Continuous double loop closure for midline laparotomy wounds

Ghassan A. Nasir, FRCS(Ed), FICS, *Kais K. Baker,* MBChB.

ABSTRACT

Objective: To determine the efficiency of continuous double loop closure of midline laparotomy wounds and how it prevents and reduces wound dehiscence.

Methods: A prospective study of one hundred patients who underwent laparotomy through midline incision in Basrah General Hospital over a one year period. This study is designed to compare the difference between 2 suturing techniques for closure of midline laparotomy wounds, one is new and unpopular to use, which is the continuous double loop closure, and the other one is the continuous mass closure technique.

Results: By comparison of the 2 techniques, we found that infection of wounds was less using the continuous double loop closure technique (12%) as compared with the control (18%). We also found that wound dehiscence is nil with the continuous double loop closure technique as compared to 8% with the control.

Conclusion: The continuous double loop closure technique is superior in closure of midline laparotomy wounds and prevention of wound dehiscence and we recommend it for closure of these wounds in high risk patients.

Keywords: Laparotomy wounds, midline closure, continuous double loop closure.

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Closure of the abdominal wall during surgery should be a routine procedure and is one of the first things a surgeon in training is taught.[1] A surgeon will successfully close thousands of laparotomy wounds during his career, but the problem of wound dehiscence after laparotomy remains challenging.[2] Increasing the strength of the sutured wound could prevent wound rupture.[2] Continuous double loop closure (CDLC) is a new and unpopular technique for laparotomy wound closure.[1,2] The aim of this study to assess the benefit of CDLC closure by comparison with ordinary continuous mass closure of midline laparotomy wounds.

Methods. This is a prospective study of one hundred patients who underwent laparotomy through midline incision conducted in the Department of Surgery in Basrah General Hospital during the period between June 1998 and July 1999. It is a comparative study designed to assess the differences between 2 suturing techniques for closure of midline laparotomy wounds. We divided our patients into 2 groups, each with 50 patients chosen randomly to minimize the variables. The patients were referred from private clinics, peripheral hospitals, out-patients and casualty departments. We examined and evaluated the patients preoperatively (including history, clinical examination, laboratory investigations and x-ray evaluations according to the patient), noting that some of the investigations were not performed in emergency cases due to shortage of laboratory facilities. Patients suffering from different pathologies were operated on (both elective

From the Department of Surgery, Saddam Medical City, Baghdad (Nasir), and the Department of Surgery, General Basrah Hospital, Basrah (Baker), Iraq

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Address correspondence and reprint request to: Dr. G. A. Nasir, Medical City Post Office (12114), PO Box 61078, Baghdad, Iraq. Tel. +964 (1) 7741255/8864666. Fax. +964 (1) 7193867.

and emergency) under general anesthesia as show in Table 1. In 50 patients the closure of laparotomies was carried out using the CDLC technique for the anterior abdominal wall, and in the remaining 50 patients (the control group) using continuous mass closure. The procedures were carried out by one surgeon and using one type of suture material (polypropylene NO 0). The CDLC technique is performed by passing the needle through the anterior rectus sheath, rectus muscle, the posterior rectus sheath and the peritoneum approximately 2.5-3 cm from the edge of incision, entering the peritoneal cavity. The needle is then passed through the same layers on the opposite side of the wound. The distance from the edge is identical for the outer loop. The needle is then passed through the anterior rectus sheath, rectus muscle and posterior sheath of the first side approximately 0.5-1 cm from the edge, and passed through the same layers on the opposite side forming the inner loop. The sutures are placed approximately 1-1.5 cm apart.[2] Drains were placed according to the patients through a separate incision. The skin was closed classically and conventional dressings were applied. In the postoperative period, all the patients were given antibiotics according to the operative findings. The majority of the patients were discharged from hospital on the 5th-7th postoperative days, and the skin stitches were removed on the 10th postoperative day. All patients were routinely examined again at the 3rd and 6th postoperative week.

Table 1 - Shows the pathology of the patients.

Pathology	CDLC No.	CDLC %	Control No.	Control %
Gastroenterology & Hepatobiliary				
Esophageal and stomach carcinoma	2	4	2	4
Duodenal ulcer	8	16	8	16
Perforated duodenal ulcer	5	10	6	12
Perforated small intestine	4	8	4	8
Perforated large intestine	1	2	1	2
Small intestine obstruction	5	10	6	12
Large intestine obstruction	6	12	5	10
Ischemic bowel	1	2	1	2
Toxic dilatation of colon	-	-	1	2
Empyema of gall bladder	1	2	1	2
Liver injury	1	2	1	2
Advanced malignancy	1	2	1	2
Rectal prolapse	1	2	-	-
Jaundice	1	2	-	-
Urological				
Kidney tumor	1	2	1	2
Bladder tumor	2	4	2	4
Gynecological				
Ectopic pregnancy	2	4	3	6
Hemorrhagic ovarian cyst	2	4	2	4
Twisted ovarian cyst	2	4	2	4
Hysterectomy	2	4	2	4
Abdominal wall hernia				
Repair of incisional hernia	1	2	1	2
-ve laparotomy	1	2	1	2
TOTAL	**50**	**100**	**50**	**100**

CDLC - Continuous double loop closure
No. - Number
-ve - negative

Table 2 - Type of incision among patients.

Type of incision	CDLC No.	CDLC %	Control No.	Control %
Upper midline	19	38	17	34
Lower midline	27	53	24	48
Whole midline	4	8	9	18
TOTAL	**50**	**100**	**50**	**100**

Results. Our study was conducted on one hundred patients who were subjected to midline laparotomies.

Age and sex distribution. The age of patients in the CDLC group ranged from 9 months to 73 years, with mean age of 39.4 years. Sixty six percent were male and 34% female. The majority of the patients were between 30-59 years of age (58%). In the control group, the age of the patients ranged from 1 year to 69 years, with a mean age of 36.6 years. Sixty eight percent were male and 32% female. The majority of the patients were also between 30-59 years of age (58%).

Type of incision. The main type of incision was the lower midline incision in both groups as shown in Table 2.

Type of surgery. There were 52 elective and 48 emergency operations carried out. Fifty six percent (28 patients) of elective operations were closed by CDLC and 48% (24 patients) closed by continuous mass closure. Forty four percent (22 patients) of emergency operations were closed by CDLC and 52% (26 patients) by continuous mass closure.

Medical illness. Malignancy was the main medical illness in both groups (14% of the CDLC group and 16% of the control group). Noting that some patients had more than one illness, eg. malignancy, diabetes mellitus and renal failure.

Infection. Infection occurred in 18% of the control group and 12% of the CDLC group, as show in Table 3.

Incidence of wound dehiscence. There were 4 patients in the control (8%) that developed wound dehiscence, but none in the CDLC group. The characteristics of the 4 patients who developed wound dehiscence are summarized in Table 4.

Discussion. Despite increased knowledge of wound healing and advances in suture materials and

Table 3 - The infection incidence in the patients.

Type of surgery	CDLC No.	%	Control No.	%
Emergency	4	8	6	12
Elective	2	4	3	6
TOTAL	**6**	**12**	**9**	**18**

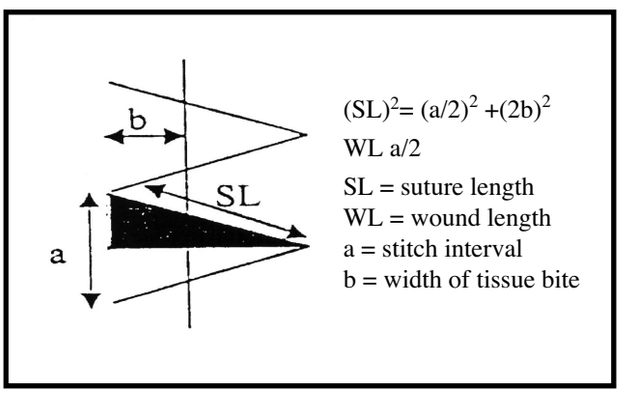

Figure 1 - Pythagorean theorem demonstrating suture length:wound length ratio.

wound care, the incidence of wound dehiscence has not declined.[3] In 12 series before 1940 (including more than 71,000 incisions) the incidence ranged from 0.24% to 3%, while the incidence among 34 series published between 1950-1984 (including 320,000 incisions) ranged between 0.25% to 6%.[5,12] The wound disruption data published after 1985 among 18,133 incisions was 1.2% which does not demonstrate a downward trend from earlier series. The length of suture material and its ratio to the length of the wound is important in reducing the incidence of wound dehiscence.[1] In classical continuous mass closure, the stitch interval was 1 cm and the width of tissue bits was 1 cm giving a suture length:wound length ratio (SL:WL) of 4:1.[1] This can be calculated with the Phythagorean theorem applied to the shaded triangle in Figure 1. Jenkins advised the use of at least 4:1 suture length to wound length to secure adequate reserve of suture length to allow for the abdominal distension that may occur after operation and postulated a lower incidence of wound failure. In the post-operative period an abdominal incision may lengthen by 30% if the abdomen was distended, so the stitch interval elongates in step with the incision, and when combined with small tissue bite these sutures (which only approximate the wound edge during closure) may then strangulate the wound edges and cause necrosis. So there is an increased tendency for the suture to cut through the tissue.[2,5] Martyak and Curtis[5] advocated a longer tissue bite of 2.5-4 cm from the wound edge and recorded no dehiscence in 280 midline incisions. In CDLC, the width of tissue bite was more than 2 cm giving an SL:WL ratio of 8:1 according to the previous equation $(SL)^2-(a/2)^2+(2b)^2$. In our study, 2 male and 2 female patients presented with burst abdomen, giving a M:F ration of 1:1 in the control group, which corresponds to other studies of burst abdomen which regards the male sex as a risk factor. Burst abdomen occurred in 4 patients in the control group of different ages (one older age, 2 younger age

Figure 4 - Summary of 4 cases of wound dehiscence.

Patients	Sex	Age	Type of surgery	Type of incision	Pathology	Infection	Predisposing factors	Mortality
Patient 1	Female	63 years	Elective	Upper midline	Small intestine malignancy	negative	old age malignancy malnourished	negative
Patient 2	Female	25 years	Emergency	Lower midline	Hemorrhagic ovarian cyst	positive	obese infection	negative
Patient 3	Male	36 years	Emergency	Lower midline	Perforation small intestine typhoid fever	positive	peritonitis septicemia	positive
Patient 4	Male	1 year	Emergency	Lower midline	Paralytic ileus perforation of colon	positive	peritonitis septicemia	positive

and one infant). Although the disruption of abdominal wounds occurs more frequently in older rather than younger aged patients, this means that other risk factors should be considered in our patients. In our study, the burst abdomen occurred in 3 patients with lower midline incision and in one patient with upper midline incision of the control group, and to none of the patients in the CDLC group. Although other studies show that disruption occurred more in the upper midline incisions,[7] this belief has not been verified by the available prospective data.[8] Dehiscence occurred in 3 out of 52 cases of emergency operations and in 1 out of 52 cases of elective operations. This is confirmed by current reports which regard emergency operations to be a risk factor for development of dehiscence.[9,10] This may be related to the hemodynamic unstability of the patients and to the unscheduled operations. The associated medical illnesses from 32% of the CDLC group and 28% of the control group and the main medical illness, malignancy, which forms 14% of the CDLC group and 16% of the control group are considered risk factors. The infection rate was 12% in the CDLC group, although no wound dehiscence was noted, and 18% in the control group which showed 4 cases of dehiscence. The infection may be the cause of the dehiscence, in which the fascia has disintegrated by necrotizing infection.[13,14] The infection could be due to operations on immunocompromised patients with different medical illness and infections occur more in emergency operation patients who can be hemodynamically unstable. The decreased rate of infection in the CDLC group may be due to the configuration of the suture material, which allows the use of thread with elasticity without compromising wound approximation, the outer loop pulls the inner loop tightly if the tensile force on the wound increases. Thus keeping the edge of the wound approximated and decreasing the chance of strangulation.[2] Burst abdomen occurs in 0.5-5% of abdominal operations with a mortality of approximately 30%.[7] In our study, burst abdomen occurred in 8% of the control group with a mortality of 50%, however, there were no cases of burst abdomen in the CDLC group. When the results are statistically evaluated, the fisher test is marginally significant and favors CDLC ($p=0.059$), but the chi square test cannot be applied due to the small sample size. The decrease in dehiscence in the CDLC group may be attributed to that, the greater tissue strength is obtained by taking a wide bite of the tissue, and to the total amount of the tissue encircled by the double loop suture, which is at least twice that encompassed by continuous mass closure. This reduced the force per unit area and reduced the fascial disruption and led to increased strength of the sutured wounds. Also, when the tensile force on the wound increased, the outer loop, which contains more tissue than the inner loop, pulled the inner loop tight which results in perfect apposition of the wound edges instead of divergence, as is the case in continuous mass closure.[2] This superiority of the CDLC technique in decreasing wound dehiscence may outweigh the consumption of a few extra minutes in surgery time. Lastly, our study shows that the CDLC technique is superior to continuous mass closure in dealing with midline laparotomy wounds and is recommended in high risk patients.

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References

1. Slater BJ, Leapear DJ. Laparotomy, wound closure and repair of incisional hermis. Surgery International 1988; 41: 91-95.
2. Niggebrugge AHP, Trimbose JB, Hermans J, Knippenberge B, Velde CJH. Continuous double loop closure: A new technique for repair of laparotomy wounds. Br J Surgery 1997; 84: 258-261.
3. Junji M, Akira G, Yasuaki K, et al. Chopstick retention sutures for the closure of abdominal wounds. J Am Coll Surg 1995; 181: 471-474.
4. Ellis H. Incision, closure and management of wound. In: Zinner MJ, Shwart SI, Ellise H, editors. Maingot's abdominal operations. 10th ed. USA: Prentice Hall International; 1997. p. 416-425.
5. Barbul A. Wound healing. The Surgical Clinics of North America 1997; 77: 3.
6. Jenkins TPN. The burst abdominal wound: A mechanical approach. Br J Surg 1976; 63: 873-876.
7. Walter JB, Talbot IC. Wound healing. In: Walter JB, Israel MS, editors. General Pathology. 7th ed. Edinburgh, London, New York: Churchill Livingstone; 1996. p. 165-180.
8. Richards PC, Balch CM, Aldrete JS. Abdominal wound closure: A randomized prospective study of 571 patients comparing continuous vs. interrupted suture techniques. Ann Surg 1983; 197: 238-243.
9. Makela JT, Kiviniemi H, Juvonen T et al. Factors influencing wound dehiscence after midline laparotomy. Am J Surg 1995; 170: 387-390.
10. Niggebrugge AH, Trimbose JB, Hermans J, Knippenberge B, Velde CJH. Mechanical factors influencing the incidence of burst abdomen. Eur J Surg 1995; 161: 655-661.
11. Riou JP, Cohen JR, Johnson H. Factors influencing wound dehiscence. Am J Surg 1992; 163: 324-330.
12. Col C, Soran A, Col M. Can post operative abdominal wound dehiscence be predicted? Tokai J Exp Clin Med 1998; 23: 123-127.
13. Gislason H, Gronbech JE, Soreide O. Burst abdomen and incisional hernia after major gastrointestinal operations - comparison of three closure techniques. Eur J Surg 1995; 161: 349-354.
14. Poole GV. Mechanical factors in abdominal wound closure: The prevention of fascial dehiscence. Surgery 1985; 97: 631-640.