Section: General Surgery

Original Research Article

COMPARISON BETWEEN HAND SUTURE AND CARTER-THOMASON NEEDLE CLOSURE OF PORT SITES IN LAPAROSCOPY

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Abstract

Background: Trocar-site complications, particularly port-site hernias, remain a recognised concern following laparoscopic surgery, most frequently arising from ports ≥10 mm. Secure fascial closure is crucial in prevention. The Carter-Thomason needle closure device enables under-vision fascial approximation, potentially improving safety and efficiency compared with conventional blind hand suturing. **Aim:** To compare the efficacy and safety of hand suture closure versus Carter-Thomason needle closure of laparoscopic port sites. **Materials and Methods:** A prospective randomised controlled study was conducted in the Department of General Surgery, SSG Hospital, Vadodara, from July 2023 to July 2024. Sixty patients undergoing laparoscopic surgery with at least one ≥10 mm port were randomised equally into two groups: Group A – Carter-Thomason closure; Group B – hand suture closure. Baseline demographics, BMI, and operative procedures were recorded. Outcomes measured included time for port closure, port-site infection, wound dehiscence, seroma formation, ascitic fluid leak, andport-site hernia during 12-month follow-up. Statistical analysis used t-tests, chi-square/Fisher's exact test, with $p < 0.05$ considered significant. **Result:** Mean age was significantly lower in Group A (34.23 ± 14.48 years) than Group B (45.87 ± 16.03 years) ($p = 0.0046$). Gender distribution, BMI, and procedure type were comparable between groups. Mean closure time was significantly shorter with Carter-Thomason (4.37 ± 1.69 min) versus hand suturing (5.20 ± 1.30 min) ($p = 0.0372$). Port-site infection occurred in 1 patient (3.33%) in Group A and 3 patients (10%) in Group B ($p = 0.0601$, not statistically significant). No wound dehiscence, seroma, ascitic leak, or port-site hernia was observed in either group during follow-up. **Conclusion:** Carter-Thomason needle closure provides faster port-site closure with a trend towards fewer infections compared with blind hand suturing, without increasing other complications. Under-vision closure appears to be a safe and efficient technique for fascial closure in laparoscopic surgery.

INTRODUCTION

Over the last few decades, surgical practice has undergone a paradigm shift from traditional open procedures to minimally invasive techniques. Laparoscopic surgery, also known as minimal access surgery, has revolutionized the surgical landscape by offering smaller incisions, reduced

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postoperative pain, shorter hospital stays, and quicker return to daily activities.[1,2]

Although laparoscopic surgery offers multiple benefits, it is not without complications. One of the most significant postoperative issues is trocar site hernia (TSH), defined as an incisional hernia occurring at the cannula insertion site. TSHs typically develop at larger port sites (≥10 mm), especially at the umbilical port, and carry a high risk of bowel strangulation due to the small defect size. Incidence rates vary from 0.02% to 3.6%, but the condition is often underreported until complications arise.[3,4]

The closure of the fascial defect at ports ≥10 mm is a key preventive measure. However, achieving secure closure can be challenging, particularly in obese patients or those with thick abdominal walls. Blind fascial closure techniques, such as conventional hand suturing, carry risks of incomplete closure and inadvertent bowel injury.[5]

Aim

To compare the efficacy and safety of hand suture closure versus Carter-Thomason needle closure of laparoscopic port sites.

Objectives

1. To compare the time taken for port site closure between the two techniques.
2. To assess and compare the incidence of wound-related complications (infection, dehiscence, seroma, ascitic fluid leak).
3. To evaluate the occurrence of port site hernia during follow-up in both groups.

MATERIALS AND METHODS

Source of Data

The study was conducted in the Department of General Surgery, SSG Hospital, Vadodara, from July 2023 to July 2024. Patients undergoing laparoscopic surgery with at least one port size of 10 mm or more were included.

Study Design

- **Type**: Prospective randomized controlled trial
- **Duration**: 1 year
- **Sample Size**: 60 patients (30 in each arm)

Inclusion Criteria

- Patients undergoing laparoscopic surgery with at least one port size ≥10 mm.

Exclusion Criteria

- Patients with diabetes mellitus, coronary artery disease, or hypertension.

Randomization

Patients were randomly assigned into two groups:

- **Group A**: Carter-Thomason needle closure technique
- **Group B**: Conventional hand suture closure

Randomization was done by assigning odd-numbered cases to Group A and even-numbered cases to Group B.

Procedure and Methodology

Preoperative Work-up

All patients underwent:

- Complete blood count
- Renal and liver function tests
- Chest X-ray
- Abdominal ultrasonography
- Physician and anesthetic fitness evaluation

Closure Using Carter-Thomason Needle

1. The pilot guide was inserted through the port site.
2. The Carter-Thomason suture passer, loaded with Vicryl 1-0, was passed through one side of the guide, piercing the fascia and peritoneum.
3. The suture was dropped intraperitoneally.
4. The passer was inserted through the opposite side of the guide to retrieve the suture.
5. Both ends were brought out, the guide was removed, and the suture was tied to achieve complete fascial closure.

Closure Using Hand Suture

1. After port removal, the rectus sheath was grasped using Allis forceps.
2. A deep bite was taken blindly with Vicryl 1-0 to close the fascia.
3. The time for closure and any intraoperative complications were noted.

Follow-up and Data Collection

Patients were followed at 1, 3, 6, 9, and 12 months postoperatively for:

- Port site infection
- Wound dehiscence
- Seroma formation
- Ascitic fluid leak
- Port site hernia

Closure time was measured intraoperatively. Data were recorded in a predesigned proforma.

Statistical Analysis

- Continuous variables: Mean ± Standard Deviation (SD), compared using unpaired t-test
- Categorical variables: Frequency and percentage, compared using Chi-square or Fisher's exact test
- p-value < 0.05 considered statistically significant
- Data analysis performed using MedCalc v12.5 and Microsoft Office.

RESULTS

Table 1: Age distribution and summary statistics (n=30 per arm)

Age group	Group A – Carter-Thomason n (%)	Group B – Hand suture n (%)
10–19	5 (16.7%)	2 (6.7%)
20–29	6 (20.0%)	4 (13.3%)
30–39	6 (20.0%)	2 (6.7%)

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40–49	5 (16.7%)	8 (26.7%)
50–59	8 (26.7%)	7 (23.3%)
60–69	0 (0.0%)	5 (16.7%)
≥70	0 (0.0%)	2 (6.7%)
Age, years (Mean ± SD)	**34.23 ± 14.48**	**45.87 ± 16.03**

Test of significance (age-group distribution): $\chi^2(6) = 11.45$; **p = 0.0756**
Mean difference (A–B): −11.64 years (95% CI −19.54 to −3.74); **Welch t** = −2.95, df = 57.41; **p = 0.0046**
Table 1 shows that in the Carter-Thomason group, the highest proportion of patients were in the 50–59 years age group (26.7%), followed by 20–29 years and 30–39 years (20.0% each). In the hand suture group, the largest proportion fell in the 40–49 years category (26.7%), with a notable number in the 50–59 years group (23.3%) and the 60–69 years group (16.7%). The mean age in the Carter-Thomason group was 34.23 ± 14.48 years, which was significantly lower than the mean age of 45.87 ± 16.03 years in the hand suture group. Although the difference in the overall age-group distribution between the two arms did not reach statistical significance ($\chi^2(6) = 11.45$, p = 0.0756), the mean age difference of −11.64 years (95% CI −19.54 to −3.74) was statistically significant (Welch t = −2.95, df = 57.41, p = 0.0046).

Table 2: Gender distribution (n=30 per arm)

Gender	Group A – Carter-Thomason n (%)	Group B – Hand suture n (%)
Male	13 (43.3%)	10 (33.3%)
Female	17 (56.7%)	20 (66.7%)

Test of significance: $\chi^2(1) = 0.63$; **p = 0.4257** (Fisher's exact **p = 0.5959**)
Difference in male proportion (A–B): +0.10 (95% CI −0.238 to +0.416)
Table 2 presents the gender distribution. Males comprised 43.3% in the Carter-Thomason group and 33.3% in the hand suture group, while females constituted 56.7% and 66.7%, respectively. There was no statistically significant difference in gender distribution between the groups ($\chi^2(1) = 0.63$, p = 0.4257; Fisher's exact p = 0.5959). The absolute difference in male proportion between the groups was +0.10 (95% CI −0.238 to +0.416).

Table 3: Body mass index (BMI) (n=30 per arm)

Variable	Group A – Carter-Thomason Mean (SD)	Group B – Hand suture Mean (SD)
BMI (kg/m²)	23.22 (2.92)	23.75 (3.04)

Mean difference (A–B): −0.53 (95% CI −2.07 to +1.01)
Welch t = −0.69, df = 57.91; **p = 0.4938**
Table 3summarises the BMI comparison between the groups. The Carter-Thomason group had a mean BMI of 23.22 ± 2.92 kg/m², while the hand suture group had a mean BMI of 23.75 ± 3.04 kg/m². The difference of −0.53 kg/m² (95% CI −2.07 to +1.01) was not statistically significant (Welch t = −0.69, df = 57.91, p = 0.4938), indicating comparable BMI profiles across groups.

Table 4: OT procedure distribution (n=30 per arm)

Procedure	Group A – Carter-Thomason n (%)	Group B – Hand suture n (%)
Laparoscopic appendicectomy	10 (33.3%)	10 (33.3%)
Laparoscopic cholecystectomy	20 (66.7%)	20 (66.7%)

Test of significance: $\chi^2(1) = 0.00$; **p = 1.0000**
Difference in cholecystectomy proportion (A–B): 0.00 (95% CI −0.320 to +0.320)
Table 4 outlines the distribution of operative procedures. In both groups, laparoscopic cholecystectomy was the most common surgery performed (66.7%), followed by laparoscopic appendicectomy (33.3%). The distribution of procedures was identical between the groups, with no statistical difference observed ($\chi^2(1) = 0.00$, p = 1.0000). The difference in the proportion of laparoscopic cholecystectomy cases was 0.00 (95% CI −0.320 to +0.320), confirming complete procedural comparability between the study arms.

DISCUSSION

Table 1 (Age) Carter–Thomason (CT) arm skews younger than hand-suture (HS): mean 34.2 vs 45.9 years, a significant −11.6-year difference (p=0.0046), though the categorical age-band distribution narrowly misses significance (χ^2=11.45; p=0.076). Age differences matter because trocar-site outcomes (infection, seroma, and especially hernia) are known to rise with age and frailty; several series report higher TSH rates in older cohorts and in patients with impaired tissue quality or comorbidities. Kim HYet al.(2019),[6] both flagged older age among clinical risk correlates for port-site complications/hernias, alongside BMI and wound infection. Tonouchi's classification paper

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emphasized timing/phenotypes but also indirectly points to host factors that shape presentation. In donor nephrectomy patients, Jones Cet al.(2020),[7] compared CT vs conventional closure and achieved better wound outcomes and shorter closure time with CT; their groups were similar in baseline age, which strengthens causal inference in that study. By contrast, your age imbalance could bias outcomes in favor of CT unless you adjust (e.g., stratify by <40 vs ≥40 years, or run an age-adjusted model). Pragmatically, present age-adjusted results or a sensitivity analysis to show robustness.

Table 2 (Gender) Sex distribution did not differ (male 43.3% vs 33.3%; p=0.43), aligning with multiple mixed-case laparoscopic cohorts where sex effects on TSH are inconsistent or small after accounting for BMI and port size. Selvaraj Net al.(2021),[8] Any residual confounding by sex is unlikely to explain between-group differences in closure time or superficial SSI.

Table 3 (BMI) Mean BMI was comparable (23.22 vs 23.75 kg/m²; p=0.49). That's important because obesity is a consistent risk amplifier for difficult fascial capture and TSH/SSI, especially at ≥10–12 mm ports. With BMI balanced, your comparison isolates the closure method more cleanly—mirroring Madany MEet al.(2024),[9] who found device-assisted closure improved technical success across body habitus. Iranmanesh Pet al.(2020),[10] specifically warned about working-port hernias in obese patients and argued in favor of systematic closure; comparability here means your results aren't simply driven by different obesity loads.

Table 4 (OT procedure mix) Procedure spectrum was identical (LC 66.7%, LA 33.3%; p=1.00), which is ideal because LC typically dominates port-closure research and has distinct umbilical-port demands. In cohorts where procedure mix differed (e.g., more midline ports or prolonged instrument torque), higher port-site morbidity followed. Makram F.(2017),[11] also highlights that risk is technique- and site-dependent (midline ≥10–12 mm ports especially), so matching procedure type helps.

CONCLUSION

The present study comparing hand suture closure and Carter-Thomason needle closure of laparoscopic port sites demonstrates that closure with the Carter-Thomason device is associated with significantly shorter closure time and a trend towards reduced port-site infection rates, without any increase in other complications such as wound dehiscence, seroma formation, ascitic fluid leak, or port-site hernia. No port-site hernias were observed in either group during the 12-month follow-up. Under-vision closure with the Carter-Thomason needle offers the advantage of ensuring complete fascial approximation while minimizing the risk of inadvertent visceral injury, particularly in obese patients or when ports ≥10 mm are used. These findings support the Carter-Thomason method as a safe, efficient, and potentially superior alternative to conventional blind hand suturing for port-site closure in laparoscopic surgery.

Limitations

1. **Single-centre study** – Conducted at one tertiary-care hospital, which may limit the generalizability of results.
2. **Small sample size** – Thirty patients per arm may be underpowered to detect differences in rare complications such as port-site hernia.
3. **Age imbalance between groups** – The Carter-Thomason group was significantly younger, which could influence wound healing and infection rates.
4. **No cost analysis** – The economic implications of using the Carter-Thomason device versus hand suturing were not evaluated.
5. **Operator experience** – The time required for closure may vary depending on surgeon familiarity with the device; this was not standardised or adjusted for in analysis.
6. **Short-to-moderate follow-up for hernia detection** – Although follow-up was 12 months, some late-onset trocar-site hernias may occur beyond this period.

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