



# Cosmetic outcomes of infraumbilical, supraumbilical, and transumbilical entry routes in laparoscopic surgery

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## ABSTRACT

**Objective:** The aim of the present study was to determine which of the umbilical entry routes for intraperitoneal access has a better cosmetic result.

**Material and Methods:** This was a prospective study (Canadian Task Force classification II-1). In total, 105 patients who underwent laparoscopic surgery were included. A vertical or transverse umbilical incision is appropriately made for the trocar to be inserted, and an infraumbilical, supraumbilical, or transumbilical route was preferred for initial intraperitoneal access. Demographic data of patients, body mass indices, entry point of the trocars (infraumbilical–transumbilical–supraumbilical), type of incision (vertical–transverse), duration of the operation, and scar properties at postoperative week 12 were prospectively collected and analyzed. The Vancouver scar scale was used to evaluate the cosmetic results.

**Results:** Cosmetic results did not differ statistically between the transumbilical–infraumbilical–supraumbilical groups. The variables, such as vascularity, height, and total score, of the Vancouver scar scale were significantly higher in patients who had transverse incisions. There was no statistically significant effect of using a Veress needle with the cosmetic results. There was no statistically significant correlation between age, gravida, body mass indices, skin thickness, time of entry, duration of the operation, and cosmetic results in terms of vascularity, height, and total score.

**Conclusion:** During laparoscopic surgery, each patient should be assessed individually for the satisfaction of the patient and, thereby, of the surgeon in terms of cosmetic outcomes. Vertical incision offers superior cosmetic effects than transverse incision. Further research is required to define long-term scar-related outcomes of the laparoscopic intraperitoneal access techniques.

**Keywords:** Cosmetic outcome, laparoscopic surgery, umbilical incision, scarless surgery

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## INTRODUCTION

Laparoscopic surgery is now a well-established alternative to open surgery for many gynecological disorders owing to its faster wound healing, shorter hospital stay, less postoperative pain, and better cosmetic results (1). Postoperative scar cosmesis is a critical issue for women, especially for young women. These scars may have negative impacts, such as psychological consequences. The symptoms associated with the wound, such as pain, tenderness, and itching, can be induced by the scars (2, 3). Recently, there has been an increased surge of interest in laparoscopy for scarless surgery with the development of surgical instruments and advancement of techniques. Surgeons are concerned about how to restore the natural appearance of the umbilicus as it is an important aesthetic component of the abdomen (4). In a review of laparoscopic practice, approximately half of the laparoscopists preferred the infraumbilical route and 35.7% the supraumbilical area for entry (5). To our knowledge, there are no studies in the literature describing cosmetic outcomes specific to the umbilical port insertion techniques.

The aim of the present study was to determine which method of infra–trans–supraumbilical entry techniques in laparoscopic surgery should be preferred in terms of cosmetic results.

## Anatomy

The umbilicus is a cone-shaped tract with its apex pointing toward the surface. Its vertex, formed by the fusion of the skin, fascia, and peritoneum, is devoid of preperitoneal and subcutaneous fat no matter how obese the patient is. It is discernible on the surface as a tiny but clearly circumscribed punctum with a diameter of approximately 1 to 3 mm. The fascia, peritoneum, and skin are fused at the punctum. From the peripheral to the umbilical punctum, the fascia is separated from the overlying skin and the underlying peritoneum by variable amounts of fat even within the confines of the umbilical ring, and more laterally still, the fascia splits to cover the rectus muscles. At the umbilical ring, the circumferential confluence of the abdominal wall fascia and the skin results in a shallow region, allowing easy access to the abdominal cavity. The absence of the subcutaneous fat and muscle at the umbilicus suggests that

the dissection plane remains bloodless to the peritoneum if the midline is adhered to (6).

## MATERIAL AND METHODS

This was a prospective study conducted between January and June 2016 at a single tertiary center. A total of 105 patients who underwent laparoscopic surgery were included in the study. The local ethics committee approved the study (clinical trial no: NCT02672956, approval no: 129). Written informed consent was obtained from all participants prior to enrollment in the study.

Patients with previous abdominal surgery and scar, umbilical hernia, burns in the umbilical region; who are in the post-menopausal period; and who have hyperpigmented skins were excluded from the study. Demographic data of patients, body mass indices (BMIs), entry point of the trocars (infra-trans-supraumbilical), type of incision (vertical-transverse), duration of the operation, and scar properties at follow-ups were prospectively collected and analyzed.

Patients were assigned to one of the groups by random allocation. The assigned entry points (infra-trans-supraumbilical) and incision types were sealed in secure opaque envelopes. The allocated envelope was opened before surgery. Under general anesthesia, the umbilicus was prepared by removing all debris using gauze, cotton swabs. A vertical or transverse umbilical incision was appropriately widened enough (1.0–1.5 cm) for the trocar to be inserted without undue resistance from the skin so that the trocar passed through the fascia and the peritoneum with ease. Infraumbilical, supraumbilical, or transumbilical incision was performed for initial intraperitoneal access. Access to the abdominal cavity was performed by direct trocar in some of the patients, whereas a Veress needle was inserted before the entry of the trocar in others. No clamps were used to elevate the abdominal wall in both methods. The trocar entry sites for intraperitoneal access and incision type were randomized, whereas the choice of using a Veress needle was left to the experience and preference of the surgeon. A 10-millimeter trocar was inserted, and the pneumoperitoneum was achieved by carbon dioxide insufflation, up to a pressure of 12 mm Hg. Surgical procedures were performed using conventional laparoscopic instruments under vision with a rigid 0-degree, 10-millimeter EndoEYE laparoscope (Laparoscope; Olympus Surgical Technologies America, Ohio, United States of America). The type of suture and technique for closing the skin and the fascia after the operation was the same for all cases. The fascia layer of the umbilical incision was closed with a number 0 absorbable monofilament suture material. The skin incision was closed with a number 2/0 rapid absorbable vicryl suture using a simple interrupted suture technique. Neither additional incisions nor laparotomic conversion was required in any cases. In the present case series, no major surgical complications were experienced. All of the operations were performed by two surgeons who were educated and experienced in laparoscopic operations.

Scar assessment was performed at postoperative week 12 by another surgeon other than the operator. The Vancouver scar scale was used to evaluate the healing of the port entry site in the umbilical region, and cosmesis analysis was performed.

All patients were divided into groups according to the site of trocar insertion and incision type then compared in terms of cosmetic outcome.

All statistical analyses were performed using the Statistical Package for the Social Sciences version 22.0 for Windows (SPSS Inc., Chicago, IL, USA). Data were expressed by mean, median, standard deviation, percentage, and minimum and maximum values. The comparisons were conducted using the chi-square test, Spearman rank correlation analysis, and Kruskal–Wallis one-way ANOVA test, with post hoc analysis performed using the Mann–Whitney U test, as needed, for categorical and continuous variables. A p-value <0.05 was considered as statistically significant.

## RESULTS

A total of 105 patients who underwent laparoscopic surgery for various gynecological disorders were evaluated. All patients were females. The mean age of the patients was 39.79±11.99 years. The BMI of the patients was 24.55±4.37 kg/m<sup>2</sup>. The mean laparoscopic surgery duration was 94.90±42.88 min, and the mean time of trocar insertion was 2 (1–5) min. Transumbilical incisions were performed in 35 (33.3%) patients, infraumbilical incision in 36 (34.3%), and supraumbilical incision in 34 (32.4%). In addition, 53 (50.4%) patients had vertical incision, and 52 (49.5%) had transverse incision. A Veress needle was not used in 17 (16.2%) patients, and intraperitoneal access was provided by direct trocar entry. Table 1 shows the demographic data of the patients. The transverse incision was the most preferred incision in the supraumbilical group,

Table 1. Patient characteristics (n=105)

Age* (year)	39.79±11.99
Gravida (median (minimum–maximum))	2 (0–9)
BMI* (kg/m <sup>2</sup> )	24.55±4.37
Skin thickness*	1.56±0.64
Site of entry <sup>#</sup>	
Infraumbilical	35 (33.3)
Supraumbilical	36 (34.3)
Transumbilical	34 (32.4)
Incision <sup>#</sup>	
Vertical	53 (50.4)
Transverse	52 (49.5)
Trocar entry time (min) (median (minimum–maximum))	2 (1–5)
Veress needle <sup>#</sup>	
Not used	17 (16.2)
Used	88 (83.8)
Duration of the operation* (min)	94.90±42.88
Vascularity* (median)	1.21±0.50 (1)
Pigmentation* (median)	1.54±0.57 (2)
Pliability* (median)	1.28±0.70 (1)
Height* (median)	0.89±0.66 (1)
Total* (median)	4.94±1.58 (5)

\*; mean±SD, #; n (%); BMI; body mass index

Table 2. Patient characteristics versus entry routes

	Infraumbilical (n=35)	Supraumbilical (n=36)	Transumbilical (n=34)	p
	Mean±SD	Mean±SD	Mean±SD	
Age*** (year)	37.03±11.93	40.14±12.17	42.26±11.61	0.190*
BMI*** (kg/m <sup>2</sup> )	24.66±3.40	24.68±4.76	24.32±4.91	0.932*
Duration of the entry*** (min)	2.23±1.03	2.47±1.25	2.09±1.26	0.394*
Skin thickness***	1.65±0.67	1.50±0.60	1.54±0.66	0.598*
Gravida median (IQR)	2(3)	2(1.75)	2(3)	0.246**
Incision*				
Vertical	23(65.7)	10(27.7)	20(58.8)	0.001**
Transverse	12(34.2)	26(72.2)	14(41.1)	
Veres needle <sup>†</sup>	35(100.0)	34(94.4)	19(55.9)	0.001**

\*Spearman rank correlation analysis \*\*Kruskal–Wallis one-way ANOVA test \*\*\*; mean±SD, #; n (%)  
BMI; body mass index

Table 3. Cosmetic results according to the site of trocar entry

	Infraumbilical (n=35)	Supraumbilical (n=6)	Transumbilical (n=34)	p
	Mean±SD (median)	Mean±SD (median)	Mean±SD (median)	
Vascularity	1.23±0.55(1)	1.25±0.55(1)	1.18±0.39(1)	0.744
Pigmentation	1.54±0.51(2)	1.53±0.61(2)	1.56±0.61(2)	0.924
Pliability	1.17±0.71(1)	1.33±0.63(1)	1.32±0.77(1)	0.557
Height	0.89±0.58(1)	1.00±0.68(1)	0.79±0.73(1)	0.412
Total	4.83±1.54(5)	5.11±1.75(5)	4.88±1.45(5)	0.631

Kruskal–Wallis one-way ANOVA test

Table 4. Cosmetic results according to the type of incision

	Vertical (n=53)	Transverse (n=52)	p
	Mean±SD (median)	Mean±SD (median)	
Vascularity	1.18±0.49(1)	1.44±0.51(1)	0.040
Pigmentation	1.51±0.59(2)	1.75±0.45(2)	0.122
Pliability	1.22±0.70(1)	1.56±0.63(1.5)	0.076
Height	0.82±0.63(1)	1.31±0.70(1)	0.008
Total	4.74±1.49(5)	6.06±1.61(6)	0.004

Mann–Whitney U test

Table 5. Cosmetic results according to the use of a Veress needle

	Not used (n=17)	Used (n=88)	p
	Mean±SD (median)	Mean±SD (median)	
Vascularity	1.29±0.47(1)	1.20±0.51(1)	0.460
Pigmentation	1.53±0.62(2)	1.55±0.57(2)	0.988
Pliability	1.29±0.77(1)	1.27±0.69(1)	0.950
Height	0.94±0.75(1)	0.89±0.65(1)	0.786
Total	5.12±1.76(5)	4.91±1.55(5)	0.915

Mann–Whitney U test

and a Veress needle was used more frequently in the infra–supraumbilical group than in the transumbilical group (Table 2).

Cosmetic results did not differ statistically between the trans–infra–supraumbilical groups ( $p>0.05$ ) (Table 3). Vascularity, height, and total score were significantly higher in patients who had transverse incision ( $p=0.040$ ,  $p=0.008$ , and  $p=0.004$ , respectively) (Table 4). There was no statistically significant effect of using a Veress needle on the cosmetic results (Table 5). There was no statistically significant correlation between age, gravida, BMI, skin thickness, time of entry, duration of the operation, and cosmetic results in terms of vascularity, height, and total score. As BMI increased, pigmentation also increased ( $p=0.015$ ). The increase in gravida increased pliability ( $p=0.029$ ). These relationships were found to be statistically significant (Table 6).

## DISCUSSION

Laparoscopically, at the entrance to the abdominal cavity, an umbilical incision is often the first choice. This can be an infraumbilical, transumbilical, or supraumbilical incision. In the literature, there is a scarcity of data in terms of the cosmetic outcome on all three routes for laparoscopic port insertion (infra–trans–supraumbilical). Our study addresses this important need.

In the present study, it was shown that there were no differences between infra–trans–supraumbilical routes of entry to the peritoneal cavity in terms of cosmetic results, whereas it was found that cosmetic results were better in the vertical incision. It was suggested that the patient should be evaluated individually at admission, and vertical incision should be used with the technique that may have better cosmetic results.

Table 6. Correlation of cosmetic results and age, gravida, BMI, skin thickness, duration of the trocar entry, and operation

	Vascularity		Pigmentation		Pliability		Height		Total	
	r	p	r	p	r	p	r	p	r	p
Age (year)	-0.150	0.128	0.053	0.593	0.083	0.402	0.006	0.955	0.046	0.640
Gravida	0.019	0.850	0.010	0.923	0.214	0.029	0.024	0.809	0.091	0.355
BMI (kg/m <sup>2</sup> )	0.053	0.588	0.237	0.015	-0.159	0.106	-0.069	0.483	0.001	0.991
Skin thickness	-0.10	0.325	-0.048	0.627	-0.015	0.877	-0.099	0.314	-0.061	0.538
Duration of the trocar entry (min)	0.052	0.600	0.070	0.477	-0.160	0.102	0.133	0.175	0.001	0.994
Duration of the operation (min)	0.103	0.295	-0.166	0.112	0.029	0.770	0.098	0.319	-0.025	0.798

Spearman rank correlation analysis  
BMI; body mass index

Nozaki et al. (4) showed that a U-shaped infraumbilical incision that is made traditionally along the umbilical ring and the standardized site for access to the abdominal cavity for laparoscopy are well known; however, this type of incision leaves a more postoperative scar or umbilical deformity. Therefore, the umbilical depression had been everted, and the longitudinal skin incision of the umbilicus was made at the midline. The incision length was within the depression of the umbilicus. The scar receded into the umbilicus and was hardly visible (4). If the umbilicus has been previously used to gain access to the abdomen, one may access the abdomen through alternative incisions, such as infraumbilical incision (7). From our study, since there was no difference among cosmetic results of all three infra-trans-supraumbilical techniques, the umbilical entrance route may be selected, which has not been used during previous surgeries, to access the abdominal cavity easier and end up with better cosmetic results. The results of the present study showed no umbilical deformity on postoperative evaluation.

Kim et al. (8) preferred entry to the peritoneal cavity with supraumbilical incision, which they thought had better cosmetic results, based on the complaints of postoperative scars of female patients. The scar at the supraumbilical incision was found to be barely visible. Both patients and surgeons were satisfied with the cosmetic results of the supraumbilical entry, and the scar was integrated into the natural umbilical fold 3 months after surgery (8). In our study, the patients had postoperative follow-up in 12 weeks, and there was no difference in cosmetic results between all three infra-trans-supraumbilical techniques. Wang et al. (9) found that the cosmetic results of the transumbilical incision are remarkably well. However, the present study had no data on infra-supraumbilical incision (9).

Sinha used all three techniques and found that the transumbilical incision, rather than a supra- or infraumbilical incision, has a better cosmetic scar and a nearly normal-looking umbilicus (10). Transumbilical camera port insertion leaves no scar, but it has higher complication rates. Many pediatric surgeons use supraumbilical or infraumbilical port incision owing to complications following transumbilical insertion, such as wound site infection or trocar site hernia (11). According to our study, the cosmetic results of transumbilical port insertion appear to have no difference from other techniques. Therefore, it would be more advantageous to use other entry techniques instead of transumbilical entry that has more complication rates.

In a review that assessed the practice of general surgeons in Canada, it was shown that surgeons mostly prefer the transumbilical route in patients with no previous abdominal surgery. Half of the laparoscopists preferred infraumbilical port insertion, and 35.7% preferred suprapubic insertion. In the presence of suspected adhesions, the most preferred entry sites were the supraumbilical and infraumbilical regions with a frequency of 41.9% and 36.6%, respectively (12). Since patients with existing scar tissue due to previous surgery or burn were excluded in our study, intraoperative complications of the umbilical port insertion routes could not be evaluated. No data were found with regard to adhesions. These issues may be the limitations of our study.

The depth and length of the incision should depend on the size and diameter of the trocar to be inserted further. Sasmal et al. (13) suggested that vertical incision has better postoperative cosmetic results than transverse incision. Similar to our study, vertical incision had more satisfactory postoperative cosmetic results than transverse incision. On the contrary, Mowat et al. (14) reported that transverse incision is advantageous over longitudinal incision with regard to postoperative pain, mobility, and cosmetic effects.

In 1978, Dingfelder et al. (15) described direct trocar entry into the abdominal cavity and argued that the complications associated with a Veress needle do not occur at the entrance with direct trocars. In the literature, there are many studies that compare the entrance to the abdominal cavity with the aid of a Veress needle or with a direct trocar (16, 17). However, to our knowledge, there were no studies on the effect of a Veress needle on wound healing and cosmetic results. The use of a Veress needle had no statistically significant effect on the cosmetic results of the present study.

Studies have shown that as the BMI increases, the distance between the port insertion area and the abdominal organs increases, making it difficult to enter the abdominal cavity (18). Cosmetic healing can be negatively affected by micro and macro tissue damages during trocar entry. Although the Vancouver scar scale computes the total score rating, the scar height is the decisive factor (19, 20). In our study, no statistically significant relationship was found between vascularity, height, and total score with regard to the Vancouver scar scale of BMI.

The positive effect of estrogen on skin collagen and wound healing has been proven. Estrogen increases collagen content, skin thickness, and pliability (21). As gravida increases, the amount of exposed estrogen increases, hence pliability of the skin increases. In our study, the increase in gravida increases the pliability of the skin. However, as mentioned previously, the increase in pliability alone does not cause a clinically significant change in terms of cosmetic results. Estrogen also causes an increase in pigmentation; however, in our study, no significant difference was found between gravida increase and pigmentation. Since none of our patients were in the menopausal period, no estrogen deficiency was considered.

## CONCLUSION

During laparoscopic surgery, each patient should be assessed individually for the satisfaction of the patient and, thereby, of the surgeon in terms of cosmetic outcomes. Vertical incision offers superior cosmetic effects than transverse incision. Further research is required to define long-term scar-related outcomes of the laparoscopic intraperitoneal access techniques (infra-supra-transumbilical).

**Ethics Committee Approval:** The local ethics committee approved the study (NCT02672956/129).

**Informed Consent:** Written informed consent was obtained from all patients who participated in this study.

**Author Contributions:** Concept - M.B.Ş., O.D., Ç.K.; Design - M.B.Ş., O.D., Ç.P.; Supervision - M.P., A.T.T., O.D.; Resource - M.P., Ç.P., A.T.T.; Materials - M.B.Ş., O.D., M.P.; Data Collection and/or Processing - O.D., Ç.P., M.P.; Analysis and/or Interpretation - A.T.T., O.D., M.B.Ş.; Literature Search - O.D., Ç.P.; Writing Manuscript - O.D., Ç.P., M.B.Ş.; Critical Reviews - Ç.K., O.D., M.B.Ş.

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