

1 SUBMITTED 20 DEC 22
2 REVISION REQ. 21 FEB 23; REVISION RECD. 1 MAR 23
3 ACCEPTED 22 MAR 23
4 **ONLINE-FIRST: MAY 2023**
5 DOI: <https://doi.org/10.18295/squmj.5.2023.027>
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7 **Intraoperative and Postoperative Outcomes of Modified Bidirectional Intra-**
8 **Umbilical versus Infra-Umbilical Incision for Direct Trocar Insertion in**
9 **Gynecological Laparoscopy**
10 *A randomized controlled trial*

11 ***Atef Darwish, Mohammad Tawfik, Amal Gaflan, Dina Darwish**

12
13 *Department of Obstetrics & Gynecology, Women's Health University Hospital, Assiut*
14 *University, Assiut, Egypt.*

15 **Corresponding Author's e-mail: atef_darwish@yahoo.com*
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17 **Abstract**

18 **Objectives:** To describe a modified curved deep bidirectional intra-umbilical vertical incision for
19 primary trocar insertion and prospectively compare its intraoperative and postoperative outcomes
20 with infra-umbilical incision in gynecologic laparoscopy. **Methods:** Between August 2019 and
21 March 2021, 110 patients subjected to direct trocar insertion technique for laparoscopic
22 intervention were classified into two groups. Group A comprised 55 cases of infra-umbilical
23 incision while a modified curved longitudinal bidirectional deep intra-umbilical incision was
24 used in group B (55 cases). Intraoperative and postoperative assessments were performed.

25 **Results:** There was statistically significant increased numbers of parity, gravidity, and previous
26 cesarean sections; and a smaller number of infertility complaints in group B. Likewise, group B
27 expressed a statistically significant less peri-trocar CO₂ leakage (46 patients, 83.6% versus 28
28 patients, 50.9%) and more tightness of the primary portal entry (45 patients, 81.8% versus 30
29 patients, 54.5%) if compared to group A throughout the whole operation. On follow-up after one
30 month, there was a statistically significant (p-value = 0.029) decreased OSAS and PSAS in

31 group B (10.4 ± 4.2 and 11.8 ± 4.3) i.e., better cosmeses when compared to group A (13.3 ± 5.7
32 and 16.0 ± 6.8) respectively. **Conclusion:** Performing a modified curved deep bidirectional intra-
33 umbilical vertical incision for insertion of primary laparoscopic trocar is a simple and fast step
34 that results in elimination of intraoperative gas leakage and trocar slippage without the need of
35 any additional sutures. Aesthetically, it results in a better scar with satisfactory cosmeses if
36 compared to infra-umbilical incision.

37 **Keywords:** Laparoscopy; Trocar; Entry.

38

39 **Advances in Knowledge:**

- 40 • Primary trocar umbilical insertion for laparoscopy is the commonest approach.
- 41 • Modified technique results in less gas leakage and trocar slippage.
- 42 • It is more cosmetic if compared to other access techniques.

43

44 **Application to Patient Care:**

- 45 • Umbilicus cosmeses is important particularly for females.
- 46 • The proposed method for laparoscopic entry will help preserve umbilicus cosmeses as it
47 is totally intra-umbilical.

48

49 **Introduction**

50 Nowadays, laparoscopic surgery is a well-established modern tool for treating many
51 gynecological disorders as it is followed by rapid wound healing, short hospital stay, less
52 postoperative pain, and better aesthetic results.¹ Different laparoscopic entry techniques include
53 Veress needle insertion, open laparoscopy, and direct trocar insertion without a statistically
54 significant difference regarding patient safety.² Nevertheless, direct trocar insertion is gaining
55 popularity.³ Postoperative umbilical scar cosmeses and appearance are important issues for
56 women. As the umbilicus is an important aesthetic component of the abdomen, surgeons are
57 concerned about how to maintain cosmetic appearance of the umbilicus. In addition to
58 psychological upsetting, bad scars may result in pain, tenderness, and itching.⁴⁻⁶

59 Some studies compared different types of primary portal for gynecologic laparoscopy,⁷⁻⁸
60 however, there is no universal agreement on an ideal periumbilical incision for gynecologic
61 laparoscopy. Moreover, there is lack of studies addressing intraoperative outcomes of different
62 periumbilical incisions. This study aims to introduce a modified curved bidirectional deep intra-
63 umbilical incision for primary trocar insertion and prospectively compare its intraoperative and
64 postoperative outcomes with infra-umbilical incision in gynecologic laparoscopy.

65 66 **Methods**

67 This prospective study was performed at the Endoscopy Unit of the Woman's Health University
68 Hospital between August 2019 and March 2021 on women in the reproductive age subjected to
69 direct trocar insertion of gynecologic laparoscopy for different indications without any history of
70 previous umbilical operation or umbilical hernia. It was approved by the ethics committee of the
71 Faculty of Medicine (17100792) and was registered at The Clinicaltrials.gov (NCT03988348).

72 All women signed consent to participate in this single blinded RCT to enter one of two groups by
73 random allocation. They were assigned according to the 10 mm primary laparoscopic direct
74 trocar entry points (infra or a modified intra umbilical) and incision types (transverse versus
75 curved longitudinal) respectively using sealed envelopes. The allocated envelopes were opened
76 just before surgery.

77
78 The sample size was estimated using epi info version 7.2.5.0. Using 95% confidence interval and
79 power of 80% assuming percent of unexposed with outcome=5, while percent of exposed with
80 outcome =28. The estimated sample size was 96. Adding 15% drop out rate, the total sample size
81 estimated to be 110.⁹ Allocated 110 cases were divided into two groups. Group A comprised 55
82 cases subjected to infra-umbilical 10 mm transverse incision while group B comprised 55 cases
83 of a modified curved bidirectional longitudinal intra-umbilical incision for primary laparoscopic
84 direct trocar insertion. Exclusion criteria included patients scheduled for 5mm primary trocar
85 insertion, open laparoscopy, Verres needle insertion, patients with previous abdominal surgery
86 and scar, umbilical hernia, umbilical infection e.g. pilonidal sinus disease,¹⁰ previous
87 laparoscopy, or previous umbilical surgery, scarred, previously burned or hyperpigmented
88 umbilicus. Prepubertal or postmenopausal patients were also excluded from this study.

89

90 In the operating room, the umbilicus was prepared by removing all debris using copious amounts
91 of povidone iodine gauze and cotton swabs. Preoperatively, the surgeon commented on the shape
92 of the umbilicus¹¹ (Figure 1) and any umbilical fascial defect signifying any tiny hernia,
93 tightness of the abdominal muscles and skin laxity. To avoid skin disfigurement, clamps to
94 elevate the abdominal wall in all cases was not used, but toothed forceps was used to facilitate
95 delicate skin cut to avoid slipping of the scalpel. In group A, a 10 mm infra-umbilical transverse
96 incision was done to allow trocar to be inserted without undue resistance from the skin so that
97 the trocar passed directly through the fascia and the peritoneum with ease. In group B, a 10 mm
98 right-sided modified curved deep bidirectional longitudinal intra-umbilical incision was made.
99 The technique started by grasping the right edge of the umbilicus with a toothed forceps. Then, a
100 curved vertical incision was made as deep as possible. Thereafter, the trocar was inserted inside
101 the incision till the level of the edge of the sleeve passed the skin. At this moment, the trocar was
102 directed transversely (horizontally) on the right side of the umbilicus for one to two centimeters
103 in the subcutaneous tissue.

104
105 The final step was tilting the trocar to the vertical plane to pierce the fascia towards the pelvis
106 (figure 2). By this way the trocar had 2 pathways (bidirectional) until it reached the peritoneal
107 cavity (horizontally then vertically). In both groups, inflation of the peritoneal cavity with CO₂
108 was done up to a pressure of 12-15 mm Hg. Surgical procedures were performed using
109 conventional laparoscopic instruments under vision with a rigid 0-degree, 10-millimeter
110 endoscope. Intraoperatively, the surgeon commented on easiness of movement of the trocar and
111 telescope, any leakage of CO₂ alongside the primary trocar and any intraoperative slippage of
112 the trocar during forward and backward movement of the telescope. Operative time varied
113 according to the intraperitoneal laparoscopic procedure. This study didn't report entry site or
114 intraperitoneal complications in both groups. In both groups, the skin incision was sutured using
115 4/0 Monocryl subcuticular stitch. Patients were offered regular post-laparoscopic surgery care as
116 usual at our institution with on-need analgesics till discharge. They were instructed to take care
117 of the sterile dressings and they came back after one week for check-up and wound dressing.
118 Another follow-up visit was scheduled after one month to properly assess the scar as previously
119 consented by the patients.

120

121 We performed both observer scar assessment scale (OSAS) as well as patient scar assessment
122 scale (PSAS)¹² which compare the wound to the nearby skin. In both scales, the lower the score
123 the better the scar. Maximal scores of OSAS and PSAS are 50 and 60 respectively. Moreover,
124 the patient was clearly asked if she or her partner can see the scar by naked eye or not to assess
125 effect of the incision on aesthetic appearance of the umbilicus. Primary outcome of this study
126 was to assess intraoperative performance using two different periumbilical incisions as regards
127 easiness of surgery, CO2 leakage and trocar slippage. Secondary outcomes were observer and
128 couple satisfactions using either incision.

129
130 Statistical Program for Social Science (SPSS) version 24 was used to analyze data. Quantitative
131 data were expressed as mean \pm SD. Qualitative data were expressed as frequency and percentage.
132 Mean (average) is the central value of a discrete set of numbers, specifically the sum of values
133 divided by the number of values. Standard deviation (SD) is the measure of dispersion of a set of
134 values. A low SD indicates that the values tend to be close to the mean of the set, while a high
135 SD indicate that the values are spread out over a wider range. Independent-samples t-test (T) of
136 significance was used when comparing between two means (for normally distributed data).
137 Mann–Whitney U (MW) test was used when comparing between two means (for abnormal
138 distributed data). Chi-square test (X²) was used when comparing between non-parametric data.
139 Probability (P-value) < 0.05 was considered significant (S), < 0.001 was considered as highly
140 significant (HS) and > 0.05 was considered non-significant (NS).

141 142 ***Statement of Ethics***

143 Authors state that subjects have given their written informed consent. Assiut University Medical
144 School Ethical Review Board approved the study protocol (17100792).

145 146 **Results**

147 This study comprised 110 patients subjected to 10 mm direct trocar insertion for gynecologic
148 laparoscopic surgery. They were divided into two groups. Group A comprised 55 cases of
149 transverse infra-umbilical incision while group B comprised 55 cases subjected to modified
150 curved deep bidirectional longitudinal intra-umbilical incision. Table 1 shows insignificant
151 difference regarding age, duration of marriage, and history of previous operations, abortion, or

152 duration of infertility between both groups. However, increased numbers of parity, gravidity and
153 previous cesarean sections; and a smaller number of infertility complaints were statistically
154 significant in group B.

155
156 Indications of laparoscopic surgery were variable in both groups. In group A, indications were
157 1ry infertility in 24 patients (43.6%), 2ry infertility in 19 patients (34.56%), hematocolpus and
158 hematometra in 1 patient (1.8%), left ectopic pregnancy in 1 patient (1.8%), missed IUD threads
159 in 7 patients (12.7%), Rt. Adnexal cyst in 2 patients (3.6%) and Rt. Ovarian torsion in 1 patient
160 (1.8%). In group B. It was 1ry infertility in 8 patients (14.5%), 2ry infertility in 16 patients
161 (29.1%), 2ry amenorrhea in 1 patient (1.8%), bilateral endometrioma in 1 patient (1.8%), chronic
162 pelvic pain in 2 patients (3.6%), Ewing sarcoma for transposition of ovaries in 1 patient (1.8%),
163 undisturbed tubal ectopic pregnancy in 10 patients (18.1%), missed IUD in 6 patients (10.9%),
164 right disturbed ectopic pregnancy in 1 patient (1.8%), ovarian cyst in 7 patients (12.7%), adnexal
165 hematoma in 1 patient (1.8%) and laparoscopic monitoring of hysteroscopic metroplasty of a
166 uterine septum in 1 patient (1.8%).

167
168 There was insignificant difference between both groups regarding preoperative assessment of the
169 umbilicus including presence of dimple, shape and appearance, index finger test for minute
170 hernia and use of conical trocar end. The most common umbilical shape noted in both groups
171 was vertical (84 cases, 76.3%) followed by transverse umbilicus (21 cases, 19%). However, there
172 was a statistically significant difference between both groups regarding abdominal wall muscle
173 and skin laxity as shown in table 2.

174
175 Group B expressed a statistically significant less peri-trocar CO₂ leakage (46 patients, 83.6%
176 versus 28 patients, 50.9%) and more tightness of the primary portal entry (45 patients, 81.8%
177 versus 30 patients, 54.5%) if compared to group A throughout the whole operation as seen in
178 table 3. On follow-up after one month, there was a statistically significant (p-value = 0.029)
179 decreased OSAS and PSAS in group B (10.4 ± 4.2 and 11.8 ± 4.3) when compared to group A
180 (13.3 ± 5.7 and 16.0 ± 6.8) respectively as shown in table 4 and figure 3. Moreover, 47 patients
181 (85.4%) and 23 patients (41.8%) reported failure to see the umbilical scar by naked eye by

182 herself or her partner in group B and A respectively and were satisfied by the aesthetic
183 appearance of the umbilicus.

184

185 **Discussion**

186 Primary umbilical trocar insertion is a procedural step of critical importance.¹³ Despite the
187 widespread use of advanced gynecologic laparoscopic surgeries, many surgeons give little
188 attention to skin incisions after lengthy and tedious operations and leave young staff to close
189 abdominal wall incisions. Most of gynecologic patients are young and very concerned about
190 aesthetic appearance of their belly. The umbilicus is very essential to the aesthetic appearance of
191 the abdomen¹⁴ and umbilical incisions directly affect female cosmeses.

192

193 This study included patients in the reproductive age with exclusion of young girls and
194 postmenopausal cases to eliminate age-related factors of wound healing.¹⁵ To minimize study
195 bias, direct trocar insertion was only used in this study with exclusion of cases of open
196 laparoscopy and Veress needle insertion. Surgical trocars may be bladed (safety) or bladeless,
197 disposable, or reusable, or spiral (corrugated) or non-spiral. Trocar end may be pyramidal or
198 conical without a significant difference in literature. An animal study demonstrated that using
199 conical and pyramidal trocars resulted in similar force, deformation, time, and distance of
200 exposed blade if they were of the same size.¹⁶

201

202 In this study, trocar type was standardized as bladeless reusable non-spiral with conical end to
203 eliminate the effect of these variables on the incision. Incision sites for primary trocar insertion
204 may be infra-umbilical, supra-umbilical, or trans-umbilical.¹⁶ Supraumbilical incision was
205 excluded as it is seldom used by gynecologists. In a review of laparoscopic practice by general
206 surgeons, approximately half of the laparoscopists preferred the infra-umbilical route and 35.7%
207 the supraumbilical area for entry.⁶ Vertical incision is usually preferred for initial intraperitoneal
208 access as it offered superior cosmetic effects than transverse incision.¹⁷ The infra-umbilical
209 incision cuts through the skin, the subcutaneous fat, and the fascia. In contrast, the intra-
210 umbilical incision is a linear incision from the skin to the fascia, extending only the length of the
211 umbilical ring. An intra-umbilical incision may take less time, is easier to perform, and is
212 theoretically less traumatic as only the skin and fascia need to be divided.

213

214 Nowadays, the intra-umbilical incision is being used more frequently, with the increasing cases
215 of single incision laparoscopic surgery (SILS), which has recently been proven to be a feasible
216 alternative for conventional laparoscopic surgery with better cosmetic outcome.¹⁸ In a
217 retrospective comparison of gynecologic laparoscopy cases, intra-umbilical incision, and peri-
218 umbilical incision (longitudinal/transverse oblique/arc incision according to the bellybutton
219 natural skin folds) were compared. They concluded that intra-umbilical incision should be
220 promoted in gynecologic laparoscopy.¹⁹

221

222 Postpartum sterilization using intra-umbilical skin incision was more efficient regarding aesthetic
223 concerns and operation time in a RCT.⁸ What's new in the current prospective RCT is to assess
224 the impact of modifications of the intra-umbilical incision on intraoperative and postoperative
225 outcomes (Darwish laparoscopic entry). Making the incision as deep as possible aims to make it
226 invisible and less liable to cause pain on touch using the maximal benefit of the natural umbilical
227 dimple. Addressing this important point would fulfil the requirements of the aesthetic appearance
228 of the umbilicus as the scar was not seen in 47 patients (85.4%) using this modified technique if
229 compared to 23 patients (41.8%) if infra-umbilical incision was made. Since most of the
230 umbilical shape of human being is vertical oval (in this study it was seen in 84 cases, 76.3%),
231 vertical incision used in this study in group B is more anatomic than transverse incision used in
232 group A.

233

234 Another additional advantage of the modified technique was making a curved intra-umbilical
235 incision (Figure 2) to be adapted with the natural curve of the umbilical dimple. In this study,
236 umbilical dimple was present in 95 cases (86.3%) in both groups, so selection of a curved
237 incision in group B was more anatomic. Importantly, the surgeon did not use any instrument to
238 elevate the anterior abdominal wall unlike others who usually use pointed towel forceps or
239 Kocher forceps¹¹ or other traumatic instruments that may leave a scar and hyperpigmentation
240 adding more disfigurement and psychological upset to the patients. Not only does aggressive
241 elevation of the skin around the umbilical region injurious and non-aesthetic, but also it doesn't
242 add any surgical benefit because the skin and fascia at the umbilicus are in direct contact that is
243 why it is the preferred site for primary entry. This proximity can be explained by the absence of

244 subcutaneous fat and muscle at the umbilicus that makes the midline dissection plane bloodless
245 to the peritoneum.⁵

246
247 All these technical tricks resulted in a better aesthetic appearance of the umbilicus and lower
248 OSAS and PSAS scales (better cosmeses) using this modified technique if compared to the
249 transverse infra-umbilical incision group. This study incorporated patient impressions and
250 comments on all issues of umbilical incision including their comment on the visibility of the scar
251 by herself or her partner which is considered one of the best aesthetic evaluation variables. This
252 step is commonly used after liposuction operations which may affect the appearance and shape
253 of the umbilicus.²⁰

254
255 Intraoperative benefits of the modified intra-umbilical to the surgical procedures are many.
256 Insertion of the trocar horizontally for one to two centimeters then its direction vertically
257 (bidirectional) adds an advantage of maintaining an airtight seal to avoid gas leakage alongside
258 the trocar and avoiding trocar slippage throughout the operation. This is simply explained by the
259 making fascial perforation away from the alignment with skin incision. Trocar dislodgment
260 occurs frequently during laparoscopic surgery particularly in some lean women, those with weak
261 anterior abdominal wall muscle or fascia and those with lax redundant skin. The best example is
262 multiparous or malnourished women.

263
264 The results of this study supported these concepts as the modified bidirectional technique was
265 more successful than classic infra-umbilical technique even in women with increased parity or
266 gravidity who were prone to weak anterior abdominal wall and lax skin (Table 2). Frequent
267 slippage of the trocar and abdominal deflation is a real distressing problem. Abdominal wall
268 emphysema can occur besides the risky prolongation of the surgical procedure.²¹ To overcome
269 this problem, some authors take a stitch at the fascia and encircle the trocar throughout the
270 procedure.²² Others use spiral trocars whether disposable or reusable.²³ Disposable spiral trocars
271 are very expensive if compared with reusable trocar and cannot be afforded by healthcare
272 authorities in many hospitals particularly developing countries with limited resources. Reusable
273 spiral trocar may require more force for insertion that may carry a risk of unintentional injury²⁴
274 due to repeated resistance to the corrugations along the whole shaft. Moreover, despite lack of

275 sufficient supporting studies, using 10 spiral trocars with force may be a risk factor for
276 subsequent umbilical trocar-site hernia as previously reported²⁵ due to repeated tears of the
277 fascia. On post-operative follow-up of all cases of this study, using ordinary reusable conical 10
278 mm trocar, there was no case of trocar-site hernia in either group.

279

280 Despite being a prospective RCT, this study has some limitations. Small sample size is a definite
281 limitation. Including all types of umbilici in either group would carry a bias as some umbilici are
282 already inverted with a definite dimple while others are protruding which may affect scar
283 appearance and pain scoring. Moreover, comments on easiness of movement of trocar and
284 telescope, leakage of CO₂ and intraoperative slippage of trocar were all subjectively assessed.
285 Theoretically, more accurate tools of assessment would be more informative. Nevertheless, in
286 some situations, intraoperative observations particularly by expert surgeons would be as accurate
287 and clinically informative as some sophisticated time-consuming tests. In modern statistics,
288 subjectivity is respected and is replaced by awareness of multiple perspectives and context
289 dependence.²⁶ A larger sample size and a multicentre study is needed to achieve a definite
290 conclusion in this respect.

291

292 **Conclusion**

293 From this study, it is concluded that performing curved deep bidirectional longitudinal intra-
294 umbilical incision for insertion of primary laparoscopic trocar (Darwish laparoscopic entry) is a
295 simple and fast step that results in elimination of intraoperative gas leakage and trocar slippage
296 without the need of any additional sutures. Aesthetically, it results in a better scar with
297 satisfactory cosmeses if compared to infra-umbilical incision.

298

299 **Conflicts of Interest**

300 The authors declare no conflict of interests.

301

302 **Funding**

303 No funding was received for this study.

304

305 **Authors' Contribution**

306 AD is the principal investigator who conceptualized the study, refined the study protocol,
307 performed many operations, and wrote the full paper. MT conceived the idea, wrote the protocol,
308 performed many operations, supervised the candidate and reviewed the thesis and the full paper.
309 AG was the active candidate who made the interviews, collected data and made all statistical
310 analyses with the aid of a statistician. DD reviewed the paper and made some corrections. All
311 authors approved the final version of the manuscript.

312

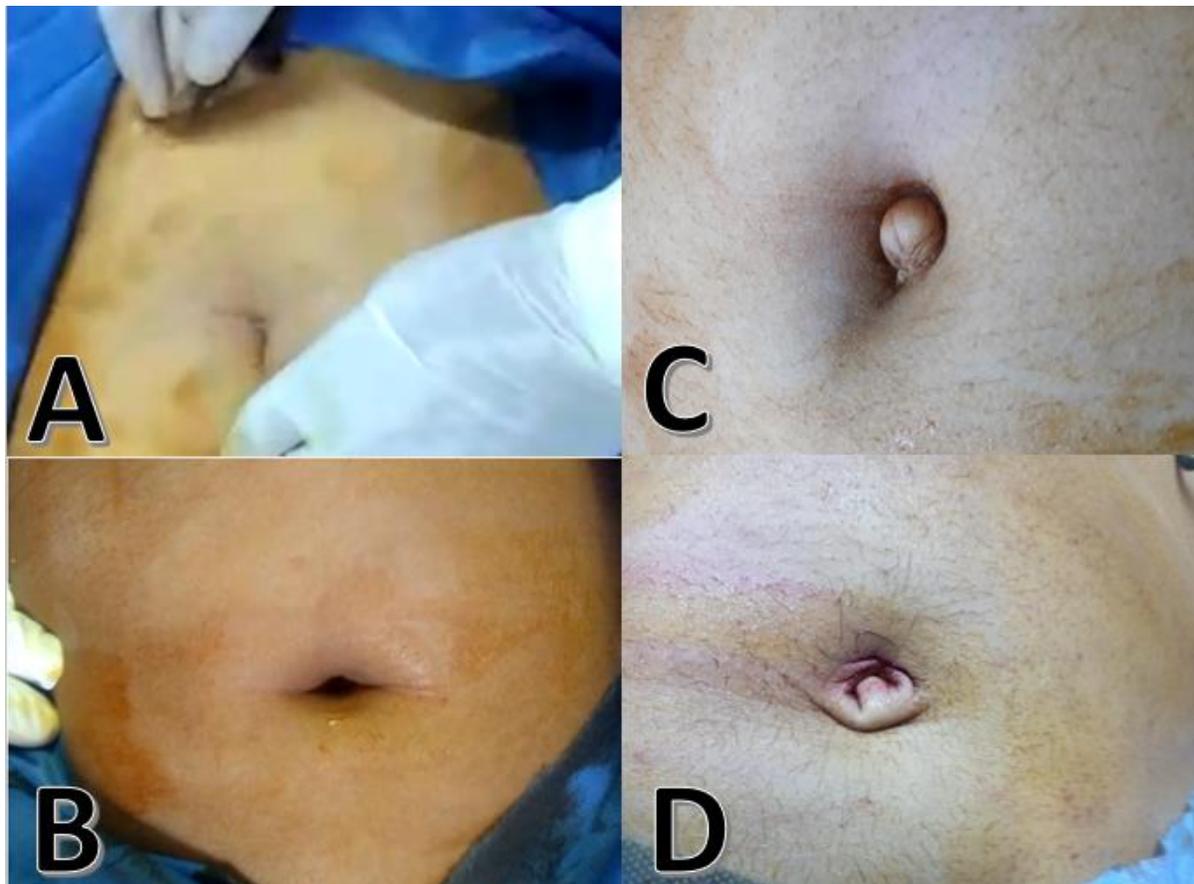
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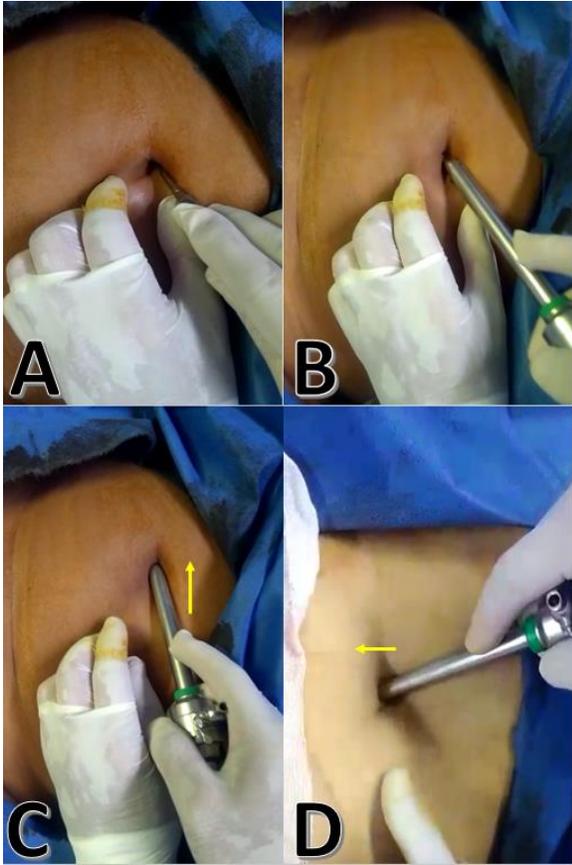
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399 **Figure 1:** Different shapes of umbilicus in studied cases. A) Vertical oval umbilicus, B)
400 Transverse funnel-shaped umbilicus, C) Outie projecting umbilicus, D) button-like transverse
401 bulging umbilicus.

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Figure 2: Steps of modified intra-umbilical direct trocar insertion. A) deep curved longitudinal intra-umbilical incision, B) insertion of a 10 mm trocar till disappearance of sleeve edge, C) Transverse insertion of the trocar for 1-2 cm in horizontal plane in the subcutaneous tissue, D) rotation of the trocar 90 degrees to the vertical plane followed by penetration of the fascia).

409 **Table 1:** Sociodemographic and obstetric data of the studied groups.

		Group A (N = 55)		Group B (N = 55)		Stat. test	P-value
Age (years)	Mean	28.5		29.1		T = 0.46	0.643 ^{NS}
	±SD	7.1		6.8			
Duration of marriage (years)	Mean	7.2		9.0		MW = 1237.5	0.457 ^{NS}
	±SD	3.7		7.0			
Gravidity	Mean	1.4		2.2		MW = 1048.5	0.004 ^{HS}
	±SD	1.9		1.9			
Parity	Mean	0.8		1.7		MW = 947	< 0.001 ^{HS}
	±SD	1.4		1.6			
Abortions	Mean	0.6		0.5		MW = 1494	0.895 ^{NS}
	±SD	0.9		0.8			
No. of CS	Mean	0.5		0.9		MW = 1211	0.038 ^S
	±SD	0.7		1.2			
Previous operation	No	54	98.2%	52	94.5%	X ² = 1.03	0.308 ^{NS}
	Yes	1	1.8%	3	5.5%		
Infertility	No	12	21.8%	29	52.7%	X ² = 11.2	0.001 ^{HS}
	Yes	43	78.2%	26	47.3%		
Infertility duration	Mean	5.2		4.5		MW = 464.5	0.351 ^{NS}
	±SD	3.2		3.1			

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412 **Table 2:** Intraoperative assessments of umbilicus and abdominal wall in both groups.

		Group A (N = 55)		Group B (N = 55)		X ²	P-value
Shape	Vertical oval	52	94.5%	47	85.5%	2.5	0.112 ^{NS}
	Horizontal oval	3	5.5%	8	14.5%		
Appearance	Inverted	48	87.3%	46	83.6%	0.29	0.589 ^{NS}
	Everted (protruded)	7	12.7%	9	16.4%		
Dimple	Absent	6	10.9%	9	16.4%	0.69	0.405 ^{NS}
	Present	49	89.1%	46	83.6%		
Index finger test for hernia	Negative	55	100%	55	100%	----	----
Abdominal skin laxity	No	41	74.5%	29	52.7%	5.6	0.017 ^S
	Yes	14	25.4%	26	47.2%		
Abdominal muscles	Weak	16	29.1%	32	58.1%	9.4	0.002 ^{HS}
	Strong	39	70.9%	23	41.8%		
Trocar tip	Conical	55	100%	55	100%	----	----
Umbilical incision	Transverse	55	100%	0	0%	110	< 0.001 ^{HS}
	Longitudinal	0	0%	55	100%		

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415 **Table 3:** Comparisons of intra-operative assessments of umbilicus between studied groups.

		Group A (N = 55)		Group B (N = 55)		Stat test	P-value
Easy trocar and telescope movement	No	6	10.9%	3	5.5%	$X^2 = 1.08$	0.297 ^{NS}
	Yes	49	89.1%	52	94.5%		
leakage of CO2	No	28	50.9%	46	83.6%	$X^2 = 13.4$	< 0.001 ^{HS}
	Yes	27	49.1%	9	16.4%		
Tightness	Tight	30	54.5%	45	81.8%	$X^2 = 9.4$	0.002 ^s
	Loose	25	45.5%	10	18.2%		

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