

Original Research Article

A novel modified trans-umbilical open technique for secure laparoscopic entry through the natural umbilical defect: Sheredi's technique

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ABSTRACT

Background: Safe and efficient entry into the peritoneal cavity is essential in laparoscopic surgery. The umbilicus is a preferred site for trocar insertion; however, the prevalence and surgical utility of a small physiological defect in the umbilical linea alba are poorly documented. This study describes a novel open-access method, Sheredi's modified trans umbilical open technique-which utilizes this anatomical feature and assesses its prevalence.

Methods: A prospective cohort study of 193 consecutive patients undergoing laparoscopic surgery by a single surgeon at the Mid Yorkshire NHS Trust between January 2020 and February 2023 was conducted. Open peritoneal entry was performed through a physiological umbilical linea alba defect, when present. Patients with umbilical or paraumbilical hernias, or with a history of prior umbilical surgery, were excluded. A prospectively maintained database captured demographic and operative data, including defect presence and size, access time, complications, and cosmetic outcomes. Associations between defect presence and age, sex, and BMI were analysed.

Results: Of the 193 patients (median age 44 years; 81 males, 112 females), 124 (67%) had a physiological umbilical defect. There was no significant association between defect presence and age, sex, or body mass index (BMI). No bowel, vascular, or visceral injuries occurred. The mean access time was 1.2 minutes. Three patients (1.6%) developed surgical site infections (SSIs); all were smokers, and one had diabetes. All patients reported satisfaction with the cosmetic outcome.

Conclusions: The author's open technique is safe, rapid, and cosmetically favourable when a physiological umbilical defect is present, supporting its use as a primary peritoneal entry method in laparoscopic surgery.

Keywords: Laparoscopic access, Open technique, Transumbilical, Linea alba, Trocar insertion, Surgical entry, Complication rate

INTRODUCTION

Since the introduction of laparoscopic surgery more than three decades ago, its advantages over open surgery have been well documented, including reduced postoperative pain, lower rates of surgical site infection, faster recovery, and improved cosmetic outcomes.¹⁻³ However, in laparoscopic surgery, achieving a safe pneumoperitoneum can be challenging, particularly in

individuals who have undergone multiple previous operations resulting in adhesions or in those with an elevated BMI.^{4,5}

As with open surgery, laparoscopic procedures also carry the risk of complications. One of the most concerning is the potential for vascular or visceral injury during the placement of the first trocar. Over the years, several techniques have been developed to facilitate safe entry

into the peritoneal cavity; however, the literature indicates that approximately 50% of all complications associated with laparoscopic surgery occur during this initial trocar insertion.⁶

Among the various techniques, two are most used were as follows.

Closed technique

This involves the initial placement of a Veress needle into the peritoneal cavity for CO₂ insufflation, followed by the blind insertion of the primary trocar.

Open technique

First described by Hasson in 1971, this method involves making a small infraumbilical incision, then incising the linea alba and peritoneum under direct vision before inserting the primary trocar, followed by CO₂ insufflation.⁷

Despite the known risks associated with the closed technique, it remains a popular choice among surgeons. This preference is believed to stem from the perception that the open technique is more time-consuming and carries an increased risk of gas leakage from the incision site. Open techniques commonly utilize either a supra- or infraumbilical incision to create pneumoperitoneum. In contrast, a transumbilical incision is less frequently employed due to concerns about a potentially higher risk of surgical site infection.⁷

However, we believe that the transumbilical approach, which has been performed by the author for over a decade, offers an effective alternative. This technique is simple, safe, and efficient, and when a physiological umbilical defect is present, it eliminates the need to create an additional incision, thereby reducing operative trauma and facilitating rapid access to the peritoneal cavity.

It is well known that the linea alba, deep to the umbilicus, contains a natural defect present at birth, as it serves as a passage for the umbilical vessels connecting the fetus to the placenta.⁹ Traditionally, this umbilical defect is believed to close spontaneously within seven days after birth, although closure may take up to 24 months.¹⁰ However, this view was challenged by Fathi et al who reported the presence of umbilical fascial defects in approximately 25% of adult cadavers.¹¹ There remains, however, a paucity of literature regarding the true incidence of these native umbilical defects and their potential role in facilitating safe and efficient peritoneal access during laparoscopic surgery.

This study aimed to determine the prevalence and size of physiological umbilical defects, assess correlations between the presence and size of these defects with BMI, age, and gender.

Evaluate the outcomes of using the author's modified transumbilical open technique for peritoneal entry via small physiological umbilical defects, with specific focus on postoperative pain, SSIs, and patient satisfaction with cosmetic results.

METHODS

This cohort study included 193 consecutive patients who underwent laparoscopic general surgery performed by a single surgeon at the Mid Yorkshire NHS Trust between January 2020 and February 2023. The inclusion criteria comprised all individuals who underwent the transumbilical approach for establishing pneumoperitoneum. Informed consent was obtained from all participants included in the study. The exclusion criteria encompassed individuals with a clinically evident paraumbilical or umbilical hernia, as well as those with a history of previous surgery involving the umbilicus that had altered the normal umbilical anatomy.

A prospectively maintained database was used to collect patient demographics (age, sex, BMI, diabetes mellitus status, smoking status, and steroid use); type and date of laparoscopic surgery; presence and size of the physiological umbilical defect; time taken to gain access to the peritoneal cavity; intraoperative complications (bowel or vascular injury, bleeding); time taken to close the wound; and postoperative complications (severity of postoperative pain, hematoma, surgical site infection, and cosmetic concerns).

The associations between the presence and size of a physiological umbilical defect and patient factors such as BMI, age, and sex were analysed.

Statistical analysis

Statistical analyses were performed using SPSS software, version 26.0. Continuous variables were presented as means±SD or medians with interquartile ranges (IQR), whereas categorical variables were expressed as frequencies and percentages. Independent t-tests were used to assess associations between continuous variables, and chi-squared (χ^2) tests were applied to evaluate associations between categorical variables. A $p \leq 0.05$ was considered statistically significant.

Technique

Modified transumbilical open technique

Two Littlewood's forceps were placed at the base of the umbilicus, and traction was applied to evert it (Figure 1).

The umbilical skin was then divided vertically using an 11-blade scalpel (Figure 2), and the presence and diameter of the physiological defect were assessed and calibrated using the tips of a Kelly forceps (Figure 3).

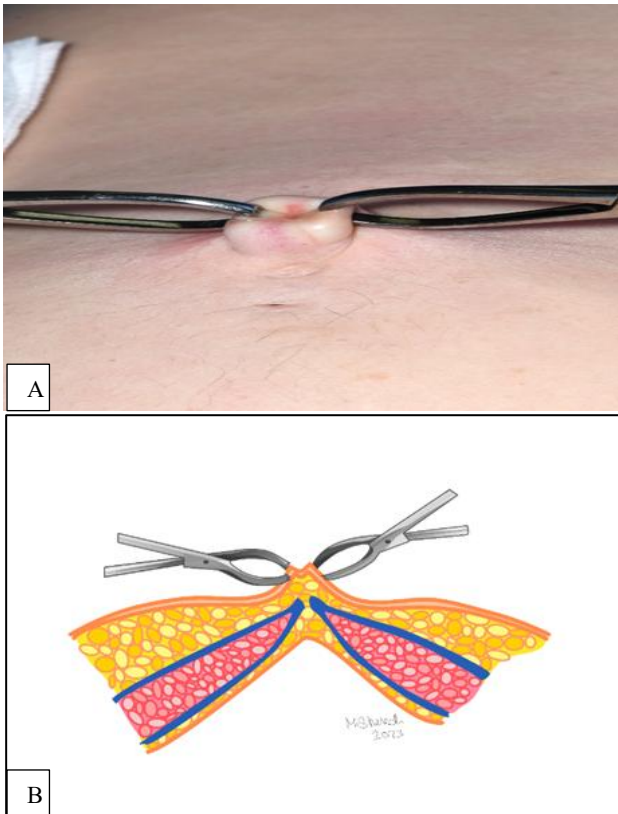


Figure 1 (A and B): Two littlewoods are placed at the bottom of the umbilicus, and the umbilicus is everted.

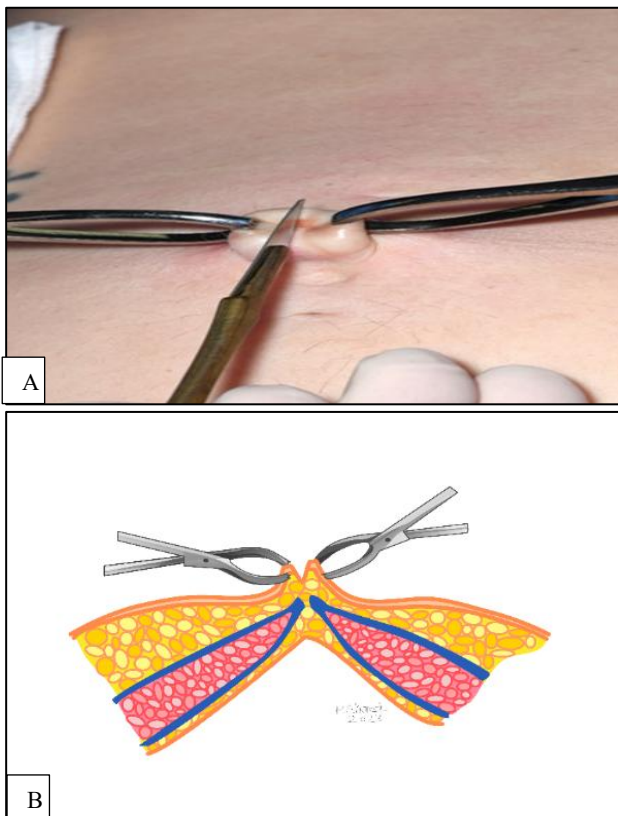


Figure 2 (A and B): The umbilical skin and subcutaneous tissue (only) divided vertically.

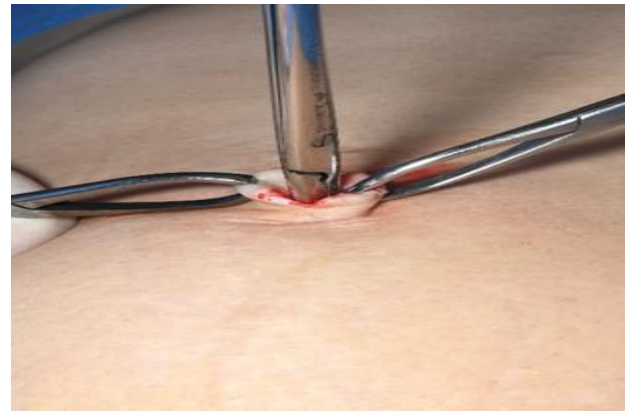


Figure 3: The presence of a defect was tested and calibrated with the tips of a Kelly forceps.

In the presence of a physiological linea alba defect, the tip of the Kelly forceps was gently advanced through the defect and then further passed until traversing to the peritoneal cavity. The forceps were then opened to stretch the defect adequately to accommodate an 11-12 mm trocar (Figure 4).

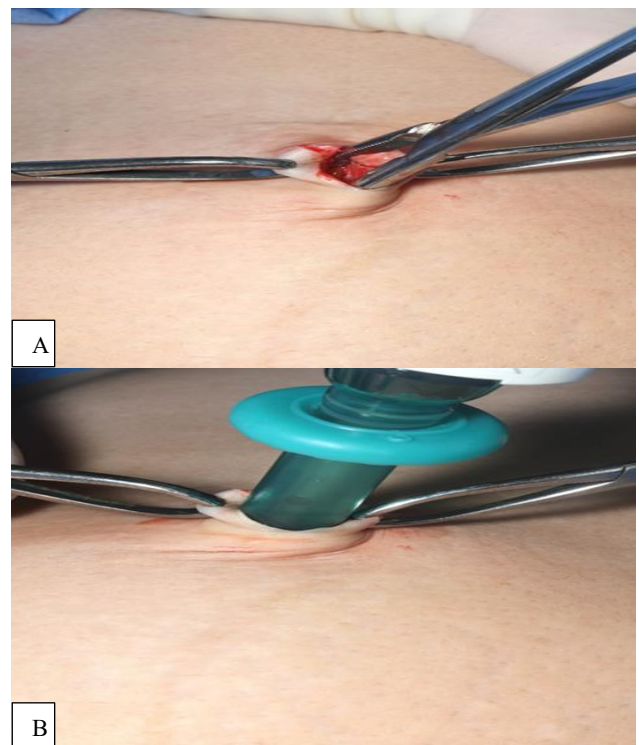


Figure 4 (A and B): Kelly forceps pass through the linea alba and are opened wide, stretching the defect, and pass the trocar.

While maintaining upward traction with the Littlewood's forceps, a 12 mm blunt balloon trocar was inserted under direct vision; the trocar should advance without resistance (Figure 4). In some individuals, the defect was identified by the protrusion of a small amount of extraperitoneal fat, which was easily distinguishable from subcutaneous fat upon visual inspection.

Next, the insufflation tube was connected to the balloon port, and insufflation was initiated at a high flow rate of 4 L/min. Once an intra-abdominal pressure of 12-15 mmHg was achieved, laparoscope was inserted, and a thorough inspection of peritoneal cavity was performed. Any injuries sustained during creation of pneumoperitoneum were recorded. The time from skin incision to laparoscope insertion was measured and documented.

At the end of the procedure, linea alba of rectus sheath was exposed using Langenbeck retractors and closed with J-PDS sutures. Finally, the skin was closed using a subcuticular 5-0 Monocryl suture, and the umbilicus was inverted back into its natural position (Figure 5).

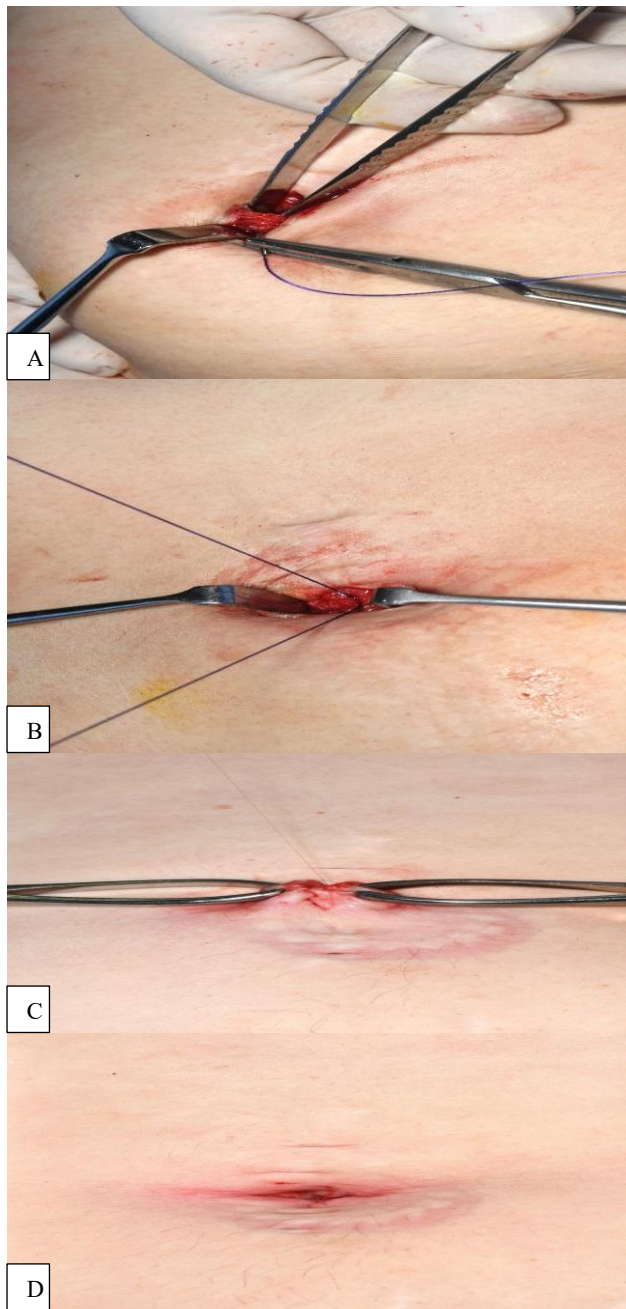


Figure 5 (A-D): The skin was closed with subcuticular 5-0 Monocryl, and the umbilicus was inverted back.

In the absence of a physiological umbilical linea alba defect, the standard transumbilical technique was employed. Two Littlewood's forceps were placed at the base of the umbilicus to evert it. The skin was divided, and under direct vision, the linea alba sheath was incised vertically by approximately 1–1.5 cm to create an opening sufficient for the introduction of a 12 mm trocar (Figure 6).

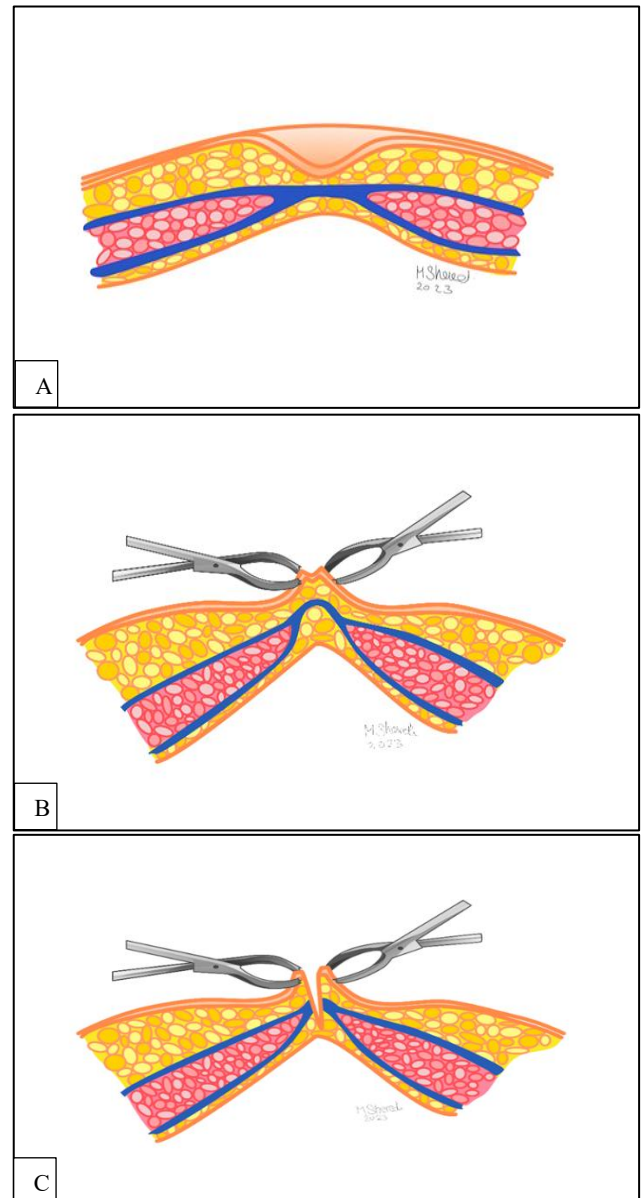


Figure 6 (A-C): Standard trans-umbilical technique.

RESULTS

During the study period, 185 patients met the inclusion criteria. The participants' ages ranged from 7 to 91 years, and 15 (8.1%) were children under 18 years of age. Of the total cohort, 108 (58.3%) were female and 77 (41.6%) were male. The mean BMI was 28.8 kg/m². Six patients (3.5%) had diabetes mellitus, 10 (5.8%) were on regular steroid therapy, and 24 (13.9%) were smokers (Table 1).

Table 1: Patient demographics and clinical characteristics.

Variables	N, mean (SD)	Range
Total patients	185	
Median age (in years)	44	7-91
Children (<18 years)	15	8.1%
Female	108	58.3%
Male	77	41.6%
Mean BMI (kg/m²)	28.8 kg/m ²	
Diabetes mellitus	6	3.5%
Regular steroid use	10	5.8%
Smokers	24	13.0%

The median age was 44 years, with 58.3% females and a mean BMI of 28.8 kg/m². Overall, 3.5% had diabetes, 5.8% used steroids, and 13% were smokers.

A physiological umbilical defect was observed intraoperatively in 124 patients (67%) and was utilized as the primary access point for establishing pneumoperitoneum. The diameter of the defect, measured intraoperatively, ranged from 5 mm to 9 mm. Among children, the incidence was 53%. BMI and sex were not significantly associated with the presence of a physiological umbilical defect (Table 2).

Table 2: Intraoperative findings.

Variables	N	Range	Notes
Presence of a physiological defect	124	67.0%	Used as the primary access site
Diameter of defect	5-9 mm	<10 mm	Measured intraoperatively
Incidence in children	8	53%	

A physiological umbilical defect was present in 67% of patients, with diameters ranging from 5-9 mm. The incidence among children was 53%.

The laparoscopic procedures performed included cholecystectomy (59.0%), appendectomy (21.4%), inguinal hernia repair (15.6%), and diagnostic laparoscopy (4.0%) (Table 3).

Table 3: Types of laparoscopic procedures performed.

Procedure type	N	Percent (%)
Cholecystectomy	109	59.0
Appendectomy	40	21.4
Inguinal hernia repair	29	15.6
Diagnostic laparoscopy	7	4.0

Cholecystectomy was the most common procedure (59%), followed by appendectomy (21.4%) and inguinal hernia repair (15.6%).

The mean time to gain access to the peritoneal cavity was 1.02 minutes (range: 1-2 minutes). No complications occurred when the physiological umbilical defect was used for primary port placement. The mean time required to close the wound was 6.04 minutes (range: 4-8 minutes).

Regarding postoperative pain, 50 patients (27.0%) reported experiencing less pain than expected, 89 patients (48.1%) reported pain at the expected level, and 34 patients (18.3%) experienced more pain than expected.

Three patients (1.6%) developed postoperative complications in the form of SSIs; all three were smokers, and one was also diagnosed with diabetes mellitus. All patients reported satisfaction with the cosmetic appearance of the scar (Table 4).

Table 4: Operative and postoperative outcomes.

Variables	Mean (Range)	Percent
Time to gain peritoneal access (min)	1.02	-
Time to close wound (min)	6.04	-
Complications	0	0%
Postoperative pain-less than expected	50	27.0%
Postoperative pain-expected level	89	48.1%
Postoperative pain-more than expected	34	18.3%
Postoperative complications (SSI)	3	1.3%
Satisfaction with cosmetic result		100%

Peritoneal access and wound closure were rapid, with minimal complications (1.3% SSI) and high cosmetic satisfaction (100%).

DISCUSSION

With advancements in laparoscopic equipment and surgical techniques over the years, an increasing number of procedures are now performed laparoscopically. However, achieving pneumoperitoneum and placing the primary port remain critical steps in the procedure, with two main approaches available, the open and closed techniques.¹²

A literature review by Bonier et al compared the incidence of visceral and vascular injuries between the open (Hasson) and closed (Veress needle) techniques. They reported incidences of visceral and vascular injury of 0.048% and 0.000%, respectively, for the open technique (12,444 cases), compared with 0.083% and

0.075% for the closed technique (489,335 cases). The authors concluded that the open technique was safer, with significantly fewer visceral and vascular injuries ($p=0.002$).¹⁴ However, most studies included in this review were retrospective, introducing a potential bias due to underreporting.

A prospective study by Dunne et al evaluated complication rates between the two techniques in patients undergoing laparoscopic surgery over a six-year period. They reported visceral injury rates of 0.1% with the Veress needle (1,887 cases) compared with 0.08% for the open technique (1,200 cases).¹⁵ Although slightly higher than the findings of Bonier et al this difference is likely explained by Dunne's smaller sample size and the prospective nature of data collection. The authors concluded that there is no strong evidence supporting the superiority of one technique over the other and that either method can be performed safely without excessive risk.^{14,15}

Several studies have described techniques for gaining access to the peritoneal cavity through the umbilical cicatrix using supra-or infraumbilical incisions. In this study, however, we present a modification of the open technique that utilizes a transumbilical incision and takes advantage of a physiological umbilical defect, when present, for primary port placement. To our knowledge, this is the first study in the literature to describe this approach, which provides a rapid and safe method of accessing the peritoneal cavity without creating an additional fascial defect. Importantly, no vascular or visceral injuries occurred during primary port placement, likely because entry was performed under direct vision and without force and blind sharp instrumentation.

In this study, 124 patients (67%) were found to have a physiological umbilical defect. There is limited literature on the prevalence of such defects in adults and their potential role in achieving pneumoperitoneum. Furthermore, no studies to date have correlated the size of the defect with age, sex, or BMI. In our study, only defects smaller than 1 cm were included, with an average defect size of 5 mm. Defects smaller than 5 mm were likely underreported, as they may have been too small to detect. It is therefore reasonable to presume that the true prevalence of physiological umbilical defects may be higher, warranting further studies employing more meticulous intraoperative assessments.

An additional advantage of utilizing the physiological umbilical defect is that the defect is closed with sutures during wound closure, which may reduce the risk of future umbilical hernia formation. In contrast, with other techniques, the fascial defect may remain unclosed, potentially increasing the risk of hernia development.

Patient factors, including BMI, sex, and age, to evaluate possible associations with the presence of a physiological umbilical defect were analyzed. Unexpectedly, no

significant associations were identified, suggesting that this technique is broadly applicable across diverse patient populations.

In our study, the SSI rate was 1.6%, which is substantially lower than the reported European SSI rates, ranging from 5% to 18%.¹⁷ Furthermore, all patients expressed satisfaction with the cosmetic appearance of their scars, likely due to the incision being concealed within the umbilicus when restored to its natural orientation.

Finally, this technique is simple, requiring only two Littlewood's forceps and a scalpel, making it easy to learn and perform. It is particularly advantageous in resource-limited settings, as the use of fewer instruments reduces both operative complexity and costs associated with sterilization. Furthermore, the method accommodates any available port or trocar for primary port placement-an important consideration in low-resource environments where specialised equipment may be limited.¹⁸

The main limitation of this study is the relatively small sample size. We therefore recommend conducting a randomized controlled trial comparing this modified transumbilical open technique with established methods to validate our findings and assess long-term outcomes.

CONCLUSION

A modified open technique was presented that utilizes a small physiological umbilical defect, when present, to access the peritoneal cavity during laparoscopic surgery. Based on our experience, insertion of the primary laparoscopic port through this defect is rapid, safe, and straightforward, eliminating the need to create an additional fascial defect to achieve pneumoperitoneum. This technique is associated with minimal intraoperative and postoperative complications, provides excellent cosmetic outcomes, and is applicable across all age groups.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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