacy. To prevent any bias in the study a single procedure was chosen, colostomy closures, to compare the two methods of anastomosis.

### MATERIALS AND METHODS

#### Inclusion Criteria

All paediatric patients (less than 12 years of age) admitted in the surgical wards of a tertiary care hospital, for colostomy closures were considered for the study. The cases were considered for single and double layer anastomosis, so as to avoid bias on age, sex and nutritional status in a randomized manner.

The paediatric patients (less than 12 years of age) included in this study are

1. Patients with colostomy for anorectal malformations
2. Patients with colostomy for Hirschsprung's disease.
3. Patients with colostomy for intestinal obstruction.
4. Patients with colostomy for blunt abdominal trauma.

#### Exclusion Criteria

- Patients above 12 years of age were excluded from this study

#### Sample size

- 30 patients admitted in SKNMC and GH during the period of September 2015 to September 2017

#### Type of study

- Prospective randomized

#### Plan of the study

- Both the techniques would be studied with respect to the following criteria

1. Amount of blood loss
2. Duration of surgery
3. Number of suture materials used
4. Post operative recovery
  - Day of return of bowel sounds
  - Day of removal of nasogastric feeding tube
  - Day of starting oral feeds
  - Day of removing drain
  - Day of discharge
5. Post operative complications
  - Early - Anastomotic leak
  - Wound infections
  - Wound dehiscence
  - Delayed - Post operative strictures
  - Post operative adhesions

#### Suture material used

- Extramucosal single layer closure
- 3-0 silk on round body
- Double layer closure
- Transmural - 3-0 silk on round body
- Seromuscular - 3-0 silk on round body

### RESULTS

We enrolled 30 patients in this study who were less than or equal to 12 years of age (ranging from 1 to 12 years of age) with a median age of 4.6 years in Group A (single layer group) and 3.6 years in Group B (double layer group). Of the 30 patients, 17 were males and 13 were females. Single layer group had 15 patients of which 9 were males and 6 females while double layer group had 15 patients of which 8 were males and 7 cases were females.

Of the 15 patients in single layer anastomosis group, 5 patients had Hirschsprung's disease while rest 10 had Anorectal Malformation as the cause for colostomy and of the other 15 patients in double layer anastomosis group, 4 patients had Hirschsprung's disease while rest 11 had Anorectal Malformation as the cause for colostomy.

In Group A ( single layer group) -10 patients had a sigmoid loop colostomy, 3 transverse loop colostomy and 2 double barrel colostomy while in Group B ( double layer group ) – 9 patients had sigmoid loop colostomy, 6 patients transverse loop colostomy and none had double barrel colostomy. Irrespective of the indication of the colostomy, the colostomy closure was done a minimum of 6 weeks after the distal anastomosis or repair. The type of colostomy did not make a difference in the outcome as the edges of the loop of the stoma were freshened before constructing the anastomosis.

Prior to the colostomy closure each of these cases underwent a distal loopogram to establish the patency of the distal bowel. As also all patients of Hirschsprung's disease were subjected to the Kanji test to check for proper functioning of the pull through ganglionic bowel. Of the 30 patients, in Group A ( single layer group )–out of 15, 4 cases had peristomal excoriation, 2 cases had sunken distal loop and 1 case had parastomal hernia while in Group B ( double layer group ) out of 15 patients – 2 cases had peristomal excoriation, 2 had sunken distal loop and none had parastomal hernia.

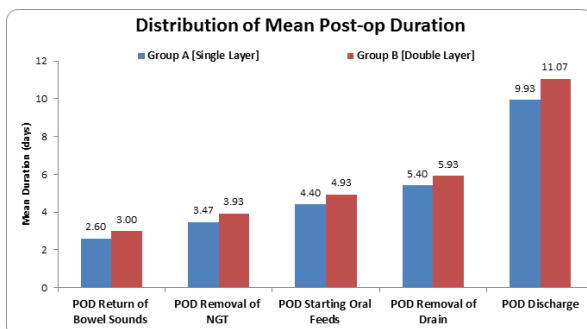
All the patients received a preoperative bowel preparation, mechanical bowel cleansing with Exelyte for proximal loop and distal loop was prepared with normal saline wash. They also received antibiotic prophylaxis on the preoperative day. It was observed that the duration of surgery was comparatively shorter for a single layer colostomy closure with the p value being <0.05 by independent sample t test. In the single layer group, the mean time for anastomosis was 14.3 minutes while that in the double layer group the mean time for anastomosis came to be 22.3 minutes. The volume of blood loss was also significantly lesser (p<0.05) in the single layer anastomosis as compared to the double layer closure. The mean blood loss in the single layer group was 28.7 ml while the blood loss in the double layer group was 36.7 ml.

The comparison done between the two techniques on basis of postoperative parameters are as follows-

**Table 1) The distribution of mean post-op parameters across two study groups.**

Post-op Day (POD) Parameters	Group A [Single Layer] (n=15)		Group B [Double Layer] (n=15)		P- value (Single Layer v Double Layer)
	Mean	SD	Mean	SD	
POD Return of Bowel Sounds	2.60	1.12	3.00	0.53	0.021*
POD Removal of NGT	3.47	1.12	3.93	0.46	0.004**
POD Starting Oral Feeds	4.40	0.80	4.93	0.46	0.004**
POD Removal of Drain	5.40	1.18	5.93	0.46	0.004**
POD Discharge	9.93	1.62	11.07	0.80	0.048*

Values are Mean and SD. P-values by Mann-Whitney U test. P-value<0.05 is considered to be statistically significant. \*P-value<0.05, \*\*P-value<0.01.



This trial proved that there is a significant difference in the intraoperative parameters – duration of surgery and amount of blood loss among the patients of colostomy closure by single layer technique as compared to a double layered closure technique.

The incidence of significant postoperative complication rate was not found to be different in either group. There were total of 5 cases of wound infection which were documented – one from the single layer group and the rest 4 from the double layer group. There was one instance of wound dehiscence/ burst abdomen in both the groups and one patient documented with anastomotic leak in the double layer group.

**Table 2) – Post operative complications across the two study groups**

	Anastomotic leak	Wound infection	Wound dehiscence /Burst abdomen	Re-exploration for leak
Single layer	0	1	1	0
Double layer	1	4	1	0
Total	1	5	2	0

In the patient who developed an anastomotic leak, return of bowel sounds were noted on the 5<sup>th</sup> postoperative day which were sluggish initially. After the presence of a leak was confirmed based on the drain output the patient was managed conservatively on the suspicion of a lateral leak. The same patient also developed full thickness wound dehiscence and burst abdomen. The patient recovered with conservative management and did not require re exploration for either anastomotic leak or burst abdomen. The nasogastric tube of this patient was removed on 9<sup>th</sup> postoperative day and the patient was started on oral feeds on the 10<sup>th</sup> postoperative day. The drain of this patient was removed on the 11<sup>th</sup> postoperative day and the patient was discharged on the 13<sup>th</sup> postoperative day.

The number of suture materials required for an anastomosis in a single layer anastomosis was one 3-0 silk in all the 15 patients of the single layer group, in comparison to a double layered anastomosis which required two silk 3-0 in all the 15 patients of the double layer anastomosis group. Hence, the single layer anastomosis was less expensive to construct, Rs.168, as compared to the cost of a double layer anastomosis, Rs.336.

**DISCUSSION**

Of the 30 patients included in this study, all the patients were less than or equal to 12 years of age with a median age of 4.6 years in Group A (single layer group) and 3.6 years in Group B (double layer group). At either extremes of age group the process of healing is impaired<sup>4</sup>. Of the 30 patients, 17 were males and 13 were females. Similar study of Wani et al<sup>5</sup> included 40 patients of which, 28 patients were male while 12 patients were female. Gender bias could be accounted for in Asian population, as the nutritional status of males, in terms of haemoglobin level was better as compared to females. The ages and sex of the patients in both the groups in our study were not significantly different and hence it did not affect the outcome of the study.

The most common cause for colostomy in paediatric age group are Anorectal malformations or Hirschsprung's disease. In our study, 21 patients had Anorectal malformation while 9 patients had Hirschsprung's disease. In the study of Wani et al<sup>5</sup> out of 40 patients –18 patients had colostomy done for Anorectal malformations while the rest 22 had ileostomy done for intussusception (6), ileal atresia (7) and perforation (9)

The ideal time for reversal of stoma is 9 to 12 weeks after the primary surgery, so as to allow the proper recovery from previous surgery and to let the adhesions settle on their own as also it gave an adequate interval for optimizing the nutritional status of the patient. The interval advocated by studies varied from 90 days in the study by Pokorny et al<sup>6</sup>, to 6 months in the study by Wani SA<sup>7</sup>

revealed the optimal timing of closure varies from the patient to patient, but report by Cha SH<sup>8</sup> concluded that closure within 6 weeks of the initial operation significantly increased the morbidity.

Controversy exists on whether mechanical bowel preparations influence the rates of anastomotic leaks in elective colorectal surgery. However, we decided to give all our patients bowel preparation as a standard protocol. The patients included in the Wani trial<sup>5</sup>, for colostomy closure by single versus double layer underwent elective surgeries while the studies of Baviskar et al<sup>9</sup>, Flores et al<sup>10</sup>, Ross et al<sup>11</sup>, Habash et al<sup>12</sup> included both elective as well as emergency cases for the comparison of single layer versus double layer anastomosis. The lack of a prepared bowel causing contamination and hence leak in emergency cases could cause bias in the study. Hence we chose colostomy closures, an elective procedure, as a mode for comparing and evaluating single and double layer anastomosis.

**Table 1 - Comparison of duration of anastomosis as per literature survey**

Study	Single layer	Double layer
Our study	14.3 mins	22.3 mins
Irvin et al (1973) <sup>13</sup>	23.4 mins	36.9 mins
Flores et al (1998) <sup>10</sup>	26 min	43 min
Aslam et al (2008) <sup>14</sup>	10.04 mins	30.7 mins
Khan et al (2010) <sup>15</sup>	20 mins	35 mins
Khair et al (2013) <sup>16</sup>	30 mins	45 mins
Mittal et al (2014) <sup>17</sup>	15.3 mins	24.2 mins
Saboo et al (2015) <sup>18</sup>	23.6 mins	33.06 mins

After the anastomosis was constructed the adequacy of the lumen was checked mechanically by insinuating a finger across the the anastomosis and doubly confirmed by milking the contents of the proximal loop across the anastomosis into the distal loop. It was found that the lumen of the extramucosal anastomosis was wider than the double layer anastomosis.

In our study we observed that the bowel sounds returned earlier in single layer anastomosis 2.47 days as compared to double layer anastomosis 3 days. The difference was considered significant as the p value was <0.05. The return of peristalsis lead to an early decrease in the nasogastric tube aspiration and early removal of the nasogastric tube in single layer anastomosis as compared to double layer anastomosis – Group A ( single layer group ) 3.33 days and Group B ( double layer group ) 3.93 days.

The prolonged duration of paralytic ileus and the delayed return of bowel sounds could be attributed to the comparatively greater anastomotic site oedema and ischemia caused by a double layer anastomosis as opposed to a single layer extramucosal anastomosis. It was demonstrated by Polglase et al<sup>19</sup>, in experiments on dogs, that there was least reduction in vascularity with single layer anastomosis.

In our study, patients who underwent single layer anastomosis were started on oral feeds on the 4.27 (mean) post operative day while those who had undergone double layer anastomosis were started on the 4.93 (mean) post operative day. The early resumption of the oral feeds caused improvement in the nutritional status and hence faster recovery. After the absence of leak was confirmed the drain was removed on 5.27 (mean) which was earlier in the single layer anastomosis group as compared to 5.93 (mean) in the double layer anastomosis group.

**Table 2) - Mean length of hospital stay for patients in both the groups in days**

Study	Single layer	Double layer
Our study	9.87	11.07
Irvin et al (1973) <sup>13</sup>	9.9	13.0
Maurya et al (1984) <sup>20</sup>	11.4	18.6
Flores et al (1998) <sup>10</sup>	10.4	10.4

In this study 30 patients underwent colostomy closure – of which the incidence of postoperative complications were almost equal in both single and double layer anastomosis. Both the groups documented one case of wound dehiscence/ burst abdomen which were managed conservatively. One patient included in this study, from the double layer group developed anastomotic leak. However the leak was managed conservatively on the suspicion of a lateral fistula as the patient did not show any signs of peritonitis and was passing stools per rectum. This patient recovered well with conservative management and did not require re – exploration. There was no mortality in this study.

The findings with respect to anastomotic leak have been listed in the table below.

**Table 3 - Comparison of anastomotic leak**

Study	Single layer	Double layer
Our study	0	1(6.7%)
Irvin et al (1973) <sup>13</sup>	5 (17%)	5(16%)
Goligher et al (1977) <sup>21</sup>	31 (45%)	17 (26%)
Flores et al (1988) <sup>10</sup>	2 (5%)	3 (7%)
Maurya et al (1988) <sup>20</sup>	4 (7%)	12 (18%)
Mittal et al (2014) <sup>17</sup>	2 (6.67%)	2 (6.67%)
Saboo et al (2015) <sup>18</sup>	3 (10%)	2 (6.67%)

The incidence of wound infection in the single layer patients was 6.7% and in double layer patients was 26.7%. There was no mortality in either group in this study.

The patients were followed up postoperatively for 6 months in our study. There was no incidence of obstruction, anastomotic stricture, anastomotic stenosis or any other long term complication in either group during the duration of our study. These patients were followed up with dye studies done at 6 months to check for evidence of strictures, luminal narrowing or stenosis.

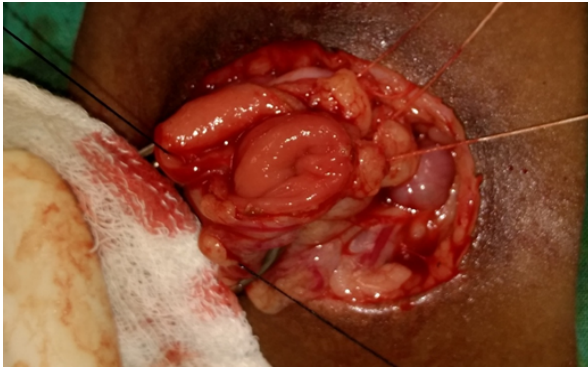
**CONCLUSION**

In our study, a randomized prospective trial, 30 patients were divided into two groups evenly matched for age, sex and nutritional status, colostomy closure was done after mobilizing the stoma loops and refreshing the edges. Prior to the operation patency of the distal loops were checked by a distal loopogram and distal stomal loop washes and anal dilatation was done by Hegar's dilator followed by adequate mechanical bowel preparation and antibiotic prophylaxis given preoperatively. Closure was done either by single layer extramucosal or conventional double layer technique and the patient was followed upto 6 months postoperatively. The results from this study suggest that a single layer extramucosal colostomy closure was a technically simpler, less expensive to construct , resulted in no increased risk of leak or postoperative complications, causing lesser patient morbidity and shorter postoperative stay at the hospital for patients as compared to patients undergoing double layered colostomy closure. Hence we advocate the use of single layer extramucosal anastomosis for all cases of colostomy closure in paediatric age group.

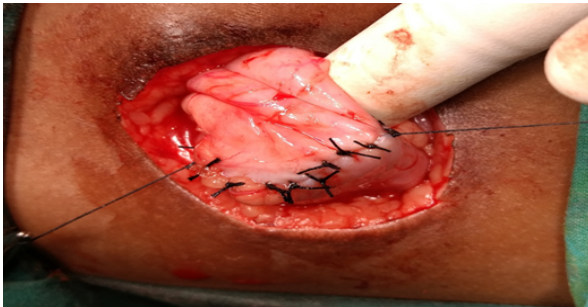


**Figure 1 – Colostomy completely mobilized**

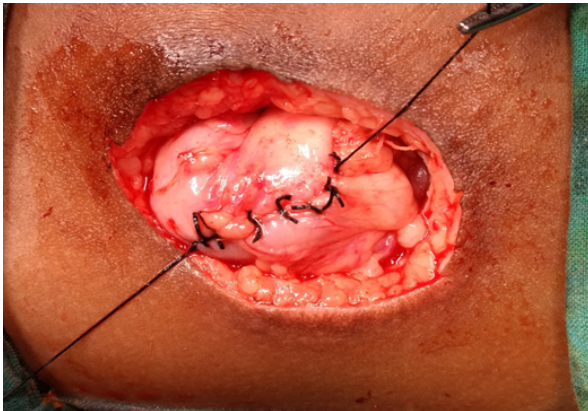


**DOUBLE LAYER ANASTOMOSIS**

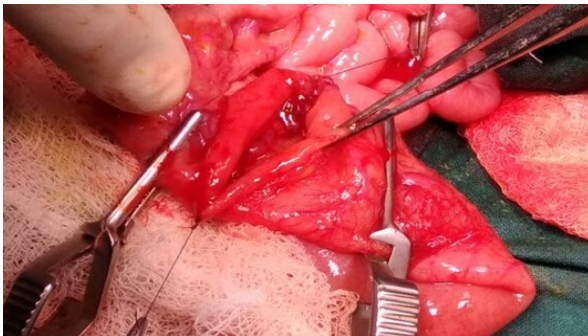
**Figure 2 – Colostomy stump has been excised. Both the proximal and distal colonic bowel loops can be visualised. The first hitch suture of Lembert's transmural suture has been taken with silk (inner layer)**



**Figure 3 – Interrupted seromuscular sutures of anterior layer involving proximal and distal loop has been done inverting the previous suture line**



**Figure 4 – Interrupted seromuscular sutures of posterior layer involving proximal and distal loop has been done inverting the previous suture line**

**SINGLE LAYER ANASTOMOSIS**

**Figure 5 – Anterior layer extramucosal single layer anastomosis**



**Figure 6 – Posterior layer extramucosal single layer anastomosis**

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