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Octylcyanoacrylate Skin Closure in Laparoscopy

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ABSTRACT

Objectives: Octylcyanoacrylate (Dermabond) is a dermal bond useful in closing surgical skin incisions. We compared skin octylcyanoacrylate with subcuticular skin sutures to close laparoscopic trocar sites.

Methods: A randomized, double-armed, prospective study was performed with 59 patients, in whom 228 trocar sites were closed. Twenty-nine patients underwent subcuticular closure of laparoscopic incisions, and 30 patients received closure with octylcyanoacrylate. Sutured trocar sites were closed with subcuticular 4-0 absorbable suture. Octylcyanoacrylate wounds received closure in accordance with the recommendations of the manufacturer (Ethicon, Somerville, NJ). The number of sutures or vials of octylcyanoacrylate used, closure times, and postoperative wound problems were recorded. Wounds were assessed 2 weeks postoperatively for healing complications. Closure costs were estimated using published operating room time per hour plus the cost of octylcyanoacrylate or suture. The Student paired *t* test was used for statistical analysis.

Results: The overall mean time for skin closure using octylcyanoacrylate and suture was 3.7 minutes and 14 minutes, respectively ($P<0.00001$). An average of 2.2 packets of suture were used to close all port sites, while those closed with octylcyanoacrylate required an average of 3.4 vials per patient. Wound complications consisted of subcuticular seroma with skin separation. No difference was noted in complication rates between the 2 groups. Overall average cost per closure using octylcyanoacrylate was $198 while cost for closure using suture was $497 ($P<0.00001$).

Conclusions: Laparoscopic port-site skin closure with octylcyanoacrylate is rapid and effective. Closure with octylcyanoacrylate yields cost savings and a decrease in operative time of more than 9 minutes per case.

Key Words: Laparoscopy, Skin closure, Octylcyanoacrylate.

INTRODUCTION

Traditionally, laparoscopic trocar sites have been closed using subcuticular sutures. Other closure methods include skin staples, full thickness cuticular sutures, surgical tape, and skin adhesives. Cyanoacrylates have been recognized for decades as excellent tissue adhesives.[1] They are easy to use, cost-effective, and provide good cosmesis.[2,3] Skin adhesives have been used extensively in the closure of pediatric extremity, head, and neck lacerations. Use of cyanoacrylates in otologic and ophthalmologic surgery has also been described.[4,5]

Octylcyanoacrylate (Dermabond, Ethicon; Somerville, NJ) is a new generation, long- chain cyanoacrylate tissue adhesive. It is a combination of monomer and plasticizers that form a flexible bond but has a breaking strength comparable to 5-0 monofilament suture. Multiple clinical applications for which it is commonly being used exist. However, no studies compare its use in closing laparoscopic trocar sites.

The objective of this study was to determine the clinical applicability of octylcyanoacrylate in laparoscopic surgery for rapid closure of trocar sites compared with that in subcuticular suturing. We compared the speed, cost of closure, cosmetic result, and complications between these 2 closure methods.

METHODS

All patients undergoing laparoscopic surgery by one surgeon (JTB) were randomized to receive skin closure with either subcuticular suture or octylcyanoacrylate. Twenty-nine patients received subcuticular closure, and 30 patients received adhesive closure. In the suture group, 110 incisions were closed, and in the octylcyanoacrylate group, 118 incisions were closed. We recorded each patient's age, weight, type of surgery, preoperative

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antibiotics, blood loss, and intraoperative fluids **(Tables 1 and 2)**. The time to close and dress the skin incisions was noted and recorded by the operating room nurse **(Table 3)**. Patients were evaluated 2 weeks postoperatively for evidence of infection, dehiscence, seroma, and general cosmetic appearance. In addition, any complications associated with surgery were noted. In some patients undergoing nephrectomy, the kidney was extracted intact through an enlarged trocar site. The total length of trocar sites and extended incision was recorded for each patient.

The fascia of all sites >1 cm were closed with absorbable suture. Wounds in both groups that did not closely approximate 1 cm received interrupted, subcutaneous sutures. The suture closure group received subcuticular closure with either 4-0 Vicryl or 4-0 Monocryl. Each wound was then dressed with steri-strips, a 2x2-cm gauze pad, and tape or a Tegaderm dressing. Octylcyanoacry-late adhesive was applied by approximation of the wound edges and topically painting the adhesive. Care was taken not to implant adhesive between the wound edges. No dressing was applied to the octylcyanoacrylate-closed wounds.

The closure times were compared for significance with the 2-tailed Student *t* test. Closure costs were calculated using the sum of operating room time cost and cost of suture material or the octylcyanoacrylate. Operating room cost was estimated at $35 per minute.[6] The cost of 4-0 Vicryl was $3.60 per packet, while 4-0 Monocryl was $4.12 per packet. Dermabond (octylcyanoacrylate) costs $20.30 per vial.

Table 1.
Operation Types

Patient #	Suture	Octylcyanoacrylate
1	Nephrectomy	Pyeloplasty
2	Nephrectomy	Partial nephrectomy
3	Nephrectomy	Adrenalectomy
4	Nephrectomy	Nephrectomy
5	Partial nephrectomy	Heminephrectomy
6	Partial nephrectomy	Nephrectomy
7	Nephrectomy	Nephrectomy
8	Lymph node biopsy	Nephrectomy
9	Varicocelectomy	Nephrectomy
10	Adrenal biopsy/MPLND	Nephrectomy
11	Prostatectomy	Nephrectomy
12	Partial nephrectomy	Nephrectomy
13	Diverticulectomy	Prostatectomy
14	Nephrectomy	Nephrectomy
15	Nephrectomy	Nephrectomy
16	Nephrectomy	Partial nephrectomy
17	Pyeloplasty	Partial nephrectomy
18	Nephrectomy	Nephrectomy
19	Nephrectomy	Nephrectomy
20	Nephrectomy	Nephrectomy
21	Partial nephrectomy	Pyeloplasty
22	Nephrectomy	Nephrectomy
23	Pyeloplasty	Nephrectomy
24	Nephrectomy	Adrenalectomy
25	Partial nephrectomy	Nephroureterectomy
26	Nephrectomy	Varicocelectomy
27	Partial nephrectomy	Neprhrectomy
28	Partial cystectomy	Herniorrhaphy
29	Partial nephrectomy	Prostatectomy
30	Nephrectomy	

RESULTS

A total of 228 trocar sites were closed in 59 different patients. Twenty-nine patients received ocytlcyanoacrylate closure of 110 incisions. A mean of 3.8 incisions was made per patient (range, 3 to 6). The mean total length of incisions was 44.16 mm with a range from 25 to 95 mm, and a standard deviation of ±2.6 cm. Mean closure time per case was 3 minutes 42 seconds (range, 2:41 to 5:00 minutes; standard deviation, ±1:13 minutes).

The suture closure group consisted of 30 patients receiving closure of 118 incisions. A mean of 3.8 incisions was made per patient (range, 3 to 6). Mean total length of the incisions was 44 mm with a range of 20 mm to 115 mm and a standard deviation of ±2.7 cm. Mean closure time in this group was 14 minutes and 5 seconds (range, 8:27 to 24:43 minutes; standard deviation, ±6:00 minutes).

The mean octylcyanoacrylate cost per patient was $65.10 (range, $40.60 to $101.5, standard deviation ±$13.70). Mean suture cost per patient was $7.74 (range, $3.60 to $10.80; standard deviation, ±$2.05). Time cost in the ocytlcyanoacrylate group was a mean of $128.90 (range, $69.60 to $179.22; standard deviation, $42.30). The mean time cost for the suture group was $490.93 (range, $295 to $835; standard deviation, $139.70). Total cost in the groups was $193.32 (range, $130 to $365; standard devi-

Table 2.
Operation Data

Patient	Suture			Octylcyanoacrylate		
	HT/WT (cm/kg)	OR Time (min)	EBL/Fluids (mL)	HT/WT (cm/kg)	OR Time (min)	EBL/Fluids (mL)
1	163/82	180	100/5900	156/84	180	300/2500
2	149/78	180	100/6000	166/77	180	20/2500
3	158/66	230	1000/6000	170/130	145	50/2800
4	161/82	150	200/2500	163/71	165	150/2100
5	166/80	165	300/3000	163/95	180	200/3600
6	158/75	240	600/4000	163/75	128	50/2500
7	154/50	140	100/2000	158/50	150	100/6300
8	168/91	50	50/1000	163/93	164	50/6300
9	173/91	55	0/1500	158/68	180	50/6500
10	161/75	150	200/2500	163/164	180	100/7000
11	163/91	300	200/3600	158/82	120	50/2500
12	173/95	180	50/3000	163/77	180	50/3000
13	163/82	180	150/3500	158/75	320	200/6000
14	168/86	120	200/5600	158/83	180	300/3000
15	158/82	180	100/6000	168/95	180	50/5400
16	173/136	240	100/2800	144/48	120	50/2600
17	168/50	180	50/4000	163/82	140	100/2500
18	163/76	128	50/2400	158/82	110	50/2500
19	154/61	194	120/4500	163/82	120	50/2300
20	154/91	180	100/5800	158/73	120	150/2400
21	158/75	180	50/3000	166/100	110	200/5500
22	168/98	150	100/6500	163/89	170	100/3200
23	161/68	150	100/2600	158/75	120	120/4800
24	163/77	120	150/2800	163/80	60	50/2200
25	158/82	130	200/3000	166/50	120	180/3200
26	156/82	115	150/2000	163/73	60	50/1900
27	144/86	210	150/2500	158/82	120	200/2700
28	168/86	130	200/2800	161/86	210	220/3200
29	163/86	125	100/2000	166/81	390	100/5500
30	158/64	120	200/2500	-	-	-
Mean	**145/81**	**162**	**170/3510**	**161/83**	**159**	**113/3670**

ation, $49.40) for closure with octylcyanoacrylate, while suture closure cost a mean of $497 (range, $295 to $835; standard deviation, $139.70) ($P<0.0005$).

Postoperative wound complications were similar for both groups. Five patients in the octylcyanoacrylate group had wound complications in 9 incisions. Two patients experienced skin separation in 5 incisions. One patient had a minor wound infection at one incision site treated with oral antibiotics. Two patients experienced small seromas at 3 incision sites, requiring incision opening and healing

Table 3.
Closure Times

Patient	Suture			Octylcyanoacrylate		
	Port Sites	Suture Packets	Time to Close (seconds)	Vials	Port Sites	Time to Close (seconds)
1	4	3	765	3	4	207
2	5	3	885	3	4	218
3	5	3	990	3	4	225
4	4	2	716	4	4	190
5	3	2	540	3	3	195
6	4	1	761	4	4	310
7	3	1	845	4	3	166
8	3	2	720	2	3	161
9	3	1	507	3	3	120
10	6	3	1200	3	3	180
11	5	2	588	3	4	235
12	4	2	856	3	4	266
13	4	2	910	5	5	235
14	3	2	675	3	3	180
15	4	2	607	4	4	288
16	3	2	969	2	3	165
17	3	1	933	2	4	165
18	3	2	990	6	4	228
19	3	2	896	3	3	126
20	4	2	490	3	3	240
21	4	2	810	3	3	160
22	5	2	708	3	4	150
23	4	2	720	4	3	216
24	4	2	1260	4	4	490
25	3	2	710	3	4	309
26	3	2	726	3	3	251
27	3	2	838	3	3	235
28	4	3	1428	3	3	235
29	5	2	878	3	5	300
30	3	2	1428	-	-	-
Mean	**3.8**	**2**	**790**	**3.6**	**3.2**	**222**

by secondary intention. We noted small seromas in 2 patients receiving suture closure. These healed by secondary intention after skin opening and drainage. **Table 4** presents a summary of the results.

DISCUSSION

The ultimate goal of surgical wound closure is to achieve a cosmetically acceptable, infection-free, and functional scar. Traditional methods of closing small trocar sites can be technically challenging, and time-consuming while adding to operating room costs. Simple skin reapproximation with a tissue adhesive provides a rapid, easy, and cost-effective alternative to traditional suture closure.

The use cyanoacrylates for tissue adhesion was first described in 1959.[1] These liquid monomers polymerize in an exothermic reaction into a solid material upon contact with a fluid or basic material. Earlier use of short-chain cyanoacrylates demonstrated rapid degeneration

Table 4.
Overall Results Summary

Mean Values	Octylcyanoacrylate	Suture
No. of trocar sites	3.8	3.8
Total wound length	44.16 mm	44 mm
Closure time	3:42 min	14.05 min
Material cost	$65.10	$7.74
Time cost	$128.90	$490.93
Total cost	$193.32	$497.00

and inflammatory reactions.[7] The longer chain derivative (octylcyanoacrylate) used today has not demonstrated these types of reactions.[8] There exist numerous reports of success in using cyanoacrylates for closure of skin wounds without reports of toxicity or carcinogenicity.[9-15]

The application of octylcyanoacrylate to laparascopic surgical wounds provides an optimal closure method. In general, laparoscopic procedures are longer than are open surgical procedures. The longer operating room time adds to the procedure cost. Using octylcyanoacrylate is a closure method that decreases operating room time and overall procedure costs. In addition, the wounds in laparoscopy are small (generally less than 1 cm). Lacerations less than 4 cm in length demonstrate comparable cosmetic results when closed with suture or octylcyanoacrylate.[16] Consequently, laparoscopic surgical wounds are ideal for closure with a tissue adhesive. Wound closure with octylcyanoacrylate in laparoscopic procedures provides adequate closure with decreased operating room time and cost.

Our study demonstrates that the time for closure with octylcyanoacrylate is significantly decreased when compared with that for suture closure. The material costs of octylcyanoacrylate are higher than those for suture. Yet, when total closure costs (material expenses + operating room time) are considered, the octylcyanoacrylate closure is more economical than is suture closure. In addition, the quicker closure yields less anesthesia time and risk to the patient.

One consideration in closing deep abdominal wounds is the need for fascial reapproximation and deep subcutaneous sutures. This eliminates the subcutaneous dead space, decreases wound tension, and maximizes skin edge eversion.[17] Thus, subcutaneous sutures should be placed in all deep and long (>1 cm) incisions. Because laparoscopic trocar sites are generally less than 1 cm, only larger incisions from open trocar placement or tissue extraction benefit from approximation of deep tissue layers. Likewise, our closure times reflect the time necessary to apply adhesive to the skin. We do, however, recommend placement of deep sutures in longer incisions to provide optimal aesthetic closure.

Placement of the tissue adhesive is a simple procedure. It is, indeed, less technically demanding than placement of subcutaneous sutures. The surgeon must, however, avoid placing adhesive directly in the wound. This can be avoided by obtaining approximation with deep sutures. In addition, careful use of tissue forceps to obtain skin edge approximation and tissue eversion is effective. Any polymer deposited below the closure line will extrude through the wound, as would any foreign body. Our careful use the octylcyanoacrylate in skin closure resulted in the low wound complication rates.

Low wound complication rates may also be attributed to bacteriostatic properties of tissue adhesives. Both n-2-butylcyanoacrylate and 2-octylcyanoacrylate demonstrate antimicrobial effects against gram-positive organisms.18 It has been demonstrated that wounds closed with n-2-butylcyanoacrylate have considerable resistance to bacterial growth when compared with suture closure.[19]

CONCLUSION

The use of cyanoacrylate for skin closure in laparoscopic skin incisions is effective and economical. This method

of skin closure has been proven to provide adequate cosmesis. It is much quicker to close these incisions with octylcyanoacrylate than suture. The technique for closure is easy to learn and not technically demanding. This leads to shorter overall operating times, lower cost, and greater efficiency in wound closure.

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