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The Four-Clamp Technique for primary laparoscopic access in morbidly obese patients: a retrospective cohort study

Murat Api[1], Esra Keles[1], Uğur Kemal Öztürk[1], Damlanur Yücel[1], Fatih Şanlıkan[1], Özge Nur Gülen[1], Ümmügülsüm Kuyucu[1], İsmail Bağlar[2]

[1]Department of Gynecologic Oncology, University of Health Sciences Türkiye, Kartal Dr. Lütfi Kırdar City Hospital, İstanbul, Turkey
[2]Department of Obstetrics and Gynecology, University of Health Sciences Türkiye, Kartal Dr.Lütfi Kırdar City Hospital, İstanbul, Turkey

ABSTRACT

This retrospective, single-centre cohort study evaluated the Four-Clamp Technique for primary laparoscopic access in 45 morbidly obese women (body mass index ≥40 kg/m^2) undergoing gynaecological procedures at a tertiary centre between January 2015 and August 2025. The technique utilised four symmetrically positioned towel clamps to allow omnidirectional traction to achieve stable abdominal wall elevation before direct trocar insertion. First-attempt success was achieved in 39 (86.7%) of patients, with overall success in 42 (93.3%) women. No major vascular or visceral injuries occurred. Ten (22.2%) minor complications occurred: trocar-site or clamp-site bleeding (4, 8.9%), minor omental injury (3, 6.6%), subcutaneous emphysema (2, 4.4%), and extraperitoneal insufflation (1, 2.2%). Mean time to intraperitoneal access was 74±18 seconds. Target intra-abdominal pressure was maintained at 12–14 mmHg. The Four-Clamp Technique may represent a feasible and reproducible method for primary laparoscopic access in morbidly obese patients in this single-centre cohort; however, prospective comparative studies are warranted to confirm these preliminary findings.

Keywords: Abdominal wall traction, intraoperative complications, laparoscopy, morbid obesity, trocar

Introduction

Safe primary access to the peritoneal cavity represents the most critical step in laparoscopic surgery, yet entry-related complications continue to contribute disproportionately to laparoscopic morbidity. Entry-related injuries occur in 0.02% to 0.64% of procedures but account for up to 17% of perioperative deaths.[1] The 2019 Cochrane systematic review by Ahmad et al.,[2] analysing 57 randomised controlled trials involving 9,865 participants, concluded that insufficient evidence exists to recommend one entry technique over another, noting that more than 50% of laparoscopic injuries occur during primary access.

These challenges are substantially magnified in morbidly obese patients [body mass index (BMI ≥40 kg/m^2], who present unique anatomical difficulties fundamentally altering the risk profile of laparoscopic entry. Thick, mobile panniculus obscures anatomical landmarks, substantially increases skin-to-peritoneum distance (often exceeding 10–15 cm vs. 2–4 cm in normal-weight individuals), and diminishes tactile feedback during trocar insertion.[3] The considerable weight of redundant abdominal wall compromises effective counter-traction, essential for safe entry in standard-weight patients.[4]

Corresponding Author: Esra Keles, MD, Department of Gynecologic Oncology, University of Health Sciences Türkiye, Kartal Dr. Lütfi Kırdar City Hospital, İstanbul, Turkey
E-mail: dresrakeles@gmail.com **ORCID ID:** orcid.org/0000-0001-8099-8883
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Traditional access approaches—Veress needle (closed), Hasson (open), and direct trocar insertion (DTI)—each present distinct limitations in obese populations. The Veress needle method relies on blind entry with inherent risk of major vessel or visceral injury. Moreover, traditional confirmation tests for correct needle placement, including the hanging-drop test, saline aspiration-injection test, and opening intra-abdominal pressure measurement, have reduced sensitivity in morbidly obese patients because preperitoneal fat may mimic free peritoneal space, the weight of the panniculus elevates baseline intra-abdominal pressure, and the characteristic tactile feedback is attenuated by thick subcutaneous tissue.[5] The Hasson approach, whilst providing direct visualisation, is time-consuming and technically challenging due to thick subcutaneous tissue requiring extensive dissection.[6] Standard DTI avoids pre-insufflation but frequently lacks sufficient control in patients with substantially thickened, mobile abdominal walls.[7] Optical-access trocar systems offer the theoretical advantage of continuous visualisation during trocar advancement through abdominal wall layers; however, their higher cost limits availability in resource-constrained settings, and adequately powered comparative trials demonstrating consistent superiority over standard DTI in morbidly obese populations are lacking.[8,9]

Comparative studies have not demonstrated consistent superiority of one method over others, particularly within obese populations, where study enrolment is often limited or excluded entirely.[2] The paucity of standardised techniques specifically designed for morbidly obese patients represents a critical unmet clinical need.

We developed the Four-Clamp Technique, a standardised DTI modification employing omnidirectional traction via four symmetrically placed towel clamps. This configuration enhances abdominal wall stability and vertical elevation through symmetrical force distribution, maximising the distance between peritoneum and underlying retroperitoneal vascular structures and intraperitoneal viscera whilst mitigating risks of uncontrolled lateral displacement or oblique trocar advancement. We hypothesised that the Four-Clamp Technique would achieve a high rate of successful primary peritoneal access with an acceptable safety profile in morbidly obese patients (BMI ≥40 kg/m^2), defined as an overall success rate exceeding 90% with no major entry-related vascular or visceral injuries. This study comprehensively evaluates the safety, efficacy, and reproducibility of the Four-Clamp Technique in morbidly obese patients.

Methods

Study Design and Setting

This retrospective cohort study analysed prospectively maintained surgical data from a tertiary academic centre in İstanbul, Türkiye, specialising in gynaecological oncology and advanced laparoscopic surgery. The study period extended from January 2015 to August 2025. All procedures were performed by a single surgical team comprising a board-certified gynaecological oncologist with laparoscopic experience. Ethics committee approval was obtained from the Scientific Research Ethics Committee of, University of Health Sciences Türkiye, Kartal Dr. Lütfi Kırdar City Hospital prior to data collection (approval number: 2025/010.99/22/34, date: 26.11.2025). All patients gave written consent to the collection of data and surgical data from their operations to be stored in the database and used subsequently for research and publication.

Patient Selection

The study included 45 consecutive morbidly obese women (BMI ≥40 kg/m^2) who underwent laparoscopic gynaecological procedures using the Four-Clamp Technique for primary peritoneal access. Inclusion criteria comprised women aged ≥18 years, BMI ≥40 kg/m^2, American Society of Anaesthesiologists (ASA) physical status I–III, and who underwent laparoscopic gynaecological surgery.

Exclusion criteria included dense periumbilical adhesions from prior midline laparotomy, history of extensive open pelvic operations (≥2 previous laparotomies with known intraperitoneal adhesions), previous ventral or incisional hernias at the proposed entry site, coagulopathy (international normalised ratio >1.5 or platelet count <50,000/μL), and emergency surgical indications. Patients with prior lower-segment caesarean delivery or prior laparoscopic surgery without clinical or radiological suspicion of periumbilical adhesions were not excluded, as lower transverse incisions typically do not produce significant periumbilical adhesion formation.

The Four-Clamp Technique

Following induction of general anaesthesia with endotracheal intubation and neuromuscular blockade, patients were positioned supine in the dorsal lithotomy position with arms tucked. A urinary catheter was inserted for bladder decompression, and an orogastric or nasogastric tube was placed for gastric decompression.

Abdominal skin was prepared using povidone-iodine solution. A 10–12 mm transverse skin incision was made at either the umbilical or supraumbilical (Lee-Huang point) midline location, selected according to uterine size, panniculus distribution, and estimated abdominal wall thickness. The incision was carried through the skin and subcutaneous tissue. The technique employs omnidirectional traction via four symmetrically positioned towel clamps to achieve stable abdominal wall elevation before DTI. Clamps grasped the full-thickness abdominal wall, creating a square configuration around the entry site at approximately 3–4 cm from the incision in each cardinal direction (Figure 1). The surgical assistant and the surgeon simultaneously and forcefully elevated four clamps perpendicular (90 degrees) to the operating table surface. This manoeuvre was performed with a sustained, strong upward force to achieve maximal tissue tension and maximal distance between the peritoneum and the underlying viscera. Elevation was maintained consistently throughout trocar insertion.

Whilst maintaining maximum upward traction, a 10 mm or 12 mm sharp, non-optical, disposable trocar with a pyramidal tip was inserted with perpendicular pressure to the elevated abdominal wall using a single,

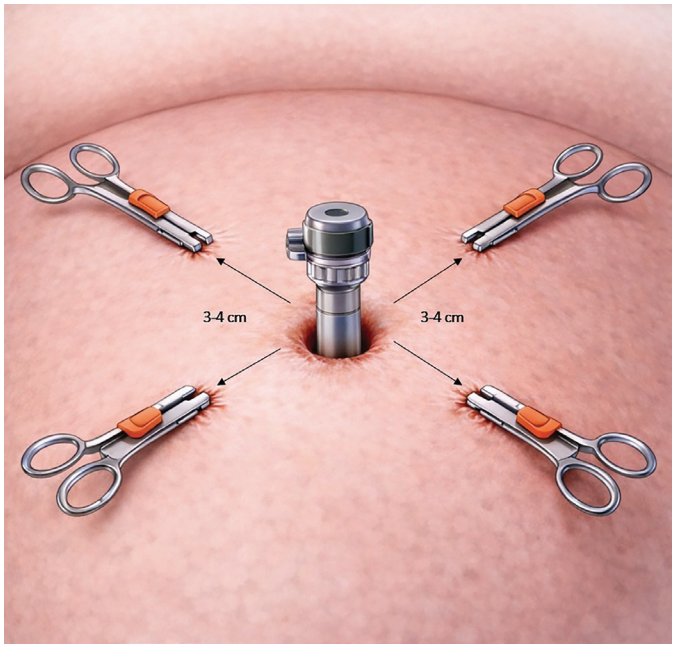

Figure 1. Schematic illustration of the Four-Clamp Technique. Four towel clamps are placed in a square configuration at approximately 3–4 cm from the entry incision in each cardinal direction, grasping the full-thickness abdominal wall. Omnidirectional traction vectors (arrows) demonstrating simultaneous perpendicular elevation by the surgeon and assistant. Perpendicular trocar insertion through the elevated, taut abdominal wall with a stable tissue platform.

controlled, by rotating left and right motion. The surgeon maintained continuous tactile feedback throughout insertion, assessing a composite of indicators including a perceptible reduction in tissue resistance, the presence of fascial or peritoneal penetration sensation (the characteristic "two-pop" representing sequential breach of rectus fascia and peritoneum), and the depth of trocar insertion relative to the estimated abdominal wall thickness.

Upon the surgeon's assessment that peritoneal entry had likely occurred—based on the composite tactile indicators described above—trocar advancement was halted, the trocar obturator was removed, and a 10 mm 30-degree rigid laparoscope was inserted through the trocar sleeve for direct visual confirmation of intraperitoneal placement. The correct position was confirmed by direct visualisation of intra-abdominal viscera (omentum, bowel serosa, or uterine fundus). If preperitoneal or extraperitoneal placement was identified, the trocar was either advanced cautiously under direct vision or redirected. The laparoscopic camera was swept through 360 degrees to inspect for immediate complications. Only after direct visual confirmation was pneumoperitoneum established using CO_2 insufflation at an initial flow rate of 1–2 L/min, gradually increased to 4–6 L/min to achieve the target intra-abdominal pressure of 12–14 mmHg (Video 1).

Ancillary Port Placement

All subsequent trocars were placed under direct laparoscopic visualisation. A standard triangular configuration was employed, consisting of two lateral 5 mm ports placed in the bilateral lower quadrants at or lateral to the inferior epigastric vessels. When dictated by surgical complexity, an additional 5 mm or 10–12 mm port was placed in the suprapubic midline or contralateral upper quadrant. Port-site selection was adjusted intraoperatively to accommodate panniculus position and ensure optimal instrument triangulation, particularly in the presence of a thick, overhanging panniculus.

Outcome Measures

Primary Outcomes

1. First-attempt success rate: Successful intraperitoneal access achieved on initial trocar insertion with direct laparoscopic confirmation
2. Overall success rate: Successful access achieved within two attempts using the Four-Clamp Technique

Conversion to alternative entry technique: abandonment of the technique after two unsuccessful attempts

3. Major complications: Major vascular injury (aorta, inferior vena cava, iliac vessels, requiring repair) or visceral injury (bowel perforation, liver laceration, splenic injury requiring intervention)

Secondary Outcomes

1. Time to intraperitoneal access: Measured from skin incision to achievement of direct visual confirmation of intraperitoneal placement
2. Minor complications: Trocar-site bleeding not requiring intervention beyond local pressure or cautery, subcutaneous emphysema, extraperitoneal insufflation, minor omental injury, localised clamp-site haematoma
3. Postoperative entry-site complications within 30 days: Wound infection, fascial dehiscence, incisional hernia

All complications were classified using the Clavien-Dindo system, with major complications defined as grade III or higher.[10]

Data Collection and Statistical Analysis

Data were extracted from electronic health records. Statistical analyses were performed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables with normal distribution were presented as mean ± standard deviation, whilst non-normally distributed variables were presented as median (interquartile range). Normality was assessed using the Shapiro-Wilk test and visual inspection of histograms. Categorical variables were presented as absolute counts and percentages. Success rates and complication rates were calculated with 95% confidence intervals (CIs) using the Wilson score method. Stratified analyses by BMI subcategory and prior surgical history were performed using Fisher's exact test, given the small, expected cell counts. A two-sided *P* value <0.05 was considered statistically significant.

Results

Patient Characteristics

Forty-five morbidly obese women underwent laparoscopic gynaecological procedures using the Four-Clamp Technique between January 2015 and August 2025. Mean age was 46.8±9.2 years, and mean BMI was 43.9±3.8 kg/m^2. The majority (84.4%) had class III obesity (BMI: 40.0–49.9 kg/m^2), 13.3% had super obesity (BMI: 50.0–59.9 kg/m^2), and 2.2% had super-super obesity (BMI ≥60.0 kg/m^2). Fourteen patients (31.1%) had previous abdominal surgery, including eight with prior caesarean section. Sixty per cent presented with at least one medical comorbidity, most commonly hypertension (35.6%) and type 2 diabetes mellitus (24.4%). ASA classification was II in 62.2% and III in 37.8%. Surgical indications comprised benign gynaecological disease in 68.9% and malignant disease in 31.1%. The primary entry site was umbilical in 28 patients (62.2%) and supraumbilical (Lee-Huang point) in 17 patients (37.8%). Baseline, demographic and clinical features characteristics are provided in Table 1.

Specific surgical indications comprised total laparoscopic hysterectomy with or without bilateral salpingo-oophorectomy for leiomyoma or abnormal uterine bleeding (n=14, 31.1%), laparoscopic bilateral salpingo-oophorectomy for adnexal masses (n=7, 15.6%), laparoscopic hysterectomy for endometrial hyperplasia (n=5, 11.1%), laparoscopic surgery for endometriosis (n=3, 6.7%), diagnostic laparoscopy (n=2, 4.4%), comprehensive surgical staging for endometrial cancer (n=10, 22.2%), laparoscopic staging or interval debulking for ovarian malignancy (n=3, 6.7%), and laparoscopic radical hysterectomy for cervical cancer (n=1, 2.2%) (Table 1).

Primary Outcomes

First-attempt success was achieved in 39 of 45 patients (86.7%; 95% CI: 73.2–94.5%). Among the six patients where the initial attempt was unsuccessful, contributing factors included extreme supraumbilical adiposity with difficulty achieving adequate tissue tension (n=3), thick fibrotic subcutaneous tissue impeding clamp placement (n=2), and technical difficulty with assistant coordination (n=1). Three of these six patients (50%) achieved successful access on the second attempt, yielding an overall cumulative success rate of 93.3% (42/45; 95% CI: 81.7–98.1%). Primary outcome measures specifications are provided in Table 2. The two-pop sensation was not uniformly perceptible; among successful cases, a clearly discernible two-pop was reported in 71.4%, an attenuated or single-pop sensation in 19.0%, and absent or equivocal tactile feedback in 9.5%. Mean trocar insertion depth from skin surface to peritoneal entry was 9.4±2.8 cm, reflecting the substantially increased skin-to-peritoneum distance characteristic of morbid obesity.

Table 1. Baseline demographic and clinical characteristics (n=45).	
Characteristic	**Value**
Age (years), mean ± SD	46.8±9.2
BMI (kg/m²), mean ± SD	43.9±3.8
BMI category, n (%)	
Class III obesity (BMI: 40.0-49.9)	38 (84.4)
Super obesity (BMI: 50.0-59.9)	6 (13.3)
Super-super obesity (BMI ≥60.0)	1 (2.2)
Parity, median (range)	2 (0-5)
Previous abdominal surgery, n (%)	14 (31.1)
Previous caesarean section only	8 (17.8)
Previous benign gynaecologic surgery	4 (8.9)
Previous laparoscopy	2 (4.4)
Comorbidities, n (%)	
Any comorbidity	27 (60.0)
Hypertension	16 (35.6)
Type 2 diabetes mellitus	11 (24.4)
Cardiovascular disease	4 (8.9)
Chronic pulmonary disease	3 (6.7)
Multiple comorbidities (≥2)	9 (20.0)
ASA classification, n (%)	
ASA II	28 (62.2)
ASA III	17 (37.8)
Primary entry site, n (%)	
Umbilical	28 (62.2)
Supraumbilical (Lee-Huang point)	17 (37.8)
Surgical indication, n (%)	
Benign gynaecologic disease	31 (68.9)
TLH ± BSO for leiomyoma/AUB	14 (31.1)
Laparoscopic BSO for adnexal mass	7 (15.6)
Laparoscopic hysterectomy for endometrial hyperplasia	5 (11.1)
Laparoscopic surgery for endometriosis	3 (6.7)
Diagnostic laparoscopy	2 (4.4)
Malignant disease (staging/cytoreduction)	14 (31.1)
Surgical staging for endometrial cancer	10 (22.2)
Staging/debulking for ovarian malignancy	3 (6.7)
Radical hysterectomy for cervical cancer	1 (2.2)
Haemoglobin (g/dL), mean ± SD	12.4±1.6

SD: Standard deviation, BMI: Body mass index, ASA: American Society of Anaesthesiologists, TLH: Total laparoscopic hysterectomy, BSO: Bilateral salpingo-oophorectomy, AUB: Abnormal uterine bleeding.

Table 2. Primary outcome measures (n=45).		
Outcome	**n (%)**	**95% CI**
First-attempt success	39 (86.7)	73.2-94.5
Second-attempt success*	3/6 (50.0)	18.8-81.2
Overall success (≤2 attempts)	42 (93.3)	81.7-98.1
Conversion to an alternative technique	3 (6.7)	1.9-18.3

*Among the 6 patients who had an unsuccessful first attempt. CI: Confidence interval.

Three patients (6.7%; 95% CI: 1.9–18.3%) required conversion to alternative entry methods following two unsuccessful attempts. In two patients, conversion to the left upper quadrant Palmer's point using the Veress needle technique was successfully performed. In one patient with extreme central adiposity and redundant panniculus, conversion to the open Hasson technique at the same umbilical site entry was utilised. All three conversions ultimately achieved safe peritoneal access without complications.

Stratified Analysis

When stratified by obesity subclass, first-attempt success was 89.5% (34/38) among patients with Class III obesity (BMI: 40.0–49.9 kg/m²), 66.7% (4/6) among patients with super obesity (BMI: 50.0–59.9 kg/m²), and 100% (1/1) in the single patient with super-super obesity (BMI ≥60 kg/m²). Overall success rates were 94.7% (36/38), 83.3% (5/6), and 100% (1/1), respectively. When stratified by prior abdominal surgical history, patients without prior surgery (n=31) demonstrated first-attempt and overall success rates of 90.3% (28/31) and 96.8% (30/31), respectively, compared with 78.6% (11/14) and 85.7% (12/14) among patients with prior surgery (n=14). These differences did not reach statistical significance (Fisher's exact test, *P*=0.35 for first-attempt success; *P*=0.20 for overall success), consistent with the limited statistical power of the study (Table 3).

Safety Outcomes

No major vascular injuries occurred throughout the study period, including injuries to the aorta, inferior vena cava, common iliac vessels, or external iliac vessels. No visceral injuries were observed, including bowel perforations or solid organ injuries. No patients experienced gas embolism, and there were no perioperative deaths.

Minor complications were limited to localised bleeding at clamp sites or trocar sites, occurring in four patients (8.9%; 95% CI: 3.5–20.7%). Two cases of subcutaneous

Table 3. Stratified analysis of outcomes by BMI category and prior surgical history.				
Subgroup	**n**	**First-attempt success, n (%)**	**Overall success, n (%)**	**Conversion, n (%)**
BMI category				
Class III obesity (40.0–49.9 kg/m^2)	38	34 (89.5)	36 (94.7)	2 (5.3)
Super obesity (50.0–59.9 kg/m^2)	6	4 (66.7)	5 (83.3)	1 (16.7)
Super-super obesity (≥60.0 kg/m^2)	1	1 (100)	1 (100)	0 (0)
***P* value (Fisher's exact)**		0.32	0.47	
Prior abdominal surgery				
No prior surgery	31	28 (90.3)	30 (96.8)	1 (3.2)
Prior surgery	14	11 (78.6)	12 (85.7)	2 (14.3)
***P* value (Fisher's exact)**		0.35	0.20	
BMI: Body mass index.				

emphysema, one case of extraperitoneal insufflation and three cases of clinically insignificant omental injury were documented. The total minor complication rate was 22.2% (10/45). Within a 30-day follow-up, two cases of wound infections occurred, but there were no reported fascial dehiscence, or incisional hernias (Table 4).

Procedural Efficiency

Among the 42 patients who achieved successful entry with the Four-Clamp Technique, the mean time from skin incision to direct visual confirmation of intraperitoneal placement was 74±18 seconds (median 72 seconds; range: 52–121 seconds). The majority (88%) achieved intraperitoneal access within 90 seconds. Time to intraperitoneal access did not significantly correlate with BMI (*P*=0.26).

All 45 patients successfully proceeded with the intended definitive laparoscopic procedures after achieving peritoneal access. Mean total operative time was 118±34 minutes, mean estimated blood loss was 145±78 mL, and mean length of hospital stay was 2.1±0.8 days.

Table 4. Complication profile (n=45).	
Complication category	**n (%)**
Minor complications	**10 (22)**
Trocar-site/clamp-site bleeding	4 (8.9)
Subcutaneous emphysema	2 (4.4)
Extraperitoneal insufflation	1 (2.2)
Omental injury (minor)	3 (6.6)
Postoperative entry-site complications (30 days)	**2 (4.4)**
Wound infection	2 (4.4)
Fascial dehiscence	0 (0)
Incisional hernia	0 (0)
Major complications were defined as major vascular injury (aorta, vena cava, or iliac vessels), visceral injury (bowel), solid organ injury (liver or spleen), gas embolism, or mortality. No major complications occurred in this study.	

Postoperative Histopathological Findings

Postoperative histopathological diagnoses are detailed in Table 5 Among malignant cases (n=14), the most common diagnosis was endometrioid adenocarcinoma of the endometrium (n=9, comprising International Federation of Gynaecology and Obstetrics (FIGO)

Table 5. Postoperative histopathological diagnoses (n=45).	
Diagnosis	**n (%)**
Benign (n=31)	
Uterine leiomyoma	12 (26.7)
Endometrial hyperplasia without atypia	3 (6.7)
Endometrial hyperplasia with atypia	2 (4.4)
Mature cystic teratoma	3 (6.7)
Serous cystadenoma	2 (4.4)
Mucinous cystadenoma	2 (4.4)
Endometrioma	3 (6.7)
Chronic salpingitis	2 (4.4)
Normal pelvic findings	2 (4.4)
Malignant (n=14)	
Endometrioid adenocarcinoma, FIGO Grade 1	4 (8.9)
Endometrioid adenocarcinoma, FIGO Grade 2	3 (6.7)
Endometrioid adenocarcinoma, FIGO Grade 3	2 (4.4)
Uterine serous carcinoma	1 (2.2)
High-grade serous ovarian carcinoma	2 (4.4)
Borderline mucinous ovarian tumour	1 (2.2)
Squamous cell carcinoma of the cervix	1 (2.2)
FIGO: International Federation of Gynaecology and Obstetrics.	

Grade 1 in four, FIGO Grade 2 in three, and FIGO Grade 3 in two patients), followed by uterine serous carcinoma (n=1), high-grade serous ovarian carcinoma (n=2), borderline mucinous ovarian tumour (n=1), and squamous cell carcinoma of the cervix (n=1). The predominance of endometrial carcinoma in this cohort is consistent with the well-established epidemiological association between morbid obesity and endometrial malignancy. Among benign cases (n=31), the most common pathological findings were uterine leiomyomata (n=12), endometrial hyperplasia without atypia (n=3) or with atypia (n=2), benign ovarian cysts including mature cystic teratoma (n=3), serous cystadenoma (n=2), and mucinous cystadenoma (n=2), endometriomas (n=3), chronic salpingitis (n=2), and normal pelvic findings at diagnostic laparoscopy (n=2).

Discussion

This study presents a single-centre experience with a standardised modification of DTI tailored for morbidly obese patients undergoing laparoscopic surgery. The Four-Clamp Technique achieved a 93.3% overall success rate without major entry-related complications, providing clinically relevant descriptive data supporting the feasibility of a modified DTI approach in this high-risk population. However, due to the retrospective design and absence of a concurrent control group, these findings should be interpreted as observational benchmarks rather than evidence of superiority.

The abdominal wall in morbidly obese patients presents complex biomechanical challenges beyond increased thickness alone. These include excessive subcutaneous adipose tissue, a mobile and redundant panniculus obscuring anatomical landmarks, distortion of normal tissue planes, and reduced effective counter-traction due to tissue mobility.[11] Collectively, these factors limit control during trocar advancement and may reduce the safety margin between the advancing trocar tip and intra-abdominal or retroperitoneal structures.

A recent systematic review emphasised the limited evidence available for laparoscopic entry in high-BMI patients, noting that most studies excluded this population.[2] The review concluded that current data are insufficient to determine differences in rates of vascular injury, visceral injury, or failed entry between techniques, with overall evidence graded as very low quality.

The Four-Clamp Technique was designed to help mitigate these biomechanical limitations through balanced, omnidirectional traction using four-point fixation. In contrast to single- or dual-clamp approaches,[12] which provide limited directional lift and may allow lateral tissue displacement, the four-clamp configuration stabilises the abdominal wall by distributing tension across quadrants. This creates a taut operative field, increases the perpendicular skin-to-peritoneum distance, constrains lateral movement, facilitates a controlled perpendicular trocar trajectory, and distributes mechanical stress more evenly.

The observed first-attempt success rate (86.7%) and overall success rate (93.3%) are consistent with previously reported outcomes for DTI in obese populations. Ikechebelu et al.[13] demonstrated comparable success rates between direct trocar and Veress needle entry techniques in obese patients (BMI > 30 kg/m²), with no statistically significant difference between the two methods. Notably, our cohort represents a higher-risk population (BMI ≥40 kg/m²). Similarly, Turgay et al.[14] demonstrated that obesity and prior abdominal surgery do not adversely affect laparoscopic outcomes when appropriate technical adaptations are employed, consistent with our findings.

Raimondo et al.,[15] in a systematic review and meta-analysis of randomized controlled trials, reported that direct trocar entry was associated with lower rates of failed entry compared with Veress needle and open techniques. However, differences in major complications remained inconclusive due to their low incidence. These findings support the role of DTI when appropriately modified for patient-specific anatomical conditions.

Alternative entry strategies remain important in selected cases. Palmer's point has been advocated in patients with prior midline surgery, suspected adhesions, or significant umbilical adiposity. Varghese et al.[16] reported no entry-related complications in 47 morbidly obese patients using left upper quadrant access. While this approach benefits from thinner subcutaneous tissue and reliable anatomical landmarks, it carries risks such as gastric or splenic injury and may necessitate additional ports to maintain optimal triangulation. In our series, Palmer's point was successfully utilised in one conversion case, supporting its role as a complementary strategy.

Optical trocars provide real-time visualisation during entry and may facilitate identification of tissue planes. Favourable outcomes have been reported in obese populations.[8,9,17,18] However, their use in morbid obesity is limited by restricted visualisation through thick adipose tissue, increased cost, limited availability, and the lack of

robust comparative evidence demonstrating superiority. In contrast, the Four-Clamp Technique utilises standard instruments and is immediately applicable without additional resource requirements. However, we do not position the Four-Clamp Technique as a replacement for optical entry systems; rather, it may serve as a cost-effective and immediately applicable alternative in settings where optical trocars are unavailable or impractical.

Pre-insufflation with a Veress needle increases the distance between the abdominal wall and retroperitoneal structures, theoretically enhancing safety. However, in morbidly obese patients, increased skin-to-peritoneum distance, reduced reliability of traditional confirmation tests, and the risk of preperitoneal insufflation limit its effectiveness.[2] The Four-Clamp Technique aims to achieve a similar increase in working distance through mechanical elevation while maintaining tissue stability during trocar insertion. Hybrid approaches combining mechanical elevation with insufflation may warrant further investigation, particularly in super-obese patients. Accordingly, the choice between mechanical elevation and pre-insufflation should be individualised based on patient anatomy, surgeon experience, and available resources, rather than interpreted as mutually exclusive strategies.

The conversion rate of 6.7% is clinically acceptable in this high-risk cohort. Importantly, all failed initial entries were successfully managed using alternative techniques without complications, indicating that unsuccessful initial access did not compromise overall procedural safety.

Major entry-related complications, although rare, carry significant morbidity. Alkatout[19] reported bowel injury rates of 0.04% and major vascular injury rates of 0.02–0.04%, with over 50% occurring during initial entry. A substantial proportion of these injuries remain unrecognised intraoperatively, contributing to increased morbidity and mortality. In this context, the absence of major complications in our cohort is reassuring, although the sample size precludes definitive conclusions regarding comparative risk reduction.

The optimal entry technique in morbidly obese patients remains uncertain. Veress needle entry is limited by the reduced reliability of confirmation methods in thick abdominal walls,[2] while the Hasson technique can be technically demanding and time-consuming.[20] Optical systems offer visualisation advantages but are constrained by cost and availability, and lack consistent evidence of superiority.[8,21] Within this context, the Four-Clamp Technique offers a simplified, reproducible, and cost-neutral alternative using universally available equipment.

In our practice, selection of entry technique in patients with prior abdominal surgery was individualised based on surgical history, suspected adhesions, and available imaging. Patients with limited prior lower-segment or laparoscopic surgery were considered suitable for Four-Clamp entry, whereas those with prior midline laparotomy, multiple surgeries, or suspected dense adhesions were managed using alternative approaches such as Palmer's point or open Hasson entry. This stratified approach reflects the need to tailor the entry technique to patient-specific anatomical risk.

Study Limitations

Several limitations should be acknowledged. First, the retrospective single-centre design introduces potential selection bias. The exclusion of patients with dense periumbilical adhesions, known hernias, coagulopathy, or emergency indications resulted in a cohort with relatively favourable anatomy, limiting generalizability to higher-risk populations. Second, the sample size of 45 patients is insufficient to detect statistically meaningful differences in rare but serious complications. Given baseline rates of major complications ranging from 0.1% to 0.5%, substantially larger cohorts would be required to demonstrate meaningful risk differences with adequate statistical power. Accordingly, the absence of major complications in this study should not be interpreted as evidence of superiority. Third, the absence of a concurrent control group precludes direct comparative analysis with alternative entry techniques. Although randomised controlled trials would provide higher-level evidence, such studies are challenging due to the rarity of major outcomes, ethical considerations in high-risk populations, and the logistical demands of multicentre recruitment. Fourth, all procedures were performed by a single experienced surgical team at a tertiary academic centre. While this ensures technical consistency, it limits generalizability to other settings and to surgeons with varying levels of experience.

Finally, subgroup analyses based on BMI category and prior surgical history were limited by small sample sizes. Observed trends, including potentially lower success rates in patients with super-obesity or prior surgery, should therefore be interpreted as exploratory. Prospective,

multicentre studies with adequate power, standardised outcome definitions, and inclusion of health economic analyses are required to further evaluate this technique.

Conclusion

In this single-centre retrospective cohort, the Four-Clamp Technique demonstrated feasibility, reproducibility, and an acceptable safety profile for primary laparoscopic access in morbidly obese patients. The combination of high success rates, absence of major entry-related complications, and use of universally available equipment supports its consideration as a practical option in selected patients. However, definitive clinical recommendations cannot be made on the basis of these findings alone. These findings should be interpreted within the context of a selected patient population and an experienced surgical team. Prospective, multicentre comparative studies are required to determine its relative efficacy and safety compared with established entry techniques. Future studies incorporating comparative designs and multi-surgeon settings will be essential to validate external applicability.

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Data sharing: The datasets used for this study are not available publicly due to legal and confidentiality reasons. However, the data analysis can be requested from the author.

Transparency: We affirm that the manuscript is an honest, accurate and transparent account of the study and no important aspects have been omitted. There are no discrepancies from the study as planned.

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Video 1. https://youtu.be/nJDVVEilHPY

High-resolution, unedited video demonstrating the Four-Clamp Technique for direct trocar entry in a representative morbidly obese patient (BMI 45.26 kg/m^2, height 156 cm, weight 110 kg). The video demonstrates clamp placement, omnidirectional traction, controlled trocar insertion, and laparoscopic confirmation of intraperitoneal position.