Modified Technique for Closure of Midline Abdominal Incisions

M ABDULLAH
Department of Surgery, Divisional Headquarters Hospital & Shafi Hospital, Sargodha, Pakistan.
Correspondence to Dr. Muhammad Abdullah, Consultant General Surgeon, E mail: khokhar7@hotmail.com

Background: Surgical minds are still in the search for ideal method of closure of laparotomy incision. Nonabsorable sutures have decreased the incidence of dehiscence and incisional hernia but cause suture sinuses, painful suture knots and button-hole defects. The present study describes a modified technique with polypropylene and evaluates its complication rate. **Methods:** This study is prospective analysis of 140 patients having undergone closure of midline laparotomy incisions using this technique during the period January 1999- December 2003. All the patients were followed for 12 months. Principle outcome measures were post operative complications of dehiscence, incisional hernia, infection, suture sinuses, button-hole defects and pain at wound. **Results:** Post-operative complications encountered included 12 patients with wound infection, 2 with dehiscence and 1 with incisional hernia. No patient reported with suture sinus, button-hole defect or chronic painful wound. 89.28% (125) patients studied had satisfactory repair with no complications. **Conclusions:** The technique described here provides a safe repair using nonabsorbable suture with low complication rate. This technique may be used with absorbable sutures.

Key words: midline abdominal incision, abdominal closure, suture technique

Secure wound closure is essential for an uncomplicated and appropriate recovery after major abdominal surgery. The incidence of fascial disruption after major abdominal operations is 1% to 3% and dehiscence is associated with a mortality rate of 15% to 20%[1]. The reported cumulative incidence of incisional hernia varies 9% to 19%[2-4]. Incisional hernias often require repair, with post-operative recurrence rates as high as 45%[5]. Although wound dehiscence and incisional hernia are major concerns but the long term wound complications of suture sinuses, painful suture knots and button-hole defects are also important contributors to postoperative complications.

There is broad agreement that continuous closure with nonabsorbable suture should be used to close most midline abdominal wounds[6]. But nonabsorbable sutures have greater incidence of chronic pain[7], suture sinuses[8] and "buttonhole" incisional hernia formation[9].

We describe our experience with a technique of midline abdominal wound closure with monofilament polypropylene which shows a reduced incidence of wound dehiscence, incisional hernia formation, suture sinuses, painful suture knots and buttonhole defects.

Patients and Methods:

This prospective clinical study was conducted at Divisional Headquarters Hospital and Shafi Hospital Sargodha, Pakistan, during the period between 1st Jan, 1999 and 31st Dec, 2003. A total number of 140 consecutive patients who underwent closure of midline abdominal incisions were included in the study. All the closures were done with polypropylene #1(prolene#1) and both elective and emergency operations were included. All these patients were personally operated by the author. Similar technique was used for clean, clean contaminated and contaminated cases. A consistent antibiotic policy was adopted in all cases. All clean procedures received prophylactic antibiotics. A pre-operative dose of injection Cefuroxime and Metronidazole was given 30 minutes before induction of anesthesia and two doses of same combination were repeated at 8 hours interval. The clean contaminated and contaminated procedures received antibiotics for longer periods ranging from 5 days to 14 days. Principle outcome measures included dehiscence, infection, hernia formation, suture sinus formation, button-hole defects and pain. All the patients were followed closely for 12 months.

Technique: The technique is very simple. Although per-operative pictures are presented but foam sheet is used to demonstrate the technique. In each of the wounds two strands of polypropylene #1 was used and continuous mass closure was done. One strand of suture was used to repair from one end of the wound. First bite of suture from each end was taken from inside-out on one edge and outside-in on the other edge of the linea alba and the knots tied on the inside.(Fig.1-5) The first throw was a surgeon's knot and four additional throws on top of it to complete the knots at both ends of the wound. Running closure was done with all sutures placed 1.5 cm from the fascial edge and 1 cm apart. Sutures were placed perpendicular to the edges with minimal tension just to co apt the edges (Fig.6) Both strands were brought towards the middle part of the wound and left on the inside (Fig.7&8) The last knot was placed in the similar manner as the first two and cut at 1cm after the last throw. Then the knot was pushed to the inside after lifting the edges. (Fig.9&10).The bite with apparent excess tension was eased by distribution of the suture evenly all over the wound. Hence all the three knots were placed towards the peritoneal surface with a tension free repair using the adequate suture length- to- wound length ratio (SL: WL). (Fig.11-13) No sutures were placed in the subcutaneous tissue and skin was closed with polypropylene #2/0 sutures, interrupted mattress or subcuticular.

Results:

140 patients underwent closure of midline laparotomy incision between January 1999 and December 2003. Among the studied patients, 59.2% (n=83) were males and 40.7% (n=57) females. 61.42% (n=86) operations were done as elective procedures and 38.58% (n=54) as emergency procedures. The technique described has been applied for closure of midline laparotomy incision after a wide range of surgical procedures (Table1). Out of 140, 23.57% (n=33) operations were performed for penetrating abdominal trauma, 27.14% (n=38) were done for intestinal obstruction, 42.14% (n=59) were done for peritonitis and 7.14% (n=10) were performed for other causes. All the patients were followed for 12 months. The outcome variables of dehiscence, infection, hernia formation, suture sinus formation and pain were studied and their occurrence was recorded. 12 patients developed wound infection, 2 patients had dehiscence, 1 patient developed incisional hernia, none of the patients reported with suture sinuses or chronic painful wound (Table 2).

Table1: Number of patients for which the technique was used.

Diagnosis	n=	%age
Penetrating Abdominal trauma (Firearm & stab injuries)	33	23.57
Intestinal Obstruction	38	27.14
• adhesions & band obstruction	9	
• intestinal tuberculosis	8	
• malignancy colon	6	
• strangulated hernia	5	
• inflammatory colonic mass	3	
• volvulus sigmoid colon	2	
• pyloric stenosis	2	
• volvulus ileum	1	
• mesenteric ischemia	1	
• stricture ileum (congenital)	1	
Peritonitis	59	42.14
• typhoid perforation	24	
• perforated appendix	11	
• tuberculous peritonitis	8	
• perforated duodenal ulcer	4	
• primary peritonitis	4	
• traumatic ileal perforation (blunt)	3	
• faecal fistula (post-operative)	3	
• uterine perforation (iatrogenic)	2	
Miscellaneous	10	7.14
• twisted ovarian cysts	4	
• end-ileostomy closure	3	
• hydatid cysts liver	3	
	140	100

Table 2: Results of the study.

Post-operative complication	n=	%age
Wound infection	12	8.57
Dehiscence	2	1.42
Incisional hernia	1	0.71
Suture sinus formation	nil	Nil
Chronic wound pain	nil	Nil
Button-hole defects	nil	Nil

Discussion:

The ideal method of abdominal wound closure has not been discovered. It should be technically so simple that the results are as good in the hands of a trainee as in those of surgical masters; it should be free from the complications of burst abdomen, incisional hernia and persistent sinuses. It should be comfortable to the patient and it should have a reasonably aesthetic scar.

Present day issues confronted by the surgeon regarding midline abdominal incision closure are: suture type, continuous or interrupted method of closure, suture to wound length ratio and prevention of complications due the suture used.

Many trials have been conducted comparing absorbable and nonabsorbable sutures with conflicting results[8,10,11,12,13]. Traditionally nonabsorbable sutures, mostly polypropylene, have been used but it has been demonstrated that polydioxanone (PDS), unlike all other absorbable sutures, did not have an increased risk of incisional hernia. Polyglactin (vicryl) appeared to have a significant risk of incisional hernia when compared with nonabsorbable sutures. Similarly large studies are carried out comparing continuous and interrupted suturing techniques. Clearly the evidence supports a significant benefit in using nonabsorbable sutures. Nonabsorbable sutures retain tensile strength for the duration of fascial healing[5]. Continuous suture technique also has the added benefit of being easier and less time-consuming[14].These trials have recently been subjected to mete-analysis by Weiland et al[6] and Hodgson et al[15]. In conclusion, there is reported high-quality level I evidence that the ideal suture in reducing incisional hernia rates is a nonabsorbable suture material and a continuous technique[15].

In the present scenario, although the problem of wound dehiscence and incisional hernia have been dealt to great extent due the non-absorbable and delayed absorbable sutures but the problem of suture sinuses and painful suture knots are still prevalent. Although the sinuses are produced mostly by non-absorbable sutures[16,17,18] but absorbable sutures cannot completely prevent the development of suture sinuses and granuloma[11,19].The incidence of suture sinuses with three suture materials namely monofilament nylon(ethilon), braided nylon(nurolon) and polydioxanone(PDS-II) used for closure of midline abdominal incisions was 3.3%, 10% and 6.6% respectively[20]. The cause of sinus formation long after the wound has healed is not clear. Grany (1982) in a retrospective clinical study of suture sinuses in abdominal wounds found that 90% of wounds studied had a monofilament suture at the base of sinus. It did not explain whether this was related to the material itself or the knot[21]. Post-operative wound sinuses always develop from a combination of low grade infection and foreign material, which is the suture material inserted by the surgeon[22].

Although suture length-to-wound length ratio, (SL: WL) is thought to be important in the prevention of

incisional hernia formation, there is no evidence from randomized trials to support this[23]. Jenkins was the first to define an ideal ratio on the basis of both clinical trials and a mathematical model. He recommended that for safe closure of laparotomy wounds a SL: WL ratio of at least 4:1 is necessary[24]. Israelsson and Jonsson found that SL: WL ratio was an independent predictor for the development of an incisional hernia[12]. Varshney et al proposed that an ideal SL: WL should approach 6:1.27 and approximately 6cm of suture material is required per stitch when taking 1cm by 1cm bites[25]. In a recent experimental study by Cengiz et al, the authors found that wound bursting strength increases with the number of stitches used[26].

Another drawback of non-absorbable suture material is the incidence of "button-hole 'incisional hernia formation[9]. This appears to be a late complication which is thought to be due to the cheese wire effect of the permanent suture material against the rectus sheath at the site of stitch penetration leading to multiple small incisional hernias[23].

The above described technique has followed all the present day guidelines regarding midline abdominal incision closure. Monofilament polypropylene #1 (Prolene #1) was used in continuous suturing. Two strands, one from each end with sutures placed at 1.5 cm from the fascial edge and 1cm apart easily gave the SL: WL greater than 4:1. By using two strands in every closure, surgeon is neither pushed for completing the sutures within the available suture length nor adding more knots to increase the suture length with further strands. Traditionally most of the surgeons have been placing the first knot on the inner side of the wound and then burying the last knot after running closure. Even the best effort to bury the last knot is hardly satisfactory and these large knots lead to long-term pain, palpable painful knots especially in thin patients, suture sinuses and buttonhole defects.

The described technique is easy to perform, produces a tension free repair and has shown decreased incidence of all complications.

References:

1. Poole GV Jr. Surgery 1985 Jun; 97(6):631-40.
2. Mudge M, Hughes LE. Incisional hernia; a 10-year prospective study of incidence and attitudes. Br J Surg 1985; 72:70-71.
3. Israelsson LA, Jonsson T. Incisional hernia after midline laparotomy: a prospective study. Eur J Surg 1996; 162: 125-129.
4. Osther P J, Gjode P, Mortensen BB, et al. Randomized comparison of polyglycolic acid and polyglyconate sutures for abdominal fascial closure after laparotomy in patients with suspected impaired wound healing. Br J Surg 1995; 82: 1080-1082.
5. Gecin E, Kocak S, Erscz S. Recurrence after incisional hernia repair: results and risk factors. Surg Today 1996; 26: 607-609.
6. Weiland DI, Curtis Bay R, Del Sordi S. Choosing the best abdominal closure by meta-analysis. Am J Surg 1998; 176: 666-70.
7. Mantel N, Haenszel W. Statistical aspects of the analysis of data from retrospective studies of disease. J Natl Cancer Inst 1959; 22: 719-48.
8. Leaper DJ, Pollock AV, Evans M. Abdominal wound closure: A trial of nylon, polyglycolic acid and steel sutures. Br J Surg 1977; 64: 603-06.
9. Krukowski ZH, Matheson NA. "Button hole" incisional hernia: a late complication of abdominal wound closure with continuous nonabsorbable sutures. Br J Surg 1987; 74: 824.
10. Krukowski ZH, Cusick EL, Engeset J, Matheson NA. Polydioxanone or polypropylene for closure of midline abdominal incisions: a prospective comparative clinical trial. Br J Surg 1987; 74: 828-30.
11. Wissing J, van Vroonhoven Th JMV, Schattenkerk ME, Veen HF, et al. Fascia closure after midline laparotomy: results of a randomized trial. Br J Surg 1987; 74: 738-41.
12. Israelsson LA, Jonsson T. Closure of midline laparotomy incisions with polydioxanone and nylon: the importance of suture technique. Br J Surg 1994; 81: 1606-08.
13. Binnie NR, Bainbridge CL, Macintyre IM. Abdominal wound closure with polydioxanone (PDS). J R Coll Surg Edin 1986; 31: 147-50.
14. Richards PC, Balcj CM, Aldrette JA. A randomized prospective study of 571 patients comparing continuous vs interrupted suture techniques. Ann Surg 1983; 197: 238-243.
15. Hodgson NC, Malthaner RA, Ostbye T. The search for an ideal method of abdominal fascial closure. Ann Surg 2000; 231: 436-42.
16. Johnson CD, Bernhardt LW, Bentley PG. Incisional hernia after mass closure of abdominal incisions with dexon and prolene. Br J Surg 1982; 69: 55-57.
17. MC Callum GT, Link RF. The effect of closure techniques on abdominal disruption. Surg Gyne Obst 1964; 119: 75-80.
18. Corman ML, Veiden Heimer MC, Coller JA. Controlled clinical trial of three suture materials for abdominal wall closure after bowel operation. Am J Surg 1981; 141: 510-13.
19. Gammelgaard N, Jensen J. Wound complications after closure of abdominal incisions with dexon or vicryl. A randomized double blind study. Acta Chir Scand 1983; 149: 505-8.
20. Saleem MS, Ahmad A. Suture sinuses a continuing problem in surgery. Pak J Surg 1996; 12: 95-96.
21. Grany MG. A clinical and experimental study of suture sinuses in abdominal wounds. Surg Gyne Obst 1982; 155: 712-16.
22. Kirk RM. Wound sinus. In: General Surgical Operations by Kirk RM. 3rd edition Churchill Livingstone 1994: 114.
23. O'Dwyer PJ, Courtney CA. Factors involved in abdominal wall closure and subsequent incisional hernia. Surg J R Coll Edin Irel 2003; 17-22.
24. Jenkins TP. The burst abdominal wound: a mechanical approach. Br J Surg 1976; 63: 873-76.
25. Varshney S, Manek P, Johnson CD. Six fold suture: wound length ratio for abdominal closure; Ann R Coll Surg Eng 1999; 81: 333-36.
26. Cengiz Y, Blomquist P, Israelsson LA. Small tissue bites and wound strength: an experimental study. Arch Surg 2001; 136: 272-75

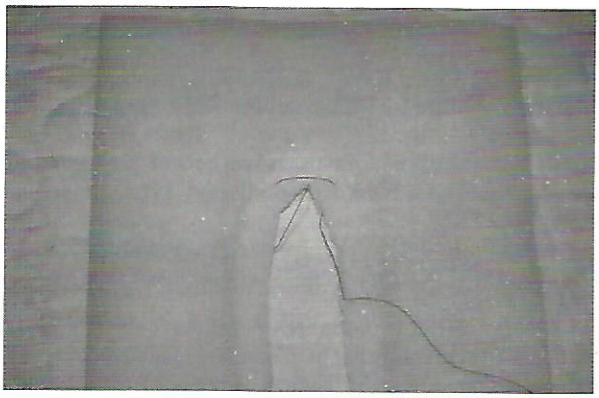

Fig. 1: Start of repair at upper end (shown on a foam model)

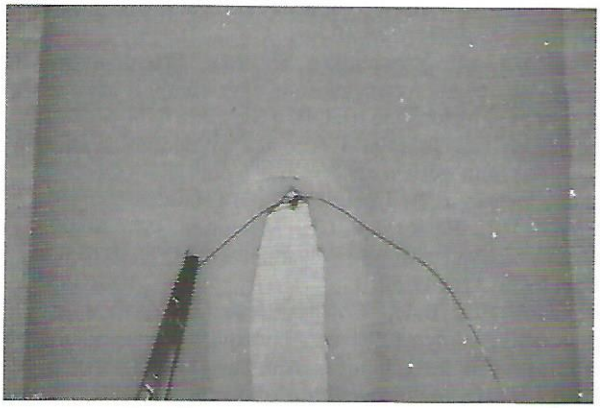

Fig. 2: Knot on the inside at upper end

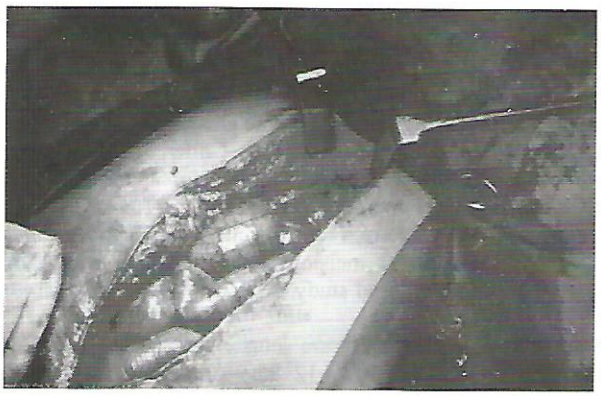

Fig. 3: Knot at upper end (per-operative)

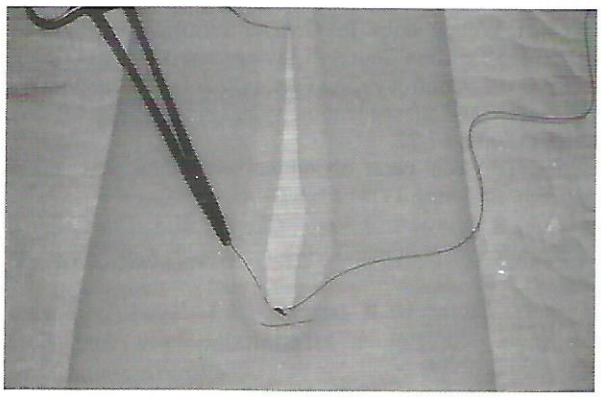

Fig. 4: Knot at the lower end

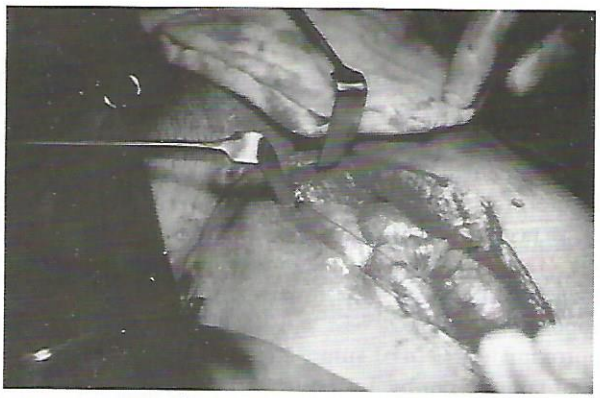

Fig. 5: Knot at lower end (per-operative)

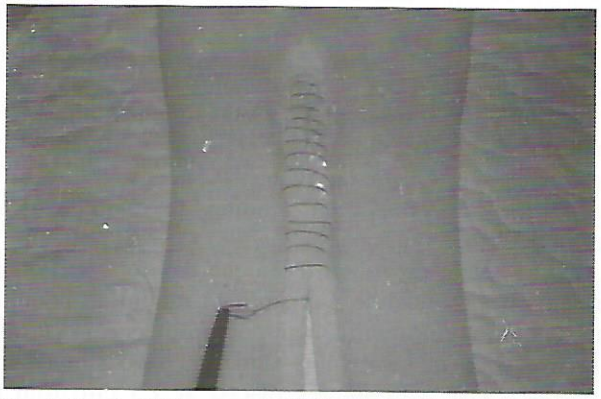

Fig. 6: Repair till the upper half of wound with last bite left on the inside.

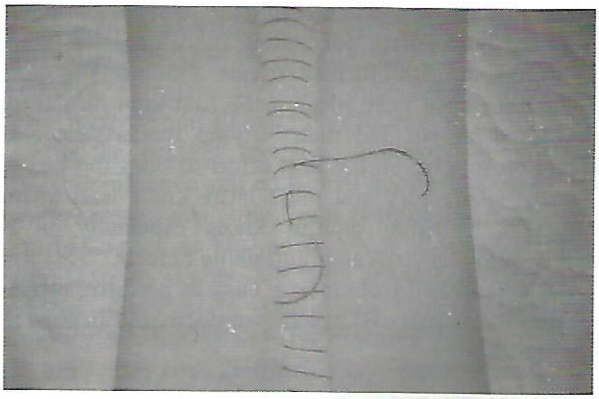

Fig. 7: Both strands at the middle of the wound.

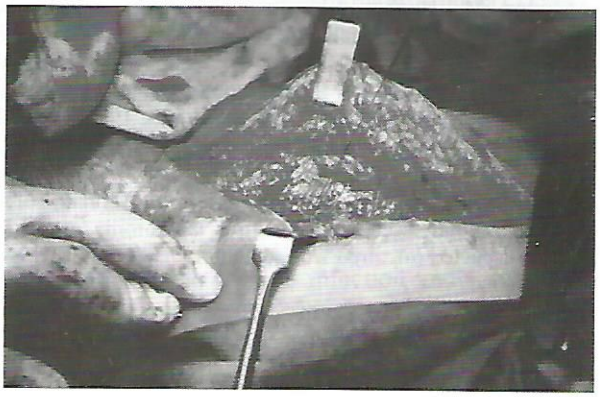

Fig. 8: Both strands at the middle of wound (per-operative)

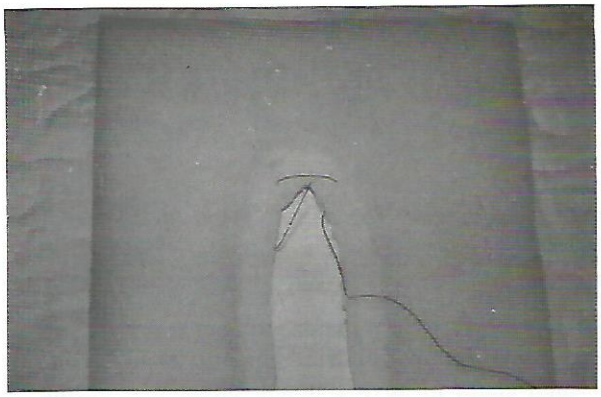

Fig. 9: Knot tied at the middle

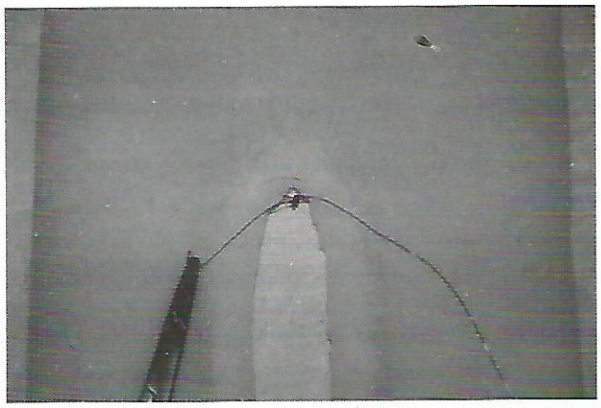

Fig. 10: Knot tied at the middle and being pushed to the inside (per-operative).

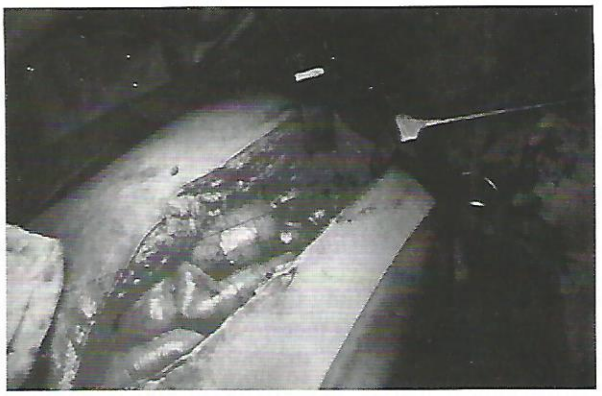

Fig. 11: Completed repair as seen from outside

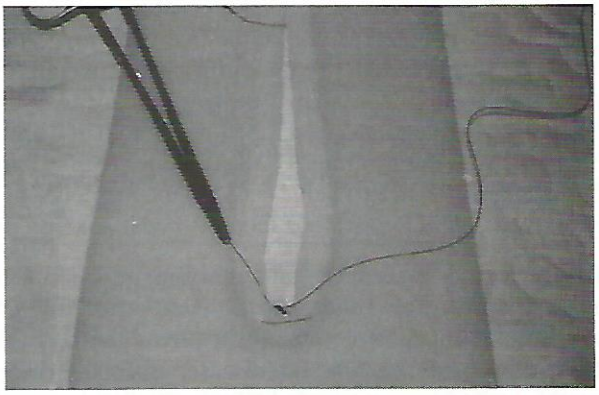

Fig. 12: Completed repair (per-operative)

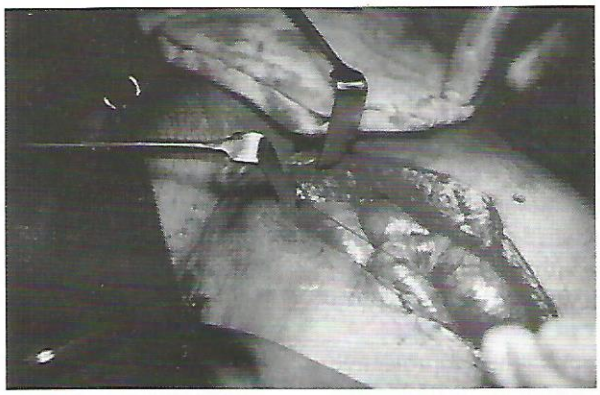

Fig. 13: Completed repair as viewed from inside (foam model)