

Principles of Laparoscopic Port Position

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INTRODUCTION

The relative position of the instrument ports is very important in the performance of surgical procedures endoscopically. The angle the instruments make with the operative site and to each other should mimic as far as possible to the natural relationship of the hands and eyes during conventional surgery. It is proved that the most common cause of stressful minimal access surgery is wrong port position. The umbilicus commonly is selected as the site for primary trocar insertion because it offers the shortest distance between

the skin and the anterior peritoneum and is cosmetically appealing.

There are different sites of primary optical port in laparoscopic surgery:

- Supraumbilical
- *Umbilical:*
 - Superior crease of umbilicus (**Fig. 1**)
 - Inferior crease of umbilicus (**Fig. 2**)
 - Transumbilical (**Fig. 3**)
- Infraumbilical (**Fig. 4**)
- Palmer's point (**Fig. 5**).



Fig. 1: Superior crease of umbilicus.

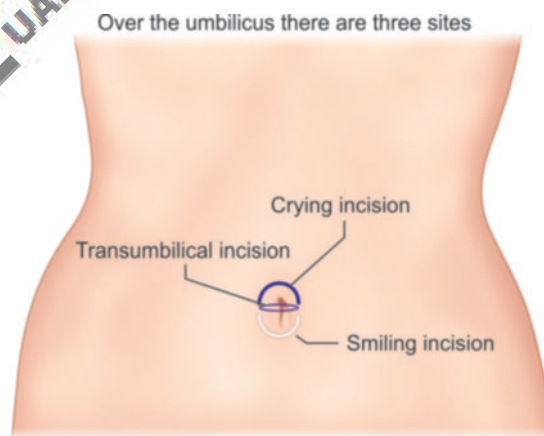


Fig. 2: Inferior crease of umbilicus.

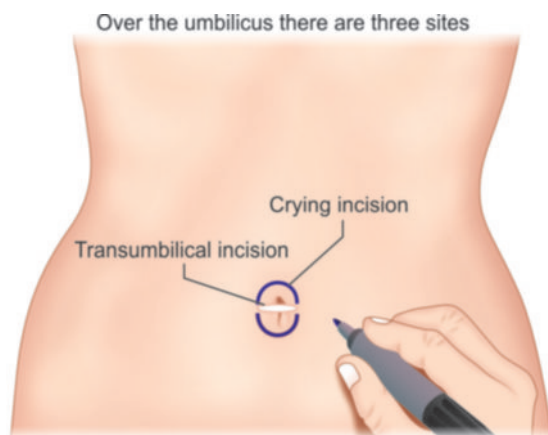


Fig. 3: Transumbilical port.

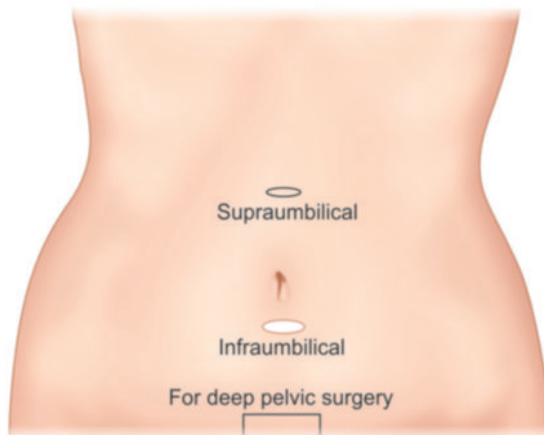


Fig. 4: Infraumbilical port.

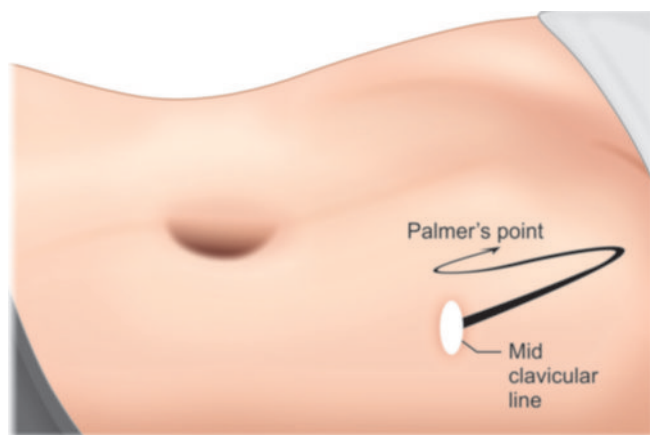


Fig. 5: Palmer's point.

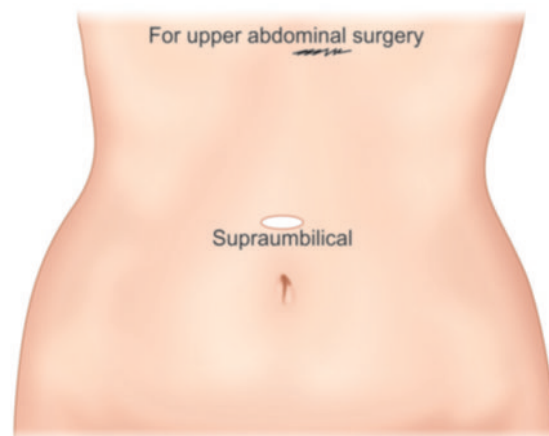


Fig. 6: Supraumbilical port.

■ SUPRAUMBILICAL PORT POSITION

Despite its common use and its relation to vital abdominal structures, there are often in gynecology when an umbilical port is not ergonomically optimum. Supraumbilical primary trocar is highly advantageous for upper abdominal surgery such as fundoplication, Heller myotomy, hiatus hernia, and most of the bariatric surgery (Fig. 6). It is also an optimum port position for most of the gynecological surgery. Advances in laparoscopy have demonstrated that supraumbilical primary ports can be desirable in complex cases with large masses. It helps to increase the distance from enlarged pelvic pathology and thereby improve exposure and surgical efficiency. Supraumbilical port use has been reported in the literature to enable minimally invasive surgical management of large fibroid uteri at the time of myomectomy or hysterectomy and of large ovarian cyst. This port position is also useful in pregnant patients with gravid uterus. In these instances, creating distance between the primary trocar and the uterus is especially important to avoid any penetrating injury to the gravid uterus from trocar insertion. Supraumbilical port use is also reported in the literature by gynecologic oncologists for laparoscopic excision of large ovarian cancers. The supraumbilical primary port is also frequently used in robotic surgery when increased interport distances are desirable to eliminate robotic arm collisions. Reports in the literature describe the common locations of the supraumbilical port site that are 5 cm above the umbilicus and at least 6–10 cm above a second-trimester gravid uterus or very large uterus and ovarian cyst. In obese patient where umbilicus is displaced down, xiphisternum should be used to plan supraumbilical port. For upper abdominal surgery and most of the bariatric surgery, supraumbilical port incisions should be given 18 cm below the xiphisternum.

■ INFRAUMBILICAL PORT POSITION

This port position is less commonly used in laparoscopic surgery. Infraumbilical port is used 3–5 cm below the umbilicus. Infraumbilical port should not be confused with

the port of inferior crease of umbilicus. This port position is used in following surgery:

- Single puncture sterilization
- For upper abdominal surgery (cholecystectomy or duodenal perforation) in very small height patient.

■ PRIMARY PORT POSITION

The central location and ability of the umbilicus to camouflage scars make it an attractive primary port site for laparoscopic surgery. There are many drawbacks with umbilicus as well. Umbilicus is a naturally weak area due to absence of all the layers. Weakness is also due to its location at the midpoint of the abdomen's greatest diameter.

It is easy to believe that there is a difference between the umbilicus and other trocar sites in both susceptibility to infection and postoperative incisional herniation.

The study showed that the increased infection rate at the umbilicus seems to be related to retrieval of infected organs through the umbilicus and not to the umbilicus itself. When umbilicus was used to retrieve gallbladder after cholecystectomy, the rate of infection was high due to port contamination with infected gallbladder. Excluding cholecystectomy, the umbilical infection rate was 2% similar to that of any alternative site. The postoperative ventral hernia rate was at 0.8%, the same at the umbilicus as elsewhere if the port >10 mm size is not repaired. It is now proved that the wound infection at the umbilicus is similar to that at other sites; postoperative ventral hernia at the umbilicus is similar to that at other sites and most of the infection after laparoscopic cholecystectomy is due to the contamination of wound due to infected gallbladder.

There are three sites over umbilicus for optical port:

1. Superior crease of umbilicus
2. Transumbilical
3. Inferior crease of umbilicus.

As it is discussed in previous chapter, inferior crease of umbilicus is most attractive site for primary entry due to presence of obliterated umbilical tube. Surgeon can access

abdominal cavity through inferior crease of umbilicus by smiling incision. Detail steps of first entry are discussed in Chapter 6: Abdominal Access Techniques. In this chapter, we will discuss basic principle of secondary port position using baseball diamond concept.

CONTRALATERAL PORT POSITION IN LAPAROSCOPIC SURGERY

In contralateral port position, telescope is placed in between the two-working ports. In contralateral port position, manipulation angle (angle between two working instrument) should be 60° and azimuth angle (angle between telescope and one working instrument) is generally 30° either side.

SECONDARY PORT POSITION

The obligatory passage of the laparoscopic instruments through the abdominal wall generates a fixed point after which all movements are reversed. For instance, when the hand moves to the left, the end of the instruments moves right and when the hand moves downward, the end of the instrument moves upward. For some surgeon's, the fulcrum effect is not a problem, but for others it is an insurmountable obstacle to the performance of advanced laparoscopy.

Because the handling of laparoscopic instruments is through the fixed point at abdominal wall, the force feedback felt by the surgeon will depend on the length of the instrument inferior to this fixed point.

BASEBALL DIAMOND CONCEPT OF PORT POSITION

A satisfactory relationship includes (Figs. 7A and B):

- An angle of 60° between the two instrument tips
- Tangential approach to the site
- Appropriate working distance.

First Decide the Target

Target may be in suprapubic region for laparoscopically-assisted vaginal hysterectomy (LAVH), right iliac fossa for appendectomy, right upper quadrant for laparoscopic cholecystectomy, or left upper quadrant for fundoplication (Fig. 8).

Draw the Line of Optimum Area

For optimum task performance, half to two-thirds instrument should be inside the abdomen. The size of adult laparoscopic instrument is 36 cm and pediatrics instrument is 28 cm (Figs. 9 and 10).

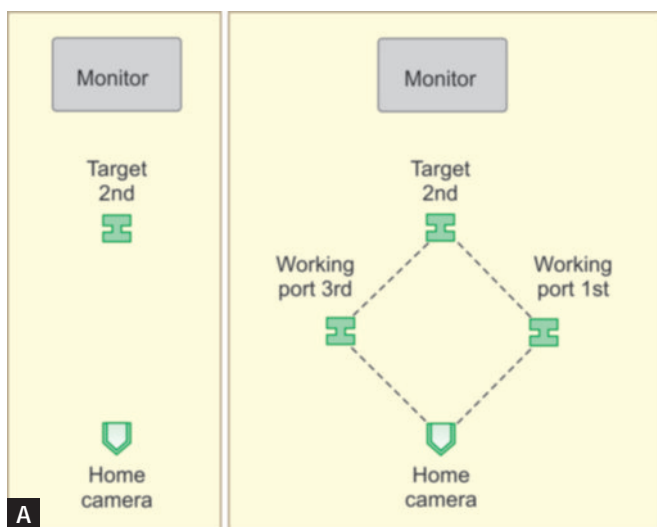
Telescope and Instruments

- Telescope should be in the middle of working instrument (Fig. 11)
- Manipulation angle of instruments should be 60° (Fig. 12).

Rule of Diamond for Laparoscopically-assisted Vaginal Hysterectomy

These factors combined with the specific anatomy will determine individual port sites. For standard operations such as cholecystectomy, standard port sites related to surface marking may suffice, but as more advanced or varied situations are tackled we recommend that you master the skill of individual port placement using the internal view. In general, the optic and the two main operating ports usually lie at the points of a flattened triangle, the optic being centrally and more distally placed. Try to keep ports at least 5 cm apart (Figs. 13 and 14).

Manipulation angle 60° is essential for optimum task performance in laparoscopic surgery (Figs. 12 and 15).



Figs. 7A and B: (A) Baseball diamond concept of port position; (B) Ports simulate field of a baseball.



Fig. 8: First decide the target.

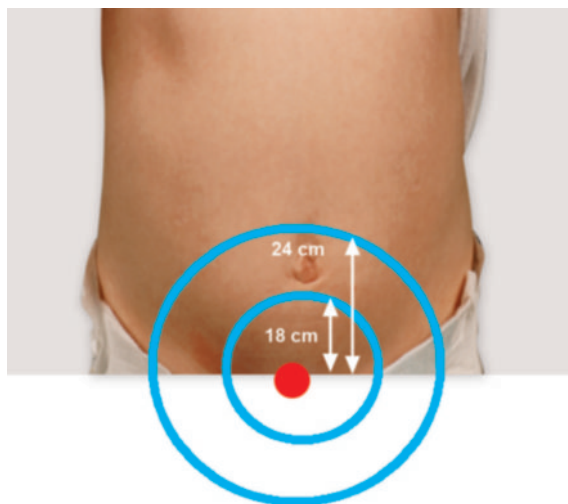


Fig. 9: Draw two arcs on the abdominal wall at 18 cm and 24 cm from that point and note area in between.



Fig. 10: Measure the length of instrument.

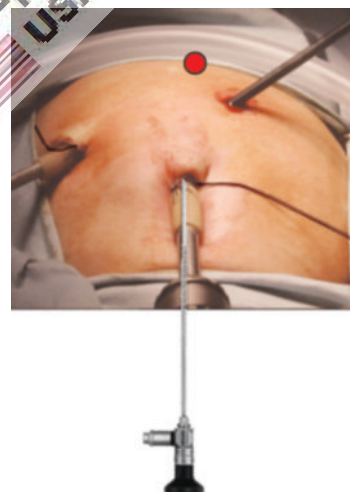


Fig. 11: Telescope should be in the center of working instrument.

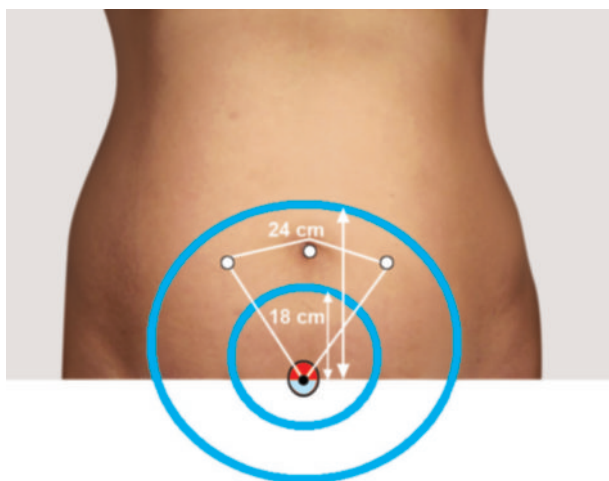


Fig. 12: Manipulation angle 60° is angle between tips of instrument.

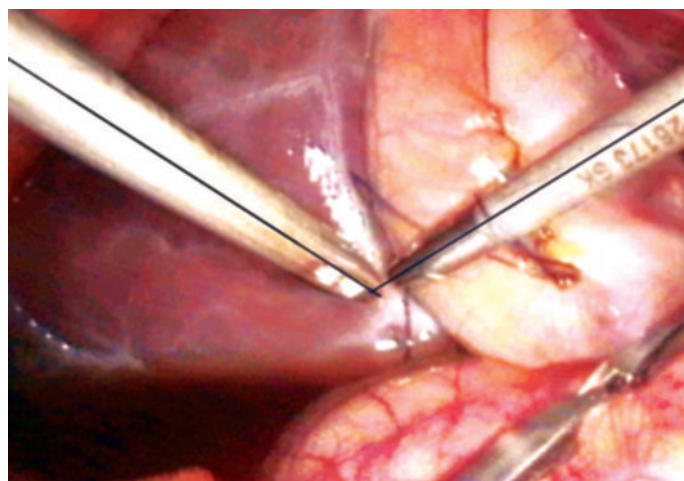


Fig. 13: 18 cm and 24 cm arc should be drawn.

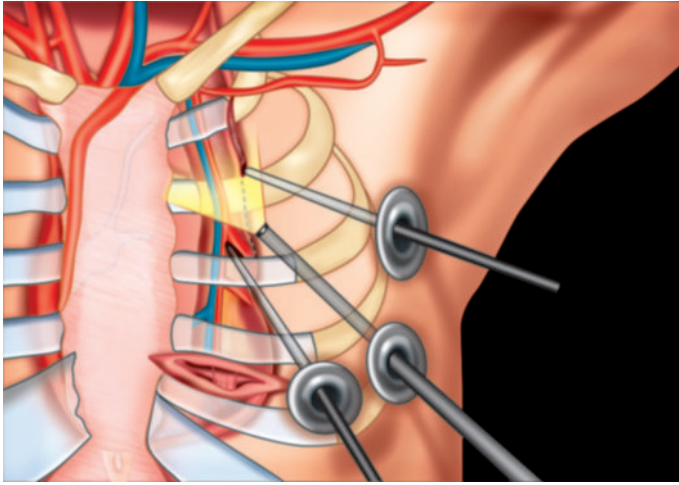


Fig. 14: Port position in thoracoscopic surgery.

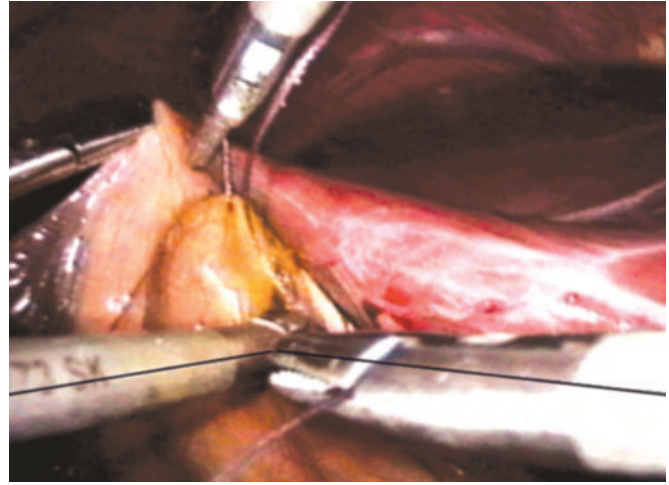


Fig. 15: Manipulation angle of 60° is ideal.

■ PORT POSITION IN VARIOUS SURGERIES

Port position in various surgeries is described in **Figures 16 to 29**.

■ DRAWBACKS OF INCORRECT PORT POSITION

Swording

Swording occurs when the telescope or the shaft of the assistant's instrument obstruct the operator's instruments. If this occurs, you may need to consider:

- Repositioning retracting instruments
- Rotation of an angled telescope allowing alteration of the position of the end of the telescope
- Withdrawal of the telescope
- Transposition of the operator's instruments
- Additional port placement
- Changing the instruments to a different port.

■ IPSILATERAL PORT POSITION IN LAPAROSCOPIC SURGERY (FIG. 30)

In ipsilateral port position, telescope is placed on one side and two-working ports are placed on another side. In ipsilateral port position, manipulation angle (angle between two working instrument) should be 30° and azimuth angle (angle between telescope and one working instrument) is generally 30° for first working instrument and 60° for second working instrument. Main advantage of ipsilateral port position is that surgeon does not have any physical contact with camera holder. Another advantage of ipsilateral port position is that surgeon does not has to abduct his or her arm because manipulation angle is only 30°, so arm will be on the side of body without any abduction. Laparoscopic ipsilateral port position is particularly useful in gynecological laparoscopy (**Fig. 31**). However, ipsilateral port position has little difficult

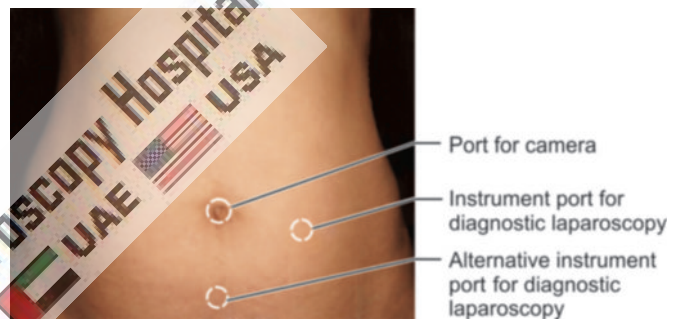


Fig. 16: Port position for diagnostic laparoscopy.

port position for suturing and knotting. Due to ergonomic physical comfort and ability to move freely without touching the camera person, ipsilateral port position is very popular among female gynecologists.

Important points to be remember during placing the port in laparoscopic surgery:

- Laparoscopic instrument should behave like type I lever
- Telescope should be in the middle of working instrument approximately 24 cm from the target of dissection
- Manipulation angle should be 60° for contralateral and 30° for ipsilateral port position
- Elevation angle (angle between instrument and body of the patient) should be ideally 30°
- Distance between telescope and instrument should not be <5 cm
- Distance between two working instruments should not be >15 cm
- Azimuth angle should be minimum 15° and maximum 45°. Ideally, it should be 30° either side for contralateral port position and 30° and 60° on same side in ipsilateral port position
- Shadow of the telescope should be below the object, so light cable should be up as much as possible.

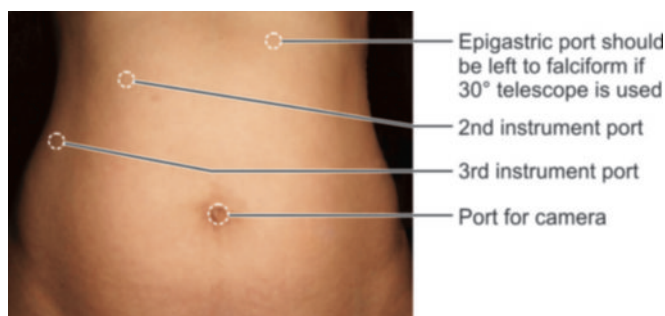


Fig. 17: Port position for cholecystectomy.

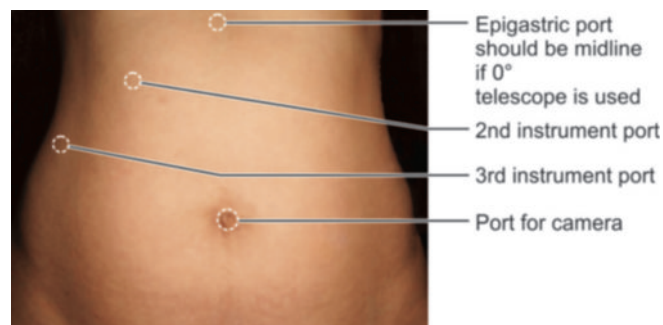


Fig. 18: Alternative port position for cholecystectomy.

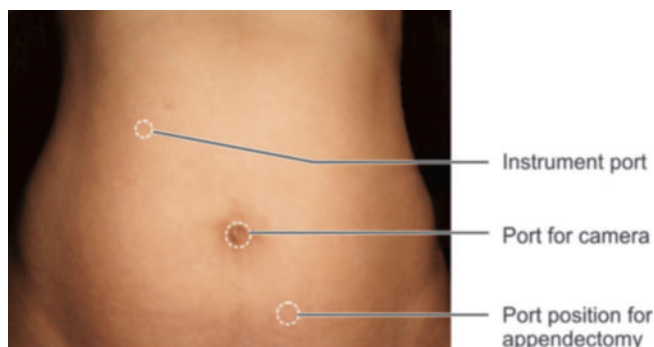


Fig. 19: Port position for appendectomy.

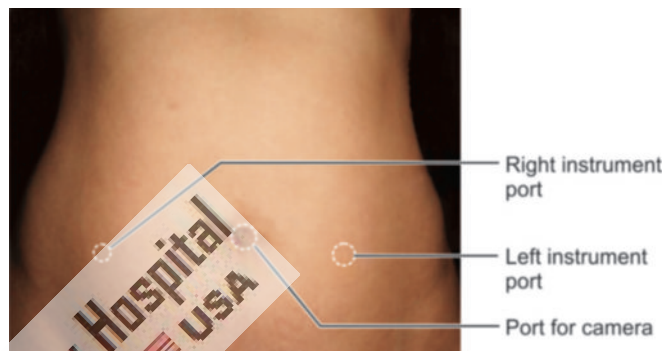


Fig. 20: Port position for bilateral hernia, laparoscopically-assisted vaginal hysterectomy (LAVH), and most of the gynecological procedures.

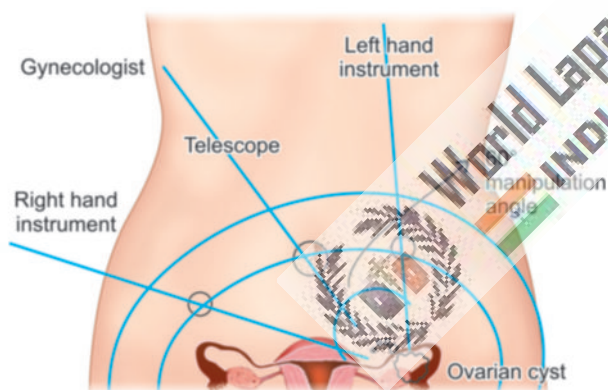


Fig. 21: Port position for left-sided laparoscopic ovarian cystectomy.

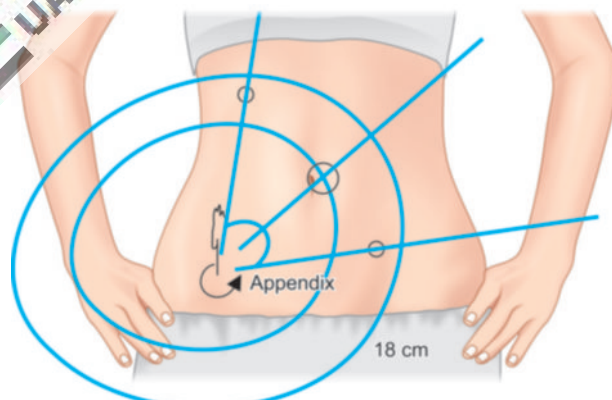


Fig. 22: Contralateral port position for laparoscopic appendectomy.

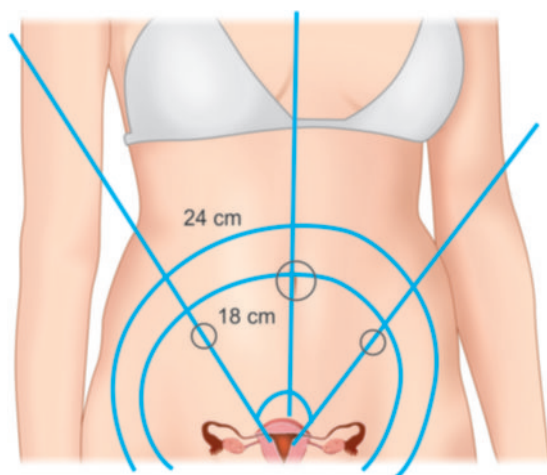


Fig. 23: Contralateral port position for small uterus laparoscopic hysterectomy.

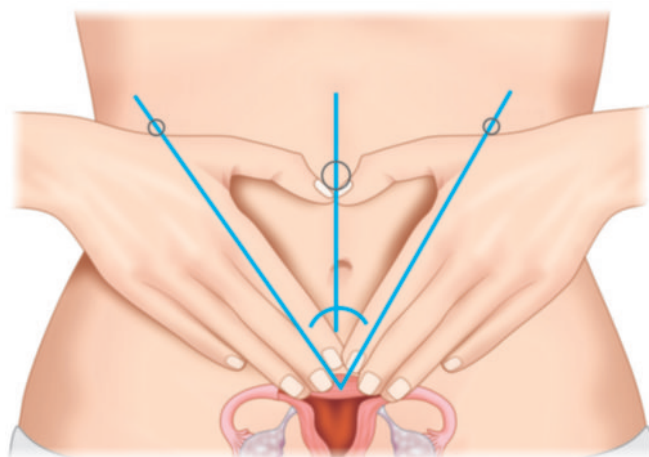


Fig. 24: Contralateral port position for large uterus laparoscopic hysterectomy.

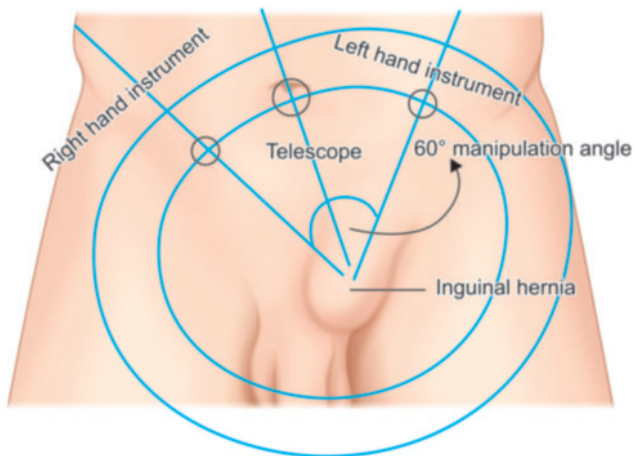


Fig. 25: Contralateral port position for left-sided laparoscopic inguinal hernia.

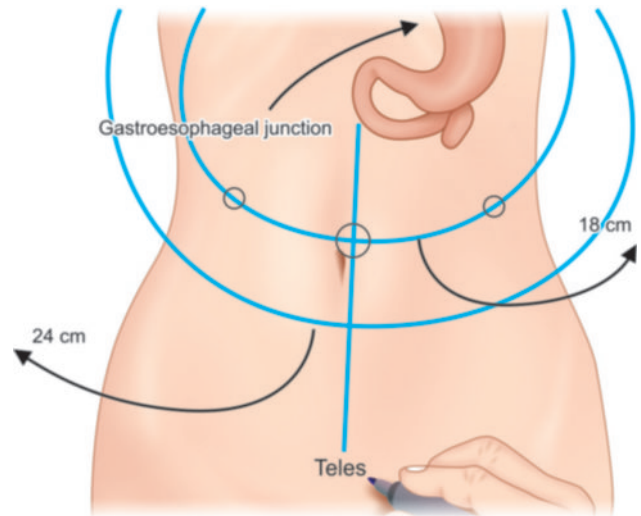


Fig. 26: Contralateral port position for laparoscopic fundoplication.

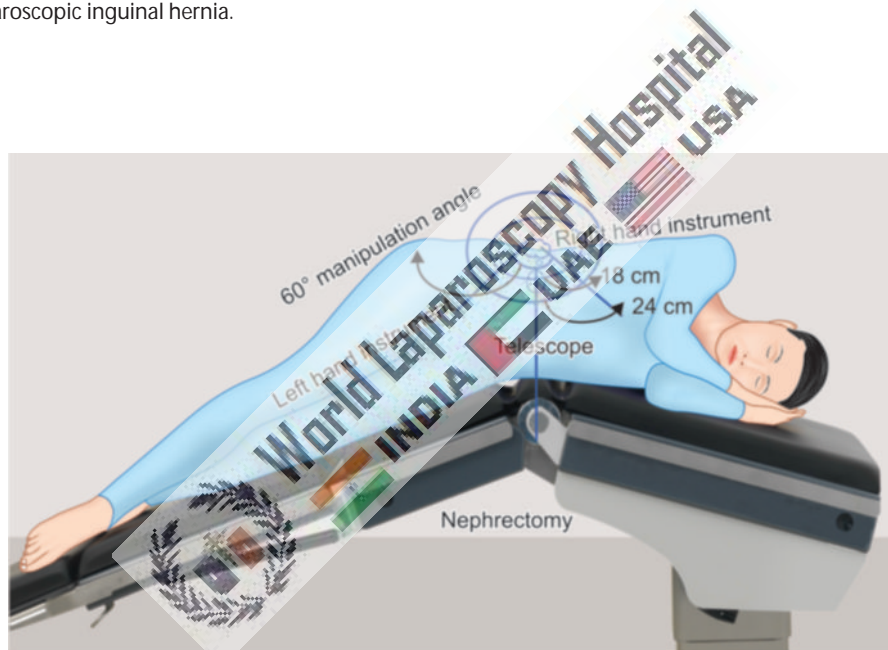


Fig. 27: Contralateral port position for laparoscopic nephrectomy.

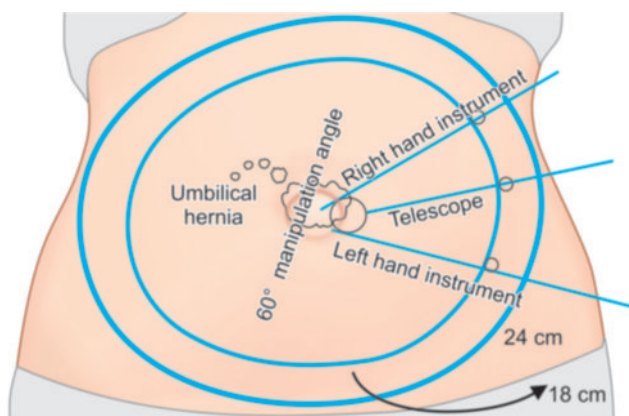


Fig. 28: Contralateral port position for laparoscopic umbilical hernia.

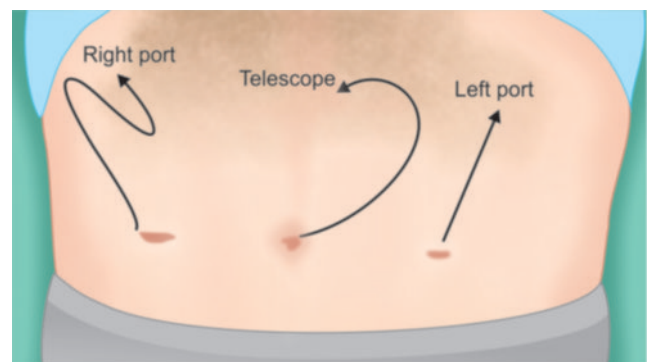


Fig. 29: Contralateral port position for laparoscopic bilateral inguinal hernia.

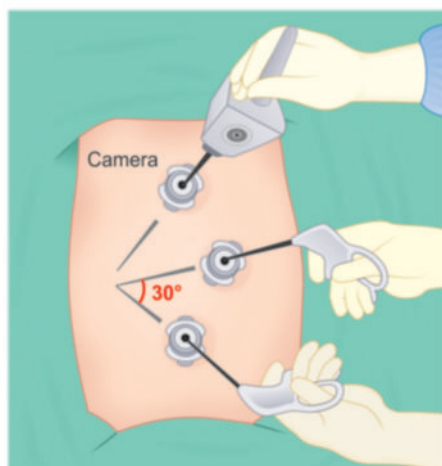


Fig. 30: Ipsilateral port position for laparoscopic appendectomy.

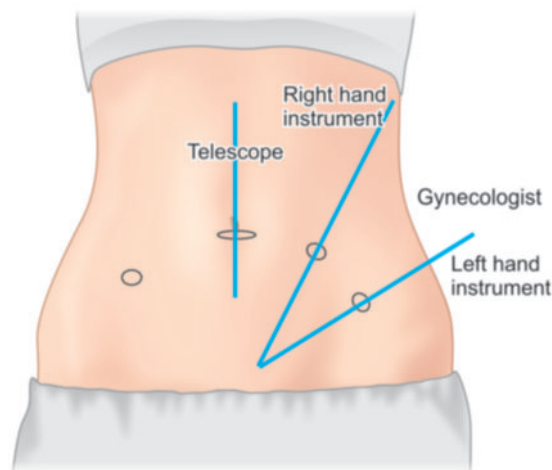


Fig. 31: Ipsilateral port position for laparoscopic gynecological surgery.

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