



Laparoscopic feeding jejunostomy

A systematic review

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Received: 7 July 2003/Accepted: 17 January 2005/Online publication: 12 May 2005

Abstract

Background: Enteral feeding devices have gained popularity since the beneficial effects of enteral nutrition have been clarified. Laparoscopic placement of a feeding jejunostomy is the most recently described enteric access route. In order to classify current surgical techniques and assess evidence on safety of laparoscopic feeding jejunostomy, a systematic review was performed.

Methods: The electronic databases Medline, Cochrane, and Embase were searched. Reference lists were checked and requests for additional or unpublished data were sent to authors. Outcome measures were surgical technique and catheter-related complications.

Results: Enteral access for feeding purposes can be effectively achieved by laparoscopic jejunostomy. Laparoscopic jejunostomy can be accomplished by either total laparoscopic or laparoscopic-aided techniques. The most experience was obtained with total laparoscopic placement. Which technique to apply should depend on the surgeon's expertise. Conversion rate is similar to other laparoscopic procedures. Complications can be serious and therefore strict patient selection should be warranted.

Conclusion: Laparoscopic feeding jejunostomy is a viable method to obtain enteral access with the advantages of minimally invasive surgery.

Key words: Laparoscopic techniques — Feeding jejunostomy — Enteral feeding — Tube feeding

The enteral route is the preferred route for nutrition administration in malnourished or oncologic patients and for patients in the postoperative period [4, 5, 19, 28]. Various access routes for enteral nutrition are available, but for the purpose of long-term tube feeding preference is given to percutaneous endoscopic gastrostomy or

operative gastrostomy or jejunostomy. Since minimally invasive techniques have many advantages, increasing attention is paid to laparoscopic or laparoscopic-assisted placement of a feeding jejunostomy [8, 20, 27, 35, 41]. Laparoscopic feeding jejunostomy was first described 1990 [34]. After several failed attempts to perform a percutaneous endoscopic gastrostomy in a quadriplegic patient on ventilatory support, the authors succeeded in placing a laparoscopic feeding jejunostomy. Following this primary report many others started to apply this technique and described their personal experience. Feeding jejunostomy is, however, associated with serious and less-serious complications [6, 23]. The laparoscopic technique is regarded as a safe procedure and an alternative to open feeding jejunostomy [43].

Following an extensive literature search to identify relevant literature and their references, this systematic review aims to classify current surgical techniques and assess evidence on safety of laparoscopic feeding jejunostomy.

Methods and techniques

The Embase, Medline, and Cochrane databases from 1981 through April 2004 were searched by two independent reviewers, using the keywords "laparoscopic" and "jejunostomy" with the Boolean operators "and" and "or." The search was restricted to titles and abstracts. There were no language restrictions. Authors were contacted for additional data on outcomes not reported in publications. Both independent reviewers extracted data. Discrepancies were resolved by discussion and consensus. From each study data were collected on indication for placement, surgical technique, and catheter-related complications. Surgical technique was categorized as total laparoscopic and laparoscopic aided. Outcomes potentially related to placement and usage of feeding jejunostomy included wound infection, dislodgement, obstruction, leakage, bowel perforation, volvulus, and reoperation.

Results

Twenty-three studies were identified [1, 2, 9, 10, 12–15, 17, 22, 25, 29, 30, 32–34, 37–39, 42–44]. Two studies

Table 1. Indications for placement of a feeding jejunostomy

Author	Year	Design	<i>n</i>	Neurologic	Trauma	Upper digestive carcinoma	Head and neck carcinoma	Gastroparesis	Motility disorder	Malnutrition	Adjunctive	Diverse
O'Regan [34]	1990	prosp	1		1							
Morris [29]	1991	prosp	3	2	1							
Albrink [1]	1992	prosp	1		1							
Ellis [14]	1992	retro	17			3					14	
Duh [9]	1993	prosp	5							5		
Eltringham [15]	1993	prosp	3		1				2			
Sangster [39]	1993	retro	23	4	16		2				1	
Edelman [13]	1994	retro	2	1	1							
Duh [10]	1995	prosp	36	11		13	12					
Ramesh [37]	1995	prosp	1				1					
Gedaly [17]	1996	prosp	9	6	3							
Hotokezaka [25]	1996	prosp	32	10		5		16	1	2		
Murayama [30]	1996	retro	5	2	1					2		
Senkal [42]	1998	prosp	18			13	1					3 ^a
Nguyen [32]	1999	prosp	66			11		2			46	7 ^b
Rosser [38]	1999	prosp	38			26						35 ^c
Alien [2]	2002	prosp	35	4		7		23		1		
Duzgun [12]	2002	prosp	7			2	5					
Nicolau [33]	2003	prosp	2			2						
Senkal [43]	2004	retro	80			68	18					8 ^d
Total			384	40	25	150	39	41	3	26	61	49

^a Esophageal rupture

^b Heller myotomy (2), esophageal perforation (4), gastric perforation (1)

^c Head and neck carcinoma, pancreatic carcinoma, aspiration

^d Benign disease

were excluded because only a technique description was given without patient characteristics [22, 44]. Attempts to obtain unpublished data from the authors were unsuccessful. One study was excluded since both laparoscopic gastrostomy and jejunostomy were described and no distinction was made in groups regarding results [11]. Sixteen studies had a prospective study design [1, 2, 9, 10, 12, 15, 17, 22, 25, 29, 32–34, 38, 42]. The earliest study dated from 1990 [34]. Additional unpublished data were obtained for two of the studies [29, 33].

Underlying pathology

Indications for placement of a feeding jejunostomy differed between studies (Table 1). Nine studies included upper digestive carcinoma. Eight studies included neurological deficit and seven studies trauma resulting in neurological damage. Malnutrition was an indication in four studies. Motility disorders of the digestive tract were mentioned in two studies and gastropareses of different origins in three. In three studies a laparoscopic jejunostomy was placed as an adjunct to surgery and postoperative recovery. Four studies mentioned diverse reasons for applying a feeding jejunostomy.

Technique

Several techniques for placement of feeding jejunostomy were used. One study does not describe method of placement in the jejunostomy group but uses T-fasteners in the gastrostomy group, making it likely the same technique was used in the jejunostomy group [13]. An

overview is given in Table 2. The techniques were classified into two groups: the total laparoscopic method and the laparoscopic-aided method, which includes exteriorizing of the small bowel.

Feeding jejunostomy using a total laparoscopic approach was applied in the majority of the studies [1, 2, 9, 10, 25, 30, 32–34, 39, 42, 43]. A further distinction was made into three different methods of retracting and anchoring the jejunum to the anterior abdominal wall (Table 2).

The first technique uses transabdominal sutures [1, 2, 25, 33, 37, 39]. After the usual establishment of a pneumoperitoneum and placement of three trocars, three or four transabdominal sutures are placed in a diamond configuration incorporating seromuscular jejunal wall and anterior abdominal wall. A feeding tube or a needle catheter is inserted through the center of the array of sutures. In one study one of the transabdominal sutures is used [34] to attain a seal around the feeding catheter to prevent leakage. In another study adjacent intracorporeal sutures were placed around the catheter [25, 33]. In the remaining studies, no fixation is used. The transabdominal sutures are tied over bolsters to prevent skin damage. After 2 weeks the jejunum is expected to be adherent to the abdominal wall and the bolsters and sutures are removed. Sangster et al. applied the transabdominal suturing technique only in the beginning of their study [39]. Allen in his study used transabdominal sutures but tied them at fascia level [2].

In four studies T-fasteners are employed that were originally developed for fixation of the anterior gastric wall in percutaneous gastrostomy [9, 10, 13, 30]. The T-fastener consists of a T-bar with a suture attached to its center. It is inserted by a slotted needle and dislodged

Table 2. Technique and complications of laparoscopic placement of a feeding jejunostomy

Author	n	Method	Fixation	Wound infection	Bleeding	Removal	Pain	Dislodgment	Obstruction	Leakage	Perforation	Volvulus	Reoperation	Conversion	Mortality
O'Regan [34]	1	tot lap	transabd	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0	0
Albrink [1]	1	tot lap	transabd	0	0	0	0	0	0	0	0	0	0	0	NR
Dun [9]	5	tot lap	Tfastener	0	0	0	0	0	0	1	0	0	0	0	1
Sangster [39]	23	tot lap	transabd	3	0	0	0	0	0	0	0	0	0	0	1
Edeleman [13]	2	tot lap	Tfastener	0	0	0	0	1	0	0	0	0	0	0	NR
Duh [10]	36	tot lap	Tfastener	3	0	0	5	0	0	0	3	1	3	3	4
Hotokezaka [25]	32	tot lap	transabd	4	0	0	4	2	0	0	1	0	1	4	3
Murayama [30]	5	tot lap	Tfastener	0	0	0	0	4	0	0	0	0	0	0	5
Senkal [42]	18	tot lap	pursestr	1	0	0	0	0	0	0	0	0	0	0	NR
Nguyen [32]	66	tot lap	pursestrg	2	0	0	0	0	1	0	1	0	2	0	NR
Allen [2]	35	tot lap	transabd	2	0	2	0	0	0	0	0	0	1	0	NR
Nicolau [33]	2	tot lap	transabd	0	0	0	0	0	0	0	0	0	0	0	NR
Senkal [43]	80	tot lap	pursestrg	3	0	2	0	0	3	0	0	0	0	0	NR
Morris [29]	3	aided lap	extracorp	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0	NR
Ellis [14]	17	aided lap	witzel	0	0	NR	NR	NR	NR	0	0	0	0	0	NR
Eltringham [15]	3	aided lap	extracorp	0	0	0	2	0	0	0	0	0	0	0	0
Ramesh [37]	1	aided lap	pursestr	0	0	0	0	0	0	0	0	0	0	0	0
Gedaly [47]	9	aided lap	extracorp	2	0	1	0	0	0	1	0	0	0	0	NR
Rosser [38]	38	aided lap	transabd	0	1	0	0	0	0	0	0	0	0	0	NR
Duzgun [12]	7	aided	extracorp	0	0	0	0	0	0	2	0	0	0	0	0
Total	384			20	1	5	2	16	6	4	5	1	7	7	9

Numbers are patient numbers. NR, Not reported

into the jejunal lumen by a stylet. Four T-fasteners are introduced percutaneously into the jejunum serving to retract and anchor the small bowel to the abdominal wall (Fig. 1A–E). They are placed in a diamond-like configuration. A needle catheter can be placed through the center of the sutures. The authors do not describe if and how they secure the catheter to the jejunum. After 2 weeks the T-fasteners are removed.

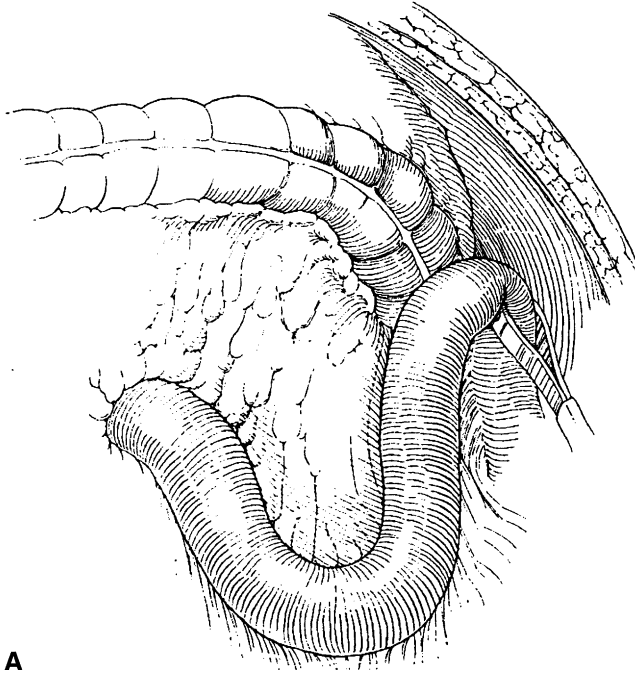
Senkal et al. and Nguyen et al. use three trocars for performing jejunostomy [32, 42]. The jejunum is fixated to the abdominal wall by an intracorporeal placed purse-string suture and additional anchoring sutures between jejunum and abdominal wall (Fig. 2).

In laparoscopic-aided feeding jejunostomy, placement of the catheter is established extracorporeally by means of a small abdominal incision through which the jejunum is retracted [12, 14, 15, 17, 29, 37, 38]. Ellis et al. advocate use of a 4-cm-wide abdominal midline incision allowing extraction of the chosen catheter entry site on the jejunum [14]. They propose serosal tunnelling of the feeding catheter to minimise the risk of an enterocutaneous fistula. The jejunum is then fixed to the abdominal wall by interrupted sutures. Rosser and colleagues also use a 4-cm skin incision, but the abdominal fascia is left intact [38] (Fig. 3A–E). With the aid of endoclose and endostitch instruments four sutures are placed in a diamond configuration fixating the small bowel to the fascia. A needle catheter is placed using the Seldinger technique from the center of the fixation points into the jejunum. The sutures are then tightened and tied to the abdominal wall. Several other authors describe a technique using one of the trocar openings through which the jejunum is exteriorized [15, 17, 29, 37]. An enterotomy is then performed and a Foley catheter is inserted and fixated by a purse-string suture. The bowel is fixated to the anterior abdominal wall by several seromuscular sutures.

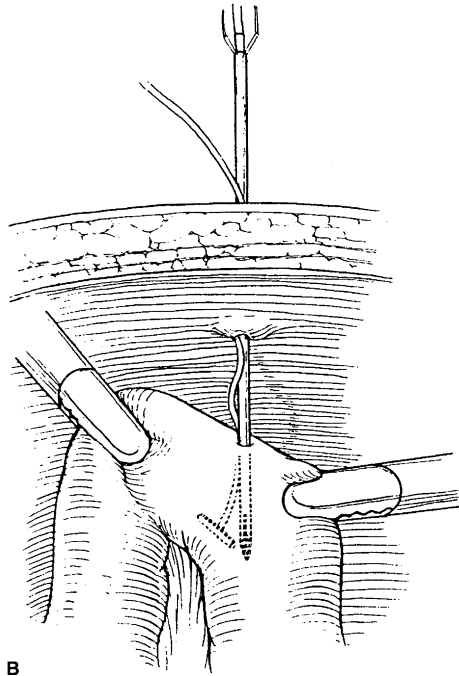
Complications

Complications were registered in 17 studies. One study does not give any data on complications in that study, but additional information from the author states that there were a few umbilical leaks and they abandoned this technique [29].

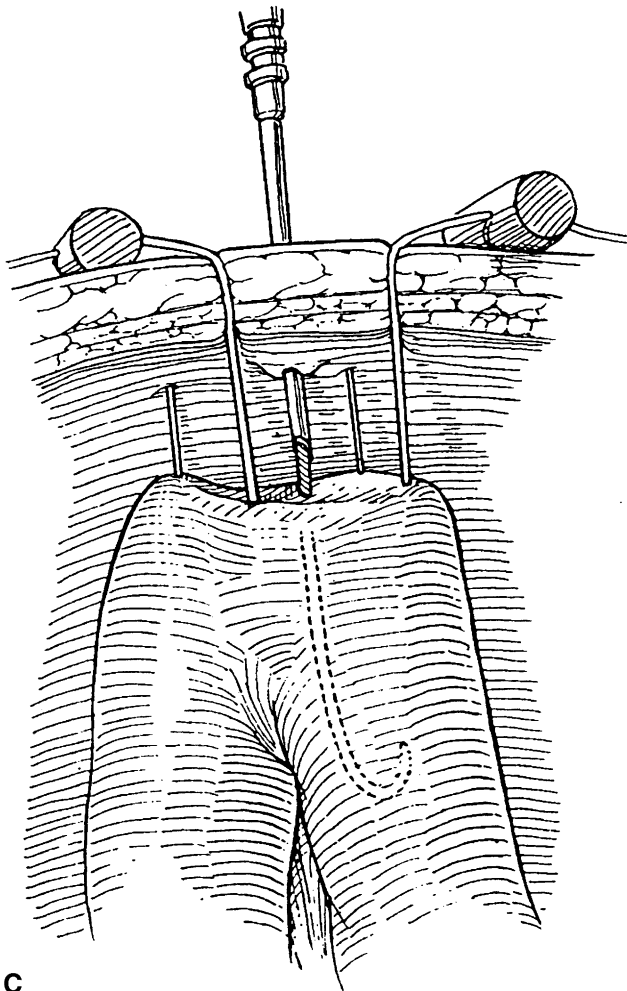
In all but three studies jejunostomy catheter-related complications were found [1, 33, 37]. Wound infection was the most frequent complication and occurred in eight studies. Intraabdominal bleeding requiring packed cells occurred once. Reoperation due to catheter-related complications was needed in four studies [2, 10, 25, 32]. In the study by Duh et al. relaparotomy was performed because of a volvulus of the jejunum, and twice a relaparotomy was performed for reinsertion of a dislodged catheter [10]. In the group of Hotokezaka et al. replacement took place by a relaparotomy [25]. Small bowel perforation was corrected by a second laparoscopy and an obstructed catheter was replaced by a new one during second laparoscopy in the study by Nguyen et al. [32]. One patient was reoperated because of persistent pain, but no catheter problems were found [2]. Conversion of the laparoscopic procedure to an open



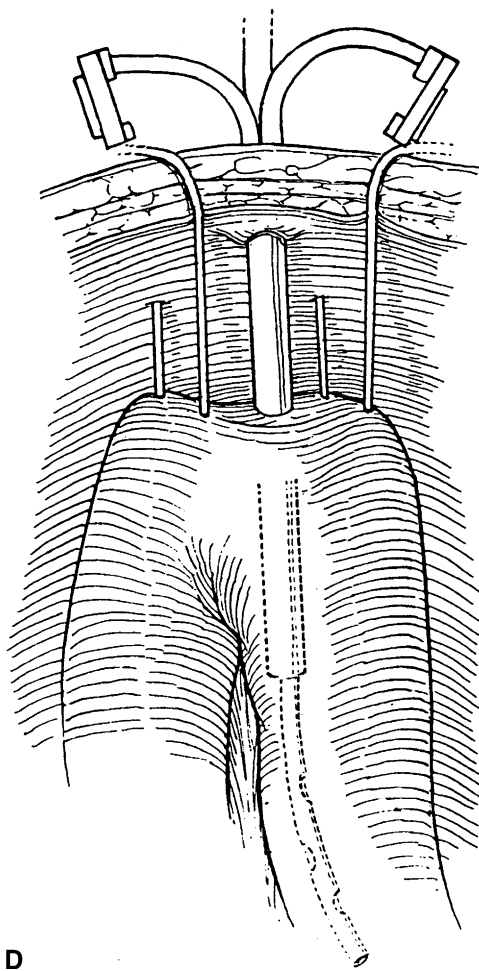
A



B

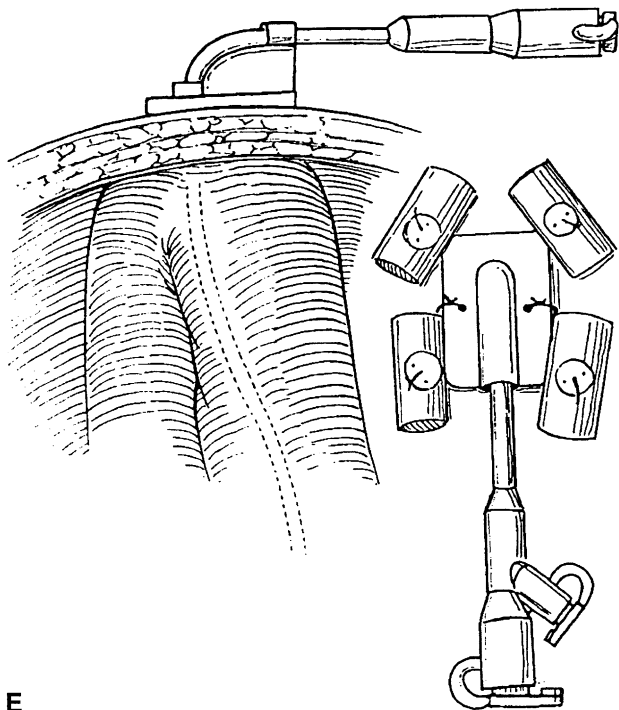


C



D

Fig. 1. (Legend on page 955.)



E
Fig. 1. (Continued) **A** The proximal jejunum and the ligament of Treitz are identified by lifting the transverse mesocolon and running the small bowel with the graspers. **B** The T-fastener is introduced percutaneously and discharged into the lumen from the slotted needle by the stylet. **C** Four T-fasteners are used to retract the antimesenteric jejunal wall. A J-wire is introduced into the lumen of the jejunum through an 18-gauge needle. **D** The jejunostomy catheter is placed through the peel-away introducer, which is then removed. **E** The T-fasteners and the jejunostomy catheter are secured to the abdominal wall. The T-fastener sutures are cut 2 weeks later, and the metal T-bars are allowed to pass in the stool. [By permission of BMJ Publishing Group: Duh QY, Senokozlieff-Englehart AL, Siperstein AE (1995) Prospective evaluation of the safety and efficacy of laparoscopic jejunostomy. *WJM* 162: 117–122.]

procedure is mentioned in two studies [10, 25]. Conversion was necessary because of perforation of the jejunum by instruments and catheter or because of severe adhesions [10, 25]. Length of operating time was estimated in 11 studies.

Mortality is reported in nine studies but deaths occurred only in four studies [9, 10, 25, 39]. One patient died of aspiration pneumonia [25]; the other deaths were not related to placement or usage of feeding jejunostomy.

Conclusion

This is a meta-analysis of studies dealing with laparoscopic jejunostomy. Many of these studies contain small patient numbers and are mainly concerned with technique description. Also, clinical heterogeneity was present. However, we were interested in giving an overview of indications, techniques, and results.

When feeding for a period of exceeding 6 weeks is expected, gastrostomy or jejunostomy is indicated. This can be accomplished by using a percutaneous, endoscopic, or operative technique.

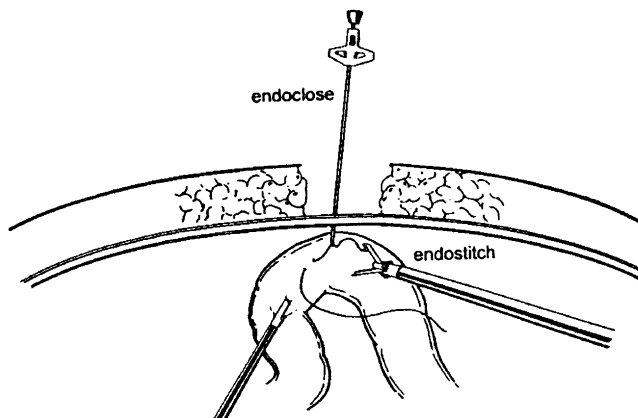


Fig. 2. Schematic view showing the position of the purse-string sutures to create a seal around the jejunal catheter using intracorporeal suturing. [By permission of Blackwell Publishing. Nguyen NT [Schauer PR, Wolfe BM (2000) Laparoscopic needle catheter jejunostomy. *Br J Surg* 87: 482–483.]

Since its introduction, percutaneous endoscopic gastrostomy is considered the procedure of choice in patients with impaired eating ability but who have a functional gastrointestinal tract [16, 36]. Contraindications for the use of percutaneous endoscopic devices are esophageal disorders and head and neck malignancies. Furthermore, in patients prone to aspiration or who have gastroparesis or gastric outlet obstruction jejunostomy is generally preferred to gastrostomy [26]. In addition, jejunostomy can be performed during upper digestive surgery to enable early postoperative feeding [3, 18, 46]. In this meta-analysis upper digestive malignancy was indeed the most common underlying pathology. Laparoscopic placement has the same advantages as other minimally invasive types of surgery and has a beneficial effect on postoperative recovery [8, 20, 27, 35, 41]. Minimally invasive access for feeding jejunostomy can be accomplished by a total laparoscopic technique or a laparoscopic-aided technique. An advantage of the laparoscopic aided procedure is the direct visualization and placement of the catheter and avoidance of intracorporeal suturing. An advantage of the total laparoscopic method is the avoidance of mini-laparotomy. Fixation of the jejunum to the abdominal wall can be performed using transabdominal sutures, intracorporeal sutures, or T-fasteners. From this meta-analysis it can only be concluded that the most experience is obtained with the total laparoscopic operative technique. Therefore, which method to use depends on the surgeons' expertise and the availability of materials.

A variety of complications are associated with placement and usage of a postoperative feeding jejunostomy, including mortality [6, 23]. Complication rates of 0–26% are reported [7, 17, 21, 24, 31, 44, 45]. In a large study reviewing more than 2000 applications, 1% jejunostomy-related reoperations are reported [31]; the authors claim that securing the catheter and confirming the correct catheter position by a contrast study could have prevented approximately half of these reoperations, but others could not confirm this statement [23]. In the current meta-analysis 69 complications were

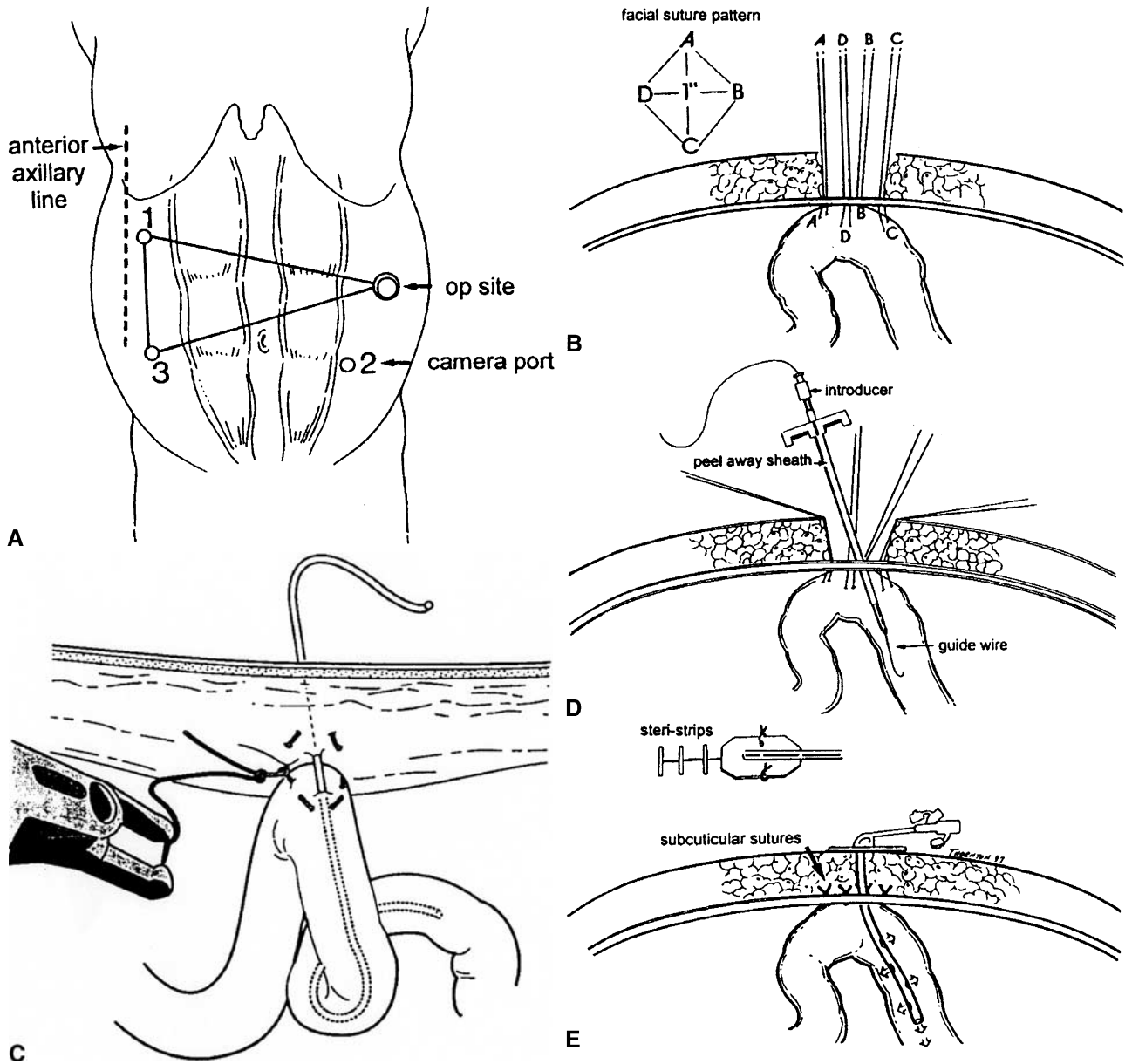


Fig. 3. A Port placement. B Diamond-shaped suture placement on small bowel. C Initial suture placement. D Guidewire, introducer, and peel-away sheath. E Jejunostomy tube in place. [By permission of Excerpta Medica Inc. Rosser JC, EB Rodas, Blancafor J (1999) A simplified technique for laparoscopic jejunostomy and gastrostomy tube placement. *Surg 177*: 61–65.]

found (17%). This is comparable to complication rates of open surgery. Two studies report higher rates of 36–50% [10, 25]. This was explained by the fact that these complications were largely related to complications of preexisting disease. Wound infection and catheter dislodgement were the most common. Major complications necessitating relaparotomy occurred in 1.8%. This finding is in accordance with rates found in open surgery for feeding jejunostomy [6, 23].

The conversion rate was high in the studies by Duh and Hotokezaka because of adhesions and accidental enterotomies [10, 25]. In other studies there was no need for conversion, but this can be largely explained by the fact that patients in whom severe adhesions were expected

from previous operations were excluded [10]. Conversion rate in laparoscopic jejunostomy is comparable to conversion rates reported in other laparoscopic procedures.

Laparoscopic jejunostomy can be adequately performed in different ways, of which the total laparoscopic method is the most frequently described. The surgeon's expertise should determine the appropriate operative technique. The conversion rate is acceptable. The morbidity rate of laparoscopic feeding jejunostomy is comparable to that of open surgery. Still, serious complications do occur and strict patient selection is therefore warranted. Laparoscopic feeding jejunostomy is a viable method to obtain enteral access with the advantages of minimally invasive surgery.

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