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# The Safety and Complications of "Z-entry" Technique of Trocar Insertion in Laparoscopic Gynecological Surgery

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**ABSTRACT**

**Background and Aims:** Laparoscopy is a minimally invasive surgical technique for abdominal and gynecological surgeries. To access the internal organs through the abdominal wall, a special tool called a trocar is used. The trocar enters the abdomen using a variety of techniques. The aim of this study was to evaluate the safety and possible complications of trocar insertion into the abdomen for gynecological laparoscopy using the "Z-entry" method.

**Methods:** From March 2018 to March 2020, 435 patients underwent laparoscopic gynecological surgery in Sarem Women's Hospital that in terms of the consequences of trocar entering the abdomen with the "Z-entry" technique, including visceral injury, vascular injury, umbilical hernia, hematoma, massive hemorrhage, infection, and mortality induced by trocar insertion, were evaluated. The results were analyzed and reported in the form of descriptive statistics and frequency distribution tables with SPSS statistical software.

**Findings:** This study showed that the rate of complications and problems due to insertion of trocar by "Z-entry" method was very low in these patients, so that only one case of infection (0.2%), one case of hematoma (0.2%), one case of trocar entry into blood vessels (0.2 %) and two cases (0.4%) of trocar entry into the viscera were seen. However, no cases of umbilical hernia, massive hemorrhage, and death induced by trocar insertion were found.

**Conclusion:** Insertion of trocar by the "Z-entry" method in laparoscopic gynecological surgeries is associated with minimal problems and complications and therefore this technique can be used as a safe method to insert trocar into the abdomen in laparoscopic surgeries.

**Keywords:** Laparoscopic Gynecological Surgery; Trocar Insertion; "Z-entry" Technique; Safety; Complication.

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## Introduction

For the first time in 1910, Hans-Christian Jacobaeus[1] performed the first clinical laparoscopic surgery in Stockholm, Sweden (1,2). Laparoscopy is a minimally invasive surgical (MIS) technique for abdominal and gynecologic surgeries, in which a special device called a "trocar" is used to access the internal organs through the abdominal wall (3). Laparoscopic gynecologic surgery is known as one of the preferred surgical methods in the world due to its low complications and shorter postoperative recovery period (4). The entrance to the abdominal cavity is done with the trocar tool, with two techniques, open and closed. In the open technique (Hasson method), the abdominal wall and peritoneal is opened with an incision below the umbilicus and the trocar enters the abdominal cavity directly from this area, vertically (5,6). In the closed technique (Veress Needle), about 3-4 liters of carbon dioxide gas is blown into the abdominal cavity by a needle for better vision and easier access to the abdominal organs, which leads to pneumoperitoneum (7,8). The trocar then enters the abdomen through a hole created by the Veress needle, approximately 1 cm below the umbilicus (3). Complications such as intestinal and visceral injuries, vascular injuries, bleeding and hematoma around the trocar site, umbilical hernia[2], and infection may occur as the trocar enters the abdomen. However, many of these complications, including vascular and visceral injury, are rare (3,10-12). At present, the evidence was insufficient to show a major difference between these two techniques (open and closed) of trocar entry into the abdominal cavity, in the rate of entry failure, vascular injury, visceral injury, or other major complications (9). Serious problems or even death are possible if the surgeon or patient does not notice the early symptoms of complications and does not treat them in a timely manner (11,13).

## The "Z-entry" Technique of Trocar Insertion

In this method, which is a closed technique, instead of inserting the trocar directly (vertically) into the abdominal cavity, the trocar is first guided transversely at an angle of 45 degrees below the umbilical slit to the surgeon's assistant side, that usually after 4-5 centimeter reaches the fascia and with a little more pressure, the mandarin tip enters the fascia and then, keeping the transverse path and maintaining the pressure of the hand, the trocar returns to the surgeon side. The trocar is then directed at a 45-degree angle to the other side of the abdomen (the surgeon's assistant side) to pass through the muscle. The trocar now returns to the umbilicus and enters the abdominal cavity with low pressure (Figure 1). In this technique, in the first stage, the fascia is perforated 4-5 cm away from the umbilical site entrance. In the second stage, the trocar passes 4-5 cm away from the umbilicus on the opposite side, through the muscle, and in the third stage, the peritoneum is perforated. Forasmuch as in this method, the trocar enters the abdominal cavity almost horizontally, compared to other entry methods, in which the trocar enters the abdominal cavity vertically, the possibility of damage to arteries and organs is much less, and also in this method no need for the clamp to retract the abdominal wall, therefore the incidence of bleeding and hematoma reduced. On the other hand, due to the distances created between the entry points of the trocar in different parts including fascia, rectus abdominis muscle, and peritoneum, the possibility of umbilical hernia is very low. This technique has been used for the first time in Iran since 1995 by the author (Figures 2 to 9).

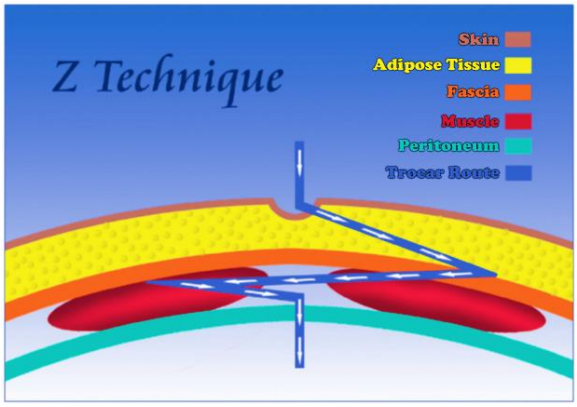



Figure 1. The schematic figure of the trocar entry into the abdominal cavity with the "Z-entry" technique.

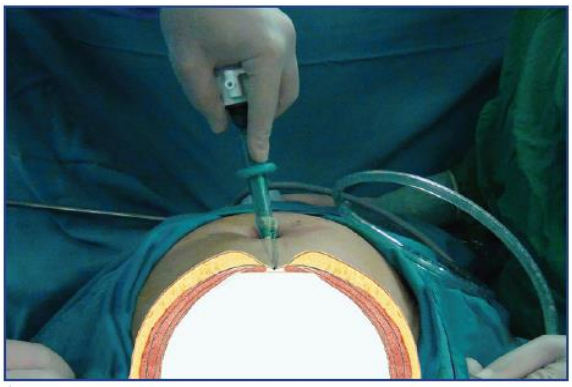


Figure 2.

[1] Hans-Christian Jacobaeus (1879–1937)

[2] Trocar Site Hernia (TSH)



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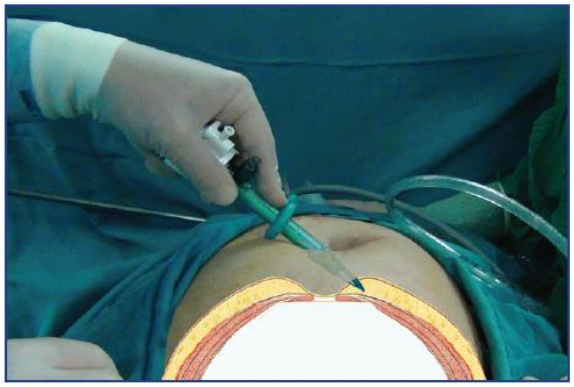


Figure 3.

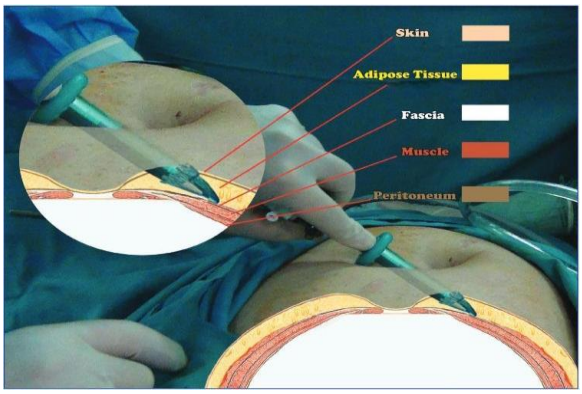



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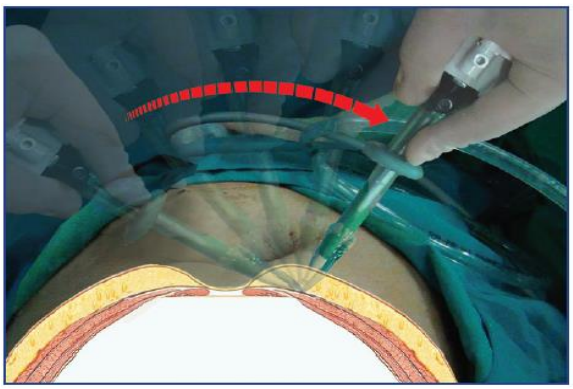


Figure 5.

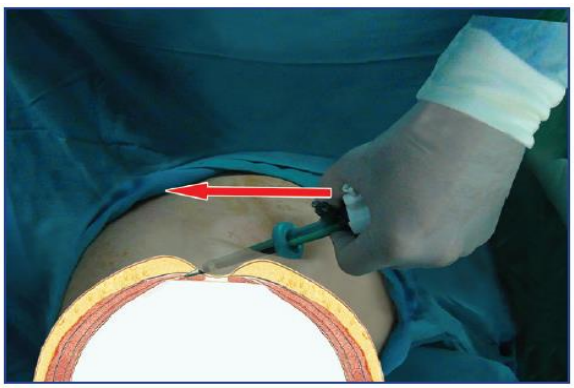


Figure 6.

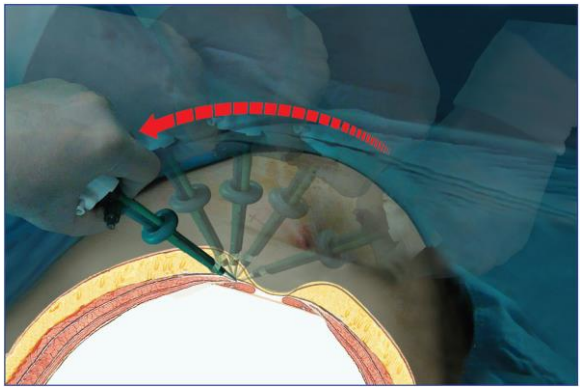


Figure 7.



Figure 8.



Figure 9.

The aim of this study was to evaluate the safety and possible complications of trocar insertion into the abdomen cavity in gynecologic laparoscopy surgery using the "Z-entry" technique.

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## Methods

In this descriptive cross-sectional and retrospective study, all the medical records of patients who underwent laparoscopic surgery in Sarem Women's Hospital from March 2018 to March 2020 due to gynecological diseases were collected and statistically analyzed. In all laparoscopic procedures performed during this period, the "Z-entry" technique was used to insert the trocar into the abdominal cavity. In this study, 435 patients were studied and in addition to demographic data, the occurrence of complications including visceral injury, vascular injury, umbilical hernia, hematoma, massive hemorrhage, infection, and mortality due to trocar complications was investigated. In cases where the patient did not go to the hospital after surgery or his medical record information was incomplete, he was contacted by phone and if he mentioned complications such as swelling and deformity around the umbilicus, the patient was re-examined, and if there was a suspicion of an umbilical hernia, the patient was examined by ultrasound. The collected data were analyzed by SPSS software[3] and the results were reported in the form of descriptive statistics and frequency distribution tables.

## Results

In this study, within two years (from March 2018 to March 2020), 435 patients underwent laparoscopic surgery and trocar insertion by the "Z-entry" method for various gynecological reasons. The minimum age of patients was 16 years and the maximum was 69 years, with a mean and standard deviation of 33.3.7±6.3 years. Among the patients, the lowest height and weight were 147 cm and 45 kg, respectively, while the highest height and weight were 180 cm and 110 kg, respectively, which the mean and standard deviation of them was 163.8±5.7 cm and 66.5±10.9 kg, respectively. The above descriptive statistics along with the body mass index (BMI) parameter are shown in Table 1.

Table 1. Demographic characteristics of the participants

| Parameters (n=435) | Mean ± Standard Deviation | Minimum | Maximum |
|---|---|---|---|
| Age (year) | 33.7 ± 6.3 | 16 | 69 |
| Height (cm) | 163.8 ± 5.7 | 147 | 180 |
| Weight (kg) | 66.5 ± 10.9 | 45 | 110 |
| Body Mass Index, BMI (kg/m$^2$) | 24.7 ± 3.9 | 16.5 | 38.9 |

[3] IBM SPSS, Version 25 (IBM Corp., Armonk, N.Y., USA)

The patients underwent laparoscopic surgery for a variety of reasons, the most common of which are shown in Figure 1. 140 (32.03%) of the cases had a history of previous abdominal surgery. In this two-year study, the rate of complications and problems due to trocar entry by Z method was very low in patients who underwent laparoscopic gynecological surgery, so that only one case of infection (0.2%), one case of hematoma (0.2%) , One case of trocar entry into arteries (0.2%) and only two cases (0.4%) of trocar entry into viscera were seen. During this time, no cases of umbilical hernia, extensive bleeding, and death from complications of trocar entry were found. Also, 14 patients had complained of deformity around the umbilicus, which during the examination in person and clinical examination, in 13 of them no case of umbilical hernia was seen and one suspected case underwent ultrasound in which no hernia was reported (Table 2).

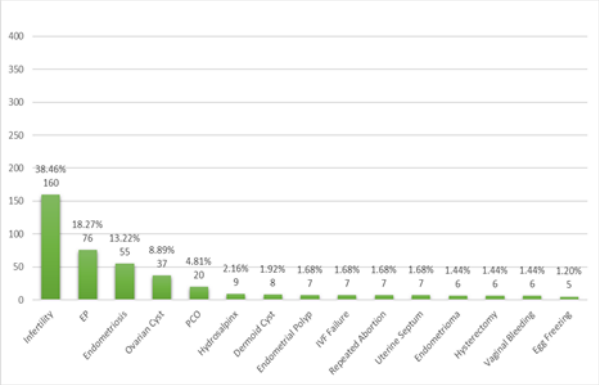



Table 2. The complications of trocar insertion by the "Z-entry" technique

| Complication | Frequency | Percent |
|---|---|---|
| Visceral Injury | | |
| Yes | 2 | 0.46 |
| No | 433 | 99.54 |
| Vascular Injury | | |
| Yes | 1 | 0.23 |
| No | 434 | 99.77 |
| Hematoma | | |
| Yes | 1 | 0.23 |
| No | 434 | 99.77 |
| Infection | | |
| Yes | 1 | 0.23 |
| No | 434 | 99.77 |
| Umbilical Hernia | | |
| Yes | 0 | 0.00 |
| No | 434 | 100.00 |
| Massive Hemorrhage | | |
| Yes | 0 | 0.00 |
| No | 434 | 100.00 |
| Death (Due to trocar Insertion) | | |
| Yes | 0 | 0.00 |
| No | 434 | 100.00 |

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## Discussion

Over the past two decades, rapid advances have been made in the techniques of laparoscopic surgery due to its high safety and low complications (11). Since half of the laparoscopic complications occur while entering the abdominal cavity, the technique of entry into the abdomen and its safety is very important (13). The closed technique (Veress Needle) and the open technique (Hasson Method) are the two most common classical methods in laparoscopy for entering the abdominal cavity (6,8,11). In the present study, a new technique was used to insert the trocar into the abdominal cavity, which is called the "Z-entry" method. In a study conducted in 2016, it was shown that the rate of complications and visceral damage in the open method was lower than in the closed method (14). On the other hand, the open technique has problems such as the long time it takes to enter the abdomen and the difficulty in the abdominal cavity insufflation due to gas leakage from around the inlet cannula (15). In the study by Taye et al., 1,500 cases of closed technique were compared with 1,500 cases of open technique, with one case reported death due to complications of the closed method (14). In this study, the overall rate of visceral injuries in the closed technique was reported to be 1.33% (14). In the present study, no cases of death due to trocar injury were found and the rate of visceral injury was about 0.4%. In various studies, the prevalence of trocar site hernia (TSH) has been reported to be 0.2 to 3.1% (10,16–19). However, in our study, no case of umbilical hernia was seen. Molloy et al. reported a rate of visceral injury during trocar entry between 0.4 and 1.1% (11,20), which this problem in the "Z-entry" method was similar to the lowest prevalence in other methods. The rate of vascular injury during trocar entry has been reported in various articles from 0.03 to 1.33% depending on the type of technique and the type of trocar device (21-23). In the present study, the vascular injury was occurred in only one case (0.2%). The incidence of abdominal wall hematoma after laparoscopic surgery is seen from 2 to 6.25% (24,25), while in the "Z-entry" technique, the hematoma was reported to be about 0.2%. In a study, Mayol et al. reported a rate of trocar site infection of 1.2% (25), which occurred in only one case (0.2%) in our study. On the other hand, in the present study, no cases of massive bleeding were seen.

## Conclusion

Today, laparoscopic surgery is widely used in abdominal surgeries and gynecology. Various techniques are used to insert the trocar into the abdominal cavity, which can be associated with injuries and complications for the patient. This study showed that the entry of the trocar into the abdominal cavity with the "Z-entry" technique is associated with minimal complications and injuries and has higher advantages over other methods and can be used as a technique with greater safety.

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## Ethics

All patient identity data in this study are confidential and secure. The study protocol was approved by the “Institutional Review Board (IRB)” of Sarem Fertility and Infertility Research Center.

## Conflict of interests

There was no conflict of interest in this study.

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